



# Long-term effects of exercise at different intensity levels on depression: A randomized controlled trial



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## ABSTRACT

Previous research has shown positive effects of exercise on depression but studies have mainly focused on the short-term effects; few have examined the long-term effect, especially with regard to differences in intensity. The aim of this study was to examine the long-term effects of prescribed exercise on depression, performed at three intensity levels. People aged 18–67 years with mild to moderate depression (Patient Health Questionnaire-9 score of  $\geq 10$ ) participated in a single-blind, parallel randomized control trial lasting 12 weeks (Sweden 2011–2013). Four arms were included: Treatment as usual (TAU,  $n = 310$ ), light ( $n = 106$ ), moderate ( $n = 105$ ) and vigorous exercise ( $n = 99$ ). Severity of depression was measured at baseline, post-treatment and 12-month follow-up using the Montgomery-Åsberg Depression Rating Scale (MADRS). Coefficients ( $\beta$ ) and odds ratios were estimated using linear mixed models with time  $\times$  group interactions. The results showed that at the 12 month follow-up the light exercise group had significantly lower depression severity scores than the TAU ( $-1.9$ , 95% CI:  $-3.7$ ,  $-0.04$ ) and the moderate exercise group ( $-2.94$  95% CI:  $-5.2$ ,  $-0.7$ ). The vigorous exercise group had significantly lower scores than the moderate exercise group only ( $-2.7$ , 95% CI:  $-4.9$ ,  $-0.4$ ). In conclusion, compared to usual care for depression, only light exercise resulted in significantly lower depression severity at 12-month follow-up. Both light and vigorous exercise was more effective than moderate exercise.

**Trial registration:** The study was registered with the German Clinical Trial Register (DRKS study ID: DRKS00008745).

## 1. Introduction

Depression is a prominent public health issue with a reported life-time prevalence of between 13 and 16% (Alonso et al., 2004; Kessler et al., 2003). Although medication and some form of psychotherapy or a combination are the most commonly prescribed treatments (Olfson et al., 2002), poor compliance (Pigott et al., 2010), and adverse effects (Khawam et al., 2006) limits successful treatment. Exercise has been suggested as an alternative or complimentary treatment as it is free of the stigma that is sometimes associated with conventional treatments (Corrigan, 2004) and it also improves somatic health (Powell et al., 2011).

Cochrane meta-analyses have found small to moderate effects of exercise on depression when compared to no treatment or control (such as waitlist or social activity), and no difference when compared to

cognitive behavioral therapy or medication (Cooney et al., 2013; Mead et al., 2008; Rimer et al., 2012). However, a recent paper suggested that the effect of exercise may be larger than reported (Ekkekakis, 2015). Regardless of the size of the effect, reviews on the subject often lament the lack of studies with long term follow-up and studies of exercise characteristics, i.e. type, intensity, duration and frequency. Maintenance of treatment response is often poor in depression treatment, so determining the effects of exercise measured several months after the exercise intervention has finished is crucial.

To date, studies reporting long-term follow-ups have shown small effects on depression when exercise is compared to no treatment or control conditions (Cooney et al., 2013). One study found that exercise after the completion of an intervention predicted lower depression levels at the end of a one year follow-up (Hoffman et al., 2011). In a previous paper we reported that exercise was at least equally effective

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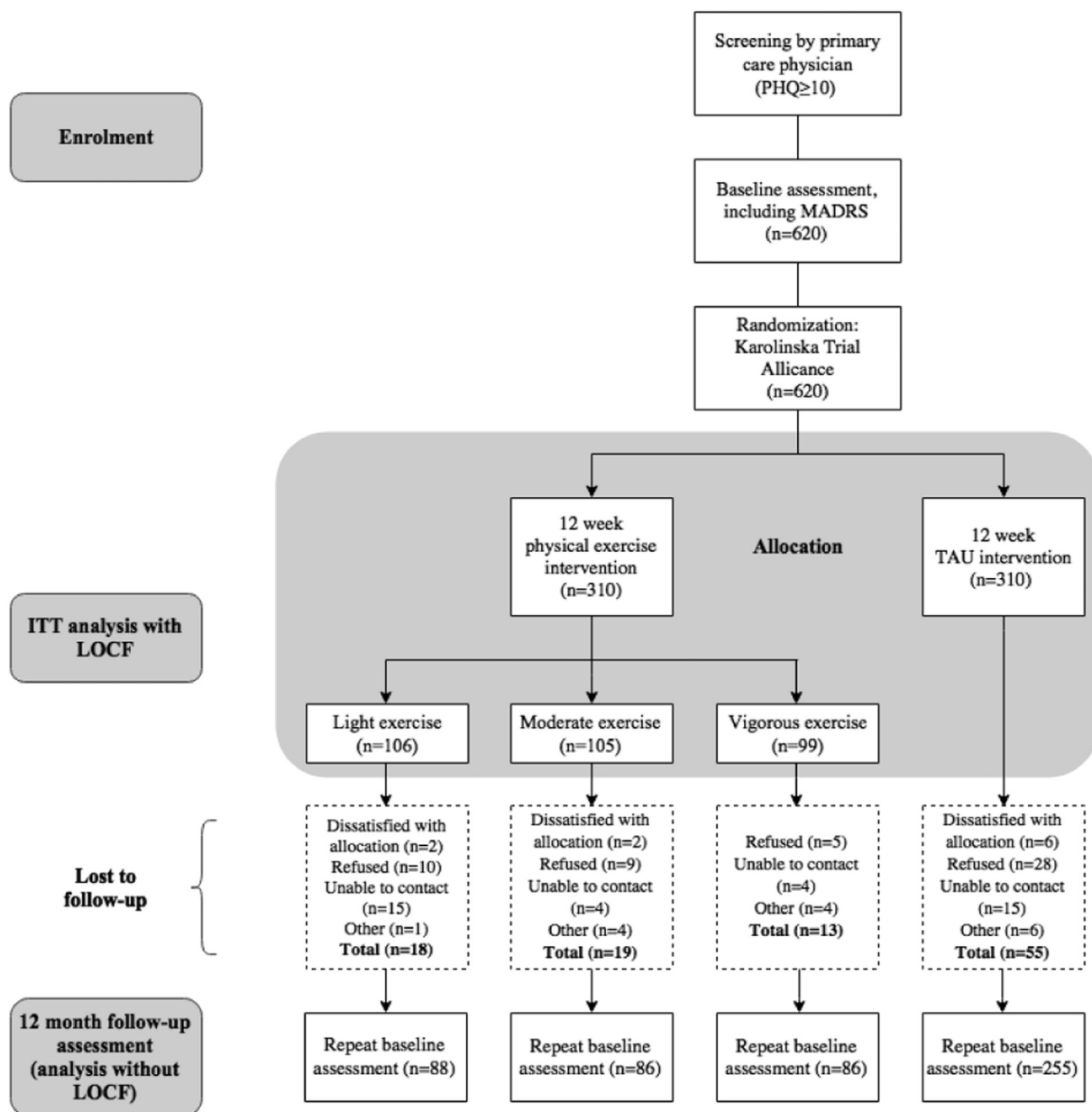


Fig. 1. Flow chart of the Regassa study (Sweden 2011–2013).

as treatment as usual or internet-based cognitive behavioral therapy in reducing depressive symptoms nine months after completion of a three month exercise intervention (Hallgren et al., 2016). Several reviews propose recommendations for optimal intensity and/or dose of exercise. One review suggest moderate or self-selected intensity, another recommended 60–80% of maximum heart rate (MHR) while yet another found that 61–74% of MHR was less effective than both lower and higher intensity exercise (Perraton et al., 2010; Rethorst et al., 2009; Stanton and Reaburn, 2014). However, these recommendations are usually based on the actual levels of exercise included in randomized controlled trials. Studies *simultaneously* comparing different exercise intensities are rare. One study showed that an exercise dose equivalent to public health recommendations reduced depression more than exercise below this level, and that frequency (three times per week vs. five) did not matter (Dunn et al., 2005). Another study, combining exercise and antidepressant medication, also found that a higher dose of exercise was more effective than a lower dose (Trivedi et al., 2011). Finally, one study with a long-term follow-up comparing high and low intensity weight training in older adults found that the high intensity

group achieved better results (Singh et al., 2005). However, to our knowledge, there are no studies have compared the long-term effects of multiple exercise intensities on depression severity. Previous research, including the often cited study by Dunn et al. (2005), has mainly focused on treatment efficacy. We therefore designed a long-term effectiveness trial intended to replicate what might occur in clinical practice.

The aim of the current study was to determine the long-term effects of assigning people affected by mild-to-moderate depression to one of three 12-week exercise interventions (light, moderate or vigorous exercise), and to compare the effects with treatment as usual. A secondary aim was to determine whether physical activity performed between the end of the prescribed exercise intervention and the long-term (12-month) follow-up affected depression severity.

## 2. Methods

Data was derived from the Regassa study, a single blind, parallel, multi-center randomized controlled trial conducted in six Swedish counties and regions (Stockholm, Kronoberg, Blekinge, Skåne, Västra

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