

THE ASSOCIATION BETWEEN STRESS AND DRINKING: MODIFYING EFFECTS OF GENDER AND VULNERABILITY

DEBORAH A. DAWSON*, BRIDGET F. GRANT and W. JUNE RUAN

Laboratory of Epidemiology and Biometry, Division of Intramural Clinical and Biological Research, National Institute on Alcohol Abuse and Alcoholism, National Institutes of Health, Bethesda, MD, USA

(Received 14 March 2005; first review notified 2 May 2005; accepted in revised form 13 May 2005; advance access publication 21 June 2005)

Abstract — **Aims:** To assess the relationship between number and type of past-year stressful experiences and alcohol consumption, with a focus on how gender, poverty, and psychological vulnerability moderate this association. **Methods:** Data from 26 946 US past-year drinkers 18 years of age and over, interviewed in the 2001–2002 National Epidemiologic Survey on Alcohol and Related Conditions (NESARC), were used to construct multivariate linear regression models predicting six measures of drinking pattern and volume. **Results:** There was a consistent positive relationship between number of past-year stressors experienced and all measures of heavy drinking. Frequency of heavy (5+ drinks for men; 4+ drinks for women) drinking increased by 24% with each additional stressor reported by men and by 13% with each additional stressor reported by women. In contrast, the frequency of moderate drinking (<5 drinks for men; <4 drinks for women) decreased as stress levels increased. Job-related and legal sources of stress were more strongly associated with alcohol consumption than were social and health-related stress. Men showed a stronger association than women between the number of stressors and the most consumption measures; they also responded more strongly to the presence of any legal and job-related stress. Having an income below the poverty level intensified the effects of job-related stress, but having a mood or anxiety disorder did not affect any of the associations between stress and consumption. **Conclusions:** Stress does not so much lead individuals to drink more often as to substitute larger quantities of alcohol on the days when they do drink. Treatment and brief interventions aimed at problem drinkers might benefit from addressing the issue of tension alleviation and the development of alternative coping mechanisms.

INTRODUCTION

Researchers have studied the association between stress and alcohol consumption since the origin of the tension reduction hypothesis (Conger, 1956). Reviews of studies conducted through the mid-1990s (e.g. Greeley and Oei, 1999) showed little consistency in terms of findings. More recent studies have continued to show results that vary not only across studies but also within studies according to type of stress, sociodemographic factors (especially gender), coping style, vulnerability, and drinking motivation.

A number of the more recent studies have examined stress as a continuous measure based on varying counts of negative life events. Two longitudinal studies that followed adolescents into adulthood found limited effects of stress on consumption. One found a positive relationship between negative events and consumption that was significant during high school years but diminished as individuals moved into late adolescence and adulthood (Aseltine and Gore, 2000), whereas the other found a positive effect only at the fourth follow-up (age 21) and only among men with relatively strong tension-reducing motivations for drinking (Rutledge and Sher, 2001). In a regional sample of 6747 adult males, both the number of stressful life events and level of perceived stress increased significantly from abstainers to 'common drinkers' to problem drinkers (Cole *et al.*, 1990). Similarly, a small ($n = 154$) sample of adults recruited from newspaper advertisement and alcohol treatment centers found a positive increase in the number of stressful life events from light drinkers to problem drinkers to alcoholics, among both men and women (King

et al., 2003). However, a 60-day diary study of the same individuals reported that consumption was higher on high-stress days than on low-stress days, but only among men with stronger positive expectancies or a greater sense of carelessness related to drinking (Armeli *et al.*, 2000). In an aggregate-level study that compared stressful life events with alcohol-related deaths and per capita consumption at the state level, 19 of the 20 correlations were positive, and most were significant, especially after adjusting for potential confounders (Linsky *et al.*, 1985).

Other studies have examined various domains of stressful events, the effects of which have often differed for men and women. In a study of more than 16 000 military personnel, work stress was positively associated with heavy alcohol in the past month among men, whereas the effect of family stress was not significant. Neither work nor family stress was a significant predictor of heavy drinking for women, although the estimated odds ratios were comparable in magnitude with those for men (Bray *et al.*, 1999). A one-year follow-up study of 515 men and women who sought treatment for alcohol problems reported that acute life events at baseline (T1) were not associated with drinking at follow-up (T2) for either men or women, after adjusting for chronic stressors and functioning at T1. Among chronic sources of stress, problems with friends at T1 were positively associated with the volume of consumption and frequency of intoxication at T2 for women, but not for men (Skaff *et al.*, 1999). On the basis of data from four waves of the Health and Retirement Study, Perreira and Sloan (2001) reported that an increase over time (Wave 1–Wave 4) in usual daily consumption was positively associated with retirement and divorce. Widowhood was also positively associated with increased consumption, but only among men.

In a representative general population sample of 2802 Dutch adults 15–74 years of age, heavy drinking was positively associated with any vs no negative life events, as well as

*Author to whom correspondence should be addressed at: NIAAA/LEB Room 3083, 5635 Fishers Lane MSC 9304, Bethesda, MD 20892-9304, USA. Tel.: +1 301 435 2255; Fax: +1 301 443 1400; E-mail: ddawson@mail.nih.gov

METHODS

specifically with crime victimization, decreased financial position, and divorce/breakup. However, all of these associations were significant only for men. In addition to acute stress, this study examined chronic stress and found a positive association between marital disruption and heavy drinking for both men and women, and a positive association between unemployment and heavy drinking for men only (San Jose *et al.*, 2000). Hussong (2003) found that gender differences in the relationship of alcohol involvement and various types of stress were modified by support seeking and coping mechanisms. Given a limited active coping style, men showed a stronger association than women between heavy drinking and social adjustment and school problems but a weaker association between heavy drinking and relationship stress. However, the effect of relationship stress was stronger for men among individuals with a limited support seeking style. In the 60-day diary study described previously, consumption was positively associated with negative non-work (i.e. social/interpersonal) events but negatively associated with both positive and negative health events, before and after adjusting for perceived level of stress (Carney *et al.*, 2000), with no gender differences reported.

Many of the studies already conducted of the association between stress and drinking are strong in terms of theoretical grounding and study design. However, apart from the Dutch study cited previously (San Jose *et al.*, 2000), no study to date has examined the relationship of stress and alcohol consumption in a representative, general population sample of adults. Data from the 2001–2002 National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) provide the opportunity to study this relationship in a US sample that is large enough to evaluate both gender differences and the moderating effects of economic and psychological vulnerability. In addition, the detailed consumption data contained in the NESARC permit comparison of the effects of life stress on various aspects of drinking pattern. This is an important advantage, as an impact of stress on risky patterns of drinking has far greater public health significance than an impact on non-risk drinking.

Accordingly, this study examined the effects of past-year acute stress, both on a continuous scale of negative life events and within the four dichotomous categories representing different types of stress, on volume of intake, drinking frequency (overall, heavy and moderate), and drinking quantity (usual and largest). It also examines the extent to which these associations are modified by gender, economic vulnerability, and psychological vulnerability. The following specific hypotheses were tested:

- (i) As per the general finding of the literature, measures of heavy drinking will show greater responsiveness to stress than measures of any drinking.
- (ii) With respect to at least the outcomes reflecting heavy drinking, men will show greater response to stress than women, as women face greater stigmatization of heavy drinking. Women may compensate by showing greater stress responsiveness for outcomes reflecting overall frequency of drinking.
- (iii) Individuals with economic or psychosocial vulnerabilities will be more responsive to stress than those without such vulnerabilities, because of fewer alternative resources for coping with stress.

Sample

This analysis is based on data from the 2001–2002 National Epidemiologic Survey on Alcohol and Related Condition (NESARC), designed and sponsored by the National Institute on Alcohol Abuse and Alcoholism. Fieldwork for the NESARC was conducted by the US Bureau of the Census. Data were collected in face-to-face computer-assisted personal interviews conducted in the homes of the respondents. The NESARC sample (Grant *et al.*, 2003a) represents the civilian, non-institutionalized adult population of USA, including the District of Columbia, Alaska, and Hawaii, and included persons living in households, military personnel living off base, and persons residing in selected group quarters. The NESARC oversampled African Americans, Hispanics and adults 18–24 years of age. One sample adult, 18 years or older, was selected for interview in each household. The overall response rate was 81% ($N = 43\,093$). All potential NESARC respondents were informed in writing about the nature of the survey, the statistical uses of the survey data, the voluntary aspect of their participation, and the Federal laws that rigorously provide for the confidentiality of identifiable survey information. Those respondents consenting to participate after receiving this information were interviewed. The research protocol, including informed consent procedures, received full ethical review and approval from the US Census Bureau and the US Office of Management and Budget. This analysis is based on 26 946 past-year drinkers, individuals who reported having at least one alcoholic drink in the 12 months preceding interview.

Measures

Stress. Respondents were asked whether they had experienced 12 different types of stressful life events in the 12 months preceding interview. Factor analysis indicated that these events were represented by four categories (data not shown):

- (i) health-related stress (death of someone close, serious illness of self or someone close, $\alpha = 0.54$);
- (ii) social stress (change in living situation, trouble with boss/co-worker, change of job responsibilities, separation/divorce/breakup, problems with neighbor/friend/relative, $\alpha = 0.47$);
- (iii) job stress (job loss, sustained unemployment, $\alpha = 0.65$); and
- (iv) legal stress (major financial crisis, own or family member's trouble with police/arrest, criminal victimization of self or family member, $\alpha = 0.37$).

In addition to dichotomous measures of whether each of these four types of stress was experienced, a continuous measure of stress was created based on the number of stressful life events reported.

Economic vulnerability. Economic vulnerability was represented by having a family income below the poverty line, using the official poverty level standards established by the Bureau of the Census. The poverty line varied as a function of the number and ages of related individuals in the household, from a low income of \$8494 for a household containing a single adult 65 years or older to a high income of \$39 413 for

a household containing nine or more related members including only one child younger than 18 years of age.

Psychological vulnerability. Psychological vulnerability was defined as having a past-year mood or anxiety disorder: major depression, dysthymia, mania, hypomania, panic disorder, social phobia, specific phobia, or generalized anxiety. In order to be classified with a mood or anxiety disorder, respondents had to satisfy the requisite number of DSM-IV (American Psychiatric Association, 1994) criteria for at least one such disorder during the 12 months preceding interview, accompanied by social and/or occupational dysfunction. Major depression excluded cases owing to bereavement, and *all* mood and anxiety disorders excluded cases exclusively associated with physical illness, alcohol use, or drug use. The test–retest reliability of the past-year mood and anxiety disorders was fair (Grant *et al.*, 2003b), and their validity was demonstrated by the fact that each disorder except for hypomania was associated with significant ($P < 0.001$) increases in disability and social and occupational dysfunctions (Grant *et al.*, 2004).

Alcohol consumption. All alcohol measures reflect past-year consumption, i.e. intake in the 12 months preceding the NESARC interview. The volume of intake was based on data summed across separate series of questions for coolers, beer, wine, and distilled spirits. For each beverage, the volume was estimated on the basis of overall frequency of drinking, usual and largest quantities consumed, frequency of consuming the largest quantity, frequency of consuming 5+ drinks, usual drink size, and ethanol content by volume of the brand usually consumed (NIAAA, 2004). All remaining consumption measures were based on a series of questions for all beverages combined. Overall frequency of drinking, usual quantity of drinks and largest quantity of drinks were asked directly. Frequency of heavy drinking reflects the frequency (days per year) of drinking 5+ drinks of any type for men and the frequency of drinking 4+ drinks of any type for women. Frequency of moderate drinking represents the difference between overall frequency of drinking and frequency of heavy drinking. Frequency responses were transformed into days per year using midpoints of response categories, e.g. 3–4 times a week = 182 days per year. The test–retest reliability of the alcohol measures varied from good to excellent, from $\kappa = 0.69$ for frequency of drinking 5+ drinks to $\kappa = 0.84$ for the largest quantity of drinks consumed (Grant *et al.*, 2003b).

Analysis

All of the statistics used in this analysis were generated by SUDAAN (Research Triangle Institute, 2002), a software package that uses Taylor series linearization to adjust variance estimates for complex multistage sample designs. Multiple linear regression models were used to estimate the association between the number and the types of past-year stressors and various drinking measures, controlling for age, gender, race/ethnicity, marital status, education, poverty status, and the presence of past-year mood/anxiety disorders. These models also tested for significant interactions between stress and (i) gender, (ii) poverty, and (iii) mood/anxiety disorders.

Preliminary model fitting revealed that the best fit was obtained by applying a natural log transformation to all of the outcome measures of alcohol consumption. Thus, the beta

coefficient for each predictor variable, when exponentiated, indicates the multiplicative (rather than additive) effect of a 1-unit increase in that variable on the consumption measure in question.

RESULTS

Past-year drinkers reported an average of 1.79 stressful events in the 12 months preceding interview (Table 1). The distribution was strongly right skewed, with 27.5% reporting no stressors and only 4.2% reporting 6 or more of the 12 stressful life events that were asked about. Health-related stress was the most commonly reported (48.3%), followed by social stress (43.9%), legal stress (20.5%), and job-related stress (12.7%). Women reported slightly more stressors than men (1.89 vs 1.71), but the differences were far greater with respect to measures of vulnerability. Individuals with family incomes below the poverty level reported an average of 2.51 stressors, compared with 1.71 for those with non-poverty incomes, and individuals with a mood or anxiety disorder reported almost twice as many stressful events as persons without such a disorder (2.74 vs 1.59).

As shown in Table 2, number of past-year stressors was positively associated with all measures of alcohol consumption except for overall frequency of drinking (no association) and frequency of moderate drinking (negative association). Drinkers who experienced six or more stressful events had an average daily volume of ethanol intake and a frequency of heavy drinking that were more than thrice than those of drinkers with no stressful events, and their usual and largest quantities of drinks consumed were about twice as high. In contrast, they experienced only about half as many moderate drinking days.

Having experienced health-related stress was not associated with any of the consumption measures at the bivariate level, but social, legal, and job-related stress were significantly associated with all consumption measures except overall frequency of drinking. As with the number of stressors, the associations with frequency of moderate drinking were negative, whereas the associations with other consumption measures were positive.

Table 3 presents the multivariate models estimating the association between the number of past-year stressors and consumption. As can be seen from the top panel of the table, the main effect of number of stressors was significant and positive for all outcomes except frequency of moderate drinking, for which it was significant and negative. As would be expected, the main effect of male gender was consistently positive. The main effects of economic and psychological vulnerability varied according to outcome and were often non-significant. There was a significant interaction between male gender and stress level for all outcomes except overall frequency of drinking. For outcomes where the main effect of stress was positive, male gender intensified this positive effect; for the outcome where the main effect of stress was negative, male gender intensified the negative effect.

The bottom panel of Table 3 shows the multiplicative effect of number of stressors on the various measures of past-year alcohol consumption. With each additional stressor reported, average daily ethanol intake increased by 14% (a factor of

Table 1. Number and type of past-year stressors reported by past-year drinkers ≥ 18 years of age, by gender, poverty status and whether experienced any past-year DSM-IV mood or anxiety disorders: USA, 2001–2002

	Gender			Poverty status		Any past-year DSM-IV mood or anxiety disorder?	
	All adults (<i>n</i> = 26 946)	Male (<i>n</i> = 13 067)	Female (<i>n</i> = 13 879)	Poor (<i>n</i> = 3406)	Not poor (<i>n</i> = 23 540)	Yes (<i>n</i> = 4996)	No (<i>n</i> = 21 950)
Percentage distribution by number of past-year stressors							
None	27.5 (0.5)	29.8 (0.7)	24.9 (0.5)	19.2 (1.1)	28.5 (0.5)	13.1 (0.6)	30.6 (0.6)
1	24.0 (0.3)	23.9 (0.5)	24.0 (0.5)	20.2 (1.0)	24.4 (0.3)	18.7 (0.7)	25.1 (0.4)
2	21.2 (0.3)	20.3 (0.4)	22.1 (0.4)	18.5 (0.8)	21.5 (0.3)	20.9 (0.7)	21.2 (0.4)
3–5	23.2 (0.4)	22.2 (0.5)	24.3 (0.5)	32.0 (1.1)	22.0 (0.4)	36.4 (0.9)	20.3 (0.4)
≥ 6	4.2 (0.2)	3.8 (0.2)	4.7 (0.2)	10.1 (0.7)	3.5 (0.2)	11.0 (0.6)	2.7 (0.2)
Mean number of past-year stressors	1.79 (0.02)	1.71 (0.02)	1.89 (0.03) ^a	2.51 (0.06)	1.71 (0.02) ^b	2.74 (0.04)	1.59 (0.02) ^c
Percentage reporting various types of stressors							
Health-related	48.3 (0.5)	45.1 (0.6)	51.8 (0.5) ^a	50.0 (1.3)	48.1 (0.5)	57.4 (0.9)	46.3 (0.5) ^c
Social	43.9 (0.6)	42.2 (0.7)	45.8 (0.7) ^a	55.8 (1.5)	42.4 (0.6) ^b	64.4 (0.9)	39.5 (0.6) ^c
Legal	20.5 (0.5)	19.8 (0.5)	21.3 (0.6)	33.5 (1.1)	18.8 (0.5) ^b	19.7 (0.7)	11.2 (0.3) ^c
Job-related	12.7 (0.3)	13.8 (0.4)	11.5 (0.4) ^a	28.1 (1.0)	10.7 (0.3) ^b	37.3 (0.9)	16.8 (0.4) ^c

Figures in parentheses are standard errors of estimates.

^aEstimate is significantly different ($P < 0.001$) than that for males.

^bEstimate is significantly different ($P < 0.001$) than that for individuals who were poor.

^cEstimate is significantly different ($P < 0.001$) than that for individuals with mood or anxiety disorders.

Table 2. Mean values for selected measures of past-year alcohol consumption, according to the number and the type of past-year stressors reported by past-year drinkers ≥ 18 years of age: USA, 2001–2002

	No. of Cases	Average daily ethanol intake		Overall frequency of drinking		Frequency of heavy drinking		Frequency of moderate drinking		Usual quantity of drinks consumed		Largest quantity of drinks consumed	
		Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Number of past-year stressors													
None	7389	0.49	(0.02)	85.6	(1.8)	16.8	(0.9)	68.5	(1.7)	2.2	(<0.1)	3.6	(0.1)
1	6380	0.56	(0.04)	82.7	(1.9)	18.7	(1.0)	63.8	(1.7)	2.4	(<0.1)	4.1	(0.1)
2	5697	0.57	(0.03)	81.9	(1.8)	19.7	(1.0)	62.1	(1.7)	2.4	(<0.1)	4.3	(0.1)
3–5	6261	0.85	(0.03)	82.0	(1.6)	31.7	(1.2)	50.3	(1.4)	3.0	(<0.1)	5.6	(0.1)
≥ 6	1219	1.71	(0.17) ^a	90.6	(4.0)	53.1	(3.5) ^a	37.4	(2.3) ^a	4.2	(0.1) ^a	7.8	(0.3) ^a
Any health-related stress													
Yes	13 099	0.68	(0.02)	84.0	(1.4)	23.4	(0.8)	60.5	(1.3)	2.6	(<0.1)	4.5	(0.1)
No	13 847	0.64	(0.02)	83.0	(1.3)	22.4	(0.8)	60.4	(1.2)	2.6	(<0.1)	4.5	(0.1)
Any social stress													
Yes	11 655	0.81	(0.03)	80.2	(1.2)	29.2	(0.9)	50.9	(1.1)	2.9	(<0.1)	5.5	(0.1)
No	15 281	0.55	(0.02) ^b	86.1	(1.5)	17.9	(0.7) ^b	67.9	(1.4) ^b	2.3	(<0.1) ^b	3.7	(0.1) ^b
Any legal stress													
Yes	5854	1.08	(0.07) ^c	84.6	(1.7)	36.8	(1.5)	47.6	(1.4)	3.3	(0.1)	5.9	(0.1)
No	21 092	0.55	(0.01) ^c	83.2	(1.2)	19.2	(0.6) ^c	63.8	(1.1) ^c	2.4	(<0.1) ^c	4.1	(0.1) ^c
Any job-related stress													
Yes	3523	1.22	(0.08)	84.7	(2.5)	41.7	(2.0)	42.9	(1.7)	3.5	(0.1)	6.4	(0.2)
No	23 423	0.58	(0.02) ^d	83.3	(1.1)	20.1	(0.6) ^d	63.0	(1.1) ^d	2.4	(<0.1) ^d	4.2	(<0.1) ^d

Figures in parentheses are standard errors of means.

^aEstimate shows significant ($P < 0.001$) variation over the number of stressors.

^bEstimate is significantly different ($P < 0.001$) than estimate for persons with any social stress.

^cEstimate is significantly different ($P < 0.001$) than estimate for persons with any legal stress.

^dEstimate is significantly different ($P < 0.001$) than estimate for persons with any job-related stress.

Table 3. Stress, gender, and vulnerability parameters from multiple linear regression models predicting selected measures of past-year drinking volume and pattern using number of past-year stressors: USA, 2001–2002

	Average ounces ethanol/day		Overall frequency of drinking		Frequency of heavy drinking		Frequency of moderate drinking		Usual quantity of drinks consumed		Largest quantity of drinks consumed	
	Beta	(SE)	Beta	(SE)	Beta	(SE)	Beta	(SE)	Beta	(SE)	Beta	(SE)
Model parameters												
Main effects												
Male gender	1.174	(0.042)	0.000	(0.025)	0.837	(0.053)	0.000	(0.045)	0.334	(0.012)	0.481	(0.016)
Poor	0.092	(0.051)	0.501	(0.039)	0.083	(0.073)	0.259	(0.060)	0.065	(0.016)	0.019	(0.020)
Mood/anxiety disorder	0.035	(0.041)	0.246	(0.031)	0.180	(0.054)	0.002	(0.046)	0.042	(0.013)	0.058	(0.015)
Number of stressors	0.081	(0.012)	0.000	(0.008)	0.121	(0.015)	0.000	(0.013)	0.033	(0.004)	0.048	(0.005)
Interactions												
Male × number of stressors	0.049	(0.017)	0.006	—	0.095	(0.023)	0.000	(0.021)	0.014	(0.006)	0.027	(0.007)
Multiplicative effect of each additional stressor on outcome (95% CI)												
Males	1.14	(1.10–1.18)	1.05	(1.03–1.06)	1.24	(1.20–1.29)	0.90	(0.87–0.93)	1.04	(1.03–1.05)	1.08	(1.07–1.09)
Females	1.08	(1.05–1.11)	1.05	(1.03–1.06)	1.13	(1.10–1.16)	0.95	(0.93–0.98)	1.03	(1.03–1.04)	1.05	(1.04–1.06)

NS, not significant.

All parameters are from models that also adjusted for age, race/ethnicity, marital status, and education. Outcome measures were transformed using a natural log scale, but multiplicative effects presented above are on unlogged consumption measures.

1.14) for men and by 8% (a factor of 1.08) for women. The association with frequency of heavy drinking was even stronger. The number of heavy drinking days increased by 24% for men and 13% for women with each additional stressor that was experienced. Positive effects of smaller magnitude were apparent for overall frequency of drinking, and usual and largest quantities of drinks consumed. In contrast, the number of moderate drinking days was reduced by 10% for men and by 5% for women by each additional stressor experienced.

Table 4 presents the multivariate models that assessed associations between specific types of stress and different measures of alcohol consumption. In general, the effects of specific types of stress mirrored the effect of the number of stressors, having the greatest impact on the frequency of heavy drinking and the volume of intake, followed by the largest quantity of drinks consumed, and a negative effect on the frequency of moderate drinking. However, there were exceptions to this rule, and effect modifiers varied according to the type of stress and outcome:

- Health-related stress was not significantly associated with either overall frequency of drinking or volume of intake. Health-related stress decreased the number of moderate drinking days by 28% among poor drinkers, but had no effect on this outcome among those whose incomes were above the poverty line.
- Social stress increased all measures of past-year alcohol consumption, even frequency of moderate drinking (the latter among women only). Male gender intensified the effect of social stress on both frequency of heavy drinking and largest quantity of drinks.
- Legal stress increased the volume of intake and the overall frequency of drinking among men only, and its effect was larger among men for the frequency of heavy drinking and the usual quantity of drinks. The frequency of moderate drinking was decreased by legal stress, but only among drinkers who were not poor.
- Job-related stress increased the volume of intake and the overall frequency of drinking among poor drinkers only.

DISCUSSION

This study found a consistent positive relationship between level of past-year stress and various measures of heavy drinking. Drinking quantity was no more responsive to stress than overall drinking frequency; however, consistent with our initial hypothesis, frequency of heavy drinking showed the strongest positive association with stress. The 13% to 24% increase in the number of heavy-drinking days associated with each additional stressful life event has significant public health implications in the light of risk curve analyses showing strong and rapid increases in the risks of alcohol use disorders (Dawson *et al.*, 2005), accidental injuries (Cherpitel *et al.*, 1995), deaths from external causes (Dawson, 2001), and assorted social and legal outcomes (Ramstedt, 2002) as the frequency of heavy drinking rises, especially at lower levels of frequency. Partially offsetting the increase in heavy drinking, this study found that the frequency of moderate drinking decreased as stress levels increased, suggesting that stress

Table 4. Stress, gender, and vulnerability parameters from multiple linear regression models predicting selected measures of past-year drinking volume and pattern: USA, 2001–2002

	Average ounces ethanol/day			Overall frequency of drinking			Frequency of heavy drinking			Frequency of moderate drinking			Usual quantity of drinks consumed			Largest quantity of drinks consumed		
	Beta	(SE)	<i>P</i>	Beta	(SE)	<i>P</i>	Beta	(SE)	<i>P</i>	Beta	(SE)	<i>P</i>	Beta	(SE)	<i>P</i>	Beta	(SE)	<i>P</i>
Model parameters																		
Main effects:																		
Male gender	1.190	(0.035)	0.000	0.750	(0.027)	0.000	0.833	(0.050)	0.000	0.265	(0.042)	0.000	0.341	(0.010)	0.000	0.484	(0.015)	0.000
Poor	−0.005	(0.059)	0.934	−0.029	(0.044)	0.509	0.090	(0.073)	0.222	−0.173	(0.098)	0.083	0.063	(0.011)	0.000	0.022	(0.020)	0.267
Mood/anxiety disorder	0.049	(0.041)	0.145	−0.025	(0.031)	0.433	0.191	(0.053)	0.001	−0.178	(0.046)	0.000	0.045	(0.013)	0.001	0.061	(0.015)	0.000
Health-related stress	0.041	(0.028)	0.145	0.018	(0.024)	0.448	0.111	(0.040)	0.007	−0.017	(0.037)	0.649	0.021	(0.009)	0.029	0.043	(0.012)	0.000
Social stress:	0.178	(0.040)	0.000	0.091	(0.031)	0.004	0.198	(0.051)	0.000	0.115	(0.046)	0.015	0.041	(0.012)	0.001	0.075	(0.016)	0.000
Legal stress:	0.069	(0.054)	0.202	−0.020	(0.041)	0.625	0.253	(0.063)	0.000	−0.339	(0.053)	0.000	0.089	(0.015)	0.000	0.129	(0.015)	0.000
Job-related stress:	0.090	(0.058)	0.128	−0.009	(0.045)	0.838	0.147	(0.072)	0.046	−0.228	(0.063)	0.001	0.063	(0.018)	0.001	0.058	(0.021)	0.007
Interactions:																		
Health stress × poor	—	—	NS	—	—	NS	—	—	NS	−0.318	(0.120)	0.010	—	—	NS	—	—	NS
Social stress × male	—	—	NS	—	—	NS	0.238	(0.077)	0.003	−0.229	(0.066)	0.001	—	—	NS	0.095	(0.022)	0.000
Legal stress × male	0.311	(0.075)	0.000	0.194	(0.056)	0.001	0.311	(0.105)	0.004	—	—	NS	0.054	(0.024)	0.031	—	—	NS
Legal stress × poor	—	—	NS	—	—	NS	—	—	NS	0.422	(0.143)	0.004	—	—	NS	—	—	NS
Job stress × poor	0.383	(0.124)	0.003	0.244	(0.090)	0.008	—	—	NS	—	—	NS	—	—	NS	—	—	NS
Multiplicative effect of each type of stressor on outcome (95% CI):																		
Health stress (poor)	1.04	(0.99–1.10)		1.02	(0.97–1.07)		1.12	(1.03–1.21)		0.72	(0.58–0.90)		1.02	(1.00–1.04)		1.04	(1.02–1.07)	
Health stress (not poor)	1.04	(0.99–1.10)		1.02	(0.97–1.07)		1.12	(1.03–1.21)		0.98	(0.91–1.06)		1.02	(1.00–1.04)		1.04	(1.02–1.07)	
Social stress (male)	1.19	(1.10–1.29)		1.10	(1.03–1.16)		1.55	(1.36–1.76)		0.89	(0.80–1.00)		1.04	(1.02–1.07)		1.19	(1.13–1.23)	
Social stress (female)	1.19	(1.10–1.29)		1.10	(1.03–1.16)		1.22	(1.10–1.35)		1.12	(1.03–1.23)		1.04	(1.02–1.07)		1.08	(1.04–1.11)	
Legal stress (male)	1.46	(1.30–1.64)		1.19	(1.09–1.30)		1.76	(1.49–2.09)		—	—		1.15	(1.11–1.20)		1.14	(1.10–1.17)	
Legal stress (female)	1.07	(0.96–1.19)		0.98	(0.90–1.06)		1.29	(1.14–1.46)		—	—		1.09	(1.06–1.13)		1.14	(1.10–1.17)	
Legal stress (poor)	—	—		—	—		—	—		1.09	(0.83–1.43)		—	—		—	—	
Legal stress (not poor)	—	—		—	—		—	—		0.71	(0.64–0.79)		—	—		—	—	
Job stress (poor)	1.60	(1.29–1.99)		1.26	(1.08–1.48)		1.16	(1.01–1.33)		0.80	(0.70–0.90)		1.06	(1.03–1.10)		1.06	(1.02–1.10)	
Job stress (not poor)	1.09	(0.98–1.23)		0.99	(0.91–1.08)		1.16	(1.01–1.33)		0.80	(0.70–0.90)		1.06	(1.03–1.10)		1.06	(1.02–1.10)	

NS, not significant.

All parameters are from models that also adjusted for age, race/ethnicity, marital status and education. Outcome measures were transformed using a natural log scale, but multiplicative effects presented above are on unlogged consumption measures.

does not so much lead individuals to drink more often as to substitute larger quantities of alcohol on the days when they do drink.

Job-related and legal sources of stress were more strongly associated with alcohol consumption than were social and health-related stress. They also were less commonly experienced by US drinkers and arguably represent more serious problems (e.g. job loss, arrest, major financial problems) than most of the items subsumed under social and health-related stressors. Thus, the stronger impact of job and legal stress would be consistent with the tension reduction hypothesis, in that they could be expected to result in greater tension—requiring a greater increase in drinking for tension alleviation—than other types of stress. Consistent with their being less often reported than other types of stress, individuals who experienced legal and job-related stress reported a larger number of stressors than those who did not experience these types of stress (data not shown). To rule out the possibility that the differential impact of job and legal stress was no more than an indirect effect of overall stress level, the models that examined individual types of stressors were rerun to include number of stressors. Even with overall stress level controlled, job and legal stress continued to be more strongly associated with consumption than health or social stress (data not shown).

Although the associations between overall stress level and consumption generally were of greater magnitude for men than women, they were almost always statistically significant for both. The same was generally true for individual types of stress, although the effects of legal and job-related stress were male limited for some outcomes. Taken as a whole, these findings are not out of line with prior studies, in which smaller sample sizes often may have made it impossible to establish the statistical significance of the reduced effects observed among female drinkers, and they are consistent with our hypothesis that stronger stigmatization of heavy drinking among women would reduce their drinking response to stress. However, there was no evidence to support the hypothesis that women might compensate by increasing their frequency of drinking to a greater extent than men in response to stress.

With respect to the hypothesis that individuals with economic or psychological vulnerability would increase their drinking more in response to stress than less vulnerable individuals, this study's results were mixed. There was some evidence that poverty intensified the effects of job stress, which makes good sense in that the level of tension provoked by job loss or unemployment might well be greater for persons with fewer financial resources. Psychological vulnerability did not modify any of the associations between stress and consumption. It is possible, though, that any potential mediating effect of psychological vulnerability might have been masked by a tendency on the part of individuals with mood or anxiety disorders to have a lower threshold for stress and therefore to report more stressful life events. Also, both the main effects of poverty and psychological vulnerability, as well as their interactions with stressful life events, might have been stronger had continuous rather than dichotomous measures of these aspects of vulnerability been used.

As with any cross-sectional survey data, the NESARC data cannot establish causality in the association between stress and alcohol consumption. Although this study treated stress

as the independent variable and alcohol consumption as the outcome, it is possible that the associations found in this analysis reflect an increase in negative life events as a result of drinking. In order to explore this possibility, we examined responses to two questions on problems caused by drinking—problems with family or friends and job- or school-related problems. (These questions were asked as part of a larger series of indicators used for classification of alcohol use disorders.) Of all the drinkers who reported past-year social problems, only 2.4% endorsed having had problems with family or friends as a result of their drinking. Similarly, only 2.3% of those who reported past-year job-related problems claimed to have had trouble at school or on the job because of their drinking (data not shown). Although the attribution of problems to drinking increased with level of consumption, it remained rare enough to suggest that the findings of this study do not largely reflect causes rather than effects of stress. However, lack of attribution to alcohol does not completely rule out the possibility that the problems did in fact result from excessive drinking. Data from the second wave of the NESARC, currently in the field, will permit reevaluation of the relationship between stress and drinking using a prospective study design. Still, the results of this study suggest that treatment and brief interventions aimed at problem drinkers—and indeed primary care visits for all drinkers reporting high levels of stress—might benefit from addressing the issue of tension alleviation and the building of alternative coping mechanisms.

REFERENCES

- American Psychiatric Association (1994) *Diagnostic and Statistical Manual of Mental Disorders*, 4th edn. American Psychiatric Association, Washington, D.C.
- Armeli, S., Carney, M. A., Tennen, H. *et al.* (2000) Stress and alcohol use: A daily process examination of the stressor-vulnerability model. *Journal of Personality and Social Psychology* **78**, 979–994.
- Aseltine, R. H. and Gore, S. L. (2000) Variable effects of stress on alcohol use from adolescence to early adulthood. *Substance Use and Misuse* **35**, 643–668.
- Bray, R. M., Fairbank, J. A. and Marsden, M. E. (1999) Stress and substance use among military women and men. *American Journal of Drug and Alcohol Abuse* **25**, 239–256.
- Carney, M. A., Armeli, S., Tennen, H. *et al.* (2000) Positive and negative daily events, perceived stress, and alcohol use: diary study. *Journal of Consulting and Clinical Psychology* **68**, 788–798.
- Cherpitel, C. J., Tam, T., Midanik, L. *et al.* (1995) Alcohol and non-fatal injury in the U.S. general population: a risk function analysis. *Accident Analysis and Prevention* **27**, 651–661.
- Cole, G., Tucker, L. and Griedman, G. M. (1990) Relationships among measures of alcohol drinking, behavior, life-events and perceived stress. *Psychological Reports* **67**, 587–591.
- Conger, J. J. (1956) Alcoholism: Theory, problem and challenge. II. Reinforcement theory and the dynamics of alcoholism. *Quarterly Journal of Studies on Alcohol* **17**, 296–305.
- Dawson, D. A. (2001) Alcohol and mortality from external causes. *Journal of Studies on Alcohol* **62**, 790–797.
- Dawson, D. A., Grant, B. F. and Li, T. K. (2005) Quantifying the risks associated with exceeding recommended drinking limits. *Alcoholism, Clinical and Experimental Research* **29**, 902–908.
- Grant, B. F., Moore, T. C. and Kaplan, K. (2003a) *Source and accuracy statement: wave 1 National Epidemiologic Survey on Alcohol and Related Conditions (NESARC)*. National Institute on Alcohol Abuse and Alcoholism, Bethesda MD.
- Grant, B. F., Dawson, D. A., Stinson, F. S. *et al.* (2003b) The Alcohol Use Disorder and Associated Disabilities Schedule (AUDADIS): reliability

- of alcohol and drug modules in a general population sample. *Drug and Alcohol Dependence* **39**, 7–16.
- Grant, B. F., Stinson, F. S., Hasin, D. S. *et al.* (2004) Prevalence and comorbidity of substance use disorders and independent mood and anxiety disorders: results from the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC). *Archives of General Psychiatry* **61**, 807–816.
- Greeley, J. and Oei, T. (1999) Alcohol and tension reduction. In: *Psychological Theories of Drinking and Alcoholism: Second Edition*, Leonard, K. E. and Blane, H. T., eds., pp. 14–53, Guilford Press, New York.
- Hussong, A. M. (2003) Further refining the stress-coping model of alcohol involvement. *Addictive Behaviors* **28**, 1515–1522.
- King, A. C., Bernardy, N. C. and Hauner, K. (2003) Stressful events, personality, and mood disturbance: gender differences in alcoholics and problem drinkers. *Addictive Behaviors* **28**, 171–187.
- Linsky, A. S., Straus, M. A. and Colby, J.P. Jr. (1985) Stressful events, stressful conditions and alcohol problems in the United States: a partial test of Bales's theory. *Journal of Studies on Alcohol* **46**, 72–80.
- National Institute on Alcohol Abuse and Alcoholism (2004) Data Notes on Alcohol Consumption Variables (Section 2A). Available at <http://niaaa.census.gov/pdfs/datanotes.pdf>
- Perreira, K. M. and Sloan, F. A. (2001) Life events and alcohol consumption among mature adults: a longitudinal analysis. *Journal of Studies on Alcohol* **62**, 501–508.
- Ramstedt, M. (2002) Alcohol consumption and the experience of adverse consequences: a comparison of six European countries. *Contemporary Drug Problems* **29**, 549–575.
- Research Triangle Institute (2002) *SUDAAN User's Manual*, Release 8.0. Research Triangle Institute, Research Triangle Park, NC.
- Rutledge, P. C. and Sher, K. J. (2001) Heavy drinking from freshman year into early young adulthood: the roles of stress, tension-reduction drinking motives, gender and personality. *Journal of Studies on Alcohol* **62**, 457–466.
- San Jose, B., van Oers, H. A. M., van de Mheen, H. D. *et al.* (2000) Stressors and alcohol consumption. *Alcohol and Alcoholism* **35**, 307–312.
- Skaff, M. M., Finney, J. W. and Moos, R. H. (1999) Gender differences in problem drinking and depression: different vulnerabilities? *American Journal of Community Psychology* **27**, 25–54.