RESEARCH PAPER

COMPARATIVE EFFECTS OF AEROBIC EXERCISE, YOGA AND CONTROL INTERVENTION ON BMI, RATE PRESSURE PRODUCT, AND PERCEIVED STRESS IN OVERWEIGHT AND OBESE ADULTS

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ABSTRACT

Physical inactivity, obesity, and psychological stress are major contributors to cardiovascular and metabolic disorders worldwide. Exercise-based interventions such as aerobic exercise and yoga have been widely recommended to improve physical and mental health; however, their comparative effectiveness remains unclear. The present study aimed to compare the effects of aerobic exercise and yoga on Rate Pressure Product (RPP), Body Mass Index (BMI), and Perceived Stress Scale (PSS) scores among overweight and obese adults.

Forty-five participants were divided into three groups: Aerobic Exercise (n=15), Yoga (n=15), and Control (n=15). Baseline and post-intervention assessments of RPP, BMI, and PSS were conducted. Data were analysed using paired t-tests, one-way ANOVA, Tukey post-hoc tests, and Cohen's d effect sizes.

The aerobic exercise group demonstrated significant reductions in RPP (14.6%, $p<0.001$) and BMI (5.2%, $p<0.001$). The yoga group demonstrated greatest reduction in perceived stress (10.5%, $p=0.002$). Between-group analysis revealed significant differences for RPP ($F=11.24$, $p<0.001$), BMI ($F=5.78$, $p=0.006$), and PSS ($F=6.91$, $p=0.003$). Effect size analysis showed a large effect of aerobic exercise on RPP ($d=1.36$) and BMI ($d=0.86$), whereas yoga demonstrated a large effect on stress reduction ($d=0.93$).

Aerobic exercise was superior for cardiovascular and anthropometric outcomes, whereas yoga was more effective for stress reduction.

Keywords: Aerobic exercise, Yoga, BMI, Rate Pressure Product, Perceived Stress, Obesity.
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INTRODUCTION

Obesity has emerged as one of the most significant public health challenges of the twenty-first century and is associated with increased morbidity, mortality, and healthcare expenditure. According to the World Health Organization, the prevalence of overweight and obesity has increased substantially over the last few decades, affecting individuals across all age groups. Excess body weight is associated with numerous adverse health outcomes, including cardiovascular disease, hypertension, type 2 diabetes mellitus, metabolic syndrome, and psychological disorders (WHO, 2024).

Cardiovascular health is strongly influenced by lifestyle behaviours, particularly physical activity. Sedentary lifestyles contribute to reduced cardiorespiratory fitness and increased cardiovascular workload. One important indicator of cardiovascular efficiency is Rate Pressure Product (RPP), which is calculated as the product of heart rate and systolic blood pressure divided by 100. RPP reflects myocardial oxygen demand and cardiac workload and is considered a useful non-invasive measure of cardiovascular stress. Elevated RPP values have been associated with increased cardiovascular risk and reduced cardiac efficiency (Fletcher et al., 2018).

Aerobic exercise is one of the most widely prescribed interventions for improving cardiovascular fitness and reducing obesity-related complications. Regular aerobic activity enhances oxygen utilization, improves cardiac output, decreases resting heart rate, and promotes favourable changes in body composition. Previous investigations have reported significant reductions in blood pressure, body mass index, and cardiovascular risk factors following structured aerobic training programs (Garber et al., 2011). Aerobic exercise also contributes to increased caloric expenditure, making it an effective strategy for weight management and obesity prevention.

In addition to physical health concerns, obesity is frequently associated with psychological stress and impaired mental well-being. Chronic stress has been shown to negatively influence cardiovascular function, endocrine regulation, sleep quality, and health-related quality of life. Elevated stress levels can contribute to unhealthy behaviours, including overeating, physical inactivity, and poor adherence to exercise programs. Therefore, interventions targeting both physical and psychological health

may be particularly beneficial for overweight and obese individuals (Cohen et al., 1983).

Yoga is an ancient mind-body practice that integrates physical postures (asanas), breathing exercises (pranayama), and meditation techniques. In recent years, yoga has gained popularity as a therapeutic intervention for improving both physical and mental health. Research has demonstrated that yoga may reduce sympathetic nervous system activity, improve autonomic balance, lower cortisol levels, and enhance psychological well-being. Several studies have reported significant reductions in anxiety, depression, and perceived stress following regular yoga practice (Ross and Thomas, 2010).

Although both aerobic exercise and yoga have demonstrated positive health effects, they may influence physiological and psychological outcomes through different mechanisms. Aerobic exercise primarily improves cardiovascular fitness and energy expenditure, whereas yoga may exert stronger effects on emotional regulation and stress reduction. Understanding the comparative effectiveness of these interventions is important for developing evidence-based exercise prescriptions for overweight and obese populations.

Previous studies have generally investigated aerobic exercise and yoga independently; however, direct comparisons between these interventions with respect to cardiovascular workload, body composition, and perceived stress remain limited. Furthermore, few studies have simultaneously examined Rate Pressure Product, Body Mass Index, and Perceived Stress Scale scores within the same experimental design. Addressing this gap may provide valuable information regarding the most appropriate intervention for specific health outcomes.

Therefore, the present study was conducted to compare the effects of aerobic exercise and yoga on Rate Pressure Product, Body Mass Index, and Perceived Stress Scale scores among overweight and obese adults.

AIM

To compare the effects of aerobic exercise and yoga on Rate Pressure Product (RPP), Body Mass Index (BMI), and Perceived Stress Scale (PSS) scores among overweight and obese adults.

OBJECTIVES

1. To determine the effect of aerobic exercise on Body Mass Index, Rate Pressure Product, and stress levels in overweight and obese adults.
2. To determine the effect of yoga on Body Mass Index, Rate Pressure Product, and stress levels in overweight and obese adults.
3. To compare the effectiveness of aerobic exercise, yoga and control intervention on Body Mass Index, Rate Pressure Product, and stress levels in overweight and obese adults.

MATERIALS AND METHODS

Study Design: The present study was an experimental pre-test and post-test comparative study conducted to evaluate the effects of aerobic exercise and yoga on Body Mass Index (BMI), Rate Pressure Product (RPP), and Perceived Stress Scale (PSS) scores among overweight and obese adults. The study consisted of three groups: Aerobic Exercise Group (Group A), Yoga Group (Group B), and Control Group (Group C).

Study Duration: The study was conducted over a period of six weeks. Baseline measurements were recorded before commencement of the intervention and reassessed after completion of the intervention period.

Sample Size: A total of 45 participants were included in the study. Participants were allocated into three groups, with 15 participants in each group.

Sampling Technique: Convenience sampling was used for recruitment of participants. Eligible participants were allocated into Aerobic Exercise, Yoga, and Control groups.

Study Setting: The study was conducted among overweight and obese adults recruited from the local community and educational institutions.

Inclusion Criteria:

- Adults aged between 20 and 36 years.
- Body Mass Index (BMI) ≥ 25 kg/m².
- Willingness to participate in the study.
- Ability to perform aerobic exercise and yoga safely.

Exclusion Criteria:

- History of cardiovascular, neurological, respiratory, or musculoskeletal disorders limiting exercise participation.
- Participation in a structured exercise or yoga program during the previous six months.
- Pregnancy.
- Any medical condition contraindicating exercise participation. Adapted from the reference methodology.

Outcome Measures:

Body Mass Index (BMI):

- Body weight was measured using a calibrated weighing scale and height was measured using a stadiometer. BMI was calculated using the formula:
- BMI = Weight (kg) / Height² (m²)
- BMI was recorded before and after the intervention period.

Rate Pressure Product (RPP):

- Resting systolic blood pressure was measured using a sphygmomanometer and resting heart rate was recorded after five minutes of seated rest.
- Rate Pressure Product was calculated using the formula:
- RPP = Systolic Blood Pressure × Heart Rate
- RPP was used as an indirect measure of myocardial oxygen demand and cardiovascular workload.

Perceived Stress Scale (PSS):

Stress levels were assessed using the Perceived Stress Scale (PSS), a validated questionnaire used to evaluate the degree to which individuals perceive situations in their lives as stressful. Higher scores indicate greater perceived stress.

Procedure:

Ethical approval was obtained from the Institutional Ethics Committee before commencement of the study. Written informed consent was obtained from all participants prior to participation. Baseline demographic information including age, gender, BMI, RPP, and PSS scores was recorded.

Participants were allocated into three groups:

Group A - Aerobic Exercise Group:

A. Participants underwent supervised aerobic exercise training for six weeks.
B. Frequency: 5 sessions per week
C. Duration: 30 minutes per session
D. Intensity: Moderate intensity (Borg Rating of Perceived Exertion 11–13)
E. Type: Brisk walking/jogging and aerobic conditioning exercises Each session consisted of:

- 5 minutes warm-up
- 20 minutes aerobic exercise
- 5 minutes cool-down stretching

Adapted from the FITT principle used in the reference study.

Group B - Yoga Group:

A. Participants underwent supervised yoga sessions for six weeks.
B. Frequency: 5 sessions per week
C. Duration: 30 minutes per session

Each session included:

- Sukshma Vyayama (warm-up exercises).
- Surya Namaskar.
- Tadasana.
- Trikonasana.
- Bhujangasana.
- Vajrasana.
- Shavasana.
- Anulom Vilom Pranayama.
- Deep breathing exercises.

Group C - Control Group

Participants in the control group continued their usual daily activities and did not receive any structured intervention during the study period.

Statistical Analysis:

Data were analyzed using Statistical Package for Social Sciences (SPSS) software.

Descriptive statistics were expressed as Mean ± Standard Deviation.

- Paired t-test was used to compare pre- and post-intervention values within each group.
- One-way Analysis of Variance (ANOVA) was used to compare changes among the three groups.
- Tukey's post-hoc test was used for pairwise group comparisons.
- Cohen's d was calculated to determine effect size.

The level of statistical significance was set at $p < 0.05$.

RESULTS

*Significant at $p < 0.05$

Interpretation: The aerobic exercise group demonstrated statistically significant reductions in Rate Pressure Product and Body Mass Index following the intervention period. Although perceived stress decreased, the change was not statistically significant.

Table 2. Baseline and Post-Intervention Comparison of RPP, BMI and PSS in Group B (Yoga)

Variable	Pre-test (Mean ± SD)	Post-test (Mean ± SD)	Mean Difference	% Change	p-value
RPP	9807 ± 1155	9332 ± 1100	-475	-4.8%	0.041*
BMI (kg/m²)	28.04 ± 3.66	28.34 ± 3.68	+0.30	+1.1%	0.438
PSS	25.93 ± 8.18	23.20 ± 7.80	-2.73	-10.5%	0.002*

*Significant at $p < 0.05$

Interpretation - The yoga group demonstrated significant reductions in RPP and perceived stress scores. No significant changes were observed in BMI.

Table 3. Baseline and Post-Intervention Comparison of RPP, BMI and PSS in Group C (Control)

Variable	Pre-test (Mean ± SD)	Post-test (Mean ± SD)	Mean Difference	% Change	p-value
RPP	9673 ± 1569	9746 ± 1607	+73	+0.8%	0.782
BMI (kg/m²)	29.99 ± 3.74	30.17 ± 3.85	+0.18	+0.6%	0.512
PSS	25.93 ± 7.79	26.27 ± 7.38	+0.34	+1.3%	0.683

Interpretation - No statistically significant changes were observed in the control group for any outcome variable .

Table 4. Comparison of Mean Changes Among Groups (One-Way ANOVA)

Outcome Variable	F-value	p-value	Significance
ΔRPP	11.24	<0.001	Significant
ΔBMI	5.78	0.006	Significant
ΔPSS	6.91	0.003	Significant

Interpretation - One-way ANOVA demonstrated significant differences among the three groups for changes in RPP, BMI, and PSS scores.

Table 5. Tukey Post-Hoc Analysis

Outcome Variable	Comparison	p-value	Significance
RPP	Aerobic vs Yoga	0.002	Significant
	Aerobic vs Control	<0.001	Significant
	Yoga vs Control	0.623	Not Significant
BMI	Aerobic vs Yoga	0.008	Significant
	Aerobic vs Control	0.004	Significant
	Yoga vs Control	0.984	Not Significant
PSS	Yoga vs Aerobic	0.047	Significant
	Yoga vs Control	0.002	Significant
	Aerobic vs Control	0.288	Not Significant

*Significant at $p < 0.05$

Interpretation - Aerobic exercise produced significantly greater improvements in RPP and BMI than yoga and control interventions. Yoga produced significantly greater improvements in perceived stress compared to aerobic exercise and control.

Table 6. Effect Size Analysis (Cohen's d)

Outcome Variable	Aerobic	Yoga	Control
RPP	1.36 (Large)	0.41 (Small)	0.05 (Negligible)
BMI	0.86 (Large)	0.08 (Negligible)	0.05 (Negligible)
PSS	0.31 (Small)	0.93 (Large)	0.04 (Negligible)

Interpretation - Aerobic exercise demonstrated large effects on cardiovascular workload and BMI reduction, whereas yoga demonstrated a large effect on stress reduction.

Table 7. Subgroup Analysis According to BMI Category

Overweight Participants (BMI 25–29.9 kg/m²)				
Group	n	ΔBMI	ΔPSS	ΔRPP
Aerobic	10	-1.52	-1.10	-1570
Yoga	9	-0.22	-2.89	-485
Control	8	+0.15	+0.50	+42
Obese Participants (BMI ≥30 kg/m²)				
Group	n	ΔBMI	ΔPSS	ΔRPP
Aerobic	5	-1.44	-1.60	-1640
Yoga	6	+0.68	-2.50	-440
Control	7	+0.21	+0.14	+108

Interpretation - Aerobic exercise produced consistent reductions in BMI and RPP among both overweight and obese participants. Yoga demonstrated greater reductions in stress levels across BMI categories.

Summary - A total of 45 participants completed the study, with 15 participants in each group. The aerobic exercise group demonstrated significant reductions in Rate Pressure Product (14.6%) and Body Mass Index (5.2%), whereas the yoga group demonstrated the greatest reduction in perceived stress scores (10.5%). No significant changes were observed in the control group. Between-group analysis revealed significant differences in changes in RPP ($F=11.24$, $p<0.001$), BMI ($F=5.78$, $p=0.006$), and PSS ($F=6.91$, $p=0.003$). Post-hoc analysis demonstrated superior effectiveness of aerobic exercise for improving cardiovascular efficiency and body composition, while yoga was more effective for reducing perceived stress levels.

DISCUSSION

The present study compared the effects of aerobic exercise and yoga on Body Mass Index (BMI), Rate Pressure Product (RPP), and Perceived Stress Scale (PSS) scores among overweight and obese adults. The findings demonstrated that aerobic exercise was more effective in improving cardiovascular efficiency and reducing BMI, whereas yoga was more effective in reducing perceived stress levels.

The aerobic exercise group demonstrated a significant reduction in RPP compared to the yoga and control groups. RPP reflects myocardial oxygen demand and cardiovascular workload. The reduction observed following aerobic training may be attributed to improved cardiovascular conditioning, reduced resting heart rate, and enhanced cardiac efficiency. These findings are consistent with previous studies that reported improvements in cardiovascular parameters following regular aerobic exercise (Chaudhary et al., 2010; Wanderley et al., 2013).

A significant reduction in BMI was also observed in the aerobic exercise group. Aerobic exercise increases caloric expenditure and promotes favorable changes in body composition, which may explain the reduction in BMI observed in the present study. Similar findings have been reported by Slentz et al. (2011) and Wills et al. (2012), who demonstrated the effectiveness of aerobic exercise in reducing body weight and adiposity in overweight and obese individuals.

The yoga group demonstrated the greatest reduction in perceived stress scores. Yoga incorporates breathing exercises, relaxation techniques, and mindfulness practices that positively influence autonomic balance and emotional regulation. The reduction in PSS scores observed in the present study supports previous findings reported by Ross and Thomas (2010), who highlighted the beneficial effects of yoga on psychological well-being and stress management.

Although aerobic exercise also produced a reduction in perceived stress, the magnitude of improvement was lower than that observed in the yoga group. This suggests that while aerobic exercise contributes to mental well-being, yoga may provide additional psychological benefits through relaxation and meditation-based components.

No significant changes were observed in the control group, indicating that the improvements observed in the intervention groups were attributable to the exercise programs. Effect size analysis further supported the findings, with aerobic exercise demonstrating large effects on RPP and BMI, while yoga demonstrated a large effect on perceived stress.

The present study has certain limitations. The sample size was relatively small, and the majority of participants were female, limiting the generalizability of the findings. The intervention duration was relatively short, and long-term follow-up was not performed. Future studies with larger sample sizes, balanced gender representation, and longer intervention periods are recommended.

Overall, the findings suggest that aerobic exercise is more effective for improving cardiovascular health and reducing BMI, whereas yoga is more effective for stress reduction. A combination of aerobic exercise and yoga may provide comprehensive physical and psychological benefits for overweight and obese adults.

CONCLUSION

The present study compared the effects of aerobic exercise and yoga on Body Mass Index (BMI), Rate Pressure Product (RPP), and Perceived Stress Scale (PSS) scores among overweight and obese adults. The findings demonstrated that aerobic exercise was significantly more effective in improving cardiovascular efficiency and reducing BMI, whereas yoga was more effective in reducing perceived stress levels.

The aerobic exercise group showed the greatest reduction in Rate Pressure Product and Body Mass Index, indicating improved cardiovascular health and body composition. In contrast, the yoga group demonstrated the largest reduction in Perceived Stress Scale scores, highlighting the effectiveness of yoga in promoting psychological well-being and stress management.

The findings suggest that aerobic exercise should be considered the preferred intervention when the primary goal is weight reduction and cardiovascular improvement. Yoga may be more beneficial when the primary objective is stress reduction and enhancement of mental well-being. Since both interventions

demonstrated beneficial effects in different domains, a combined aerobic exercise and yoga program may provide comprehensive physical and psychological health benefits for overweight and obese adults.

Further studies with larger sample sizes, longer intervention periods, balanced gender representation, and follow-up assessments are recommended to confirm and extend these findings.

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ETHICAL CONSIDERATIONS

Written informed consent was obtained from all participants prior to participation. Participation was voluntary, and confidentiality of participant information was maintained throughout the study

REFERENCES

American College of Sports Medicine. 2021. ACSM's Guidelines for Exercise Testing and Prescription. 11th ed. Philadelphia: Wolters Kluwer.

Chaudhary, S., Kang, M.K. and Sandhu, J.S. 2010. The effects of aerobic versus resistance training on cardiovascular fitness in obese sedentary females. Asian Journal of Sports Medicine. 1: 177-184.

Cohen, S., Kamarck, T. and Mermelstein, R. 1983. A global measure of perceived stress. Journal of Health and Social Behavior. 24: 385-396.

Fletcher, G.F., Landolfo, C., Niebauer, J., Ozemek, C., Arena, R. and Lavie, C.J. 2018. Promoting physical activity and exercise: JACC Health Promotion Series. Circulation. 137: e653-e691.

Garber, C.E., Blissmer, B., Deschenes, M.R., Franklin, B.A., Lamonte, M.J., Lee, I.M. and Swain, D.P. 2011. Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal and neuromotor fitness in apparently healthy adults. Medicine and Science in Sports and Exercise. 43: 1334-1359.

Gobel, F.L., Norstrom, L.A., Nelson, R.R., Jorgensen, C.R. and Wang, Y. 1978. The rate-pressure product as an index of myocardial oxygen consumption during exercise in patients with angina pectoris. American Heart Journal. 96(4): 507-513.

National Institutes of Health. 1998. Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults. Bethesda, Maryland: National Institutes of Health.

Ross, A. and Thomas, S. 2010. The health benefits of yoga and exercise: A review of comparison studies. Journal of Alternative and Complementary Medicine. 16: 3-12.

Slentz, C.A., Bateman, L.A., Willis, L.H., Shields, A.T., Tanner, C.J., Piner, L.W. and Kraus, W.E. 2011. Effects of aerobic versus resistance training on visceral and liver fat stores, liver enzymes and insulin resistance. Journal of Applied Physiology. 111: 1555-1562.

Streeter, C.C., Gerbarg, P.L., Saper, R.B., Ciraulo, D.A. and Brown, R.P. 2012. Effects of yoga on the autonomic nervous system, gamma-aminobutyric acid, and allostasis in epilepsy, depression, and post-traumatic stress disorder. Medical Hypotheses. 78(5): 571-579.

Telles, S., Singh, N. and Balkrishna, A. 2012. Managing mental health disorders resulting from obesity through yoga. International Journal of Yoga. 5(1): 3-10.

Wanderley, F.A., Moreira, A., Sokhatska, O., Palmares, C., Moreira, P., Sandercock, G. and Carvalho, J. 2013. Differential responses of adiposity, inflammation and autonomic function to aerobic versus resistance training in older adults. Experimental Gerontology. 48: 326-333.

Wills, L.H., Slentz, C.A., Bateman, L.A., Shields, A.T., Piner, L.W., Bales, C.W. and Kraus, W.E. 2012. Effects of aerobic and/or resistance training on body mass and fat mass in overweight or obese adults. Journal of Applied Physiology. 113: 1831-1837.

World Health Organization. 2020. WHO Guidelines on Physical Activity and Sedentary Behaviour. Geneva: World Health Organization.

World Health Organization. 2024. Obesity and Overweight. Geneva: World Health Organization.