

# The Effects of Resistance Exercise Training on Anxiety: A Meta-Analysis and Meta-Regression Analysis of Randomized Controlled Trials

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## Abstract

## Background

The salutary effects of resistance exercise training (RET) are well established, including increased strength and function; however, less is known regarding the effects of RET on mental health outcomes. Aerobic exercise has well-documented positive effects on anxiety, but a quantitative synthesis of RET effects on anxiety is needed.

## Objectives

To estimate the population effect size for resistance exercise training (RET) effects on anxiety and to determine whether variables of logical, theoretical, and/or prior empirical relation to anxiety moderate the overall effect.

## Methods

Thirty-one effects were derived from 16 articles published before February 2017, located using Google Scholar, MEDLINE, PsycINFO, PubMed, and Web of Science. Trials involved 922 participants (mean age =  $43 \pm 21$  years, 68% female/32% male) and included both randomization to RET ( $n = 486$ ) or a non-active control condition ( $n = 436$ ), and a validated anxiety outcome measured at baseline, mid-, and/or post-intervention. Hedges'  $d$  effect sizes were computed and random effects models were used for all analyses. Meta-regression quantified the extent to which participant and trial characteristics moderated the mean effect.

## Results

RET significantly reduced anxiety symptoms ( $\Delta = 0.31$ , 95% CI 0.17–0.44;  $z = 4.43$ ;  $p < 0.001$ ). Significant heterogeneity was not indicated ( $Q_T(30) = 40.5$ ,  $p > 0.09$ ;  $I^2 = 28.3\%$ , 95% CI 10.17–42.81); sampling error accounted for 77.7% of observed variance. Larger effects were found among healthy participants ( $\Delta = 0.50$ , 95% CI 0.22–0.78) compared to participants with a physical or mental illness ( $\Delta = 0.19$ , 95% CI 0.06–0.31,  $z = 2.16$ ,  $p < 0.04$ ). Effect sizes did not significantly vary according to sex ( $\beta = -0.31$ ), age ( $\beta = -0.10$ ), control condition ( $\beta = 0.08$ ), program length ( $\beta = 0.07$ ), session duration ( $\beta = 0.08$ ), frequency ( $\beta = -0.10$ ), intensity ( $\beta = -0.18$ ), anxiety recall time frame ( $\beta = 0.21$ ), or whether strength significantly improved ( $\beta = 0.19$ ) (all  $p \geq 0.06$ ).

## Conclusions

RET significantly improves anxiety symptoms among both healthy participants and participants with a physical or mental illness. Improvements were not moderated by sex, or based on features of RET. Future trials should compare RET to other empirically-supported therapies for anxiety.

## Electronic supplementary material

The online version of this article (doi:[10.1007/s40279-017-0769-0](https://doi.org/10.1007/s40279-017-0769-0) (<https://doi.org/10.1007/s40279-017-0769-0>)) contains supplementary material, which is available to authorized users.