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Suicide in Colorado, 2011-2015: 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 Americans. The number of suicides has increased over the past decade for the United States and also in Colorado. In 2015, Colorado had the ninth highest suicide rate (19.5 deaths per 100,000 population) among all states.[1] In 2015, suicide was the seventh leading cause of death in Colorado.[2] From 2011 to 2015, the suicide deaths in Colorado outnumbered deaths by motor vehicle collision, unintentional poisoning, falls or homicide.[2] 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. Data from 2010 estimate that each suicide death in Colorado costs $3,572 on average in direct costs (health care, autopsy and law enforcement investigation expense) and $1,310,568 in indirect costs[3] (work loss cost).

In an effort to help reduce the burden of suicide, the Colorado Violent Death Reporting System (CoVDRS) was implemented at the Colorado Department of Public Health and Environment (CDPHE) in 2004. The CoVDRS is a public health surveillance system designed to obtain a complete census of all violent deaths occurring in Colorado, 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 undetermined intent when the death may have been the result of violence. Colorado is one of 42 states and territories currently participating in the broader National Violent Death Reporting System (NVDRS), which is maintained and funded by the Centers for Disease

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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 and inputs data from multiple sources including death certificates, coroner/medical examiner reports, and law enforcement investigations.

This report provides descriptive information using CoVDRS surveillance data from 2011 to 2015 and includes summaries of demographic characteristics of suicide victims and suicide trends in Colorado. Life and situational circumstances most frequently associated with suicide death will also 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 suicide in Colorado among residents from 2011 to 2015. For the purposes of this report, suicide deaths that occurred in Colorado among non-Colorado residents were excluded. Colorado residents who died by suicide in other states were also excluded. 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 of death (X60–X84 and Y87.0).[4] A full description of the data collection processes of the NVDRS is provided elsewhere.[5] Circumstances associated with most suicide deaths were obtained through information contained in the death certificates, coroner/medical examiner investigation and autopsy reports, and the law enforcement investigation reports.

Suicide deaths were analyzed by year, geographic region of residence, age, gender, race/ethnicity, marital status, poverty, lethal means of suicide, and associated precipitating circumstances. For this report, lethal means are reported as one of four possible categories: firearm, hanging/asphyxiation/suffocation, poisoning (including illicit and prescription drugs as well as carbon monoxide), and other (including jumping from a high place and sharp objects). 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 and area-based poverty estimates) are based on 2015 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 2011-2015 five-year American Community Survey for the population 18 years of age and older in the state of Colorado.

Poverty is estimated using area-based poverty status. Area-based poverty status is measured by calculating the percent of the population in each decedent's census tract of residence that is living at or below the federal poverty level.[6] These population data come from the 2011-2015 five-year American Community Survey estimates made available by the U.S. Census Bureau. The poverty level categories used in this report include 0–9.9 percent of the population in a decedent's community living at or below the federal poverty level, 10–19.9 percent, 20–29.9 percent and 30 percent or greater.

To calculate suicide rates and frequencies by geographic location with the state, counties in Colorado were categorized in two different ways. First, Colorado counties 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 as urban, rural, or frontier, according to the Colorado Office of Rural Health.[7] Both geographic locations are based on the decedent's county of residence, which isn't always the same as county of death.

Results are generally presented with 95 percent confidence intervals. Differences between rates are described as 'significant' if the confidence intervals of two rates being compared do not overlap, or the p-value of a formal comparison test is less than 0.05.

Results

Suicide Deaths

Suicide Rates - State of Colorado.

From 2011 to 2015, the number and age-adjusted rate of suicide deaths remained relatively stable. An increase in the number of suicide deaths and the suicide rate was seen in 2014 and 2015; however, no statistically significant changes were observed during this time period (Table 1). It should be noted that the included age-adjusted rates differ slightly from official state-released age-adjusted suicide rates, due to the fact the CoVDRS currently doesn't capture information on suicide deaths of Colorado residents who die out of state. Between 2011–2015 there were 93 suicides among Colorado residents that occurred out of state, or 19 per year on average (data not shown).[2]

Table 1. Suicide deaths and age-adjusted rates, Colorado residents, 2011-2015.

Year	N	Age-adjusted rate (95% CI)
2011	884	16.95 (15.82-18.09)
2012	1,021	19.09 (17.90-20.27)
2013	996	18.34 (17.19-19.50)
2014	1,063	19.49 (18.30-20.68)
2015	1,066	19.03 (17.87-20.18)

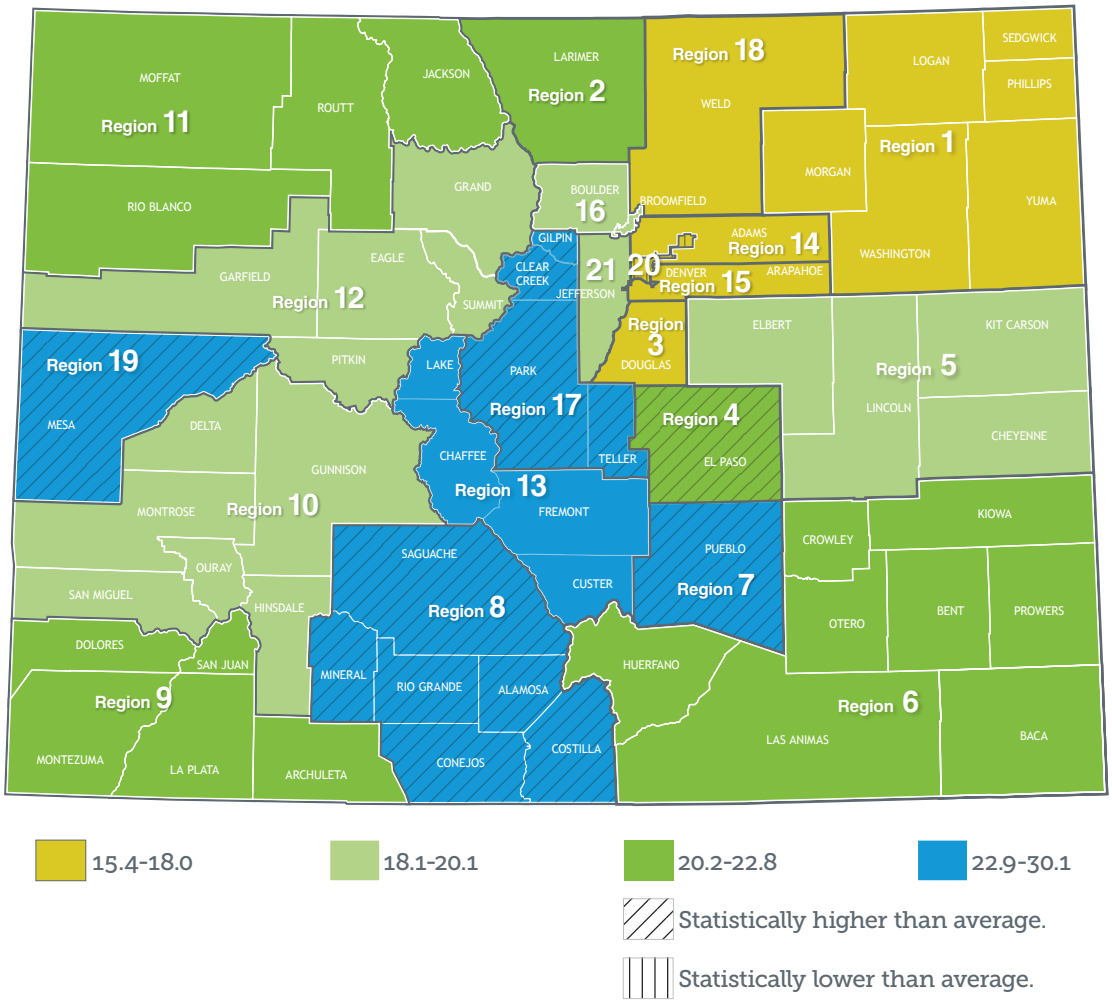
Rates are per 100,000 population.

Source: Colorado Violent Death Reporting System, Colorado Department of Public Health and Environment.

Suicide Rates - Region of Residence.

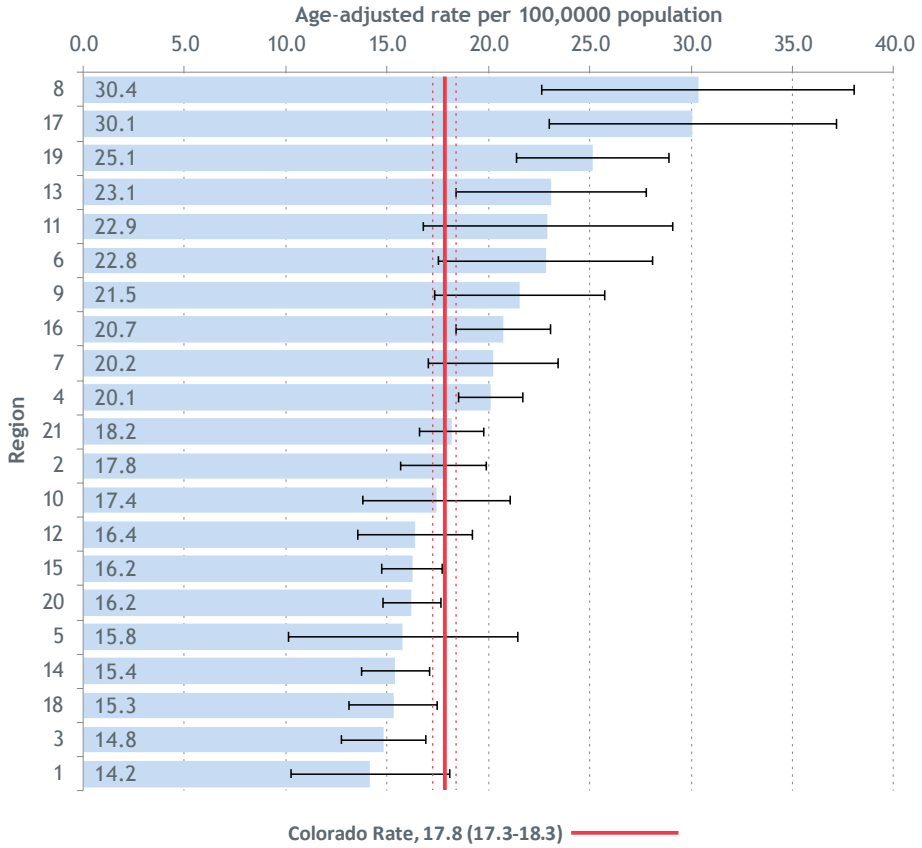
Figure 1 shows a map of the age-adjusted suicide rates across the state of Colorado by Health Statistics Region (HSR) for 2011 to 2015 (combined). Suicide rates by region are grouped by quartile and further identified by whether they are significantly higher or lower than the statewide suicide rate (18.6 deaths per 100,000 population). Region 20 (Denver City/County) was the only region with age-adjusted suicide rates lower than the state. Areas that have age-adjusted suicide rates that are higher than the state include regions 4, 7, 8, 17 and 19. Figure 2 presents the same results in chart form.

Figure 1. Map of age-adjusted suicide rate by Health Statistics Region, Colorado residents (2011-2015).



Rates are per 100,000 population.
Source: Colorado Violent Death Reporting System, Colorado Department of Public Health and Environment.

Figure 2. Age-adjusted suicide rate rank by Health Statistics Region, Colorado Residents, 2011-2015.



Error bars represent the 95% confidence interval.
Rates are per 100,000 population.
Source: Colorado Violent Death Reporting System, Colorado Department of Public Health and Environment.

Table 2 presents the age-adjusted suicide rates by urban, rural or frontier residence status. 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 rate for rural counties was significantly higher than that for urban counties.

Table 2. Age-adjusted suicide rates by county of residence classification, Colorado residents (2011-2015).

County classification	N	Age-adjusted rate (95% CI)
Frontier	144	21.8 (18.1-25.5)
Rural	617	20.8 (19.1-22.5)
Urban	4,265	18.2 (17.7-18.8)

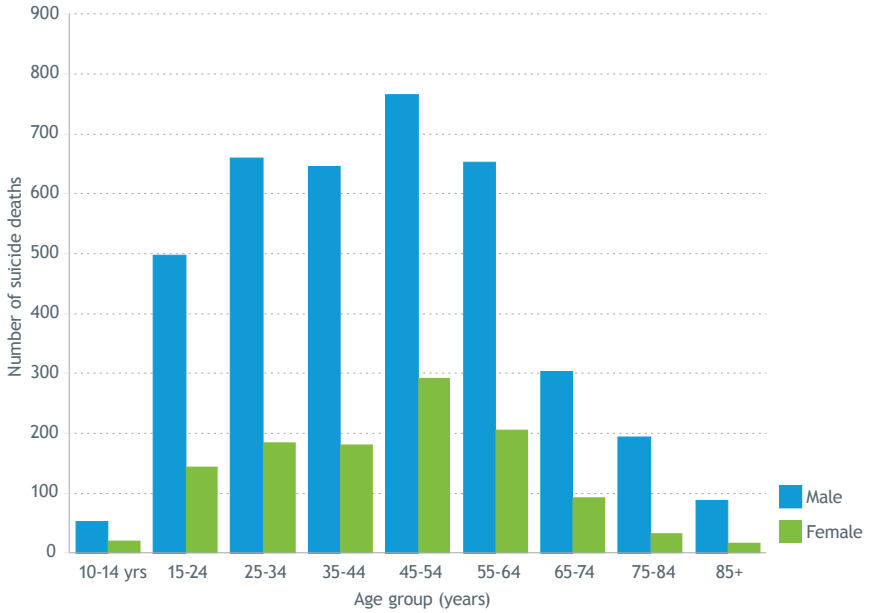
Rates are per 100,000 population.
Source: Colorado Violent Death Reporting System, Colorado Department of Public Health and Environment.

Suicide Demographics

Age and Gender

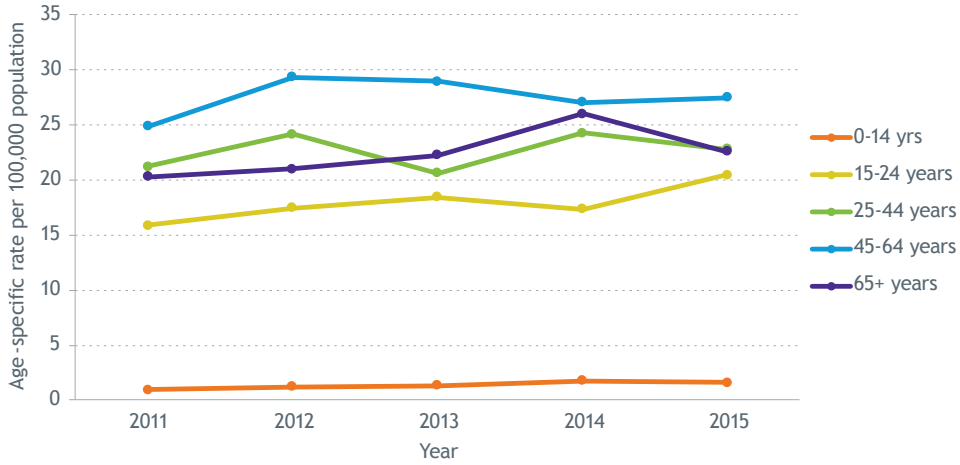
Figure 3 shows the total number of suicide deaths in Colorado among residents by age and gender. During that time period, the number of male suicides was more than three times the total number of female suicides (3,855 and 1,175 deaths, respectively). Among male suicides, the number of deaths was highest in the 45-54 year age group (765 deaths). A similar trend was seen among female suicides: The highest number of deaths occurred in the 45-54 year age group (292 deaths).

Figure 3. Suicide deaths by age and gender, Colorado residents, 2011-2015.



Source: Colorado Violent Death Reporting System, Colorado Department of Public Health and Environment.

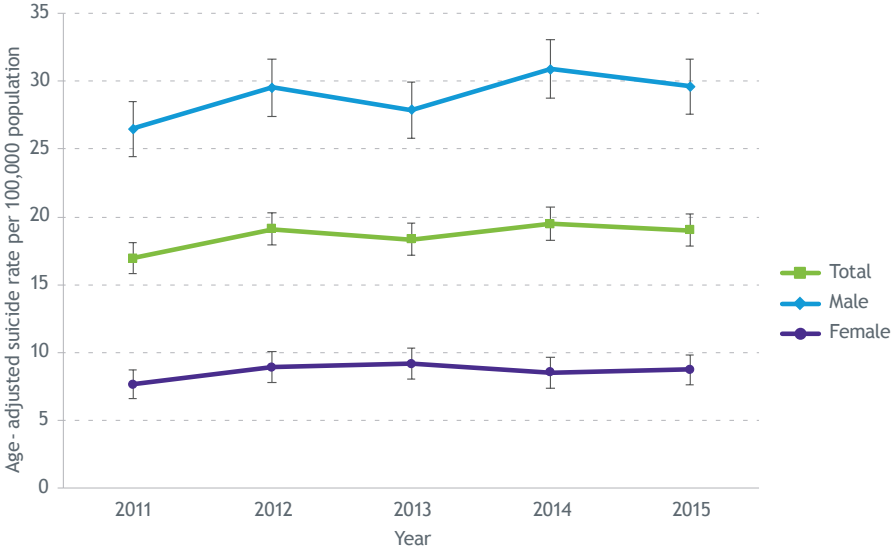
Figure 4. Age-specific suicide rate, Colorado residents, 2011-2015.



Rates are per 100,000 population.
Source: Colorado Violent Death Reporting System, Colorado Department of Public Health and Environment.

Figure 4 shows age-specific suicide rates among the age groups. The suicide rate among 45-64 year-olds was consistently the highest compared to all other age groups. The rates for 15-24 year-olds steadily increased since 2011 although the difference was not statistically significant (data not shown).

Figure 5. Age-adjusted suicide rate by gender, Colorado residents, 2011-2015.



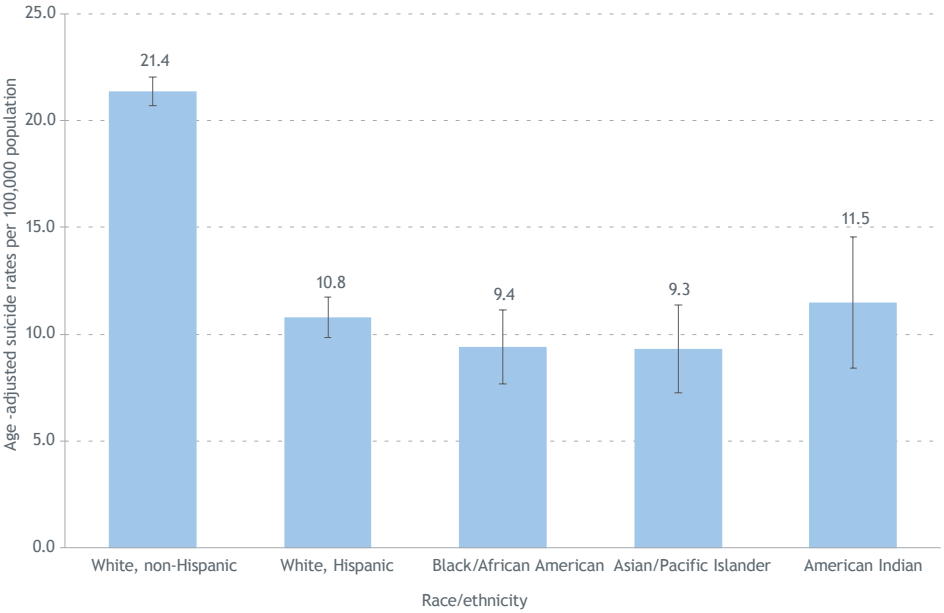
Error bars represent the 95% confidence interval.
Rates are per 100,000 population.
Source: Colorado Violent Death Reporting System, Colorado Department of Public Health and Environment.

Consistently from 2011 to 2015, males had significantly higher age-adjusted suicide rates compared to females; on average, the age-adjusted suicide rate in men was over three times higher than in women (28.9 vs. 8.6, respectively) (Figure 5).

Race/Ethnicity.

The highest rate of suicide among all race and ethnic groups was observed among White, non-Hispanics at 21.4 deaths per 100,000 population, with age-adjusted rates nearly twice as high compared to all others (Figure 6).

Figure 6. Age-adjusted suicide rates by race/ethnicity, Colorado residents, 2011-2015.

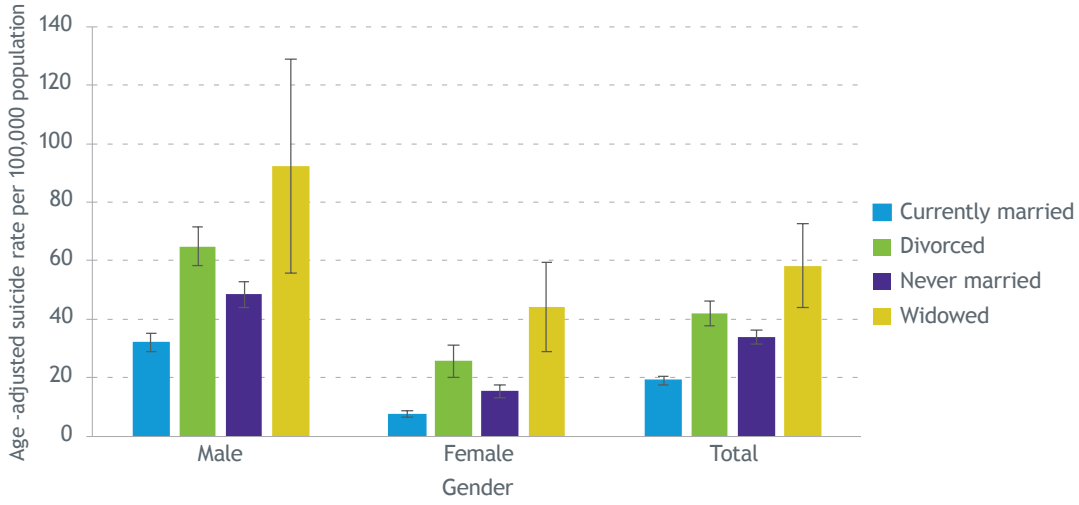


Error bars represent the 95% confidence interval.
Rates are per 100,000 population.
Source: Colorado Violent Death Reporting System, Colorado Department of Public Health and Environment.

Marital Status and Poverty

Among suicides in victims 18 years of age and older (n=4,930) the greatest proportion of deaths occurred in those who were married (36.4%) although the age-adjusted rate was significantly lower compared to those with any other marital status. Widowed and divorced victims had the highest age-adjusted rates, with statistically significantly higher rates than those never married or those currently married. Among males, those who were widowed had the highest rate of suicide overall: Widowed males were nearly three times more likely to die by suicide than married males, but this is also the smallest number of suicides (n=254), as seen in the large confidence interval (43.8-72.7). This relationship is also seen in widowed women who were more than five times as likely to die by suicide than married females (Figure 7).

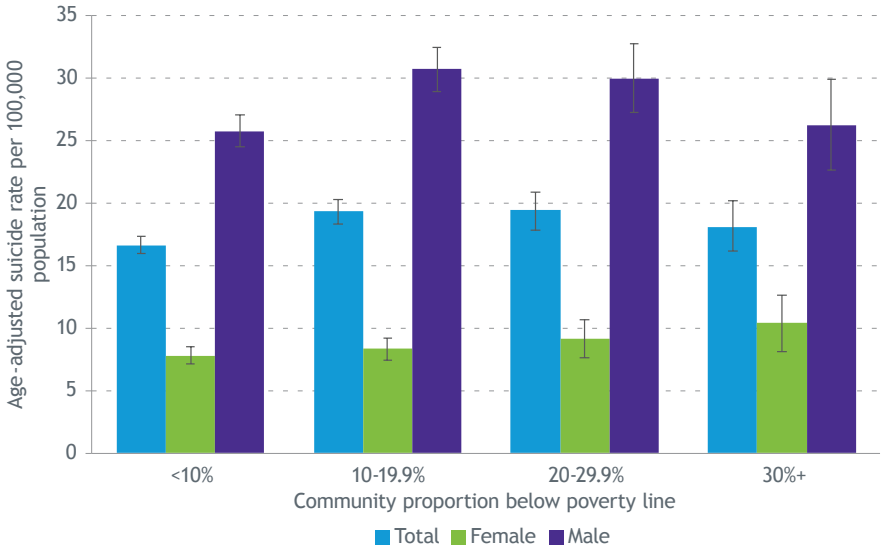
Figure 7. Suicide rates by gender and marital status, age ≥ 18 years, Colorado residents, 2011-2015.



Error bars represent the 95% confidence interval.
Rates are per 100,000 population.
Source: Colorado Violent Death Reporting System, Colorado Department of Public Health and Environment.

Figure 8 shows the area-based poverty estimates for Colorado residents. Area-based poverty status represents the percentage of the population in the census tract of the decedent's residence living at or below the federal poverty level. Among both females and males, as well as overall, these results suggest that as the proportion of one's community that lives below the poverty level increases, the age-adjusted suicide rate also increases. This relationship is seen until the most-poor communities, where the suicide rate drops back down. The only statistically significant differences are observed in the total and male groups between <10 percent and the 10-19/9 percent and 20-29.9 percent groups.

Figure 8. Area-based poverty estimates, Colorado residents, 2011-2015.



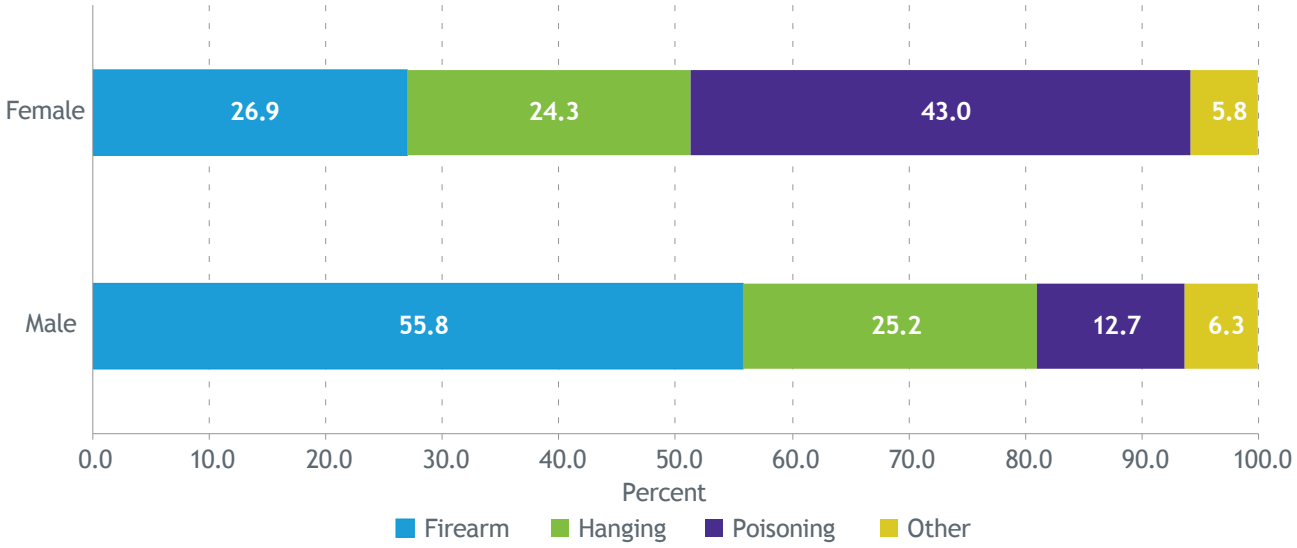
Error bars represent the 95% confidence interval.
Rates are per 100,000 population.
Source: Colorado Violent Death Reporting System, Colorado Department of Public Health and Environment.

Suicide Methods

Age and Gender

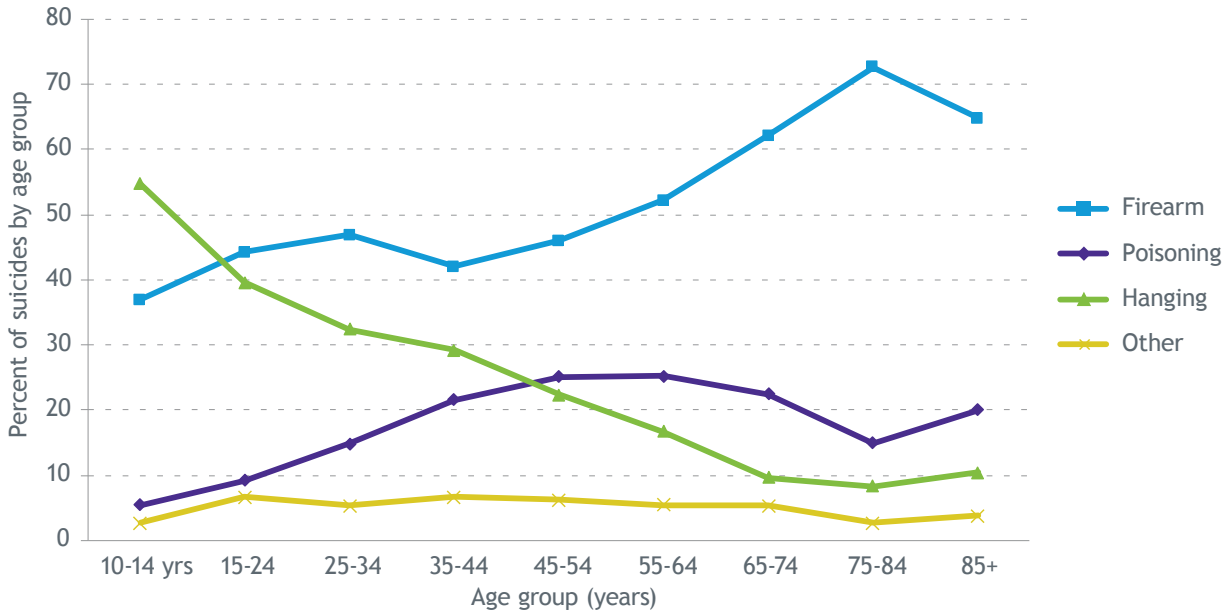
Male suicide deaths most frequently involved the use of a firearm as lethal means (55.8%), followed by hanging/asphyxiation/suffocation (25.2%) and poisoning (12.7%). In contrast, the greatest proportion of female suicide deaths involved the use of poison as lethal means (43.0%), followed by firearm (26.9%) and hanging/asphyxiation/suffocation (24.3%) (Figure 9). The method of suicide also varied according to age. As age increased, the use of a firearm as a lethal method increased; whereas the use of hanging/asphyxiation/suffocation was highest among younger victims (Figure 10).

Figure 9. Suicide deaths by method and gender, Colorado residents, 2011-2015.



"Other" methods include jumping from a high place, sharp object or other/unspecified methods.
Source: Colorado Violent Death Reporting System, Colorado Department of Public Health and Environment.

Figure 10. Suicide methods by age group, Colorado residents, 2011-2015.



"Other" methods include jumping from a high place, sharp object or other/unspecified methods.
Source: Colorado Violent Death Reporting System, Colorado Department of Public Health and Environment.

Suicide Circumstances

Table 3 outlines the 20 circumstances most frequently associated with suicide deaths in Colorado among residents. The most frequent circumstance associated with Colorado suicide deaths was indication by family, friends, or acquaintances that the victim was exhibiting a "depressed mood" (including being noted as feeling "sad" or "despondent") close to the date/time of death (55.8%). There are numerous circumstances related to mental health and treatment as well as other adverse life events that were documented to be related to the suicide deaths. Additionally more than a quarter of suicide decedents had attempted suicide in the past (27.4%)

Table 3. Suicide deaths by circumstance, Colorado residents, 2011-2015.

Circumstance	N	Percent
Suicides with 1 or more known circumstance	4,576	91.0
Current depressed mood	2,552	55.8
Current mental health problem	2,248	49.1
Ever treated for mental health problem	1,831	40.0
Diagnosis of depression	1,672	36.5
Left a suicide note	1,670	36.5
Intimate partner problem	1,599	34.9
Physical health problem	1,495	32.7
Disclosed suicidal intent 2 weeks before death	1,426	31.2
Current mental health treatment	1,399	30.6
History of suicidal thoughts or plans	1,330	29.1
Problem with alcohol	1,269	27.7
History of previous suicide attempts	1,255	27.4
Crisis in last two weeks	1,254	27.4
Death preceded by argument	1,050	23.0
Job problem	835	18.3
Problem with other substance	798	17.4
Contributing criminal legal problem	735	16.1
Financial problem	721	15.8
Family relationship problem	714	15.6
Recent non-suicide death of friend or family	380	8.3

*Percent of total cases with at least one circumstance known.
Source: Colorado Violent Death Reporting System, Colorado Department of Public Health and Environment.

Table 4 contains similar circumstance information as Table 3, but broken out by age group. For each age group the top 5 most frequent circumstances are highlighted (including tie values). The percentages are calculated out of cases where at least one circumstance was known, and ranges from 89.0 percent to 92.9 percent between age groups (data not shown). The table reveals vast differences between age groups for circumstances that contributed to suicide deaths. Physical health problem had wide variation between age groups with the oldest age group having this present in 85.7 percent of suicide deaths. Family problem contributing to death was much more prevalent in younger ages, and was the most prevalent circumstance in the 10-14 age group (47.7%). Additionally, intimate partner problem and problem with alcohol were the most prevalent in the working age group (25-54).

Table 4. Suicide deaths by circumstance and age group, Colorado residents, 2011-2015.

Circumstance	Age group								
	10-14	15-19	20-24	25-34	35-44	45-54	55-64	65-74	75+
	%	%	%	%	%	%	%	%	%
Current depressed mood	43.1	47.3	53.4	54.5	57.4	57.4	61.9	51.8	50.2
Current mental health problem	43.1	47.3	51.4	49.0	47.5	55.9	51.3	41.9	34.6
Ever treated for mental health problem	41.5	36.8	41.3	41.2	40.4	46.6	39.8	33.7	23.6
Diagnosis of depression	18.5	27.3	35.5	34.0	35.2	43.6	40.5	34.0	28.6
Left a suicide note	27.7	36.4	31.8	30.1	35.7	40.4	40.4	37.4	38.9
Intimate partner problem	20.0	35.9	40.8	49.9	47.0	35.5	25.7	14.2	8.3
Physical health problem	**	6.8	7.8	16.2	21.4	31.8	47.3	64.6	85.7
Disclosed suicidal intent	15.4	31.4	35.2	34.4	33.3	31.0	28.7	25.5	29.6
Current mental health treatment	35.4	25.5	27.7	30.3	29.8	36.4	32.5	26.9	20.3
History of suicidal thoughts or plans	30.8	28.2	35.2	31.6	27.9	30.3	28.7	24.9	20.6
Problem with alcohol	**	9.1	25.7	32.5	38.8	35.3	25.7	14.7	5.7
History of previous suicide attempts	18.5	26.8	35.5	31.7	29.6	31.8	23.2	19.3	10.6
Crisis in last two weeks	18.5	25.0	29.3	31.6	30.5	25.9	24.3	23.5	27.9
Death preceded by argument	33.9	32.7	31.3	32.9	28.1	21.1	15.2	9.6	7.0
Job problem	**	3.6	14.8	20.1	19.7	25.3	24.5	8.8	1.0
Problem with other substance	7.7	22.3	25.7	27.8	20.6	15.6	13.0	7.9	**
Contributing criminal legal problem	**	15.0	21.8	23.3	20.7	16.9	12.0	5.4	3.0
Financial problem	**	3.6	8.7	14.0	16.9	22.1	23.2	11.6	3.3
Family relationship problem	47.7	32.7	16.2	15.5	15.4	18.0	11.9	10.2	4.7
Recent non-suicide death of friend or family	9.2	8.2	5.9	4.8	6.8	9.5	10.2	10.2	13.0
Diagnosis of Bipolar Disorder	6.2	4.6	12.3	8.9	9.2	9.8	6.2	2.6	1.0
Other Mental Health Diagnosis	29.2	19.1	10.9	10.8	5.1	4.7	3.4	3.7	6.0
Diagnosis of Anxiety	4.6	3.6	6.7	5.4	6.6	9.4	8.3	6.5	6.3
Eviction or loss of home	**	1.8	2.8	3.5	6.6	7.6	7.8	4.0	7.0
Civil legal problem	**	1.8	2.8	7.6	8.5	6.8	4.8	1.1	1.0
Recent suicide of friend or family	10.8	6.4	5.3	5.0	2.6	4.4	3.3	3.7	2.7
School Problem	35.4	28.6	3.6	0.7	0.4	**	**	**	**

All percentages are based on total cases with at least one circumstance known.

** Percentages based on fewer than three suicide deaths are suppressed.

Source: Colorado Violent Death Reporting System, Colorado Department of Public Health and Environment.

Table 5 presents documented toxicological results associated with these suicide deaths, that is, what substances were present in the victim at the time of death. Among suicide deaths for which toxicology results were available, Alcohol (35.8%) was the most frequently identified substance, followed by Opioids (17.8%) and Antidepressants (15.7%).

Table 5. Suicide deaths by presence of substances, Colorado residents, 2011-2015.

Toxicology	N	Percent
Toxicology available	3,939	78.3
Alcohol present	1,409	35.8
Opioid present	699	17.8
Antidepressant present	619	15.7
Benzodiazepine present	533	13.5
Marijuana present	531	13.5
Amphetamine present	225	5.7
Anticonvulsant present	142	3.6
Cocaine present	106	2.7

*Percent of total cases with toxicology results known.

Source: Colorado Violent Death Reporting System, Colorado Department of Public Health and Environment.

Discussion

Over the past five 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 collisions, and suicide has become the seventh leading cause of death in Colorado. Not only does the state maintain an average suicide rate nearly 1½ times greater than the national rate (19.5 Colorado crude suicide death rate, 2015; 13.3 US rate, 2015),[1] the state's average suicide rate has ranked among the 10 highest in the nation for several consecutive years. Within the state of Colorado, considerable variation in suicide frequency and suicide risk was observed among Colorado's diverse populations: Differences by geographic region, racial/ethnic group, gender, method of lethal means, age category, relationship status, and poverty were apparent in Colorado suicides from 2011 to 2015. Analysis of precipitating circumstances prior to death among suicide victims by age revealed important differences that may provide information useful for guiding suicide intervention efforts in Colorado communities.

Variations in the age-adjusted suicide rate were seen in neighboring regions within 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.[8-10] Suicide 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 1½ times greater than the Colorado state average and over three times greater than females. Male Colorado residents between the ages of 35 and 54 years not only experienced the highest suicide rates among the age groups and genders, they have consistently contributed the largest proportion of all Colorado resident suicides over the past five years (28%). The high suicide rate and frequency seen in the middle-aged Colorado male population have important implications on statewide public health planning and prevention efforts.

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 two times greater than the average rate of the White, Hispanic, Black/African American, Asian American/ Pacific Islander, and American Indian populations.

Previous studies have demonstrated that suicide rates vary significantly by marital status,[11] and some studies even indicate a possible protective effect of marriage.[12] 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. The age-adjusted suicide rates in the widowed male and female populations were the highest.

There are three major types of weapons used most frequently in suicide deaths: firearm, hanging/ asphyxiation/suffocation, or poisoning (including prescription and illicit drugs, other chemicals, and carbon monoxide). The frequency of weapon use varies significantly by gender and by age group. Compared to women, men are more likely to use a firearm as lethal means and less likely to die 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.

Analysis of the toxicological results show a relatively high prevalence of alcohol among victims of suicide, and not insignificant prevalence of opioids (both prescription and illicit). Substance misuse and abuse remain significant public health concerns in Colorado, with rates of both intentional (suicide) and accidental drug overdose deaths increasing in recent years.[13] Better understanding the relationships between substance misuse and abuse,

mental health (specifically depression), and thoughts and behaviors that lead to suicide will be key to suicide prevention strategies.

The 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 support the efforts of local and state agencies toward suicide planning and intervention by providing a better understanding of the populations at greatest risk for suicide death. This report will also serve Colorado citizens by contributing to decreased burden of suicide in Colorado communities attained through evidence-based prevention programs based on the findings of these and future CoVDRS analyses.

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