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THE COLLABORATIVE ALCOHOL-RELATED LONGITUDINAL PROJECT

A meta-analysis of depressive symptomatology and alcohol consumption over time*

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Abstract

Meta-analysis (eight general population longitudinal studies) describes the relationships (regressions) between quantity per occasion and depressive symptomatology over time. Quantity and depression are the strongest and most consistent predictors of final levels of themselves in all data sets. Age significantly and consistently predicts quantity for both sexes combined (the general pattern is replicated among males only). Depression significantly predicts quantity and quantity significantly predicts depression for females. Controlling for interval between measurements produces stronger prediction (more consistent over shorter intervals) for males. Depression only predicts quantity over longer intervals and quantity only predicts depression over shorter intervals for females. Explicit control for age found stronger relationships between initial and final measurement quantity, and depression for males. Quantity and depression significantly predict quantity and depression among young females. The relationship between quantity and depression among females illustrates the importance of controlling for age and sex. Methodological considerations are discussed.

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Introduction

Using meta-analysis, this paper describes the relationship between alcohol consumption per typical occasion and depressive symptomatology in several longitudinal studies from the US, Canada and Great Britain. We were primarily interested in whether or not the co-occurrence of heavy drinking and depressive symptoms in clinical populations is consistently present in the general population. Furthermore, since the constituent studies in the meta-analysis all employed a longitudinal design, this enabled us to investigate whether alcohol consumption at earlier time points predicts depression at later time points, and vice-versa. The meta-analytic technique measures the degree of similarity in relationships between alcohol consumption and depression across different research studies.

What is depression?

The term 'depression' is used to describe a wide range of emotional states, from normal to psychopathological. In this paper, we focus on depressive symptoms, rather than depressive disorder, *per se*, because our data base comprises large survey data sets that commonly measure only symptomatology. Newmann (1989) outlines two major approaches to the measurement of depression in epidemiological research—the *psychometric* approach and the *clinical diagnostic* approach. The psychometric approach uses standard screening scales to score the presence or absence of components of depressive syndrome during a fixed time period. These components scores are summed together, and it is assumed that the magnitude of the summed scale score matches the intensity of the depressive symptomatology that is being measured. Clinical diagnostic assessments also test for the presence or absence of various components of a depressive syndrome during a fixed time period, but in the clinical view, depression is either completely present or absent, and does not vary in magnitude.

We have interpreted the instruments and scales in the present meta-analysis as though they were developed in the psychometric school. Most scales used in these studies include items designed to detect the following symptoms of a major depressive disorder:

(1) poor appetite or significant weight loss, or increased appetite or significant weight gain;
(2) insomnia or hypersomnia;
(3) psychomotor agitation or retardation;
(4) loss of interest or pleasure in usual activities;
(5) loss of energy, fatigue;
(6) feelings of worthlessness, self-reproach, or excessive or inappropriate guilt;
(7) diminished ability to concentrate;
(8) suicidal thoughts, intentions, or attempts (Nolen-Hoeksema, 1988).

No attempt is made to determine if clinical depression is present in a particular respondent. Our working assumption is that the presence of depressed mood is directly proportional to the number of 'symptoms' present in a particular respondent, and that depressed mood can be inferred from a person's questionnaire responses. For present purposes, we will use the terms 'depression' and 'depressive symptomatology' interchangeably, although it is important to note that they do not mean the same thing.

Theories about depression

Biological theories (Klerman, 1987a) cite many adaptive functions of depressed mood, particularly as a natural reaction to separation and loss. Animals and human infants alike use depressed mood to communicate a need for nurturance or protection. Psychological theories, such as Seligman's learned helplessness theory (1975), posit that when a person (or an animal) perceives that he or she lacks control over environmental events, hopelessness and depression result. Attributional theories of depression (Abramson *et al.*, 1978; Miller & Norman, 1979) assume that helplessness results from uncontrollable events, but propose 'locus-of-control' (varying from 'internal' to 'external') as an additional dimension of depression. Events perceived as more internally caused are predicted to result in lower self-esteem than are events with perceived external causes. Abramson *et al.* (1989) refined their helplessness theory, proposing a new theoretically-based subtype of depression called 'hopelessness depression'. An important tenet of this theory is the introduction of hopelessness as a proximal sufficient cause of the symptoms of hopelessness depression. All of these psychological theories focus on the notion of depression as a reaction to feelings of hopelessness and helplessness.

What is the relationship between alcohol use and depression?

Alcohol use is often mentioned in medical discus-

sions of depression because depressive symptoms occur quite naturally as by-products of alcohol and drug abuse. In fact, much of what we 'know' about alcohol and depression applies to heavy drinkers. For example, 'it is known that about 40% of alcohol-dependent individuals will experience a clinical depression within a year or two following delirium tremens or other withdrawal reactions' (Klerman, 1987b, p. 25). Several studies have reported that alcoholics experience increased dysphoria and anxiety as a result of alcohol consumption (Mendelson, 1974; Nathan & Lisman, 1976; Freed, 1978). A recent study by Brown & Shuckit (1988) indicates that 42% of male patients entering a treatment program for alcoholism display depressive symptoms comparable in severity to those of patients hospitalized for depression, but that these symptoms declined dramatically throughout the 4-week course of treatment.

Results from studies of the alcohol-dependent, including those mentioned above, suggest that drastic changes in alcohol consumption (e.g. withdrawal) trigger depressive episodes. However, one of alcohol's more gratuitous effects is the production of subjective feelings of relaxation, and, not surprisingly, some drinkers use it to self-medicate for depressed mood (Segal *et al.*, 1980), or as a coping resource (Pearlin & Radabaugh, 1976). With reference to the psychological theories described in the previous section, one might deduce that people drink to alleviate feelings of helplessness; on the other hand, one could also argue that excessive drinking instigates feelings of helplessness in the drinker, causing him/her to feel depressed.

How do alcohol use and depression co-vary over time?

Little is known about the relationship between depressed mood and alcohol consumption over time. Previous research is inconclusive about whether feeling depressed makes people drink more, or whether drinking more makes people feel depressed. Robins *et al.* (1988) report cross-sectional results showing a modest degree of association between alcohol disorders and depression in the general population. Longitudinal studies of alcohol use and depressive symptomatology in general populations are rare (for exceptions, see Aneshensel & Huba, 1983; Wilsnack *et al.*, 1984), and there have been few attempts to systematically compare or synthesize research findings on this subject.

Because alcohol is so widely available in Western cultures, understanding the relationship between its use and depressed mood would be helpful for designing clinical treatment programs. Obviously, if depressed mood causes increases in alcohol consumption (and subsequent alcohol problems), then simply treating the alcohol abuse and ignoring concomitant depressive symptoms does not address the total clinical picture. On the other hand, if depressed mood is merely a symptom or result of alcohol abuse, then treating the alcohol problem should alleviate depressive symptoms.

Furthermore, study of the relationship of depressed mood and alcohol consumption may lend insight to the etiology of affective disorders, thought by some authors to be the 'special problems of women alcoholics' (Midanik, 1983, p. 10). Midanik's general population results support findings in the clinical literature of high co-occurrence of alcohol problems with depressive symptoms in females.

In one of the few examples in the literature on the topic of drinking and depression, Aneshensel & Huba (1983) used causal modeling techniques to study depression, alcohol use and smoking over one year. The researchers tested a large US general population community sample at four measurement points to study how alcohol use is related to changes in depressive symptomatology and, conversely, the extent to which depressive symptomatology is related to changes in alcohol use. They found that the best predictors of current depression measures were previous depression measures; and that the best predictor of current drinking measures were previous drinking measures. In the short term, alcohol use led to decreased levels of depression; but in the long term, it led to exacerbated levels of depression. Likewise, in the short-term, depression increased alcohol use, but in the long-term alcohol use decreased. This important study illustrates how critical it is to study trends in depression and alcohol use longitudinally rather than cross-sectionally, in order to accurately assess relationships between the two behaviors.

We acknowledge that a longitudinal analysis with only two measurement points does not allow one to make definitive statements about the causal sequence of events—more than two measurement points are necessary (Dwyer, 1983). Therefore, the results presented here represent a preliminary step in our meta-analysis plan. Later analyses will extract longitudinal studies from the archive con-

taining three or more measurement points for more detailed causal sequencing.

Other factors affecting depression

While the effects of drinking and depressed mood are important issues in their own right, we acknowledge that many other factors figure prominently in the etiology of depressed mood and alcohol consumption. Stabilizing factors, such as marriage or steady and gainful employment, may work to offset the effects of depressed mood. In addition, studies of rates of depression in women have highlighted the importance of demographic variables such as age, education, employment and income. These studies have also noted that psychosocial variables such as perceived life control, perceived accomplishment, identity, perceived social support and alienation correlate with depression in cross-sectional samples (Warren & McEachren, 1983; Goldman & Ravid, 1980; Radloff, 1980).

Two significant demographic variables involved in the description of depression, as well as alcohol use, are gender and age. Many studies have documented sex differences in reported depressive symptomatology, and there is general agreement that females are at higher risk for depression than males (Weissman & Klerman, 1977; Goldman & Ravid, 1980; Amenson & Lewinsohn, 1981; Midanik, 1983; Myers *et al.*, 1984; Caetano, 1987; Parker *et al.*, 1987; Weissman, 1987). Several studies have found that both younger men and women are at higher risk for most psychiatric disorders including depression (Goldman & Ravid, 1980; Myers *et al.*, 1984; Parker *et al.*, 1987; Weissman, 1987; Klerman & Weissman, 1989). Newmann (1989) re-analysed the results from 21 community surveys and found that age-graded patterns of results differed for assessments using a clinical diagnostic versus a psychometric approach. Briefly, data from samples surveyed using psychometric techniques found high depression scores for the young and the old, and decreased depression in middle adulthood. Rates of depression calculated from the clinical samples show that depression is highest among those in middle-adulthood, lowest for those in late-adulthood and in the middle for young adults.

Because of documented sex differences in rates of depression, and also because of the importance of age, we control for these two variables in the present analysis. The relative importance of psychosocial variables and other demographic factors beside sex and age are important questions for future analyses.

Methods

Eight longitudinal studies containing measures of depression and alcohol consumption per occasion are used in this meta-analysis (individual studies are described in Fillmore *et al.*, 1990a). Intervals between measurement points ranged from 2 to 10 years and ages surveyed ranged from late adolescence to late adulthood. Studies from three nations are represented: United States, Canada and Scotland. All studies were conducted during the 1970s and 1980s. Most of the studies measured depression and the quantity of alcohol consumed at two time points; however, some studies with missing information on either variable were included in portions of the meta-analysis to maximize the number included.

Two types of regression models were tested with the studies available:

(1) the quantity of alcohol consumed per occasion at the final measurement point was predicted from initial quantity and depression level;
(2) initial levels of quantity consumed per occasion and depression were used to predict depression at the final measurement point.

Age was included as a control variable, and all regressions were run separately by sex.

The eight studies used a variety of different measures for depression, as well as quantity of alcohol consumed per typical occasion. Using the raw data from each study, the quantity measure was recoded to a standard construct reflecting 'number of drinks per typical drinking occasion during the previous year'. The quantity consumed for abstainers was set to zero for all analyses. (Abstainers were defined as those consuming less than one drink during the previous twelve months.) Previous research has shown that quantity of alcohol consumed is more highly correlated with depressive symptomatology than is frequency of alcohol use (Parker *et al.*, 1987).

Efforts to standardize the depression measures proved challenging. Researchers used instruments ranging from a single question, e.g. 'do you often feel depressed?', to complete batteries of questions such as the depression subscale from the General Health Questionnaire. We decided to recode all items and scale scores so that higher scores signified greater depression, rather than reduce all depression measures to a single common question. These recoded items and summed scale were used in the

meta-analyses (see Friedman & Booth-Kewley, 1987, for more details on this approach).

Since base rates for clinical depression in the general population hover at about 10%, we were not surprised by the low rates of depressive symptoms that we obtained in these samples. We examined the distributions of depression scores and found skewed distributions in a few of the samples. Since skewdness does pose a problem for the regression analysis we analysed a subset of the data, conducting log-normal transformation of the consumption and depressive measures. Results of these transformed variables are reported below.

Meta-analysis is used to quantify the consistency of research findings using unstandardized regression coefficients as recommended by Greenland (1987). A detailed discussion of these procedures is presented in Johnstone *et al.* (1990).

The findings

(A) *The meta analysis of the total samples, regardless of sex*

Results of initial regression analyses are shown in Table 1 for models including both males and females. The results replicate two important findings reported by Aneshensel & Huba (1983). Overall, the best predictor of subsequent depression is previous depression; and the best predictor of the quantity of alcohol consumed per occasion at the final measurement point is the typical quantity consumed at the initial point.

The symbol *b.* denotes the weighted mean regression coefficient. In the regression model predicting final measurement point consumption from Time 1 consumption, depression and age, the only significant predictors were Time 1 consumption and age. The mean weighted regression coefficient for age is negative, indicating that consumption decreases with increasing age. This finding confirms results from other cross-sectional and longitudinal studies of alcohol consumption (Cahalan *et al.*, 1969; Fillmore, 1988; Temple *et al.*, 1989) and from our own meta-analysis (Fillmore *et al.*, 1990b). The estimates for the Time 1 depression and age coefficients are homogeneous (consistent) across studies; the estimates for Time 1 consumption are not. This means that depression and age predict later consumption in a manner that is consistent across all studies; and that, although initial alcohol consumption is overall a significant predictor of later consumption, its magnitude varies maredly between samples.

In the regression model predicting final measurement point depression from Time 1 depression, Time 1 alcohol consumption and age, significant predictors include both Time 1 depression and Time 1 consumption. Age did not significantly improve prediction of consumption. The results of the homogeneity test for this model show that regression coefficients for Time 1 consumption and age are consistent across the samples surveyed, but that estimates for the Time 1 depression coefficients are not. Secondary analyses (reported below) will explore which study characteristics contribute to this inconsistency.

(B) *Log normal transformations of the data*

A log-normal transformation was applied to a subset of the depression, as well as the alcohol consumption data to modify the non-normality detected for these variables in the raw data. Regression coefficients were re-calculated to check for differences in results and the meta-analysis was repeated.

In general, the log-transformation had the effect of strengthening the relationship between the dependent and independent variables; beta weights after the transformation were slightly larger, and standard errors slightly smaller. However, when we repeated the meta-analysis on the transformed data, results varied negligibly from those on the transformed variables. In fact, the main effort of the transformation on the meta-analysis was to decrease the amount of homogeneity in the estimates. Furthermore, the transformation did not at all affect the results of the meta-analysis; results for transformed and untransformed variables were virtually identical. For this reason, the remainder of the analysis was conducted on the non-normalized depression and alcohol consumption variables.

(C) *The meta-analysis for each sex separately*

The results for males and females separately are shown in Table 2. For males, Time 1 consumption significantly predicts final measurement point consumption. Initial levels of depression in males add nothing to the prediction of final measurement point consumption, although age is still a negative predictor of consumption.

Initial levels of depression, as well as alcohol consumption, significantly predict final measurement point depression. The regression coefficients

Table 1. *Regression coefficient estimates predicting quantity of alcohol consumed at Time 2 and depression at Time 2*

	Quantity per occasion at Time 2			Depression at Time 2		
	βT1 quantity	βT1 depression	βT1 age	βT1 depression	βT1 quantity	βT1 age
Canada-m	0.336 (0.023)[1]	0.020 (0.012)	−0.053 (0.056)	0.296 (0.026)	−0.059 (0.048)	0.080 (0.121)
Shetland	0.662 (0.034)	−0.006 (0.022)	−0.018 (0.008)	0.514 (0.058)	0.004 (0.092)	0.030 (0.021)
USA-b	0.333 (0.062)	0.114 (0.125)	0.042 (0.179)	0.236 (0.034)	−0.003 (0.017)	−0.007 (0.048)
USA-g	0.485 (0.048)	−0.057 (0.082)	−0.027 (0.025)	0.346 (0.056)	−0.032 (0.032)	0.014 (0.015)
Scotland-p	0.553 (0.244)	na[2]	na	na	0.009 (0.005)	na
USA-d	0.512 (0.029)	0.491 (0.363)	−0.017 (0.008)	0.227 (0.034)	−0.007 (0.004)	0.000 (0.001)
USA-3/4	0.481 (0.048)	0.260 (0.169)	−0.033 (0.013)	0.395 (0.037)	0.026 (0.011)	−0.001 (0.003)
USA-w	0.398 (0.058)	0.038 (0.046)	−0.031 (0.013)	0.416 (0.041)	0.090 (0.050)	−0.031 (0.011)
UK-p	0.168 (0.013)	−0.039 (0.021)	na	na	na	na
b	0.305 (0.007)	0.006 (0.009)	−0.022 (0.005)	0.318 (0.014)	0.008 (0.003)	−0.001 (0.002)
z	32.39 [0.0000][3]	0.62 [ns]	−4.64 [0.0000]	22.82 [0.0000]	2.88 [0.05	−0.38 [ns]
H	305 [0.0000]	12.11 [ns]	2.31 [ns]	35.41 [0.0000]	9.32 [ns]	11.28 [ns]
df	8	7	6	6	7	6

1. Standard errors are in parentheses.
2. Coefficient cannot be estimated because data are unavailable.
3. Significance levels are in brackets.

Table 2 (A). *Regression coefficient estimates predicting quantity of alcohol consumed at Time 2 and depression at Time 2 separately for males*

	Quantity per occasion at Time 2			Depression at Time 2		
	βT1 quantity	βT1 depression	βT1 age	βT1 depression	βT1 quantity	βT1 age
Canada-m	0.295 (0.035)[1]	0.005 (0.026)	−0.095 (0.114)	0.303 (0.044)	−0.041 (0.059)	−0.070 (0.194)
Shetland	0.369 (0.051)	0.018 (0.041)	−0.061 (0.013)	0.410 (0.076)	0.105 (0.095)	0.027 (0.025)
USA-d	0.512 (0.029)	0.491 (0.363)	−0.017 (0.008)	0.227 (0.034)	0.007 (0.004)	0.000 (0.001)
USA-b	0.255 (0.098)	0.290 (0.237)	0.112 (0.344)	0.248 (0.053)	−0.004 (0.022)	−0.063 (0.076)
USA-3/4	0.481 (0.048)	0.260 (0.169)	−0.033 (0.013)	0.395 (0.037)	0.026 (0.011)	−0.001 (0.003)
Scotland-p	0.638 (0.401)	na[2]	na	na	0.001 (0.007)	na
UK-p	0.128 (0.018)	0.005 (0.033)	na	na	na	na
USA-g	0.574 (0.080)	−0.242 (0.137)	−0.045 (0.043)	0.412 (0.077)	−0.059 (0.046)	0.017 (0.023)
b.	0.278 (0.013)	0.009 (0.018)	−0.030 (0.006)	0.309 (0.189)	0.007 (0.003)	−0.000 (0.001)
z	21.83 [0.0000][3]	0.50 [ns]	−5.08 [0.0000]	16.41 [0.0000]	2.07 [0.05]	0.333 [ns]
H	170.41 [0.0000]	8.82 [ns]	8.99 [ns]	16.11 [0.006]	7.75 [ns]	2.64 [ns]
df	7	6	5	5	6	5

Table 2 (B) *Regression coefficient estimates predicting quantity of alcohol consumed at Time 2 and depression at Time 2 separately for females*

	Quantity per occasion at Time 2			Depression at Time 2		
	βT1 quantity	βT1 depression	βT1 age	βT1 depression	βT1 quantity	βT1 age
Canada-m	0.345 (0.035)	0.038 (0.012)	−0.017 (0.056)	0.280 (0.033)	0.011 (0.096)	0.167 (0.154)
USA-w	0.398 (0.058)	0.038 (0.046)	−0.031 (0.013)	0.416 (0.041)	0.090 (0.050)	−0.031 (0.011)
Shetland	0.414 (0.060)	−0.011 (0.018)	−0.021 (0.007)	0.520 (0.069)	−0.128 (0.230)	0.040 (0.026)
USA-b	0.357 (0.068)	0.080 (0.102)	0.006 (0.144)	0.227 (0.045)	−0.005 (0.030)	0.039 (0.061)
USA-g	0.308 (0.050)	0.115 (0.085)	−0.027 (0.025)	0.250 (0.081)	−0.024 (0.048)	0.003 (0.021)
Scotland-p	0.096 (0.244)	na	na	na	0.021 (0.009)	na
UK-p	0.106 (0.016)	0.002 (0.020)	na	na	na	na
b.	0.191 (0.013)	0.021 (0.009)	−0.023 (0.006)	0.322 (0.020)	0.019 (0.008)	−0.014 (0.009)
z	14.69 [0.0000]	2.40 [0.02]	−3.92 [0.0000]	15.70 [0.0000]	2.31 [0.02]	−1.55 [ns]
H	85.72 [0.0000]	7.76 [ns]	0.535 [ns]	20.38 [0.0004]	3.92 [ns]	9.49 [0.05]
df	6	5	4	4	5	4

1. Standard errors are in parentheses.
2. Coefficient cannot be estimated because data are unavailable.
3. Significance levels are in brackets.

for Time 1 consumption in the prediction of final measurement point consumption and Time 1 depression in the prediction of final measurement point depression are heterogeneous; coefficients for both Time 1 quantity and Time age are homogeneous.

Two important findings are noted in the female sample. First, as for males, Time 1 alcohol consumption and Time 1 depression are significant predictors of final measurement point depression. While this result is similar to the result obtained in the males-only analysis, the beta weight is larger for females. The positive coefficient for Time 1 consumption indicates that higher consumption leads to greater depressed mood. This result is consistent across all studies in the female-only analysis. Second, Time 1 depression, Time 1 alcohol consumption, and age are all significant predictors of final measurement point alcohol consumption for females. Again, the relationship between age and final measurement point consumption is negative. The small but positive coefficient for Time 1 depression demonstrates that higher levels of depression at the initial measurement point are associated with high levels of consumption at the final measurement point. Again, this is a consistent result for all studies included in the current analysis.

The results of the homogeneity tests for consumption as a dependent variable replicate those obtained for the combined-sex samples. Results for depression as a dependent variable for males and females diverge from the combined-sex results, however. Time 1 age is a non-significant, non-homogeneous predictor of Time 2 drinking for women, while it is a non-significant, but homogeneous predictor for men. This implies that the combined action of alcohol and depression may have different impacts on later depression at different ages for women. We note that the strongest predictors of final measurement point behaviors are also the most inconsistent. This inconsistency implies that these relationships, while significant, differ across these populations, assuming study characteristics (i.e. methodology or sample attributes) do not account for the differences.

The results thus far demonstrate a trend of greater inconsistency among the 'strong' predictors of future behavior—initial depression in the prediction of future depression, and initial quantity consumed in the prediction of future quantity consumed—than among the 'weaker' predictors. This seems counter intuitive, but it might be explained on the basis of differences in research methodology among the studies that we used.

(D) *The meta-analysis controlling for interval between measurements*

We investigate methodological characteristics of the samples which might account for the perceived inconsistency among sample regression coefficients. Since Aneshensel and Huba found differences in the prediction of long-term versus short-term drinking and depression, we decided to evaluate whether interval of measurement has any effect as a 'blocking' factor in the meta-analysis. In other words, it is possible that different intervals between measurement points across studies may account for the inconsistency in strength of prediction. We are unable to replicate the Aneshensel and Huba analysis completely because their 'shortterm' measure was 6–9 months. The shortest interval between measurement points represented in the present analysis is 2 years.

1. The male samples. First of all, the mean regression weights for shorter intevals are much larger than those over longer intervals, for both prediction models. In Table 3, we show that the 'blocking' technique succeeded in producing consistent estimates for all predictors with one noticeable exception: Time 1 alcohol consumption is a heterogeneous predictor of final measurement point consumption over longer intervals. This result is due primarily to the large regression coefficient and a small standard error for Time 1 consumption in a US sample of Boston area men recruited for a health study (USA-d) (a) whose consumption per occasion at both points in time was higher than that in other samples and (b) whose mean age at Time 1 exceeded that of other samples.

2. The female samples. Controlling for interval between measurements did not produce as much consistency in estimates for females as it did for males. For the model predicting final consumption from initial consumption and initial depression, homogeneous results are obtained for all estimates except for the regression coefficient for initial consumption over long intervals (the same result was obtained for males). The heterogeneity in the consumption variable is obviously due to the small regression weight for a birth cohort study from the

Table 3. (A) *Regression coefficient estimates predicting quantity of alcohol consumed at Time 2 and depression at Time 2 separately for males and controlling for interval of measurement*

	Quantity per occasion at Time 2			Depression at Time 2		
	βT1 quantity	βT1 depression	βT1 age	βT1 depression	βT1 quantity	βT1 age
Studies of 5-year intervals or less						
Shetland	0.369 (0.051)[1]	0.018 (0.041)	−0.061 (0.013)	0.410 (0.076)	0.105 (0.095)	0.027 (0.025)
USA-g	0.574 (0.080)	−0.242 (0.137)	−0.045 (0.043)	0.412 (0.077)	−0.059 (0.046)	0.017 (0.023)
USA-3/4	0.481 (0.048)	0.260 (0.169)	−0.033 (0.013)	0.395 (0.037)	0.026 (0.011)	−0.001 (0.003)
Scotland-p	0.638 (0.401)	na[2]	na	na	0.001 (0.007)	na
b	0.453 (0.032)	−0.010 (0.038)	−0.047 (0.009)	0.400 (0.030)	0.007 (0.006)	0.000 (0.003)
z	14.18 [0.0000][3]	0.260 [ns]	−5.22 [0.0000]	13.10 [0.0000]	1.28 [ns]	−0.105 (ns)
H	5.55 [ns]	5.61 [ns]	2.32 [ns]	0.06 [ns]	6.83 [ns]	1.81 [ns]
df	3	2	2	2	3	2
Studies of more than 5-year intervals						
Canada-m	0.295 (0.035)	0.005 (0.026)	−0.094 (0.114)	0.303 (0.044)	−0.041 (0.059)	−0.070 (0.194)
USA-b	0.255 (0.098)	0.290 (0.237)	0.112 (0.344)	0.248 (0.053)	−0.004 (0.022)	−0.063 (0.076)
USA-d	0.512 (0.029)	0.491 (0.363)	−0.017 (0.008)	0.227 (0.034)	0.007 (0.004)	0.000 (0.001)
UK-p	0.128 (0.018)	0.005 (0.033)	na	na	na	na
b.	0.245 (0.014)	0.009 (0.020)	−0.017 (0.008)	0.253 (0.024)	0.006 (0.004)	−0.000 (0.001)
z	17.63 [0.0000]	0.42 [ns]	−2.17 [0.03]	10.58 [0.0000]	1.64 [ns]	−0.013 [ns]
H	129.07 [0.0000]	3.21 [ns]	0.595 [ns]	1.88 [ns]	0.89 [ns]	0.82 [ns]
df	3	3	2	2	2	2

Table 3. (B) *Regression coefficient estimates predicting quantity of alcohol consumed at Time 2 and depression at Time 2 separately for females and controlling for interval of measurement*

	Quantity per occasion at Time 2			Depression at Time 2		
	βT1 quantity	βT1 depression	βT1 age	βT1 depression	βT1 quantity	βT1 age
Studies of 5-year intervals or less						
Shetland	0.414 (0.060)	−0.011 (0.018)	−0.021 (0.007)	0.520 (0.069)	−0.128 (0.230)	0.040 (0.026)
USA-w	0.398 (0.058)	0.038 (0.046)	−0.031 (0.013)	0.416 (0.041)	0.090 (0.050)	−0.031 (0.011)
USA-g	0.308 (0.050)	0.115 (0.085)	−0.027 (0.025)	0.250 (0.081)	−0.024 (0.048)	0.003 (0.021)
Scotland-p	0.096 (0.244)	na	na	na	0.021 (0.009)	na
b.	0.361 (0.032)	−0.000 (0.016)	−0.023 (0.006)	0.412 (0.032)	0.021 (0.009)	−0.016 (0.009)
z	11.37 [0.0000]	−0.001 [ns]	−3.92 [0.0000]	12.76 [0.0000]	2.46 [0.012]	−1.73 [ns]
H	3.49 [ns]	2.89 [ns]	0.48 [ns]	6.45 [0.03]	3.20 [ns]	7.32 [0.025]
df	3	2	2	2	3	2
Studies of more than 5-year intervals						
Canada-m	0.345 (0.035)	0.038 (0.012)	−0.017 (0.056)	0.280 (0.033)	0.011 (0.096)	0.167 (0.154)
USA-b	0.357 (0.068)	0.080 (0.102)	0.006 (0.144)	0.227 (0.045)	−0.005 (0.030)	0.039 (0.061)
UK-p	0.106 (0.016)	0.002 (0.020)	na	na	na	na
b.	0.156 (0.014)	0.029 (0.010)	−0.014 (0.052)	0.261 (0.027)	−0.003 (0.029)	0.056 (0.057)
z	10.99 [0.0000]	2.83 [0.004]	−0.267 (ns)	9.82 [0.0000]	−0.125 [ns]	0.99 [ns]
H	47.66 [0.0000]	2.63 [ns]	0.022 [ns]	0.902 [ns]	0.025 [ns]	0.597 [ns]
df	2	2	1	1	1	1

1. Standard errors are in parentheses.
2. Coefficient cannot be estimated because data are unavailable.
3. Significance levels are in brackets.

United Kingdom (UK-p). For the regression model predicting final depression, heterogeneity occurred in the predictors for initial depression and age in the prediction of final measurement point depression over shorter intervals. It is more difficult to say why this occurred for the studies under scrutiny, except to point out that the two studies (USA-w and Shetland) which have larger regression coefficients, sampled females over a wide age range and consisted of a national sample and a community sample, while the remaining two (Scotland-p and USA-g) studies used much more age-restrictred samples in school-based samples.

As a final note on blocking (for both male and female samples), it is unclear whether the consistency we obtain by analysing the coefficients by interval is due to greater homogeneity in the parameter estimates we use, or is a result of a loss of degrees of freedom. However, since the finding is logical and the results are in the expected direction (the stronger coefficients for the shorter intervals between measurement) though inconclusive, we are more confident that the 'blocking' is an appropriate mechanism to use in testing these results.

(D) *The meta analysis controlling for age*

We investigate the impact of age on the results, by blocking respondents at younger ages (18–39 years) versus older ages (over 40 years). Justification for blocking by age is based on the observation that both depressed mood and alcohol consumption vary with chronological age.

1. The male samples. Generally, we find that estimates are more homogeneous in older groups of males compared to younger groups (Table 4A). However, this result must be qualified by the fact that there are fewer studies with older respondents, and therefore the gain in homogeneity may be explained by a loss of degrees of freedom, as in the previous section. Furthermore, the relationship of Time 1 quantity to Time 2 quantity is stronger among older males than younger males, but this is not true of Time 1 depression to Time 2 depression.

2. The female samples. Results for females indicate a slightly greater degree of consistency in estimates for the younger groups compared to the older groups. The regression coefficients for initial depressed mood and consumption are consistent predictors of final measurement point depressed mood. Initial consumption is not a homogeneous predictor of later consumption for younger respondents, although depression is. Furthermore, results for the older respondent groups are quite homogeneous, but the number of groups included at this stage of the analysis is quite small.

Discussion

These results demonstrate the importance of statistical control, both within and across studies, when exploring the relationship between depression and alcohol consumption. The preliminary results are summarized below, as are directions for future analyses.

We find that current levels of depression are the best predictors of future levels of depression, and that current levels of alcohol consumption are the best indicators of later levels of consumption. For both males and females, Time 1 consumption significantly predicts final measurement depression—although prediction is stronger for females than males. The major difference between the sexes occurs in the prediction of final measurement point consumption. For males, only Time 1 consumption significantly predicts final measurement consumption; therefore, earlier depression has no significant impact on later drinking among males. For females, strong positive relationships are found between Time 1 depression and later consumption as well as Time 1 consumption and later consumption; therefore, alcohol consumption and depression are more closely related among females. Finally, we also find that, when controlling for the interval of measurement, more consistent predictors of later levels of depression and alcohol consumption among the males are obtained over shorter intervals between measurement points. For females, over longer intervals, prediction of later levels of consumption is improved when initial levels of depression are taken into account; over the short term, prediction of depression is improved when previous levels of alcohol consumption are included in the analysis.

Research on sex differences in alcohol use and depression consistently yields the following findings:

(1) rates of heavy alcohol use are greater among men than women;
(2) women report depression more than men.

Some researchers (Klerman & Weissman, 1980) have suggested that men use alcohol to self-

Table 4. (A) *Regression coefficients estimates predicing quantity of alcohol consumed at Time 2 and depression at Time 2 separately for males and controlling for age*

	Quantity per occasion at Time 2		Depression at Time 2	
	βT1 quantity	βT1 depression	βT1 depression	βT1 quantity
Males: age 18–39 at Time 1				
USA-3/4	0.414 (0.069)[1]	0.490 (0.259)	0.358 (0.062)	0.025 (0.016)
Shetland	0.488 (0.071)	0.021 (0.052)	0.504 (0.108)	−0.169 (0.147)
Canada-m	0.296 (0.035)	0.006 (0.026)	0.303 (0.044)	−0.040 (0.059)
Scotland-p	0.638 (0.401)	na[2]	na	0.001 (0.007)
USA-d	0.708 (0.105)	−0.985 (0.807)	0.151 (0.041)	−0.011 (0.009)
UK-p	0.128 (0.018)	0.005 (0.033)	na	na
USA-g	0.594 (0.078)	−0.265 (0.136)	0.411 (0.074)	−0.073 (0.043)
USA-b	0.253 (0.098)	0.297 (0.235)	0.246 (0.053)	−0.000 (0.022)
b.	0.216 (0.015)	0.006 (0.019)	0.273 (0.022)	−0.022 (0.005)
z	14.81 [0.0000][3]	0.34 [ns]	12.21 [0.0000]	−0.38 [ns]
H	98.73 [0.0000]	10.59 [ns]	8.47 [ns]	19.51 [0.002]
df	7	6	5	6
Males: age 40+ at Time 1				
USA-3/4	0.577 (0.063)	0.066 (0.202)	0.457 (0.060)	0.009 (0.019)
Shetland	0.443 (0.118)	−0.030 (0.064)	0.294 (0.125)	0.822 (0.229)
USA-d	0.487 (0.030)	1.043 (0.419)	0.315 (0.052)	−0.006 (0.004)
b.	0.501 (0.026)	0.001 (0.060)	0.368 (0.037)	−0.005 (0.004)
z	18.96 [0.0000]	0.014 [ns]	9.83 [0.0000]	−1.31 [ns]
H	1.91 [ns]	6.52 [0.04]	3.59 [ns]	13.65 [0.001]
df	2	2	2	2

1. Standard errors are in parentheses.
2. Coefficient cannot be estimated because data are unavailable.
3. Significance levels are in brackets.

medicate for depression, while women who feel depressed turn to the health care system for help. Our findings substantiate the close ties found between drinking and depression reported for women in other studies (Midanik, 1983; Wilsnack *et al.*, 1984). However, the results for males contradict the hypothesis that men who are depressed drink to alleviate their feelings of sadness by finding no relationship between depression at Time 1 and later consumption.

Results did not precisely replicate the long-term and short-term results of Aneshensel and Huba. The signs of the regression coefficients did not reverse themselves when we controlled for interval between measurement points, although this may be an artifact of the method we used for controlling for interval. Future analyses, using datasets with more than two measurement points, should repeat the Areshensel and Huba analysis. In general, however, these preliminary results point to the importance of utilizing longitudinal datasets to study the issue of long-term versus short-term effects of alcohol consumption and depression. In particular, Aneshensel & Huba's (1983) interval-specific analyses found that alcohol use led to short-term reduction in depressive symptoms (for men, and not for women), but in the long term it led to slightly increased levels of depression. In our male samples, there was no relationship between Time 1 consumption and final measurement depression for either long or short intervals between measurement points.

In the short term, Aneshensel and Huba found that depression seemed to increase alcohol use, whereas over the long term it was associated with decreases in alcohol use. In our samples, over the short term, depression also decreased alcohol use for both males and females, confirming Aneshensel and Huba's findings. Over the long term, depression had no effect on male drinking, but it had a strong positive effect on female drinking. These results illustrate the importance of qualifying relationships between consumption per occasion and depressive symptomatology by the time frame within which the behaviors are measured. However, caution must be exercised in making generalizations about the interval-specific findings in these samples, since the meta-analyses were conducted on a small number of

Table 4. (B) *Regression coefficient estimates predicting quantity of alcohol consumed at Time 2 and depression at Time 2 separately for females and controlling for age*

	Quantity per occasion at Time 2		Depression at Time 2	
	βT1 quantity	βT1 depression	βT1 depression	βT1 quantity
Females: age 18–39 at Time 1				
Shetland	0.430 [0.071][1]	0.015 (0.026)	0.429 (0.119)	−0.418 (0.328)
Canada-m	0.345 (0.034)	0.038 (0.012)	0.278 (0.032)	0.008 (0.096)
UK-p	0.106 (0.016)	0.002 (0.020)	na	na
Scotland-p	0.096 (0.244)	na[2]	na	0.021 (0.009)
USA-g	0.317 (0.050)	0.105 (0.086)	0.261 (0.082)	−0.041 (0.048)
USA-b	0.358 (0.067)	0.080 (0.102)	0.224 (0.045)	−0.002 (0.030)
USA-w	0.401 (0.074)	−0.004 (0.069)	0.391 (0.058)	0.106 (0.062)
b.	0.186 (0.013)	0.027 (0.009)	0.306 (0.026)	0.020 (0.009)
z	14.18 [0.0000][3]	2.93 [0.003]	11.82 [0.0000]	2.32 [0.02]
H	80.71 [0.0000]	3.91 [ns]	4.28 [ns]	5.35 [ns]
df	6	5	3	4
Females: age 40+ at Time 1				
USA-w	0.486 (0.097)	0.109 (0.059)	0.459 (0.057)	0.111 (0.093)
Shetland	0.552 (0.099)	0.004 (0.015)	0.658 (0.115)	0.677 (0.773)
b.	0.518 (0.069)	0.010 (0.014)	0.498 (0.051)	0.119 (0.092)
Z	7.48 [0.0000]	0.71 [ns]	9.75 [0.0000]	1.29 [ns]
H	0.27 [ns]	2.97 [ns]	2.40 [ns]	0.53 [ns]
df	1	1	1	1

1. Standard errors are in parentheses.
2. Coefficient cannot be estimated because data are unavailable.
3. Significance levels are in brackets.

studies, and the corresponding degrees of freedom are small.

Although cross-sectional studies of the demographics of depression (Myers *et al.*, 1984) show that the occurrence of depression is much higher in younger age groups for both males and females, our analyses show a much stronger (albeit non-significant) age effect for females. Furthermore, secondary meta-analyses show that more consistent results are obtained for samples of female respondents with similar ages (young *v.* old). We would argue that controlling for age is important in all future analyses of depression, especially for women. Furthermore, we would encourage analysts to begin exploring why age is such an important discriminator in these relationships for one sex, but not for the other.

Unfortunately, there were not enough studies containing both alcohol consumption and depression variables to allow significant cross-cultural comparisons. Only three nations represented in our analysis: the United States, Canada and Scotland. Any differences which may be attibutable to culture cannot be significantly evaluated with so few samples.

As a final note, all analyses presented here include abstainers as well as drinkers. Although Aneshensel and Huba found no significant differences in model fits when they analysed their sample separately including and excluding abstainers, these differences may account for our sex-specific findings, especially when one considers the over-representation of abstainers among females compared to males.

In summary, the prediction patterns for future depression and alcohol consumption are much more complex for females than for males. We have seen that prediction probably depends upon the interplay of age, sex, current level of depression and current alcohol consumption. Future analyses should proceed in two general directions.

(1) inclusion of psychosocial variables such as 'reason for drinking' might be utilized to investiage the relationship between alcohol consumption and depression at a more individual level;
(2) when homogeneous results are not obtained on the individual level, period and cohort effects may act as potential explanatory factors for study differences.

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