Alcohol Use and Cognitive Loss among Employed Men and Women

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Abstract: A representative sample of 1,367 employed men and women in Detroit responded to questions about their drinking practices and then completed a cognitive test which measures abstraction abilities. Abstraction, tested while respondents were sober, decreased significantly as reported quantity of alcohol usually consumed per drinking occasion increased. (*Am J Public Health* 1983; 73:521–526.)

Introduction

Health impairments associated with alcohol consumption constitute a major medical problem.[1] Central nervous system pathology resulting from alcohol abuse is an area of growing concern. In fact, cognitive impairments may be one of the earliest medical complications of alcoholism.[2]

Alcoholic patients, when examined in the sober state, exhibit significant impairments in abstracting abilities, concept formation, concept shifting, and memory.[3–6] Whether or not these impairments in cognitive functioning are related to neuroanatomic and neurochemical abnormalities has not been established; some studies report that between 50 and 70 per cent of alcoholics in treatment have either cortical or subcortical atrophy.[5]

Very little is known about the extent of alcohol-related cognitive decrements in the general population. Traditionally, research has focused on alcoholic patients, comparing their neuropsychological status to either brain-damaged patients or normal controls. The focus on alcoholic patients does not mean that alcohol-related effects are restricted to individuals who consume 10 or more drinks a day, a level of intake associated with alcoholism.[7] Insofar as alcohol consumption is a critical factor, there should be a dose-response relationship with neuropsychological parameters and studies with small samples of social drinkers suggest that there is such a relationship.[8–10]

This report is based on a representative sample of 1,367 employed men and women. The sample allows us to examine the full range of drinking practices in a general population, unlike the traditional approach which focuses on the upper range of heavy consumption among alcoholic patients. Each person in the sample was interviewed about his or her drinking practices and was administered a cognitive test that is sensitive to impairments in alcoholic patients. Increased alcohol use was found to be significantly associated with poorer abstraction performance.

Methods

The 1,367 respondents in the sample were drawn from employed men and women in the three-county central core of metropolitan Detroit consisting of Wayne, Oakland, and MaComb counties and interviewed for us by the Policy Research Corporation during the summer and fall of 1978.

A two-stage sampling procedure was used to draw the sample. The first stage was accomplished by a "random digit dialing" procedure which screened households for eligible respondents, men and women 18 years of age or older who were employed 30 or more hours per week. With the exception of households which had two or more telephone numbers, each household with a working telephone had an equal probability of selection. Selection probabilities were adjusted in cases of more than one phone number.

The second stage of the sampling procedure involved selection of eligible respondents from the households. In those instances where there were two or more eligible respondents in the household, one was selected for subsequent interview by use of predesignated "randomized" selection numbers (sometimes called "Kish tables"). Interviewers conducting the screening listed, in a predesignated order (females first, then males, ordered by age within sex), all eligible respondents within the household and then re-

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ferred to a table prepared for each screening form to determine the selected respondent.

Women were oversampled in order to permit detailed examination of their drinking experiences. This was accomplished by undersampling men by 50 per cent. Every other eligible male selected in the screening process was excluded from the final sample to be interviewed. The cases are therefore weighted to reflect the sex of the respondent as well as the number of telephones in the household, and the number of full-time workers if all were of the same sex or the inverse of a "different sex" selection table if workers were of a different sex.*

The completion rate was 70 per cent. Although the estimates derived from the Detroit study could be biased because of the non-response, data from our survey and from a survey conducted in the same three-county area of Detroit by the University of Michigan in 1978 yield similar estimates of the sociodemographic characteristics of employed persons.[11] The respondents in our study have a mean age of 38 ± 13 (sd) years, a mean educational attainment of 13 ± 3 (sd) years, and a mean annual income of $19,351 ± $11,161 (sd).

Respondents were asked about their alcohol consumption during the month before the interviews and about periods of heavier and lighter drinking throughout the course of their lives in terms of both quantity and frequency. The questions were open ended and the interviewers were trained to probe for types, numbers, and sizes of drinks usually consumed. Reported types, numbers, and sizes of drinks were used to determine total ounces of specific beverages consumed.

Because there may be greater error in reports concerning beverages used infrequently, our analysis of current alcohol consumption is based on the most frequently consumed beverage of each respondent. Frequency of consumption is the number of drinking occasions reported for the month preceding the interview. Quantity consumed per drinking occasion is the amount of alcohol a respondent typically drinks at a time and is expressed in ounces of absolute alcohol.

Cognitive functioning was measured by the Shipley Institute of Living Scale (SILS)[12] which was completed by respondents at the end of the interview. The SILS is a self-administered paper and pencil test comprised of two parts: 40 multiple-choice questions about word meanings (Vocabulary) and 20 questions which require respondents to complete sequential patterns (Abstraction). In the vocabulary section, respondents select a word that has a similar meaning to another word such as in the following example:

FASCINATE welcome fix stir enchant

In the abstraction section, respondents fill in a number or letter in the last item of a grouping such as the following:

knit in spud up both to stay ___**

Ten minutes are allowed for completion of each section. Performance is analyzed in terms of total number of correct answers on the vocabulary section adjusted for guessing (vocabulary score) and the number of correct answers on the abstraction section multiplied by 2 (abstraction score).

The rationale behind the design of the SILS is that in mild states of cognitive deterioration, acquired knowledge such as vocabulary is not affected but the capacity for discerning new abstract relationships is subject to disruption. In our analyses, vocabulary score is included as a predictive variable since abstraction scores should correspond to scores for acquired vocabulary knowledge and be predicted by them. The influence of alcohol use on cognitive functioning is measured in terms of the remaining variance in abstraction after removing that portion of the variance accounted for by vocabulary.

We selected the SILS because of its sensitivity to alcohol-related effects and its ease of administration in epidemiologic surveys. Alcoholic patients exhibit significant impairments on the SILS when tested in the sober state.[13–14] Recent studies of social drinkers have found that sober abstraction performance on the SILS decreases in relation to current drinking practices.[8,9] Under the influence of intoxicating doses of alcohol, abstraction is significantly worse than in the sober state and vocabulary is not affected.[15] This impairment is only evidenced on the rising blood alcohol curve and not when blood alcohol levels are falling.

The impact of alcohol use on cognitive functioning among the employed men and women in our sample was assessed with multiple regression procedures. Scores from respondents who did not complete the SILS as the final part of a face-to-face interview were treated as missing data. Respondents with missing values for any of the variables in the regression model were eliminated from the analysis. Respondents who were excluded from the analysis because of missing data were not significantly different from respondents who were included, in terms of their sex, age, education, income, abstraction, and quantity of alcohol consumed per occasion.

Since previous studies on alcohol-related neuropsychological deficits have focused almost exclusively on males, we first tested whether the expected relation of decreased abstraction performance with increased alcohol consumption differed by sex. Sex and the interaction term, sex × quantity of alcohol consumed per occasion, were added to the following regression model:

Abstraction Score = Vocabulary Score + Quantity of Alcohol Consumed per Drinking Occasion + Frequency of Consumption + Age + Educational Level + Race.***

*The 643 men are weighted so that they represent 934 of the 1,367 respondents which would have been the approximate number of men in the sample if they had not been undersampled. The 724 women are weighted so that they represent 433 of the 1,367 respondents which would have been the approximate number of women in the sample if the men had not been undersampled. When the men and women are examined separately, the cases are reweighted by constants in order to have the Ns for men and women correspond to the unweighted number of men and women.

**The answer to the vocabulary item is "enchant" and the answer to the abstraction item is "at".

***Race is coded as a dummy variable, where White is represented by "0" and Black is represented by "1."

TABLE 1—Predictors of Abstraction in Men (N = 481)

	Unstandardized Regression Coefficients	Standard Errors	Means and Standard Deviations
Quantity per Occasion (oz absolute alcohol)	−0.937**	0.273	1.3 ± 1.1
Frequency (occasions per month)	0.026	0.025	12 ± 12
Age (years)	−0.207**	0.025	38 ± 13
Education (years)	0.664**	0.127	13 ± 3
Vocabulary Score	0.853**	0.054	29 ± 6
Race	1.002	0.955	
R Square	.54**		

*p. < .05 **p. < .01 (F test)

The interaction term was significant [F = 9.35, df (1, 1016), p < .01]. Analyses were, therefore, conducted separately on men and women.

Results

Alcohol Use and Abstraction Performance in Men

The 481 men reported drinking on the average of 12 times per month and consuming 1.3 ounces of absolute alcohol (two to three drinks) on a typical drinking occasion. The men had a mean abstraction score of 24.6 ± 9.3 (sd). The results for the men are shown in Table 1 where each unstandardized regression coefficient indicates the effect of that variable, controlling for effects of all other variables.

Among the employed men in this sample there is a significant relationship between quantity of alcohol consumed per drinking occasion and abstraction performance on the SILS, controlling for the effects of frequency of consumption, age, education, race, and vocabulary score. As had been the case in our earlier studies of male social drinkers,[8,9] frequency of drinking occasions was not significantly related to cognitive functioning.

Alcohol Use and Abstraction Performance in Women

The 544 women reported drinking an average of seven times per month and consuming 1.0 ounces of absolute alcohol (two drinks) on a typical drinking occasion. The same regression model that was applied to the data for men was applied to the data for women. Neither the quantity of alcohol consumed per occasion nor the frequency of consumption significantly predicted abstraction performance for women as a whole.

One explanation for the lack of a relationship between alcohol consumption and cognitive functioning in women is that the drinking patterns of women differ from those of men and, as a consequence, place them at less risk for cognitive decrements. The women in this sample drink, on the average, about 60 per cent as often as men. Sixty-three per cent of the men but only 38 per cent of the women drink once a week or more.

To focus on a subsample of women whose drinking more closely approximated that of men, we estimated the basic regression model for the 213 women who reported drinking alcohol once a week or more.‡ The subsample of

‡Additional warrant for focusing on this subsample is given by the fact that the women who drink less than once a week are significantly different from the women who drink at least once per week and all of the men in terms of their education, race, vocabulary and abstraction. Women who drink less than once a week are evidently part of a different distribution and it would be inappropriate to use our basic regression model to predict their cognitive functioning.

TABLE 2—Predictors of Abstraction in Women (N = 213)

	Unstandardized Regression Coefficients	Standard Errors	Means and Standard Deviations
Quantity per Occasion (oz absolute alcohol)	−1.167*	0.573	1.4 ± 0.9
Frequency (occasions per month)	−0.054	0.056	14 ± 9
Age (years)	−0.248**	0.041	35 ± 12
Education (years)	0.058	0.215	13 ± 2
Vocabulary Score	0.711**	0.112	30 ± 5
Race	−2.152	1.361	
R Square	.31**		

*p. < .05 **p. < .01 (F test)

women reported drinking on the average of 14 times per month and consuming 1.4 ounces of absolute alcohol (two to three drinks) on a typical drinking occasion. They had a mean abstraction score of 27.1 ± 8.2 (sd). The results for these 213 women are shown in Table 2.

In the subsample of women who reported drinking at least once a week, we found a significant inverse relation between the quantity of alcohol consumed per drinking occasion and sober abstraction performance. Just as in the case of the men, the pattern of drinking predicting decrements in abstraction performance is the quantity of alcohol typically consumed when the individual drinks.

Test for Nonlinearity of the Dose-Response Relationship

It is possible that the slope of the relationship between alcohol intake and cognitive performance steepens at very high levels of consumption among the entire sample of men and the subsample of women. To test for nonlinearity, the quadratic term of quantity (usual quantity of alcohol consumed per occasion squared) was added to the regression models for all men and for women who drink at least once a week.‡‡ In neither sex was the quadratic term significant. The F-ratio for the quadratic term for the men was 0.89 with 1 and 473 degrees of freedom, and for the women was 0.82 with 1 and 205 degrees of freedom.

In order to provide a visualization of our findings, we adjusted the abstraction scores by removing the effects of the other independent variables in our basic regression model and then regressed the adjusted abstraction scores on both the linear and quadratic terms for usual quantity of alcohol consumed per drinking occasion.‡‡‡ In Figures 1 and 2 we have plotted the linear and quadratic regression lines for the relationship between the adjusted abstraction scores and quantity consumed per occasion. Although there is a substantial decline in abstraction performance at higher levels of consumption, it is not evident that only the heaviest drinkers are at risk for cognitive impairments.

While the nonlinear hypothesis is attractive from the point of view of those who believe that only heavy drinking should produce impairments of cognitive functioning, it is nevertheless a less parsimonious hypothesis. From a statistical perspective, the nonlinear hypothesis must significantly augment the explained variance or it is rejected by application of the law of parsimony and our analysis indicates that it should be rejected. This rejection is provisional, however, since a number of factors may have contributed to our failing to see a nonlinear effect when there actually was one, although the very small p-values in our analysis leave very little for which to hope.

‡‡The quadratic term weights more heavily those respondents who consume larger amounts of alcohol at a time.

‡‡‡To obtain the adjusted scores, we used the following equation: Adjusted Abstraction Score = Abstraction Score − B_1(Vocabulary Score − Vocabulary Score Mean) − B_2(Frequency of Consumption − Frequency of Consumption Mean) − B_3(Age − Age Mean) − B_4(Educational Level − Educational Level Mean) − B_5(Race − Race Mean). The Bs are the unstandardized regression coefficients from regression models for the unweighted data for men and for women who drink at least once a week.

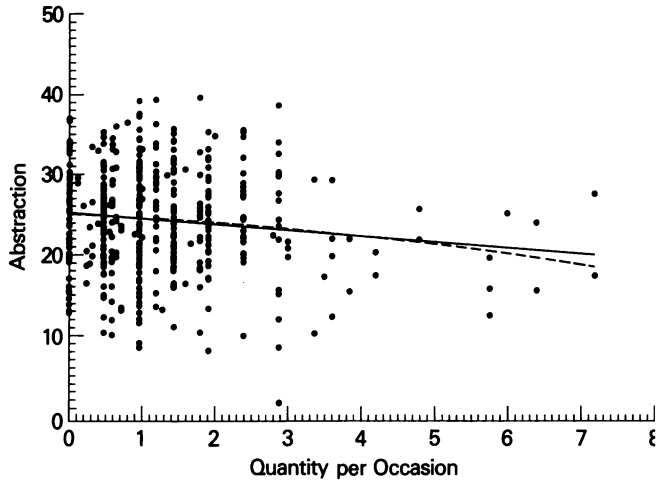

FIGURE 1—Adjusted Abstraction Scores by Quantity per Occasion (oz absolute alcohol) in Men. (The solid line is the linear regression line and the broken line is the quadratic regression line.)

Test for Consumption during Preceding 24 Hours

To test whether alcohol-related decrements were due to a drinking episode during the 24 hours prior to the interview, we classified respondents into two groups: those that reported drinking in the past 24 hours and those that did not. Controlling for the effect of drinking during the past 24 hours does not change the impact of usual quantity of alcohol consumed per drinking occasion on cognitive functioning among men and among women who drink at least once a week. This finding suggests that the impact of recent drinking on cognitive processes lasts longer than 24 hours.

Test for Lifetime Consumption

There may be both short-term and long-term effects of alcohol use. Studies of social drinkers have found that current drinking predicts cognitive impairments[8,9] while studies of alcoholic patients have found that years of alcoholism and other measures of long-term drinking predict neuropsychological impairments.[14,16]

Although it is probable that we have not measured lifetime consumption as accurately as we have current consumption, respondents' reported lifetime consumption was added to the basic equations for men and women who drank once a week or more. This factor was not significant for either sex. Lifetime consumption also failed to significantly predict cognitive impairments with current drinking variables omitted from the basic equations.

Test for Medications

Another factor that has been suggested to account for neuropsychological deficits among alcoholic patients is the ingestion of drugs other than alcohol.[17] To test whether current use of psychoactive medications might account for the apparent impact of alcohol on abstraction performance, we added a drug-use factor to the models for all men and for the subsample of women. The index of drug use was based on the respondents' reported use of medications for trouble

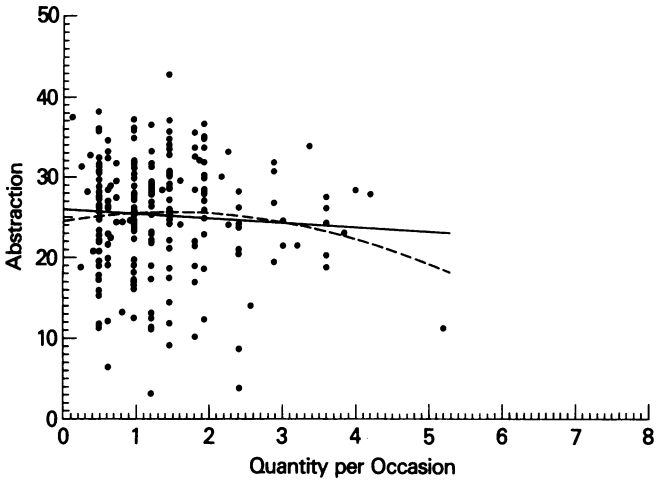

FIGURE 2—Adjusted Abstraction Scores by Quantity per Occasion (oz absolute alcohol) in Women. (The solid line is the linear regression line and the broken line is the quadratic regression line.)

sleeping, nervous illness, hypertension, alcoholism, or arthritis. Eighteen per cent of men and 21 per cent of women reported using medications for at least one of these reasons. Controlling for drug use did not significantly influence the relation between quantity consumed and abstraction performance.

Test for Body Weight

In studies with a small number of subjects, differences in body weight may influence the effects of alcohol, age, and other factors on various facets of mental and physical health. To test whether differences in body weight accounted for the effects of alcohol, age, and other factors on abstraction performance, we added body weight to the basic equations for men and women who drank at least once a week. Controlling for body weight had no appreciable effect on any of the coefficients in the models. For example, the unstandardized regression coefficients for quantity of alcohol consumed per occasion were −.91 for men and −1.17 for women in the models which included body weight.*

Discussion

The present study of employed men and women found that recent alcohol use is significantly associated with decreased abstraction abilities. Specifically, in the case of men and those women who drink at least once a week, the greater the amount of alcohol typically consumed, the lower the abstraction performance on the SILS. The linear term provided the best fit to the data, indicating that there is a linear dose-response relation between alcohol consumption and sober cognitive functioning. The fact that amount of alcohol consumed over a lifetime was not an important drinking variable suggests that, in the general population, cumulative effects of drinking may not be as important as recent drinking on sober cognitive processes. Alternatively, the predictive power of quantity per occasion might indicate that this is a better index of alcohol use than self-reported lifetime consumption. These results appear to be independent of the potentially confounding effects of age, education, race, medication use, or body weight.

We have suggested a carryover model may be appropriate for viewing the relationship between alcohol use and sober cognitive processes in social drinkers.[18] According to this model, sober cognitive decrements may result from recent perturbations in the central nervous system which are produced by acute doses of alcohol. Impairments in cognitive processes may not re-equilibrate to the normal state even though alcohol has been removed from the bloodstream. We have also suggested that poor abstraction abilities could lead to increased drinking.

It will be important to determine the nature and extent of the reversibility of the effects of current alcohol use on cognitive processes. Studies with alcoholic patients report improvement on some neuropsychological tasks, particularly during the first month of abstinence.[19] Thus, it is reasonable to expect that subtle cognitive decrements in social drinkers could be modified by changes in drinking practices.

It is premature to specify the precise levels of intake associated with cognitive loss because of the possible underreporting of alcohol use among the women and men in our sample. However, our analysis indicates that alcohol use is a significant risk factor for men and for those women who drink as frequently as men. Our analysis also indicates that the ingestion of large amounts of alcohol at a time may be more detrimental to cognitive efficiency than frequent ingestion of small amounts.

*The results from this regression model or from other models referred to but not shown in the text are available upon request to the first author.

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