

Influence of Exercise Intensity for Improving Depressed Mood in Depression: A Dose-Response Study

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Introduction: Exercise effectively improves mood in major depressive disorder (MDD), but the optimal exercise stimulus to improve depressed mood is unknown.

Purpose: To determine the dose–response relationship of acute exercise intensity with depressed mood responses to exercise in MDD. We hypothesized that the acute response to exercise would differ between light, moderate, and hard intensity exercise with higher intensities yielding more beneficial responses.

Methods: Once weekly, 24 women (age: 38.6 ± 14.0) diagnosed with MDD underwent a 30-minute session at

one of three steady-state exercise intensities (light, moderate, hard; rating of perceived exertion 11, 13 or 15) or quiet rest on a stationary bicycle. Depressed mood was evaluated with the Profile of Mood States before, 10 and 30 minutes post-exercise.

Results: Exercise reduced depressed mood 10 and 30 minutes following exercise, but this effect was not influenced by exercise intensity. Participants not currently taking antidepressants ($n = 10$) had higher baseline depression scores, but did not demonstrate a different antidepressant response to exercise compared to those taking antidepressants.

Conclusions: To acutely improve depressed mood, exercise of any intensity significantly improved feelings of depression with no differential effect following light, moderate, or hard exercise. Pharmacological antidepressant usage did not limit the mood-enhancing effect of acute exercise. Acute exercise should be used as a symptom management tool to improve mood in depression, with even light exercise an effective recommendation. These results need to be replicated and extended to other components of exercise prescription (e.g., duration, frequency, mode) to optimize exercise guidelines for improving depression.

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By 2030, DEPRESSION WILL BE ONE of the three most burdensome diseases worldwide (Mathers & Loncar, 2006). In 2003, it was estimated that depression accounted for \$44 billion in lost productivity in the United States alone (Stewart, Ricci, Chee, Hahn, & Morganstein, 2003). Unfortunately, current pharmacological antidepressant approaches are minimally effective with only approximately 30% of patients responding to initial treatment (Trivedi et al., 2006). Given the high level of disease burden, cost to society, and disappointing treatment effectiveness, it is imperative that research focuses on alternative therapies and on improving treatment efficacy.

An alternative to traditionally prescribed pharmacotherapies is exercise. Indeed, the National Institute for Health and Care Excellence in the U.K. recommends exercise therapy for mild depression (NICE, 2009). Chronic exercise training has been shown to be no different than common antidepressant treatments in reducing levels of mild to moderate depression (Barbour, Edenfield, & Blumenthal, 2007; Cooney et al., 2013; Lawlor & Hopker, 2001). However, the optimal dose of exercise is currently unknown. The majority of exercise research designed to improve depression has employed exercise prescriptions based on the American College of Sports Medicine's (ACSM) guidelines to promote and maintain health (Haskell et al., 2007). An elegant example examining the effect of these guidelines to reduce depression was performed by Dunn and colleagues (Dunn, Trivedi, Kampert, Clark, & Chambliss, 2005), who found that an exercise dose consistent with ACSM's guidelines reduced depression more than an exercise dose of roughly half of the guidelines. This research indicated a potential dose-response relationship between the amount of exercise and the reduction in depression. However, as these prescriptions are intended to improve general health, their application may not yield optimal improvements in psychological health.

Accordingly, there have been recent calls for systematic evaluations of the parameters of exercise prescription for patients with major depressive disorder (MDD; Perraton, Kumar, & Machotka, 2010; Rethorst & Trivedi, 2013; Stanton & Reaburn, 2014) to improve efficacy of exercise treatment. To this end, acute exercise studies could be employed to minimize participant burden and cost while allowing for detailed analyses of the moderating effects of specific parameters of exercise (e.g., intensity). Although acute studies cannot definitively determine the optimal parameters for exercise training programs to improve depression, they can probe the exercise-depression relationship and yield relevant information to aid in the design

and implementation of training programs. In addition, determining acute exercise-mood relationships will enhance depressed patients' abilities to use acute exercise as a symptom management tool.

We are aware of only one study specifically designed to determine the dose-response relationship of acute exercise intensity on mood in depression. In a published abstract, Nelson and Morgan (1994) tested three intensities of acute exercise on depressed mood (assessed via the Profile of Mood States; POMS) in six women with elevated levels of depression and six healthy controls. The participants were randomly assigned to 40%, 60%, or 80% of their estimated maximal heart rate and cycled for 30 minutes with each participant completing the three intensities on separate days. There was no significant effect of intensity on mood either immediately post-exercise or 15–20 minutes post-exercise, although they found a Time \times Group interaction demonstrating that the depressed group had a greater antidepressant response to exercise than the nondepressed group. However, due to the limited sample size and the lack of clinically diagnosed depression, no firm conclusions can be made regarding the intensity-affect relationship in depression from this investigation.

At present, there is mixed evidence for the presence and directionality of the relationship between exercise intensity and improvements in mood. Research that systematically evaluates the influence of exercise intensity and includes a sufficient sample of participants who meet diagnostic criteria for depression is necessary to further elucidate the exercise-depression relationship and begin to optimize exercise stimuli for improving depression in both the short and long term. Therefore, the purpose of this study was to determine if the intensity of exercise influences the acute effect of exercise on depressed mood in a sample of women diagnosed with MDD. According to the plausibility of a dose-response relationship between intensity and mood, we hypothesized that depressed mood following acute exercise would differ between light, moderate, and hard intensity exercise in depressed patients, with higher intensities yielding more beneficial mood changes.

Material and Methods

PARTICIPANTS

Twenty-four participants completed the study and were included for analysis; participant characteristics and baseline physical activity variables are presented in Table 1. Participants were recruited via newspaper advertisements in a local newspaper, a mass email to the campus community, and flyers

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