Published in final edited form as:
J Am Coll Health. 2010 ; 58(6): 539–544. doi:10.1080/07448481003686034.

A Review of Exercise as Intervention for Sedentary Hazardous Drinking College Students: Rationale and Issues

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Abstract

College students have high rates of alcohol problems despite a number of intervention initiatives designed to reduce alcohol use. Substance use, including heavy drinking, often occurs at the expense of other, substance-free, activities. This review examines the promotion of one specific substance-free activity – exercise – as an intervention for hazardous drinking. Exercise has numerous physical and mental health benefits, and data suggest that students who engage in exercise regularly are less likely to drink heavily. However, the adherence to exercise necessary to achieve these benefits and possibly reduce drinking is poor, and improved exercise adherence interventions are needed. A novel combination of motivational enhancement therapy and contingency management is discussed as a means to address the critical issue of exercise adherence.

Keywords

hazardous drinking; college students; exercise adherence

National surveys such as Monitoring the Future, CORE, and the College Alcohol Study document that approximately 40% of college students engage in heavy or hazardous drinking (5 standard drinks for men/4 standard drinks for women) and between 20% and 25% of college students do so at least once per week[1,2]. The reasons college students drink heavily varies across individuals but drinking to cope or escape negative mood is common and has a robust association with negative consequences[3]. This paper explores an alternative intervention for hazardous drinking that seeks to address reasons for drinking.

The physiological effects of heavy drinking impair an individual's judgment and self-control, which in turn result in a host of risky behaviors and negative consequences including unplanned and/or unprotected sex, operating a motor vehicle while under the influence, blackouts, injuries (estimated at 500,000 annually), illnesses, legal problems, and even death (estimated at 1,400 annually)[4]. The negative consequences of heavy drinking impact others as well. For example, heavy drinking is associated with assault, rape, and other interpersonal violence, motor vehicle accidents, damage to property and vandalism, as well as other relationship problems[4].

Based upon this body of research, the federal government has set a public health goal to reduce heavy drinking in college students by half[5,6]. The National Institute of Alcoholism and Alcohol Abuse has also targeted heavy drinking in college students as a research priority with initiatives to improve screening and interventions for this population[7]. Although brief interventions such as motivational enhancement therapy (MET) have been shown to reduce heavy drinking in

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college students[8], few college students identify heavy drinking as a concern, and an even smaller percentage voluntarily seek treatment (approximately 2%)[9,10]. Therefore, offering interventions for heavy drinking that do not stigmatize or require an individual to see a mental health professional may increase the utility and acceptability of the intervention and ultimately increase the number of individuals effectively treated.

Relation between substance use and substance-free activities

Substance use, including drinking, can be conceptualized as a goal directed behavior that is governed by the principles of reinforcement. Animal studies repeatedly demonstrate that rates of alcohol and drug self-administration vary inversely with the availability of substance-free reinforcers such as food, wheel-running, and social environments (see Ahmed, 2005 for a review)[11]. In human studies, data are emerging that suggests alcohol use often occurs at the expense of other, substance-free activities[12]. Within college students, Corriea and colleagues[13] found that heavy drinkers reported lower frequency and enjoyment in certain substance-free activities (e.g., hiking, art projects, pleasure reading) in comparison to non-heavy drinkers.

Two experimental studies have investigated the efficacy of specifically increasing alternative substance-free behaviors as a means to decrease substance use in college students. Murphy, Pagano, and Marlatt[14] randomized 60 heavy drinking college students who were not seeking treatment into one of three conditions: an exercise intervention, a meditation intervention, or a no-treatment control group. Individuals in the exercise condition met three times per week as a group for eight weeks to engage in a structured and supervised running program. Meanwhile, individuals in the meditation condition meditated three times per week in a group setting. The no-treatment control did not meet during the intervention period. All participants engaged in a daily self-monitoring procedure of 15 behavioral variables including alcohol consumption. While this study offered a small monetary bonus of $4 per week for continued participation during the intervention period, both the exercise and meditation conditions suffered attrition (>30%). Despite this limitation, results indicate that the exercise group not only showed an increase in physical fitness but also had the greatest reductions in alcohol consumption during the 8-week intervention and 6-week follow-up. Reductions were significantly greater than the no-treatment control group (d = 0.97 to 1.19) and were primarily related to reductions in weekday drinking. The meditation group was similar to both groups in terms of alcohol consumption during the intervention and follow-up periods; however, power may have played a role as effect size estimates indicate a medium effect size of exercise in comparison to meditation, d = 0.56 to 0.71. Overall, this study provides preliminary evidence that increasing a specific substance-free activity (i.e., exercise) can decrease drinking in a non-treatment seeking sample of heavy drinking college students.

The second study to investigate promotion of substance-free activities in college students was conducted by Correia, Benson, and Carey[15]. In this study, 105 substance users (primarily alcohol) who were not seeking treatment were randomized to one of three conditions: instructions to reduce substance use 50%, instructions to increase physical and creative activities 50%, or a no-instruction control. Individuals then self-monitored for four weeks the target behavior for which they received instructions. At follow-up, college students in the activity increase group spent significantly more days exercising and engaging in creative activities than the other groups. They also significantly reduced their days of substance use and total number of standard drinks consumed in comparison to baseline. The findings were similar to Murphy et al.[14] -- increasing substance-free behaviors has a positive impact upon reducing alcohol use.

Exercise as a substance-free activity

Common to both of these experimental studies was the use of exercise as a substance-free activity. The choice of exercise is not accidental. Exercise has demonstrated substantial mental and physical health benefits (for a review see Penedo and Dahn)[16]. Exercise has been shown to improve cardiovascular health, decrease risks for various chronic diseases (e.g., type-2 diabetes mellitus, coronary heart disease, obesity), and improve health-related quality of life. Exercise has also well-established beneficial effects on reducing symptoms of depression and anxiety, lowering the risk of major depression relapse[17–19], decreasing urges to drink alcohol[20], and lessening nicotine withdrawal and cigarette cravings[21]. Exercise is consistently associated with positive mood by increasing feelings of vigor and reducing tension, fatigue, and confusion[22].

Numerous studies highlight that individuals who drink primarily for purposes of enhancement and coping drink greater quantities of alcohol and are more likely to experience alcohol-related problems than those who drink primarily for social reasons[3,23–26]. Given that exercise has been shown to help individuals cope with stress (d = 0.56 to 1.42)[27,28] and induce positive affect, it is expected that exercise will also be an effective intervention for college students who are drinking as a means of coping and enhancing mood. Exercise is preferable over other substance-free activities as a means of coping. North and colleagues[29] in a meta-analysis on the effects of exercise on depression found a small to medium effect size (d = 0.39) for exercise in comparison to engaging in non-exercise recreational activities of the participant's choice and a medium effect size (d = 0.50) of exercise when compared to relaxation. Similar effect size estimates are noted for anxiety. While improved coping is the most likely mechanism of action, the evidence is preliminary. Other theorized mechanisms of action include increased socialization[30,31], emotion regulation[32,33], and anxiety sensitivity[34,35]. Researchers investigating exercise as an intervention for hazardous drinking are encouraged to assess these additional possible mechanisms of action to ascertain if any are associated with outcome.

The current exercise guidelines include three components: (1) aerobic exercise a minimum of 3 to 5 times per week for a duration of approximately 30 minutes per session at moderate (noticeably increases breathing and heart rate) to vigorous intensity (substantial increases in breathing and heart rate); (2) a strength/resistance program 2 to 3 times per week with 1 to 3 sets of 8–15 repetitions of the major muscle groups; and (3) a flexibility or stretching program of the major muscle groups 2 to 3 times per week[36].

In addition, the Department of Health and Human Services has released the 2008 Physical Activity Guidelines for Americans[37]. These recommendations were developed for Americans of all ages. The guidelines suggest for substantial health benefits, adults should complete at least 150 minutes of moderate intensity aerobic exercise or 75 minutes of vigorous intensity aerobic activity per week. In addition, muscular strength or resistance exercise (moderate to high intensity) should be completed involving all major muscle groups at least two days each week[37].

Despite the beneficial effects of exercise, a significant proportion of college students are insufficiently active to gain the mental and physical health benefits of exercise. Approximately 40% to 50% of college students do not meet exercise guidelines[38,39] and the transition from adolescence to young adulthood is associated with an increase in sedentary behavior[40]. Therefore, sedentary college students have the most to gain from exercise interventions and as a substance-free activity it may influence drinking behavior.

Interventions to increase exercise

While few investigations have focused on college students[39], a plethora of studies have examined methods for initiating and adhering to an exercise program in various populations, including those with obesity, diabetes mellitus, cardiac disease, as well as older adults and patients with depression. Overall, these exercise studies demonstrate the difficulty of initiating and maintaining an exercise program. Many participants discontinue their exercise participation prior to realizing its many potential benefits[41,42]. A commonly cited statistic is that approximately 50% drop-out or do not adhere with the exercise regimen[43]. Conversely, several factors have been identified that are associated with successfully initiating and maintaining an exercise program[44]. These factors include social support, self-efficacy, motivation, having physical activity choices, goal setting and behavioral contracts, positive reinforcement, and feedback. More broadly, studies have found that while extrinsic motivation may be important for initiating exercise, intrinsic motivation is an important component for sustaining exercise[45,46]. To be successful exercise interventions must incorporate and address these important factors. A combination of MET and contingency management (CM) targeting exercise as an intervention has the potential to address the difficulties associated with initiating and sustaining an exercise program.

Application of MET to exercise

MET is defined as a client-centered, directive method for enhancing intrinsic motivation to change by exploring and resolving ambivalence[47]. Ambivalence, the feeling of being "stuck" between the positive and negative aspects of behavior, often prevents or inhibits change. A growing body of literature demonstrates that MET is a successful stand-alone intervention or as a module of a larger intervention across a variety of populations including healthy adults, older adults, obese adults, general medical outpatients, African Americans, cancer survivors, and individuals with diabetes mellitus and heart failure[48–55]. Overall, these MET interventions for physical activity have a medium effect size (d = 0.53) in comparison to no-treatment or placebo control groups[8]. One possible mechanism of action is that the MET intervention increased intrinsic motivation to exercise, as intrinsic motivation is a necessary component for long-term adherence to exercise[45,46]. Therefore, MET appears to be an appropriate and efficacious intervention for exercise.

Application of CM to exercise

Contingency management is a behavioral treatment in which tangible reinforcement is provided to individuals when target behaviors are completed and objectively verified. A large body of literature supports the use of CM for treating substance use disorders (SUD), as patients are typically reinforced with vouchers, exchangeable for retail goods and services, when objective evidence confirms abstinence from drugs (e.g., urine samples). CM is efficacious in a variety of SUD populations including alcohol dependent, opioid dependent, cocaine dependent, marijuana dependent, methamphetamine dependent, and methadone maintenance patients[56–60]. Consistently, in these and other studies, CM increases retention in treatment and engenders longer durations of drug abstinence (see meta-analyses[61,62]).

Contingency management has also been adopted to reinforce other behaviors besides drug abstinence. Studies have used CM to reinforce medication adherence, completion of therapy related-goals, and treatment attendance[63–65]. Common to all these applications of CM are three central tenets: (1) the environment is arranged such that target behaviors are frequently and easily monitored, (2) tangible reinforcers are provided whenever the target behavior is demonstrated, and (3) when the target behavior does not occur, rewards are systematically withheld (and sometimes a slight punisher may also be delivered). In fact, Lussier et al.[61] found that immediacy and magnitude of rewards were significant moderators of CM interventions'

effect sizes with more immediate access to large reinforcement increasing the effect size. See Petry[66] for a detailed description of CM procedures.

While CM can alter a variety of behaviors, few studies have utilized CM procedures for exercise. Several physical activity interventions utilizing contingent incentives have shown modest effects, while others have been ineffective. These differences in outcome appear to be related to the implementation of the interventions and adherence to CM principles. For example, Jeffery and colleagues[67] offered incentives (ranging from $1–$3, paid out monthly) for one specific exercise activity: attending a structured walking session in obese adults. Those receiving the incentives along with a personal trainer had better attendance at the walks than any other condition. Thus, incentives and personalized attention appear to positively impact the targeted behavior; however, the intervention did not impact overall exercise engagement or weight loss, probably because incentives were not offered for those specific target behaviors.

In another study, DeVahl, King, & Williamson[68] randomly assigned 210 physical therapy students to one of two incentive conditions that varied in magnitude. At the end of the semester participants were reinforced with either a bonus point on an exam or a bonus point on their overall course grade for changes in body fat related to exercise. The higher incentive condition suffered less attrition (38% vs. 53%) and lost significantly more body fat than those in the lower incentive condition. A significant shortcoming of this study is that the reinforcement offered was again small and was delayed until the end of the semester.

Conversely, studies showing more pronounced effects for incentives on physical activity are those that engage in frequent monitoring of the target behavior, offer tangible and immediate reinforcement, and withhold reinforcement when the behavior was not completed. For example, DeLuca & Holborn[69] using a within-subjects design found stationary bicycle pedaling intensity and duration increased significantly when children could earn points to purchase prizes (e.g., kites, model plane, puzzles) by pedaling at the prescribed level. The reinforcement program increased time spent pedaling from 14.1 minutes at baseline to 30.0 minutes during the intervention. Intensity, as assessed by revolutions per minute (rpm), increased from 65.5 rpm to 123.5 rpm.

In another study, Faith et al.[70] made television viewing contingent upon stationary bicycle pedaling in obese children. In the experimental condition, pedaling at the prescribed effort level immediately powered the television. In the control group, television viewing was not contingent upon bicycle pedaling. The contingent group increased physical activity levels, and concurrent reductions in body fat were found in comparison to the control condition. In two other studies that provided immediate positive rewards for physical activity (i.e., pedometer counts), the investigators found that the obese children were more physically active if access to video games and movies were used as rewards[71,72]. Finally, other studies have also found rewards efficacious in increasing adherence to exercise regimens in various populations including dual diagnosis patients, physically active adults, sedentary adults, and children with hemophilia[73–76]. Thus, it appears physical activity can be modified if monitored frequently, immediate and desirable rewards are offered, and reinforcement is withheld for noncompliance.

Therefore, drawing upon the successful contingent studies and lessons learned from limitations of other physical activity interventions using contingencies, a MET plus CM for exercise intervention needs to incorporate personalized attention, begin exercising according the individual's current level of fitness, utilize frequent monitoring of exercise behaviors, offer high magnitude rewards that escalate for continued completion of exercise behaviors, and enforce a reset contingency when exercise behaviors are not completed. The combination of these factors is likely to improve initiation and adherence to an exercise regimen in college students.

In summary, hazardous drinking is a significant concern within the college student population, and engaging in alternative substance-free activities appears be associated with reductions in alcohol use in college students, especially those not seeking treatment. Evidence from two small trials with college students highlights the potential of exercise as a substance-free activity. However, initiating an exercise program is problematic due to low adherence and dropout. The addition of CM to MET appears to be an intervention that might overcome many obstacles in initiating and adhering to an exercise program. By adhering to exercise, college students may gain the many benefits that it has to offer and potentially reduce the harmful consequences associated with hazardous drinking.

Acknowledgments

The research and preparation of this report was funded in part by National Institutes of Health grants P60-AA-003510 and R21-AA-017717.

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