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The Influence of Physical Activity on Alcohol Consumption among Heavy Drinkers Participating in an Alcohol Treatment Intervention

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Abstract

Researchers have hypothesized that physical activity may be beneficial for individuals attempting to reduce their alcohol consumption, although few studies have actually tested this relationship. The purpose of the present study was to describe the physical activity of 620 male veterans enrolled in a treatment intervention study for heavy drinkers, and to determine whether greater involvement in physical activity was associated with greater reductions in alcohol consumption. Participants endorsed moderate physical activity at the baseline visit (median = 1.65 kilocalories/kilogram/day expended from physical activity), although physical activity declined during over time, $p = .011$. The most frequently endorsed activities included walking, gardening/yardwork, calisthenics, biking, swimming, weight lifting, golfing, and dancing. Regression analyses revealed no significant relationships between energy expenditure from physical activity and reductions in alcohol consumption at the six- and 12-month visits. Findings suggest that engaging in physical activity does not enhance treatment outcomes within interventions that do not specifically aim to increase physical activity. However, commonly endorsed activities may be easily incorporated into interventions in which physical activity is a desired component.

Keywords

Alcohol; Drinking; Physical Activity; Exercise; Energy Expenditure; Veterans

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1. Introduction

According to the Centers for Disease Control and Prevention (CDC), approximately 4.9% of individuals in the U.S. reported heavy drinking and 15.4% reported binge drinking in 2006 (CDC, 2007). Heavy drinking (i.e., consuming an average of > one standard drink per day for women and > two standard drinks per day for men; CDC, 2006) and binge drinking (i.e., consuming $\geq$ five drinks for males and $\geq$ four drinks for females within a two-hour period; NIAAA, 2004) are associated with a variety of health and psychological problems including liver cirrhosis, pancreatitis, cancer, accidental injuries, violent behavior, alcohol abuse, and alcohol dependence (CDC, 2004). Consequently, nearly 80,000 deaths annually were attributable to heavy drinking in the U.S from 2001 to 2005 (CDC, 2004). In order to reduce heavy drinking and binge drinking, researchers must gain a better understanding of the factors that influence alcohol treatment outcomes. Such information may be utilized to improve treatments for those attempting to reduce their alcohol use or abstain from alcohol consumption altogether.

Marlatt (1985a) has emphasized the need for individuals who attempt to reduce their alcohol use or abstain from alcohol consumption to develop a balanced lifestyle that includes enjoyable activities in addition to the necessary activities of daily living. Marlatt (1985a) hypothesized that living a balanced lifestyle may result in reduced negative affect and stress overall, and thus a reduced likelihood of lapse or relapse to alcohol use. Regular physical activity is one such lifestyle factor that may help individuals to cope with stress and may also function as an alternative to drinking. Marlatt (1985a) suggested that physical activity may even develop into a “positive addiction” that has a beneficial impact on mood and health. Although the impact of physical activity on substance use treatment outcomes remains largely unknown, several studies have provided initial evidence that physical activity interventions may improve alcohol or smoking cessation treatment outcomes (Marcus et al., 1999; Marcus, Albrecht, Niaura, Abrams, & Thompson, 1991; Martin et al., 1997; Murphy, Pagano, & Marlatt, 1986; Sinyor, Brown, Rostant, & Serganian, 1982).

There are several reasons why physical activity might be beneficial for those attempting to reduce alcohol consumption. Some researchers have suggested that engaging in physical activity results in feelings of pleasure or euphoria due to the release of endogenous opioids and dopamine (Read & Brown, 2003; Williams & Streat, 2004). As a result, individuals who engage in physical activity may be able to achieve a pleasurable state without using alcohol. Similarly, physical activity has been shown to improve the symptoms of Major Depressive Disorder (Babyak et al., 2000; Dunn, Trivedi, Kampert, Clark, & Chambliss, 2005), and to reduce drinking urges, anxiety, and depression among alcohol dependent individuals (Palmer, Vacc, & Epstein, 1988; Ussher, Sampuran, Doshi, West, & Drummond, 2004). Engaging in physical activity may also provide an opportunity for enjoyable social and recreational activities that might serve as substitutes for drinking (Marlatt, 1985a). There is evidence that many individuals with alcohol use disorders are interested in participating in adjunctive physical activity programs during alcohol treatment, and the perceived benefits of physical activity include tension and stress reduction (Read et al., 2001). For these reasons, it is plausible that physical activity may have a favorable impact among individuals trying to reduce or eliminate their alcohol intake.

Despite the potential benefits of engaging in physical activity, only two studies have prospectively tested the impact of physical activity on alcohol use within an alcohol treatment intervention (Murphy et al., 1986; Sinyor et al., 1982). Murphy et al. (1986) reported that among individuals consuming at least 45 standard drinks per month, those who were randomized to a running group consumed significantly less alcohol throughout an eight-week treatment period than participants in the no-treatment control group. In the running group, participants who ran

greater than 3.5 times per week reduced their drinking by 60 percent while those who ran less than 3.5 times per week reduced their drinking by only 24 percent. Further, individuals randomized to the running condition had significantly higher maximal oxygen levels (VO₂Max) at post-treatment than at baseline. Sinyor et al. (1982) reported that 69 percent of the residents of an inpatient rehabilitation center for alcohol use disorders who participated in a physical fitness program (i.e., stretching, calisthenics, aerobic exercise) were abstinent at the three-month follow-up period compared with only 38 percent of those who were not offered the fitness program. Additionally, individuals who participated in the fitness program had significantly lower body fat percentages and significantly increased VO₂Max. Thus, there is some evidence that physical activity may benefit individuals who are attempting to reduce their alcohol consumption within the context of a treatment intervention.

Finally, little is known about the physical activity patterns and preferences of individuals entering alcohol treatment programs. The results of one survey indicated that the most commonly endorsed physical activity preferences among individuals participating in an alcohol treatment intervention included walking, weight lifting, and cycling (Read et al., 2001). In the same study, approximately 46 percent of individuals reported exercising three or more times per week. Overall, initial findings suggest that many individuals with alcohol use disorders engage in regular physical activity, and may appreciate the opportunity to control their involvement throughout treatment.

The purpose of the present study was to describe the physical activity preferences and estimated energy expenditure from physical activity among male veterans enrolled in an alcohol treatment intervention for heavy drinkers. In addition, the relationship between involvement in physical activity and alcohol treatment outcomes was examined. Specifically, it was hypothesized that greater involvement in physical activity at each visit would be associated with greater reductions in alcohol consumption at the six- and 12-month follow-up visits. The findings will provide important information about the influence of physical activity on alcohol use within alcohol treatment interventions.

2. Method

2.1. Participants

All participants met criteria for the Prevention and Treatment of Hypertension Study (PATHS), which evaluated the effects of a cognitive-behavioral intervention on alcohol consumption and blood pressure (Cushman et al., 1994). Male and female veterans were enrolled in the study if they were ambulatory, between the ages of 21 and 79 years, and possessed high normal or mildly hypertensive blood pressure (average of six readings over three visits between 80 and 99 mm Hg diastolic and ≤ 179 mm Hg systolic). Participants were asked to withdraw from antihypertensive medications prior to entering the study. Participants were eligible to participate if they reported consuming at least 21 beverages containing alcohol per week during the previous six months, as this level of alcohol consumption is consistent with currently accepted definitions of heavy drinking and is specifically associated with elevated blood pressure (see Cushman et al., 1994). Individuals were excluded from the study if they had alcohol-related medical conditions, major psychiatric diagnoses, cardiovascular end-organ damage, severe or secondary hypertension, malignancies, seizure disorders, coagulopathies, or met criteria for alcohol or other substance dependence.

2.2. Measures

Demographics and Health Information—Age, race, education, and other demographic information were obtained in a brief interview. Medical history variables (e.g., diagnoses,

presence or absence of exclusion conditions) and anthropometric data were obtained by interview, medical record review, and physical examination.

Alcohol Dependence Scale (ADS-10)—The ADS-10 is a self-report measure of the presence and severity of alcohol dependence (Skinner & Horn, 1984). This scale was administered at the first screening visit. Individuals who scored ≥ 5 on this measure were excluded from the study and referred to an external alcohol treatment program.

Lifetime Drinking History (LDH)—The LDH is a structured interview instrument that quantifies drinking behavior from the onset of regular drinking to the present (Skinner, 1982). This measure was administered at the second screening visit to identify individuals who met the primary eligibility criterion (i.e., consumption of an average of at least 21 drinks per week during the past six months).

Chronologic Drinking Record (CDR)—The CDR is an interview-assisted measure that creates a profile of drinking events occurring during the week ending the day preceding the interview (Gerstel, Mason, Piserchia, & Kristiansen, 1975). The CDR was used as the primary alcohol intake measure in the current study and responses were used to estimate intake in grams per week (g).

Beck Depression Inventory (BDI)—The BDI is self-report questionnaire designed to measure depression severity, with higher scores suggesting greater severity of depression (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961).

National Health Interview Survey, Health Promotion Disease Prevention, Survey Form (NHIS-HPDP)—The NHIS-HPDP is measure of self-reported physical activity during the previous week. Participants indicated the frequency and duration of their involvement in a variety of common activities. Average daily kilocalories expended per kilogram during the previous week (kcal/kg/day) was computed by multiplying 1) the number of times the participants reported engaging in each activity during the past week, by 2) the number of hours spent in the activity on each occasion, by 3) the associated metabolic equivalent (MET). The weekly values computed as described above were divided by seven to obtain a daily value. The MET values utilized in the present study have previously been used with older adults (Stewart et al., 2001), and range from two through seven depending on the intensity of the activity.

2.3. Procedure

Data for the current study was collected between 1990 and 1995 as part of PATHS, a prospective, randomized, Veterans Affairs Cooperative Study that examined the effects of reduced alcohol consumption on hypertension in moderate to heavy drinkers at seven sites. Veterans who reported consuming at least 10 drinks per week during the previous six months were invited to attend three screening visits. Eligible participants were enrolled in the study via a telephone call to the coordinating center. Treatment assignments were determined using a fixed randomization scheme with uniform allocation, stratification by clinic, and variable block size. The study included a pre-randomization screening phase (resulting in randomization or exclusion), followed by a six-month initial treatment phase and an 18-month maintenance phase.

Participants were randomly assigned to either a control observation condition or a cognitive-behavioral alcohol reduction condition that consisted of six individual sessions during the three month intensive treatment phase, at least three sessions during the remaining three months of the treatment phase, and at least six sessions during the maintenance phase. The cognitive-behavioral intervention was developed based on treatment materials published by Marlatt

(1985b), Miller and Munoz (1976), Sanchez-Craig (1984), and Sanchez-Craig (1987). The goal of the alcohol reduction intervention was to limit alcohol intake to no more than 14 drinks per week and to at least 50% less than the participant's intake at baseline. The intervention was implemented by professionals from a variety of disciplines, including social work, psychology, and nursing, who were centrally trained in the intervention techniques as well as common problems within medical populations. Videotaped practice of intervention techniques with a volunteer was required of all interventionists during the training protocol. Quality control was maintained through monthly conference calls, in addition to individual consultation and retraining as needed. Participants who were randomized to the control observation group attended data collection visits only. Participants who developed signs of alcohol dependence during the treatment intervention were maintained in the study, but referred to an external treatment program. Study personnel involved in data collection were blind to participant intervention assignment. The rationale, design, and primary outcomes of the PATHS project have been described in detail elsewhere (Cushman et al., 1994; Cushman et al., 1998).

3. Results

3.1. Participant Characteristics

Data for 620 male veterans were included in the present study. A total of 311 participants were randomized to the alcohol intervention, and 309 participants were randomized to the control group. There were no differences between the intervention and control groups in age, race/ethnicity, body mass index (BMI), years of education, current smoking, cigarettes smoked per day, weekly alcohol consumption, or ADS-10 scores. The mean age of the participants was 56.89 years ($SD = 11.14$), and ages ranged from 25 to 78 years. A total of 74.8% ($n = 464$) of the participants were White, 19.7% ($n = 122$) were Black, and 4.8% ($n = 30$) were Hispanic. Less than 1% ($n = 4$) of the participants were of American Indian or other descent. Participants in the study had a mean BMI of 27.94 ($SD = 4.7$) and reported an average of 13.1 ($SD = 2.9$) years of education. Participants reported consuming an average of 441.62 ($SD = 302.9$) grams of alcohol per week at baseline, which is equivalent to approximately 32 standard alcoholic beverages per week, and the mean score on the ADS-10 was 1.57 ($SD = 1.38$). A total of 38.9% of the participants reported current smoking, and the mean number of cigarettes smoked per day among those who were smoking was 25.27 ($SD = 14.61$).

3.2. Physical Activity Prevalence

A non-normal distribution of physical activity was observed among study participants, thus medians and interquartile ranges (IQR; 25th to 75th percentile) are reported for all physical activity variables and non-parametric statistics were utilized. A median total of 1.65 kcal/kg/day (IQR .4 – 4.2) was expended from physical activity during the previous week among those who provided physical activity information at baseline ($N = 619$). The most commonly endorsed activities at baseline included walking, gardening/yard work, calisthenics, biking, swimming, weight lifting, golfing, and other dancing (not including aerobic dance). Based on the criteria utilized by Schoenborn (1986), approximately 47.1% of participants were classified as sedentary (≤ 1.4 kcal/kg/day) at the baseline visit, 17.3% were moderately active (1.5-2.9 kcal/kg/day), and 35.5% were very active (≥ 3 kcal/kg/day). At the baseline visit, participants reported that they had engaged in some form of physical activity on a median total of five occasions (IQR 1 – 8) during the previous week, and the median amount of weekly self-reported physical activity was 200 minutes (IQR 45 – 480). Approximately 19.5% of participants at baseline reported that they had not engaged in any physical activity during the previous week, while 56.9% of participants engaged in at least 150 minutes of physical activity which is consistent with currently accepted recommendations (Haskell et al., 2007). Spearman correlations indicated average daily cigarette consumption was inversely associated with total kcal/kg/day expended from physical activity at baseline, Spearman's $\rho = -.134$, $p = .002$.

However, baseline age, BMI, and years of education were not significantly associated with baseline energy expenditure from physical activity.

Mann-Whitney tests indicated that participants did not differ significantly by intervention group at any visit on kcals/kg/day expended from physical activity, physical activity occasions per week, or minutes of physical activity per week. Therefore, the intervention and control groups were combined for analysis. Friedman tests indicated that the total kcals/kg/day expended from physical activity, $\chi^2(2, N = 475) = 9.08, p = .011$, as well as weekly physical activity occasions, $\chi^2(2, N = 461) = 11.74, p = .003$, declined significantly over time among participants who attended all of the visits (i.e., baseline, six-month, 12-month visits). However, no decline in minutes per week of physical activity was observed, $\chi^2(2, N = 461) = 4.63, p = .099$. See Tables 1 and 2 for the physical activity prevalence of participants from baseline through the 12-month follow-up visit. Spearman correlations indicated that baseline age, BMI, years of education, and average daily cigarette consumption were not significantly related to changes in total kcals/kg/day expended from physical activity from baseline at the six-or 12-month visits.

3.3. Physical Activity and Depression

Non-normal distributions of physical activity and BDI scores were observed among study participants, therefore non-parametric statistics were utilized in all analyses. Mann-Whitney tests indicated that participants did not differ significantly by intervention group at any visit on BDI scores, thus the intervention and control groups were combined for analysis. Friedman tests indicated that BDI scores declined significantly over time among participants who attended all visits (baseline median = 5, IQR 3-9; six-month median = 4, IQR 2-8; 12-month median = 4, IQR 2-8), $\chi^2(2, N = 451) = 35.54, p < .001$. Spearman correlations were computed with kcals/kg/day expended from physical activity at the baseline, six-, and 12 months visits; change in kcals/kg/day expended from physical activity between baseline and the six-and 12-months visits; BDI scores at the baseline, six-month, and 12-month visits; and change in BDI scores between baseline and the six-and 12-months visits. No significant correlations between energy expenditure and BDI scores were observed at any visit.

3.4. Physical Activity and Alcohol Consumption

Spearman correlations were computed to determine whether baseline ADS-10 scores were associated with total kcals/kg/day expended from physical activity at the baseline, six-, and 12-month visits or change in energy expenditure from baseline at the six-and 12 months visits. No differences between treatment conditions on baseline ADS-10 scores or energy expenditure were observed at any visit; therefore the treatment conditions were combined for analysis. Analyses indicated that baseline ADS-10 scores were negatively associated with total kcals/kg/day expended from physical activity at the six-month, Spearman's $\rho = -.089, p = .041$, and 12-month visits, Spearman's $\rho = -.098, p = .029$. However, baseline ADS-10 scores were not associated with baseline energy expenditure from physical activity or change in energy expenditure from baseline at the six-and 12-month visits.

A series of regression analyses were conducted to determine whether total kcals/kg/day expended from physical activity at the baseline, six-month, and 12-month visits would predict change (in grams per week) and percent change in weekly alcohol consumption from baseline at the six-and 12-month follow-up visits. In addition, change in energy expenditure from physical activity from baseline to the six-and 12-month visits was examined as a predictor of change (in grams per week) and percent change in weekly alcohol consumption from baseline at the six-and 12-month follow-up visits. The treatment groups (i.e., intervention group and control group) were analyzed separately due to the differential impact of the treatment groups on reductions in alcohol consumption among the participants (see Cushman et al., 1998).

Baseline alcohol consumption in grams per week was included as a covariate in each regression analysis to control for the impact of the amount of alcohol consumed at baseline on the amount of change possible. Regression analyses indicated that total kcals/kg/day expended from physical activity at the baseline, six-, and 12-month visits did not significantly predict change or percent change in alcohol consumption (g) from baseline at either the six-or 12-months follow-up visits (see Table 3 and Table 4). Similarly, changes in energy expenditure from baseline at the six-and 12-month visits did not predict change or percent change in alcohol consumption (g) from baseline at either the six-or 12-months follow-up visits.

4. Discussion

The findings of the present study suggest that engaging in physical activity prior to or during alcohol treatment does not enhance treatment outcomes within interventions that do not specifically target physical activity. It is interesting to note that participants in the study were moderately active at the initiation of treatment, and nearly half of the participants endorsed walking for exercise. In addition, a variety of other physical activities were commonly endorsed including gardening/yard work, calisthenics, biking, swimming, weight-lifting, golfing, and dancing. Although a relationship between greater physical activity and improved alcohol treatment outcomes was not identified, other studies have provided initial evidence that adding a physical activity component to an alcohol treatment intervention may improve short-term alcohol treatment outcomes (Murphy et al., 1986; Sinyor et al., 1982). Commonly endorsed activities such as walking for exercise may be included in future interventions in which a physical activity component is desired, as these activities may appeal to and fit into the lifestyles of many individuals.

The present study has several strengths and limitations. Strengths include the relatively large sample size, the racial/ethnic diversity of the participants, and the variation among study participants in activity level and type. However, the study was correlational and participants were not randomized to an exercise condition. Only male veterans were included in the study, therefore the relationship between physical activity and alcohol use in women cannot be determined. Further, the measure of physical activity utilized in the present study only assessed physical activity during the previous week and may not reflect typical physical activity levels in some cases. Although participants enrolled in the study reported heavy drinking, participants were excluded from the study if they met criteria for alcohol dependence. In addition, participants with major psychiatric diagnoses were excluded from the study. Finally, only individuals with elevated blood pressure were recruited for the study. Thus, the participants may not be representative of individuals from the general population who are seeking treatment for alcohol use. Rather, the sample utilized in the present study may be more representative of the veteran population of problem-drinkers.

Marlatt (1985a) has suggested that engaging in physical activity might improve alcohol and other substance treatment outcomes because physical activity is an alternative, competing, and pleasurable behavior, which may provide mood benefits and function as a coping skill in some high-risk situations for relapse. Future research studies must determine whether adding an exercise component to alcohol treatment interventions improves long-term treatment outcomes. If so, potential mediators and moderators of the relationship between physical activity and alcohol use should be explored to determine the mechanisms by which physical activity may impact alcohol and other substance use. More research is needed to determine whether physical activity may be a useful component of treatment interventions for alcohol and other substance use.

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Table 1

Physical activity at baseline, 6 months, and 12-months.

	Baseline	6 Months	12 Months	<i>p</i>
Kcals/kg/day from PA (median)	1.7 (IQR .4–4.2)	1.4 (IQR 0–3.7)*	1.4 (IQR .1–3.4)*	.011
PA occasions/week (median)	5 (IQR 1–8)	4 (IQR .5–7)*	3 (IQR 1–7)*	.003
Minutes per week of PA (median)	210 (IQR 45–480)	180 (IQR 5–445)	180 (IQR 14.5–420)	.099

Note: Medians and *p*-values represent only participants who provided data at every visit; IQR = interquartile range; Kcals/kg/day = kilocalories/kilogram/day; PA = physical activity

* Significantly different from baseline ($p < .05$)

Table 2

Commonly endorsed physical activities among study participants.

	Baseline	6 Months	12 Months
Walking for Exercise (%)	48.5	35.2	35.3
Gardening/Yard Work (%)	40.0	30.8	27.7
Calisthenics (%)	15.6	11.8	10.8
Biking (%)	10.0	6.8	6.6
Swimming (%)	8.5	4.5	5.3
Weight Lifting (%)	8.4	7.1	6.5
Golfing (%)	7.3	6.0	4.8
Dancing (%)	7.1	5.6	4.5

Note: Values represent the percentage of the total participants ($N = 620$) who endorsed participation in each activity during the seven days prior to the visit.

Table 3

The relationship between total kcals/kg/day expended from physical activity at baseline, 6 months, and 12 months, and change in alcohol consumption (g) from baseline to 6 and 12 months.

	M6 Change in Alcohol Consumption (g)					M12 Change in Alcohol Consumption (g)				
	B	SE	β	t	p	B	SE	β	t	p
Intervention Group										
BL kcals/kg/day	-2.54	3.61	-.04	-.70	.48	-.31	3.57	-.00	-.09	.93
M6 kcals/kg/day	-4.90	4.31	-.06	-1.14	.26	2.70	4.45	.03	.61	.55
M12 kcals/kg/day	-	-	-	-	-	4.63	3.42	.06	1.35	.18
Control Group										
BL kcals/kg/day	-5.08	3.54	-.08	-1.44	.15	.43	4.07	.01	.11	.92
M6 kcals/kg/day	-3.14	4.76	-.04	-.66	.51	-3.23	5.35	-.04	-.60	.55
M12 kcals/kg/day	-	-	-	-	-	1.36	5.17	.02	.26	.79

Note: Baseline alcohol consumption (g) was included as a covariate in each regression analysis.

BL = baseline visit; M6 = six-month visit; M12 = 12-month visit; Kcals/kg/day = kilocalories/kilogram/day

Table 4

The relationship between total kcals/kg/day expended from physical activity at baseline, 6 months, and 12 months, and percent change in alcohol consumption from baseline to 6 and 12 months.

	M6 Change in Alcohol Consumption (%)					M12 Change in Alcohol Consumption (%)				
	B	SE	β	t	p	B	SE	β	t	p
Intervention Group										
BL kcals/kg/day	-.25	2.26	-.01	-.11	.91	-1.81	2.86	-.04	-.63	.53
M6 kcals/kg/day	-3.59	2.66	-.09	-1.35	.18	.47	3.56	.01	.13	.90
M12 kcals/kg/day	-	-	-	-	-	2.20	2.73	.05	.81	.42
Control Group										
BL kcals/kg/day	-1.01	1.32	-.05	-.77	.45	-1.15	2.13	-.03	-.54	.59
M6 kcals/kg/day	-1.11	1.81	-.04	-.61	.54	-1.97	1.69	-.08	-1.17	.24
M12 kcals/kg/day	-	-	-	-	-	-2.15	2.71	-.05	.79	.43

Note: Baseline alcohol consumption (g) was included as a covariate in each regression analysis.

BL = baseline visit; M6 = six-month visit; M12 = 12-month visit; Kcals/kg/day = kilocalories/kilogram/day