

Seasonal Patterns in Violent Deaths in Colorado, Colorado Violent Death Reporting System, 2004-2018

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Introduction

Homicides and suicides have consistently been a leading cause of death in the United States for those under 45 years old.¹ In 2017, suicide was the second leading cause of death for ages 10-24 (19.2% of deaths) and 25-44 (10.9%).¹ Colorado consistently ranks among the top 10 states for suicide mortality rates.² In 2018, the state homicide rate was 4.7 deaths per 100,000³ and incidents of violent deaths have been gradually increasing in the state of Colorado over the past decade.⁴ Violent deaths affect people of all backgrounds and remain a priority in public health prevention efforts.

Leading causes of mortality, such as heart failure and lung disease often demonstrate seasonal patterns,^{5,6} raising the question of whether violent forms of mortality also follow a seasonal pattern. An international review of research on suicide seasonality reveals fairly consistent peaks of suicide rates during spring and summer months, but there is variation by country and study.⁷ Some research has suggested that youth suicides may follow the school calendar, with suicides increasing during months when school is in session due to academic-related stress and negative social interaction.⁸ When thinking about homicide, it has been theorized that higher temperatures in summer months may cause increased feelings of hostility which lead to an increase in aggressive motives and behaviors.⁹ Additionally, longitudinal studies on crime have shown that crimes are likely impacted by temperature and seasonality.¹⁰

This report aims to further explore seasonal patterns in violent death for the state of Colorado. Given the noted occurrences of violent death in Colorado, better understanding of possible associations could be a helpful tool in the prevention of these deaths. This report includes the most up to date data for homicides and suicides from the Colorado Violent Death Reporting System.

Methods

The data used in this report came from the Colorado Violent Death Reporting System (CoVDRS), an enhanced public health surveillance system which is part of the National Violent Death Reporting System (NVDRS). The NVDRS is funded and maintained by the U.S. Center for Disease Control and Prevention. CoVDRS records include detailed information on each violent death that occurs within the state of Colorado, and were compiled by trained abstractors who extract data from death certificates, coroner/medical examiner reports, and law enforcement investigations. A complete description of the data abstraction process is provided on the NVDRS website.¹¹

Deaths were selected for inclusion in this investigation based on the indication of suicide or homicide as the manner of death on the death certificate. All suicide and homicide deaths among Colorado residents within the state of Colorado between 2004 and 2018 were included. Colorado residents who died by these manner of deaths in other states are not represented in this report.

Violent deaths included in this report were analyzed by manner of death, month of injury, age, sex, victim circumstances, and toxicology. For the purposes of the report, month of injury is used to assess trends in mortality. This represents the calendar date/month when the decedent was fatally injured. It is important to note that the CoVDRS data system collects both a date of death and a date of injury. Often the date of injury and date of death are the same, but occasionally they differ (when a decedent survives the initial injury for a time and then dies later). Therefore, for this analysis, it is more appropriate to assess when the decedent was initially injured, as this is more closely aligned with potential seasonal factors. For cases where the date of injury was unknown, date of death is used. For this report months of injury are combined across years to assess seasonal patterns. For example, 'January' data represent any individual who was fatally injured in the month of January during the years 2004 through 2018. Age groups are defined as 0-9 years (homicide only), 10-18 years, 19-24 years, 25-64 years and 65 years and up. Sex represents what was reported as the sex of the decedent at time of death on the death certificate.

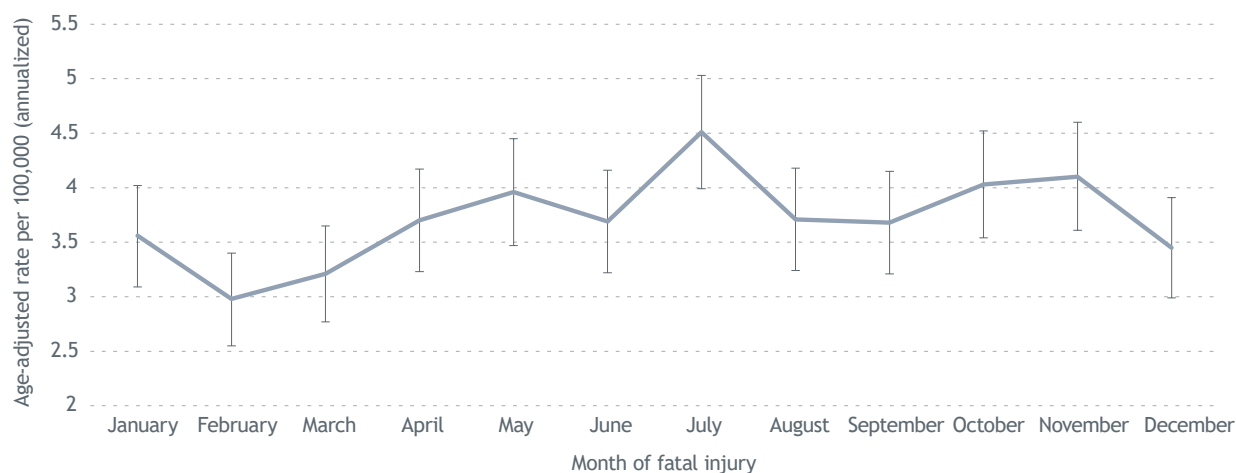
Data in this report are presented as counts, percentages, and annualized age-adjusted mortality rates by month. Annualized monthly rates estimate an expected annual rate if monthly rate prevailed for 12 months. Annual population estimates used in computing mortality rates use estimates from the State Demography Office, Colorado Department of Local Affairs. Age-adjusted mortality rates are presented per 100,000 population with the ninety-five percent (95%) confidence interval, using the direct method applying the 2000 United States standard population. Results are generally presented with 95 percent confidence intervals, where differences between rates are described as 'statistically significant' or 'significantly higher or lower' only if the confidence intervals of two rates being compared do not overlap.

Results

Homicide and Suicide Rates

There were 2,882 homicide deaths in Colorado between 2004 and 2018. Figure 1 presents the monthly trends of homicide rates in Colorado. The highest combined monthly rate of homicide was in July, with a rate of 4.5 per 100,000 (95% CI: 4.0-5.0). When comparing this rate to other months, it was significantly higher (i.e. statistically) than December [3.5 per 100,000 (95% CI: 3.0-3.9)], February [3.0 per 100,000 (95% CI: 2.6-3.4)] and March [3.2 per 100,000 (95% CI: 2.8-3.7)].

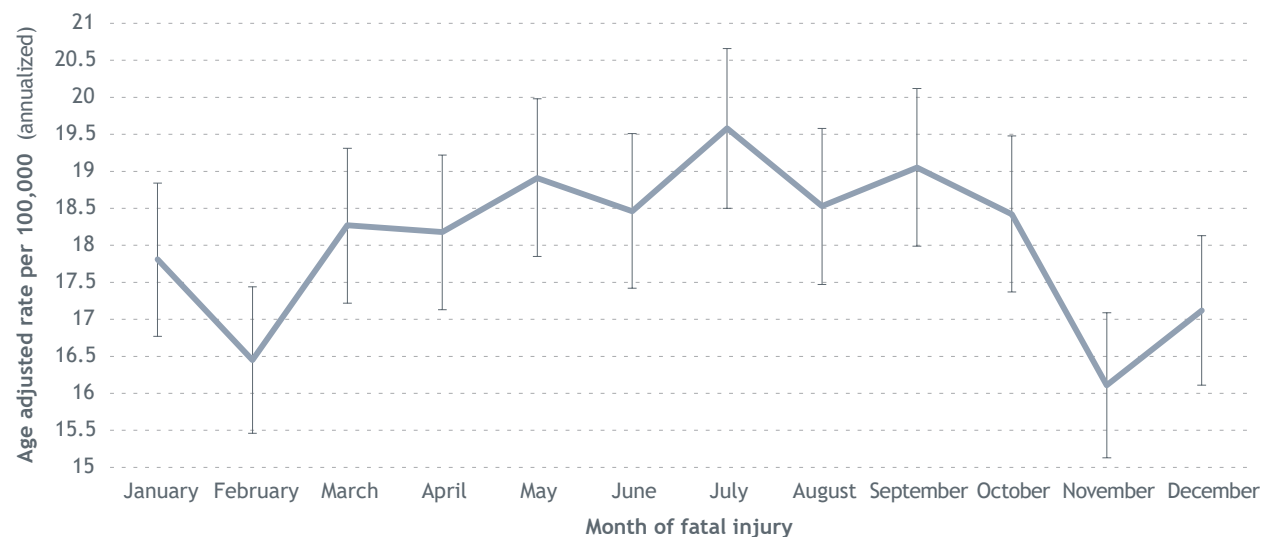
Figure 1. Age-adjusted homicide rates (annualized) by month of fatal injury, Colorado residents (2004-2018).



Source: Colorado Violent Death Reporting System, Colorado Department of Public Health and Environment. Error bars represent the 95% confidence interval of the rate.

There were 14,229 suicide deaths between 2004 and 2018. Figure 2 presents the combined monthly trends of deaths, where again, July had the highest rate over the 15 year period, 19.6 deaths per 100,000 population (95% CI: 18.5-20.7). This rate was significantly higher than November [16.1 per 100,000 (95% CI: 15.1-17.1)], December [17.1 per 100,000 (95% CI: 16.11-18.13)], and February [16.5 per 100,000 (95% CI: 15.5-17.4)].

Figure 2. Age-adjusted suicide rates (annualized) by month of fatal injury, Colorado residents (2004-2018).



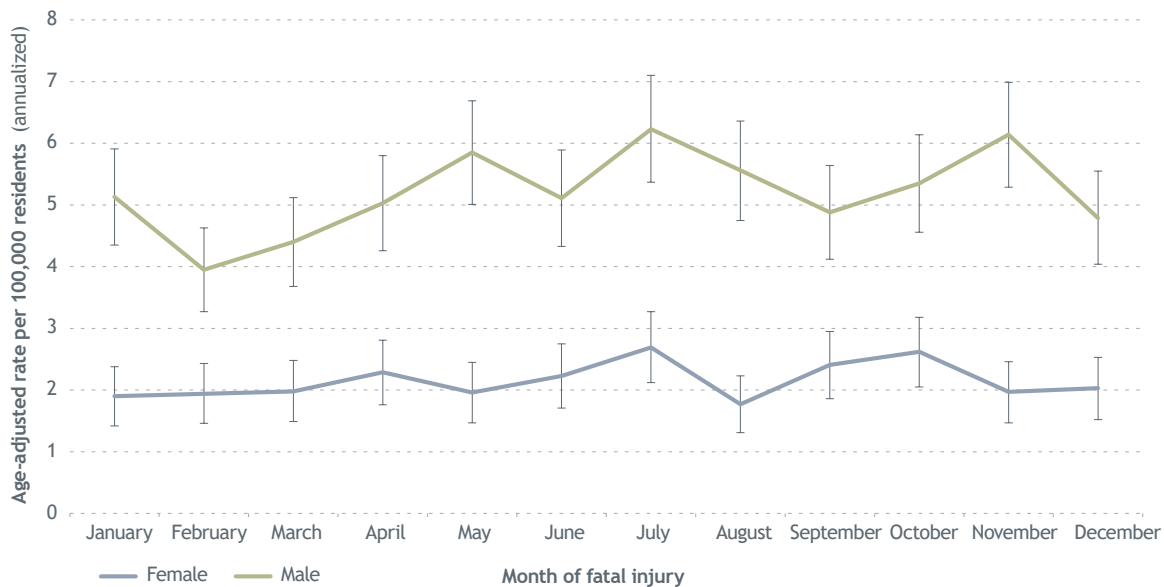
Source: Colorado Violent Death Reporting System, Colorado Department of Public Health and Environment. Error bars represent the 95% confidence interval of the rate.

Rates by Sex

Overall, males made up 71% of homicides between 2004 and 2018, when compared to females. July had the highest mortality rate for homicides among males; 6.2 per 100,000 (95% CI: 5.4-7.1). The July rate was significantly higher than February [3.9 per 100,000 (95% CI: 3.2-4.6)], and March [4.4 per 100,000 pop (95% CI: 3.6-5.12)]. Additionally, May [5.8 per 100,000 (95% CI: 5.0-6.6)], August [5.5 per 100,000 (95% CI: 4.7-6.3)],

and November [6.1 per 100,000 (95% CI: 5.2-6.9)] also have significantly higher mortality rates compared to February [4.0 per 100,000 (95% CI: 3.3-4.6)]. There were no statistically significant differences when comparing the female rates by month. See Figure 3 below.

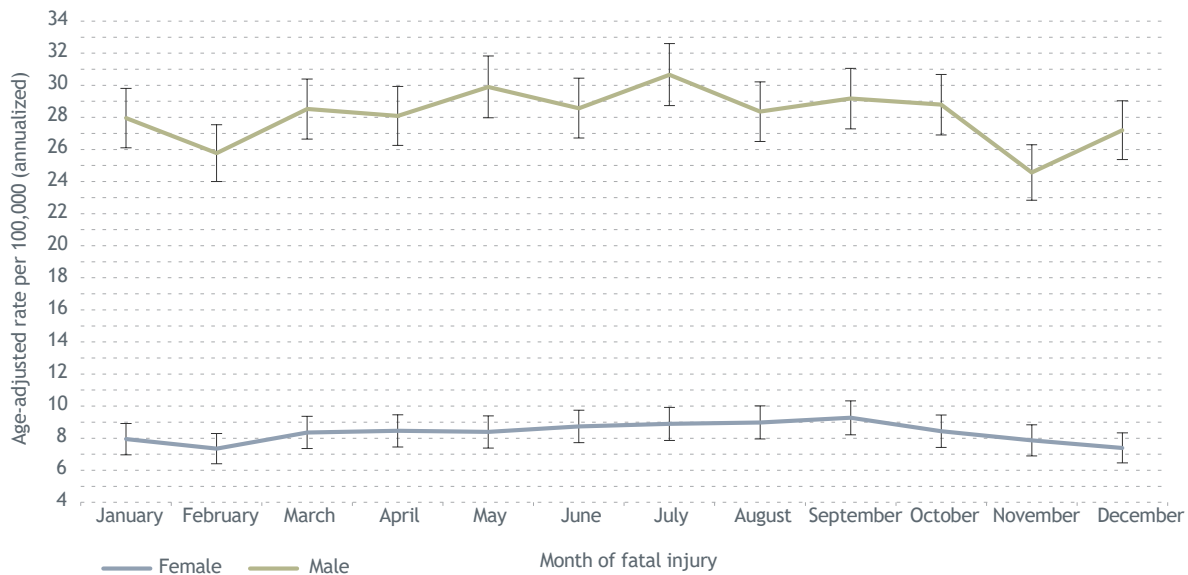
Figure 3. Age-adjusted homicide rates (annualized) by month of fatal injury and sex, Colorado residents (2004-2018).



Source: Colorado Violent Death Reporting System, Colorado Department of Public Health and Environment. Error bars represent the 95% confidence interval of the rate.

For suicides, males made up 76% of the incidents between 2004 and 2018. Again, July was highest for males with an age-adjusted rate of 30.7 per 100,000 (95% CI: 28.7-32.6). This rate was significantly higher than the February [25.7 per 100,000 pop (95% CI: 24.0-27.5)] and November [24.5 per 100,000 pop (95% CI: 22.8-26.2)] rates. Additionally, the May rate [29.9 per 100,000 pop (95% CI: 27.9-31.8)] was also significantly higher than February and November. There were no statistically significant differences between months in female suicide rates. See Figure 4 below.

Figure 4. Age-adjusted suicide rates (annualized) by month of fatal injury and sex, Colorado residents (2004-2018).

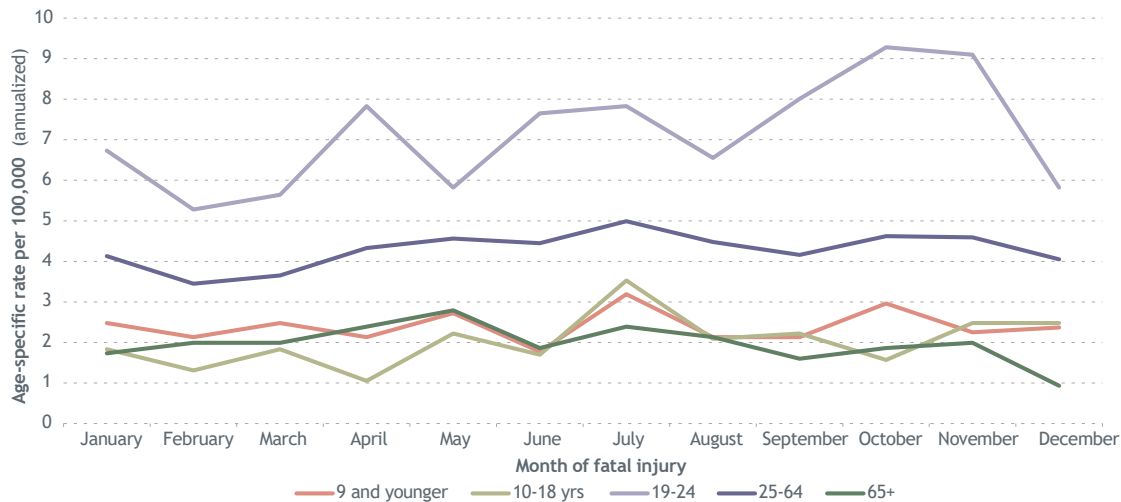


Source: Colorado Violent Death Reporting System, Colorado Department of Public Health and Environment. Error bars represent the 95% confidence interval of the rate.

Rates by Age

When looking at homicide rates by age there were few months that were statistically different from each other. For ages 10-18 years, the age specific homicide rate for July [3.5 per 100,000 (95% CI: 2.2-4.9)] was significantly higher than both February [1.3 per 100,000 (95% CI: 0.5-2.1)] and April [1.1 per 100,000 (95% CI: 0.3-1.8)]. When looking at the 25-64 years age group, July [5.0 per 100,000 (95% CI: 4.3-5.7)] was also significantly higher than February [3.5 per 100,000 (95% CI: 2.8-4.1)]. Although there was variation in the 19-24 year old group by month, none of these differences were statistically significant. For ease of viewing, Figure 5 and 6 do not include confidence intervals.

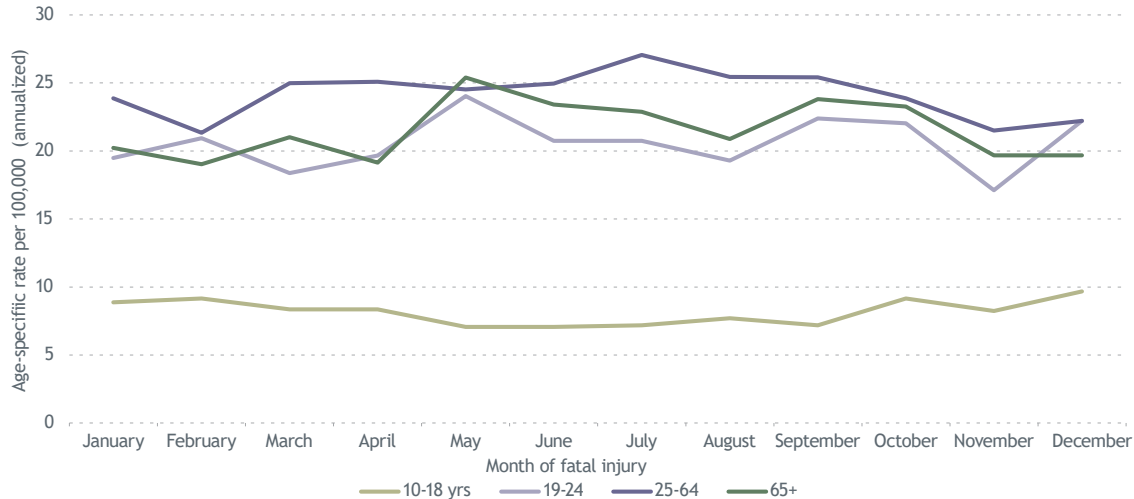
Figure 5. Age-specific homicide rates (annualized) by month of fatal injury, Colorado residents (2004-2018).



Source: Colorado Violent Death Reporting System, Colorado Department of Public Health and Environment.
95% confidence intervals not included in figure.

For suicide rates, only the age group 25-64 years showed statistically significant differences when comparing months. The July rate [27.1 per 100,000 (95% CI: 25.3-28.8)] was significantly higher than the February [21.3 per 100,000 (95% CI: 19.8-22.9)], November [21.5 per 100,000 (95% CI: 20.0-23.0)] and December [22.2 per 100,000 (95% CI: 20.7-23.8)] rates. August [25.4 per 100,000 (95% CI: 23.8-27.1)] was also significantly higher than February and November. Rates for the age group 10-18 years don't exhibit a peak in summer months, unlike other age groups; overall, there were no statistical differences between months within this age group.

Figure 6. Age specific suicide rates (annualized) by month of fatal injury, Colorado residents (2004-2018).



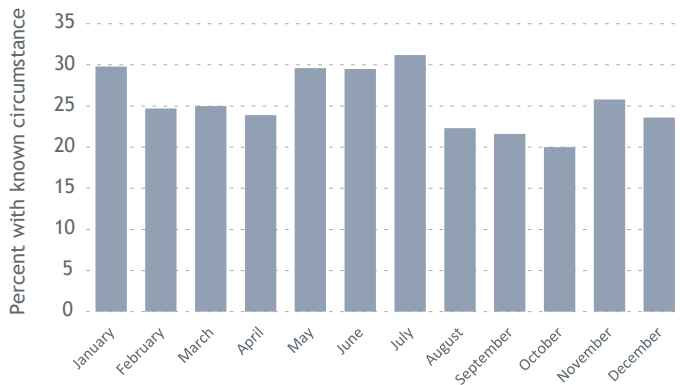
Source: Colorado Violent Death Reporting System, Colorado Department of Public Health and Environment.
95% confidence intervals not included in figure.

Toxicology and Circumstances

Toxicology data reveal that alcohol was the most common substance found in decedents of both suicide and homicide. For homicide deaths, the prevalence of alcohol was the higher in July, with 40.0% of decedents having alcohol present, compared to 32.0% in January (based on deaths for which post-mortem toxicology results were provided).

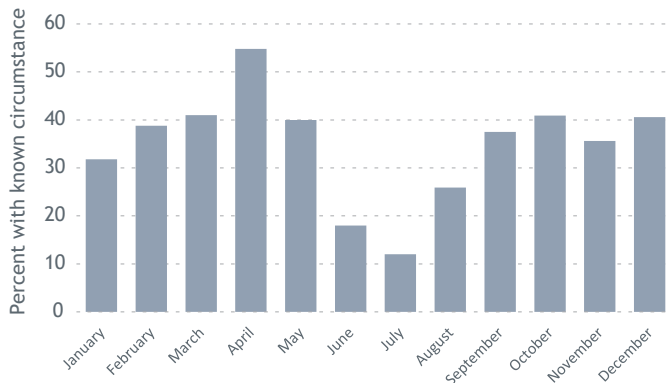
Looking at select circumstances we see some additional patterns. Figure 7 contains trends in homicides where the death was precipitated by another crime. July has the highest incidents at 31.2%, with May, June, and January also having a higher prevalence. Figure 8 illustrates suicide deaths for ages 10-18 years with a known circumstance who were identified with having a school problem. Logically, those months where school traditionally is not in session (June and July) saw the lowest percentage of contributing school problems (no statistical testing done for circumstance or toxicology data).

Figure 7. Percent of homicides where death was precipitated by another crime (based on total homicide deaths with one or more known circumstances).



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

Figure 8. Percent of Suicides with known school problem for ages 10-18 (based on total suicide deaths with one or more known circumstances).



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

Discussion

The results reveal that there were only a few months where differences in rates of violent deaths were statistically significant, when comparing months with the highest rates to those with lowest rates. July had an elevated rate of both suicides and homicides when compared to February and other winter months. It is

possible that the fewer number of days in the month of February compared to all other months may play a role in it consistently having lower annualized mortality rates. The magnitude of these differences was around 3 deaths per 100,000 for suicide rates, and 1.5 deaths per 100,000 for homicide rates (when comparing February and July). Demographically this trend appears to be driven by male deaths, and those in the 25-64 age group.

In relation to homicide trends, nationwide data has shown that assaults and other crimes are sometimes higher during the summer compared to the rest of the year.^{9,10} Some theorize it may be due to increased temperature or a change in activities, such as people being outside more.^{9,10} The toxicology data from CoVDRS shows alcohol use among homicide decedents was higher in July with 40% having alcohol present at the time of death. Although more exploration is needed, increased alcohol usage and higher crime rates may be associated with these patterns.

When looking at suicide trends, the increased rate in summer months, isn't observed in all age groups. Specifically, those ages 10-18 years did not have statistically elevated rates in the summer when compared with other months. What was observed is a smaller percentage of cases with a contributing school problem in those summer months. These trends logically follow traditional school sessions (summer months being adjourned). With that said, it is very important to note that there were no significant differences in the monthly rates of suicide for those ages 10-18 years; a similar risk of suicide for this age group persists in all months and seasons.

To that end, while the data reported here does show some patterns in the occurrence of these violent deaths by month, the general differences were small and there are high levels of variation. Therefore, year round prevention efforts for both suicide and homicide would be most recommended. The findings in this report represent the most currently available CoVDRS data on monthly trends, demographics, circumstances and toxicology report of suicides and homicides in Colorado. This information can contribute to current suicide and homicide prevention efforts as well as the collective understanding of characteristics of suicides and homicides in our communities.

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