Moderators of the Relationship Between Alcohol Dependence and Suicide and Medically Serious Suicide Attempts: Analyses of Canterbury Suicide Project Data

Kenneth R. Conner, Annette L. Beautrais, and Yeates Conwell

Background: Preliminary data indicate that age, gender, and mood disorder moderate the association of alcohol dependence and suicide. The purpose of this study was to evaluate potential moderators of the relationship between alcohol dependence and suicide and medically serious suicide attempts by using case-control data gathered in the Canterbury region of New Zealand for the Canterbury Suicide Project.

Methods: Data on 193 suicide decedents, 240 medically serious suicide attempters, and 984 community controls, all age 18 and over, were gathered by using psychological autopsy methodology. Multinomial logistic analyses were used to compare the two case groups to controls on demographic and diagnostic variables. Moderating effects were evaluated based on significant statistical interactions of predictors with alcohol dependence.

Results: The association of alcohol dependence and suicide (but not medically serious attempts) was amplified with increased age. Neither mood disorder nor gender moderated the relationship between alcohol dependence and suicide. Increased age amplified the association of mood disorder and suicide, whereas decreased age strengthened the association of mood disorder and medically serious suicide attempts.

Conclusions: Older age may serve as a marker for a construct (e.g., aggression/impulsivity) that underlies the failure to mature out of alcoholism, or a late-onset subtype of alcoholism prone to negative affect, accounting for the association of older age and suicide in this population. Older age also may merely reflect longer duration of the deleterious effects of alcoholism.

Key Words: Alcohol Dependence, Suicide Mood Disorder, Age.

Data from prospective studies suggest that 7% of alcoholics die by suicide (Inskip et al., 1998). Retrospective postmortem studies have consistently reported that at least one-third of suicide decedents met criteria for alcohol abuse or dependence (e.g., Cheng, 1995; Conwell et al., 1996; Foster et al., 1999). Alcohol use disorders are also a potent risk factor for medically serious suicide attempts (Beautrais et al., 1996b). Given the high prevalence of alcoholism and the strong link between alcohol use disorders and suicide, knowledge of factors that moderate or increase risk (Baron and Kenny, 1986) in this population is critical to advancing suicide prevention efforts.

Major depressive episode confers risk for suicide among alcoholics (Murphy et al., 1992), but major depression is also a risk factor in the general population (Cheng, 1995; Foster et al., 1999). In a case-control study conducted in East Taiwan, Cheng (1995) concluded there was a stronger association between suicide and comorbid substance use disorders and depression (odds ratio [OR], 470.2; 95% confidence interval [CI], 44.7–4942) compared with major depression alone (OR, 168; 95% CI, 17.0–1664), suggesting that depression may amplify risk in alcoholics. However, the confidence intervals were very wide, alcoholics were combined with subjects with other substance use disorders in analyses, and analyses did not seem to control for other predictors.

Based on a comprehensive review of prospective cohort studies, relative risk for suicide associated with alcoholism was estimated to be 20:1 in women and 4:1 in men (Harris and Barraclough, 1997). One interpretation is that alcoholism is a more virulent risk factor in women. However, the analyses did not control for factors that may be confounded with gender such as higher rates of depression among female alcoholics (Kessler et al., 1997). Postmortem studies have documented a higher proportion of alcohol use disorders among younger suicide decedents (Conwell et al., 1996; Rich et al., 1986), although the data may merely...

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reflect the age-related pattern of alcoholism in the general population (Conwell et al., 1996; Grant, 1997). Controlled data are needed to investigate whether mood disorder, gender, or age moderates the association of alcoholism and suicide.

The purpose of this study was to identify potential moderators of the relationship between alcohol dependence and serious suicidal behavior. This study examined data gathered for the Canterbury Suicide Project (CSP), a case-control study of suicide, medically serious suicide attempts, and randomly selected comparison subjects. Descriptions of the CSP methodology have been given previously (Beautrais et al., 1996a,b).

**METHOD**

**Subjects**

Data were collected contemporaneously for suicides, attempters, and controls between September 1, 1991, and May 31, 1994, for CSP. All subjects came from the Canterbury region (population 430,000) of New Zealand. Christchurch, with a population of 315,000, is the metropolitan center of Canterbury. For this study, the sample was restricted to ages 18 and older because age 18 was the lower cutoff age for community controls. The study also was limited to subjects for whom a proxy respondent was interviewed, yielding 193 suicide victims, 240 medically serious attempters, and 984 community controls.

Compared with suicides, medically serious attempters were more likely to use poisoning and cutting and less likely to use gases (primarily carbon monoxide), hanging, or firearms (data not shown). Next of kin of a suicide were more likely to use poisoning and cutting and less likely to use gases (primarily carbon monoxide), hanging, or firearms (data not shown). Next of kin of a suicide were more likely to use poisoning and cutting and less likely to use gases (primarily carbon monoxide), hanging, or firearms (data not shown). Next of kin of a suicide were more likely to use poisoning and cutting and less likely to use gases (primarily carbon monoxide), hanging, or firearms (data not shown). Next of kin of a suicide were more likely to use poisoning and cutting and less likely to use gases (primarily carbon monoxide), hanging, or firearms (data not shown). Next of kin of a suicide were more likely to use poisoning and cutting and less likely to use gases (primarily carbon monoxide), hanging, or firearms (data not shown). Next of kin of a suicide were more likely to use poisoning and cutting and less likely to use gases (primarily carbon monoxide), hanging, or firearms (data not shown). Next of kin of a suicide were more likely to use poisoning and cutting and less likely to use gases (primarily carbon monoxide), hanging, or firearms (data not shown).

**Routine neurological observation. Ninety-eight percent of eligible medically serious attempters were enrolled. Controls were selected from the electoral rolls for the Canterbury region; 95.5% of the eligible population was on the Canterbury electoral rolls during the study period. An age- and gender-stratified sample was obtained proportional to the known age and gender distribution of the population aged 18 and over. Eighty-six percent of eligible controls participated. The sociodemographic characteristics of the study groups are described in Table 1.**

**Table 1. Descriptive Characteristics**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Subgroup</th>
<th>Attempters (n = 240)</th>
<th>Suicides (n = 193)</th>
<th>Controls (n = 984)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>n (%)</td>
<td>n (%)</td>
<td>n (%)</td>
</tr>
<tr>
<td>Age (Mean (SD))</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women</td>
<td>126 (52.5)</td>
<td>44 (22.8)</td>
<td>508 (51.6)</td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>114 (47.5)</td>
<td>149 (77.2)</td>
<td>476 (48.4)</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td>212 (88.3)</td>
<td>174 (90.2)</td>
<td>902 (91.7)</td>
<td></td>
</tr>
<tr>
<td>Maori or part Maori</td>
<td>7 (2.9)</td>
<td>7 (3.6)</td>
<td>28 (2.9)</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>4 (1.7)</td>
<td>2 (1.0)</td>
<td>17 (1.7)</td>
<td></td>
</tr>
<tr>
<td>Race/ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married or cohabitating</td>
<td>62 (25.8)</td>
<td>75 (38.9)</td>
<td>601 (61.1)</td>
<td></td>
</tr>
<tr>
<td>Widowed, separated, or divorced</td>
<td>47 (19.6)</td>
<td>36 (18.7)</td>
<td>151 (15.3)</td>
<td></td>
</tr>
<tr>
<td>Never married</td>
<td>130 (54.2)</td>
<td>82 (42.5)</td>
<td>229 (23.3)</td>
<td></td>
</tr>
<tr>
<td>Marital status</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Missing data</td>
<td>1 (0.0)</td>
<td>0 (0.0)</td>
<td>3 (0.0)</td>
<td></td>
</tr>
<tr>
<td>Diagnostic categories</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alcohol dependence</td>
<td>62 (25.8)</td>
<td>38 (19.7)</td>
<td>46 (4.7)</td>
<td></td>
</tr>
<tr>
<td>Mood disorder</td>
<td>192 (80.0)</td>
<td>113 (58.6)</td>
<td>66 (6.7)</td>
<td></td>
</tr>
<tr>
<td>Anxiety disorder</td>
<td>63 (26.3)</td>
<td>14 (7.3)</td>
<td>50 (5.1)</td>
<td></td>
</tr>
<tr>
<td>Nonaffective psychosis</td>
<td>3 (1.3)</td>
<td>12 (6.2)</td>
<td>3 (0.3)</td>
<td></td>
</tr>
<tr>
<td>Cannabis use disorder</td>
<td>23 (9.6)</td>
<td>16 (8.3)</td>
<td>18 (1.8)</td>
<td></td>
</tr>
<tr>
<td>Other drug use disorder</td>
<td>24 (10.0)</td>
<td>15 (7.8)</td>
<td>2 (0.2)</td>
<td></td>
</tr>
<tr>
<td>Antisocial disorder</td>
<td>68 (28.3)</td>
<td>27 (14.0)</td>
<td>42 (4.3)</td>
<td></td>
</tr>
</tbody>
</table>

**Race was not used in analyses given the low prevalence of non-Caucasians.** In analyses, the never-married group and widowed, separated, divorced group were combined.

**Measures**

Diagnoses. The Structured Clinical Interview for DSM-III-R—Patient Version (SCID-III-R; Spitzer et al., 1988) was administered to proxy-respondents of suicides and to proxy-respondents and subjects themselves for attempters and controls. All medically serious attempters and controls were interviewed personally. These data plus records (psychiatric, medical) where available were used to produce consensus diagnoses by using DSM-III-R criteria (American Psychiatric Association, 1987). Diagnoses for suicide decedents were based on proxy respondent data (plus records), whereas those for medically serious attempters and controls also considered subject interview information. This diagnostic method has been used extensively in postmortem research in suicide (Cheng, 1995; Conwell et al., 1996; Henriksson et al., 1993; Lesage et al., 1994), and data on its validity are accumulating (Conner et al., 2001; Kelly and Mann, 1997).

Six categories of DSM-III-R disorders in the previous month were analyzed. Alcohol dependence in the month before suicidal behavior for cases and in the month before interview for controls was used to operationalize alcoholism. Subjects with alcohol abuse but not alcohol dependence were not included because of the dubious reliability and validity of alcohol abuse (Ustun et al., 1997). Mood disorder entailed major depression and bipolar I and bipolar II disorders. Anxiety disorder included panic disorder, agoraphobia, obsessive-compulsive disorder, simple phobia, and social phobia. Nonaffective psychoses consisted of schizophrenia, schizoaffective disorder, and psychotic disorder not otherwise specified. Cannabis use disorder included diagnoses of cannabis abuse or dependence. Drug use disorder consisted of sedative, stimulant, opioid, cocaine, hallucinogen, or polydrug abuse or dependence. A seventh diagnosis, a lifetime history of antisocial disorder, also was included, defined as a history of conduct disorder, adult antisocial behavior, or both conduct disorder and antisocial behavior. An inclusive definition of antisocial disorder was used because of the potential insensitivity of proxy-based methods to detecting a history of conduct disorder in childhood. All disorders were categorical (present/absent).

Research on substance abusers supports reliability and validity of the
SCID-III-R sections on alcohol use disorders, mood disorders, and antisocial personality disorder although not on anxiety disorders (Kranzler et al., 1996). The reliability of diagnoses of mood, substance use, and antisocial personality disorders by using best-estimate methodology in research in suicid in has been demonstrated (Henriksson et al., 1993; Lesage et al., 1994). Validity of diagnoses of mood and substance use disorders based on SCID interviews also has been shown in research on suicidal behavior (Conner et al., 2001; Kelly and Mann, 1997). In the CSP, test-retest reliabilities were evaluated by repeating the diagnostic conference procedure with a random sample of 20% of suicides, medically serious suicide attempters, and controls. Reliabilities for major diagnostic categories (e.g., mood disorders; substance use disorders) were high with \( \kappa > 0.94 \) (Beautrais, 2001).

Sociodemographic Variables. The remaining variables included in analyses were age along with four bivariate variables: gender, education (less than high school versus high school or greater), marital status (nonmarried/noncohabitating versus married/cohabitating), and socioeconomic status (low versus middle/high). The latter was measured by using the scale for socioeconomic status in New Zealand (Elley and Irving, 1976), which ranks the population into six groups based on occupation. Low socioeconomic status was defined as membership in the lowest classes, 5 and 6.

**Analyses**

Analyses were conducted by using SAS Proc Logistic (SAS Institute, Cary, NC) based on unordered multinomial logistic regression models (Hosmer and Lemeshow, 2000) by using two case groups (suicides, medically serious suicide attempters) and a reference group (community controls). Results were expressed in terms of Wald \( \chi^2 \)-square statistics. Odds ratios and asymmetric confidence intervals were computed by using the method of profile likelihood (McCullagh and Nelder, 1989). Statistical significance was based on \( \alpha = 0.05 \). Age was treated as a continuous variable, and the remaining variables were categorical and coded as 1 or 0. Model fit was assessed with the Hosmer-Lemeshow statistic (Hosmer and Lemeshow, 2000).

A purposeful selection method was used (Hosmer and Lemeshow, 2000). First, for each variable, a multinomial logistic regression controlling for age and gender was conducted. Second, variables showing an association with suicidal behavior of \( p \leq 0.25 \) were retained and entered simultaneously in a saturated model. Third, by using the log-likelihood ratio test, variables with \( p > 0.05 \) were removed sequentially based on their significance. The effect of removal of each variable was scrutinized to identify potential confounders. Once the variables for the final model were identified, tests of potential moderating effects—operationalized as significant statistical interactions (Baron and Kenny, 1986)—of alcohol dependence, age, and gender, respectively, were evaluated. The potential moderating effects of age and gender on other predictors of suicide and medically serious suicide attempts, in addition to alcohol dependence, also were evaluated because these variables often serve as moderators (Baron and Kenny, 1986) and because preliminary data suggest gender- and age-related patterns of risk for suicide associated with alcohol dependence (Conwell et al., 1996; Harris and Barracough, 1997; Rich et al., 1986).

Separate multiple logistic regression analyses comparing each case group to controls that included the interaction terms identified in the final multivariate multinomial model were run to inform the interpretation of significant interaction terms.

**RESULTS**

In separate tests, all variables were significantly \( p < 0.01 \) related to suicide and/or medically serious suicide attempts and so were retained for the saturated model. Cannabis use disorder and antisocial disorder were removed per the purposeful selection procedure. The final model, including main effects and significant interactions, is presented in Table 2. Three significant two-way interaction terms emerged: alcohol dependence by age, alcohol dependence by mood disorder, and mood disorder by age. Model fit was satisfactory for attempters \( \chi^2(8) = 8.83, p = 0.36 \) and for suicides \( \chi^2(8) = 12.19, p = 0.14 \). No gender by variable interactions approached statistical significance including a nonsignificant result for the test of the alcohol dependence by gender interaction.

Results indicate that low education, low socioeconomic status, nonaffective psychotic disorders, and drug use disorders are associated with both suicide and medically serious suicide attempts. Male gender is associated with suicide but not medically serious attempts, and being married or cohabitating was protective from medically serious suicide attempts but not suicide. Anxiety disorders did not distinguish either case group from controls, although anxiety disorders were more likely in medically serious attempters than suicides (OR, 2.96; 95% CI, 1.50–5.82) accounting for the significant overall test result (data not shown in tables). A multivariate analysis including all of the variables in the final model but considering only main effects (not interactions...
tions—data not shown) indicated an association of alcohol dependence and suicide (OR, 2.13; 95% CI, 1.18–3.85) and medically serious attempts (OR, 2.50; 95% CI, 1.38–4.52) and an association of mood disorders and suicide (OR, 28.50; 95% CI, 18.03–45.05) and medically serious attempts (OR, 53.58; 95% CI, 33.04–86.88). Clearly, these disorders are associated with the outcomes, but their interrelationships must be interpreted in light of the interactions.

The two-way interactions are presented in Fig. 1 (suicides) and Fig. 2 (attempters), which show the point estimate (OR) associated with each combination of alcohol dependence and mood disorder at age 20, 35, and 50 years, respectively. In Fig. 1, the interactions of both age and alcohol dependence and age and mood disorder are statistically significant. Alcohol dependence and mood disorder are both more strongly associated with suicide with increased age. Based on the ORs, however, risk for suicide among individuals with neither alcohol dependence nor mood disorder is lower as age is increased. The potential three-way interaction of age, alcohol dependence, and mood disorder (suggested by the line plotting the age-related association of alcohol dependence plus mood disorder) was examined and did not approach statistical significance. In Fig. 2, the interaction of age and mood disorder also was significant, but in the opposite direction, the association of mood disorder and medically serious suicide attempts was decreased with increased age. The interaction of age and alcohol dependence in medically serious attempts was nonsignificant.

The interaction of alcohol dependence and mood disorder was statistically significant in medically serious suicide attempts but not suicide. Results for each combination of alcohol dependence and mood disorder in medically serious suicide attempts were as follows: no alcohol dependence and no mood disorder (OR, 1.00), alcohol dependence and no mood disorder (OR, 1.48; 95% CI, 0.28–7.77), mood disorder and no alcohol dependence (OR, 17.73; 95% CI, 5.17–60.89), and both mood disorder and alcohol dependence (OR, 6.11; 95% CI, 0.80–47.05). Alcohol dependence and mood disorder in combination showed lower odds for attempts than expected given the elevated OR associated with mood disorder alone, accounting for the significant interaction. The data shown in Figs. 1 and 2 suggest that mood disorder is a more potent precursor of suicide and medically serious suicide attempts than alcohol dependence, and that the risk for these outcomes associated with mood disorder alone is comparable to that associated with mood disorder in combination with alcohol dependence.

**DISCUSSION**

This study used data gathered during the course of a large multiple-group case control study to examine the hypothesized roles of gender, age, and mood disorder as moderators of the effects of alcohol dependence. The data suggest that risk for suicide associated with alcohol dependence increases with age. Results do not support that gender or mood disorders moderate the association of alcohol dependence and suicide in the general population. The data also support that risk for suicide associated with mood disorder increases with age.

The data suggest that the additional risk for suicide associated with a mood disorder in alcoholics does not differ from the added risk expectable in the general population. The reverse also seems to be true—alcohol dependence does not moderate risk among individuals with a mood disorder. These findings seem inconsistent with a case-control study of suicide in Taiwan (Cheng, 1995) which reported that the association of major depression and suicide was amplified in the presence of a comorbid substance use disorder. In addition to potential cultural influences that may account for the discrepant findings, there were important methodological differences. Cheng did not report the results of a formal test of interaction, the analysis suggesting that alcohol-depression comorbidity
amplified risk did not seem to be adjusted for other variables, and subjects with alcohol and other substance use disorders were combined into a single diagnostic category. Therefore, the comparability of the findings is unclear.

Although alcohol dependence is more common during adolescence and young adulthood (Grant, 1997), results of this study suggest that middle-aged and older adults with alcoholism are especially at risk for suicide. At least four hypotheses may explain the finding. (1) Individuals in middle- and older adulthood with alcohol dependence are at greater risk for suicide because they have had greater exposure to the deleterious effects of alcoholism given longer duration of the illness. (2) Aggression/impulsivity or other latent constructs underlie both the failure to mature out of alcoholism and the risk for suicide. (3) Older alcoholics at risk for suicide represent a subgroup with a later age of onset of alcoholism prone to drinking in the context of negative affect (e.g., depression). (4) Diminished physiological reserves associated with aging, compounded by alcoholism, make surviving a suicide attempt less likely. Hypothesis 1 suggests a fairly straightforward dose-response relationship, whereas the latter three propose indirect causes. Examining these hypotheses, ideally with the use of longitudinal designs, will be critical to further the understanding of age-related patterns of suicide in this population and ultimately to improve prevention efforts.

Uncontrolled studies indicate that the proportion of suicide decedents with mood disorders uncomplicated by substance use is increased with age (Conwell et al., 1996; Rich et al., 1986). Results of this controlled study extend this research and suggest that mood disorder is a more virulent risk factor for suicide as age increases. Moreover, the data suggest that among individuals without alcohol dependence or a mood disorder, the risk for suicide seems to decrease somewhat with age. Therefore, increased risk for suicide among older adults documented in Western cultures (Murphy, 2000) may be attributable in large part to the increased vulnerability of older adults to complete suicide in the context of alcohol dependence and mood disorders, particularly the latter. Finally, unlike suicide, the risk for medically serious attempts associated with mood disorder may decrease with increased age. There have been meager data on this issue. Although suicide and medically serious suicide attempts have many shared risk correlates (Beautrais, 2001), this finding underscores that there are also differences.

Results did not support greater risk for suicide associated with alcohol dependence in women compared with men. Prior data based on cohort studies suggesting increased risk in women (Harris and Barraclough, 1997) did not control for depression and other potent risk factors for suicide that were assessed in this investigation. This may explain the discrepant findings. However, the small sample of alcohol-dependent women in both cases and controls indicates that the nil finding should be interpreted with caution. Small sample sizes have plagued investigations of suicide in women in Western cultures, and this is compounded in the study of alcoholism given the lower base rate in women (Grant, 1997).

There were limitations of the study. Data from subjects themselves were considered in determining diagnoses in medically serious attempters and controls, potentially biasing diagnoses in these groups compared with suicides. Interviewers could not be masked to case status. The small size and heterogeneity of the racial/ethnic minority groups did not allow for analyses to consider race/ethnicity. Findings of lower anxiety disorders in suicides compared with medically serious attempters may be attributable to the private nature of anxiety disorders, making them difficult to detect by proxy-respondents (e.g., Leckman et al., 1982). Generalization to the United States is unclear.

The study also had several strengths. The CSP investigators used rigorous methodology including a diagnostic interview with established reliability in research in suicide and substance abusers, a validated best-estimate procedure for establishing diagnoses, and demonstrated test-retest reliability of their diagnostic procedures. The availability of medically serious attempters, suicides, and community controls makes the CSP unique, and the participation rates of the case groups (94% suicides, 98% medically serious attempters) particularly were superior.

Suicide risk recognition and prevention efforts geared toward middle-aged and older adults with alcohol dependence and mood disorder are needed. Increased age may serve as a marker for longer duration of alcoholism and hence greater exposure to the deleterious effects and consequences of drinking. Given the particularly strong association of mood disorder and suicide, especially in older adulthood, clinical screening for depression as part of an overall prevention strategy is critical. The association of age and risk for suicide may be attributable to the moderating effects of age on risk associated with alcohol dependence and mood disorder. Indeed, suicide risk seems to decrease with age among individuals without these disorders. The study of age-related patterns of suicide across cultures should include an examination of potential cultural variation in the moderating effects of age on risk associated with alcohol dependence and mood disorder. Although there are numerous correlates in common in suicide and medically serious suicide attempts, findings suggest that mood disorders may confer greatest risk for suicide during middle-age and older adulthood but greatest risk for medically serious attempts during young adulthood.

REFERENCES
