NIH Public Access
Author Manuscript
Addiction. Author manuscript; available in PMC 2014 July 21.

Published in final edited form as:
Addiction. 2013 March ; 108(3): 547–555. doi:10.1111/j.1360-0443.2012.04098.x.

Gender differences in the presence of drugs in violent deaths

Connor M. Sheehan[1], **Richard G. Rogers**[2], **George W. Williams IV**[2], and **Jason D. Boardman**[2]

[1]Population Research Center and Department of Sociology, University of Texas at Austin, Austin, TX, USA

[2]Population Program, Institute of Behavioral Science and Department of Sociology, University of Colorado at Boulder, Boulder, CO, USA

Abstract

Aims—To investigate differences in the presence of drugs, by gender, when considering deaths attributable to homicides and suicides.

Design—Logistic regression analysis of mortality data collected by the Colorado Violent Death Reporting System.

Participants and setting—A total of 5791 Colorado decedents who died of violent causes from 2004 to 2009.

Measurement—Forensic pathologist autopsy data on drug presence at time of death, coded as present, not present or missing.

Findings—Postmortem presence of drugs is associated strongly with the specific cause of violent death. Compared with suicide decedents, homicide decedents are significantly more likely to test positive for amphetamines [odds ratio (OR): 1.79; confidence interval (CI): 1.34, 2.39], marijuana (OR: 2.03; CI: 1.60, 2.58) and cocaine (OR: 2.60; CI: 2.04, 3.31), and are less likely to test positive for opiates (OR: 0.27; CI: 0.18, 0.39) and antidepressants (OR: 0.17; CI: 0.10, 0.28). When other drugs are controlled for the influence of alcohol is abated dramatically. The patterns of drug prevalence associated with homicide (particularly marijuana) are stronger among males; the patterns of drug prevalence associated with suicide are stronger among females.

Conclusions—Suicide and homicide decedents are characterized by varying patterns of licit and illicit drug use that differ by gender. Drugs associated with homicide (marijuana, cocaine and amphetamines) are stronger among males, while drugs associated with suicide are stronger among females (antidepressants and opiates). Taking these differences into consideration may allow for targeted interventions to reduce violent deaths.

Correspondence to: Connor M. Sheehan, Population Research Center, G1800, University of Texas at Austin, Austin, TX 78712-0544, USA. connor.sheehan@utexas.edu.

Declarations of interest
None.

This paper was presented at the American Sociological Association annual meetings in Denver, Colorado. 17–20 August 2012.

Keywords

Alcohol; gender; homicide; illicit drugs; suicide; violent death

INTRODUCTION

Substance use is associated strongly with violent deaths [1–3]. For example, heavy alcohol consumption is related to higher risks of suicide [4] and homicide [5]. Nearly one in three (31%) homicide victims in New York City tested positive for benzoylecgonine at the time of death, which indicates recent use of cocaine [6], and comparable results have been shown for suicides, especially among those who committed suicide with a firearm [7]. With few exceptions [5,8], little research has described the presence of different types of drugs at the time of death among homicide compared with suicide victims, and no study has examined the role of gender in this complex process.

SUBSTANCE USE, GENDER AND VIOLENT DEATHS

Violent deaths remain a major social and health policy priority in the United States [9–12], where the age-standardized death rate from homicide for individuals aged 25–44 years is 25 times higher in the United States than in France or Japan [13]. Homicide and suicide deaths in the United States totaled 53 708 in 2009 [14] and contributed to more than 47 billion dollars in economic cost from increased medical care and lost productivity in 2005 [15]. These deaths also exert a significant impact on racial/ethnic disparities in life expectancy [16]. Characterizing the risk factors that accompany violent deaths, particularly drug presence, is crucial for developing effective prevention policies.

Many national and community-based studies rely on self-reports of drug use, which may underestimate prevalence rates [17]. Even valid and reliable reports of regular use, however, may vary substantially from actual use near the time of death. Therefore, we endeavor to analyze drug presence among decedents with a specific focus on gender differences among drugs present at the time of death and aim to improve upon past analyses by controlling for other covariates, including postmortem presence of other drugs.

Owing to the psychopharmacological effects of licit and illicit drugs [18], ‘alcohol and drug abuse are second only to depression and other mood disorders as the most frequent risk factors for suicidal behavior’. Although research has found that substance use, particularly alcohol use, is associated with violent deaths, the literature has been concerned mainly with the incidence of suicide [7,19] *or* homicide [20,21], rather than how the two causes of death are associated with different drugs.

A comparison of homicide and suicide deaths requires attention because they are associated with ecological factors (e.g. social normlessness, disorganization and inequality) that vary substantially across societies [22]. If there are no differences in the risk of homicide versus suicide as a function of the presence of drugs, then drug use may simply be part of a larger social context that structures the likelihood of both deleterious outcomes. If, however, certain substances are much more likely among homicide than suicide deaths, then the role of drug use *vis-à-vis* social etiology of violent deaths should be specific to the different causes. Previous work has indeed found differences in the types of drugs present among different kinds of violent death [8].

Marijuana, opioids and psychostimulants are significantly more prevalent among homicide deaths than among suicide deaths [8]. For example, 22.1% of homicide decedents tested positive for cannabis, compared with only 10.6% of suicide decedents. However, suicide victims were significantly more likely than homicide victims to test positive for antidepressants (12.6% versus 3.0%) and antipsychotics (5.5% versus 1.3%).

Focusing on the different types of drugs present is particularly relevant for gender differences in the risk of violent death. The rate of violent deaths is significantly higher among men than among women, and men are more likely than women to use and abuse most substances [17,23]. Compared with women, men have elevated levels of illegal substance abuse, which exposes them to a greater risk of drug violence [24]. Conversely, gender differences in stress exposure and greater prevalence of mood and anxiety disorders result in women's greater use of pharmaceuticals, including anti-depressants [25–27].

Because of their pharmacological nature and cultural significance, stimulants such as amphetamines and cocaine are more likely to be prevalent among homicide victims than among suicide victims [8]. We also hypothesize that the ability of stimulant presence to discriminate between the two types of death will be stronger for men than for women because of elevated usage by males. Similarly, we expect to see a greater prevalence of antidepressant use among suicide compared with homicide victims, an association that should be significantly higher for women than for men. A greater understanding of differences in drug use between suicide and homicide decedents could further clarify stress coping patterns; help to assign a manner of death in future cases when the cause is unclear; and lead to more effective policies regarding drug intervention, protocols for prescription drugs and violence prevention initiatives [10,28,29].

Aims

This study examines how drugs in the system at time of death differ among Coloradans who died violent deaths— suicides and homicides. We also examine whether these drugs differ systematically between male and female decedents. This research broadens the literature by using multivariate analyses; presenting results for the adult and gender-specific populations; and including prescription drugs (antidepressants) while controlling for other important covariates, including other drugs. Although past research has stressed the importance of drug combinations, this perspective has not been applied to the analysis of violent deaths [8, 30].

METHODS

We use data from the Colorado Violent Death Reporting System (COVDRS), which is conducted by the Colorado Department of Public Health as a participant in the National Violent Death Report System (NVDRS) and funded by the Centers for Disease Control and Prevention. The NVDRS was created in response to growing consensus on the need for comprehensive, high-quality data collection on violent deaths [10,31,32], which could ultimately inform the development and implementation of violence prevention policy [32–34]. Data are collected in 18 US states, including Colorado. A major advantage of NVDRS is that it links data from death certificates and medical examiner, coroner and law enforcement reports to produce a detailed surveillance system [10].

We analyze data from 2004–09, which include 5791 violent deaths among individuals aged 18 years and older in Colorado. The COVDRS contains information on the demographic characteristics of, and relationships between, the victims and suspects; circumstances of the incident; presence of alcohol and drugs in the victim at the time of death; type of location where the event occurred; and type of weapon used [10]. For this analysis, we examine only presence of alcohol and drugs. Detailed toxicology reports elucidate the specific relationships between substance use, especially drug use, and the occurrence of violent deaths.

We investigate associations between the presence of alcohol, amphetamines, antidepressants, cocaine, marijuana and opiates and whether the death was a homicide or suicide. Previous research has demonstrated racial/ethnic differences [30,35] and age differences in drug prevalence among decedents, covariates for which we can directly control; small sample sizes precluded separate analyses by detailed racial/ethnic or age groups. In addition, we control for education because drug use and cause of death may vary by educational attainment [16,36]. We use the COVDRS’s classification of homicide and suicide [10] and control for gender (male, female), age group (18–21, 22–44, 45–64, 65–84, 85 years and older), race/ethnicity (non-Hispanic white, non-Hispanic black, Latino/Hispanic, and other) and educational attainment (as measured by years of competed education at time of death). The toxicology reports tested for the presence of alcohol, amphetamines, antidepressants, marijuana, cocaine, opiates and any other drug (coded 1 if present and 0 if absent).

We use logistic regression to analyze how drug presence differs between those who died of homicide (coded 1) and those who died of suicide (coded 0). We present the coefficients as odds ratios. For the entire population, one model is computed for each drug along with the controls. Subsequently, all drugs are included into a model to determine whether the inclusion of other drugs explains the effect of each particular drug. Individual models for each drug are computed by gender, and then all the drugs are again added to analyze their combined effect within each gender. Medical examiners often do not test for certain types of drugs and sometimes do not test for any illegal substance. To avoid potential bias from excluding cases, we collapse missing values into dummy variables and include them into the model [37,38].

RESULTS

Table 1 displays drug presence among suicide and homicide decedents. Alcohol was identified in 42.2% of all tested cases, and was more common among homicide (48.9%) than suicide (30.1%) decedents. Among those tested, cocaine was present in 20.9% of homicide but only 4.4% of suicide decedents; similarly, marijuana was present in 22.4% of homicide but just 5.9% of suicide decedents. Conversely, among those tested, antidepressants were present in just 3.0% of homicide but almost 11% of suicide decedents; and opiates were present in 4.4% of homicide but almost 11% of suicide decedents. ‘Other’ drugs were found in 40.1% of all tested decedents; because there is such heterogeneity in that group— ranging from barbiturates and caffeine to ibuprofen—we do not include them in the model. Only 11.8% of all the tested decedents who died as a result of violence had no drugs in their system.

Compared with a meta-analysis conducted on only homicide decedents from around the world [3], homicide decedents in the COVDRS had elevated prevalence of marijuana and cocaine in males, lower levels of cocaine in females and lower prevalence of opiates in all decedents. The elevated use of marijuana and cocaine is congruent with surveys of drug use among Colorado adults. Compared with the national average, 3% more Colorado adults have admitted to using illicit drugs [39]. The majority of violent deaths in Colorado were due to suicide (83%) rather than homicide (17%), and the vast majority (77%) of the decedents were men. The divergent patterns of drug prevalence and type of death are articulated further in the multivariate analyses below.

Some drugs are correlated with each other. Although these correlations are not strong enough to lead to multicollinearity problems (tested with model diagnostic variance influence factor; results not shown), they merit discussion. Table 2 depicts the tetrachoric correlations between different pairs of drugs for all Colorado decedents (a), and by gender [(b), with males in the top portion of the matrix]. We use tetrachoric correlations because of their strength in measuring binary data. The strongest correlation for the entire adult population is between antidepressants and opiates (0.500), followed by marijuana and amphetamines (0.400) and alcohol and cocaine (0.330). The correlation between alcohol and cocaine is much stronger for males (0.353) than for females (0.205), and that between opiates and antidepressants is much stronger for females (0.519) than for males (0.423). These differences are statistically significant at the 0.05 level, as measured by Fisher’s exact test.

Table 3 presents multivariate logistic regression results. For the total population—with controls for age, gender, race/ethnicity and education—each of the individual drug effects, with the exception of alcohol, is associated statistically significantly with the specific manner of violent death. To model gender differences in drug presence formally, we include interaction terms between gender and drug presence to show which drugs exhibited statistically significant gender differences at the 0.05 and 0.10 levels. For the sake of parsimony, only statistically significant results of the interaction models are presented in Table 3, as indicated by superscripts c and d. In these models each drug is isolated, and an interaction term is created between drug prevalence and gender (with no other drugs controlled for). Because the interaction effects are statistically significant for every drug except alcohol, amphetamines and cocaine, we run gender-specific models. The interaction terms for amphetamines ($P < 0.10$) and cocaine ($P < 0.11$) are close to being statistically significant, despite the controls.

In the individual drug effect models, amphetamines are associated strongly with homicide: the presence of amphetamines is 79% [odds ratio (OR): 1.79; confidence interval (CI): 1.34, 2.39] more likely when the cause of death was homicide compared with suicide. Those with marijuana in their system were more than twice as likely to have died from homicide as from suicide (OR: 2.03; CI: 1.60, 2.58). Cocaine has the strongest positive association with homicide: decedents with cocaine in their system were 2.6-fold more (OR: 2.60; CI: 2.04, 3.31) likely to have died from homicide than from suicide. Conversely, the presence of antidepressants increases the relative odds of suicide compared with homicide almost sixfold (1/0.17; OR: 0.17; CI: 0.10, 0.28). Finally, the presence of opiates at the time of death is associated with a 3.7-fold (1/0.27; OR: 0.27; CI: 0.18, 0.39) increase in the odds of dying from suicide compared with homicide. Figure 1 illustrates the results of the individual drug models. Opiates and antidepressants are associated strongly with suicide compared to homicide, a pattern much stronger in women than men, while marijuana, cocaine and amphetamines are associated more strongly with homicide than suicide.

To examine the influence of each drug net of other drugs, we include all the drugs in a single model, which slightly attenuates most of the effects. For example, the strong associations of amphetamines and cocaine on violent deaths are reduced by 12% and 6%, respectively. Nevertheless, the presence of all drugs (except alcohol), net of other drugs, exert a strong and significant association on the odds of homicide versus suicide deaths.

Our results reveal substantial gender differences. For men, the odds of dying from homicide rather than suicide increase twofold with amphetamines, 2.3-fold with marijuana and 2.7-fold with cocaine. For women, only cocaine displays a significant association with homicide: female decedents with cocaine in their system were nearly twice as likely to have died from homicide compared with suicide (OR: 1.96). When all the drugs are included, the association between cocaine and homicide becomes stronger. Antidepressants and opiates exhibit a strong association with suicide, especially for women. For instance, the presence of antidepressants in women increases their odds of death from suicide compared with homicide 12.5-fold.

DISCUSSION

Our results underscore strong associations between drug use and type of violent death, as well as significant gender differences. Consistent with previous studies of other populations [3,8], all drugs tested in the Colorado adult population have sizable and significant associations with cause-specific violent mortality. Opiates and antidepressants are associated strongly with suicide, whereas amphetamines, marijuana and cocaine are associated with homicide. Because of the pharmacological nature of amphetamines and the increasingly violent markets associated with them, people using these drugs may be more likely to engage in aggressive behavior [40,41]. The effect of alcohol diminishes when controls are added for the presence of other drugs; this finding indicates that previous work might have overestimated the influence of alcohol, particularly when other drugs are present [20]. Similarly, the association between antidepressants and suicide is also tempered, but remains remarkably high when other drugs are included into a model. The presence of opiates and antidepressants among suicide decedents may indicate vulnerable individuals who have suicidal tendencies. Antidepressants exhibit a strong association with suicide, and may be prescribed to prevent it [42]. Opiates are distinct among the drugs studied here, in that they are sometimes taken as an agent of suicide [43].

Whereas previous research has documented differential drug use among decedents by race/ethnicity [6,35] and age [44], the results of this study reveal substantial gender differences in the association between drugs and violent causes of death. Among males, amphetamines, marijuana and especially cocaine are associated more strongly with homicides than with suicides. For example, male decedents who tested positive for cocaine were 2.7-fold more likely to have died from homicide than suicide. Women with positive tests for antidepressants were 12.5-fold more likely to have died by suicide than homicide. Women with opiates in their system showed a weaker association with suicide than women who tested positive for antidepressants.

Because opiates can be used intentionally to overdose, we further examined how cause of death differs by gender. More than three-quarters of women but just half of men who committed suicide and tested positive for opiates died of poison-related causes (results not shown). This finding comports with past research demonstrating that women commit suicide with less-violent methods, such as drug overdose, whereas men use more violent methods, such as guns [45]. Our work demonstrates that women are more likely than men to test positive for opiates and antidepressants, regardless of the cause of suicide. Previous descriptive work has asserted that, compared with women who are not taking cocaine, women who are taking cocaine are much more likely to be attacked [35]; indeed, in our combined model, the only drug associated with homicide for women was cocaine.

Our findings align with the tripartite contextual framework, which emphasizes three facets that increase drug users' vulnerability to violence [24]. The first two components of this perspective emphasize processes unique to the individual user, such as the psychopharmacological effects of drugs that alter the behavior of the user and the tendency for drug users to engage in violent activities to gain economic resources to fuel their addiction. The most important component of this perspective, however, is that illegal drug distribution often occurs within a social context characterized by compulsive forms of violence. Therefore, individuals who are most at risk are often placed in the most risky environments, which may be the root cause of illegal drug use. As we found, gender is a critical factor that may place men and women into quite different social contexts. Because females generally take fewer illegal drugs than men [23], they are shielded from these aspects of drug use that expose the user to violence. Indeed, we found generally that the effects for illicit drugs predicting homicide are stronger for men than for women. Of course, drug tests identify the presence of drugs but do not distinguish between licit and illicit drugs, and some homicides are unrelated to drug use, such as in random acts of violence.

Three limitations of this study should be considered. First, male and female homicide decedents were equally likely to be tested for drugs by coroners and medical examiners, but female suicide victims were more likely to be tested than male suicide victims. To control for potential selective testing bias, we employed a two-step Heckman correction [46–48]. In the first step, we estimated the likelihood that an individual would be tested for each specific drug, and included all the previously mentioned covariates in addition to manner of death and marital status. Next, we reran the models but included the probability of being tested (the inverse Mills ratio), which controlled for the selection bias. The results were similar to the models that did not use Heckman correction, indicating that selective testing is not driving our results. Importantly, even when we controlled for the testing bias, the interaction terms between drug presence and gender significant in Table 3 remained strong and statistically significant.

Secondly, toxicological testing has some inherent flaws. Because some substances dissipate over time, the amount of time between the ingestion of the substance and death will influence the likelihood that the substance will show up in the toxicology report [3]. Because testing rate limits for drug presence may differ by state and country, caution is warranted in generalizing the results based on our Colorado sample to other US states and other countries. Finally, although we have rich and detailed data about decedents, we do not have data on the population at risk, which prevents us from calculating the risk of death. To overcome these limitations, we echo the call of previous work using toxicological data that future research must include more detailed contextual factors from a wider variety of settings.

Despite these limitations, our research has substantial strengths. We were able to control statistically for social and toxicological factors that have been demonstrated to influence drug prevalence among decedents. Even net of these controls, males and females have different types of drugs present and associated with different manners of violent death. Finally, our results from a two-step Heckman correction indicate that our findings are not driven simply by selective testing. The rich data included in the NVDRS would also support future research on the associations among social, demographic and economic factors and deaths caused by violence. By exploring the interaction between the context and drug presence at death, researchers and policymakers can illuminate further violent deaths and the crucial role of alcohol and drugs.

Acknowledgments

We thank the Eunice Kennedy Shriver NICHD-funded University of Colorado Population Center (grant R24 HD066613) and the University of Texas Population Research Center (grant R24 HD42849) for administrative and computing support; the NICHD Ruth L. Kirschstien National Research Service Award (T32 HD007081-35) for training support; the Colorado Department of Health and Environment for collecting the data and making the linked files available to the research public; Laura Tesch for editorial assistance; and Holly Hedegaard, National Center for Health Statistics and the anonymous reviewers for insightful comments and suggestions on earlier drafts of this paper. These data were supplied by the Health Statistics Section of the Colorado Department of Public Health and Environment, which specifically disclaims responsibility for any analyses, interpretations or conclusions it has not provided. The content of this manuscript is solely the responsibility of the authors and does not necessarily represent the official views of NIH, NICHD, the Colorado Department of Public Health and Environment or the Centers for Disease Control and Prevention.

References

1. Brent DA. Risk factors for adolescent suicide and suicidal behavior: mental and substance abuse disorders, family environmental factors, and life stress. Suicide Life Threat Behav. 1995; 25:52–63. [PubMed: 8553429]
2. Rivara F, Mueller BA, Somes G, Mendoza CT, Rushford NB, Kellerman AL. Alcohol and illicit drug abuse and the risk of violent death in the home. JAMA. 1997; 278:569–575. [PubMed: 9268278]

3. Kuhns JB, Wilson DB, Maguire ER, Ainsworth SA, Clodfelter TA. A meta-analysis of marijuana, cocaine and opiate toxicology study findings among homicide victims. Addiction. 2009; 104:1122–1131. [PubMed: 19438418]

4. Sher L. Alcohol consumption and suicide. QJM. 2006; 99:57–61. [PubMed: 16287907]

5. Risser D, Schneider B. Drug-related deaths between 1985 and 1992 examined at the Institute of Forensic Medicine in Vienna, Austria. Addiction. 1994; 89:851–857. [PubMed: 8081183]

6. Tardiff K, Marzuk PM, Leon AC, Hirsch CS, Stajic M, Portera L, et al. Homicide in New York City: cocaine use and firearms. JAMA. 1994; 272:43–46. [PubMed: 8007078]

7. Marzuk PM, Tardiff K, Leon AC, Stajic M. Prevalence of cocaine use among residents of New York City who committed suicide during a one-year period. Am J Psychiatry. 1992; 149:43–46.

8. Darke S, Duflou J, Torok M. Drugs and violent death: comparative toxicology of homicide and non-substance toxicity suicide victims. Addiction. 2009; 104:1000–1005. [PubMed: 19466923]

9. Goldsmith, SK. Reducing Suicide: A National Imperative. Washington, DC: National Academies Press; 2002.

10. Paulozzi L, Mercy J, Frazier L, Annest J. CDC's National Violent Death Reporting System: background and methodology. Inj Prev. 2004; 10:47–52. [PubMed: 14760027]

11. Rockett IRH. Counting suicides and making suicide count as a public health problem. Crisis. 2010; 31:227–230. [PubMed: 21134841]

12. Satcher, D. The Surgeon General's Call to Action to Prevent Suicide. Washington, DC: US Public Health Service; 1999.

13. Meslé, F.; Vallin, J. Historical trends in mortality. In: Rogers, RG.; Crimmins, EM., editors. International Handbook of Adult Mortality. New York: Springer; 2011. p. 9-47.

14. Kochanek KD, Xu J, Murphy SL, Miniño AM. Deaths: final data for 2009. Natl Vital Stat Rep. 2011; 60:1–166. [PubMed: 24974587]

15. Centers for Disease Control (CDC). Cost Estimates of Violent Deaths: Figures and Tables 2007. Atlanta, GA: 2007. Available at: http://www.cdc.gov/violenceprevention/violentdeaths/cost_estimates.html#all. [http://www.webcitation.org/696fiwHHs]. [accessed 12 July 2012]

16. Williams DR. The health of men: structured inequalities and opportunities. Am J Public Health. 2003; 93:724–731. [PubMed: 12721133]

17. Magura S, Kang SY. Validity of self-reported drug use in high risk populations: a meta-analytical review. Subst Use Misuse. 1996; 31:1131–1153. [PubMed: 8853234]

18. Centers for Disease Control (CDC). Suicides due to Alcohol and/or Drug Overdose: A Data Brief from the National Violent Death Reporting System. Atlanta, GA: CDC; 2010.

19. Cherpitel CJ, Borges GLG, Wilcox HC. Acute alcohol use and suicidal behavior: a review of the literature. Alcohol Clin Exp Res. 2004; 28:18S–28S. [PubMed: 15166633]

20. Kuhns JB, Wilson DB, Clodfelter TA, Maguire ER, Ainsworth SA. A meta-analysis of alcohol toxicology study findings among homicide victims. Addiction. 2011; 106:162–172. [PubMed: 20883459]

21. Darke S. The toxicology of homicide offenders and victims: a review. Drug Alcohol Rev. 2010; 29:202–215. [PubMed: 20447230]

22. Bills CB, Li G. Correlating homicide and suicide. Int J Epidemiol. 2005; 34:837–845. [PubMed: 15851396]

23. Thoits PA. Stress and health. J Health Soc Behav. 2010; 51:S41–S53. [PubMed: 20943582]

24. Goldstein PJ. The drugs/violence nexus: a tripartite conceptual framework. J Drug Issues. 1985; 15:493–506.

25. Kessler RC, Chiu WT, Demler O, Walters EE. Prevalence, severity, and comorbidity of 12-month DSM-IV disorders in the National Comorbidity Survey Replication. Arch Gen Psychiatry. 2005; 62:617–627. [PubMed: 15939839]

26. McDonough P, Walters V. Gender and health: reassessing patterns and explanations. Soc Sci Med. 2001; 52:547–559. [PubMed: 11206652]

27. Weiss RD, Griffin ML, Mirin SM. Drug abuse as self-medication for depression: an empirical study. Am J Drug Alcohol Abuse. 1992; 18:121–129. [PubMed: 1562010]

28. Sanford C, Marshall S, Martin S, Coyne-Beasley T, Waller A, Cook P, et al. Deaths from violence in North Carolina, 2004: how deaths differ in females and males. Inj Prev. 2006; 12:i10–i16.
29. Bossarte R, Simon T, Barker L. Characteristics of homicide followed by suicide incidents in multiple states, 2003–04. Inj Prev. 2006; 12:i33–i38.
30. Tardiff K, Marzuk PM, Leon AC, Hirsch C, Stajic M, Portera L, et al. Cocaine, opiates, and ethanol in homicides in New York City: 1990 and 1991. J Forensic Sci. 1995; 40:387–390. [PubMed: 7782745]
31. Gabor LA, Genovesi A, Larsen GY, Fullerton-Gleason L, Davis A, Olson LM. A comparison of law enforcement and medical examiner reports in a violent-death surveillance system. Homicide Stud. 2008; 12:249–263.
32. Comstock R, Mallonee S, Jordan F. A comparison of two surveillance systems for deaths related to violent injury. Inj Prev. 2005; 11:58–63. [PubMed: 15691992]
33. Barber CW, Azrael D, Hemenway D, Olson LM, Nie C, Schaechter J, et al. Victim-suspect relationship, weapon type, and presence of antidepressants. Homicide Stud. 2008; 12:285–297.
34. Logan JE, Karch DL, Crosby AE. Reducing ‘unknown’ data in violent death surveillance: a study of death certificates, coroner/medical examiner and police reports from the national violent death reporting system, 2003–2004. Homicide Stud. 2009; 13:385–397.
35. Galea S, Ahern J, Tardiff K, Leon AC, Vlahov D. Drugs and firearm deaths in New York City, 1990–1998. J Urban Health. 2002; 79:70–86. [PubMed: 11937617]
36. Galea S, Nandi A, Vlahov D. The social epidemiology of substance use. Epidemiol Rev. 2004; 26:36–52. [PubMed: 15234946]
37. Hayward MD, Gorman BK. The long arm of childhood: the influence of early-life social conditions on men’s mortality. Demography. 2004; 41:87–107. [PubMed: 15074126]
38. Allison, P. Missing Data. Thousand Oaks, CA: Sage; 2001.
39. Substance Abuse and Mental Health Services Administration (SAMHSA). State Estimates of Substance Use and Mental Disorders from the 2008–2009 National Survey on Drug Use and Health (NSDUH). Rockville, MD: SAMHSA; 2011. p. 1-314.
40. Weiss B, Laties VG. Enhancement of human performance by caffeine and the amphetamines. Pharmacol Rev. 1962; 14:1–36. [PubMed: 14005855]
41. Parker RN, Auerhahn K. Alcohol, drugs, and violence. Annu Rev Sociol. 1998; 24:291–311.
42. Edwards JG. Suicide and antidepressants. BMJ. 1995; 310:205. [PubMed: 7866113]
43. Hawton K, Clements A, Simkin S, Malmberg A. Doctors who kill themselves: a study of the methods used for suicide. QJM. 2000; 93:351–357. [PubMed: 10873184]
44. Tardiff K, Marzuk PM, Lowell K, Portera L, Leon AC. A study of drug abuse and other causes of homicide in New York. J Crim Justice. 2002; 30:317–325.
45. Denning DG, Conwell Y, King D, Cox C. Method choice, intent, and gender in completed suicide. Suicide Life Threat Behav. 2000; 30:282–288. [PubMed: 11079640]
46. Heckman, JJ. Sample selection bias as a specification error (with an application to the estimation of labor supply functions). Cambridge, MA: National Bureau of Economic Research; 1977.
47. Puhani P. The Heckman correction for sample selection and its critique. J Econ Surv. 2000; 14:53–68.
48. Willson AE, Shuey KM, Elder GH JR. Cumulative advantage processes as mechanisms of inequality in life course health. Am J Sociol. 2007; 112:1886–1924.

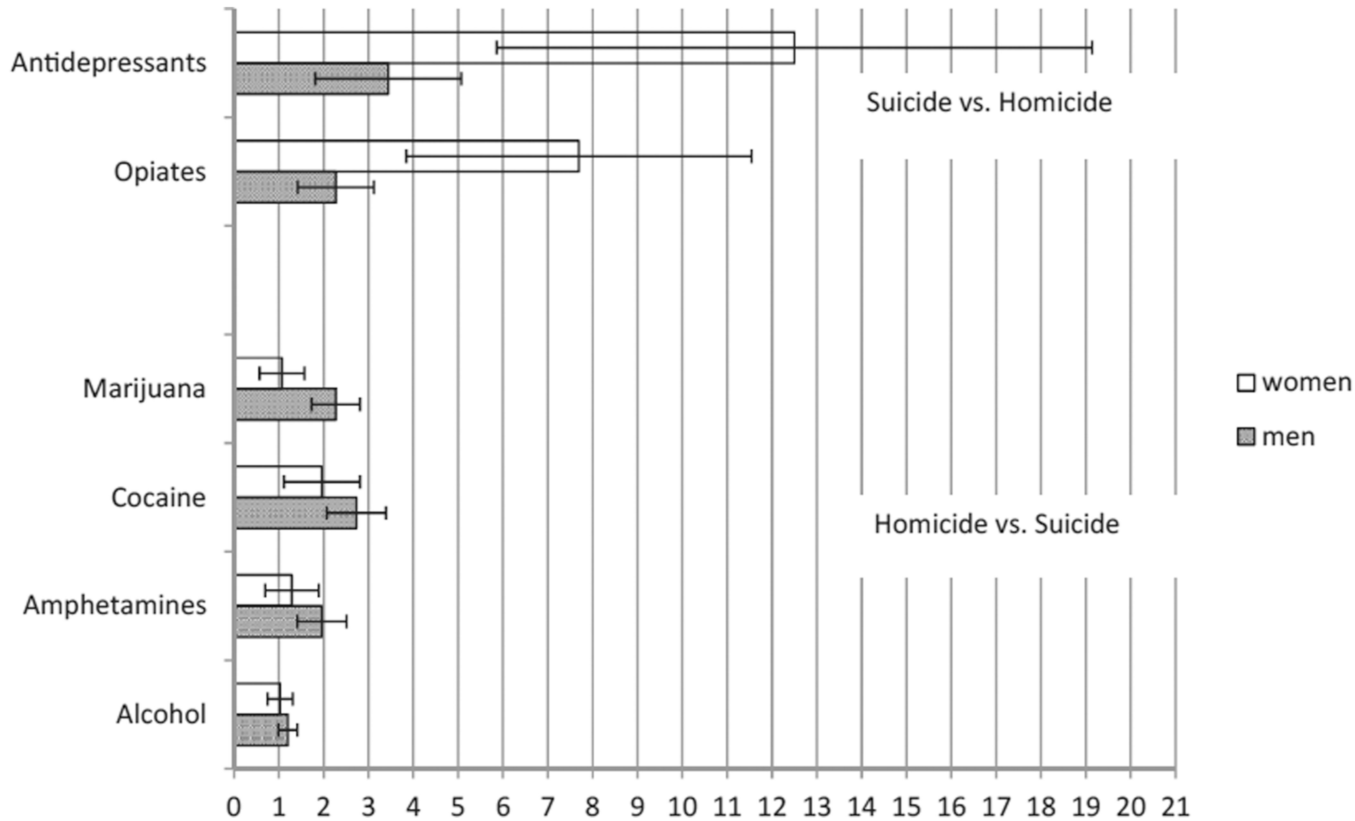

Figure 1.

Comparison of the presence of a drug and the manner of violent death, by gender of the decedent, Colorado 2004–09: odds ratios and confidence intervals. Estimates derived from Table 3. The values on the horizontal axis are odds ratios. All odds ratios are converted to increased risk. As such, the comparisons in the top part of the figure show likelihood that the death was from suicide versus a homicide, conditional on gender and the presence of a particular drug; the estimates in the bottom part of the figure show the likelihood that the of death was from homicide versus suicide. An odds ratio of 1.0 indicates no significant association. Error bars denote 95% confidence intervals

NIH-PA Author Manuscript
NIH-PA Author Manuscript

Table 1

Percentages of drug testing and presence in Colorado adult victims of violent death, 2004–09.

	Total		Homicides		Suicides	
Drug	**% tested**	**% positive**	**% tested**	**% positive**	**% tested**	**% positive**
All decedents						
Alcohol	75.1	42.2	80.6	48.9	74.0	30.1
Amphetamines	68.0	6.9	69.0	12.0	67.7	4.0
Antidepressants	63.7	14.5	56.3	3.0	65.3	10.9
Cocaine	71.1	8.9	75.9	20.9	70.1	4.4
Marijuana	66.5	11.3	68.4	22.4	66.1	5.9
Opiates	71.3	13.5	74.5	4.4	70.6	10.9
Other drugs	55.4	40.1	59.0	22.1	54.7	24.2
No substances	77.1	11.8	82.1	11.9	76.1	11.8
n	5791		1003		4788	
Male						
Alcohol	74.2	44.2	80.4	53.1	73.0	40.6
Amphetamines	67.1	7.2	68.9	13.5	66.7	5.9
Antidepressants	62.2	10.5	53.9	2.8	63.9	16.6
Cocaine	70.2	9.8	76.1	24.5	69.0	27.5
Marijuana	65.8	12.6	68.1	27.7	65.4	8.9
Opiates	70.1	10.5	74.4	4.2	69.3	15.5
Other drugs	53.4	35.7	59.4	21.2	52.2	44.2
No substances	75.9	11.9	81.9	8.8	74.7	12.5
n	4439		731		3708	
Female						
Alcohol	78.0	35.7	80.9	37.7	77.2	35.1
Amphetamines	70.8	6.3	69.1	8.0	71.2	5.9
Antidepressants	68.6	26.5	62.9	3.5	70.1	31.7
Cocaine	74.0	6.2	75.4	11.2	73.7	4.9
Marijuana	68.8	6.3	69.1	8.5	68.7	5.8
Opiates	75.1	22.8	74.6	4.9	75.2	27.2

NIH-PA Author Manuscript
NIH-PA Author Manuscript

	Total		Homicides		Suicides	
Drug	**% tested**	**% positive**	**% tested**	**% positive**	**% tested**	**% positive**
Other drugs	62.1	52.6	58.1	24.7	63.1	59.1
No substances	81.3	11.7	82.4	20.2	81.0	9.5
n	1352		272		1080	

Source: Colorado Violent Death Reporting System.

NIH-PA Author Manuscript
NIH-PA Author Manuscript

Table 2

Tetrachoric correlation matrix of drug presence in Colorado adult victims of violent death, 2004–09.[a]

	Alcohol	Amphetamines	Antidepressants	Marijuana	Cocaine	Opiates
(a) Total population						
Amphetamines	0.093[c]					
Antidepressants	0.043[c]	0.028[c]				
Marijuana	0.208[c]	0.400[c]	−0.041[c]			
Cocaine	0.330[c]	0.187[c]	−0.045	0.304[c]		
Opiates	0.033	0.056[c]	0.500[c]	0.042	0.044[c]	
(b) By gender[b]						
Alcohol		0.073	0.083	0.227	0.353	0.039
Amphetamines	0.160		0.081	0.389	0.160	0.092
Antidepressants	0.030	−0.060		−0.032	−0.028	0.423
Marijuana	0.060	0.448	0.065		0.323	0.062
Cocaine	0.205	0.292	−0.008	0.094		0.030
Opiates	0.066	−0.008	0.519	0.113	0.147	

[a]Does not account for decedents who were not tested.

[b]Males (n = 4439) in the top portion of the matrix; females (n = 1352) in the bottom portion of the matrix.

[c]Statistically significant difference in correlation between sexes at the 0.05 level as measured by Fisher's exact test. Source: Colorado Violent Death Reporting System.

Table 3

Odds ratios (OR) of homicide relative to suicide deaths among Colorado adult victims of violent death, 2004–09.

	(a) Total population[a]				(b) Males[b]				(c) Females[b]			
	Individual		Combined		Individual		Combined		Individual		Combined	
	OR	95% CI	OR	95% CI	OR	95%, CI	OR	95% CI	OR	95% CI	OR	95% CI
Alcohol	1.16	(0.98, 1.37)	1.05	(0.89, 1.25)	1.20	(0.99, 1.47)	1.13	(0.91, 1.39)	1.03	(0.75, 1.41)	1.04	(0.74, 1.44)
Amphetamines	1.79	(1.34, 2.39)	1.67	(1.22, 2.28)	1.96	(1.41, 2.72)	1.90	(1.34, 2.71)	1.29	(0.69, 2.42)	1.21	(0.62, 2.36)
Antidepressants	0.17[c]	(0.10, 0.28)	0.21	(0.12, 0.34)	0.29	(0.16, 0.55)	0.33	(0.17, 0.62)	0.08	(0.04, 0.19)	0.10	(0.04, 0.24)
Cocaine	2.60	(2.04, 3.31)	2.46	(1.88, 3.21)	2.73	(2.07, 3.59)	2.43	(1.79, 3.27)	1.96	(1.11, 3.45)	2.53	(1.31, 4.89)
Marijuana	2.03[d]	(1.60, 2.58)	1.72	(1.33, 2.23)	2.27	(1.73, 2.95)	1.89	(1.42, 2.52)	1.07	(0.57, 2.01)	1.12	(0.55, 2.2 7)
Opiates	0.27[c]	(0.18, 0.39)	0.28	(0.18, 0.41)	0.44	(0.28, 0.70)	0.42	(0.26, 0.18)	0.13	(0.07, 0.26)	0.16	(0.08, 0.32)
Model evaluation												
2LL	−2246				−1628				−589			
n	5791				4439				1352			

[a] Models control for age, gender, educational attainment, and race/ethnicity.

[b] Models control for age, educational attainment, and race/ethnicity.

[c] Statistically significant at the 0.05 level differences between gender as measured by an interaction term.

[d] Statistically significant at the 0.1 level differences between gender as measured by an interaction term. Source: Colorado Violent Death Reporting System. CI: confidence interval.