



Exercise as a buffer against difficulties with emotion regulation: A pathway to emotional wellbeing



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ABSTRACT

Though exercise is associated with emotional health, it remains unclear what psychological processes account for this relationship. The present study explores emotional recovery from and responses to stress as links. It extends prior research by exploring whether poor response tendencies, such as a ruminative response style, could mediate the relationship between regular exercise and clinical symptoms, and whether acute exercise facilitates emotional recovery from a stressor in a heterogeneous sample comprising sedentary as well as active individuals and those reporting mood and anxiety symptoms. Participants completed questionnaires, performed 30 min of cycling or stretching, and underwent a stressful speech task. State affect and difficulties with emotion regulation and rumination were measured at various time points. Minimal regular exercise predicted more depression, anxiety, and stress, and cross-sectional data suggest that poor stress response tendencies (more habitual rumination and low coping self-efficacy) could partially mediate these relationships. Relative to stretching, prior exercise did not affect initial reactions to the stressor or reports of struggling to regulate one's emotions. However, it attenuated the effects that rumination and difficulties with emotion regulation had on delaying emotional recovery. Results suggest that enhanced emotional resilience to the prolonged effects of stress accounts, at least in part, for the emotional benefits of regular exercise. There appear to be benefits afforded by even single sessions of exercise and cumulative benefits from regular activity for coping with stress.

Exercise is good for one's mental health as abundant research indicates. Cross-sectional studies show that regular exercise is associated with greater emotional wellbeing, fewer or less severe symptoms of depression, and lower anxiety (Goodwin, 2003; Harvey, Hotopf, Overland, & Mykletun, 2010; Ströhle, 2009). Prospectively, regular exercisers are less likely to develop emotional disorders in their lifetime than are non-exercisers (Harvey et al., 2017; Ströhle, 2009). And for those individuals diagnosed with depression and related psychopathology, exercise programs—particularly those involving moderate aerobic activity—tend to have significant treatment effects comparable to psychotherapy and antidepressants (Kvam, Kleppe, Nordhus, & Hovland, 2016; Schuch, Vancampfort, Richards, et al., 2016). Furthermore, in randomized controlled trials of exercise interventions dropout is lower for exercise than other conditions (Stubbs et al., 2016) and such programs can improve both physical and psychological quality of life as well as reduce symptoms of emotional disorders (Schuch, Vancampfort, Rosenbaum, et al., 2016).

Despite these replicated, positive findings, it remains unclear what psychological processes are altered by exercise that enhance resilience, emotional stability, and improve mood. Identifying such mechanisms

could aid targeted use of exercise for effective prevention and early intervention, provide tangible motivation to exercise regularly, and illuminate critical processes driving dysregulated mood. Because exercise alters multiple bodily systems, its beneficial effects on mental health likely arise from a dynamic network of interacting neurobiological, physical, cognitive, and psychosocial factors (Hopkins, Davis, VanTieghem, Whalen, & Bucci, 2012; Moylan et al., 2013). This project focuses specifically on the ability to weather and recover from stress as the pathway of interest. Clinical depression and emotional disorders more generally reflect difficulty altering, upregulating, or stabilizing one's mood after it has declined. Becoming stuck in negative mood states heightens risk for depression onset, maintenance, and relapse (Joormann & Vanderlind, 2014).

There are many studies on the effects of acute exercise on positive and negative affect. Exercise has a general “feel-better” effect (Biddle & Ekkekakis, 2012), not only increasing pleasure and other positive emotions, but also reducing anxiety and other distressing emotions (Yeung, 1996). And recent decades have seen growing specificity of this effect. For example, although some studies have found null or negative results (Backhouse, Ekkekakis, Biddle, Foskett, & Williams, 2007), it

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appears that improvements in self-reported affect most reliably accompany physical activity that is below one's ventilatory or lactate threshold. Additionally, whereas declines in pleasure are more likely during activity that is above threshold, such differences in state affect tend to disappear in post-activity reports (Ekkekakis, Parfitt, & Petruzzello, 2011). An intriguing moderator, however, is self-selection of exercise intensity. Self-selection tends to increase the likelihood of the “feel-better” effect, regardless of actual intensity (Ekkekakis et al., 2011; ZeRVAS, Ekkekakis, Emmanuel, Psychoudaki, & Kakkos, 1993). Importantly, much of this research has examined how people feel after exercising without any subsequent interruptions. Few studies have examined the effect of a single bout of exercise immediately prior to a stressor. In the present study, we aim to clarify how this “feel-better” effect manifests when people encounter emotional perturbations *after* exercising.

Experimental and observational research suggests that exercise changes how people react to and process experimentally- or naturally-induced emotional experiences. Rather than preventing or blunting initial negative emotional responses, exercise appears to facilitate emotional recovery. For example, in both between- and within-subjects experiments, a bout of prior aerobic activity attenuates the duration of negative affect following a stressor, apparently by helping individuals to overcome or be less impacted by emotion regulation difficulties (Bernstein & McNally, 2016, 2017). This hastening of recovery from negative emotion is consistent with studies showing that physically fit individuals return to their resting physiological state more easily after a stressor than do their non-fit peers, that exercise training can improve people's ability to physiologically withstand stress, and that physically active individuals are more resilient against the negative effects of rumination on cortisol reactivity than are sedentary individuals (Blumenthal et al., 1988; Calvo, Szabo, & Capafons, 1996; Puterman et al., 2011). Furthermore, in naturalistic, ecological momentary assessment studies, regular voluntary physical activity appears to lessen the effect of perceived stressors on negative affect even among underactive individuals, especially if a bout of physical activity is proximal to the reported stressor (Flueckiger, Lieb, Meyer, Witthauer, & Mata, 2016b; Puterman, Weiss, Beauchamp, Mogle, & Almeida, 2017). It also reduces emotional inertia, meaning that people who exercise do not necessarily have less frequent or intense negative emotions, but rather may be better able to recover from negative emotions when they arise (Bernstein, Curtiss, Wu, Barreira, & McNally, 2018).

In the present study, we extended this research in three ways. First, to explore enhanced coping in response to stressors as a pathway through which exercise counteracts mood symptoms, we examined the relationship among regular exercise, mood symptoms, and two examples of emotion response tendencies that could prolong stress-induced negative affect. Specifically, we hypothesized that participants reporting more frequent moderate to vigorous exercise would report less habitual rumination (repetitive, passive, self-focused thinking about one's experience), enhanced coping self-efficacy (confidence in one's ability to manage stressful situations and one's responses effectively), and fewer or less severe symptoms of depression, anxiety, and stress. Furthermore, we expected that less habitual rumination and greater coping self-efficacy to, at least partially, mediate the relation between regular exercise and mood symptoms. Both rumination and low coping self-efficacy are linked to prolonged negative affect following distressing events in and out of the lab (Chesney, Neilands, Chambers, Taylor, & Folkman, 2006; Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008) and negatively associated with an active lifestyle (Craft, 2005; Kishida & Elavsky, 2015; Steptoe, Edwards, Moses, & Mathews, 1989).

Second, using a psychosocial stressor as an ecologically valid mood induction, we aimed to replicate findings showing that prior aerobic activity facilitates emotional recovery following a stressor. Consistent with prior research, aerobic exercise (i.e. being assigned to the cycling condition as compared to the stretching condition) should moderate the

impact of poor coping on persistent negative affect. In other words, prior exercise should help those individuals who would otherwise struggle to bounce back after the stressor. Third, we recruited a sample with a wider, more representative range of exercise habits from sedentary to physically active individuals, and included those at risk for developing emotional disorders (i.e. participants reporting low mood, high anxiety, and high stress). Such diversity is important as most experimental research has concerned active, healthy participants, potentially limiting the generalizability of the results.

1. Method

Participants completed one in-person experimental session. The visit began with self-report questionnaires after which participants were randomly assigned to perform 30 min of moderate cycling or stretching. Participants then underwent a stressful speech task followed by a recovery period during which we assessed state rumination and reported difficulties with emotion regulation. State affect was measured at various points throughout the study period.

1.1. Participants

One hundred four young adults (60 women, $M_{\text{age}} = 19.94$, $SD = 2.05$, age range: 18–31) were included in our analyses. Prior to examining data, we excluded five additional participants due to non-adherence to the protocol, experimenter error, and technical difficulties. The ethnic and racial composition of the final sample was 62.5% Caucasian or white, 4.81% African American or black, 16.35% Asian or Asian American, 0.96% Native American or American Indian, 11.54% multiracial, 3.85% other or unreported, and 15.38% identified as Hispanic or Latino. Participants were recruited through the Harvard University Study Pool and included students and community members. Harvard University's Committee on the Use of Human Subjects approved the protocol, and participants provided written informed consent prior to beginning the study.

Eligible participants were at least 18 years old and able to read and sign the consent form. For safety and to avoid potential confounds related to extreme attitudes towards physical activity, we excluded potential participants if they were pregnant or possibly pregnant, answered “yes” to any question on the Physical Activity Readiness Questionnaire (PAR-Q) (Adams, 1999; Thomas, Reading, & Shephard, 1992) indicating physical or medical contraindications to exercise, or scored above the clinical cut-off (≥ 24) on the Exercise Addiction Inventory: Short Form (EAI) (Terry, Szabo, & Griffiths, 2004) suggesting risk for exercise addiction.

1.2. Procedure and materials

1.2.1. Baseline measures

Participants began the experimental session with a brief battery of self-report questionnaires, which included demographics (e.g. age, gender, ethnicity, race), trait rumination, coping self-efficacy, symptoms of depression and anxiety, and exercise habits. Resting pulse, height, and weight were also measured at baseline. The 22-item Ruminative Responses Subscale of the Response Style Questionnaire (RRS) captured the proclivity to ruminate following negative emotional experiences (Treyner, Gonzalez, & Nolen-Hoeksema, 2003). Higher RRS scores indicate more habitual and extreme rumination. Coping self-efficacy was assessed with the 26-item Coping Self-Efficacy Scale (CSE; Chesney et al., 2006). Participants are asked to rate how much they believe they could perform various behaviors related to coping on a scale from 0 (“cannot do at all”) to 10 (“certain can do”). Scores range from 0 (no self-efficacy) to 260 (maximum self-efficacy). Participants also completed baseline measures of mood and anxiety symptoms. The Depression Anxiety Stress Scales, 21-item (DASS-21) yields three subscales: depression, anxiety, and stress (Lovibond & Lovibond, 1995).

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