

# Alcohol Consumption, Neuropsychological Status and Computer-Tomographic Findings in a Random Sample of Men and Women from the General Population<sup>1</sup>

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BERGMAN, H., G. AXELSSON, C.-M. IDESTRÖM, S. BORG, T. HINDMARSH, J. MAKOWER AND S. MÜTZELL. *Alcohol consumption, neuropsychological status and computer-tomographic findings in a random sample of men and women from the general population.* PHARMACOL BIOCHEM BEHAV 18: (Suppl. 1, 501-505, 1983.—There was no correlation between reported amount of alcohol consumed on each drinking occasion per se and neuropsychological and neuroradiological signs of cerebral disorder in age-stratified random sample of 200 men and 200 women taken from the general population. Furthermore, moderate to heavy social drinking as assessed by an index based on amount of alcohol consumed on each drinking occasion and the responses to some other alcohol-habit questions was not associated with signs of cerebral disorder. Alcohol dependence, however, was associated with signs often diagnosed in alcoholic patients but milder in degree. There were indications of important differences between men and women with regard to the relationship between advanced alcohol-habits and cerebral disorder.

Alcohol consumption  
Computer tomography

Alcohol abuse

Brain damage

Cerebral disorder

Neuropsychological deficit

THE results from many empirical studies carried out in different laboratories and clinical settings speak in favor of a relationship between chronic alcoholism and cerebral disorder. Particularly during the last few years, neuroradiological and neuropsychological studies have shown that anatomical cerebral changes and neuropsychological deficits can often be diagnosed in alcoholic patients without clinically evident symptoms of cerebral disorder (see [17] for a recent review).

Thus, many alcoholic patients have morphological cerebral changes when examined with computed tomography of the brain appearing as an enlargement of the ventricular system, particularly the 3rd ventricle, and as a widening of cortical sulci. These changes have been interpreted as indicating central and cortical atrophy of the brain.

Widened cortical sulci are often observed even in quite young alcoholic patients, below the age of thirty, while

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enlargement of the ventricular system is more often diagnosed in older alcoholics with a long duration of heavy drinking. Furthermore, such cortical and ventricular changes seem to follow different courses and they correlate with somewhat different patterns of neuropsychological deficits [3-6].

Neuropsychological studies of such patients have shown an increased incidence of intellectual impairment, particularly with regard to abstracting and problem-solving abilities when dealing with visuo-spatial tasks. Long-term memory-dependent abilities and sensory or motor functions are less often impaired [5,15].

The correlation between morphological cerebral changes and neuropsychological deficit is generally modest with the possible exception of old alcoholics who often have clinically manifest symptoms of cerebral disorder [2-4, 6]. Furthermore, in some studies using the partial correlation technique, the relationship is to a great extent explained by chronological age [4,6]. However, in partial correlations some of the covariance which is actually due to the duration of heavy drinking per se is taken away.

It is difficult to distinguish between heavy social drinking and alcoholism and it seems reasonable that there might be a continuum of cerebral disorder in connection with advancing alcohol habits. This continuum would go from nonimpaired low consumers of alcohol or abstainers, through an unknown degree of morphological cerebral changes and neuropsychological deficit in moderate or heavy social drinkers and alcohol dependents in the general population to diagnosed cerebral disorder in alcoholic patients. Unfortunately, very little research on cerebral disorder in social drinkers taken from the general population has been carried out. However, in two studies a correlation between amount of alcohol consumed per drinking occasion and impaired neuropsychological performance in selected social drinkers was reported [13,14].

The purpose of the present study was to investigate a possible relationship between alcohol habits and cerebral disorder in the general population while controlling for the confounding influences of chronological age and formal education for each sex.

#### METHOD

A sample of 200 men and 200 women was randomly drawn from the general population of a defined geographical area in Stockholm. The dropout was less than 10% in the male group and about 15% in the female. The sample was drawn from a National Register covering all Swedish inhabitants according to a two-stage plan to achieve a rectangular age distribution between 20 and 65 yrs for each sex [6]. Because of mental retardation, alcohol intoxication (one person), language difficulties or lack of motivation, five men and eight women were not psychologically investigated. There was an additional loss of a few persons in the computer-tomographic examination.

The general medical examination included an assessment of neurological status. Tests of blood and urine were also taken. The medical case history and a social anamnesis were taken by means of the same standardized procedures as had been used for alcoholic patients taking part in the KARTAD project (see below). Some data from official registers was also collected.

The psychological examination included a comprehensive neuropsychological assessment including the Halstead Rei-

tan test battery. For further details see [3,7]. Raw scores were transformed into T-scores, i.e., the mean was set to 50 and the standard deviation to 10 for each test, based on the results of the sample separated into three age intervals and two levels of formal education [7]. By means of this double standardization technique, satisfactory control over the influence of age- and education differences was achieved. Both these variables are highly correlated with performance on most neuropsychological tests [7,10].

The computed-tomography investigation included an assessment of the width of the lateral ventricles and the third ventricle, for further details see [3]. The same kind of T-score standardization as was carried out for the neuropsychological tests was also done for the two ventricular measures with regard to chronological age, separately for each sex. Widened cortical sulci was assessed by means of a 4-step rating scale which was left unstandardized.

The alcoholic patients of the KARTAD project [1, 8, 9, 11] were used as a comparison group. In the KARTAD project more than 700 consecutively admitted alcoholic patients living in the same geographical area as the random sample were investigated. The data was fed into the computer to create a vast interdisciplinary data bank on alcoholism. Every second KARTAD patient was examined with the same psychological test battery of sensory, motor, intellectual and personality functioning as the random sample [1,7]. During a 2-year period they were also investigated with computed tomography of the brain in the same way as the random sample.

#### RESULTS

The reported amount of alcohol consumed on one occasion expressed in terms of grams of absolute alcohol usually consumed per day when drinking the most is shown in Fig. 1, separately for the men and the women. The median amount was 16 g for the men and 15 g for the women. Disregarding those who denied alcohol consumption altogether, the median amount was 30 g for both sexes, corresponding to half a bottle of light wine.

There was no correlation between the alcohol consumption variable and neuropsychological test results or computer-tomographic findings when analyzed separately for each sex, irrespective of the exclusion of subjects consuming less than 30 g. However, in order to get an index of advancing alcohol habits a Guttman scalogram analysis was carried out [16] on the consumption variable dichotomized at 30 g and the responses to some drinking-habit questions. The questions concerned experienced loss of control over drinking, taking morning drinks and having had blackouts. A 5-step scale which satisfied the psychometric criteria of unidimensionality and cumulativeness could be constructed for each sex, i.e., persons who responded positively to an advanced habit as a rule also responded positively to the less advanced. The male drinking habit scale is shown in Fig. 2. The female scale was identical except that morning drinks and blackouts changed places.

One-hundred and fourteen men who scored 0 on the drinking habit scale since they responded negatively to all the questions were called "low consumers." Sixty-nine scored 1 or 2, i.e., as a rule reported a daily consumption level of at least 30 g and in about 20 cases in combination with subjective loss of control were called "advanced consumers." Thirteen men scored 3 or 4 since they responded positively to either or both of the most advanced drinking-

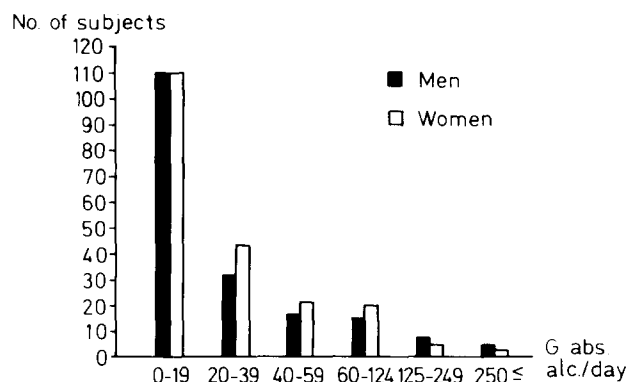


FIG. 1. Quantity of reported daily alcohol consumption when drinking the most, in grammes of absolute alcohol per day in a random sample of 200 men and 200 women taken from the general population of Stockholm.

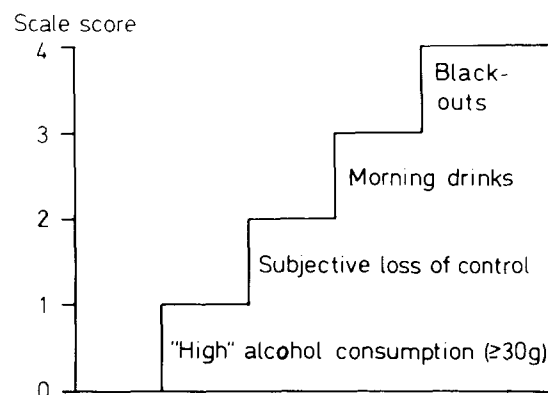


FIG. 2. Cumulative Guttman scale of alcohol-habits in the male random sample.

habits, i.e., morning drinks and blackouts. They were called "alcohol dependents."

The "advanced consumers" were younger than the other groups and those who reported loss of control had experienced it since 10 yrs on the average (see Table 1). The "alcohol dependents" were older and less formally educated than the others. Their daily consumption level when drinking the most corresponded to one 75 cl bottle of light wine. Two men of the "advanced consumers" and one of the "alcohol dependents" reported previous hospital treatment for alcohol problems. As expected, actions from the Temperance Board and pathological gammaglutamyltransferase values (S-GT) were more common in this group than in the two less advanced (see Table 1).

When we compared the "advanced consumers" with the "low consumers" in terms of age- and education-scaled neuropsychological test results and age- and sex-scaled computer-tomographic measurements, no deficit whatsoever was observed. Thus, no relationship between moderate to heavy social drinking and signs of cerebral disorder was observed. However, when the "alcohol dependents" were compared with the "low consumers" in a series of *t*-tests, a trend of neuropsychological deficit and enlarged ventricles was observed. This trend was statistically significant in logical reasoning ( $p < 0.05$ ). The age- and education-scaled results of the male "alcohol dependents" are plotted in Fig. 3. However, only those neuropsychological functions are shown which often are impaired in alcoholic patients [2, 5, 15]. For reason of comparison we have also plotted the results of male alcoholic KARTAD patients. But for the higher

TABLE 1

SOME SOCIAL AND MEDICAL CHARACTERISTICS OF MALE AND FEMALE ALCOHOL-HABIT GROUPS RANDOMLY DRAWN FROM THE GENERAL POPULATION

	Male Alcohol-Habit Groups			Female Alcohol-Habit Groups		
	"Low consumers" (N=114)	"Advanced consumers" (N=69)	"Alcohol dependents" (N=13)	"Low consumers" (N=127)	"Advanced consumers" (N=46)	"Alcohol dependents" (N=18)
Chronological age, Mdn.	48 yrs	41 yrs	55 yrs	49 yrs	42 yrs	36 yrs
Secondary school or higher	50 %	53 %	15 %	35 %	46 %	56 %
Employed at least 16 hrs/week	85 %	82 %	69 %	75 %	91 %	67 %
Alcohol consumption when drinking the most in g absolute alcohol day, Mdn.	6 g	37 g	57 g	7 g	49 g	51 g
Duration of subjective loss of control	—	10 yrs	15 yrs	—	—	6 yrs
Pathological S-GT* (>1.0 $\mu$ Cat/l)	11 %	14 %	46 %	—	—	—
Actions from the Temperance Board	8 %	17 %	38 %	0 %	4 %	11 %

\*Since S-GT (gammaglutamyltransferase) is an unreliable indicator for heavy drinking in women it is not tabulated for the female alcohol-habit groups.

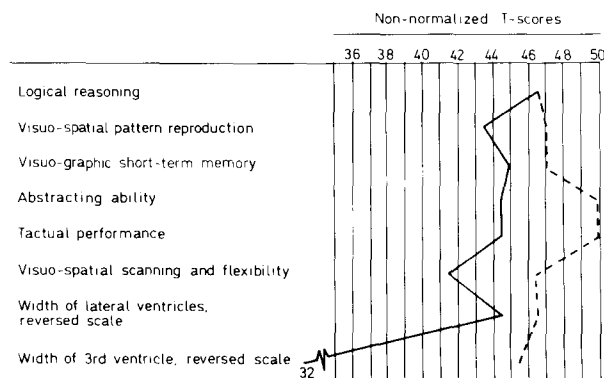


FIG. 3. Neuropsychological and computer-tomographic profiles of 13 randomly selected male "alcoholic dependents" from the general population (---) and 247 male alcoholic patients (—). The right most vertical line below number 50 corresponds to the value of the whole male random sample. The further to the left of this line, i.e., the lower the T-score, the more neuropsychological deficit and wider ventricles.

level, the profile of the "alcoholic dependents" does not deviate much from that of the alcoholic KARTAD patients, but the non-impaired abstracting ability and tactual performance should be noted. The greatly enlarged 3rd ventricle of the KARTAD patients should also be noted.

It was found that an unproportionately high number of the "alcoholic dependents" had widened cortical sulci. However, since this analysis was performed on unstandardized scores, the subjects were older than the "low consumers" and the fact that there is a correlation between advancing age and sulcal width in the general population [6] this finding should be interpreted with caution.

One-hundred and thirty-two women responded negatively to all the alcohol-habit questions of the Guttman scale and were thus called "low consumers." Forty-seven who scored 1, i.e., reported a consumption level of 30 g or more, were called "advanced consumers." Eighteen who scored 2 or more, i.e., responded positively also to the loss of control question and in a few cases also to the more advanced questions concerning morning drinks and blackouts, were called "alcohol dependents." One woman in this group reported previous hospital treatment for alcohol problems. The female "alcohol dependents" were younger and better educated than the less advanced women.

When we compared the female "advanced consumers" with the "low consumers" in a series of *t*-tests, no signs of any kind of deficit were observed. But when we compared the "alcohol dependents" with the "low consumers" a trend of neuropsychological deficit but not of ventricular enlargement was observed (see Fig. 4). This trend was statistically significant ( $p < 0.05$ ) in verbal learning (not shown in Fig. 4), and approached significance in logical reasoning ability. However, the deficit was very much less than that observed in the female KARTAD patients.

#### DISCUSSION

There was no correlation between amount of alcohol consumed on each occasion and neuropsychological or neuroradiological signs of cerebral disorder in an age-stratified random sample of 400 men and women from the

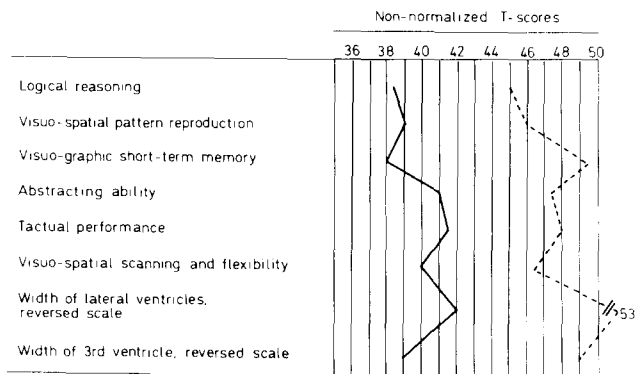


FIG. 4. Neuropsychological and computer-tomographic profiles of 18 randomly selected female "alcoholic dependents" from the general population (---) and 75 female alcoholic patients (—).

general population. Such a correlation with regard to neuropsychological deficit was reported by Parker *et al.* [13,14]. However, their samples of 45 and 102 male social drinkers were not representative of the general population, no neuroradiological examination was performed and there were important methodological differences.

In the present study, a cumulative scale of advancing alcohol-habits was constructed, based on reported daily alcohol consumption when drinking the most, and the responses to some other alcohol-habit questions. On the basis of the scale scores the sample was divided into "low consumers," "advanced consumers" and "alcohol dependents," separately for men and women. The "advanced consumers" and the "alcohol dependents" were compared with the "low consumers." The results indicated that alcohol dependence but not moderate to heavy drinking in the general population is associated with slight neuropsychological and neuroradiological signs of cerebral disorder. Stated differently, even a comparatively high level of alcohol consumption per se does not seem to be associated with cerebral disorder. Only in combination with such alcoholic behaviors as having blackouts and/or taking morning drinks is such an association observed. Thus, alcohol-dependent persons appear to have the same symptoms of cerebral disorder but to a lesser degree than those often diagnosed in medically treated alcoholics. The results also indicated sex differences in this regard, since the morphological cerebral changes observed in the male "alcohol dependents" were not evident in the female despite a trend of neuropsychological deficit. However, the less advanced alcohol dependency in the female sample than in the male should be considered.

Of course, the responses to drinking-habit questions cannot always be taken at face value. However, in order to make the data as reliable as possible, a combination of questionnaires and interviews was used. This data collection procedure was found to be satisfactory in a project where more than 700 alcoholic patients were investigated in our department [12].

There is a correlation between advancing chronological age and neuropsychological impairment, sulcal widening of the cortex and ventricular enlargement [6]. Furthermore, neuropsychological performance is correlated with formal education and ventricular size with sex (the diameter of the

3rd ventricle was 4.7 mm in the male and 3.9 mm in the female, a highly significant difference,  $t(343)=5.42$ ,  $p<0.001$ ). Since alcohol habits are correlated with age, and alcoholics often are less formally educated than non-alcoholics, age-, sex- and education-differences should be controlled for in the present type of studies. Here, a satisfactory control was achieved by using norm group-based T-scores.

The fact that the "alcohol dependents" of the present study, at least the male, evidenced signs of cerebral disorder of course cannot rule out the possibility that the suspected disorder in some of the subjects might have antedated the advanced alcohol-habits instead of being a probable consequence of them. As we have discussed elsewhere [3], reports

of correlations between the hyperactive child syndrome and alcoholism later in life makes this hypothesis plausible. Of course, it cannot be ruled out that the suggested mild cerebral disorder might also be due to undiagnosed pathological processes which are related to, but not caused by, the neurotoxic effects of alcohol abuse per se in some of the subjects.

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