

Work-Based Critical Incidents and Problem Drinking

Taking Intrusive Reactions, Traumatic Distress, and the Kindling Effect Into Account

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The association between exposure to workplace critical incidents and problem drinking is examined using a sample of males employed in a variety of blue-collar occupations. Incident exposure is found to have a significant association with problem drinking. Consistent with the “kindling” hypothesis, findings indicate a positive association between the number of such exposures reported during the past year and both intrusive reactions and distress, with both intrusive reactions and distress mediating the association between exposure and problem drinking. However, the mediating role of intrusive reactions declines with the number of exposures reported. Implications for labor, management, and policy are discussed.

Keywords: *work-based critical incidents; trauma; problem drinking; workplace injury*

A critical incident is an event that is overwhelming, dangerous either to one’s self or significant others, and sufficiently unusual so as to potentially overwhelm the individual’s ability to cope, consequently generating significant reactions (Monnier, Cameron, Hobfoll, & Gribble, 2002; Paton & Smith, 1996). Unlike acute stress, the stress generated by critical incidents is typically viewed less as a disorder and more as “a natural reaction of a normal person to an extremely difficult situation” (Paton & Smith, 1996, p. 19). Nevertheless, as with employee exposure to other occupational stressors, employees exposed to work-based critical incidents, particularly those incidents involving injury to oneself, may have a heightened risk of alcohol problems (Frone, 1999).

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The comorbidity of critical incident exposure and alcohol consumption has been demonstrated in numerous studies (see Jacobsen, Southwick, & Kosten, 2001; Stewart, Pihl, Conrod, & Dongier, 1998, for recent reviews). However, even though individuals are exposed to dangerous and overwhelming or life-threatening incidents at work (in some cases, on a regular basis), relatively few studies have examined the psychological implications of exposure to such incidents in the workplace (National Institute for Occupational Safety and Health [NIOSH], 1996; Paton & Smith, 1996). Indeed, the bulk of the research literature regarding the comorbidity of critical incident exposure and problematic drinking behavior focuses on such incidents as they occur in the context of war, crime, disasters, or accidents outside of the workplace (Stewart et al., 1998). Consequently, with the exception of a handful of studies examining the comorbidity of incident exposure and alcohol consumption among law enforcement officers and firefighters (e.g., Brown, Mulhern, & Joseph, 2002; Haslam & Mallon, 2003), we know relatively little about the possible association between work-based incident exposure and employee alcohol consumption.

In the current study, I focus on one particular type of work-based critical incident: those involving injury to oneself severe enough to require the attention of trained medical personnel either on or off the work site (i.e., moderate to severe injury). Although many such injuries may not necessarily be life threatening, the fact that they require professional attention suggests that such injury events typically encompass those elements noted above as being characteristic of critical incidents (i.e., they tend to be overwhelming and dangerous). The primary objective of the current analysis is to examine the generalizability of previous comorbidity findings to those employed in more mainstream manufacturing and service occupations who nonetheless may be exposed to critical incidents involving such injury to oneself at work. The question of generalizability is of particular interest with regard to such workers in that the majority of the injury-related incidents to which such workers are exposed, although still sufficiently dangerous and overwhelming to require professional medical attention, are nevertheless likely to be of a less catastrophic and life-threatening nature than those work-related incidents studied to date. Furthermore, given the excessive costs of alcohol-related problems to the American economy (Bacharach, Bamberger, & Sonnenstuhl, 2002), the generalizability of comorbidity findings may be of significant interest to management, labor, and policy makers interested in further identifying the work-related risk factors associated with alcoholism and alcohol abuse. A secondary objective of the current study is to provide further insight into the kindling effect—the tendency of individuals having a prior history of incident exposure to exhibit greater psychological impairment in response to

a critical incident exposure than individuals lacking such a prior history of incident exposure—as it may apply to work-based critical incidents. Consequently, the study also examines the extent to which the frequency of incident exposure may be associated with drinking problems and assesses the extent to which such an association may be explained by intrusive reactions to the incident and/or somatic stress.

PREVALENCE AND COMORBIDITY

Critical incidents may be less of a rarity in the workplace than commonly believed. First, in many natural and man-made disasters or catastrophic events (e.g., aircraft emergency, shooting, flood), there are workers involved (e.g., flight attendants, police officers, firefighters). Their role in and response to the event is typically quite different from that of others involved, such as community members, passengers, and families of survivors (Monnier et al., 2002). Second, many catastrophes occur in which the population of primary victims is limited to the employed workforce (e.g., a fire in a manufacturing facility or shooting in an office) and in which community members are at most secondary victims (Creamer, Burgess, & Pattison, 1992).

Finally, critical incidents in the form of work-related accidents occur in many occupational contexts on a fairly regular basis. More than 2.4 million incidents involving employee injuries severe enough to result in lost work time or restriction of work and an additional 2.4 million incidents involving injuries requiring medical attention (but not resulting in lost work time) were reported in the private sector in the United States in 2001, yielding an overall incident rate of 5.4 injury cases reported per 100 workers (Bureau of Labor Statistics [BLS], 2001). That is, for the average American worker, the likelihood of being directly exposed to a critical work-based incident (i.e., being injured severely enough to require medical attention or result in lost work time) in a given year is greater than 1 in 20 (BLS, 2001). For those employed in many manufacturing and service jobs (e.g., transportation), the likelihood of at least one such exposure in a given year is twice as great, as are the odds of multiple direct exposures in a given year (BLS, 2001; NIOSH, 1996). The data regarding multiple exposures may be of particular relevance in that a number of studies have found that among those exposed to a critical incident, the prevalence of psychological distress and alcohol consumption tends to be greater among those with prior or more chronic incident exposure (Johnsen, Eid, Laberg, & Thayer, 2002; McFarlane, 1998). McFarlane (1998, p. 817) refers to this tendency as the kindling effect.

Stewart's (1996) review of the research on the comorbidity of exposure to traumatic incidents and alcohol abuse (i.e., consumption at levels sufficient

to cause physical or mental damage) suggests that many of those workers suffering from acute injury may be at a heightened risk of developing alcohol-related problems. Indeed, McFarlane (1998, p. 823) concludes that the association between critical incidents exposure, traumatic distress, and alcohol consumption is by no means limited to victims of disaster, combat, or assault. He found that nearly 15% of the 469 Australian firefighters included in his sample developed traumatic distress symptoms 29 months after being exposed to a deadly bushfire and that more than half of these individuals experienced a significant change in their alcohol consumption subsequent to their exposure to the critical incident. Other studies of emergency service workers report rates of traumatic distress of between 10% to 20% of those workers exposed to a particular critical incident (Emsley, Seedat, & Stein, 2003; Hodgins, Creamer, & Bell, 2001), with the likelihood of alcohol consumption and abuse increasing as a function of distress severity (Stewart et al., 1998). Finally, Sims and Sims (1998) found that the alcohol consumption of a sample of 70 police officers involved in a major disaster and who were already drinkers increased significantly subsequent to their exposure to the traumatic event.

Volpicelli, Balaraman, Hahn, Wallace, and Bux (1999) offer a physiological explanation for the causal relationship between incident exposure and alcohol consumption. According to these researchers, endorphin levels remain elevated and help numb the emotional and physical pain of trauma during and immediately after the actual incident experience. However, as endorphin levels eventually decline with time, endorphin withdrawal can occur, producing many of the symptoms commonly associated with posttraumatic stress disorder. Alcohol, by increasing endorphin activity, may thus be used to compensate for endorphin withdrawal and thus serve as a means by which to medicate posttraumatic stress symptoms. Moreover, the use of alcohol as a means by which to compensate for endorphin withdrawal may be self-reinforcing (Volpicelli et al., 1999, p. 258). In a similar vein, Jacobsen et al. (2001) also explain the association between incident exposure and alcohol consumption in terms of the victim's need to self-medicate the emotions released by incident exposure.

The comorbidity of critical incident exposure and employee alcohol abuse may also be influenced by the nature or degree of incident exposure. For example, a number of studies of veterans have found that comorbidity rates are higher among those veterans who had more severe combat experiences (Fisher, 1991; Jordan et al., 1991). Similarly, Barling (1995, p. 36) argues that those directly experiencing such incidents at work (i.e., the victims) are likely to be more subject to distress than those indirectly exposed at work (i.e., witnesses). According to Barling, perceived personal vulnerability to a

reoccurrence of the event is likely to be greater among those who are direct victims relative to those who merely witnessed the incident. Furthermore, whereas the consequences of the incident for direct victims may endure for years, the point at which witnesses believe that the consequences of the event have dissipated is likely to occur far earlier. The findings of Weiss, Marmar, Metzler, and Ronfeldt (1995)—that among rescue workers, the level of traumatic distress experienced is positively associated with the mode and severity of incident exposure—suggest strong empirical support for the idea that the distress precipitated by direct exposure is greater than that precipitated by indirect exposure.

Given the positive association between traumatic distress and alcohol consumption (Stewart et al., 1998), the results of the Weiss et al. (1995) study suggest that a positive association between exposure and drinking problems may be more likely to be found among employees directly exposed to a critical incident (i.e., those personally incurring an injury severe enough to require professional attention) than among those only indirectly exposed (i.e., witnessing) to incidents involving the injury of others. Consequently, I posit the following hypothesis:

Hypothesis 1: Incurring a moderate to severe injury in the context of a work-based critical incident will be positively associated with problem drinking such that such direct victims of at least one injury-related critical incident during the past 12-month period will report a significantly higher degree of problem drinking than nonvictims (i.e., those reporting no incident exposure of any kind, those reporting only indirect exposure as witnesses, and those reporting direct exposure only to some non-injury-related incident, such as harassment).

THE KINDLING EFFECT

Examination of the “kindling effect has been limited by the relative infrequency with which individuals’ trauma history” has been collected in comorbidity research (McFarlane, 1998, p. 820). Nevertheless, several studies have found evidence of such a relationship. For example, Wagner, Heirichs, and Ehlert (1998), in their study of 402 professional firefighters in Germany, found that the odds of posttraumatic distress increased as a function of job experience and the number of distressing incidents the individual had been exposed to during the previous month. They also found traumatic distress to be predictive of psychiatric impairment, including social dysfunction and substance abuse. Others (e.g., Brown et al., 2002; Emsley et al., 2003) have found similar effects, concluding that prior exposure to work-related critical incidents increases the likelihood that any subsequent exposure will result in increased alcohol consumption.

Despite such empirical evidence, theory development aimed at providing a direct, theoretical explanation for the kindling effect has been limited. Nevertheless, it is likely that underlying the kindling effect are both psychological and physiological processes.

From a psychological perspective, the conservation of resources (COR) theory (Monnier et al., 2002) suggests that exposure to a critical incident may result in the loss of personal resources (e.g., sense of self-esteem or security, energy). Although such a loss may itself be stress inducing, it may also place limits on the individual's ability to cope with incident-related strain. Although the ability to quickly recoup used resources may allow many individuals to be resilient to such strain, it is likely that the exposure to multiple incidents in a relatively short period of time drains resources faster than they can be restored, thus limiting individual coping capabilities. Indeed, the COR theory has been used extensively to explain the link between a variety of occupational stressors and distress, and most recently, it has been used to explain the association between incidence of exposure and distress (Monnier et al., 2002). If, as suggested above, the association between incident exposure and drinking operates via intrusive reactions and distress, then based on COR theory, it is likely that increased incidence of exposure will also be associated with heightened alcohol consumption.

From a physiological perspective, the work of Volpicelli et al. (1999) suggests that victims may learn from prior experiences that alcohol consumption is an effective means by which to medicate posttraumatic endorphin withdrawal. If, as Volpicelli et al. posit, individuals learn that alcohol consumption is an effective way to cope with the intrusive reactions caused by such endorphin withdrawal, it is likely that with each subsequent exposure, we are likely to observe a positive shift in alcohol consumption.

Consequently, drawing from these two perspectives, I posit the following:

Hypothesis 2: There will be a positive association between the incidence of exposure (i.e., the total number of work-related injuries reported by the individual during the prior 12-month period) and problem drinking.

THE MEDIATING ROLE OF INTRUSIVE REACTIONS AND DISTRESS

Among the more widely accepted explanations for the comorbidity of incident exposure and problem drinking is the cognitive or information processing model (Brewin & Holmes, 2003). According to this model, until a critical incident "can be assimilated and integrated into existing schematic representations (regarding one's safety and invulnerability), it is stored in active memory, and the psychological elements of the event continue to produce intrusive and emotionally upsetting recollections" (Creamer et al.,

1992, p. 452). For example, individuals experiencing such intrusive reactions often report incident-related memories, sleep-related problems and nightmares, or problems with concentration (Nishith, Resick, & Mueser, 2001). As noted above, a number of researchers claim that because some individuals may seek to medicate such intrusive reactions to incident exposure, they are at an increased risk of developing a pattern of problematic drinking (Stewart et al., 1998; Volpicelli et al., 1999). Consequently, I propose the following:

Hypothesis 3a: The association between the incidence of injury in the previous 12-month period and problem drinking will be mediated by intrusive reactions to a work-based critical incident involving injury to oneself.

However, the association between the incidence of work-related injury and problematic drinking may also be explained in terms of the psychological distress generated by the exposure to one or more such incidents, with this distress often manifested in terms of somatic stress (McFarlane, 1998; van der Kolk et al., 1996). Based on their review of the literature, Jacobsen et al. (2001) conclude that although the link between critical incidents and problem drinking is complex, trauma-related distress is likely to play a critical mediating role. Specifically, they argue that the cognitive processing of critical incidents may trigger a "pathophysiological cascade" resulting in both posttraumatic distress symptomatology (i.e., somatic symptoms, anxiety, and depression) and subsequent self-medication as a means by which to cope with these symptoms. Such self-medication may, with time, even result in alcohol dependence because of the tendency of substance abuse withdrawal to generate or exacerbate trauma-related symptoms, thereby prompting a relapse.¹ Thus, according to Jacobsen et al., victims may alter their drinking behaviors as a means by which to cope with or medicate the somatic stress generated by the incident itself or fears of its recurrence. Such a model is consistent with the mediation model of work stress and alcoholism in which the association between a work-related stressor (i.e., exposure to the critical incident or the intrusive reactions generated by it) and alcohol consumption is mediated by distress (Frone, 1999). Consequently, I also hypothesize the following:

Hypothesis 3b: The association between the incidence of injury during the previous 12-month period and problem drinking will be mediated by somatic stress (as a manifestation of psychological distress).

However, drawing from the physiological or self-medication perspective (Volpicelli et al., 1999), I also posit that such mediating effects may not be monotonic. Rather, the association between both intrusive reactions and

distress on one hand and drinking problems on the other may vary depending on the number of injury-related incidents to which the individual has been exposed. As noted above, employees may have learned from prior experiences with critical incidents that alcohol is a useful means by which to cope with incident-related reactions and/or distress. Consequently, employees with more chronic incident exposure may be more likely or quicker to medicate intrusive reactions and/or distress than those with fewer or no prior exposure experiences. As Jacobsen et al. (2001, p. 1185) suggest, alcohol's calming effects may cue individuals to resume substance use when distress symptoms reemerge. Based on this logic, I propose the following:

Hypothesis 3c: The total number of work-related injuries reported by the individual during the prior 12-month period will moderate the link between both intrusive reactions and somatic stress on one hand and problem drinking on the other such that the strength of association between intrusive reactions or somatic stress and problem drinking will increase as a function of the incidence of exposure.

METHOD

SAMPLE

To test the hypotheses specified above, I collected data from 797 male workers drawn from a random sample of the membership of four unions (overall response rate was 47.3%) representing workers in a variety of manufacturing and service occupations. Thirty-five of the observations were dropped because of incomplete or missing data, leaving an effective sample of 762 males. I focused on manufacturing and service workers because male workers in these two employment sectors account for nearly 25% of the total male civilian labor force (and approximately 50% of the nonprofessional and nonmanagerial male civilian labor force) in the United States (BLS, 2004). Furthermore, relative to managerial and professional workers, service workers have significantly greater risk of injury on the job (BLS, 2001). By including a variety of manufacturing and service occupations, I was able to take into account the possibility that the injury-drinking relationship might be unique to certain occupation-specific types of injuries or particular occupational cultures.

Respondents included 152 unskilled assembly line operators, 44 tool and die makers, 33 machinists, and 17 maintenance workers and forklift operators employed by a manufacturer of auto parts; 53 nurses aids and orderlies employed in a number of nursing homes and health-related facilities; 335

paramedical staff employed in the public sector; and 128 warehouse workers employed by a large retail outlet. All of those sampled were employed at worksites located in rural, suburban, and urban communities in the state of New York. Study participants completed the survey in groups of between 5 and 20 workers at formal survey sessions (held either on the company premises or in their union hall) during the late 1990s.

The average age of the sampled workers was 40. The majority of the respondents were married or living with a partner (60%), and most (97%) had received at least a high school education. Average workplace tenure for those included in this sample was 11.5 ($SD = 2.2$) years. As detailed elsewhere (Bacharach & Bamberger, 2004), in each of the four unions, I checked for a possible nonresponse bias, finding that across a wide range of criteria, final samples were representative of the membership of their respective unions with respect to age, marital status, seniority, and ethnicity. Furthermore, because all employees were union members, by definition, the sample is also representative of the workforce employed in each of the work units covered by the unions' respective collective bargaining agreements.

Given my primary interest in the drinking behavior of those who either currently drink or reported having consumed alcohol at some point in their lives, I excluded from analyses 111 males who reported having abstained all of their lives (i.e., lifetime abstainers). Indeed, in etiological research in general, one studies only those who have the necessary preconditions to develop the illness or problem to begin with. In the current case, a necessary precondition for becoming a problem drinker is to have consumed or to currently consume alcohol in the first place. Furthermore, Cooper, Russell, and Frone (1990, p. 264) argue that the inclusion of even current abstainers (i.e., those who may have consumed alcohol in the past but not longer do so) in risk factor analyses is likely to result in the attenuation of the predicted effects.

MEASURES

All of the data analyzed in the current study were collected on the basis of self-report questionnaires. All of the measures included in this questionnaire have been previously validated and were selected on the basis of their psychometric properties.

Problem drinking. Although many drinking-related studies have used quantity and frequency measures as indicators of the presence of alcohol problems (Mangione et al., 1999), a number of studies (e.g., Cooper, Russell, & George, 1988) indicate that aggregate or averaged levels of consumption are poorly correlated with the adverse effects of drinking. Consequently, the

trend in more recent alcohol research has been to assess alcohol problems on the basis of problem drinking. In the current study, problem drinking was assessed on the basis of the four-item, self-report, CAGE screening instrument, which was developed by psychiatric researchers for practical application. In a number of studies, self-report measures of problem drinking behaviors have been found to be more accurate than collateral reports (cf., Stasciewicz, Bradizza, & Connors, 1997). The CAGE measure has been widely validated (Mayfield, McLeod, & Hall, 1974), correlating significantly with a diagnosis of alcoholism and showing a strong association with other screening instruments for alcohol dependence, such as the *Diagnostic and Statistical Manual of Mental Disorders* (4th ed., American Psychiatric Association, 1994; Bacharach et al., 2002). Using the CAGE, respondents are asked about the presence or absence of four potential problematic consequences of their drinking in the past month. Consistent with previous applications (Bacharach et al., 2002), I summed the responses to the four dichotomous items, yielding an ordinal scale ranging from 0 to 4, with a score of 4 indicative of a severe drinking problem. Of those who drink, 85% (680) received a score of 0 and 7% (52) received a score of 2 or higher, viewed in the psychiatric literature as warranting professional intervention (Mayfield et al., 1974).

Incident exposure and number of exposures. Despite the potential biases inherent in retrospective self-reports of injury, a number of studies have demonstrated the reliability, accuracy, and predictive validity of such measures (Grimmer, Williams, & Pitt, 2000; Smith et al., 2001). Moreover, given that work-related injury events are often poorly documented (Smith et al., 2001) and that asymmetric power relations may make some employees fearful of the consequences of filing a formal injury report (Eakin & MacEachen, 1998), self-reports of injury may, to some degree, provide a more accurate picture of injury events than managerial or corporate medical records.

In this context, respondents were asked to report the number of times they had incurred a moderate to severe injury on the job during the previous 12 months. To ensure that minor injuries were not included, respondents were instructed to include only those injuries severe enough to warrant professional medical attention either onsite (e.g., plant medical office) or offsite (e.g., at a clinic or hospital). Critical incident exposure was assessed on the basis of a binary dummy variable coded as 1 if the individual reported having been injured in such a way on the job at least one time in the past 12 months ($n = 357$, or 45% of the sample) and 0 in all other cases. Number of exposures was assessed on the basis of the number of times in the past 12 months the individual incurred such an injury on the job. Because the distribution on this

variable was highly skewed, in the multivariate analyses reported herein, this variable was transformed using log to the base e by first adding 1 to the total number of exposures reported.

These self-report injury data, when aggregated to the union level, were consistent with the injury data maintained by each of the unions whose members were included in the sample. Sixty percent of those injured on the job also reported having been directly exposed to (i.e., the victim of) at least one traumatic incident in the workplace during the same period of time. Although it is possible that for the remaining 40% the incident in which the injury occurred was not subjectively traumatic, such occurrences were still identified as critical incidents, as being injured on the job severely enough to warrant professional medical attention typically involves an occurrence that is by definition dangerous to oneself, is typically extraordinary, and has the potential to produce significant reactions (e.g., nightmares, unwanted thoughts) for the individual, key defining criteria for a critical incident (Paton & Smith, 1996).

Intrusive reactions. To assess the severity of intrusive reactions to work-based critical incidents involving oneself as the direct victim, I used the 7-item intrusion subscale from Horowitz, Wilner, and Alvez's (1979) Subjective Impact of Event Scale (IES). Creamer, Bell, and Failla (2003) report that the IES subscales are widely used and are a "useful instrument in the assessment of traumatic stress" (p. 1495). Moreover, in his psychometric evaluation of the IES, Joseph (2000, p. 110) concludes that there is "evidence supporting the validity of the IES as a measure of trauma-related distress" and that "the main usefulness of the IES is as a measure of the intrusive processes that mediate between the experience of trauma and subsequent adjustment" (p. 110). Because this instrument assesses intrusive processes associated with a particular event, respondents were asked to first "think of the most traumatic event that you experienced in the last year at work." Those indicating that they had been a victim of this event (i.e., direct exposure) were then asked to indicate how true each of the seven intrusion-related items was for them with respect to this particular injury-related event. Those who indicated that they had either not experienced any such event in the past year or experienced this incident strictly as a witness (i.e., indirect exposure) were asked to leave these items unanswered and automatically received a score of 0 for this measure. Sample items included the following: "I thought about it when I didn't mean to," and "I had dreams about it." Cronbach's alpha for intrusive reactions was .91.

Somatic stress. Somatic stress was assessed on the basis of the somatic complaints measure developed and validated by Caplan, Cobb, French,

Harrison, and Pinneau (1975). Respondents were asked how often they experienced 10 different described conditions (including trembling hands, sweaty hands, and heart palpitations) in the past month. Cronbach's alpha for somatic stress was .90.

Control variables. Given previous findings regarding the association of drinking behavior with personality and demographic factors (Koppes, Twisk, Snel, DeVente, & Kemper, 2001), controls were included for social desirability, age, marital status, socioeconomic status, and occupation. Social desirability was included as a control variable because it may in some cases create spurious relationships, whereas in others, it might suppresses relationships that might otherwise be significant. Using the self-deceptive enhancement component of Paulhus's (1991) Balanced Inventory of Desirable Responding instrument, social desirability was measured on the basis of a 7-point response format (1 = *not at all true*, 7 = *very true*), with a higher value indicating greater self-deceptive enhancement and consequently an increased risk of a social desirability bias. As Paulhus recommends, I summed the responses for the 19 items after recoding items receiving a value of less than 6 as 0 and items receiving a value of 6 or 7 as 1. Cronbach's alpha for social desirability was .70.

Age was assessed on the basis of a 10-point categorical variable ranging from *younger than 20* (1) to *60 or older* (10). Marital status was assessed on the basis of a dichotomous variable coded as 1 if the individual reported being currently married or living with a partner and 0 if otherwise. Socioeconomic status was assessed on the basis of self-reported household income, a 7-point categorical variable ranging from *\$20,000 to \$30,000* (1) to *more than \$80,000* (7). Because the distribution on this variable was highly skewed (i.e., nearly 50% of the sample scored 2 or less), in the multivariate analyses reported herein, this variable was transformed using log to the base *e*. To take into account the possibility that heavy drinking may be more prevalent in some (e.g., hazardous) occupations than in others, I also controlled for occupation using six occupational dummy variables with warehouse workers as the reference group.

Finally, a number of studies have demonstrated that workplace injuries may be correlated with such workplace intoxication variables as on-the-job drinking or drinking just prior to one's work shift (e.g., Ames, Grube, & Moore, 1997). To avoid any confounding between such variables and injuries, I controlled for the effect of the latter by including in my models variables tapping both the frequency of alcohol consumption just prior to coming to work and the tendency of individuals to consume alcohol during working hours. Preshift consumption was assessed on the basis of a single item

measure asking respondents to indicate the number of days in the past month that they consumed alcohol up to 2 hours prior to reporting to work. On-the-job drinking was assessed by asking respondents to think about where they drank in the past month and estimate what percentage of all alcohol consumed during that period was consumed at each of four different locations: (a) work, (b) home, (c) a bar, and (d) other. I used the percentage recorded for at work as the measure of on-the-job drinking. Because the distributions on these two variables were highly skewed, in the multivariate analyses reported herein, these variables were also transformed using log to the base e by first adding 1 to the total number of days in the past month that the respondent reported drinking just before starting the work shift or to the percentage of drinking reportedly done at work.

RESULTS

Table 1 shows means, standard deviations, and intercorrelations between the variables examined in the study. From this table, it is apparent that there are significant bivariate associations between problem drinking and most of the variables under examination. The table also indicates that among those surveyed, exposure prevalence was, as noted above, 45%. Table 2 shows the results of analyses examining the antecedents of problem drinking, and in Table 3, I report additional results relevant to the mediation analyses.

CRITICAL INCIDENT EXPOSURE AND ALCOHOL CONSUMPTION

To test Hypothesis 1 (namely, that exposure to an injury-related critical incident at work is positively associated with problem drinking and that victims of at least one injury-related critical incident during the past 12-month period will report significantly more drinking problems than nonvictims), I first ran a t test comparing the mean level of problem drinking for those exposed to a critical incident in the past year to those unexposed. Those exposed to a critical incident reported a significantly higher mean level of problem drinking (0.34 problems, $SD = 0.78$, vs. 0.23 problems, $SD = 0.61$ for those unexposed; $t = 2.02$, $p < .05$).

Next, I conducted a hierarchical regression analysis entering first the four individual difference (social desirability, age, marital status, and household income), two workplace intoxication, and six occupation variables as controls. As can be seen in Table 2 (Model 1), the frequency of preshift drinking

(continued on page 276)

TABLE 1: Correlation Matrix of Independent and Dependent Variables

<i>Means and Standard Deviations</i>		M	SD
<i>Variable</i>			
1. Problem drinking (CAGE)		0.27	0.69
2. Social desirability		7.21	4.15
3. Age		5.31	1.94
4. Married (dummy)		0.60	0.49
5. Household income (log)		1.18	0.60
6. Frequency of drinking before work in past month (log)		0.54	0.37
7. Percentage of drinking at work (log)		0.05	0.38
8. Nurses aides and orderlies		0.06	0.24
9. Manufacturing—unskilled operators		0.19	0.40
10. Manufacturing—machinists		0.04	0.20
11. Manufacturing—tool and die makers		0.06	0.24
12. Manufacturing—other		0.02	0.15
13. Medical technicians		0.44	0.50
14. Injured (dummy)		0.45	0.50
15. Injuries (log)		0.41	0.49
16. Intrusive reactions		1.16	1.49
17. Somatic stress		2.21	0.67

Correlations

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	1.00																
2	-0.10**	1.00															
3	-0.12***	0.06	1.00														
4	-0.08**	-0.04	0.16***	1.00													
5	0.05	-0.04	0.17***	0.36	1.00												
6	0.30***	-0.08**	-0.18***	-0.07*	0.09**	1.00											
7	0.06	-0.05	-0.08**	-0.02	-0.02	0.11***	1.00										
8	0.02	0.08**	0.06	0.01	-0.21***	-0.03	-0.04	1.00									
9	0.04	-0.07**	-0.10***	-0.02	-0.11**	-0.03	-0.02	-0.13**	1.00								
10	-0.05	-0.02	0.03	0.04	0.09**	0.02	-0.03	-0.05	-0.10*	1.00							
11	-0.02	-0.08**	0.23***	0.12***	0.18***	0.04	-0.04	-0.07*	-0.13***	-0.05	1.00						
12	-0.05	-0.02	0.08**	0.03	0.04	-0.08**	-0.02	-0.04	-0.08*	-0.03	-0.04	1.00					
13	-0.01	0.06	-0.33***	-0.03	0.08*	0.09**	0.10***	-0.23***	-0.43***	-0.19***	-0.22***	-0.14***	1.00				
14	0.08**	-0.04	-0.21***	-0.02	-0.04	0.02	0.02	-0.10***	-0.08**	-0.03	-0.08**	-0.06*	0.34***	1.00			
15	0.06	-0.02	-0.24***	-0.02	-0.02	0.01	0.02	-0.11***	-0.10**	-0.05	-0.09**	-0.08**	0.38***	0.92***	1.00		
16	0.08**	-0.04	-0.22***	-0.08*	0.00	0.04	0.09**	-0.09**	-0.22***	-0.13***	-0.15***	-0.05	0.51***	0.33***	0.38***	1.00	
17	0.19***	-0.30***	-0.16***	-0.02	-0.01	0.04	0.04	-0.05	-0.01	-0.07	-0.03	-0.01	0.13***	0.23***	0.26***	0.33***	1.00

* $p < .10$. ** $p < .05$. *** $p < .01$.

TABLE 2: Antecedents of Drinking Problems Among Males Regardless of Current Consumption Status

Variable	Model 1: Control Variables Only		Model 2: Direct Effect of Exposure		Model 3: Direct Effect of Number of Exposures		Model 4: Mediating Role of Intrusive Reactions		Model 5: Mediating Role of Somatic Stress		Model 6: Mediating Role of Intrusive Reactions and Somatic Stress		Model 7: Moderating Role of Number of Exposures on Impact of Intrusive Reactions		Model 8: Moderating Role of Number of Exposures on Impact of Somatic Stress	
	Beta	SE	Beta	SE	Beta	SE	Beta	SE	Beta	SE	Beta	SE	Beta	SE	Beta	SE
Social desirability	-.01*	.01	-.01*	.01	-.01*	.01	-.01*	.01	-.00	.01	-.00	.01	-.01	.01	-.00	.01
Age	-.03**	.02	-.03**	.02	-.03*	.02	-.03*	.02	-.03*	.02	-.03*	.02	-.03*	.02	-.03*	.02
Marital status	-.11*	.06	-.12**	.06	-.12**	.06	-.11*	.06	-.11*	.06	-.11*	.06	-.12**	.06	-.11**	.06
Household income (log)	.12**	.05	.12**	.05	.12**	.05	.12**	.05	.12**	.05	.12**	.05	.12**	.05	.12**	.05
Frequency of drinking before work in past month (log)	.52***	.07	.53***	.07	.53***	.07	.53***	.07	.53***	.07	.53***	.07	.53***	.07	.52***	.07
Percentage of drinking at work (log)	.04	.07	.04	.07	.04	.07	.04	.07	.04	.07	.04	.07	.03	.07	.04	.07
Nurses aides and orderlies	.06	.13	.06	.13	.06	.13	.06	.13	.06	.13	.05	.13	.05	.13	.05	.13
Manufacturing unskilled operators	-.04	.09	-.06	.09	-.05	.09	-.05	.09	-.05	.09	-.05	.09	-.03	.09	-.06	.09
Manufacturing— machinists	-.32**	.14	-.34**	.14	-.33**	.14	-.32**	.14	-.30**	.14	-.29**	.14	-.31**	.14	-.30**	.14
Manufacturing— tool and die makers	-.17	.13	-.19	.13	-.18	.13	-.17	.13	-.17	.12	-.17	.12	-.17	.13	-.18	.12

Manufacturing— other	-.22	.19	-.21	.18	-.21	.18	-.22	.18	-.23	.18	-.22	.18	-.23	.18
Medical technicians	-.17**	.08	-.23**	.09	-.22**	.09	-.26***	.09	-.23***	.08	-.25***	.09	-.23***	.08
Direct exposure (dummy)			.14**	.06										
Number of direct expo- sures (log)			.12**	.06			.10	.06	.07	.06	.06	.06	.24*	.14
Intrusive reactions				.04*			.04*	.02	.16***	.04	.02	.02	.07***	.03
Somatic stress													.19***	.05
Number of direct exposures × intrusive reaction													-.03**	.02
Number of direct exposures × stress													-.04	.03
F	7.45***	7.41	7.23***	6.93**	7.89***	7.39***	6.80***	7.48***						
Adjusted R ²	.106	.114	.111	.113	.129	.129	.118	.130						
ΔR ² (from Models 1, 2, or 3)	(Model 1)	(Model 1)	(Model 1)	(Model 3)	(Model 3)	(Model 3)	(Model 4)	(Model 5)						

* $p < .10$. ** $p < .05$. *** $p < .01$.

TABLE 3: Antecedents of Intrusive Memories and Somatic Stress

Variable	Model 1: Intrusive Reactions (Control Variables Only)		Model 2: Intrusive Reactions (Main Effects of Exposure)		Model 3: (Decomposition of Exposure Reactions)		Model 4: Somatic Stress (Control Variables Only)		Model 5: Somatic Stress (Main Effects of Exposure)		Model 6: Decomposition of Exposure on Somatic Stress	
	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE	Beta	SE	Beta	SE
Social desirability	-0.03**	.01	-0.03**	.01	-0.03**	.01	-0.05***	.01	-0.05***	.01	-0.05***	.01
Age	-0.03	.03	-0.01	.03	-0.01	.03	-0.03**	.02	-0.03**	.01	-0.02	.01
Marital status	-0.19	.11	-0.20	.11	-0.20	.11	-0.03	.06	-0.04	.05	-0.04	.05
Household income (log)	0.02	.10	0.04	.09	0.04	.09	0.01	.05	0.02	.05	0.02	.05
Frequency of drinking before work in past month (log)	-0.09	.14	-0.05	.14	-0.04	.14	0.01	.07	0.03	.07	0.04	.07
Percentage of drinking at work (log)	0.15	.13	0.17	.13	0.17	.13	0.00	.06	0.01	.06	0.02	.06
Nurses aides and orderlies	0.16	.24	0.17	.24	0.18	.24	0.03	.12	0.04	.12	0.04	.12
Manufacturing— unskilled operators	-0.09	.18	-0.14	.17	-0.12	.17	0.03	.09	0.00	.09	0.01	.09
Manufacturing— machinists	-0.27	.27	-0.33	.27	-0.32	.27	-0.16	.14	-0.19	.13	-0.18	.13

Manufacturing—tool and die makers	-.23	.24	-.28	.24	-.27	.24	-.03	.12	-.06	.12	-.05	.12
Manufacturing—other	0.20	.36	0.25	.35	0.26	.35	0.06	.18	0.08	.17	0.08	.17
Medical technicians	1.45***	.16	1.20***	.16	1.20***	.16	0.16**	.08	0.03	.08	0.04	.08
Number of direct exposures (log)		.11	0.64***						0.32***			
Single exposure in past year				.12	0.36***						0.18***	.06
Two exposures in past year				.17	0.63***						0.31***	.08
Three or more exposures in past year				.19	1.03***						0.54***	.10
F	20.38***	—	22.44***	—	19.54***	—	7.36***	—	9.89***	—	8.74***	—
Adjusted R ²	.264	—	.30	—	.30	—	.105	—	.15	—	0.15	—
Change in R ² from control	—	—	.037***	—	.039***	—	—	—	.045***	—	.049***	—

p < .05. *p < .01.

($B = 0.52, p < .01$) and household income ($B = 0.12, p < .05$) had significant positive associations with problem drinking, whereas social desirability, age, and being married were inversely associated with problem drinking and at varying levels of statistical significance. In addition, relative to the warehouse workers, machinists and medical technicians reported significantly lower levels of problem drinking on average ($B = -0.32$ and -0.17 , respectively, $p < .05$ in both cases). As a whole, this control model explained just more than 10% of the variance in problem drinking. In Step 2, I included the dummy variable for exposure (see Model 2 of Table 2). With the inclusion of this dummy variable, there was a statistically significant increase in the amount of variance explained ($\Delta R^2 = 0.01, p < .01$), and as hypothesized, exposure had a significant positive association with the frequency of consumption ($B = 0.14, p < .05$).

THE KINDLING EFFECT

Based on the kindling effect, I posited (Hypothesis 2) that there would be a positive association between the incidence of exposure (i.e., the total number of work-related injuries reported by the individual during the prior 12-month period) and problem drinking. To test this hypothesis, I replaced the dummy variable for exposure used in Model 2 with an ordinal variable tapping the number of injury-related exposures to which the respondent had been exposed in the past year. Consistent with kindling theory, the coefficient ($B = 0.12$) was statistically significant ($p < .05$) with this additional variable, explaining a significantly greater portion of the variance in problems relative to the control model ($\Delta R^2 = 0.01, p < .01$). I then decomposed this effect to ascertain whether the effects of subsequent exposures were indeed greater than that of a solitary or initial exposure. I did this by testing a similar model in which, rather than including a single variable tapping the number of incidents experienced, three dummy variables representing the number of exposures experienced (i.e., one, two, or three or more, with none as the reference category) were included. When specified in such a manner, no direct support was found for the kindling hypothesis. Indeed, although the estimates were in the hypothesized direction for the two multiple exposure variables, only the estimate for the single exposure variable ($B = 0.16, p < .05$) was significant.

MEDIATING EFFECT OF INTRUSIVE REACTIONS AND SOMATIC STRESS

I next tested Hypothesis 3a, which posited that the association between the incidence of injury-related critical incident exposure during the previous 12-month period and problem drinking would be mediated by intrusive

reactions to a work-based critical incident involving injury to oneself. As noted above, critical incident exposure had a significant positive association with problem drinking, thus satisfying Baron and Kenny's (1986) first criterion for mediation. To assess the degree to which the strength of this relationship was sensitive to the inclusion of intrusive reactions (Baron and Kenny's second criterion), I included this variable in Model 4. As can be seen in Model 4 of Table 2, with the inclusion of intrusive reactions, the coefficient for incidence of injury-related exposure shrank from .12 to .10 and became statistically insignificant (thus satisfying Criterion 2), and intrusive reaction was significantly associated (albeit marginally so) with problem drinking in the direction hypothesized ($B = 0.04, p < .10$). Finally, to test the fourth criterion of mediation, I regressed intrusive reactions on both the control variables and exposure. As can be seen in Table 3 (Model 2), the incidence of injury-related exposure is significantly associated with the level of intrusive reactions ($B = 0.64^{**}, p < .01$) and the inclusion of exposure results in a significant change in the proportion of variance explained as compared with a control model (Model 1 of Table 3; $\Delta R^2 = 0.04, p < .01$). Further evidence of a significant, albeit marginal, mediation effect is provided by marginally significant Sobol ($t = 1.89, p < .10$) and Goodman I ($t = 1.87, p < .10$) test results. Using the same approach noted above, I again decomposed the effects of multiple exposures, this time on intrusive reactions. This time, as shown in Model 3 of Table 3, the effects of subsequent occurrences on intrusive reactions were not only significant, they were in fact greater than that of the initial or solitary event ($B = 0.36, 0.63, \text{ and } 1.03$ for one, two, and three or more exposures, respectively, $p < .01$ in all cases).

Model 5 of Table 2 contains the results of the test of Hypothesis 3b, which posited that the association between the incidence of injury-related exposure and problem drinking would be mediated by distress. As in the case of intrusive reactions, the inclusion of the distress mediating variable (i.e., somatic stress) resulted in a decline in the magnitude and statistical significance of the coefficient for incidence (from $B = 0.12, p < .05$, to $B = 0.07, p > .10$) of injury-related exposure, whereas somatic stress was significantly associated with problem drinking in the direction hypothesized ($B = 0.16, p < .01$). Furthermore, as can be seen in Model 5 of Table 3, the incidence of injury-related incident exposure is significantly associated with higher levels of somatic stress ($B = 0.32, p < .01$), and the inclusion of exposure results in a significant change in the proportion of variance in somatic stress explained as compared with a control model ($\Delta R^2 = 0.05, p < .01$), thus satisfying Baron and Kenny's (1986) fourth criteria. In this case, the Sobol ($t = 3.39, p < .01$) and Goodman ($t = 3.36, p < .01$) tests of mediation indicate that distress serves as a robust and significant mediator of the link between exposure incidence and problem

drinking. Moreover, based on the decomposition analysis (the results of which are displayed in Model 6 of Table 3), subsequent occurrences again manifested stronger effects than that of an initial event ($B = 0.18, 0.31,$ and 0.54 for one, two, and three or more exposures, respectively, $p < .01$ in all cases).

In Model 6 of Table 2, I present the results of the mediation model including both intrusive reactions and somatic stress as mediators. Taken in the context of the results presented above, the insignificant coefficients for both exposure incidence and intrusive reactions suggestions along with the significant coefficient for somatic stress ($B = 0.15, p < .01$) suggest that although intrusive reactions fully mediate the effects of exposure incidence on problem drinking, the effects of intrusive reactions are themselves fully mediated by distress.

Finally, I also posited that the strength of such mediation effects might themselves vary as a function of the incidence of injury-related incident exposure. Specifically, Hypothesis 3c suggested that the total number of work-related injuries reported by the individual during the prior 12-month period would moderate the link between both intrusive reactions and somatic stress on one hand and problem drinking on the other such that the strength of association between these variables would increase as a function of the incidence of exposure. As can be seen in Models 7 and 8 of Table 2, no support was found for this hypothesis. As can be seen in Model 8, the mediating effect of somatic stress was robust in variance in the incidence of injury-related incident exposures (coefficient for the interaction term = $-0.04, p > .10$). In contrast, although a significant moderation effect for incidence of exposure was found with respect to intrusive reactions (see Model 7 of Table 2), the sign preceding the coefficient ($B = -0.03, p < .05$) suggests an effect precisely the opposite of that hypothesized. In contrast to what we might expect on the basis of the kindling hypotheses, the results indicate that the association between intrusive reactions and problem drinking becomes significantly weaker as the number of exposures to injury-related incidents rises. Following the recommendations of Cohen, Cohen, West, and Aiken (2003), I decomposed this interaction effect by plotting the regression lines on the basis of three levels of injury (i.e., one injury [$n = 212$], two injuries [$n = 83$], and three or more injuries [$n = 62$]). This decomposition revealed that the regression lines were not parallel, with the slope steepest in the case of a single injury and the coefficient for intrusive reactions being significant ($p < .001$) only in the case of a single injury.

DISCUSSION

Although studies demonstrating the comorbidity of critical incident exposure and problem drinking have typically been based on studies of individuals exposed to incidents outside of the workplace, the results presented above suggest that such comorbidity findings may be generalizable to employees incurring injuries in the context of critical incidents at work as well. Specifically, among the male employees studied, consistent with Hypothesis 1, simple exposure to such incidents was found to be related to drinking problems and to explain significantly more of the variance in problem drinking than that explained by a combination of demographic, occupational, and consumption variables.

However, the findings with regard to kindling theory (Hypothesis 2) are more complex. Although I found, as hypothesized, a positive association between the number of such exposures experienced in the past year and the degree of self-reported problem drinking, when decomposing this effect, it was apparent that this association stemmed strictly from the positive effect of a solitary or initial incident exposure. The estimates for subsequent exposures, although in the hypothesized direction, were of a smaller magnitude and were not statistically significant. Nevertheless, this may stem from the low base rates and highly skewed distributions for both the multiple exposure dummy variables ($n = 71$ and 56 for two and three or more exposures, respectively) and problem drinking ($n = 117$ for those reporting one or more drinking problems). Alternatively, the lack of significance may be caused by the compressed (1-year) time frame within which I tested for the effects of multiple exposures on problem drinking. As noted above, evidence of a kindling effect was found with regard to both intrusive reactions and distress, with the effects of subsequent exposures on these two mediating variables being greater than that of a solitary or initial event. However, a 1-year time frame may be too short a period to expect multiple exposures to influence affective states and for the latter to subsequently influence self-medicating behaviors (i.e., problem drinking).

The findings presented above are generally consistent with the cognitive processing and self-medication models of comorbidity, which suggest that as individuals attempt to assimilate and integrate the incident into existing mental schemas, they are likely to experience distress as well as a variety of emotionally upsetting recollections that may themselves be highly stress inducing and consequently motivate individuals to self-medicate. Specifically, I found that both distress (operationalized in terms of somatic stress) and intrusive reactions mediate the association between exposure incidence and problem drinking (Hypotheses 3a and 3b), although the latter effect was only

marginally significant and was itself mediated by distress. In addition, it should be noted that even this marginal mediation of the exposure effect by intrusive reactions may be suspect given the necessary conceptual and operational association between exposure incidence and intrusive reactions. Specifically, although respondents reported intrusive reactions stemming from the single most significant incident to which they were exposed in the past year, this incident was one of those included when calculating the exposure incidence variable. Still, although exposure is a necessary condition for intrusive reactions, it is by no means a sufficient condition. Indeed, many of those workers exposed experienced no intrusive reactions whatsoever. Nevertheless, I suggest that the findings regarding the mediating role of intrusive reactions be interpreted cautiously and that future research examine the mediating role of this variable in the context of several years' worth of incidents to minimize any dependence between these two independent variables.

Finally, I found that although the effect of exposure-related distress on problem drinking was unaffected by the number of incident exposures, the effect of intrusive reactions on problem drinking was attenuated as a function of exposure incidence. That is, contrary to Hypothesis 3c, exposure incidence was found to actually attenuate the effect of intrusive reactions (but not somatic stress) on problem drinking. Specifically, as noted above, the interaction of exposure incidence and intrusive reactions was inversely related to the degree of problem drinking, indicating that the strength of the positive association between the severity of intrusive reactions and problem drinking diminishes as a function of exposure incidence. This finding suggests that there may be an element of learning or acclimation involved in an individual's response to a critical incident, with earlier exposures perhaps having an "inoculating effect" on subsequent exposures (Hodgins et al., 2001, p. 546). Although victims of prior incidents may still experience significant intrusive reactions as a result of the most recent exposure, precisely through such experiences, victims may also develop alternative coping mechanisms, thus perhaps diminishing the current perceived need for self-medication. Alternatively, it may be that those who used alcohol to self-medicate intrusive reactions to prior incidents became aware of the potential risks of adopting such a strategy and, as a result, became less likely to increase their consumption as a means by which to cope with their most recent exposure.

LIMITATIONS

More work is necessary to further investigate the complex findings with regard to the kindling hypothesis and to overcome the methodological limitations of the current study. One of these limitations has to do with the possibility

of reverse causality, namely that drinking problems may be causally prior to incident exposure and somatic stress. Certainly, as Brady, Dansky, Sonne, and Saladin (1998) note, there may be reason to believe that alcohol consumption is associated with the tendency of heavy drinkers to place themselves in dangerous situations or to respond to dangerous situations at work in a more reckless manner, and a number of studies suggest that problem drinking may be associated with a heightened risk of job-related accidents or injuries (e.g., Frone, 1999). Moreover, as Jacobsen et al. (2001) notes, "chronic substance abuse can lead to higher levels of arousal and anxiety" (p. 1185).

However, in the current study, there was no significant difference in the mean number of injury-related exposures reported by males having a moderate to severe drinking problem (i.e., meeting the standard problem drinking cutoff requirement of two or more CAGE problems) and those not having a drinking problem (i.e., score of 1 or less on the CAGE; $t = 1.12, p > .10$). In addition, when I reversed Regression Model 3 (with drinking problems as an independent variable and the log of exposure incidence as the dependent variable), drinking problems had only a marginal association with exposure incidence, and the additional variance in the dependent variable explained by drinking problems (0.4%) was not statistically significant. It is interesting that the coefficient for the drinking problems became statistically insignificant (i.e., $p > .10$) when I controlled for job-related hazards.

Moreover, a number of recent studies question the assumption underlying the reverse causality argument, namely that heightened consumption increases the risk of occupational injury (Mangione et al., 1999). For example, among current drinkers enrolled in the National Longitudinal Survey of Youth since 1979, Veazie and Smith (2000) found that after controlling for confounding factors, there remained no significant association between injuries and heavy drinking. Ames et al. (1997) report similar findings. Mangione et al. (1999) found abstainers and heavy drinkers to have precisely the same mean rates of injury. These authors note that if there is reversed causality, drinking problems are likely only to reduce the risk of injury in that supervisors often modify work demands for such employees precisely with such risks in mind. Still, most studies provide support for the causal relationships assumed in the current analysis, with incident exposure serving as an antecedent of both distress and heightened alcohol consumption (Jacobsen et al., 2001; Stewart et al., 1998). For example, in a 5-year longitudinal study, Chilcoat and Breslau (1998) failed to find preexisting substance abuse to increase subjects' risk for subsequent critical incident exposure. Rather, they found that incident exposure increased the risk for subsequent development of a substance use disorder, with substance abuse problems emerging only among those who experienced traumatic distress subsequent to incident

exposure. Nevertheless, future studies on the psychological consequences work-based critical incidents should adopt longitudinal designs to ascertain causal relations, take into account any possible secondary effects of substance abuse on arousal and anxiety, and minimize possible confounding with individuals' exposure to other contemporaneous work and nonwork incidents.

Given that the current analysis focused on male employees only, a second limitation has to do with the generalizability of the study's results to female workers employed in similar occupations. Based on their review of the literature, Jacobsen et al. (2001, p. 1184) suggest that comorbidity may be gender sensitive. Although a number of studies have found that among men experiencing traumatic distress, alcohol abuse or dependence is the most common co-occurring disorder and that among women experiencing traumatic distress, alcohol-related problems are less common than a variety of other disorders (e.g., comorbid depression and anxiety disorders). Consequently, the comorbidity findings for men reported in the current analysis may not be generalizable to women. Similarly, because the current study focused on nonexempt workers employed in manufacturing and service occupations, the findings may also lack generalizability to exempt employees such as those in managerial, professional, and technical occupations. Researchers may wish to take account of this issue when designing future comorbidity studies.

A third possible limitation concerns the possibility of a spurious relationship between injury-related incidents and problem drinking, particularly if heavy drinkers tend to work at hazardous jobs (Leigh, 1996) or if they are embedded in more permissive drinking cultures (Bacharach et al., 2002). Still, in the current analysis, I attempted to control for any such spurious effect by including dummy variables for occupation in the control model. Consequently, the likelihood that the findings are the result of a simply spurious relationship is considered to be rather remote.

A fourth limitation may have to do with the use of work-based injury as a proxy for direct exposure to a critical incident at work. Using such a measure as a proxy of incident exposures may be problematic for several reasons. First, as noted earlier, only 60% of those reporting an injury on the job during the past year also reported being a direct victim of a traumatic incident at work during the same period. Consequently, perhaps because they perceived their injury to be minor (despite the fact that it required medical attention) or because injuries in certain workplaces are so common that they are rarely viewed as traumatic, many of those I coded as being exposed did not see themselves as having been exposed and consequently did not have a reason to complete the intrusive reactions items.

Second, even for those reporting direct exposure to a traumatic incident in the past year, there is no way of ensuring that the incident culminating in their

injury was the same traumatic incident to which they reported being exposed. Consequently, for some of those in the sample, the intrusive reactions and distress experienced may have been completely unrelated to the incident in which they received their injury. Indeed, because the distress measure did not distinguish between acute and chronic distress, even those uninjured and reporting no exposure to a traumatic incident may, nonetheless, have reported somatic symptoms.

A final problem with using injury as a proxy for incident exposure is that many of those who were not injured during the prior year may have, nevertheless, witnessed the injury of others and consequently may have been indirectly exposed to a critical incident. Indeed, depending on the nature of the particular circumstance, such indirect exposure may be just as (if not even more) psychologically draining as incurring many types of workplace injuries (Monnier et al., 2002). Although the mean level of somatic stress for the 148 (34%) of those 440 uninjured males reporting having witnessed a traumatic incident at work was significantly lower than that of the 357 injured males (2.09 vs. 2.36, $t = 4.00$, $p < .01$), the mean level of intrusive reactions was not significantly different (1.74 for uninjured witnesses compared with 1.70 for those injured; $t = 0.26$, $p > .10$).

Nevertheless, given that all three of these problems increase the risk of a Type II error (i.e., create a situation in which it is more difficult to demonstrate support for the hypothesized relationships), any confounding generated by the use of injury as a proxy for critical incident exposure is likely to have, if anything, resulted in a more conservative test of the hypotheses and an underestimation of the hypothesized effects.

A further factor increasing the likelihood of underestimated effects stems from the use of a 1-year time frame for the analysis of multiple exposures. As noted above, limiting respondents to a 1-year time frame drastically limits the number of multiexposure observations because (gratefully) most employees are not subject to multiple incident exposures in any given year. When combined with the typically low base rate for problem drinking, even samples of several hundred employees may lack the statistical power required for such analyses. Given that seniority may serve as a poor alternative proxy measure for multiple exposure, researchers may wish to expand the period under analysis to 2 or 3 years to capture a greater number of multiple exposure cases. Such a broader time frame may also eliminate the problem of lag suggested above, allowing sufficient time for the affective consequences of multiple exposures to manifest themselves in terms of problem drinking.

A final limitation may stem from the retrospective, "snapshot" (Paton & Smith, 1996, p. 45) nature of the study. Although aggregated self-reports of injury were consistent with objective union reports, there may still have been

some degree of retrospective bias with regard to respondents' recollection of both intrusive reactions and somatic symptoms. In the future, researchers may wish to adopt a more opportunistic prospective approach similar to that adopted at Three Mile Island by Chisholm, Kasl, and Mueller (1986), an explosives factory by Barling, Bluen, and Fain (1987), and an office building shooting by Creamer et al. (1992). Such an approach allows the researcher to not only track the psychological and behavioral consequences of a specific critical incident throughout time (i.e., by taking assessments at regular intervals) but compare different groups of workers having different levels of exposure severity (Weiss et al., 1995).

CONCLUSION

The findings reported above shed some important new light on the relations between work-related critical incident exposure, intrusive reactions, distress, and alcohol consumption. From a theory perspective, they support the extension of current comorbidity models to the workplace arena. This is no trivial matter, because although injury-related critical incident exposure may be relatively rare in society as a whole, as noted earlier, the average worker in the United States has a better than 1 in 20 likelihood of experiencing precisely the kind of injury-related critical incidents studied in the current article and found to be linked to problem drinking.

However, beyond demonstrating that the association between critical incident exposure and drinking behavior holds true among male employees exposed to such incidents in the context of their work, these findings also provide important insights with respect to a number of key theories underlying comorbidity research. First, the finding that there is a significant association between the number of incidents to which the individual has been exposed and such trauma-related outcomes as intrusive reactions and distress provides some of the most direct empirical support for the kindling hypothesis to date. As noted earlier, much of the earlier research regarding the kindling hypothesis used workplace or occupational seniority as a proxy for exposure. In the current study, despite the short time frame within which I estimated the number of injury-related direct exposures (limiting it to the past year alone), it was still possible to demonstrate significant support for the hypothesis.

Second, the results offer important insights into just how this kindling effect might work. Specifically, consistent with the cognitive processing and self-medication perspectives, intrusive reactions and distress were demonstrated to mediate the relationship between exposure incidence and problem drinking. Moreover, the findings suggest that although (consistent with COR

theory) increased incidence of exposure may heighten intrusive reactions and distress, contrary to the self-medication perspective, increased incidence may also significantly attenuate the association between intrusive reactions and problem drinking.

For each of these theoretical insights, there are important practitioner and policy implications. Given the findings regarding the comorbidity of critical incident exposure in the workplace and drinking problems and given the substantial costs of drinking problems to employers and the economy at large (Bacharach et al., 2002), labor and management officials involved in employee assistance and employee safety and health may wish to consider new types of programs designed to directly address the alcohol-related problems potentially associated with work-based critical incident exposure. Many companies and unions have already developed critical incident response programs as part of their employee assistance system, involving victim debriefings, peer support, and trauma-related counseling focusing on, among other things, intrusive reactions and trauma-related avoidance tendencies (Bacharach, Bamberger, & Sonnenstuhl, 2001). However, in most cases, these programs are geared toward more catastrophic workplace incidents involving multiple victims, such as shootings, fires, or structural collapses (Bacharach et al., 2001). The results presented above suggest that there may be a role for such programs on the more day-to-day level, with interventions developed for far less catastrophic incidents involving even individual microaccidents at work (Zohar, 2000). In particular, programs helping individual victims of workplace injuries cope with intrusive reactions may play an important role in reducing the risk of problem drinking. The findings with respect to the kindling effect suggest that such interventions may be particularly important in those work contexts in which individuals tend to be exposed to critical incidents on a more frequent and recurring basis.

DIRECTIONS FOR FUTURE RESEARCH

Although the current study demonstrated that for some of those injured in workplace critical incidents such exposure may have significant psychological and alcohol-related implications, it is important to keep in mind that direct victims are likely to account for only a small portion of those who view themselves as having been exposed to work-related critical incidents. The current study did not examine the impact of other forms of exposure, such as witnessing an incident or being a direct victim of some other form of non-injury-related critical incident (e.g., being the target of extreme verbal abuse or sexual harassment). Indeed, there is increasing evidence that other forms of incident

exposure may also have alcohol-related implications (see, for example, the work of Rospenda, Richman, Wislar, & Flaherty, 2000, on the association between sexual harassment and drinking among women). Consequently, these findings should encourage organizational researchers to begin to examine work-based critical incidents as a potentially critical determinant of overall employee well-being.

It is also important to keep in mind that the direct and mediated relationships identified in the current study may be moderated by a variety of protective and risk-enhancing factors. Individual difference factors, such as positive and negative affectivity, the tendency of drinking to cope, and alcohol expectations, may play an important role in this regard, as might factors related to the organizational context. Regarding the latter, Bacharach et al. (2002) suggest that workplace drinking norms moderate the association between stress and drinking behavior. If this is indeed the case, it may be the case that comorbidity rates will be higher in those work environments in which drinking norms are more permissive and lower in those environments in which drinking norms are more restrictive. Peer support processes and the nature of job tasks may also moderate the extent to which critical incident exposure results in heightened drinking problems. For example, although buffering (Stephens & Long, 2000) models suggest that individual reactions to incident exposure may be moderated by enhanced social support and greater employee task control, to date, relatively few studies have investigated the extent to which such models apply with respect to employee responses to work-based critical incidents (Haslam & Mallon, 2003). Consequently, researchers may wish to expand on the basic models examined in the current study and to adopt study designs taking such individual and contextual moderating variables into account.

NOTE

1. According to the DSM-IV (American Psychiatric Association, 1994), alcohol dependence involves harmful (i.e., abusive) drinking as well as alcohol tolerance, withdrawal symptoms, drinking to avoid withdrawal symptoms, or drink-seeking behavior.

REFERENCES

American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.

- Ames, G. M., Grube, J. W., & Moore, R. S. (1997). The relationship of drinking and hangovers to workplace problems: An empirical study. *Journal of Studies on Alcohol, 58*, 37-47.
- Bacharach, S. B., & Bamberger, P. A. (2004). Diversity and the union: The effect of demographic dissimilarity on members' union attachment. *Group and Organization Management, 29*, 385-418.
- Bacharach, S. B., Bamberger, P. A., & Sonnenstuhl, W. J. (2001). *Mutual aid and union renewal: Cycles of logics of action*. Ithaca, NY: Cornell University Press.
- Bacharach, S. B., Bamberger, P. A., & Sonnenstuhl, W. J. (2002). Driven to drink: Managerial control, work-related risk factors and employee problem drinking. *Academy of Management Journal, 45*, 637-658.
- Barling, J. (1995). The prediction, experience and consequences of workplace violence. In G. van den Bos (Ed.), *Workplace violence* (pp. 29-49). Washington, DC: American Psychological Association.
- Barling, J., Bluen, S. D., & Fain, R. (1987). Psychological functioning following an acute disaster. *Journal of Applied Psychology, 72*, 683-690.
- Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic and statistical considerations. *Journal of Personality and Social Psychology, 51*, 1173-1182.
- Brady, K. T., Dansky, B. S., Sonne, S. C., & Saladin, M. E. (1998). Posttraumatic stress disorder and cocaine dependence. *American Journal of Addiction, 7*, 128-135.
- Brewin, C. R., & Holmes, E. A. (2003). Psychological theories of posttraumatic stress disorder. *Clinical Psychology Review, 23*, 339-376.
- Brown, J., Mulhern, G., & Joseph, S. (2002). Incident-related stressors, locus of control, coping and psychological distress among firefighters in Northern Ireland. *Journal of Traumatic Stress, 15*, 161-168.
- Bureau of Labor Statistics. (2001). *Workplace injuries and illnesses in 2001* (USDL News Release 02-687). Retrieved November 1, 2004, from www.bls.gov/iif/oshwc/osh/os/osnr0016.txt
- Bureau of Labor Statistics. (2004). *Employed persons by occupation, sex, and age for 2003*. Retrieved November 1, 2004, from <ftp://ftp.bls.gov/pub/special.requests/lf/aat9.txt>
- Caplan, R. D., Cobb, S., French, J. R. P., Jr., Harrison, R. V., & Pinneau, S. R., Jr. (1975). *Job demands and worker health* (Department of Health, Education and Welfare Publication No. 75-160). Washington, DC: U.S. Department of Health Education and Welfare.
- Chilcoat, H. D., & Breslau, N. (1998). Posttraumatic stress disorder and drug disorders: Testing causal pathways. *Archives of General Psychiatry, 55*, 913-917.
- Chisholm, R. F., Kasl, S. V., & Mueller, L. (1986). The effects of social support on nuclear worker responses to the Three Mile Accident. *Journal of Occupational Behavior, 7*, 179-194.
- Cohen, J., Cohen, P., West, S. G., & Aiken, L. S. (2003). *Applied multiple regression/correlation analysis for the behavioral sciences* (3rd ed.). Mahwah, NJ: Lawrence Erlbaum.
- Cooper, M. L., Russell, M., & Frone, M. R. (1990). Work stress and alcohol effects: A test of stress-induced drinking. *Journal of Health and Social Behavior, 31*, 206-276.
- Cooper, M., Russell, M., & George, W. (1988). Coping expectancies and alcohol abuse: A test of social learning formulations. *Journal of Abnormal Psychology, 97*, 218-230.
- Creamer, M., Bell, R., & Failla, S. (2003). Psychometric properties of the Impact of Event Scale-Revised. *Behavior Research and Therapy, 41*, 1489-1496.
- Creamer, M., Burgess, P., & Pattison, P. (1992). Reaction to trauma: A cognitive processing model. *Journal of Abnormal Psychology, 101*, 452-459.

- Eakin, J. M., & MacEachen, E. (1998). Health and the social relations of work: A study of the health-related experiences of employees in small workplaces. *Sociology of Health and Illness*, *20*, 896-914.
- Emsley, R. A., Seedat, S., & Stein, D. J. (2003). Posttraumatic stress disorder and occupational disability in South African security force members. *Journal of Nervous and Mental Disease*, *191*, 237-241.
- Fisher, V. I. (1991). Combat exposure and the etiology of post discharge substance abuse problems among Vietnam veterans. *Journal of Traumatic Stress*, *48*, 207-215.
- Frone, M. R. (1999). Work stress and alcohol use. *Alcohol Research and Health*, *23*, 284-291.
- Grimmer, K., Williams, J., & Pitt, M. (2000). Reliability of adolescents' self-report of recent recreational injury. *Journal of Adolescent Health*, *27*, 273-275.
- Haslam, C., & Mallon, K. (2003). A preliminary investigation of post-traumatic stress symptoms among firefighters. *Work and Stress*, *17*, 277-285.
- Hodgins, G. A., Creamer, M., & Bell, R. (2001). Risk factors for posttrauma reactions in police officers: A longitudinal study. *Journal of Nervous and Mental Disease*, *189*, 541-547.
- Horowitz, M., Wilner, N., & Alvarez, W. (1979). Impact of event scale: A measure of subjective stress. *Psychosomatic Medicine*, *41*, 209-218.
- Jacobsen, L. K., Southwick, S. M., & Kosten, T. R. (2001). Substance abuse disorders in patients with posttraumatic stress disorder: A review of the literature. *American Journal of Psychiatry*, *158*, 1184-1190.
- Johnsen, B., Eid, J., Laberg, J. C., & Thayer, J. F. (2002). The effect of sensitization and coping style on post-traumatic stress symptoms and quality of life: Two longitudinal studies. *Scandinavian Journal of Psychology*, *43*, 181-188.
- Jordan, B. K., Schlenger, W. E., Hough, R., Kulka, R. A., Weiss, D., Fairbank, J. A., et al. (1991). Lifetime and prevalence of specific psychiatric disorders among Vietnam veterans and controls. *Archives of General Psychiatry*, *48*, 207-215.
- Joseph, S. (2000). Psychometric evaluation of Horowitz's Impact of Event Scale: A review. *Journal of Traumatic Stress*, *13*, 101-113.
- Koppes, L. L. J., Twisk, J. W. R., Snel, J., DeVente, W., & Kemper, H. C. G. (2001). Personality characteristics and alcohol consumption: Longitudinal analyses in men and women followed from ages 13 to 32. *Journal of Studies on Alcohol*, *62*, 494-500.
- Leigh, J. P. (1996). Alcohol abuse and job hazards. *Journal of Safety Research*, *27*, 17-32.
- Mangione, T. W., Howland, J., Amick, B., Cote, J., Lee, M., Bell, N., et al. (1999). Employee drinking practices and work performance. *Journal of Studies on Alcohol*, *60*, 261-270.
- Mayfield, D. G., McLeod, G., & Hall, P. (1974). The CAGE Questionnaire. *American Journal of Psychiatry*, *131*, 1121-1123.
- McFarlane, A. C. (1998). Epidemiological evidence about the relationship between PTSD and alcohol abuse: The nature of the association. *Addictive Behaviors*, *23*, 813-825.
- Monnier, J., Cameron, R. P., Hobfoll, S. E., & Gribble, J. R. (2002). The impact of resource loss and critical incidents on psychological functioning in fire-emergency workers: A pilot study. *International Journal of Stress Management*, *9*, 11-29.
- National Institute for Occupational Safety and Health. (1996). *National occupational research agenda*. Washington, DC: Author.
- Nishith, P., Resick, P. A., & Mueser, K. T. (2001). Sleep difficulties and alcohol use motives in female rape victims with posttraumatic stress disorder. *Journal of Traumatic Stress*, *14*, 469-479.
- Paton, D., & Smith, L. M. (1996). Psychological trauma in critical occupations: Methodological and assessment strategies. In D. Paton & J. M. Violanti (Eds.), *Traumatic stress in critical oc-*

- cupations: Recognition, consequences and treatment* (pp. 15-57). Springfield, IL: Charles C Thomas.
- Paulhus, D. L. (1991). Measurement and control of response bias. In J. P. Robinson, P. R. Shaver, & L. S. Wrightsman (Eds.), *Measures of personality & social psychological attitudes* (pp. 17-59). San Diego, CA: Academic.
- Rospenda, K. M., Richman, J. A., Wislar, J. S., & Flaherty, J. A. (2000). Chronicity of sexual harassment and generalized work-place abuse: Effects on drinking outcomes. *Addiction, 95*, 1805-1820.
- Sims, A. C. P., & Sims, D. (1998). The phenomenology of post-traumatic stress disorder: A symptomatic study of 70 victims of psychological trauma. *Psychopathology, 31*, 96-112.
- Smith, C. S., Silverman, G. S., Heckert, T. M., Brodke, M. H., Hayes, B. E., Silverman, M. K., et al. (2001). A comprehensive method for the assessment of industrial injury events. *Journal of Prevention and Intervention in the Community, 22*, 5-20.
- Stasciewicz, P. C., Bradizza, C. M., & Connors, G. I. (1997). Subject-collateral reports of drinking in inpatient alcoholics. *Alcoholism: Clinical & Experimental Research, 21*, 530-536.
- Stephens, C., & Long, N. (2000). Communication with police supervisors and peers as a buffer of work-related traumatic stress. *Journal of Organizational Behavior, 21*, 407-424.
- Stewart, S. H. (1996). Alcohol abuse in individuals exposed to trauma: A critical review. *Psychological Bulletin, 120*, 83-112.
- Stewart, S. H., Pihl, R. O., Conrod, P. J., & Dongier, M. (1998). Functional associations among trauma, PTSD and substance-related disorders. *Addictive Behaviors, 23*, 797-812.
- van der Kolk, B., Bessel, A., Pelcovitz, D., Roth, S., Mandel, F. S., McFarlane, A., et al. (1996). Dissociation, somatization, and affect dysregulation: The complexity of adaptation to trauma. *American Journal of Psychiatry, 153*, 83-93.
- Veazie, M. A., & Smith, G. S. (2000). Heavy drinking, alcohol dependence, and injuries at work among young workers in the United States labor force. *Alcoholism: Clinical and Experimental Research, 24*, 1811-1819.
- Volpicelli, J., Balaraman, G., Hahn, J., Wallace, M. A., & Bux, D. (1999). The role of uncontrollable trauma in the development of PTSD and alcohol addiction. *Alcohol Research and Health, 23*, 256-262.
- Wagner, D., Heirichs, M., & Ehlert, U. (1998). Prevalence of symptoms of posttraumatic stress disorder in German professional firefighters. *American Journal of Psychiatry, 155*, 1727-1732.
- Weiss, D. S., Marmar, C. R., Metzler, T. J., & Ronfeldt, H. M. (1995). Predicting symptomatic distress in emergency services personnel. *Journal of Consulting and Clinical Psychology, 63*, 361-368.
- Zohar, D. (2000). A group-level model of safety climate: Testing the effect of group climate on microaccidents in manufacturing jobs. *Journal of Applied Psychology, 85*, 587-596.

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