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Preliminary Findings from a Study of the Effects of a Challenge Dose of Alcohol in Male Twins

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Abstract. Twelve pairs of MZ and 7 of DZ normal adult male twins were given a challenge dose of 0.8 mg ethanol per kg body weight diluted to a 30% v/v solution. Measures of blood alcohol, mood, craving for alcohol, body sway, heart rate and four psychomotor tasks were taken before, during and after intoxication. Genetic factors were found to be involved in the response of heart rate, body sway and two of the psychomotor tasks, but not in changes in blood alcohol, alertness or craving for alcohol. Drinking habits did not exert a strong influence upon acute responses to alcohol, but were significantly related to craving for alcohol whilst intoxicated.

Key words: Alcohol intoxication, Twins, Genetic factors

INTRODUCTION

Several studies have suggested that genetic factors may be involved in normal levels of alcohol consumption, and in some responses to alcohol. These investigations showed (a) a genetic influence upon the amount of alcohol consumed weekly by normal twins [2]; (b) identical EEG responses to alcohol among MZ twins [4]; and (c) an absence of genetic factors in the response of twins to alcohol, as measured by certain psychomotor tasks [5].

A tension reduction model of alcohol consumption suggests that changes in mood during intoxication may influence drinking patterns [3]. An investigation of this possible potentiator of alcohol consumption would be of interest in determining the mode of operation of those inherited factors associated with normal drinking levels. Furthermore, studying physiological and psychological responses to alcohol may clarify the role of

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genetic and environmental influences in alcohol use and its effects.

This report deals with some of the measures taken in a wide-ranging study of the acute effects of alcohol on normal twins. A number of tests of performance were made, but only some are described in this first report.

METHODS

Subjects

The subjects were 12 pairs of monozygotic (MZ) and 7 of dizygotic (DZ) adult male twins, aged between 18 and 53 years. All were normal, volunteer members of the Institute of Psychiatry Twin Register, and had responded to an invitation by letter to participate in the experiment, for which they received a small financial reward. All volunteers had been screened for the prescription of contra-indicated drugs.

Procedures

Subjects arrived at the Institute at 9.15 am, having consumed nothing from midnight the previous evening. Approximately two hours after arrival, subjects were given a challenge dose of 0.8 mg ethanol per kg body weight, diluted to a 30% v/v solution of water and low calorie orange squash. Subjects were allowed a maximum of 15 min to drink the mixture. They were given a meal of their choice 120 min after consuming the alcohol, and were free and fit to leave 260 min after the dose.

Upon arrival, each twin was given a set of questionnaires relating to personality and drinking habits. At seven points during the 240 min after alcohol consumption, heart rate, blood alcohol level, and body sway (measured by a Wright-Codoc Ataxiameter) were measured. At the same times, measures were taken of alertness (Lader Mood scale 1 [1]) and of craving for alcohol (measured on 100-point scale).

Subjects completed a range of psychomotor tests on arrival, at 60 and at 180 min after the consumption of alcohol. These tests included Digit Symbol and Symbol Copying tasks, Wechsler Logical Memory and the Seguin-Godard Form Board (performed blindfold).

RESULTS

The total weekly alcohol consumption of this sample appeared to involve genetic factors, as indicated by the intraclass correlations ($r_{MZ} = +0.48, P < 0.05$; $r_{DZ} = -0.35$, ns).

Mean blood alcohol levels for all subjects over the period of intoxication are shown in Table 1, together with data on craving for alcohol, alterness, heart rate, body sway and the results of the psychomotor tests. The overall change in mean craving level closely matches the change in mean blood alcohol levels: for example, craving for alcohol and blood alcohol level are positively correlated within individuals at 60 min after alcohol consumption ($r = 0.36, P = 0.01$). Alertness decreased during peak periods of intoxication, and subjects performed significantly less well whilst intoxicated on the four psychomotor tests. The only significant correlations between change in performance and blood alcohol level occured for the Symbol Copying task (at 60 min, $r = -0.47, P < 0.01$; at 180 min $r = -0.30, P < 0.04$).

Performance on all four psychomotor tests appeared to have important genetic components prior to alcohol, with significant MZ intraclass correlations (Table 2).

Changes in performance after alcohol on two measures had an important environmental component. During the period after alcohol consumption, both the change in craving for alcohol and the increase in time taken to complete the Form Board at 60 min after the dose were positively correlated with total weekly alcohol intake (Table 3). Thus,

Table 1 - Summary of Mean Responses to Alcohol

Test	Time after alcohol (min)						
	Pre	30	60	90	120	180	240
Blood alcohol (mg/l)							
Mean	0.0	92.03	96.45	87.58	78.07	62.4	44.00
SE		4.21	2.31	2.15	1.81	1.22	1.35
Body sway (20' arc)							
Mean	5.63	10.42	9.3	11.15	9.92	7.34	5.45
SE	0.78	2.17	1.6	3.19	2.14	1.14	1.05
Alertness							
Mean	642	570	555	550	570	642	675
SE	34.7	41.0	42.2	36.3	40.2	35.7	35.9
Craving for alcohol							
Mean	16.7	35.0	32.0	26.5	25.5	17.0	14.3
SE	5.0	8.0	6.83	6.72	6.34	5.14	4.8
Symbol copying (no. copied)							
Mean	142.25		137.56			151.5	
SE	3.11		3.13			3.21	
Symbol digit (no. copied)							
Mean	62.7		55.35			61.7	
SE	1.00		1.26			1.11	
Form board (sec)							
Mean	321.8		401.84			297.94	
SE	8.35		9.7			7.28	
Immediate memory (%)							
Mean	55.78		42.26			43.35	
SE	2.37		2.55			1.78	

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heavier drinkers experienced greater craving for alcohol and showed a greater deficit on the Form Board task.

Evidence for a genetic contribution to change in performance was assessed by computing an F ratio of the variance in the intraclass differences of change scores [6]. A significant F value suggests a genetic influence on the measure, as the DZ within-pair differences have a significantly greater variance than the MZ pairs.

No significant differences were observed for blood alcohol level. Consistent significant effects were found for both change in body sway and change in heart rate, after alcohol consumption, indicating the presence of genetic factors governing these responses (Table 4).

Although genetic factors existed in the prealcohol base levels of all four psychomotor tasks, the changes in performance of the Symbol Copying and Digit Symbol tasks did not show evidence of a genetic component. Genetic factors did appear to be involved in the decrease in performance whilst intoxicated for the Form Board ($F = 6.7$, $P < 0.01$, $df = 12,7$) and Immediate Memory ($F = 4.09$, $P = 0.02$, $df = 12,7$). There were no significant F ratios for changes in alertness, and only a small effect for changes in craving for alcohol (at 30 min after alcohol, $F = 3.51$, $P < 0.03$, $df = 12,7$). In general, these results show only small support for the suggestion that genetic components exist in most of these measures of the psychological effects of alcohol consumption.

DISCUSSION

The preliminary results reported here indicate that the relationship between consumption of alcohol, blood alcohol levels and performance whilst intoxicated, is highly complex, with both genetic and environmental factors having significant effects upon different aspects of the response to alcohol.

The alcohol dose used in this experiment has clear consequences for performance, mood and physiological functioning. Surprisingly, however, the correlations between performance changes after alcohol, the amount of alcohol consumed and blood alcohol levels are generally nonsignificant, although the small sample size may be an important constraint on the validity of this result. These findings suggest that there are sources of variation, other than those reported, which may be exerting an important influence upon individual responsiveness to alcohol. We hope that further observations will enable us to examine this phenomenon.

Genetic factors were observed for changes in the two physiological measures described - body sway and heart rate. Digit Symbol and Symbol Copying tasks displayed a strong genetic component in subjects' prealcohol performance, but no such effect when changes in performance after alcohol were measured. It seems likely that those factors influencing the basic prealcohol psychomotor performance may be unrelated to the ones affecting these abilities after alcohol consumption. The first appears to have a strong genetic component, the second does not. This is reinforced by the fact that apart from the Form Board score, none of the psychological or psychomotor variables showed any consistent genetic effects in their change after alcohol. This is consistent with results found by previous investigators [5].

The relationship of some of the variables to total weekly drinking is of interest. The positive correlation between alcohol craving and drinking total indicates that heavier

Table 2 - MZ and DZ Intraclass Correlations for Psychomotor Tests Before Alcohol

Test	Zygosity	r	P
Digit symbol	MZ	0.55	0.03
	DZ	−0.11	ns
Symbol copying	MZ	0.68	0.006
	DZ	0.3	ns
Immediate memory	MZ	0.85	0.001
	DZ	0.3	ns
Form board	MZ	0.61	0.01
	DZ	0.00	ns

Table 3 - Correlation of Changes in Craving for Alcohol and Time Taken to Complete From Board with Weekly Alcohol Intake

	Time					
Test	30	60	90	120	180	240
Craving for alcohol (Change from base)						
Mean	17.69	15.38	8.75	7.24	−0.37	−3.24
r	0.34	0.42	0.32	0.42	0.26	0.2
P	0.02	0.004	0.03	0.005	ns	ns
Form board (Change in sec)						
Mean		35.1			−14.86	
r		0.31			0.06	
P		0.03			ns	

Table 4 - Intraclass Correlations in Change Score

	Time from predose level (min)					
Measure	30	60	90	120	180	240
Heart rate change						
F	1.55	8.31	1.76	16.9	14.16	2.49
P	ns	0.001	ns	0.001	0.001	ns
df	12.6	12.7	9.7	11.7	11.7	10.7
Body sway change						
F	1.88	11.38	15.84	5.1	<1.00	4.92
P	ns	0.001	0.001	0.015	ns	0.02
df	10.6	11.7	8.7	10.7	10.7	9.7

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drinkers experience greater craving for alcohol during intoxication. They also show a greater deficit on the Form Board task. This might be indicative either of minor physical damage, or of a greater psychological response to intoxication amongst these subjects. The absence of any genetic factor in the change in alertness or craving after alcohol consumption provides no evidence for the suggestion that such mood changes may be involved in mediating the genetic variation found for normal drinking levels.

These preliminary findings suggest that the study of responses to alcohol in normal individuals contains much of interest to both the behaviour geneticist and those interested in alcohol consumption patterns. A variety of genetic and environmental effects have been found, using relatively simple statistical methods. An increase in the sample size and analysis of other measures taken will increase the value of this study.

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