The Effects of Acute Resistance Exercise on State Anxiety in Adults: A Systematic Review with Meta-Analysis

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RATIONALE

- Anxiety is a prevalent mental health concern with associated burden and its treatments are not intended for immediate relief.[1,2,3,4]
- Evidence supports the use of resistance exercise (RE) training for anxiety, but the acute effects of a single bout of RE on state anxiety remain unclear.[5]

Purpose: To quantify the overall effect of acute RE on state anxiety in adults across a single session and to synthesize existing literature.

KEY FINDINGS

- **Resistance exercise** has non-significantly **stronger anxiolytic effects** than control (SMD favoring RE = -0.11).
- **Resistance exercise** significantly **lowers state anxiety** for **up to three hours** post-RE (SMD = -0.34).
- Reductions in state anxiety were stronger for **RE** compared to control, particularly between 50 and 150m post-session.

CONCLUSIONS

- The first hour after RE appears to be an optimal window to experience reductions in state anxiety.
- The anxiolytic effects of control conditions were short-lived, while those of **RE** were sustained for ≥ 3 hours.
- **Future research** should be conducted in samples **with elevated anxiety levels** to identify a clearer effect in those in need of symptom management tools.

METHODS

PROCEDURES

- PsycInfo, PubMed, PubMed Central, Web of Science Core Collection, ScienceDirect, and CENTRAL were used to locate randomized controlled studies published between 2000 and 2023.
- **Inclusion Criteria:**

Randomized controlled studies (RE vs control) Measured state anxiety pre- and post-session with reliable & valid measure	Studies published 2000-2023	Participants in Studies: 18+ y/o Any health status (e.g., healthy, ill)

Note: there were no exclusion criteria.

ANALYSIS

- Aim 1: A multi-level model was created to quantify the overall acute changes (pre-post condition) in state anxiety between RE and control conditions.
  - Time was included as a moderator as there were multiple post-condition assessments (e.g., immediately post, 5min-, 30min-, 60min-post, etc.).
- Aim 2: Multi-level models were created to quantify the acute changes (pre-post condition) in state anxiety within conditions with time as a moderator.
- Effect sizes were calculated as Standardized Mean Difference (SMD) and 95% confidence intervals (CI).
- Between-study residual heterogeneity was calculated using the QE statistic (QE).

RESULTS

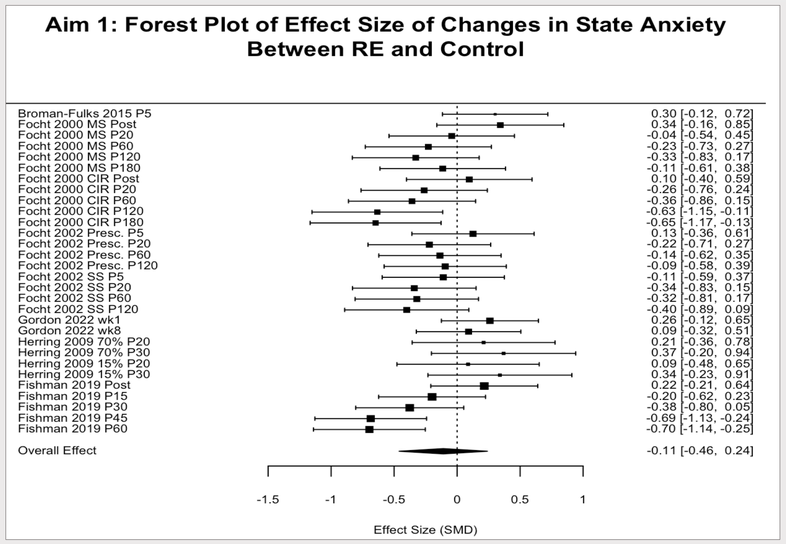

Figure 1: Changes in state anxiety were non-significantly greater for RE compared to control conditions (**SMD = -0.11**; 95% CI: -0.46, 0.24, p=0.42; QE(df=28) = 39.84, p=0.07) and significantly moderated by time ($F_{2,28}$=15.42, p< 0.001). See *Table 1* notes for abbreviations.

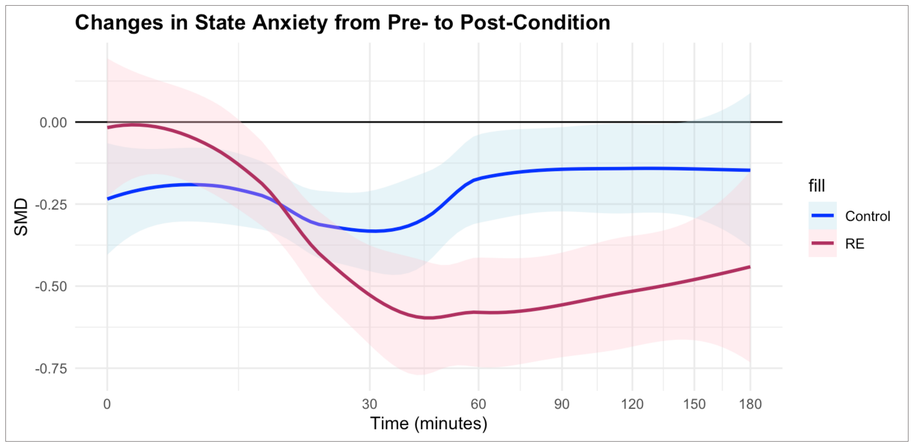

Figure 2: Changes in state anxiety across time, post-condition.

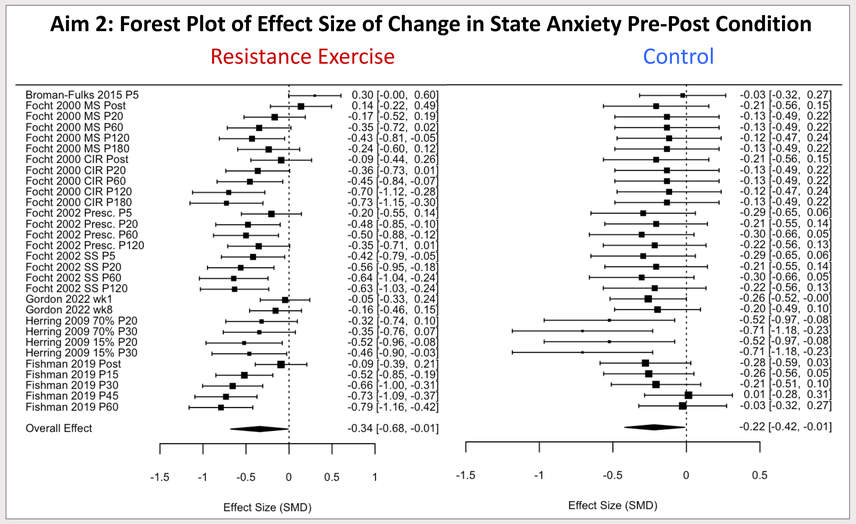

Figure 3: Within condition, state anxiety was significantly reduced for RE (**SMD=-0.34**; 95% CI: -0.68, -0.01, p=0.045) and control (SMD=-0.22; 95% CI: -0.43, 0.01, p=0.04). See *Table 1* notes for abbreviations.

Table 1. Characteristics of Studies Included for Systematic Review

First Author, Year	Sample Size	Outcome Measure	Health Status	RE Familiarization	RE Setting	RE Description	Control Description
Broman-Fulks, 2015	77	STAI	Healthy	Instruction & Practice	Research lab	3 large-muscle ex to exhaustion	20m quiet rest
Focht, 2000	54	STAI	Healthy females	NR	NR	4 ex, 3x10 reps @75% 1RM (MS); or 12 ex, 1x10-20 reps @50% (CIR)	30m watching RE video
Focht, 2002	19	STAI	Healthy females	NR	Lab	4 ex, 3x10 reps @75% 1RM (Presc) and @ SS intensity	Quiet rest
Gordon, 2022	62	STAI	AGAD & Healthy	NR	NR	8 free weight ex, 2x8-12 reps	30m quiet rest in empty room
Herring, 2009	14	POMS-tension	Sed females w/ fatigue	Instruction & Practice	Exercise center	3 machine ex, 4 x10 reps @15% and 70% 1RM	Seated rest on ex machines
Fishman, 2019	25	STAI	Healthy females	Informal brief instruction	Campus gym	8 ex, 3x10 reps @70% 10RM	Hatha yoga
*Arent, 2005	31	STAI	Healthy	NR	NR	6 ex, 3x10 reps @70% 10RM	45m video of history of RE
*Bibeau, 2010	104	STAI	Healthy	NR	Common-use gym	4 machine ex, 1x10-11 reps @50-55% 1RM or 1x6-7 reps @80-85%	NR
*Hill, 2019	30	STAI	NR	NR	NR	6 ex, 3x10 reps	Quiet rest

Notes: Studies with an * were included in the systematic review only. STAI = State-Trait Anxiety Inventory; ex = exercises; in Focht 2000, MS = multiple sets and CIR = circuit; in Focht 2002, Presc = prescribed, SS = self-selected; AGAD = analogue generalized anxiety disorder; POMS = Profile of Mood States; Sed = sedentary.

Key References

1. Schafer, K. M., Lieberman, A., Sever, A. C., & Joiner, T. (2022). Prevalence rates of anxiety, depressive, and eating pathology symptoms between the pre- and peri-COVID-19 eras: A meta-analysis. *Journal of Affective Disorders*, *298*, 364–372. https://doi.org/10.1016/j.jad.2021.10.115
2. American Psychiatric Association (Ed.). (2013). *Diagnostic and statistical manual of mental disorders: DSM-5* (5th ed). American Psychiatric Association.
3. Baxter, A. J., Vos, T., Scott, K. M., Ferrari, A. J., & Whiteford, H. A. (2014). The global burden of anxiety disorders in 2010. *Psychological Medicine*, *44*(11), 2363–2374. https://doi.org/10.1017/S0033291713003243
4. Ormel, J., Petukhova, M., Chatterji, S., Aguilar-Gaxiola, S., Alonso, J., Angermeyer, M. C., Bromet, E. J., Burger, H., Demyttenaere, K., Girolamo, G. de, Haro, J. M., Hwang, I., Karam, E., Kawakami, N., Lépine, J. P., Medina-Mora, M. E., Posada-Villa, J., Sampson, N., Scott, K., … Kessler, R. C. (2008). Disability and treatment of specific mental and physical disorders across the world. *The British Journal of Psychiatry*, *192*(5), 368–375. https://doi.org/10.1192/bjp.bp.107.039107
5. Gordon, B. R., McDowell, C. P., Lyons, M., & Herring, M. P. (2017). The Effects of Resistance Exercise Training on Anxiety: A Meta-Analysis and Meta-Regression Analysis of Randomized Controlled Trials. *Sports Medicine (Auckland, N.Z.)*, *47*(12), 2521–2532. https://doi.org/10.1007/s40279-017-0769-0