RESEARCH PAPER

Effects of Progressive Resisted Exercise versus Aerobic Exercise on Anxiety and Body Mass Index among Overweight College Students: A Randomized Controlled Trial

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Abstract

Background: Overweight and anxiety are common among college students, and exercise is a non-pharmacological option for both. This trial compared progressive resisted exercise (PRE) with aerobic exercise for anxiety and body mass index (BMI) in overweight college students. Methods: Of 400 students screened, 220 overweight students (BMI 25–29.9 kg/m²) aged 18–25 years were randomly allocated to Group A (PRE, n = 110) or Group B (aerobic exercise, n = 110) for 4 weeks. Anxiety was measured with the Hamilton Anxiety Rating Scale (HAM-A) and BMI by height and weight, before and after the intervention. Within-group change was tested with the paired t test and between-group differences with the independent t test and baseline-adjusted analysis ($p < 0.05$). Results: Groups were comparable at baseline (BMI $p = 0.136$; HAM-A $p = 0.478$). Both groups improved significantly ($p < 0.001$). BMI fell by 2.35 ± 1.70 kg/m² in Group A and 1.33 ± 0.85 kg/m² in Group B ($p < 0.001$). HAM-A fell by 14.71 ± 5.84 points in Group A and 11.04 ± 7.77 points in Group B ($p = 0.0001$). Post-intervention values were lower in Group A for both outcomes.Conclusion: Both exercise programs reduced anxiety and BMI over 4 weeks, with PRE giving greater short-term reductions than aerobic exercise. Longer trials with blinded assessment are needed.

Keywords: Body mass index; Progressive resisted exercise; Aerobic exercise; Hamilton Anxiety Rating Scale; College students

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1. Introduction

Over one-fifth of university students across 22 countries were overweight or obese in a large multinational survey,[1] and excess weight in college students has been linked to stress, mental health problems and poorer academic performance.[2] Anxiety disorders are among the most common psychiatric conditions; anxiety is an adaptive response to stress, but becomes pathological when it is excessive or out of proportion to the situation.[3] Medication and cognitive behavioral therapy are the usual treatments, and exercise has been proposed as a non-pharmacological alternative.[4],[5]

Aerobic exercise has the larger evidence base for anxiety. Programs of aerobic exercise reduced anxiety and depressive symptoms in adults with depression[6] and in older adults,[7] and a systematic review supports its suse in anxiety disorders.[3] Resistance exercise has been studied less, although a meta-analysis of randomized trials found that it significantly reduced anxiety in healthy people and in people with physical

or mental illness,[8] and it may also improve sleep quality.[9] Progressive resisted exercise (PRE) loads muscle against a resistance that is raised as strength improves,[10] and it also benefits bone density.[11]

For body composition, aerobic training lowers body mass and fat mass, while resistance training increases lean mass.[12] Which mode gives the better combined effect on anxiety and BMI in overweight young adults is unclear, and trials comparing the two directly in this group are scarce. This trial therefore compared PRE with aerobic exercise for anxiety and BMI in overweight college students. The null hypothesis was that the two programs would not differ.

Methods

Design and setting. This was a two-arm randomized controlled trial conducted at the School of Physiotherapy, Aarupadai Veedu Medical College and Hospital, Puducherry. The study was approved by the Institutional Research Committee (IRC No. SPT/IRC/2023/087, 9 May 2023), and all participants gave written informed consent.

Participants. Students aged 18–25 years of either sex with a BMI of 25–29.9 kg/m² who were physically inactive were eligible. Students with trauma or recent injury, joint disease, alcohol use, smoking or substance abuse, those already in a regular exercise program, and those unwilling to participate were excluded. Of 400 students assessed, 180 were excluded and 220 were randomized.

Randomization. Participants were allocated by computer-generated simple randomization to Group A (PRE, n = 110) or Group B (aerobic exercise, n = 110) (Figure 1).

Outcome measures. Anxiety was measured with the 14-item Hamilton Anxiety Rating Scale (HAM-A; each item scored 0–4, total 0–56; higher scores indicate greater anxiety). BMI was calculated as weight (kg) divided by height squared (m²). Both were recorded before and after 4 weeks.

Interventions. Both groups trained for 4 weeks, 3 days per week, each session consisting of a 10-minute warm-up, 30 minutes of conditioning exercise and a 10-minute cool-down. Group A (PRE). Exercises were performed as 3 sets of 10 repetitions using the daily adjustable progressive resistive exercise (DAPRE) principle, with load raised in stages from 50% to 75% to the full working weight, and supervised by a physiotherapist.

Group B (aerobic). Participants exercised on a treadmill using alternating walk, jog and run intervals, and on a stationary cycle with a gradual increase and decrease in speed, at a moderate intensity of 64–76% of age-predicted maximum heart rate.

Statistical analysis. Data were analyzed using SPSS version 28. Continuous variables are given as mean ± standard deviation and categorical variables as number (%). Baseline comparability was assessed with the independent t test (age, BMI, HAM-A) and chi-square test (sex). Pre–post change within each group was tested with the paired t test, and change scores and post-intervention values were compared between groups with the independent t test. A baseline-adjusted (ANCOVA) comparison of post-intervention values was also done. Significance was set at $p < 0.05$. All 220 randomized participants were analyzed.

Results

The groups were comparable at baseline in age, sex, BMI and HAM-A (Table 1). Mean baseline HAM-A scores of about 30 indicate moderate to severe anxiety in both groups.

Table 1. Baseline characteristics

Variable	Group A – PRE (n = 110)	Group B – Aerobic (n = 110)	p value
Age (years)	21.30 ± 2.08	20.78 ± 1.96	0.058
Male, n (%)	48 (43.6)	44 (40.0)	0.682
Female, n (%)	62 (56.4)	66 (60.0)	
BMI (kg/m²)	27.37 ± 1.38	27.04 ± 1.83	0.136
HAM-A score	30.76 ± 6.90	30.12 ± 6.56	0.478

Both groups improved significantly in BMI and HAM-A from pre- to post-intervention (Table 2).

Table 2. Within-group changes (paired t test, df = 109)

Outcome	Group	Pre	Post	Mean change	t	p value
BMI (kg/m²)	A – PRE	27.37 ± 1.38	25.02 ± 1.67	2.35 ± 1.70	14.49	< 0.001
	B – Aerobic	27.04 ± 1.83	25.71 ± 1.90	1.33 ± 0.85	16.35	< 0.001
HAM-A	A – PRE	30.76 ± 6.90	16.05 ± 6.30	14.71 ± 5.84	26.43	< 0.001
	B – Aerobic	30.12 ± 6.56	19.08 ± 9.97	11.04 ± 7.77	14.90	< 0.001

Between groups, Group A showed greater reductions in both outcomes (Table 3). The baseline-adjusted difference in post-intervention values was 0.94 kg/m² (SE 0.18, $p < 0.001$) for BMI and 3.51 points (SE 0.90, $p < 0.001$) for HAM-A, both favoring PRE (Figure 2). Excluding the five participants whose age or BMI fell outside the stated criteria did not change these findings.

Table 3. Between-group comparison (independent t test, df = 218)

Outcome	Group A – PRE	Group B – Aerobic	t	p value
BMI change (kg/m²)	2.35 ± 1.70	1.33 ± 0.85	5.62	< 0.001
BMI post-intervention	25.02 ± 1.67	25.71 ± 1.90	−2.87	0.005
HAM-A change	14.71 ± 5.84	11.04 ± 7.77	3.96	0.0001
HAM-A post-intervention	16.05 ± 6.30	19.08 ± 9.97	−2.69	0.008

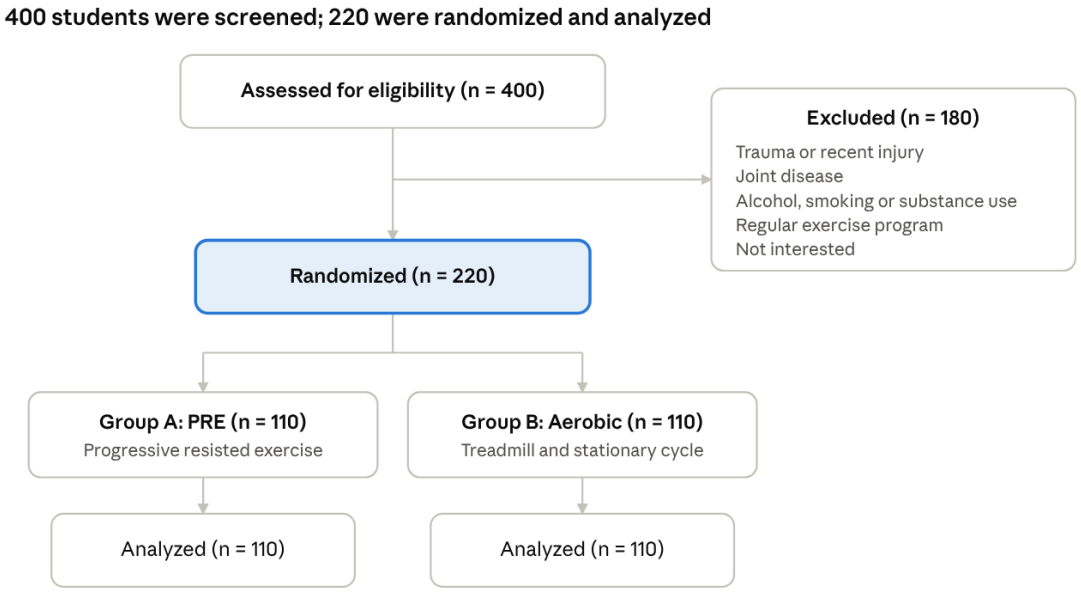


Figure 1. Participant flow through the trial.

means from the study datasheet · n = 110 per group

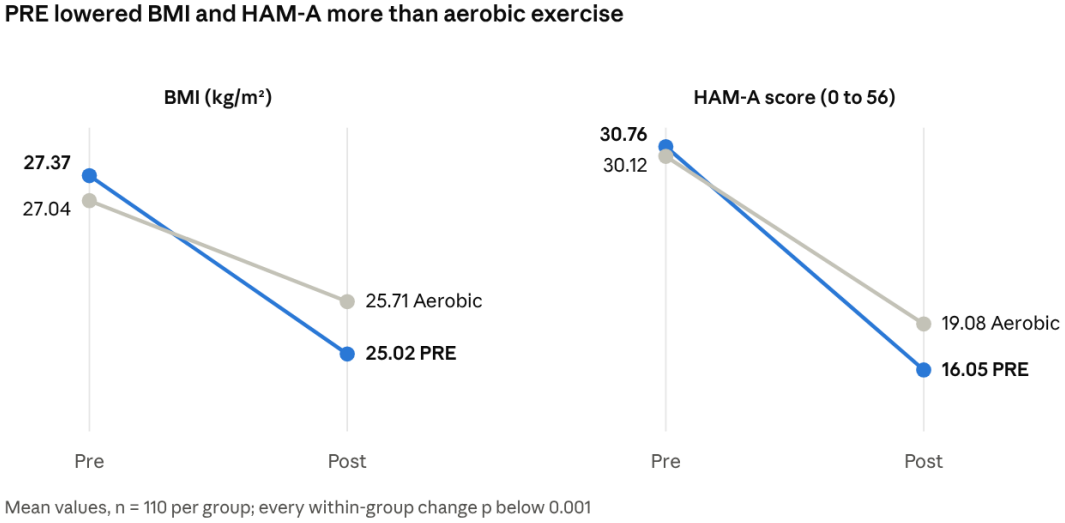


Figure 2. Mean BMI and HAM-A before and after 4 weeks of PRE or aerobic exercise.

Discussion

In this trial of 220 overweight college students, both 4-week programs reduced anxiety and BMI, but PRE produced the larger reductions in both outcomes. The null hypothesis is therefore rejected.

The anxiety result agrees with the meta-analytic finding that resistance training reduces anxiety,[8] and the improvement with aerobic exercise agrees with earlier aerobic trials.[6],[7] Our finding that PRE was the more effective of the two on HAM-A differs from the view that aerobic exercise is the preferred mode for anxiety, and it should be confirmed in independent samples before it is generalized. Possible explanations, which this trial did not test, include the supervised, progressively loaded nature of PRE and the sense of mastery it may give.

For BMI, aerobic training is generally expected to lower body mass and fat mass more than resistance training, which tends to raise lean mass.[12] The larger BMI fall with PRE here is therefore unexpected, and its size (2.35 kg/m² in 4 weeks) is greater than usually reported over such a short period. Diet, daily activity and body composition were not measured, so these changes should be interpreted cautiously and not attributed to fat loss.

Strengths include the large sample, comparable groups at baseline and supervised delivery of both programs.

Limitations. The follow-up was only 4 weeks and there was no long-term follow-up. Participants were from a single institution and were not selected on an anxiety criterion, although baseline HAM-A scores were high. Blinding, diet and physical activity outside the sessions were not controlled, and BMI does not distinguish fat from lean mass. A sample size calculation was not reported, and the training protocol needs to be reported consistently for replication.

Conclusion

Progressive resisted exercise and aerobic exercise both reduced anxiety and BMI in overweight college students over 4 weeks, with PRE giving significantly greater reductions in both. PRE can be considered for overweight students with anxiety; longer, blinded, multi-centre trials with body composition and lifestyle measures are recommended.

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Conflict of interest

None declared.

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