

Acute effect of a brief bout of exercise on alcohol urges

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ABSTRACT

Aim To examine whether a brief bout of moderate intensity exercise reduces alcohol urges and mood disturbance in those with alcohol dependence.

Design A counterbalanced cross-over design (within-subjects).

Setting A hospital-based alcohol rehabilitation clinic.

Participants Twenty males and females [mean (SD) age = 40.1 (8.2) years, mean (SD) Severity of Alcohol Dependence Questionnaire score = 34.2 (13.4)] who had recently completed alcohol detoxification [mean (SD) days since completing detoxification = 3.5 (2.3)].

Intervention On the first day of experimentation all participants ($N = 20$) were randomized to undergo one of two conditions, either: (i) a single bout of 10 minutes of moderate intensity cycling (experimental), or (ii) a single bout of 10 minutes of very light intensity cycling (control). On the following day they underwent the remaining condition.

Measurements All participants completed the Alcohol Urge Questionnaire and a six-item measure of mood disturbance at the following times: (i) immediately before exercise (baseline), (ii) during exercise (at 5 minutes), (iii) immediately following exercise, (iv) 5 minutes following exercise and (v) 10 minutes after exercise.

Findings Relative to baseline, there was a significant decline in alcohol urges for the experimental condition versus control during exercise ($P = 0.02$) but not at any measurement point following exercise. At baseline, by chance, there was a non-significant tendency for there to be higher ratings of alcohol urges for the experimental condition versus the control. For mood, there was no evidence for significant differences between treatment conditions for baseline versus any subsequent measurement point.

Conclusions A brief bout of moderate intensity exercise may provide some short-term relief from alcohol urges during exercise. Further studies are required to replicate the present findings and to confirm whether any moderating effect of exercise on alcohol urges is sustained following exercise.

KEYWORDS Acute effects, alcohol urges, exercise, mood.

INTRODUCTION

Urges for alcohol are considered a defining characteristic of alcohol dependence (Pickens & Johanson 1992) and have been related to severity of alcohol dependence (Greeley *et al.* 1992; Glautier & Drummond 1994; Bohn *et al.*

1995) and negative affect (Greeley *et al.* 1992; Cooney *et al.* 1997). Severe alcohol urges and mood disturbance are likely to be a discomfort for those who are alcohol dependent and for some individuals these symptoms may contribute to relapse following treatment (Marlatt & Gordon 1980; Litt *et al.* 2000). Little is known about the

moderators of alcohol urges and few interventions are available which target these urges (Drummond *et al.* 2000).

A short bout of moderate intensity cardiovascular-type exercise has been shown to have an acute effect on reducing negative affect in the general population (Ekkekakis & Petruzzello 1999). Furthermore, a brief bout of moderate intensity cardiovascular exercise has been shown to have an acute effect on reducing tobacco withdrawal symptoms, including mood disturbance and urges to smoke in abstinent smokers (Ussher *et al.* 2001; Daniel *et al.* 2004). Brief cardiovascular exercise has also been shown to suppress appetite (Blundell & King 2000) and to reduce cravings for sugary foods (Thayer *et al.* 1993).

The present study examined whether cardiovascular exercise moderates urges for alcohol and mood disturbance following alcohol detoxification. If exercise were shown to be effective for this purpose exercise could be promoted in alcohol rehabilitation programmes as a strategy for managing alcohol urges and mood. For those undergoing treatment for alcohol dependence, exercise has been shown to be acceptable, to provide fitness and other general health benefits, and it is a low-cost intervention which is suitable for the vast majority of patients (Read & Brown 2003; Donaghy & Ussher 2004).

The aim of this study was to examine whether moderate intensity exercise has a significantly greater effect than very light intensity exercise on reducing alcohol urges and mood disturbance during and up to 10 minutes following a bout of exercise.

METHOD

Sample

Across a 3-month period, men and women undergoing alcohol detoxification at a psychiatric hospital in south-west London were invited to join the study by clinicians. Potential participants were invited to make contact by telephone, at which point the study was explained to them and they were screened for eligibility. The criteria were: complete abstinence from alcohol, aged 18–65 years, not pregnant, and not having any contraindications for exercise (Thomas *et al.* 1992). Using a written script, all prospective participants were informed that they would be taking part in a study which would involve them reporting their urges for alcohol and mood before, during and following 10 minutes of exercise. They were also informed that the exercise would be on a stationary exercise bicycle and would be no more intense than the equivalent of a brisk walk. Eligible individuals who expressed an interest in participating were invited to attend the laboratory.

The target sample size was 20. Based on studies of the acute effects of exercise on urges to smoke (Ussher *et al.* 2001) it was estimated that this sample size would have 80% power to detect a significant difference between the two conditions both during and following exercise. The volunteers participated in the study following 10–14 days of alcohol detoxification, at which time alcohol urges and mood disturbance tend to be heightened (Cantwell & Chick 1994). Between their admission for detoxification and the end of the study all the participants resided in the hospital and did not have access to alcohol. For all participants, abstinence from alcohol was confirmed by frequent random biochemical breath testing using a Lion Alcometer (SD-400). None of the participants were on selective serotonin reuptake inhibitor (SSRI) therapy, nor were any of the participants using anti-alcohol craving medications. Participants were offered modest financial compensation for their time in the form of vouchers for 'alcohol-free' stores and they provided written consent. The study was approved by the local ethics committee.

Experimental design

Using a counterbalanced cross-over design (within-subjects), a single group of 20 participants were assigned randomly to receive, on the afternoon of day 1, either: (i) a 10-minute bout of moderate intensity exercise (experimental), or (ii) a 10-minute bout of very light intensity exercise (control). They underwent the remaining condition on the afternoon of day 2. It was decided to include a control condition requiring very light intensity exercise, rather than a more passive control, because passive inactivity can exacerbate negative affect (Heide & Borkovec 1984). Additionally, the proposed control condition allowed for equal contact time with the experimenter across both conditions. Furthermore, this design allowed the hypothesis that any differences in outcome measures between the two conditions would be due largely to differences in physical workload, rather than due to differences in distraction. This design has been used previously in a study with abstinent smokers (Daniel *et al.* 2004).

Exercise tasks

Both exercise conditions involved a single bout of stationary cycling (Monark 824E). In the experimental condition a moderate intensity exercise prescription of 40–60% of heart rate reserve (HRR) was calculated for each individual (Karvonen *et al.* 1957; Franklin 2000). The controls were prescribed very light intensity exercise at 5–20% HRR. Each participant's exercise heart-rate was continuously measured via a chest transmitter

Table 1 Demographic characteristics of the sample ($n = 20$)

Variable	Percentage (frequency)
Female	35 (7)
Caucasian	95 (19)
Married/cohabiting	25 (5)
Professional/managerial	15 (3)
Smokers	75 (15)
	Mean (SD)
Age	40.10 (8.23)
Full-time education (years)	11.80 (2.33)
Severity of Alcohol Dependence Questionnaire score (range: 9–53)	34.15 (13.41)
Number of days spent in detoxification	10.25 (2.63)
Number of days since completing detoxification on day 1 of experiment	3.55 (2.28)
Days since last alcoholic drink on day 1 of testing	15.00 (3.61)
Body mass index (kg/M^2)	22.83 (2.65)
Hours of at least moderate intensity exercise in the previous week	2.03 (2.51)
Number of cigarettes per day ($n = 15$)	23.53 (10.49)
Concomitant psychiatric diagnosis	
Depression	75 (15)
Anxiety disorder	50 (10)
Suicide/self-harm	70 (14)
Multiple substance misuse	35 (7)

using a heart-rate monitor (Polar Advantage, New York, USA).

For both conditions there was a warm-up period of 1–2 minutes. On reaching the lower limit of the heart-rate prescription the 10-minute exercise bout commenced. In order to maintain the required exercise intensity participants were advised when to adjust their cycle speed. During the exercise tasks contact between the investigator and participant was kept to the minimum and this contact was equivalent across the two exercise conditions. Following 10 minutes of exercise, participants cooled down for 2 minutes at a reduced cycle speed.

Participants were asked to avoid strenuous exercise on the mornings before both conditions.

Measures

The baseline-only measures (see Table 1) included an assessment of current levels of physical activity (7-day physical activity recall questionnaire, Blair *et al.* 1985) and the Severity of Alcohol Dependence Questionnaire (Stockwell *et al.* 1983). Details of concomitant psychiatric illness were provided by each participant's consultant psychiatrist. Immediately before exercise, during exercise (after 5 minutes), immediately following the 10-minute exercise intervention, and 5 and 10 minutes following

the exercise intervention participants completed the eight-item Alcohol Urge Questionnaire (Bohn *et al.* 1995; 1 = strongly disagree, 7 = strongly agree) and a six-item measure of mood disturbance which has been shown to be sensitive to the acute effects of exercise (Steptoe *et al.* 1998). The six mood items were tense, unhappy, lively, nervous, hopeless and cheerful (1 = not at all, 5 = very).

The same investigators were responsible for supervising the exercise tasks and for collecting ratings of alcohol urges and mood. In order to avoid the investigators biasing the responses for mood and alcohol urges, contact between the investigator and respondent was minimal. These measures were presented on cards and participants responded orally without verbal prompts. For statistical analyses SPSS version 10 was used and all the tests were two-tailed. Baseline ratings of alcohol urges and mood were compared for the two conditions using analysis of variance (ANOVA). A series of condition by time ANOVAs were used to compare ratings for alcohol urges and mood for the moderate intensity exercise condition versus the control condition between baseline and during and following exercise. In addition, ANOVAs were employed to assess whether changes in alcohol urges were related to concomitant psychiatric illness. All analyses used absolute alcohol urge or mood scores.

RESULTS

Compliance

All the participants remained in their prescribed heart-rate zone throughout the 10 minutes of the exercise intervention.

Baseline comparisons

The baseline characteristics of the sample are presented in Table 1. As is standard, a composite alcohol urge score was calculated as the sum of the scores from the individual items (range = 8–56). ANOVAs did not reveal any significant differences in baseline ratings of alcohol urges or mood for the moderate intensity exercise condition (range of ratings at baseline = 8–46) versus the control condition (range of ratings at baseline = 8–54), although there was tendency for ratings of alcohol urges to be higher for the moderate intensity exercise condition versus the control (see Table 2 and Fig. 1). When considering outliers to be those exceeding the mean plus two standard deviations (Howell 2002), both conditions had just one high outlier (high outliers: experimental condition = rating of 46, control condition = rating of

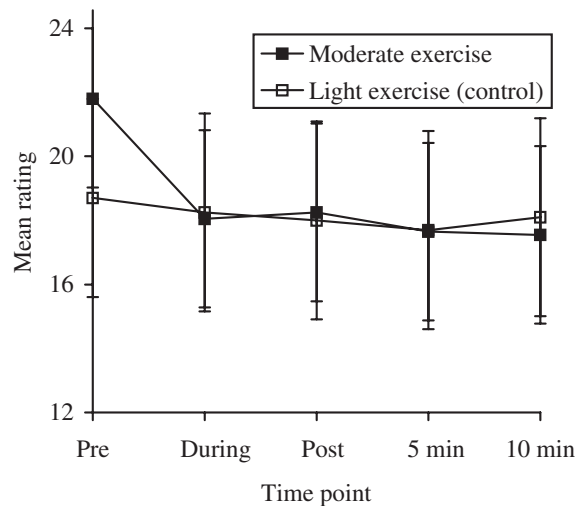


Figure 1 Mean rating of alcohol urges before exercise, during exercise, immediately following exercise and at 5 minutes and 10 minutes following exercise (standard error bars are shown)

54). Therefore, there is no evidence to suggest that the baseline ratings of alcohol urges tended to be higher for the experimental condition compared with the control condition due to high outliers.

Primary analyses

The primary outcome measures were changes in alcohol urges and mood from baseline (immediately before exercise) to during and immediately following exercise. A condition $\times$ time ANOVA, with planned comparisons, showed a significant interaction whereby there was a decline in scores for alcohol urges for the moderate intensity exercise condition versus control condition between baseline and during exercise ($F_{1,19} = 6.57$, $P = 0.02$, $\eta^2 = 0.257$, see Table 2 and Fig. 1). A further condition $\times$ time ANOVA, with planned comparisons, did not reveal any significant changes in alcohol urges scores between baseline and immediately following exercise for moderate exercise versus control ($F_{1,19} = 2.68$, $P = 0.12$, $\eta^2 = 0.124$). Additionally, condition by time ANOVAs, with planned comparisons, did not reveal any significant changes in any mood scores between baseline and during or immediately following exercise. Using a series of ANOVAs there was no evidence to suggest that the magnitude of change in ratings of alcohol urges between baseline and during moderate intensity exercise was related to any concomitant psychiatric diagnosis

Secondary analyses

Secondary outcome measures were changes in alcohol urges and mood from baseline to 5 and 10 minutes

Table 2 Mean (SD) rating for alcohol urges at each measurement point.

Measurement point	Moderate exercise mean (SD)	Light exercise mean (SD)
1. Before exercise (baseline)	21.80 (10.19)	18.70 (14.09)
2. During exercise	18.05 (13.12)	18.25 (13.99)
3. Immediately after exercise	18.25 (13.09)	18.00 (13.80)
4. 5 minutes after exercise	17.65 (13.11)	17.70 (13.0)
5. 10 minutes after exercise	17.55 (12.48)	18.10 (14.34)

following exercise. Condition by time ANOVAs, with planned comparisons, did not reveal any significant changes in any mood scores or alcohol urge scores between baseline and 5 minutes or 10 minutes post-exercise for moderate intensity exercise versus control.

DISCUSSION

This is the first study to report the acute effects of exercise on alcohol urges. The results provide some evidence to suggest that a short bout of moderate intensity exercise may reduce alcohol urges during the exercise. This was an experimental study using a rating of alcohol urges and the rating units are arbitrary, therefore the clinical significance of a reduction of 3.75 units in the ratings for the moderate intensity exercise condition between baseline and during exercise has yet to be determined. By chance, the ratings of alcohol urges tended to be higher at baseline for the moderate intensity exercise condition versus the control condition (see Fig. 1 and Table 2) and this increased the likelihood of finding a significant reduction in alcohol urges during exercise for the moderate intensity exercise condition versus the control. Therefore, the observed beneficial effect of moderate intensity exercise on ratings of alcohol urges during exercise requires replication. Additionally, further studies, with larger sample sizes, are required to confirm whether any moderating effect of exercise on alcohol urges is sustained following exercise.

The hypothesis behind the study was not made known to the participants; however, the psychological benefits of exercise are now widely known and it is possible that the participants' expectations influenced the outcomes of the study. For example, the observed significant effect of moderate versus very light intensity exercise on ratings of alcohol urges during exercise may be partly due to an expectation bias, whereby the participants expected a greater reduction in alcohol urges during the moderate intensity condition relative to the very light intensity condition. Future studies need to explore this issue through assessing the participants'

expectations for the effects of different experimental conditions on alcohol urges.

The acute effects of moderate intensity exercise on alcohol urges reported here are weaker than have been found for urges to smoke (Ussher *et al.* 2001; Daniel *et al.* 2004). In addition, the present study observed no effects of exercise on mood, whereas previous studies have shown a significant reduction in cigarette withdrawal-related mood disturbance following a short bout of exercise (Ussher *et al.* 2001; Daniel *et al.* 2004). In the current study the chances of finding a significant effect of exercise on mood may have been reduced because the vast majority of the sample had a concomitant psychiatric disorder. It is also possible that exercise is more effective for moderating withdrawal from central nervous system (CNS) stimulants (e.g. tobacco) than it is for moderating withdrawal from CNS sedatives (e.g. alcohol). Further studies are needed to explore these hypotheses. Studies are also required to examine the acute effect of different modes, durations and intensities of exercise on mood and alcohol urges in this population, and using more comprehensive measures of mood. For example, increasing the duration of exercise has been shown to result in greater reductions in withdrawal symptoms and urges to smoke in abstinent smokers (Ussher *et al.* 2001; Daniel *et al.* 2004) and it is possible that a bout of exercise exceeding 10 minutes could have a more pronounced and sustained effect on moderating alcohol urges and mood disturbance among those receiving treatment for alcohol dependence. The absolute level of ratings for alcohol urges and mood may have been influenced by the environment in which the study was carried out; however, this influence would be equivalent for both the experimental condition and the control condition. Studies of the effects of exercise on alcohol urges and mood need to be carried out with community-based samples and at different stages of alcohol rehabilitation.

The mechanisms underlying any moderating effects of exercise on alcohol urges during exercise are unclear. There is evidence to suggest that part of the mechanism underlying the psychological benefits of exercise is distraction (Breus & O'Connor 1998) and it is possible that exercise offers a coping strategy for diverting attention away from alcohol urges. In the current study an attempt was made to control for the distracting effects of exercise by including a condition which demanded very light exercise. However, it is possible that exercise acts as a distraction only once a certain level of exercise intensity is achieved, such that very light exercise does not provide any distraction. To explore fully the role of distraction in this context future studies need to include control conditions which entail standard distraction tasks, such as computer games or reading.

It is possible that effects on serotonergic systems could mediate any effect of exercise on alcohol urges. For example, reduced serotonin is associated with alcohol dependence (Heinz *et al.* 2001) and there is also some evidence to suggest that cardiovascular exercise results in activation of central serotonergic systems (Chaouloff 1997; Weicker & Struder 2001). Elevations in blood glucose levels and reductions in cravings for sugars during exercise could also play a role in mediating a beneficial effect of exercise on alcohol urges (Edwards & Hopkins 1993; Thayer *et al.* 1993; Anderson & Woodend 2003). Future studies need to explore the mechanisms underlying any effects of exercise on alcohol urges through monitoring psychophysiological changes both during and following exercise.

The present study was an experimental study of alcohol urges and mood rather than a study of clinical outcomes. For those who are alcohol dependent, alcohol urges are likely to be distressing and these symptoms may lead to relapse in some individuals (Marlatt & Gordon 1980; Litt *et al.* 2000); therefore, if exercise were shown to produce an acute reduction in alcohol urges it may be an attractive self-help strategy, providing immediate relief for those experiencing severe alcohol urges. However, if reductions in alcohol urges during or following exercise are to have clinical significance then future studies will need to demonstrate that any beneficial effects of exercise translate into clinical outcomes, for example through increasing rates of abstinence from alcohol. Specifically, such studies will need to examine whether a regular exercise programme increases rates of abstinence from alcohol and whether any effects of exercise on abstinence rates are mediated by reductions in alcohol urges during or following exercise.

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