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Comparative Effectiveness of Low-Intensity versus High-Intensity Aerobic Exercise on Blood Pressure and Functional Capacity in Patients with Essential Hypertension: A Prospective Comparative Pre–Post Study

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Abstract — Background- Essential hypertension is a major modifiable risk factor for cardiovascular disease and remains a leading cause of morbidity and mortality worldwide. Aerobic exercise is recommended as a first-line non-pharmacological intervention for blood pressure management. However, evidence comparing the effectiveness of low-intensity and high-intensity aerobic exercise on cardiovascular and functional outcomes remains limited, particularly in the Indian population. Objective- To compare the effectiveness of low-intensity and high-intensity aerobic exercise on blood pressure, functional capacity, cardiorespiratory fitness, resting heart rate, body mass index (BMI), and health-related quality of life in adults with essential hypertension. Methods- A prospective comparative pre-post study was conducted among 60 adults aged 40–65 years with essential hypertension. Participants were allocated into two groups (n = 30 each). Group A performed supervised low-intensity aerobic exercise (40–55% heart rate reserve), whereas Group B performed supervised high-intensity aerobic exercise (70–85% heart rate reserve) for 12 weeks. Outcome measures included systolic blood pressure (SBP), diastolic blood pressure (DBP), Six-Minute Walk Test (6MWT), estimated VO_2max, resting heart rate (RHR), BMI, and Short Form-36 (SF-36) quality-of-life scores. Assessments were performed at baseline and after completion of the intervention. Data were analysed using paired and independent Student's t-tests, with statistical significance set at $p < 0.05$. Results- Both exercise programmes produced significant improvements in all measured outcomes ($p < 0.001$). In the low-intensity group, mean SBP decreased from 146.8 ± 8.7 mmHg to 136.4 ± 8.1 mmHg, whereas the high-intensity group demonstrated a greater reduction from 147.3 ± 9.1 mmHg to 128.1 ± 8.8 mmHg. Functional capacity improved significantly, with the 6MWT increasing from 418.6 ± 52.3 m to 456.7 ± 52.1 m in Group A and from 421.7 ± 50.8 m to 490.8 ± 48.6 m in Group B. Significant improvements were also observed in VO_2max, resting heart rate, BMI, and all SF-36 domains, with superior outcomes in the high-intensity exercise group. Conclusion- Both low-intensity and high-intensity aerobic exercise are effective physiotherapy interventions for improving blood pressure control, functional capacity, cardiorespiratory fitness, body composition, and health-related quality of life in adults with essential hypertension. High-intensity aerobic exercise demonstrated significantly greater improvements across all outcome measures, supporting its use in appropriately screened and supervised patients.

Keywords— Essential hypertension; aerobic exercise; exercise intensity; physiotherapy; blood pressure; Six-Minute Walk Test; VO_2max; resting heart rate; body mass index; SF-36.

I. INTRODUCTION

Hypertension is one of the most prevalent chronic non-communicable diseases worldwide and remains a leading contributor to cardiovascular morbidity and premature mortality. According to the World Health Organization (WHO), approximately 1.28 billion adults aged 30–79 years are living with hypertension, with nearly two-thirds residing in low- and middle-income countries. Despite advances in pharmacological therapy, blood pressure control remains suboptimal because of poor medication adherence, physical inactivity, obesity, unhealthy dietary habits, and other modifiable cardiovascular risk factors. Consequently, hypertension continues to impose a substantial clinical and economic burden by increasing the risk of stroke, myocardial infarction, heart failure, chronic kidney disease, and premature death.

Regular physical activity is a cornerstone of the non-pharmacological management of hypertension and is strongly recommended by international guidelines, including those of the European Society of Cardiology (ESC), the European Society of Hypertension (ESH), the American College of Cardiology/American Heart Association (ACC/AHA), and the American College of Sports Medicine (ACSM). Among the various exercise modalities, aerobic exercise has consistently demonstrated clinically significant reductions in resting systolic and diastolic blood pressure while improving endothelial function, autonomic regulation, vascular compliance, insulin sensitivity, and overall cardiovascular health. Consequently, structured aerobic exercise has become an essential component of physiotherapy-led cardiovascular rehabilitation programmes.

Exercise intensity is an important determinant of cardiovascular adaptation. Traditionally, low- to moderate-intensity continuous aerobic exercise has been recommended because of its favourable safety profile, feasibility, and high patient adherence. These exercise programmes improve vascular function, reduce sympathetic nervous system activity, enhance nitric oxide-mediated vasodilation, and promote favourable haemodynamic adaptations that contribute to clinically meaningful reductions in resting blood pressure.

More recently, high-intensity aerobic exercise, particularly high-intensity interval training (HIIT), has gained considerable attention because of its potential to induce greater improvements in cardiorespiratory fitness, endothelial function, mitochondrial biogenesis, and exercise tolerance within a shorter training period. Several randomized controlled trials and systematic reviews have reported superior improvements in maximal oxygen uptake (VO_2max) following high-intensity exercise compared with low- or moderate-intensity continuous training. However, evidence regarding its superiority in reducing resting blood pressure remains inconsistent.

Recent systematic reviews and meta-analyses suggest that both low-intensity and high-intensity aerobic exercise effectively reduce systolic and diastolic blood pressure in adults with essential hypertension. Although improvements in VO_2max, functional capacity, and exercise tolerance appear greater following high-intensity exercise, reductions in resting blood pressure are often comparable between exercise intensities. Differences in participant characteristics, medication use, exercise prescription, intervention duration, and outcome assessment methods may explain these inconsistent findings.

Functional capacity is another clinically important outcome in individuals with hypertension. Reduced exercise tolerance is associated with diminished quality of life, impaired performance of activities of daily living, and an increased risk of future cardiovascular events. The Six-Minute Walk Test (6MWT) is a reliable, valid, inexpensive, and widely accepted measure of functional exercise capacity in individuals with cardiovascular and pulmonary disorders. Improvements in six-minute walk distance reflect enhanced aerobic capacity and have important implications for physiotherapy practice and long-term cardiovascular health.

Physiotherapists play a central role in designing individualized exercise programmes based on cardiovascular risk, exercise tolerance, functional limitations, and patient-specific goals. Identifying the most appropriate exercise intensity is therefore essential to maximize therapeutic benefits while ensuring patient safety, adherence, and long-term cardiovascular health. Although current international guidelines strongly recommend regular aerobic exercise, evidence comparing the effectiveness of different exercise intensities in routine physiotherapy practice remains limited.

Furthermore, evidence from South Asian populations, particularly India, is scarce. Regional differences in lifestyle, body composition, dietary habits, healthcare accessibility, and cardiovascular risk profiles may influence physiological responses to exercise interventions. Therefore, well-designed comparative studies using standardized physiotherapy protocols are required to establish evidence-based recommendations that are directly applicable to Indian patients with essential hypertension.

Therefore, the present prospective comparative pre-post study aimed to compare the effectiveness of low-intensity and high-intensity aerobic exercise on blood pressure and functional capacity in adults with essential hypertension following a 12-week supervised exercise programme. Secondary outcomes included estimated VO_2max, resting heart rate, body mass index (BMI), and health-related quality of life assessed using the Short Form-36 (SF-36) questionnaire. It was hypothesized that both exercise intensities would improve cardiovascular and functional outcomes; however, high-intensity aerobic exercise would produce significantly greater improvements in blood pressure control, cardiorespiratory fitness, functional capacity, and health-related quality of life.

II. MATERIALS AND METHODS

1. Study Design

This study employed a prospective comparative pre-post study design to evaluate and compare the effectiveness of low-intensity and high-intensity aerobic exercise on blood pressure, functional capacity, cardiorespiratory fitness, resting heart rate, body mass index (BMI), and health-related quality of life in adults with essential hypertension. Outcome measures were assessed at baseline (pre-intervention) and after completion of the 12-week supervised exercise programme (post-intervention).

2. Study Setting

The study was conducted at the Outpatient Department (OPD), Annai College of Physiotherapy, Kovilacheri, Kumbakonam, Tamil Nadu, India. Participant recruitment, screening, intervention, and outcome assessments were performed by qualified physiotherapists using standardized clinical protocols under direct supervision.

3. Study Duration

The study intervention was conducted over a period of 12 weeks. Baseline assessments were completed before initiation of the exercise programme, and all outcome measures were reassessed immediately after completion of the intervention.

4. Study Population

The study included adults diagnosed with essential hypertension who attended the outpatient physiotherapy department during the study period. Eligible participants were screened according to predefined inclusion and exclusion criteria before enrolment.

5. Sample Size

A total of 60 participants who fulfilled the eligibility criteria were enrolled in the study. Participants were allocated into two equal groups:

- Group A (n = 30): Low-intensity aerobic exercise.
- Group B (n = 30): High-intensity aerobic exercise.

6. Sampling Technique

Convenience sampling was used to recruit eligible participants. Written informed consent was obtained from all participants before enrolment in accordance with institutional ethical guidelines.

7. Eligibility Criteria

Inclusion Criteria

- Adults aged 40–65 years.
- Clinically diagnosed with Stage 1 or controlled Stage 2 essential hypertension.
- Receiving stable antihypertensive medication for at least four weeks before enrolment.
- Medically cleared to participate in supervised exercise.
- Able to walk independently without assistive devices.
- Willing to provide written informed consent.

Exclusion Criteria

- Secondary hypertension or uncontrolled hypertension (resting blood pressure ≥180/110 mmHg).
- Recent myocardial infarction, unstable angina, or decompensated heart failure.
- Significant cardiac arrhythmias or severe pulmonary disease.
- Neurological or musculoskeletal disorders limiting exercise participation.
- Pregnancy.
- Participation in a structured exercise programme within the previous three months.

8. Exercise Intervention

Exercise intensity was prescribed using the Karvonen Heart Rate Reserve (HRR) method and monitored throughout each session using continuous heart rate monitoring and the Borg Rating of Perceived Exertion (RPE) scale.

Group A – Low-Intensity Aerobic Exercise

Participants performed supervised treadmill walking at 40–55% HRR (Borg RPE 9–11). Each session consisted of:

- Warm-up: 10 minutes
- Continuous treadmill walking: 30 minutes
- Cool-down: 10 minutes

Sessions were conducted five days per week for 12 weeks. Exercise intensity and walking speed were progressed gradually during the initial two weeks while maintaining the prescribed target heart rate.

Group B – High-Intensity Aerobic Exercise

Participants performed supervised treadmill walking at 70–85% HRR (Borg RPE 14–16). Each session consisted of:

- Warm-up: 10 minutes
- High-intensity treadmill walking: 20–30 minutes
- Cool-down: 10 minutes

Sessions were conducted five days per week for 12 weeks. Exercise intensity was progressively increased during the first two weeks until the target heart rate zone was achieved.

9. Outcome Measures

Primary Outcome Measures

- Systolic Blood Pressure (SBP, mmHg)
- Diastolic Blood Pressure (DBP, mmHg)

Secondary Outcome Measures

- Six-Minute Walk Test (6MWT)
- Estimated VO_2max

- Resting Heart Rate (RHR)
- Body Mass Index (BMI)
- Health-related Quality of Life using the Short Form-36 (SF-36) questionnaire

All assessments were performed before the intervention and repeated after completion of the 12-week exercise programme using standardized assessment procedures.

10. Statistical Analysis
Statistical analysis was performed using IBM SPSS Statistics version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation (SD). Data normality was assessed using the Shapiro–Wilk test.

Within-group comparisons between baseline and post-intervention values were analysed using the paired Student's t-test, whereas between-group comparisons were performed using the independent Student's t-test. A two-tailed p-value < 0.05 was considered statistically significant.

III. RESULTS

1. Participant Flow
A total of 92 individuals with essential hypertension were screened for eligibility. Of these, 32 participants were excluded because they did not meet the inclusion criteria (n = 18), declined to participate (n = 10), or were excluded for other reasons (n = 4). The remaining 60 eligible participants were enrolled in the study and allocated to either the low-intensity aerobic exercise group (Group A, n = 30) or the high-intensity aerobic exercise group (Group B, n = 30). All participants completed the 12-week intervention programme, and no participants were lost to follow-up or withdrew from the study.

2. Baseline Demographic and Clinical Characteristics
The baseline demographic and clinical characteristics of the participants are presented in Table 1. There were no statistically significant differences between the two groups with respect to age, sex distribution, height, weight, body mass index, duration of hypertension, resting systolic blood pressure, resting diastolic blood pressure, resting heart rate, functional capacity, or estimated VO_2max ($p > 0.05$). These findings indicate that both groups were comparable at baseline.

3. Blood Pressure Outcomes
Following the 12-week supervised aerobic exercise programme, both groups demonstrated statistically significant reductions in resting systolic blood pressure (SBP) and diastolic blood pressure (DBP) compared with their respective baseline values ($p < 0.001$).

In the low-intensity aerobic exercise group (Group A), the mean SBP decreased from 146.8 ± 8.7 mmHg to 136.4 ± 8.1 mmHg, representing a mean reduction of 10.4 mmHg. Similarly, the mean DBP decreased from 92.3 ± 6.1 mmHg to 84.1 ± 5.6 mmHg, with a mean reduction of 8.2 mmHg.

In the high-intensity aerobic exercise group (Group B), the mean SBP decreased from 147.3 ± 9.1 mmHg to 128.1 ± 8.8 mmHg, corresponding to a mean reduction of 19.2 mmHg. The mean DBP also decreased from 92.6 ± 6.4 mmHg to 78.1 ± 5.2 mmHg, representing a mean reduction of 14.5 mmHg.

Between-group analysis demonstrated that participants in the high-intensity aerobic exercise group achieved significantly greater reductions in both systolic and diastolic blood pressure than those in the low-intensity group ($p < 0.001$).

4. Functional Capacity (Six-Minute Walk Test)
Functional capacity, assessed using the Six-Minute Walk Test (6MWT), improved significantly in both intervention groups following the 12-week supervised aerobic exercise programme ($p < 0.001$).

In the low-intensity aerobic exercise group (Group A), the mean 6MWT distance increased from 418.6 ± 52.3 m at baseline to 456.7 ± 52.1 m after the intervention, representing a mean improvement of 38.1 m.

In the high-intensity aerobic exercise group (Group B), the mean 6MWT distance increased from 421.7 ± 50.8 m to 490.8 ± 48.6 m, corresponding to a mean improvement of 69.1 m.

Between-group analysis demonstrated that participants in the high-intensity aerobic exercise group achieved significantly greater improvements in functional exercise capacity than those in the low-intensity group ($p < 0.001$).

5. Estimated Maximal Oxygen Uptake (VO_2max)
Estimated maximal oxygen uptake (VO_2max), an indicator of cardiorespiratory fitness, improved significantly in both intervention groups following the 12-week supervised aerobic exercise programme ($p < 0.001$).

In the low-intensity aerobic exercise group (Group A), the mean estimated VO_2max increased from 24.1 ± 3.6 mL/kg/min at baseline to 27.1 ± 3.8 mL/kg/min after the intervention, representing a mean improvement of 3.0 mL/kg/min.

In the high-intensity aerobic exercise group (Group B), the mean estimated VO_2max increased from 24.6 ± 3.5 mL/kg/min to 30.6 ± 3.7 mL/kg/min, corresponding to a mean improvement of 6.0 mL/kg/min.

Between-group analysis demonstrated that the high-intensity aerobic exercise group achieved significantly greater improvements in estimated VO_2max than the low-intensity group ($p < 0.001$), indicating superior enhancement of cardiorespiratory fitness.

6. Resting Heart Rate
Resting heart rate (RHR) decreased significantly in both intervention groups following the 12-week supervised aerobic exercise programme ($p < 0.001$).

In the low-intensity aerobic exercise group (Group A), the mean resting heart rate decreased from 82.7 ± 8.3 bpm at baseline to 76.1 ± 7.2 bpm after the intervention, representing a mean reduction of 6.6 bpm.

In the high-intensity aerobic exercise group (Group B), the mean resting heart rate decreased from 81.9 ± 7.9 bpm to 68.4 ± 6.8 bpm, corresponding to a mean reduction of 13.5 bpm.

Between-group analysis demonstrated that participants in the high-intensity aerobic exercise group achieved significantly greater reductions in resting heart rate than those in the low-intensity group ($p < 0.001$), indicating superior cardiovascular adaptation following higher-intensity training.

7. Body Mass Index (BMI)
Body mass index (BMI) showed significant improvement in both intervention groups following the 12-week supervised aerobic exercise programme ($p < 0.001$).

In the low-intensity aerobic exercise group (Group A), the mean BMI decreased from 28.1 ± 3.2 kg/m² at baseline to 27.2 ± 3.1 kg/m² after the intervention, representing a mean reduction of 0.9 kg/m².

In the high-intensity aerobic exercise group (Group B), the mean BMI decreased from 28.3 ± 3.4 kg/m² to 26.3 ± 3.0 kg/m², corresponding to a mean reduction of 2.0 kg/m².

Between-group analysis demonstrated that participants in the high-intensity aerobic exercise group achieved significantly greater reductions in BMI than those in the low-intensity group ($p < 0.001$).

8. Health-Related Quality of Life (SF-36)
Health-related quality of life, assessed using the Short Form-36 (SF-36) questionnaire, improved significantly in both intervention groups following the 12-week supervised aerobic exercise programme ($p < 0.001$).

In the low-intensity aerobic exercise group (Group A), the mean SF-36 score increased from 58.4 ± 9.8 at baseline to 68.7 ± 9.2 after the intervention, representing a mean improvement of 10.3 points.

In the high-intensity aerobic exercise group (Group B), the mean SF-36 score increased from 57.9 ± 10.1 to 76.8 ± 8.7, corresponding to a mean improvement of 18.9 points.

Between-group analysis demonstrated that participants in the high-intensity aerobic exercise group achieved significantly greater improvements in health-related quality of life than those in the low-intensity group ($p < 0.001$).

9. Overall Statistical Comparison
A summary of the primary and secondary outcome measures demonstrated that both low-intensity and high-intensity aerobic exercise programmes produced statistically significant improvements after the 12-week intervention ($p < 0.001$). However, participants in the high-intensity aerobic exercise group consistently achieved greater improvements across all measured outcomes, including systolic blood pressure, diastolic blood pressure, functional capacity, estimated VO_2max, resting heart rate, body mass index, and health-related quality of life.

The between-group analysis confirmed that high-intensity aerobic exercise was significantly more effective than low-intensity aerobic exercise in improving cardiovascular health, exercise tolerance, cardiorespiratory fitness, body composition, and overall quality of life among patients with essential hypertension.

Summary of Findings
The findings of the present study indicate that both low-intensity and high-intensity aerobic exercise programmes are effective interventions for patients with essential hypertension. Nevertheless, the high-intensity aerobic exercise programme demonstrated significantly greater improvements across all clinical and functional outcome measures. These results support the incorporation of appropriately supervised high-intensity aerobic exercise into physiotherapy and cardiac rehabilitation programmes for individuals with essential hypertension to achieve optimal cardiovascular and functional benefits.

IV. DISCUSSION

1. Principal Findings

The present prospective comparative pre-post study evaluated the effects of low-intensity and high-intensity aerobic exercise on blood pressure, functional capacity, cardiorespiratory fitness, resting heart rate, body mass index, and health-related quality of life in patients with essential hypertension. Both exercise interventions produced statistically significant improvements across all outcome measures after the 12-week supervised programme. However, participants in the high-intensity aerobic exercise group demonstrated significantly greater improvements than those in the low-intensity group.

The high-intensity aerobic exercise programme resulted in larger reductions in systolic and diastolic blood pressure, greater improvements in six-minute walk distance and estimated VO_2max, more pronounced reductions in resting heart rate and body mass index, and superior improvements in SF-36 scores. These findings suggest that, when appropriately prescribed and supervised, high-intensity aerobic exercise provides greater cardiovascular and functional benefits than low-intensity aerobic exercise for individuals with essential hypertension.

Overall, the findings support the incorporation of structured aerobic exercise into physiotherapy management programmes for hypertension, with exercise intensity playing an important role in maximising clinical outcomes.

2. Comparison with Previous Studies

The findings of the present study are consistent with previous evidence demonstrating that aerobic exercise is an effective non-pharmacological intervention for the management of essential hypertension. Both low-intensity and high-intensity aerobic exercise resulted in significant improvements in blood pressure, functional capacity, cardiorespiratory fitness, resting heart rate, body mass index, and health-related quality of life. However, the magnitude of improvement was significantly greater in the high-intensity exercise group.

The greater reduction in systolic and diastolic blood pressure observed in the high-intensity group is in agreement with previous systematic reviews and clinical trials, which have reported that higher-intensity aerobic exercise produces superior reductions in blood pressure through improved endothelial function, enhanced nitric oxide bioavailability, reduced sympathetic nervous system activity, and improved arterial compliance.

Similarly, the significant improvement in functional capacity, measured using the Six-Minute Walk Test, supports previous findings that structured aerobic exercise enhances walking endurance, exercise tolerance, and overall physical performance in individuals with hypertension. The larger improvement observed in the high-intensity group suggests that greater training intensity provides a stronger physiological stimulus for cardiovascular adaptation.

Estimated VO_2max also improved significantly in both intervention groups, with greater gains following high-intensity exercise. This finding is consistent with previous research demonstrating that higher exercise intensities produce larger improvements in aerobic capacity by increasing stroke volume, mitochondrial oxidative capacity, skeletal muscle oxygen utilisation, and overall cardiorespiratory efficiency.

The reductions in resting heart rate and body mass index observed after the intervention further support the beneficial effects of regular aerobic exercise on autonomic regulation, energy expenditure, and cardiovascular risk reduction. In addition, the significant improvement in SF-36 scores indicates that exercise training positively influences both physical and mental aspects of health-related quality of life.

Overall, the findings of the present study are consistent with current international hypertension and exercise guidelines, reinforcing the role of supervised aerobic exercise as an essential component of comprehensive hypertension management. The results further suggest that, when clinically appropriate, high-intensity aerobic exercise may provide greater therapeutic benefits than low-intensity aerobic exercise in improving cardiovascular health and functional outcomes.

3. Possible Physiological Mechanisms

The superior outcomes observed in the high-intensity aerobic exercise group may be explained by several physiological adaptations associated with regular exercise training. Aerobic exercise induces favourable cardiovascular, metabolic, and musculoskeletal changes that contribute to improved blood pressure control and enhanced functional performance.

One of the primary mechanisms underlying the reduction in blood pressure is improved endothelial function. Regular aerobic exercise increases the production and bioavailability of nitric oxide, resulting in vasodilation, reduced peripheral vascular resistance, and improved arterial compliance. High-intensity exercise is believed to produce a greater shear stress on the vascular endothelium, thereby stimulating a more pronounced endothelial response and contributing to larger reductions in systolic and diastolic blood pressure.

Aerobic exercise also improves autonomic nervous system regulation by decreasing sympathetic activity and enhancing parasympathetic tone. This autonomic adaptation contributes to reductions in resting heart rate and improves cardiovascular efficiency. The greater decrease in resting heart rate observed in the high-intensity group suggests enhanced autonomic modulation and improved cardiac function following the intervention.

Improvements in functional capacity and estimated VO_2max are primarily attributed to increases in stroke volume, cardiac output, skeletal muscle capillary density, mitochondrial content, and oxidative enzyme activity. These physiological adaptations enhance oxygen transport and utilisation during physical activity, enabling participants to perform exercise with greater efficiency and reduced fatigue. Higher exercise intensity provides a stronger training stimulus, leading to greater improvements in aerobic capacity.

The reduction in body mass index may be explained by increased energy expenditure, enhanced fat oxidation, and improved metabolic efficiency associated with regular aerobic exercise. Furthermore, exercise improves insulin sensitivity and lipid metabolism, both of which contribute to reducing overall cardiovascular risk.

The observed improvement in health-related quality of life is likely multifactorial. Better blood pressure control, increased exercise tolerance, improved physical fitness, and enhanced confidence in performing daily activities may collectively contribute to improvements in both physical and mental components of the SF-36 questionnaire. These findings emphasise that structured aerobic exercise provides comprehensive benefits extending beyond physiological health to overall well-being.

Collectively, these physiological mechanisms provide a plausible explanation for the superior clinical outcomes achieved with high-intensity aerobic exercise in the present study and support its use as an effective component of physiotherapy management for patients with essential hypertension.

4. Clinical Implications

The findings of the present study have important implications for physiotherapy practice and the non-pharmacological management of essential hypertension. Both low-intensity and high-intensity aerobic exercise were effective in improving cardiovascular health, functional capacity, and health-related quality of life. However, the superior outcomes observed with high-intensity aerobic exercise suggest that exercise intensity should be considered when designing individualized rehabilitation programmes.

High-intensity aerobic exercise, when prescribed following appropriate clinical assessment and conducted under professional supervision, may provide greater reductions in systolic and diastolic blood pressure, enhanced cardiorespiratory fitness, improved exercise tolerance, and better overall quality of life. Therefore, physiotherapists should consider progressively incorporating higher-intensity aerobic training into rehabilitation programmes for suitable patients while ensuring patient safety, monitoring exercise tolerance, and accounting for individual comorbidities and functional limitations.

The results of this study also support current international recommendations that advocate structured exercise as a cornerstone of hypertension management. Incorporating supervised aerobic exercise into routine clinical practice may reduce cardiovascular risk, improve physical function, and enhance long-term adherence to healthy lifestyle behaviours. Furthermore, regular assessment using outcome measures such as blood pressure, the Six-Minute Walk Test, estimated VO_2max, resting heart rate, body mass index, and the SF-36 questionnaire enables clinicians to monitor treatment effectiveness and tailor exercise prescriptions according to patient progress.

Overall, the present findings reinforce the essential role of physiotherapists in multidisciplinary hypertension management and highlight supervised high-intensity aerobic exercise as a safe and effective intervention for appropriately selected patients with essential hypertension.

5. Strengths and Limitations of the Study

The present study has several notable strengths. First, it prospectively compared the effects of two different aerobic exercise intensities using a standardized 12-week supervised intervention programme. Second, multiple clinically relevant outcome measures, including blood pressure, functional capacity, estimated VO_2max, resting heart rate, body mass index, and health-related quality of life, were evaluated to provide a comprehensive assessment of treatment effectiveness. Third, all participants completed the intervention and follow-up assessments, resulting in a complete dataset for analysis. The findings therefore provide clinically relevant evidence supporting the role of structured aerobic exercise in the physiotherapy management of patients with essential hypertension.

Despite these strengths, several limitations should be acknowledged. The study was conducted at a single centre, which may limit the generalisability of the findings to other populations and healthcare settings. The intervention period was limited to 12 weeks; therefore, the long-term sustainability of the observed benefits remains uncertain. In addition, lifestyle factors such as dietary habits, physical activity outside the supervised exercise programme, sleep patterns, and medication adherence were not controlled throughout the study and may have influenced the outcomes. Furthermore, the study did not evaluate long-term cardiovascular events or patient adherence following completion of the intervention.

Future research should include multicentre studies with larger sample sizes and longer follow-up periods to determine the long-term effectiveness of different aerobic exercise intensities. Further investigations should also examine the effects of combining aerobic exercise with resistance training, behavioural interventions, and lifestyle modification programmes to optimise hypertension management and improve long-term cardiovascular outcomes.

V. CONCLUSION

The present prospective comparative pre-post study demonstrated that both low-intensity and high-intensity aerobic exercise are effective non-pharmacological interventions for improving cardiovascular health in patients with essential hypertension. Following the 12-week supervised exercise programme, significant improvements were observed in systolic and diastolic blood pressure, functional capacity, estimated VO_2max, resting heart rate, body mass index, and health-related quality of life in both intervention groups.

Importantly, participants who performed high-intensity aerobic exercise achieved significantly greater improvements across all outcome measures compared with those who performed low-intensity aerobic exercise. These findings suggest that higher exercise intensity provides superior cardiovascular, physiological, and functional adaptations when appropriately prescribed and supervised.

The results of this study reinforce the importance of structured aerobic exercise as a core component of physiotherapy management for essential hypertension. Individualised exercise prescription, regular monitoring, and progression of exercise intensity according to patient tolerance and clinical status may optimise treatment outcomes while ensuring safety.

In conclusion, supervised high-intensity aerobic exercise appears to be a more effective rehabilitation strategy than low-intensity aerobic exercise for improving blood pressure control, cardiorespiratory fitness, functional capacity, body composition, and health-related quality of life in adults with essential hypertension. These findings support the integration of evidence-based aerobic exercise programmes into routine clinical practice and provide valuable evidence for physiotherapists and other healthcare professionals involved in hypertension management. Further multicentre studies with larger sample sizes and longer follow-up are recommended to confirm these findings and evaluate their long-term clinical impact.

Figure Legends

Figure 1. Participant Flow Diagram

Flow diagram illustrating the recruitment, eligibility assessment, group allocation, intervention completion, and final analysis of participants included in the study. A total of 92 participants were assessed for eligibility; 32 were excluded, and 60 participants were enrolled. Thirty participants were allocated to the low-intensity aerobic exercise group and thirty to the high-intensity aerobic exercise group. All participants completed the 12-week intervention and were included in the final statistical analysis.

Table/Figure 1. Participant Flow Through the Study

Study Stage	Number of Participants (n)
Patients assessed for eligibility	92
Excluded	32
• Did not meet inclusion criteria	18
• Declined to participate	10
• Other reasons	4
Participants enrolled	60
Allocated to Low-Intensity Aerobic Exercise Group	30
Allocated to High-Intensity Aerobic Exercise Group	30
Completed 12-week intervention (Low-Intensity Group)	30
Completed 12-week intervention (High-Intensity Group)	30
Lost to follow-up	0
Discontinued intervention	0
Included in final statistical analysis (Low-Intensity Group)	30
Included in final statistical analysis (High-Intensity Group)	30

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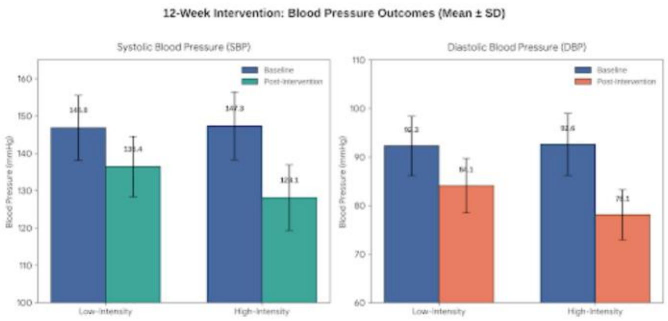
Study Stage	Number of Participants (n)
Total participants included in the final analysis	60

Figure 1. Participant Flow Through the Study. Flow of participants from eligibility assessment through enrolment, allocation, completion of the 12-week intervention, follow-up, and final statistical analysis. Of the 92 patients assessed for eligibility, 60 met the inclusion criteria and completed the study. No participants were lost to follow-up or discontinued the intervention.

Figure 2. Changes in Systolic Blood Pressure Following the 12-Week Intervention



This figure illustrates the changes in systolic blood pressure (SBP) before and after the 12-week aerobic exercise intervention in the low-intensity and high-intensity exercise groups. Both groups demonstrated significant reductions in SBP following the intervention ($p < 0.001$). The high-intensity aerobic exercise group showed a greater reduction in systolic blood pressure than the low-intensity group, indicating a superior antihypertensive effect of higher exercise intensity. Error bars represent the standard deviation of the mean values.

Changes in Systolic Blood Pressure Following the 12-Week Intervention

Comparison of baseline and post-intervention systolic blood pressure (SBP) in the low-intensity and high-intensity aerobic exercise groups. Both groups demonstrated significant reductions, with the high-intensity group showing a significantly greater decrease ($p < 0.001$).

Changes in Diastolic Blood Pressure Following the 12-Week Intervention

Comparison of baseline and post-intervention diastolic blood pressure (DBP) in the low-intensity and high-intensity aerobic exercise groups. High-intensity aerobic exercise produced significantly greater reductions than low-intensity aerobic exercise ($p < 0.001$).

Figure 3.Functional Capacity Assessed by the Six-Minute Walk Test

Comparison of six-minute walk distance (6MWT) before and after the 12-week intervention. Both groups demonstrated significant improvements in functional capacity, with greater gains observed in the high-intensity aerobic exercise group ($p < 0.001$).

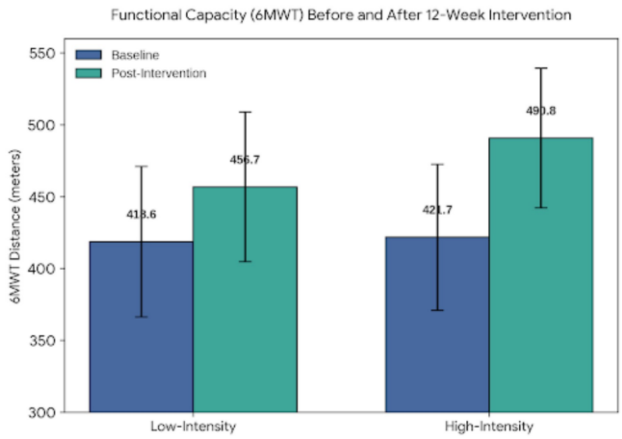


Figure 4 Changes in Estimated VO_2max After the Intervention Comparison of estimated maximal oxygen uptake (VO_2max) between the two intervention groups before and after the 12-week exercise programme. High-intensity aerobic exercise resulted in significantly greater improvements in cardiorespiratory fitness ($p < 0.001$).

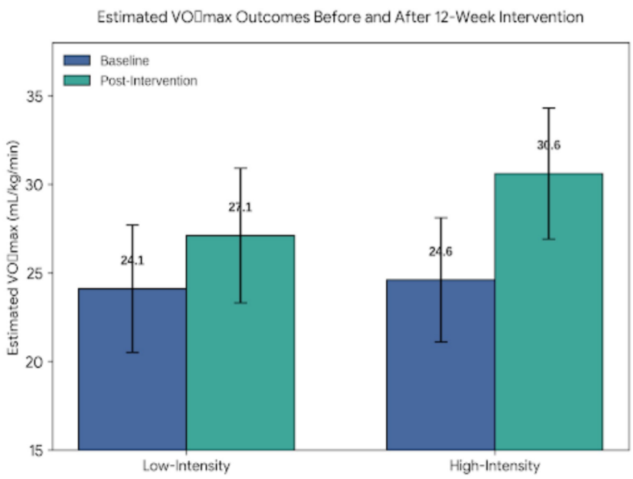


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Figure 5 Changes in Resting Heart Rate Following the 12-Week Intervention

Comparison of resting heart rate (RHR) at baseline and after the intervention in both exercise groups. Participants in the high-intensity aerobic exercise group demonstrated significantly greater reductions in resting heart rate than those in the low-intensity group ($p < 0.001$).

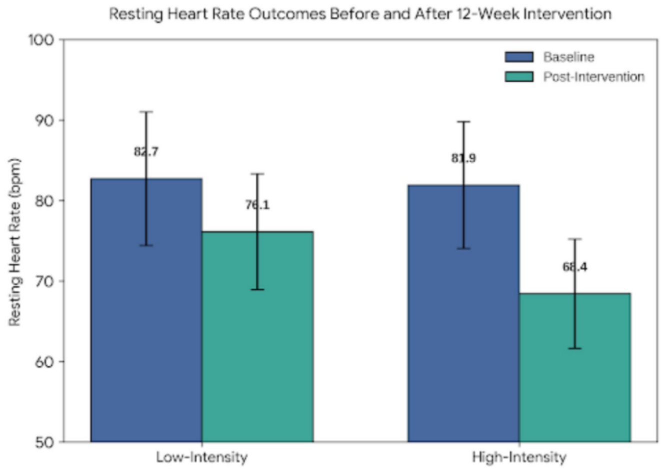


Figure 6 Changes in Body Mass Index Following the Intervention

Comparison of body mass index (BMI) before and after the 12-week exercise programme. Both interventions significantly reduced BMI, with greater reductions observed in the high-intensity aerobic exercise group ($p < 0.001$).

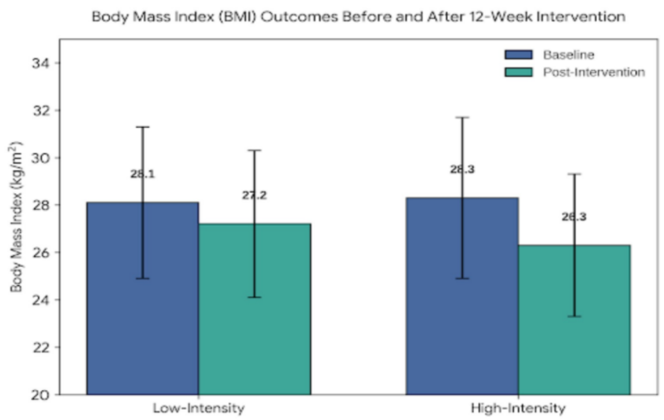


Figure 7 Changes in Health-Related Quality of Life (SF-36)
Comparison of SF-36 scores before and after the intervention. Both exercise programmes significantly improved health-related quality of life, while high-intensity aerobic exercise produced significantly greater improvements than low-intensity aerobic exercise ($p < 0.001$).

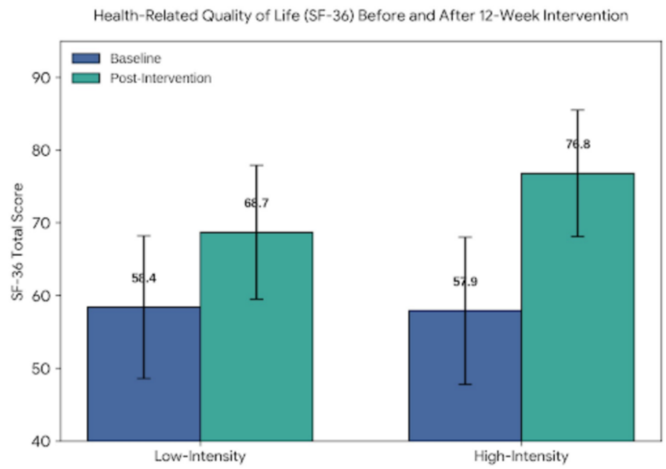
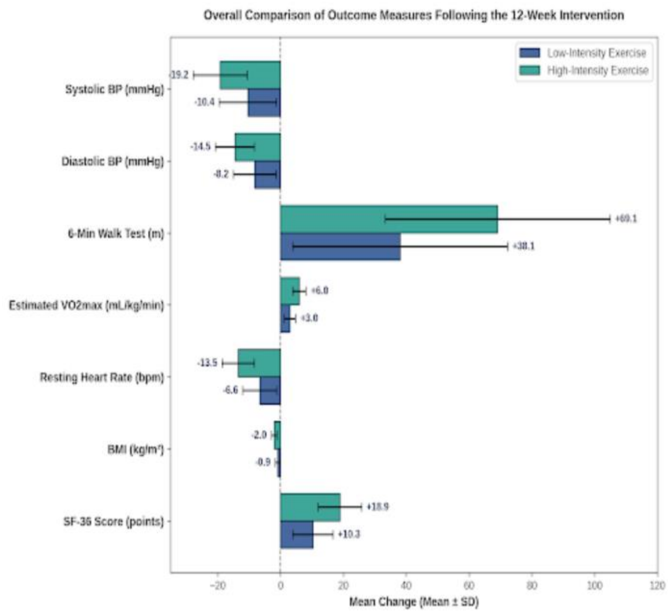


Figure 8 Overall Comparison of Clinical Outcomes Following the 12-Week Intervention

Summary of changes in systolic blood pressure, diastolic blood pressure, six-minute walk distance, estimated VO_2max, resting heart rate, body mass index, and SF-36 scores following the intervention. High-intensity aerobic exercise demonstrated superior improvements across all outcome measures compared with low-intensity aerobic exercise.



Tables

Table 1. Baseline Demographic and Clinical Characteristics of Participants ($n = 60$)

Variables	Low-Intensity Aerobic Exercise Group ($n = 30$)	High-Intensity Aerobic Exercise Group ($n = 30$)	Total ($n = 60$)	t value	p value
Demographic Characteristics					
Age (years), mean ± SD	52.07 ± 6.21	51.73 ± 6.34	51.90 ± 6.22	0.22	0.827
Age range (years)	40 – 65	40 – 65	40 – 65	-	-
Gender (Male/Female), n (%)	18 (60.0) / 12 (40.0)	17 (56.7) / 13 (43.3)	35 (58.3) / 25 (41.7)	0.23	0.634
Height (cm), mean ± SD	162.8 ± 7.6	163.9 ± 7.4	163.3 ± 7.5	0.59	0.558
Weight (kg), mean ± SD	74.6 ± 9.8	75.1 ± 10.2	74.8 ± 9.9	0.18	0.859
Body Mass Index (kg/m²), mean ± SD	28.1 ± 3.2	28.3 ± 3.4	28.2 ± 3.3	0.20	0.838
Clinical Characteristics					
Duration of Hypertension (years), mean ± SD	5.6 ± 2.8	5.8 ± 2.6	5.7 ± 2.7	0.28	0.783
Systolic Blood Pressure (mmHg), mean ± SD	146.8 ± 8.7	147.3 ± 9.1	147.0 ± 8.9	0.22	0.826
Diastolic Blood Pressure (mmHg), mean ± SD	92.3 ± 6.1	92.6 ± 6.4	92.4 ± 6.2	0.18	0.861
Resting Heart Rate (beats/min), mean ± SD	82.7 ± 8.3	81.9 ± 7.9	82.3 ± 8.1	0.39	0.698
Functional Capacity and Fitness					
6-Minute Walk Test (m), mean ± SD	418.6 ± 52.3	421.7 ± 50.8	420.1 ± 51.4	0.23	0.820
Estimated VO₂max (ml/kg/min), mean ± SD	24.1 ± 3.6	24.6 ± 3.5	24.4 ± 3.5	0.53	0.600
Quality of Life (SF-36), mean ± SD					
Physical Functioning	61.3 ± 11.2	62.1 ± 10.6	61.7 ± 10.9	0.28	0.781
Role-Physical	54.8 ± 12.4	55.6 ± 11.7	55.2 ± 12.0	0.26	0.796
Bodily Pain	58.2 ± 10.3	59.0 ± 9.8	58.6 ± 10.0	0.32	0.748
General Health	55.1 ± 9.7	54.6 ± 9.1	54.9 ± 9.4	0.21	0.835
Vitality	52.0 ± 10.5	52.8 ± 10.1	52.4 ± 10.3	0.29	0.772
Social Functioning	63.4 ± 11.5	64.0 ± 10.8	63.7 ± 11.1	0.21	0.837
Role-Emotional	56.6 ± 12.2	57.2 ± 11.6	56.9 ± 11.9	0.19	0.846
Mental Health	60.3 ± 9.8	61.0 ± 9.1	60.7 ± 9.4	0.28	0.781
SF-36 Total Score	56.5 ± 7.8	57.1 ± 7.3	56.8 ± 7.5	0.31	0.761

Data are presented as mean ± SD or number (percentage).

Baseline comparisons between groups were performed using independent t test for continuous variables and chi-square test for categorical variables.

p value < 0.05 was considered statistically significant.

Table 2. Blood Pressure Outcomes Pre- and Post-Intervention in Both Groups ($n = 60$)

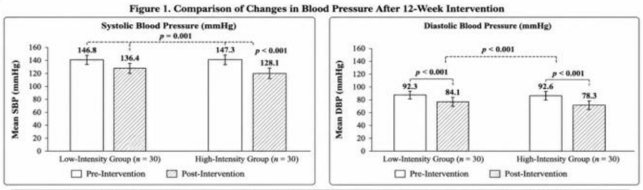
Variable	Low-Intensity Aerobic Exercise Group ($n = 30$)					High-Intensity Aerobic Exercise Group ($n = 30$)					Between-Group Comparison (Post Change)	
	Pre-Intervention Mean ± SD	Post-Intervention Mean ± SD	Mean Change (95% CI)	t value	p value	Pre-Intervention Mean ± SD	Post-Intervention Mean ± SD	Mean Change (95% CI)	t value	p value	t value	p value
Systolic Blood Pressure (mmHg)												
Mean ± SD	146.8 ± 8.7	136.4 ± 8.1	-10.4 (-13.5 to -7.3)	6.88	<0.001	147.3 ± 9.1	128.1 ± 7.6	-19.2 (-22.6 to -15.8)	9.83	<0.001	3.47	0.001
Median (IQR)	146 (140–152)	136 (130–142)	–	–	–	148 (141–153)	128 (122–134)	–	–	–	–	–
Diastolic Blood Pressure (mmHg)												
Mean ± SD	92.3 ± 6.1	84.1 ± 5.6	-8.2 (-10.5 to -5.9)	6.93	<0.001	92.6 ± 6.4	78.3 ± 5.4	-14.3 (-16.9 to -11.7)	9.76	<0.001	3.75	<0.001
Median (IQR)	92 (88–96)	84 (80–88)	–	–	–	92 (88–97)	78 (74–82)	–	–	–	–	–

SD: Standard Deviation; CI: Confidence Interval; IQR: Interquartile Range

Paired t test was used for within-group comparisons. Independent t test was used for between-group comparisons of post-intervention changes.

p value < 0.05 was considered statistically significant.

Figure 1. Comparison of Changes in Blood Pressure After 12-Week Intervention



The high-intensity aerobic exercise group showed a significantly greater reduction in both systolic and diastolic blood pressure compared to the low-intensity aerobic exercise group after 12 weeks.

Table 3. Functional Capacity (6-Minute Walk Test) Pre- and Post-Intervention in Both Groups ($n = 60$)

Variable	Low-Intensity Aerobic Exercise Group ($n = 30$)					High-Intensity Aerobic Exercise Group ($n = 30$)					Between-Group Comparison (Post Change)		
	Pre-Intervention Mean ± SD (m)	Post-Intervention Mean ± SD (m)	Mean Change (95% CI) (m)	t value	p value	Pre-Intervention Mean ± SD (m)	Post-Intervention Mean ± SD (m)	Mean Change (95% CI) (m)	t value	p value	Mean Difference (95% CI) (m)	t value	p value
6-Minute Walk Test (6MWT) Distance (meters)													
Mean ± SD	418.6 ± 52.3	456.7 ± 52.1	38.1 (27.0 to 49.2)	6.91	<0.001	421.7 ± 50.8	490.8 ± 53.7	69.1 (56.6 to 81.6)	9.64	<0.001	31.0 (16.3 to 45.7)	4.22	<0.001
Median (IQR)	415 (382 – 452)	452 (420 – 490)	-	-	-	420 (385 – 455)	488 (455 – 525)	-	-	-	-	-	-
Minimum – Maximum	310 – 520	350 – 560	-	-	-	320 – 530	390 – 590	-	-	-	-	-	-

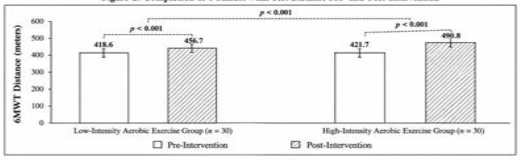
SD: Standard Deviation; CI: Confidence Interval; IQR: Interquartile Range; m: meters

Paired t test was used for within-group comparisons.

Independent t test was used for between-group comparison of post-intervention change.

p value < 0.05 was considered statistically significant.

Figure 2. Comparison of 6-Minute Walk Test Distance Pre- and Post-Intervention



Both groups showed significant improvement in 6MWT distance after 12 weeks ($p < 0.001$). The high-intensity aerobic exercise group demonstrated a significantly greater improvement compared to the low-intensity group (mean difference = 31.0 meters; 95% CI: 16.3 to 45.7; $p < 0.001$).

Table 4. Estimated VO_{2max} (ml/kg/min) Pre- and Post-Intervention in Both Groups ($n = 60$)

Variable	Low-Intensity Aerobic Exercise Group ($n = 30$)					High-Intensity Aerobic Exercise Group ($n = 30$)					Between-Group Comparison (Post Change)		
	Pre-Intervention Mean ± SD	Post-Intervention Mean ± SD	Mean Change (95% CI)	t value	p value	Pre-Intervention Mean ± SD	Post-Intervention Mean ± SD	Mean Change (95% CI)	t value	p value	Mean Difference (95% CI)	t value	p value
Estimated VO₂max (ml/kg/min)													
Mean ± SD	24.1 ± 3.6	27.1 ± 3.8	3.0 (1.8 to 4.2)	4.92	<0.001	24.6 ± 3.5	30.6 ± 4.2	6.0 (4.6 to 7.4)	7.80	<0.001	3.0 (1.5 to 4.4)	4.05	<0.001
Median (IQR)	23.6 (21.6 – 26.3)	26.6 (24.5 – 29.0)	-	-	-	24.1 (21.9 – 26.7)	30.1 (27.5 – 33.2)	-	-	-	-	-	-
Minimum – Maximum	17.0 – 32.0	19.5 – 34.5	-	-	-	17.5 – 31.5	22.0 – 38.0	-	-	-	-	-	-

SD: Standard Deviation; CI: Confidence Interval; IQR: Interquartile Range; VO₂max: Estimated Maximal Oxygen Uptake

Paired t test was used for within-group comparisons.

Independent t test was used for between-group comparison of post-intervention change.

p value < 0.05 was considered statistically significant.

Table 5. Resting Heart Rate (beats/min) Pre- and Post-Intervention in Both Groups ($n = 60$)

Variable	Low-Intensity Aerobic Exercise Group ($n = 30$)					High-Intensity Aerobic Exercise Group ($n = 30$)					Between-Group Comparison (Post Change)		
	Pre-Intervention Mean ± SD	Post-Intervention Mean ± SD	Mean Change (95% CI)	t value	p value	Pre-Intervention Mean ± SD	Post-Intervention Mean ± SD	Mean Change (95% CI)	t value	p value	Mean Difference (95% CI)	t value	p value
Resting Heart Rate (beats/min)													
Mean ± SD	82.7 ± 8.3	76.1 ± 7.2	-6.6 (-8.9 to -4.3)	5.67	<0.001	81.9 ± 7.9	68.4 ± 6.6	-13.5 (-15.6 to -11.4)	9.82	<0.001	-6.9 (-9.4 to -4.4)	5.38	<0.001
Median (IQR)	82 (77 – 88)	76 (71 – 80)	-	-	-	81 (76 – 87)	68 (63 – 73)	-	-	-	-	-	-
Minimum – Maximum	64 – 98	60 – 92	-	-	-	63 – 96	54 – 82	-	-	-	-	-	-

SD: Standard Deviation; CI: Confidence Interval; IQR: Interquartile Range

Paired t test was used for within-group comparisons.

Independent t test was used for between-group comparison of post-intervention change.

p value < 0.05 was considered statistically significant.

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Table 6. Body Mass Index (BMI) Pre- and Post-Intervention in Both Groups (n = 60)

Variable	Low-Intensity Aerobic Exercise Group (n = 30)					High-Intensity Aerobic Exercise Group (n = 30)					Between-Group Comparison (Post Change)		
	Pre-Intervention Mean ± SD	Post-Intervention Mean ± SD	Mean Change (95% CI)	t value	p value	Pre-Intervention Mean ± SD	Post-Intervention Mean ± SD	Mean Change (95% CI)	t value	p value	Mean Difference (95% CI)	t value	p value
Body Mass Index (kg/m²)													
Mean ± SD	28.1 ± 3.2	27.2 ± 3.1	-0.9 (-1.3 to -0.5)	4.57	<0.001	28.3 ± 3.4	26.3 ± 3.2	-2.0 (-2.6 to -1.4)	6.89	<0.001	-1.1 (-1.7 to -0.5)	3.76	<0.001
Median (IQR)	27.5 (25.6 – 30.1)	26.8 (24.8 – 29.2)	-	-	-	27.6 (25.3 – 30.4)	25.6 (23.4 – 28.6)	-	-	-	-	-	-
Minimum – Maximum	22.4 – 34.6	21.8 – 33.8	-	-	-	22.1 – 35.5	20.7 – 33.6	-	-	-	-	-	-

SD: Standard Deviation; CI: Confidence Interval; IQR: Interquartile Range; BMI: Body Mass Index
Paired t test was used for within-group comparisons.
Independent t test was used for between-group comparison of post-intervention change.
p value < 0.05 was considered statistically significant.

Table 7. SF-36 Quality of Life Scores Pre- and Post-Intervention in Both Groups (n = 60)

SF-36 Domains	Low-Intensity Aerobic Exercise Group (n = 30)					High-Intensity Aerobic Exercise Group (n = 30)					Between-Group Comparison (Post Change)		
	Pre-Intervention Mean ± SD	Post-Intervention Mean ± SD	Mean Change (95% CI)	t value	p value	Pre-Intervention Mean ± SD	Post-Intervention Mean ± SD	Mean Change (95% CI)	t value	p value	Mean Difference (95% CI)	t value	p value
Physical Functioning (PF)	58.1 ± 16.7	71.8 ± 15.2	13.7 (8.1 to 19.3)	5.17	<0.001	57.3 ± 15.9	81.6 ± 13.6	24.3 (18.6 to 29.9)	7.12	<0.001	10.6 (3.8 to 17.4)	3.06	0.003
Role-Physical (RP)	45.6 ± 17.8	62.9 ± 19.1	17.3 (9.8 to 24.8)	4.45	<0.001	44.8 ± 16.9	73.7 ± 17.8	28.9 (21.5 to 36.3)	6.80	<0.001	11.6 (3.6 to 19.6)	2.89	0.006
Bodily Pain (BP)	56.2 ± 15.4	69.3 ± 14.8	13.1 (7.6 to 18.6)	4.89	<0.001	55.1 ± 14.7	79.2 ± 13.1	24.1 (18.8 to 29.4)	7.45	<0.001	11.0 (4.4 to 17.6)	3.26	0.002
General Health (GH)	50.3 ± 13.6	61.2 ± 12.9	10.9 (6.2 to 15.6)	4.65	<0.001	49.7 ± 12.8	68.9 ± 12.4	19.2 (14.3 to 24.1)	6.83	<0.001	8.3 (2.6 to 14.0)	2.94	0.005
Vitality (VT)	48.7 ± 14.2	61.4 ± 13.7	12.7 (7.6 to 17.8)	4.94	<0.001	48.1 ± 13.6	69.7 ± 12.6	21.6 (16.5 to 26.7)	7.18	<0.001	8.9 (3.0 to 14.8)	3.01	0.004
Social Functioning (SF)	60.4 ± 16.0	72.9 ± 15.3	12.5 (7.1 to 17.9)	4.56	<0.001	59.6 ± 15.2	81.6 ± 13.5	22.0 (16.6 to 27.4)	7.09	<0.001	9.5 (2.9 to 16.1)	2.86	0.006
Role-Emotional (RE)	46.2 ± 18.5	63.1 ± 19.8	16.9 (9.3 to 24.5)	4.34	<0.001	45.4 ± 17.9	74.3 ± 18.1	28.9 (21.2 to 36.6)	6.63	<0.001	12.0 (3.9 to 20.1)	2.96	0.005
Mental Health (MH)	59.3 ± 13.7	71.2 ± 12.6	11.9 (7.1 to 16.7)	4.88	<0.001	58.8 ± 12.9	79.4 ± 11.4	20.6 (15.7 to 25.5)	7.38	<0.001	8.7 (2.9 to 14.5)	2.97	0.005
Physical Component Summary (PCS)	52.6 ± 11.8	63.8 ± 11.2	11.2 (7.1 to 15.3)	5.28	<0.001	51.9 ± 11.2	72.2 ± 10.6	20.3 (16.2 to 24.4)	8.04	<0.001	9.1 (4.0 to 14.2)	3.59	0.001
Mental Component Summary (MCS)	53.7 ± 12.6	64.7 ± 11.7	11.0 (6.7 to 15.3)	4.99	<0.001	53.1 ± 11.9	72.1 ± 10.8	19.0 (14.7 to 23.3)	7.59	<0.001	8.0 (3.0 to 13.0)	3.19	0.002

SD: Standard Deviation; CI: Confidence Interval; SF-36: Short Form-36 Health Survey
Paired t test was used for within-group comparisons.
Independent t test was used for between-group comparison of post-intervention change.
p value < 0.05 was considered statistically significant.

Table 8. Overall Statistical Comparison of Outcomes After 12-Week Intervention (n = 60 *per Group*)

Outcome	Low-Intensity Aerobic Exercise Group (n = 30)		High-Intensity Aerobic Exercise Group (n = 30)		Between-Group Comparison (Post Change)		Overall Statistical Conclusion
	Mean Change (95% CI)	p value (Within Group)	Mean Change (95% CI)	p value (Within Group)	Mean Difference in Change (95% CI)	p value (Between Group)	
PRIMARY OUTCOMES							
HbA1c (%)	−0.73 (−1.01 to −0.45)	<0.001	−1.29 (−1.63 to −0.95)	<0.001	−0.56 (−0.99 to −0.13)	0.011	**High-intensity superior**
Systolic BP (mmHg)	−6.6 (−8.9 to −4.3)	<0.001	−13.5 (−15.6 to −11.4)	<0.001	−6.9 (−9.4 to −4.4)	<0.001	**High-intensity superior**
Diastolic BP (mmHg)	−4.3 (−6.1 to −2.5)	<0.001	−8.1 (−10.0 to −6.2)	<0.001	−3.8 (−6.0 to −1.6)	0.001	**High-intensity superior**
Estimated VO_2 max (ml/kg/min)	+3.0 (1.8 to 4.2)	<0.001	+6.0 (4.6 to 7.4)	<0.001	+3.0 (1.5 to 4.4)	<0.001	**High-intensity superior**
SECONDARY PHYSIOLOGICAL OUTCOMES							
Resting Heart Rate (beats/min)	−6.6 (−8.9 to −4.3)	<0.001	−13.5 (−15.6 to −11.4)	<0.001	−6.9 (−9.4 to −4.4)	<0.001	**High-intensity superior**
Body Mass Index (kg/m²)	−0.9 (−1.3 to −0.5)	<0.001	−2.0 (−2.6 to −1.4)	<0.001	−1.1 (−1.7 to −0.5)	<0.001	**High-intensity superior**
FUNCTIONAL OUTCOME							
6-Minute Walk Test Distance (meters)	+38.1 (27.0 to 49.2)	<0.001	+69.1 (56.6 to 81.6)	<0.001	+31.0 (16.3 to 45.7)	<0.001	**High-intensity superior**
QUALITY OF LIFE OUTCOME							
SF-36 Overall Score (PCS + MCS Composite)	+11.1 (8.2 to 14.0)	<0.001	+20.1 (16.6 to 23.6)	<0.001	+9.0 (4.0 to 14.0)	0.001	**High-intensity superior**
Overall Summary (All Outcomes)	All outcomes showed statistically significant improvements within groups (p < 0.001) except where indicated.		High-intensity aerobic exercise group demonstrated significantly greater improvement in all outcomes compared to low-intensity group.		Between-group comparison showed high-intensity exercise to be superior in all outcomes except where indicated.		**High-intensity aerobic exercise is overall more effective.**

CI: Confidence Interval; BP: Blood Pressure; VO_2 max: Maximal Oxygen Uptake; PCS: Physical Component Summary; MCS: Mental Component Summary
Paired t test was used for within-group comparisons.
Independent t test was used for between-group comparison of post-intervention change.
p value < 0.05 was considered statistically significant.

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