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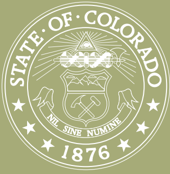

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Suicide in Colorado, 2007-2011: A Summary from the Colorado Violent Death Reporting System

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Introduction

Suicide is a critical public health concern that adversely affects a diverse population of Colorado citizens. On average, more than 850 Coloradoans die by suicide each year.[1] From 2007 to 2011, there were 4,323 suicide deaths in Colorado, outnumbering deaths by motor vehicle accident, unintentional poisoning, falls or homicide. In 2011, suicide was the seventh leading cause of death in Colorado.[2] Additionally, the state's suicide rate ranks among the highest in the nation. In 2009, Colorado had the sixth highest suicide rate among all states with an age-adjusted rate of 18.6 deaths per 100,000 population.[3] In addition to the impact on the lives of victims' families and friends, suicide also causes tremendous burden to the state and its financial and administrative resources. Each suicide death in Colorado costs $3,088 on average in direct costs (health care, autopsy and law enforcement investigation expense) and $1,100,885 in indirect costs (work loss cost).[4]

Suicide is considered a largely preventable cause of death, and prevention efforts by several agencies within the state have been implemented to reduce the burden of suicide.[5] The Colorado Department of Public Health and Environment (CDPHE) has identified a series of public and environmental health concerns, known as *Colorado's 10 Winnable Battles,* in an effort to effect change upon 10 specific priority areas that may offer the greatest measureable positive impact on the health of Colorado citizens.[6] Injury prevention, including suicide and suicidal behavior, is one of these Winnable Battles. In order to inform effective prevention strategies, it is essential that complete, accurate, and timely information be available concerning the population at risk for suicide and the factors that contribute to the high suicide rate in Colorado.

To assist in this effort, the Colorado Violent Death Reporting System (CoVDRS) was implemented at CDPHE in 2004. The CoVDRS is an epidemiologic surveillance system designed to obtain a complete census of all Colorado occurring violent deaths, to collect demographic information and associated risk factor data, and to track the circumstantial information surrounding each death. A violent death includes any death by suicide, homicide, unintentional firearm discharge, legal intervention, or acts of terrorism, as well as selected deaths of undeter-

mined intent when the death may have been the result of violence. Colorado is one of 18 states currently participating in the national surveillance system (NVDRS), which is maintained and funded by the Centers for Disease Control and Prevention (CDC). The NVDRS is the centralized database consisting of de-identified violent death data submitted by all participating states. The CoVDRS collects data from multiple sources including death certificates, coroner/medical examiner reports, and law enforcement investigations. Data collected are maintained in a single electronic database for analysis and reporting.

This report provides descriptive information using CoVDRS surveillance data from 2007 to 2011 and includes summaries of demographic characteristics of suicide victims and suicide trends in Colorado. Life and situational circumstances most frequently associated with suicide death also will be presented. The purpose of this report is to increase suicide awareness, to explore suicide trends in recent years, and to gain a better understanding of the populations that may be at greater risk for suicide in Colorado. This information may be used to inform prevention and intervention efforts by agencies interested in decreasing the impact of suicide in their communities.

Methods

Data for this report were obtained from the CoVDRS database and include all deaths resulting from acts of suicide by Colorado residents in Colorado from 2007 to 2011. For the purposes of this report, suicide deaths that occurred in Colorado to non-Colorado residents were excluded. Colorado residents who committed suicide in states other than Colorado also were excluded. A death was defined as a suicide according to the CoVDRS criteria, which state that a suicide is any death resulting from the use of "force against oneself when a preponderance of the evidence indicates that the use of force was intentional."[7] Deaths were selected for inclusion in the CoVDRS based on either the indication of suicide as manner of death on the death certificate or the presence of International Classification of Diseases, 10th Revision (ICD-10) coding for suicide as underlying cause(s) of death (X60–X84 and Y87.0).[8] A full description of the data collection processes of the NVDRS is provided elsewhere.[7] Circumstances associated with most suicide deaths were obtained through information contained in the coroner/medical examiner investigation and autopsy reports, the law enforcement investigation reports, and from other sources where available and as described in the NVDRS data collection protocol.[7]

Suicide deaths were analyzed by year, geographic region of residence, age, gender, race/ethnicity, marital status, educational attainment, lethal means of suicide, and associated precipitating circumstances. For this report, lethal means are reported as 1 of 4 possible categories: firearm, hanging/asphyxiation/suffocation, poisoning, and other. Suicide deaths are presented as number of cases for a given category, percent of the total number of deaths for a given category, or as a mortality rate (frequency of death per 100,000 population) with the ninety-five percent (95%) confidence interval.

Population estimates used in computing suicide mortality rates (with the exception of marital status-specific rates) are based on 2011 estimates from the State Demography Office, Colorado Department of Local Affairs. Age-adjusted suicide rates were calculated using the direct method and standardized according to the 2000 United States standard population. Population estimates for suicide rates by marital status were obtained from the 2011 five-year American Community Survey for the population 18 years of age and older in the state of Colorado.[9] Age-adjusted suicide rates by marital status from 2007-2011 were calculated using the direct method and standardized according to the distribution of the projected US population > 18 years of age in the year 2000 (distribution #9).[10]

To calculate suicide rates and frequencies by geographic location with the state, counties in Colorado were categorized in 2 different ways. First, Colorado counties of residence for all suicide deaths were categorized by Health Statistics Region (HSR), a method often used to examine regional differences for various health indicators within Colorado. Second, counties of residence were categorized according to county-type classification: urban, rural, or frontier. Counties were classified as urban, rural or frontier according to characteristics as defined by the Colorado Office of Rural Health.[11]

Results

Suicide Deaths

Suicide Rates – State of Colorado. From 2007 to 2011, the number and age-adjusted rate of suicide deaths remained relatively stable with an average annual rate increase of 1percent per year. An increase in the number of suicide deaths and the suicide rate was seen in 2009. In 2009, the age-adjusted suicide rate was approximately 10 percent higher than rates in other years, though this difference did not reach statistical significance (Table 1).

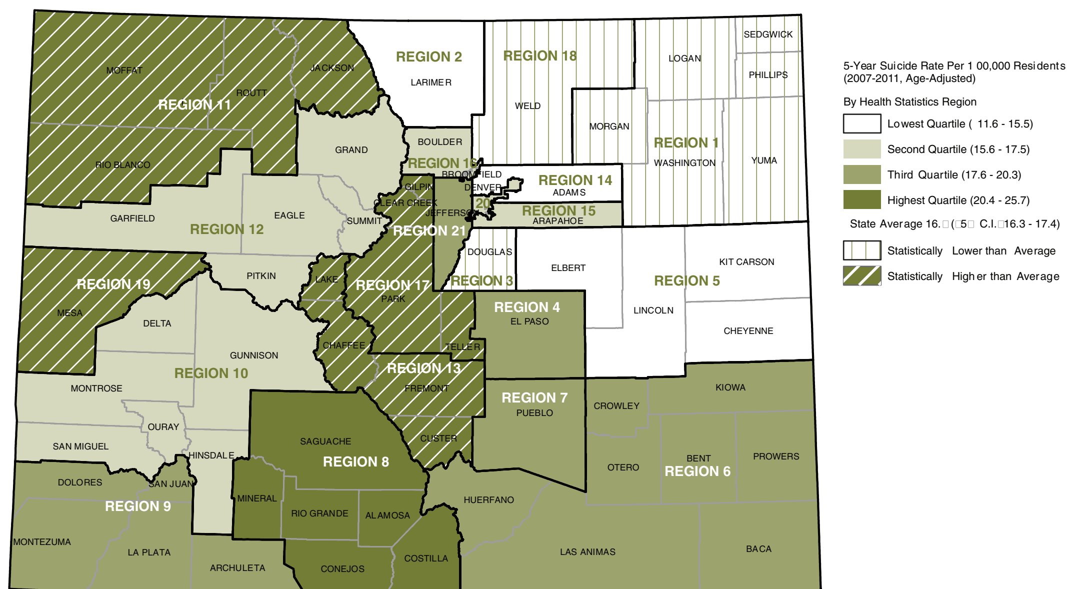
Table 1. Suicide deaths and age-adjusted rates, 2007-2011.

Year	n	Age-adjusted rate* (95% CI)
2007	807	16.5 (15.4-17.7)
2008	799	16.0 (14.9-17.2)
2009	919	18.3 (17.1-19.5)
2010	850	16.4 (15.3-17.5)
2011	882	16.9 (15.8-18.1)

*per 100,000 population; Colorado residents who died in Colorado.
Source: Health Statistics Section, Colorado Department of Public Health and Environment.

Suicide Rates – Region of Residence. Figure 1 shows a map of the age-adjusted suicide rates across the state of Colorado by HSR for 2007 to 2011. Suicide rates by region are grouped by quartile and further identified by whether they lie significantly above or below the statewide suicide rate. Among the regions with age-adjusted suicide rates lower than the state are regions 1 and 18 (in the northeast corner of the state) and region 3 (Douglas County). Regions that have age-adjusted suicide rates that are significantly higher than the state include region 11 (counties located in the northwestern corner of the state), region 19 (Mesa County), and regions 13 and 17 (central Colorado counties).

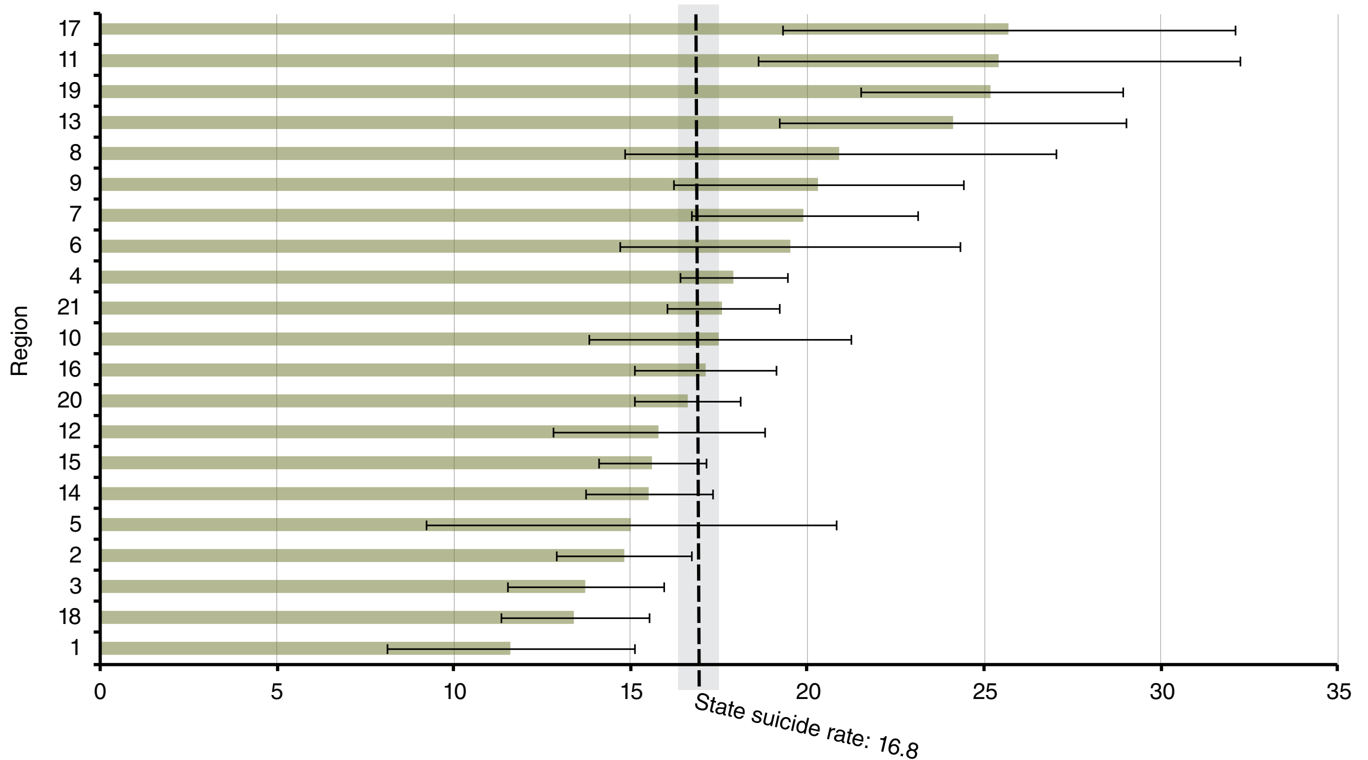
Figure 1. Map of age-adjusted suicide rate by Health Statistics Region, 2007-2011.



Rates are per 100,000 population; Colorado residents who died in Colorado.
SOURCE: Health Statistics Section, Colorado Department of Public Health and Environment.

Figure 2 shows the same Health Statistics Region data in chart form. Regions with age-adjusted suicide rates that are significantly lower or higher than the Statewide rate have error bars (representing that region's 95% confidence interval) which do not overlap with the shaded region around the vertical dashed line (the state's rate and 95% confidence interval).

Figure 2. Age-adjusted suicide rate rank by Health Statistics Region, 2007-2011.



Age-adjusted suicide rate (per 100,000 population).
Error bars represent the 95% confidence interval.
Source: Health Statistics Section, Colorado Department of Public Health and Environment.

Table 2 presents the age-adjusted suicide rates by urban, rural or frontier residence status from 2007 to 2011. Urban counties are found along the Front Range urban corridor, beginning with Larimer County and ending with Pueblo County in southern Colorado. Also included in the urban counties is Mesa County. The counties designated as rural and frontier lie scattered in the regions directly surrounding Colorado's urban corridor. Though residents of urban counties accounted for the greatest number of suicide deaths, urban county residents had the lowest age-adjusted suicide rates among all three county types. The age-adjusted suicide rate for urban county residents was similar to the Colorado state average age-adjusted suicide rate for the same time period (16.6 and 16.8, respectively). Residents of rural counties had the highest age-adjusted rate of suicide (18.4); rural county resident suicide rates were approximately 10 percent higher than the Colorado state average. Residents of frontier counties had the fewest number of suicide deaths but experienced a rate greater than the state average and greater than the urban county residents (17.1). None of the differences by county classification reached statistically significant levels.

Table 2. Age-adjusted suicide rates by county of residence classification, 2007-2011.

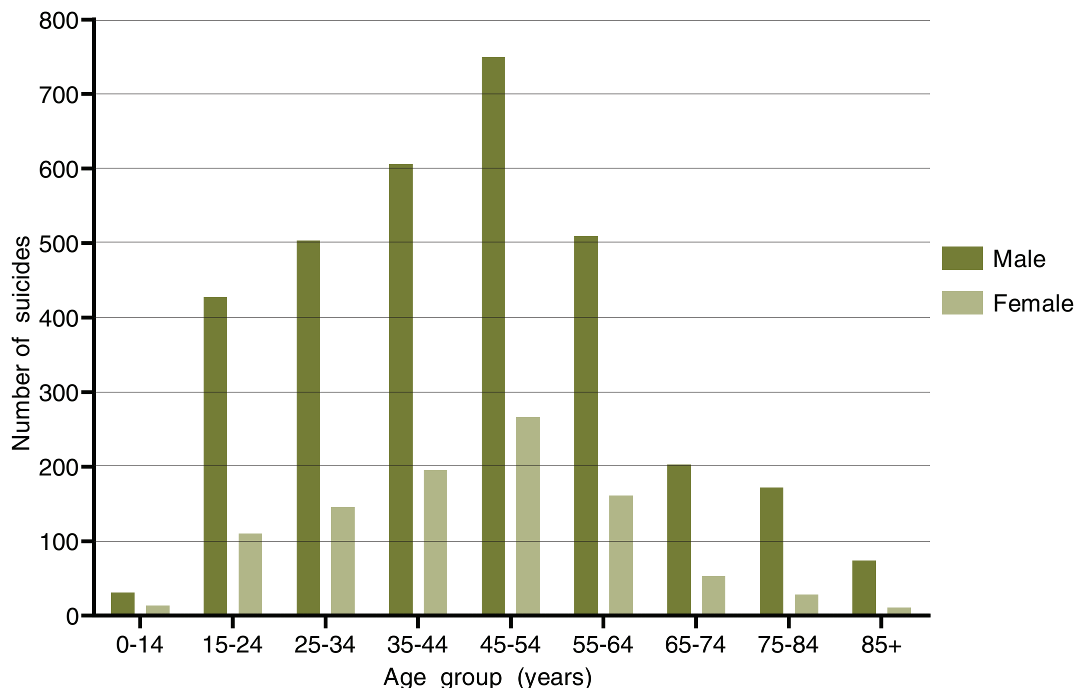
County classification	n	Age-adjusted rate* (95% CI)
Urban	3,605	16.6 (16-17.1)
Rural	529	18.4 (16.8-20)
Frontier	118	17.1 (13.9-20.2)

*per 100,000 population; Colorado residents who died in Colorado.
Source: Health Statistics Section, Colorado Department of Public Health and Environment.

Suicide Demographics

Age and Gender. Figure 3 shows the total number of suicide deaths in Colorado residents from 2007 to 2011 by age and gender. During this time period, the number of male suicides was more than 3 times the total number of female suicides (3,274 and 983 deaths, respectively). The average age for all suicide victims was 45 years. Males ages 25-54 years accounted for almost half of all Colorado suicides during this time (44%, n=1,858). Among male suicides, the number of deaths was highest in the 45-54 year age group (749 deaths), followed by the 35-44 year age group (606 deaths) and the 55-64 and 25-34 year age groups (509 and 503 deaths, respectively). A similar trend was seen among female suicides; the highest number of deaths occurred in the 45-54 year age group (266 deaths), followed by the 35-44 year age group (195 deaths).

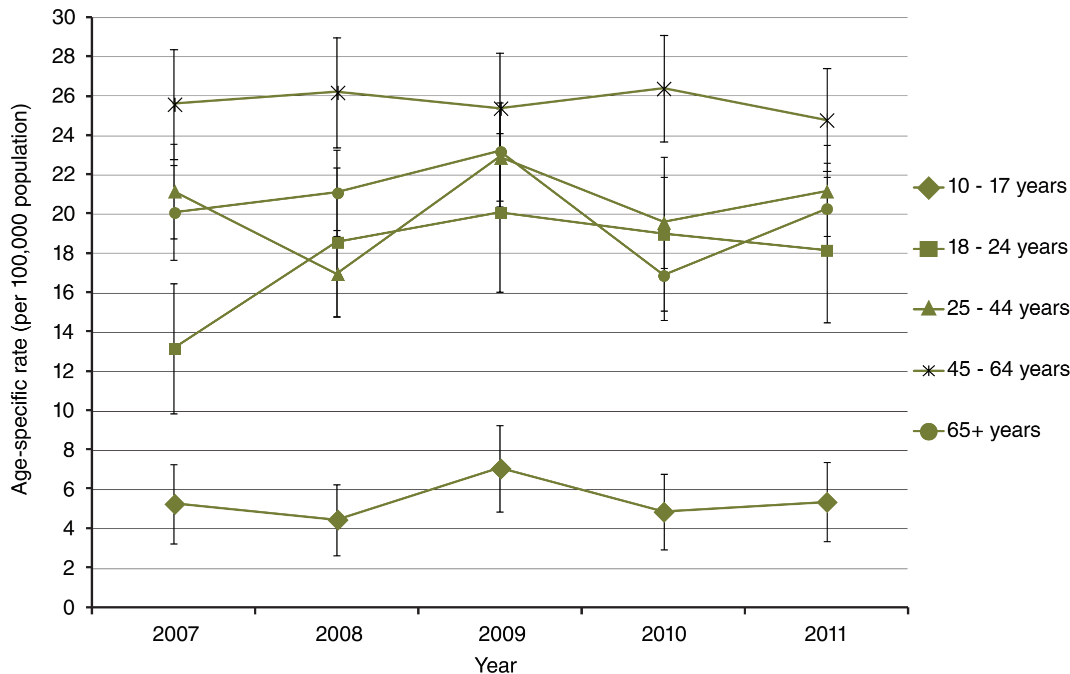
Figure 3. Suicide deaths by age and gender, 2007-2011.



Numbers include Colorado residents who died in Colorado
Source: Health Statistics Section, Colorado Department of Public Health and Environment

Figure 4 shows age-specific suicide rates among the age groups from 2007 to 2011. The 45-64 year-olds consistently had the highest suicide rate compared to all other age groups, and in 2010 the rate in this age group was significantly higher than rates in all other age groups (26.4). The lowest suicide rates were seen among the 10-17 year-olds who had significantly lower rates compared with other age groups with an average rate of approximately 5 deaths per 100,000 population. With the exception of the 45-64 year-olds who saw a slight decrease in suicide rate from 2008 to 2009, an increase in rate was seen for all age groups from 2008 to 2009, and this increase was statistically significant in the 25-44 year-olds (17.0, 95% CI: 14.8-19.2 and 22.9, 95% CI: 20.4-25.4, 2008 and 2009 suicide rate 25-44 year-olds, respectively). The suicide rates for the 45-64 year-old age group showed relatively stable patterns during the time period of 2007 to 2011.

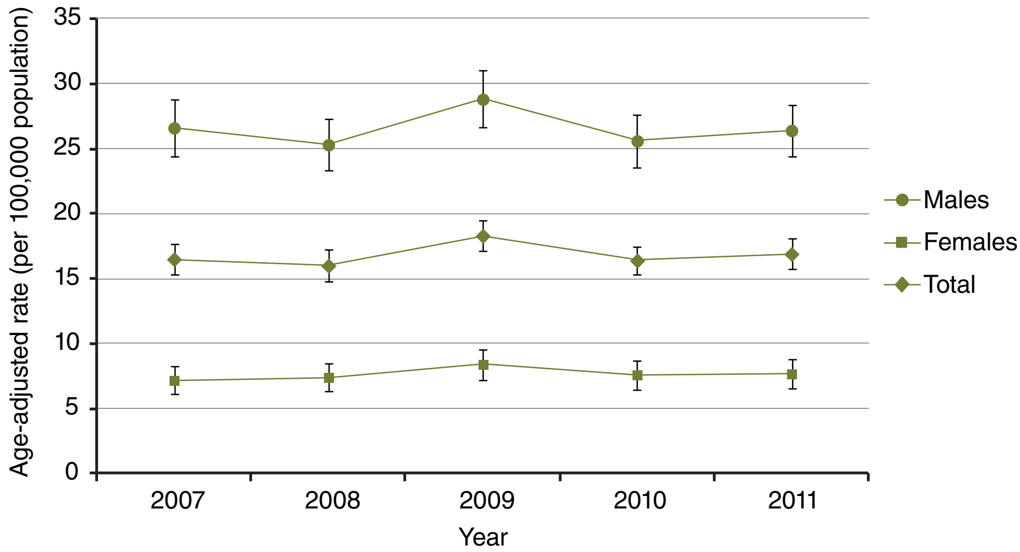
Figure 4. Age-specific suicide rate, 2007 – 2011.



Rates are per 100,000 population; Colorado residents who died in Colorado.
Error bars represent the 95% confidence interval.
Source: Health Statistics Section, Colorado Department of Public Health and Environment.

Consistently from 2007 to 2011, males had significantly higher age-adjusted suicide rates compared to females; on average, the age-adjusted suicide rate in men was over 3 times higher than in women (27.0 vs. 8.0, respectively). Similar to the trend seen in the total age-adjusted suicide rate from 2007 to 2011, males as well as females showed a slight average annual increase in age-adjusted rate from 2007 to 2011: the average annual increase in age-adjusted rate for males was 0.3 percent and for females was 2.0 percent (Figure 5).

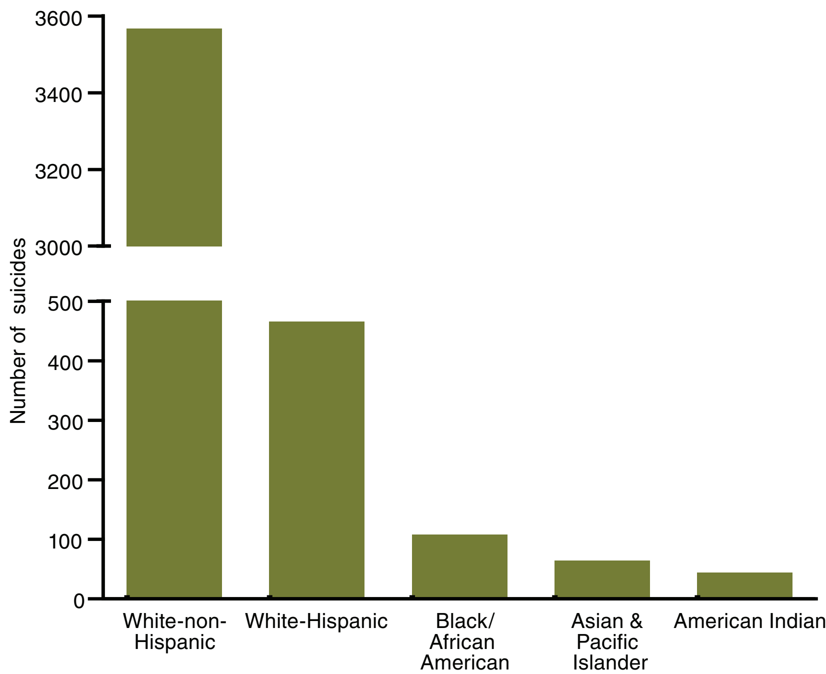
Figure 5. Age-adjusted suicide rate by gender, 2007-2011.



Rates are per 100,000 population; Colorado residents who died in Colorado
Error bars represent the 95% confidence interval.
Source: Health Statistics Section, Colorado Department of Public Health and Environment

Race/Ethnicity. White non-Hispanics accounted for the majority of the suicides from 2007 to 2011 (84%, n=3,566), followed by White Hispanics (11%, n=466). Black/African Americans, Asian American/Pacific Islanders and American Indians had the fewest number of suicides among all ethnic groups (108, 64, and 44, respectively) (Figure 6).

Figure 6. Suicide deaths by race/ethnicity, 2007-2011 (n=4,248).



Numbers include Colorado residents who died in Colorado.
Source: Health Statistics Section, Colorado Department of Public Health and Environment

White non-Hispanics also had the highest rate of suicide among all ethnic groups from 2007 to 2011 at 18.8. Compared to White non-Hispanics, the rate was significantly lower in the White Hispanic population (10.7), the Black/African American population (9.9), the Asian American/Pacific Islander population (8.2), and the American Indian population (10.5) (Table 3). From 2007 to 2011, the White non-Hispanic population experienced suicide rates significantly higher than the state's average suicide rate for the same time period (18.8, 95% CI: 18.2-19.4 and 16.8, 95% CI: 16.3-17.4, respectively). Conversely, the White Hispanic, Black/African American, Asian American/Pacific Islander, and American Indian populations all experienced suicide rates significantly lower than the state average from 2007 to 2011.

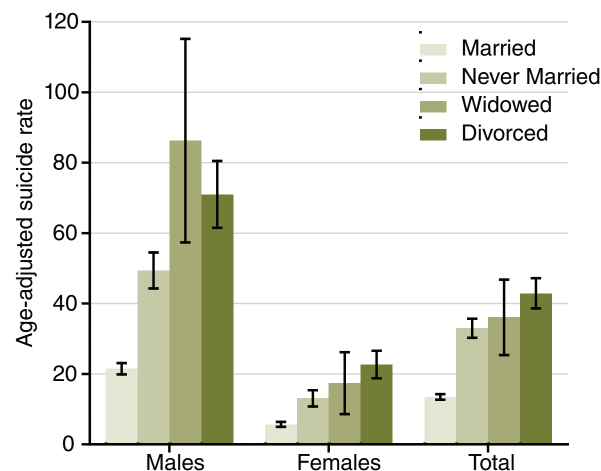
Table 3. Suicide rates byrRaceeEthnicity, 2007-2011.

Race/ethnicity	Age-adjusted rate* (95% CI)
White/non-Hispanic	18.8 (18.2-19.4)
White/Hispanic	10.7 (9.7-11.8)
Black/African American	9.9 (8-11.9)
Asian & Pacific Islander	8.2 (6.1-10.3)
American Indian	10.5 (7.3-13.6)

*per 100,000 population; Colorado residents who died in Colorado.
Source: Health Statistics Section, Colorado Department of Public Health and Environment.

Marital Status and Education. Among all suicides in victims 18 years of age and older (n=4,112), the greatest proportion of deaths occurred in those who were married (36.5%). A slightly lower proportion was seen in victims who were never married (31.4%). The proportion of victims who were divorced was 26.0 percent, followed by widowed (5.6%). Comparing rates of suicide from 2007-2011, divorced victims had the highest age-adjusted rate, with statistically significant differences seen between the divorced and married groups as well as divorced and never married groups. Suicide rates in males were higher than females regardless of marital status. In both sexes, those who were married had significantly lower rates of suicide compared to those with any other marital status. Among males, those who were widowed had the highest rate of suicide; widowed males were over 4 times more likely to die by suicide than married males. Among females, those who were divorced had the highest rate of suicide; divorced females were more than 2 times more likely to die by suicide than married females (Figure 7).

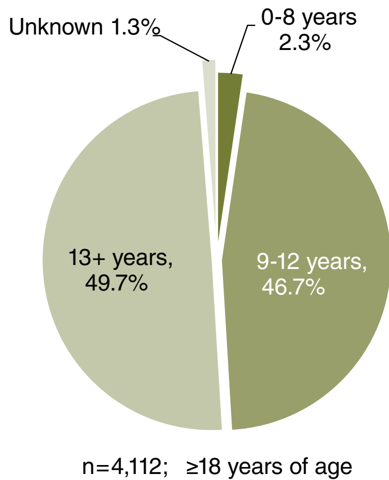
Figure 7. Suicide rates by gender and marital status, age > 18 years, 2007-2011.



Rates are per 100,000 population; Colorado residents who died in Colorado.
Error bars represent the 95% confidence interval.
Source: Health Statistics Section, Colorado Department of Public Health and Environment.

Comparing number of years of education for suicide victims 18 years of age and older from 2007-2011 (n=4,112), the greatest proportion of suicides was seen among those with 13+ years of education (49.7%). A slightly lower proportion was seen among those with 9-12 years of education (46.7%). Those with less than 9 years of education and those of unknown educational status represented the smallest proportions (2.3% and 1.3%, respectively) (Figure 8).

Figure 8. Suicide deaths by years of education, age > 18 years, 2007-2011.



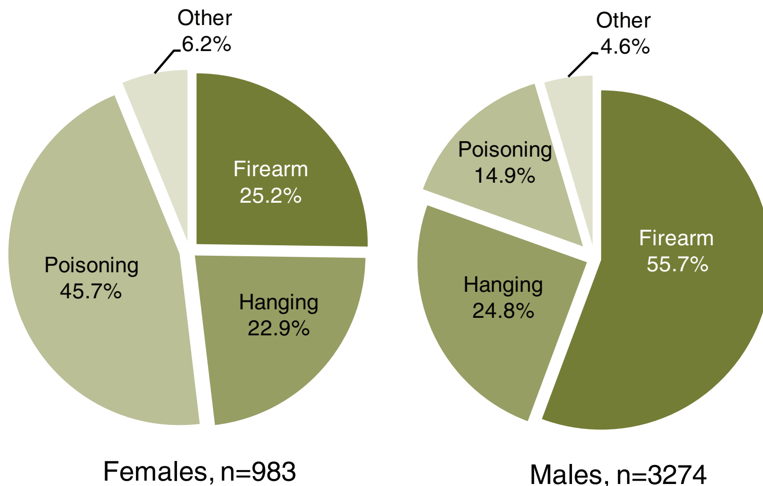
n=4,112; ≥18 years of age

Numbers include Colorado residents who died in Colorado.
Source: Health Statistics Section, Colorado Department of Public Health and Environment.

Suicide Methods

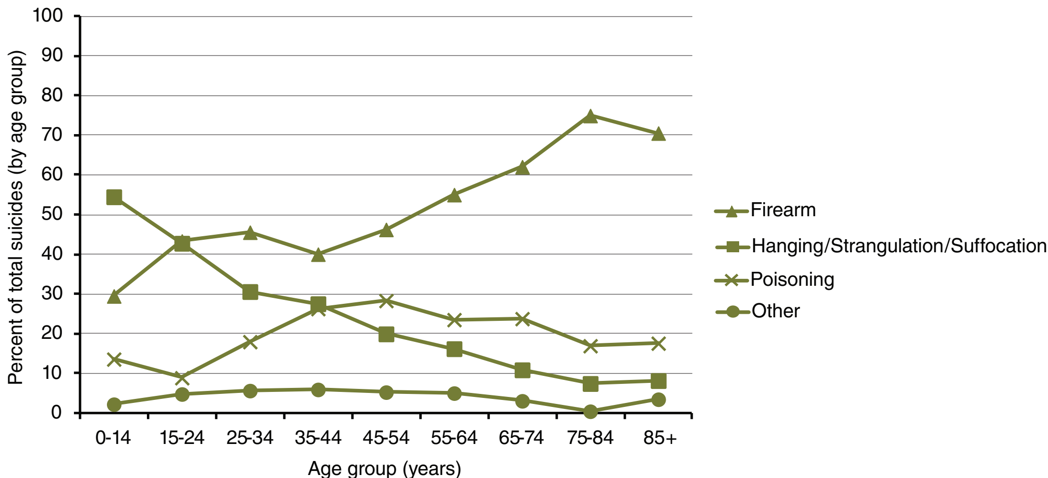
Age and Gender. Male suicide deaths from 2007 to 2011 most frequently involved use of a firearm as lethal means (55.7%), followed by hanging/asphyxiation/suffocation (24.8%) and poisoning (14.9%). In contrast, the greatest proportion of female suicide deaths were completed by using poison as lethal means (45.7%), followed by firearm (25.2%) and hanging/asphyxiation/suffocation (22.9%) (Figure 9). The chosen method of suicide also varied according to age. There was a substantial positive association between age and firearm use and a similar negative association between age and hanging/asphyxiation/suffocation use. Those > 75 years-old were nearly 2 times more likely to complete suicide using a firearm than were those 15-24 years-old. All other age groups showed approximately equal tendency toward the different methods (Figure 10).

Figure 9. Suicide deaths by method and gender, 2007-2011.



Numbers include Colorado residents who died in Colorado.
Source: Health Statistics Section, Colorado Department of Public Health and Environment.

Figure 10. Suicide methods by age group, 2007-2011.



Numbers include Colorado residents who died in Colorado.
Source: Health Statistics Section, Colorado Department of Public Health and Environment.

Suicide Circumstances

Table 4 outlines the fifteen circumstances most frequently associated with suicide cases in Colorado residents from 2007 to 2011, identified from information contained in the coroner/medical examiner report and the law enforcement investigation report. The most frequent circumstance associated with Colorado suicide deaths was indication by family, friends, or acquaintances of the victim that he or she was exhibiting a "depressed mood" (including being noted as feeling "sad" or "despondent") close to the date/time of death (62.6%). The "depressed mood" circumstance differs from the next most frequent circumstance, "current mental health problem" (42.0%), in that the victim need not be formally diagnosed with a mental health problem. Additionally, 33.0 percent of suicide victims were receiving mental health treatment at the time of their death, and 39.5 percent of suicide victims had documented treatment for mental illness at some point in their lifetime, including a diagnosis of depression (31.2%). A substantial portion of suicide victims also left suicide notes (40.0%) and disclosed their intent to commit suicide in such a manner that intervention to prevent the suicide might have been possible (38.4%). Many victims also had record of previous suicide attempts (28.0%).

Certain adverse life situations and events are common in suicide deaths, including intimate partner problems (37.2%), crisis within the two weeks prior to death (34.8%), financial problems (22.5%), job problems (21.5%), and physical health problems (31.9%). Problems with substances and alcohol also are frequently seen in Colorado suicide cases – 26.0 percent of suicide victims had documented evidence of a problem with alcohol or alcoholism and 15.3 percent a problem with substances other than alcohol.

Table 4. Suicide deaths by circumstance, 2007-2011.

Suicides with at least 1 known circumstance	4,006	94.1
	N	Percent*
Current depressed mood	2,507	62.6
Current mental health problem	1,682	42.0
Left a suicide note	1,603	40.0
Ever treated for mental health problem	1,584	39.5
Disclosed intent to commit suicide	1,539	38.4
Intimate partner problem	1,490	37.2
Crisis within two weeks of the suicide	1,393	34.8
Current mental health treatment	1,323	33.0
Physical health problem	1,277	31.9
Diagnosis of depression	1,251	31.2
History of previous suicide attempts	1,122	28.0
Problem with alcohol	1,075	26.8
Financial problem	903	22.5
Job problem	862	21.5
Problem with other substance	611	15.3

*Percent of total cases with at least one circumstance known; Colorado residents who died in Colorado.
Source: Health Statistics Section, Colorado Department of Public Health and Environment.

Discussion

Over the past 5 years, the rate of mortality from suicide among Colorado residents has consistently remained at a high level. In recent years, the number of suicide deaths has surpassed the number of deaths due to motor vehicle accidents, and suicide has become the seventh leading cause of death in Colorado. Not only does the state maintain an average suicide rate nearly 1.5 times the national rate (18.6 age-adjusted Colorado rate, 2009; 11.8 age-adjusted US rate, 2009),[3] the state's average suicide rate has ranked among the ten highest in the nation for several consecutive years. Within the State of Colorado, variations of considerable magnitude in suicide frequency and suicide risk were noted among different subpopulations. These differences included geographic region, race/ethnicity, gender, weapon, age, relationship status, and education. While differences in demographic characteristics were noted, analysis of precipitating circumstances prior to death among suicide victims also revealed important commonalities that may provide information useful for guiding suicide intervention efforts in Colorado communities.

Variations in the age-adjusted suicide rate were seen in geographic clusters of counties located in various regions of the state. Even beyond the United States, those who live in counties designated rural or frontier are generally considered to be at increased risk of death by suicide compared to those who live in urban-designated counties.[12-14] Suicides rates among rural versus urban Colorado residents show similar trends and support the findings of prior studies.

Certain demographic populations within the state are disproportionately affected by suicide; the male population consistently experienced suicide rates over 1.5 times greater than the Colorado state average and over 3 times greater than females. Male Colorado residents between the ages of 25 and 54 years not only experienced the highest suicide rates among the age groups and genders, they have consistently contributed a staggering proportion of all Colorado resident suicides over the past five years (44%). The high suicide rate and frequency seen in the middle-aged Colorado male population may have important implications on statewide public health planning and prevention efforts within Colorado communities.

Disparities in suicide rates also exist among Colorado's racial/ethnic groups. The age-adjusted suicide rate in the White non-Hispanic population is nearly 2 times greater than the average rate of the White Hispanic, Black/African American, Asian American/Pacific Islander, and American Indian populations. This finding is similar to many other states with respect to the White non-Hispanic population; however, wide regional variation in suicide rates among the ethnic minorities and, in particular, disparities in suicide rates between ethnic minorities and White non-Hispanics have been observed in other reports.[15]

Previous studies have demonstrated that suicide rates vary significantly by marital status,[16] and some studies even indicate a possible protective effect of marriage.[17] Among Colorado residents, differences by marital status similar to those seen in other studies were observed. Married victims had significantly lower rates of suicide, regardless of gender. Independent of gender, the highest age-adjusted suicide rates occurred in the divorced, widowed, and never married populations. The association between marital status and suicide rate also is modified by gender. The age-adjusted suicide rates in the widowed male and female populations were consistently the highest.

Colorado suicides are completed most frequently by use of 1of 3 major types of weapons: firearm, hanging/asphyxiation/suffocation, or poisoning. The frequency of weapon use varies significantly by gender and by age group. Compared to women, men are over 2 times more likely to use a firearm as lethal means and approximately 3 times less likely to complete suicide by poisoning. The younger Colorado population shows a tendency toward use of hanging/asphyxiation as lethal means while the older Colorado population tends toward use of a firearm. The lethal means variations seen by gender and age may provide information important for the development of efficient and specialized suicide prevention strategies and efforts among population subgroups in Colorado.[18,19]

While this report contributes to the current body of knowledge concerning the characteristics of suicide victims and risk factors for suicide among Colorado residents, there have been a number of suicide deaths completed by non-Colorado residents within the state over the past five years (occurrent

nonresident suicides: n=147). On average, non-Colorado residents who commit suicide in Colorado contribute approximately 6 percent of the total suicide burden in the state annually, and may represent special populations, such as college students and transients. Further research is needed to understand the behaviors and risk factors associated with nonresident Colorado suicides and the impact these suicides may have upon the state's economic and administrative infrastructure. It also is important to note that because the state does not obtain detailed information concerning deaths to Colorado residents that occur beyond the state boundaries, the CoVDRS does not capture suicide deaths completed by Colorado residents outside the state of Colorado. Therefore, suicides that may have occurred to Colorado residents in areas outside of Colorado have been excluded from all rate calculations in this report, and the rates reported likely represent an underestimation of the true Colorado resident suicide rate.

The analysis findings contained in this report represent the most currently available information concerning the circumstances, demographics and recent trends of suicide among Colorado residents. While the suicide rate among Colorado residents remains at a critically elevated level, the information presented here can contribute to current suicide prevention efforts. The results of these analyses will serve the interest of local and state agencies for suicide planning and intervention efforts by providing a better understanding of the populations at greatest risk for suicide death. This report also will serve the interest of Colorado citizens by contributing to decreased burden of suicide in Colorado communities attained through evidence-based prevention programs based on the findings of further CoVDRS analyses.

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