



Changes in physical activity and sedentary behavior associated with an exercise intervention in depressed adults



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ABSTRACT

Background: Exercise is beneficial for depression, but less is known about its impact on post-intervention physical activity and sedentary behavior. The aim of this paper was to determine the extent to which participation in light-, moderate- and vigorous-intensity exercise intervention influenced habitual physical activity and sedentary behavior patterns in depressed adults.

Methods: Accelerometer data was collected pre- and post-intervention from depressed participants randomized to one of three 12-week intervention groups: light ($n = 21$), moderate ($n = 25$) and vigorous ($n = 22$) exercise. Mixed models examined changes in time spent sedentary and in light and moderate-to-vigorous physical activity (MVPA); time accumulated in sedentary and MVPA bouts; and, number of MVPA bouts and interruptions in sedentary time.

Results: Overall sedentary time decreased while light activity time increased across all intervention groups but not significantly so. The light exercise intervention group reduced MVPA minutes (-8.22 , 95% CI: -16.44 , -0.01), time in MVPA bouts (-8.44 , 95% CI: -14.27 , -2.62), and number of activity bouts (-0.43 , 95% CI: -0.77 , -0.09). The moderate exercise intervention group reduced time in MVPA bouts (-6.27 , 95% CI: -11.71 , -0.82) and number of sedentary interruptions (-6.07 , 95% CI: -9.30 , -2.84). No changes were observed for the vigorous exercise intervention group.

Conclusions: The exercise intervention led to an increase in overall light physical activity and decrease in sedentary time, though neither change was statistically significant. Participation in the light and moderate exercise intervention groups was associated with reductions of time in MVPA bouts, but this was not evident for the vigorous exercise intervention group.

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1. Introduction

Physical activity has a beneficial role in depression (Farmer et al., 1988; Harvey, Hotopf, Overland, & Mykletun, 2010; Mammen & Faulkner, 2013; Song, Lee, Baek, & Miller, 2012; Stanton, Happell, & Reaburn, 2014; Vallance et al., 2011). The findings of a systematic review conducted in 2008 suggested that physical activity is

protective against depression even at low doses (Teychenne, Ball, & Salmon, 2008). According to Cochrane reviews, exercise interventions have a small to moderate effect in reducing depression compared to a placebo or a control group and can be equally effective as pharmacotherapy or psychotherapy (Cooney et al., 2013; Rimer et al., 2012), though other reviews have suggested that this effect is even larger (Ekkekakis, 2015; Rethorst, Wipfli, & Landers, 2009; Stathopoulou, Powers, Berry, Smits, & Otto, 2006). While the mechanisms for these benefits are likely to be complex, it is possible that they may include increased serotonin synthesis, hippocampal cell proliferation (Bjornebekk, Mathe, & Brene, 2005; Dunn & Jewell, 2010) reduced levels of pro-inflammatory cytokines (Eyre, Papps, & Baune, 2013), distraction, mastery and improved self-efficacy (Barbour, Edenfield, & Blumenthal, 2007).

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More recently, increased research attention has been directed at sedentary behavior – put simply, too much sitting as distinct from too little exercise – as a risk factor for several health outcomes. Self-reported sedentary time has been associated with increased risk of type 2 diabetes (Ford et al., 2010), poor health outcomes in general, such, cardiovascular disease and cancer (Thorpe, Owen, Neuhaus, & Dunstan, 2011) and higher risk of premature mortality (Matthews et al., 2012). Evidence concerning the association between sedentary behavior and depression is less clear. A recent review concluded that sedentary behavior is related to an increased risk of depression (Teychenne, Ball, & Salmon, 2011), and findings from a longitudinal study suggest that both sedentary behavior (assessed as TV viewing time) and low physical activity increased risk for depression (Lucas et al., 2011).

One important research question that has not been elucidated is whether those who participate in structured exercise programs subsequently change their overall physical activity and sedentary behavior. A recent review concluded that it is possible to reduce overall sedentary behavior through structured behavioral interventions, however, the interventions that were effective specifically targeted sedentary time, or had multiple components such as physical activity and nutrition (Martin et al., 2015). To date, no studies have examined the effects on sedentary behavior of prescribed exercise interventions for depression.

A limitation of previous exercise intervention studies in depressed adults is that all used self-report measures of physical activity and sedentary behavior. More recently, objective measurement devices have been used in physical activity research. These have primarily been enabling the assessment of participation in exercise interventions on patterns of overall physical activity and sedentary behavior (including sedentary time accumulated in longer bouts and interruptions in sedentary time). Accelerometer-measured sedentary time accumulated in longer bouts, for example 20 and 30 min, were found to have deleterious associations with cardio-metabolic health (Lyden, Keadle, Staudenmayer, Braun, & Freedson, 2015), while frequently interrupting sedentary time has a more beneficial association with metabolic risk (Healy et al., 2008; Healy, Matthews, Dunstan, Winkler, & Owen, 2011). Moderate-to-vigorous physical activity and sedentary time has been associated with depression, especially in overweight and obese adults, (Vallance et al., 2011) and a higher number of objectively-assessed sedentary bouts have been found to be associated with increased depression severity (Helgadóttir, Forsell, & Ekblom, 2015).

Before going further it is important to the aim of this paper to address the difference between exercise and physical activity. Physical activity is defined as all expenditure of energy through skeletal muscles while exercise is a subset of physical activity that is planned, structured, repetitive, and its purpose is to improve fitness (Caspersen, Powell, & Christenson, 1985). Where previous studies using data from exercise interventions for depression have restricted themselves to reporting impact on depressive symptoms, occasionally reporting the level of exercise/physical activity done by the participants at the end of the study, we will try to disentangle the concepts of exercise and physical activity to see how an exercise intervention for depression might impact on the habitual levels of physical activity and sedentary behaviour. The aim of our study therefore is to examine changes in overall accelerometer-measured physical activity and sedentary behavior associated with participation in light-, moderate- and vigorous-intensity physical exercise in depressed adults, comparing baseline with follow-up after the conclusion of the intervention using a unique dataset from one of the largest community-based RCT's on the effect of exercise on depression.

2. Methods

2.1. Study design

Data were derived from the Regassa study (protocol available at regassa.se), a pragmatic, single-blind, randomized controlled trial of three parallel intervention arms for depression, conducted in six Swedish counties and regions. One of the aims of the Regassa study was to evaluate the effectiveness of three different treatments for mild-to-moderate depression (Hallgren et al., 2015). The three intervention arms were exercise, internet-based cognitive behavioral therapy and treatment as usual. The current study uses the data only from the exercise arm and as it is a sub-study of the main study no power calculations were performed for the current analysis a priori. The Regassa study was originally registered with the Karolinska Clinical Registry (KCTR study ID: CT20110063) before the start of the study but as this registry has closed down the trial was re-registered at the German Clinical Trial Register (DRKS study ID: DRKS00008745).

2.2. Participants

Participant recruitment was undertaken through primary health care centers and via advertisements from the 14th of February 2011 to the 31st of January 2013. People aged 18–67 years, who scored ≥ 10 points on the Patient Health Questionnaire, corresponding to at least mild depression, were invited to participate. Exclusion criteria included insufficient understanding of Swedish, a primary diagnosis of alcohol or drug dependency or abuse, serious somatic disorders that precluded participation in exercise or was the underlying cause of depression as judged by their primary care physician, or a mental disorder requiring specialist psychiatric treatment (e.g. psychosis). Suicide risk was monitored throughout the study period and people at high risk were excluded from the trial and offered usual treatment by their physician.

Participants ($N = 310$) in the exercise arm were further randomized to three levels of exercise intensity: light, moderate and vigorous. The randomization was done by an external organization, the Karolinska Trial Alliance. The ratio of participants per group was 1:1:1. The assignment of the participants was computer generated and it was not possible to get the randomization information until all the pre-treatment measurements had been completed. Fig. 1 depicts how participants were included and excluded in the study. All participants provided a written informed consent and the study was approved by the Stockholm regional ethical review board (Dnr: 2010/1779-31/4).

2.3. Intervention

The 12-week exercise intervention was undertaken 3 times per week for approximately 55 min each occasion. For the duration of the study the participants had a free subscription to the fitness center chain. The “light” exercise classes consisted of basic yoga, stretching and balance movements (without a strong mindfulness component). The “moderate” group consisted of intermediate level aerobic exercise training. The standardized classes consisted mainly of dynamic whole body movements designed to increase heart-rate, such as light jogging and hopping exercises intermixed with isometric movements (e.g. knee bends). The “vigorous” aerobic exercise classes were more challenging with a stronger emphasis on the repetition of both static and explosive movements, such as push-ups and sit-ups, the focus being on higher intensity training. Objectively measured differences between the three exercise groups have been reported elsewhere (Helgadóttir, Hallgren, Ekblom, & Forsell, 2016). Further details on how the

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