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Substance Use as a Mediator of the Association between Demographics, Suicide Attempt History, and Future Suicide Attempts in Emergency Department Patients

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Abstract

Background—Identification of factors that predict and protect against attempted suicide are critical for the development of effective suicide prevention and intervention programs.

Aims—To examine whether substance use mediates the association between demographic characteristics, suicide attempt history, and reports of a suicide attempt within 12-months after screening positive for active suicidal ideation or behavior during the index emergency department (ED) visit.

Method—Data were collected during the first two phases of the Emergency Department Safety Assessment and Follow-up Evaluation (ED-SAFE) study. Data collection included baseline interview; 6- and 12-month chart reviews; and 6-, 12-, 24-, 36-, and 52-week telephone follow-up assessments. Structural equation modeling was used. All *P*-values were two-tailed, with *P*<0.05 considered statistically significant.

Results—Among the 874 subjects, 195 (22%) reported a suicide attempt within 12-months after the index ED visit. Of participants reporting a suicide attempt, 59% were <40 years old, 59% female, and 76% non-Hispanic white. Associations between race, sex, and suicide attempt 12-

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months after the index ED visit may be mediated by a combination of alcohol misuse and cocaine use.

Conclusions—Findings from the mediation analyses provide insight on the impact of substance use on future suicide attempts in various socio-demographic groups.

Keywords

Suicide attempt; Substance use; Structural Equation Modeling; Statistical Mediation Analysis; Emergency Departments

In many health systems, the emergency department (ED) plays a large role in the care of suicidal patients, with an average of 420,000 ED visits per year for attempted suicide or intentional self-injury (Ting, Sullivan, Boudreaux, Miller, & Camargo, 2012). Compared to the general populace, people seeking treatment in the ED tend to be younger and more likely to be unemployed, depend on public assistance, live alone, have unstable residence, and have substance abuse as a primary or secondary diagnosis (Downey, Zun, & Gonzales, 2009). Research in both community and clinical samples indicates that a high proportion of individuals who attempt suicide report alcohol and drug abuse or dependence (Borges, Walters, & Kessler, 2000). Despite accumulating evidence on the link between substance use and suicidal behavior, the underlying mechanisms remain unclear. Accordingly, experts have encouraged further examination of the association between substance use and suicide attempts by age, sex, race, ethnicity, or type of substance used (Neeleman & Farrell, 1997).

Many of the factors known to predispose individuals to suicide are also associated with substance use, such as depression, physical illness, poor family relationships, social isolation, unemployment, and stressful life events (Range et al., 1997). The frequency of suicide attempts among substance users is five times greater than the frequency among people who do not use substances. Approximately 50% of all suicide attempts involve alcohol and illegal drugs. When compared to nonusers, substance users with suicidal ideation have an elevated risk of first suicide attempts even in the absence of a plan (Borges, Walters, & Kessler, 2000). In addition, substance use in patients who have attempted suicide has been identified as one of the strongest predictors of eventual suicide (Hawton, Zahl, & Weatherall, 2003).

A recent literature review on substance use and suicide indicated that reported use of alcohol and cocaine, in particular, were associated with increased rates of suicide attempts (Vijayakumara, Kumarb, & Vijayakumara, 2011). Current alcohol use also was identified as a significant predictor of suicide attempts within 12-months after the index ED visit (Arias et al., 2015). However, some research suggests that after controlling for the confounding effects of socio-demographics and psychiatric disorders, the strength of association with suicide attempts is similar for all the types of drugs studied. Clarifying the association between substance use and attempted and completed suicide may aid prevention efforts for these patients (Britton & Conner, 2010). Improving the care of patients presenting with suicidal ideation or attempts may reduce morbidity and mortality from suicide attempts and may reduce the ED burden and related healthcare costs of repeat suicide related visits (Larkin, Smith, & Beautrais, 2008).

In the current longitudinal study of ED patients presenting to the ED with suicidal ideation or behavior, we aimed to identify the relation between substance type used (e.g., alcohol, cocaine, marijuana) on having at least one suicide attempt 12-months after the index ED visit. We also examined whether substance use mediates the association between demographic characteristics (e.g., age, sex, race, ethnicity), a history of suicide attempts, and future suicide attempts in an ED population.

Method

Data were collected during the Emergency Department Safety Assessment and Follow-up Evaluation (ED-SAFE) study (U01 MH088278; Boudreaux, Camargo, Miller), a quasi-experimental clinical trial that includes participation from eight emergency departments (EDs) across the United States (see Boudreaux et al., 2013 for full description of the study). The ED-SAFE consists of three phases of data collection: (1) Treatment as Usual, (2) Universal Screening, and (3) Universal Screening + Intervention. The current study focused on the first two phases, Treatment as Usual and Universal Screening, because our interest was on examining the factors affecting future suicide attempts under ED treatment without the study-related suicide intervention introduced in Phase 3. Data for these phases were collected from *August 2010 to January 2012* (Treatment as Usual) and *November 2011 to December 2012* (Universal Screening).

To gather baseline data, research assistants (RAs) staffed the ED 40 hours per week generally during the peak volume hours of 12:00 pm to 10:00 pm. Patients age 18 years, who reported thoughts of killing themselves in the past week, or had an actual, aborted, or interrupted suicide attempt in the past week, were invited to participate in the longitudinal portion of the study. Additional inclusion criteria included the ability to consent and a willingness to complete five telephone interview assessments. Exclusion criteria included; being medically or cognitively unable to participate in the assessment or advising calls, currently dwelling in a non-community setting, currently in state custody or pending legal action, no permanent residence, no reliable telephone service, insurmountable language barrier, or already enrolled in the ED-SAFE trial.

Variables for analysis

Demographic characteristics—A subset of demographic variables collected during the baseline assessment was examined including age, sex (male/female), race (non-white/white), and ethnicity (non-Hispanic/Hispanic).

Substance Use—Substance use is defined by the question “Over the past 12 months, have you used drugs other than those required for medical reasons?” (Skinner, 1982). Responses included: marijuana, painkillers used for *non*-medical purposes (e.g., Oxycontin, Percocet), cocaine, tranquilizers or sedatives (e.g., Xanax, Valium), hallucinogens (e.g., LSD, PCP), stimulants (e.g., speed, methamphetamines), ecstasy, heroin, cold or cough medicines used for *non*-medical purposes, inhalants (e.g., gasoline, glue), or other drugs not listed.

Alcohol misuse was assessed by calculating a score based on responses to “How often do you have a drink containing alcohol?”, “How many drinks containing alcohol do you have

on a typical day when you are drinking?”, and “How often do you have four or more drinks on one occasion?” For men and women *under* 65 years of age, a total score of 8 or more and a score of 7 or more for men and women *over* 65 were considered indicators of harmful or hazardous alcohol use (Babor, Higgins-Biddle, Saunders, & Monteiro, 2001).

Suicide attempt history—History of suicide attempt was measured using data collected at baseline: “Any history, current or past, of suicide attempt?” (yes/no).

Outcomes—The primary outcome measure is whether a suicide attempt was reported during the 52-week period after the index ED visit (yes/no).

Following the index ED visit, each participant was telephoned by an interviewer from a centralized call center trained to use the Columbia Suicide Severity Rating Scale (C-SSRS; Posner et al., 2008) at 6-, 12-, 24-, 36-, and 52-weeks for an outcome assessment. All interviewing staff received at least eight hours of training specific to the proposed effort with coaching and practice before interviews began. To ensure quality and measure productivity, a supervisor was present in the call center at all times. Productivity reports were reviewed periodically to ensure performance and study standards were being met.

Chart reviews were conducted by the site RA at 6- and 12-months. Prior to data collection, chart abstractors attended a training presentation conducted by the study principal investigator and project director via telephone. The first three chart reviews were independently reviewed by the site PI for accuracy. For the major predictor variables, kappas between the RA and the site PI were very strong, ranging from 0.96 to 1.00.

Statistical analyses

We performed descriptive statistics for the overall sample. The association between baseline variables (categorical) and report of a suicide attempt 12-months after the index ED visit (yes/no) were examined by using the Pearson chi-squared statistic for differences in proportions. All proportions were reported with 95% confidence intervals (95% CI). All variables that were $P \leq 0.10$ (two-tailed) were included in the final structural equation model (SEM).

We tested the direct and indirect effects of demographic characteristics, history of suicide attempts, and substance use on the suicide attempt 12-months after the index ED visit using gsem command (generalized structural equation model) in STATA 13.1 (StataCorp, College Station, TX). SEM allows for the estimation of multiple models at the same time, providing a comprehensive view of the association among a set of variables (Hoyle & Smith, 1994), and are typically used to address mediation questions (Hayes, 2013; Preacher et al., 2007). Indirect effects were calculated by multiplying the parameter estimates for the direct effects on the pathway between the predicting and outcome variables. The total effect of a predictor on the outcome was calculated by summing the parameter estimates for all indirect and direct pathways from the predictor to the outcome (Arlinghaus et al., 2012). As the outcome and mediator variables were binary or categorical, the logit link was used and direct, indirect, and total effects are presented as Odds Ratios (OR), obtained by exponentiation of the regression parameters. Based on results of the unadjusted analyses, alcohol misuse,

cocaine use, and suicide attempt history were included as mediators of the association between age, sex, race, ethnicity, and future reports of suicide attempts (Figure 1). A two-tailed $P<0.05$ was considered statistically significant.

Results

There were 2,385 patients approached to complete eligibility interviews. Of those, 933 were enrolled in the study; however, 18 withdrew prior to baseline and 41 were found to be ineligible at baseline, resulting in 874 eligible and enrolled participants. Of the 874 respondents, 56% are female, 74% white, and 13% Hispanic. The median age was 36 years, with most patients reporting active suicidal ideation at baseline (66%), 34% reporting alcohol misuse, and 8% reporting cocaine use (Table 1).

Several drug categories were tested using unadjusted analyses including marijuana, painkillers (e.g., Oxycontin), cocaine, tranquilizers (e.g., Valium), hallucinogens (e.g., LSD), stimulants (e.g., amphetamines), ecstasy, heroin, cold or cough medicines, inhalants (e.g., whippets), and other drugs not listed. Results indicated that there was a moderate association with cocaine use and a statistically significant association with alcohol misuse and a suicide attempt within 12-months after the index ED visit. There was a potential association with cocaine use, where those reporting cocaine use were more likely to have a suicide attempt 12-months after the index ED visit (31%) when compared to non-cocaine users (22%, $P=0.08$). Alcohol misuse had an association with the suicide outcome, such that those reporting alcohol misuse were more likely to have a suicide attempt 12-months after the index ED visit (39%) when compared to those without alcohol misuse (21%, $P=0.008$). In addition, reports of comorbid alcohol misuse and cocaine use had a significantly higher proportion of “yes” responses for the suicide attempt outcome (39%) compared to those without comorbid alcohol misuse and cocaine use (21%, $P=0.008$). Thus, in the SEM, the mediating effect of substance use was tested by adding comorbid alcohol misuse and cocaine use as a mediator.

A significant direct effect of comorbid alcohol misuse and cocaine use on the outcome, future suicide attempt, was confirmed. The indirect effect of race on future suicide attempt via substance abuse indicated that white adults were at a lower risk of future suicide attempt through lower substance use ($P=0.05$). History of suicide attempt was associated with a future suicide attempt (direct effect), but this effect was not mediated by alcohol misuse and cocaine use (Table 2).

SEM results indicated that older adults reported significantly higher alcohol misuse and cocaine use compared to younger adults. In addition, white adults reported significantly lower alcohol misuse and cocaine use compared to non-white adults. Women reported significantly lower alcohol misuse and cocaine use compared to men. An indirect effect of sex on suicide attempt via substance use was suggested ($P=0.07$), with women being at lower risk of a future suicide attempt through lower substance use. However, women reported a higher proportion of past suicide attempts, and through this pathway, were at a higher risk of reporting future suicide attempts. Because of these opposite indirect effects, the total direct effect of sex on future suicide attempts was close to the null (Figure 1).

Discussion

The current study findings indicated that older adults reported significantly higher alcohol misuse and cocaine use compared to younger adults. In addition, white adults reported significantly lower alcohol misuse and cocaine use compared to non-white adults. Women reported significantly lower alcohol misuse and cocaine use compared to men. This lowered women's risk of a future suicide attempt through lower substance use. However, women reported a higher proportion of past suicide attempts, and through this pathway, were at a higher risk of reporting future suicide attempts. The associations between race, sex, and suicide attempt 12-months after the index ED visit may be mediated by a combination of alcohol misuse and cocaine use.

Examining substance use alone, older and non-white patients reported more alcohol misuse and cocaine use than their younger and white counterparts. These trends in our ED population match what has been found in the general population (Briggs, Magnus, Lassiter, Patterson, & Smith, 2011). When we examined alcohol misuse and cocaine use as mediators of the association between age, sex, race, and future suicide attempts, both whites and women had indirect effects where fewer future suicide attempts were attributed to lower substance use in these groups compared to others. This suggests that substance use in these groups may not be a useful indicator of future suicide risk.

Further investigation into the demographic differences confirmed previous findings that women had more past suicide attempts which put them at greater risk of a future attempt (e.g., Lewinsohn, Rohde, Seeley, & Baldwin, 2001). Thus, women have a lower risk of future suicide attempts because they are less likely to use substances, but they also are at higher risk of attempts because they have higher reports of past attempts. These disparate findings emphasize the complex interaction of sex, substance use, and suicide attempts. They also suggest that women may be differentially at risk depending on whether they report substance use or past suicide attempts.

One unexpected finding was when examined independently, alcohol use had no significant association, and cocaine use had a borderline significant association. However, reporting both alcohol misuse and cocaine use was significantly associated with a future suicide attempt. This may be due to previous research indicating that concurrent use of alcohol and cocaine elicit an amplified high that can last three to five times longer than a high from cocaine use alone (Pennings, Leccese, & de Wolff, 2002). These findings suggest that comorbid use of alcohol and cocaine may have a differential impact on suicide outcomes when compared against single substance use (i.e., considering only alcohol misuse). Although existing research shows that multi-substance use is an important predictor of suicidal behavior (Borges, Walters, & Kessler, 2000), additional research is needed to determine whether comorbid substance use reliably predicts future suicide attempts in additional populations.

Suicide is a major public health concern and identification of factors that predict and protect against attempted suicide are critical for the development of effective suicide prevention and intervention programs. These findings contribute to improving research strategies for

examining factors used to identify ED patients at risk for attempting suicide within a year after the index ED visit.

Limitations

One potential limitation of our study was that data were not from a randomly selected group of EDs. Although the EDs were selected to represent the general ED population in the United States, not all regions and ED types were represented which could limit the generalizability of our findings. That being said, the ED-SAFE population is the only large-scale database involving adult patients who screened positive for active suicidal ideation and/or suicide behavior at the index ED visit. The ED-SAFE data provide a unique opportunity to examine a high-risk, but currently understudied, population. Another potential limitation is that we were focused on substance use and history of suicide attempts as mediators. Although these variables were targeted both due to the strong association with our ED population and availability in the ED-SAFE database, inclusion of additional factors, such as impulsivity, which was not examined for our study, may help further explain our study findings.

In addition, our study excluded heavy substance users. Patients presenting to the ED who were cognitively unable to participate, which included severe intoxication, were excluded from study enrollment. Those with intoxication or serious drug abuse problems were less likely to be enrolled because of our exclusion criteria, so the current findings cannot be applied to all substance users presenting to the ED. Additionally, it may be beneficial to collect data using toxicology screening to determine whether self-report data on drug and alcohol use align with actual behavior. However, the intent of the current research was not to target all substance users, but to identify whether substance use mediated the relationship between demographic factors and future suicide attempts.

Conclusion

Despite developments in treatment research and increased use of health care services among suicidal persons in the United States, there has been minimal change in the rate of suicide attempts or suicide completions over the past decade (Nock et al., 2008). Substance use disorders have been recognized as risk factors for suicide attempts in both clinical and general population studies (Oquendo et al., 2010), but there is limited research on at-risk for suicide adult ED populations. Our findings provide some insight into the impact of substance use on future suicide attempts in various socio-demographic groups. These results may be useful in the ED setting to facilitate the assessment of a patient's future suicide risk.

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Figure 1.

Significant pathways linking socio-demographic factors to future suicide attempts

NOTE: Boxes represent measured variables. **Bolded lines** represent significant pathways, and *dotted lines* represent non-significant pathways. Odds ratios are listed for significant pathways only. A positive sign indicates that the probability of the categorical dependent variable is increased when the predictor variable increases.

† $P < 0.10$, * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$

Table 1

Characteristics of emergency department patients (18 years and older) who screened positive for active suicidal ideation or behavior at the index ED visit

Characteristics	All enrolled subjects (n=874)		Subjects reporting at least one suicide attempt (n=195)	
	<i>n</i>	%	<i>n</i>	%
<40 years old	501	57%	114	59%
Female	488	56%	114	58%
Non-white	225	26%	46	24%
Hispanic	113	13%	21	11%
History of a suicide attempt	619	71%	163	84%
Alcohol misuse	298	34%	74	38%
Cocaine use	72	8%	22	11%
Alcohol misuse <u>and</u> cocaine use	41	5%	16	8%

Table 2

Path coefficients and odds ratios for indirect and total effects of socio-demographic characteristics and history of suicide attempt on future suicide attempts

Model	Parameter estimate (<i>b</i>)	OR	95%CI for OR	
<u>Indirect effects</u>				
Age → History of suicide attempts → outcome	−0.19	0.83	0.63	1.09
Sex → History of suicide attempts → outcome	0.43	1.54	1.10	2.14
Race → History of suicide attempts → outcome	−0.09	0.91	0.67	1.25
Ethnicity → History of suicide attempts → outcome	−0.07	0.93	0.63	1.38
Age → Alcohol misuse and cocaine use → outcome	0.68	1.97	0.90	4.26
Sex → Alcohol misuse and cocaine use → outcome	−0.79	0.45	0.19	1.06
Race → Alcohol misuse and cocaine use → outcome	−0.88	0.41	0.17	1.01
Ethnicity → Alcohol misuse and cocaine use → outcome	−0.73	0.48	0.15	1.60
History of suicide attempts → Alcohol misuse and cocaine use → outcome	0.46	1.58	0.74	3.35
Age → History of suicide attempts → Alcohol misuse and cocaine use → outcome	−0.10	0.90	0.73	1.13
Sex → History of suicide attempts → Alcohol misuse and cocaine use → outcome	0.22	1.25	0.84	1.82
Race → History of suicide attempts → Alcohol misuse and cocaine use → outcome	−0.05	0.95	0.80	1.14
Ethnicity → History of suicide attempts → Alcohol misuse and cocaine use → outcome	−0.04	0.96	0.79	1.19
<u>Total effects</u>				
Age	0.32	1.38	0.57	3.39
Sex	−0.05	0.95	0.37	2.44
Race	−0.81	0.44	0.15	1.28
Ethnicity	−1.04	0.35	0.08	1.49
History of suicide attempts	1.00	2.72	1.00	7.46

Abbreviations: OR=odds ratio, 95%CI=95% confidence interval

Values in **bold** denote associations significant at the $p < .05$ level