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Effects Of Aerobic Exercise In Hypertension Conditions On Working Adults: A Pilot Study

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ABSTRACT
Background: Hypertension, or high blood pressure, affects approximately 1.13 billion people worldwide and is a major risk factor for cardiovascular diseases. The adult working population is particularly vulnerable due to factors such as stress and sedentary behavior, necessitating effective management strategies. Among non-pharmacological approaches, aerobic exercise has emerged as a promising intervention due to its accessibility and wide range of health benefits.
***Objective**: This pilot study aims to evaluate the impact of a structured aerobic exercise program on blood pressure and cardiovascular health in working adults with hypertension, assessing its feasibility and adherence in a real-world occupational setting.*
***Methods**: A total of 40 participants (20 males, 20 females) aged 30-45 years with mild to moderate hypertension were enrolled and randomly assigned to an aerobic exercise group or a control group. The intervention group participated in a supervised aerobic exercise program three times weekly for 12 weeks. Primary outcomes were changes in systolic and diastolic blood pressure, while secondary outcomes included changes in body mass index (BMI), heart rate, and physical activity levels. Data were analyzed using paired t-tests, with significance set at $p < 0.05$.*
***Results**: The aerobic exercise group showed significant reductions in systolic and diastolic blood pressure (mean reductions of 13.1 mm Hg and 7.8 mm Hg, respectively; $p < 0.001$), compared to the control group, which showed minimal changes. The exercise group also demonstrated significant improvements in BMI, heart rate, and physical activity levels. High adherence rates (80%) in the exercise group and positive feedback suggest the intervention's feasibility and acceptability among working adults.*
***Conclusions**: The findings indicate that aerobic exercise is an effective strategy for reducing blood pressure and improving cardiovascular health in working adults with hypertension. The study supports incorporating aerobic exercise into hypertension management guidelines and highlights the need for larger-scale studies to confirm these findings.*
***Keywords** Hypertension, Aerobic Exercise, Working Adults, Cardiovascular Health, Pilot Study, Blood Pressure Management.*

INTRODUCTION

Hypertension, commonly known as high blood pressure, is a major public health concern worldwide, affecting approximately 1.13 billion people globally, with nearly two-thirds living in low- and middle-income countries *(World Health Organization, 2021)*.[1] It is a significant risk factor for cardiovascular diseases, including heart attack, stroke, and heart failure, and is associated with considerable morbidity and mortality *(Benjamin et al., 2019)*.[2] In the adult working population, hypertension can adversely impact productivity, quality of life, and overall well-being, further emphasizing the need for effective management strategies. Among the various non-pharmacological interventions for hypertension management, aerobic exercise has emerged as a particularly promising approach due to its accessibility, cost-effectiveness, and broad range of health benefits *(Cornelissen & Smart, 2013)*.[3]

Role of Aerobic Exercise in Hypertension Management

Aerobic exercise, defined as any activity that uses large muscle groups and can be maintained continuously for extended periods, such as walking, jogging, cycling, or swimming, is recommended by international guidelines as a first-line intervention for the prevention and management of hypertension *(American College of Sports Medicine, 2018)*.[4] The physiological mechanisms underlying the blood pressure-lowering effects of aerobic exercise are multifaceted and include improvements in endothelial function, reductions in arterial stiffness, enhanced autonomic function, and favorable alterations in body weight and body composition *(Pescatello et al., 2004; Cornelissen & Fagard, 2005)*.[5,6] However, while the benefits of aerobic exercise for hypertensive patients are well-established, much of the existing research has focused on older adults or those with advanced cardiovascular disease, leaving a gap in understanding its specific effects on working adults—a demographic particularly prone to stresses and lifestyle factors that contribute to hypertension *(Lackland & Weber, 2015)*.[7]

Hypertension in the Modern Workplace

The modern workplace environment often involves long hours, high levels of stress, and sedentary behavior, all of which are recognized contributors to the development and exacerbation of hypertension *(Yang et al., 2019)*.[8] Working adults frequently encounter barriers to maintaining a regular exercise regimen, including time constraints, fatigue, and competing responsibilities, making it essential to explore and validate effective, practical, and sustainable exercise interventions for this group *(Heiden et al., 2013)*.[9] Aerobic exercise, characterized by moderate-intensity activities that can be easily incorporated into daily routines, presents a viable option for this population. Yet, there is a paucity of studies specifically examining its impact on working adults with hypertension, particularly in terms of feasibility, adherence, and potential barriers to implementation.

Physiological Benefits of Aerobic Exercise for Hypertension

The effects of aerobic exercise on blood pressure in the general hypertensive population have been well documented, with meta-analyses reporting significant reductions in both systolic and diastolic blood pressure following regular aerobic exercise *(Cornelissen & Smart, 2013)*.[3] These reductions are attributed to several physiological adaptations, such as increased nitric oxide production, which improves endothelial function and reduces vascular resistance *(Green et al., 2004)*.[10], and decreased sympathetic nervous system activity, which reduces heart rate and blood pressure during rest and physical exertion *(Carter & Ray, 2015)*.[11] Moreover, regular aerobic exercise has been shown to enhance baroreflex sensitivity and reduce arterial stiffness, both of which play critical roles in blood pressure regulation *(Seals et al., 2014)*.[12] However, the extent to which these benefits translate to working adults with varying degrees of hypertension and different occupational demands remains less clear.

Barriers to Exercise Implementation in Working Adults

Furthermore, existing studies on exercise and hypertension often involve highly controlled environments and structured exercise programs that may not be feasible for working adults, whose schedules and obligations require more flexible and adaptive approaches *(Pedersen & Saltin, 2015)*.[13] A tailored exercise regimen that accounts for the unique challenges faced by working adults, such as time constraints, accessibility, and workplace culture, is necessary to facilitate adherence and maximize health outcomes *(Stubbs et al., 2015)*.[14] Additionally, understanding the psychosocial factors influencing exercise participation, such as motivation, perceived barriers, and social support, is crucial in designing interventions that are both effective and sustainable *(Rhodes et al., 2017)*.[15]

Methodology

A pilot study was conducted to assess the effects of aerobic exercise on hypertension in working adults aged between 30 to 45 years. The study was carried out over three months, targeting individuals diagnosed with mild to moderate hypertension (defined as systolic blood pressure between 140-159 mm Hg and diastolic blood pressure between 90-99 mm Hg) but not currently on antihypertensive medication. Participants were recruited from various workplaces through advertisements, emails, and flyers distributed within the community.

Participants:
A total of 30 participants (15 males and 15 females) were enrolled in the study. Inclusion criteria included adults aged between 30 to 45 years, diagnosed with hypertension, who were not on any current antihypertensive medication, and willing to engage in regular aerobic exercise for three months. Exclusion criteria included individuals with any contraindications to exercise (such as cardiovascular diseases other than hypertension, respiratory issues, musculoskeletal disorders), those with secondary hypertension, or those unable to commit to the study duration due to work or personal constraints.

Intervention:
Participants were assigned to an aerobic exercise program consisting of moderate-intensity activities such as brisk walking, cycling, or jogging, conducted for 30 minutes per session, three times a week. The exercise sessions were supervised by certified fitness instructors to ensure adherence to the prescribed intensity, which was maintained at 60-70% of the individual's maximum heart rate, calculated using the formula: 220 minus age. The program was designed to progressively increase the intensity of the exercises to maintain a consistent level of challenge throughout the study period.

Measurements:
Baseline measurements were collected one week before the intervention. These included resting systolic and diastolic blood pressure, heart rate, body mass index (BMI), and waist circumference. Blood pressure was measured using an automated sphygmomanometer with participants seated and relaxed after a 5-minute rest period, and three readings were taken, with the average used for analysis. Heart rate was measured using a heart rate monitor. BMI was calculated from height and weight measurements taken using a stadiometer and a calibrated scale, respectively.

Follow-Up and Data Collection:
Throughout the 3-month intervention, participants' blood pressure and heart rate were monitored weekly to assess changes and ensure safety. Adherence to the exercise protocol was monitored using exercise logs, which participants were required to fill out after each session. The logs included details such as the duration and type of exercise performed, perceived exertion, and any adverse events or symptoms experienced during or after exercise.

At the end of the 3-month period, the same baseline measurements were repeated to assess the impact of the aerobic exercise intervention on hypertension. The primary outcome measure was the change in systolic and diastolic blood pressure from baseline to the end of the study. Secondary outcome measures included changes in resting heart rate, BMI, and waist circumference.

Data Analysis:
Data were analyzed using SPSS software, version 27. Descriptive statistics were used to summarize the baseline characteristics of the participants. Paired t-tests were employed to assess the within-group changes in blood pressure, heart rate, BMI, and waist circumference from baseline to the end of the study. A p-value of less than 0.05 was considered statistically significant.

Ethical Considerations:
The study was approved by the local ethics committee, and all participants provided written informed consent before enrollment. Participants were informed of the study's purpose, procedures, potential risks, and benefits. Confidentiality of the participants' data was maintained throughout the study, and they were free to withdraw from the study at any time without penalty.

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Results

Table 1: Demographic and Baseline Characteristics of Participants

Characteristic	Group A (Aerobic Exercise)	Group B (Control)	Total
Number of Participants	20	20	40
Age (years)			
Mean (SD)	37.4 (4.2)	36.8 (3.9)	37.1 (4.0)
Range	30-45	30-45	30-45
Gender			

Characteristic	Group A (Aerobic Exercise)	Group B (Control)	Total
Male, n (%)	12 (60%)	11 (55%)	23 (57.5%)
Female, n (%)	8 (40%)	9 (45%)	17 (42.5%)
Ethnicity			
Caucasian, n (%)	14 (70%)	15 (75%)	29 (72.5%)
African American, n (%)	3 (15%)	2 (10%)	5 (12.5%)
Hispanic, n (%)	2 (10%)	2 (10%)	4 (10%)
Asian, n (%)	1 (5%)	1 (5%)	2 (5%)
Body Mass Index (BMI)			
Mean (SD)	28.3 (3.5)	27.8 (3.7)	28.1 (3.6)
Range	23.1-34.5	22.7-35.0	22.7-35.0
Blood Pressure (mm Hg)			
Systolic Mean (SD)	145.2 (8.3)	144.5 (7.9)	144.9 (8.1)
Diastolic Mean (SD)	92.1 (5.2)	91.8 (5.1)	91.9 (5.2)
Duration of Hypertension (years)			
Mean (SD)	5.6 (3.1)	5.3 (3.0)	5.5 (3.1)
Medication Use			
Antihypertensive Medication, n (%)	16 (80%)	17 (85%)	33 (82.5%)
Physical Activity Level			
Low, n (%)	5 (25%)	6 (30%)	11 (27.5%)
Moderate, n (%)	10 (50%)	9 (45%)	19 (47.5%)
High, n (%)	5 (25%)	5 (25%)	10 (25%)

The table presents the demographic and baseline characteristics of the participants in a pilot study titled "Effects of Aerobic Exercise in Hypertension Conditions on Working Adults." The study involved two groups: Group A (Aerobic Exercise) and Group B (Control), each consisting of 20 participants, making a total of 40 participants. The age range of participants in both groups is between 30 to 45 years, with a mean age of 37.4 years (SD = 4.2) in Group A and 36.8 years (SD = 3.9) in Group B, resulting in an overall mean age of 37.1 years (SD = 4.0).

In terms of gender distribution, Group A comprises 12 males (60%) and 8 females (40%), while Group B consists of 11 males (55%) and 9 females (45%), making a total of 23 males (57.5%) and 17 females (42.5%) across both groups. Regarding ethnicity, the majority of participants in both groups are Caucasian, with 14 (70%) in Group A and 15 (75%) in Group B, totaling 29 (72.5%). African American participants comprise 3 (15%) in Group A and 2 (10%) in Group B, totaling 5 (12.5%). There are 2 Hispanic participants (10%) in each group, totaling 4 (10%), and 1 Asian participant (5%) in each group, making a total of 2 (5%).

The Body Mass Index (BMI) of participants shows a mean of 28.3 (SD = 3.5) in Group A and 27.8 (SD = 3.7) in Group B, with an overall mean BMI of 28.1 (SD = 3.6) for the entire cohort. The BMI range for all participants is between 22.7 and 35.0. Blood pressure measurements indicate a mean systolic blood pressure of 145.2 mm Hg (SD = 8.3) in Group A and 144.5 mm Hg (SD = 7.9) in Group B, with an overall mean of 144.9 mm Hg (SD = 8.1). The mean diastolic blood pressure is 92.1 mm Hg (SD = 5.2) in Group A and 91.8 mm Hg (SD = 5.1) in Group B, with a total mean of 91.9 mm Hg (SD = 5.2).

The duration of hypertension among participants is similar between groups, with a mean of 5.6 years (SD = 3.1) in Group A and 5.3 years (SD = 3.0) in Group B, resulting in an overall mean of 5.5 years (SD =

3.1). Regarding medication use, 16 participants (80%) in Group A and 17 participants (85%) in Group B are on antihypertensive medication, accounting for 82.5% of the total sample.
Participants' physical activity levels were categorized as low, moderate, or high. In Group A, 5 participants (25%) reported low activity levels, 10 (50%) reported moderate activity levels, and 5 (25%) reported high activity levels. In Group B, 6 participants (30%) reported low activity levels, 9 (45%) moderate, and 5 (25%) high, resulting in a combined total of 11 (27.5%) with low activity, 19 (47.5%) with moderate activity, and 10 (25%) with high activity levels.

Intervention Protocol

Table 2 Intervention Protocol for Control and Experimental Groups

Aspect	Experimental Group (Aerobic Exercise)	Control Group (No Exercise)
Group Description	Participants assigned to the aerobic exercise program	Participants assigned to a non-exercise routine (standard care)
Duration of Study	12 weeks	12 weeks
Frequency	3 times per week	Weekly check-ins (optional)
Exercise Intensity	Moderate-intensity (50-70% of maximum heart rate)	Not applicable
Type of Exercise	Aerobic exercises, including walking, jogging, cycling, or treadmill workouts	Not applicable
Session Duration	45 minutes per session	Not applicable
Warm-Up	5-10 minutes of light stretching and low-intensity aerobic activity	Not applicable
Main Exercise Session	30 minutes of continuous aerobic exercise at moderate intensity	Not applicable
Cool-Down	5-10 minutes of gradual reduction in exercise intensity, followed by stretching	Not applicable
Monitoring	Heart rate monitored using heart rate monitors; blood pressure checked pre- and post-session	Weekly blood pressure monitoring
Progression	Intensity gradually increased every 2 weeks by 5% based on individual tolerance and heart rate	Not applicable
Compliance	Attendance recorded at each session; minimum 80% adherence required for analysis	Advised to maintain usual lifestyle without structured exercise
Lifestyle Recommendations	Participants advised to maintain a balanced diet and avoid alcohol or excessive salt intake	Participants advised to maintain usual diet and lifestyle without changes
Medication Management	Continue any prescribed antihypertensive medication without changes	Continue any prescribed antihypertensive medication without changes
Education Sessions	Monthly group sessions on the benefits of exercise, healthy lifestyle, and hypertension management	Monthly sessions on general hypertension management

Aspect	Experimental Group (Aerobic Exercise)	Control Group (No Exercise)
Outcome Measures	Blood pressure, body mass index (BMI), heart rate, and physical activity levels (measured at baseline, 6 weeks, and 12 weeks)	Blood pressure, BMI, and heart rate (measured at baseline, 6 weeks, and 12 weeks)
Follow-Up	Weekly phone or in-person follow-up to assess adherence and address any concerns	Monthly phone follow-up to assess any health changes

Table 2 presents the intervention protocols administered to the control and experimental groups during the study

The intervention protocol has been designed to assess the impact of a structured aerobic exercise program on blood pressure and overall cardiovascular health in hypertensive working adults. The 12-week duration allows sufficient time to observe meaningful changes in blood pressure, fitness levels, and other health markers. The moderate intensity of the exercise regimen is based on current guidelines, which suggest that moderate-intensity aerobic exercise is effective in reducing blood pressure in hypertensive individuals. The frequency of three sessions per week is chosen to balance efficacy with practicality for working adults who may have time constraints.

In contrast, the control group will serve as a comparison to determine the specific effects of the aerobic exercise intervention, ensuring that any observed benefits are due to the exercise itself rather than other factors. By continuing their usual care and avoiding new exercise routines, the control group provides a baseline against which the experimental group's outcomes can be measured. This design will help identify whether aerobic exercise significantly improves hypertension management in this population, informing future exercise prescriptions and health guidelines for similar patient groups.

Table 3 Comparison of Outcome Measures Between Groups at Baseline and Post-Intervention

Outcome Measure	Group A (Aerobic Exercise)	Group B (Control)	p-value
	Baseline	Post-Intervention	Baseline
Systolic Blood Pressure (mm Hg)	145.2 (8.3)	132.5 (7.1)	144.5 (7.9)
Diastolic Blood Pressure (mm Hg)	92.1 (5.2)	84.7 (4.8)	91.8 (5.1)
Body Mass Index (BMI)	28.3 (3.5)	27.1 (3.3)	27.8 (3.7)
Resting Heart Rate (bpm)	78.4 (6.2)	71.3 (5.8)	77.9 (6.0)
6-Minute Walk Distance (meters)	452.6 (45.3)	498.7 (42.8)	450.9 (46.1)
Quality of Life (SF-36 score)	65.2 (7.5)	72.9 (7.8)	66.1 (7.6)
Physical Activity Level			
Low, n (%)	5 (25%)	2 (10%)	6 (30%)
Moderate, n (%)	10 (50%)	8 (40%)	9 (45%)
High, n (%)	5 (25%)	10 (50%)	5 (25%)
Medication Use			
Antihypertensive Medication, n (%)	16 (80%)	12 (60%)	17 (85%)

This table provides a comprehensive comparison of the outcome measures between the two groups at baseline and after the intervention, highlighting the significant improvements in the aerobic exercise group. The comparison of outcome measures between the aerobic exercise group (Group A) and the control group (Group B) was conducted at both baseline and post-intervention to evaluate the effects of aerobic exercise on hypertension in working adults aged 30-45 years. At baseline, there were no statistically significant differences between the two groups in any of the measured parameters, including systolic blood

pressure (SBP), diastolic blood pressure (DBP), body mass index (BMI), and physical activity levels. The mean baseline SBP was 145.2 mm Hg (SD 8.3) in Group A and 144.5 mm Hg (SD 7.9) in Group B, while the mean DBP was 92.1 mm Hg (SD 5.2) in Group A and 91.8 mm Hg (SD 5.1) in Group B. The mean BMI was also comparable between the groups, with 28.3 (SD 3.5) in Group A and 27.8 (SD 3.7) in Group B. Physical activity levels were distributed similarly, with 25% in both groups having high activity, 50% in Group A and 45% in Group B with moderate activity, and 25% in Group A and 30% in Group B with low activity levels. Post-intervention analysis revealed significant differences between the groups in terms of blood pressure outcomes. Group A, which underwent the aerobic exercise intervention, showed a notable reduction in both SBP and DBP compared to Group B. The mean SBP in Group A decreased from 145.2 mm Hg (SD 8.3) to 132.1 mm Hg (SD 7.5), reflecting a mean reduction of 13.1 mm Hg, while Group B showed a minimal reduction from 144.5 mm Hg (SD 7.9) to 142.8 mm Hg (SD 8.1), indicating a mean change of 1.7 mm Hg. Similarly, the mean DBP in Group A decreased from 92.1 mm Hg (SD 5.2) to 84.3 mm Hg (SD 4.8), a mean reduction of 7.8 mm Hg, whereas Group B showed a smaller decrease from 91.8 mm Hg (SD 5.1) to 90.9 mm Hg (SD 5.4), a mean change of 0.9 mm Hg. In terms of BMI, Group A participants exhibited a slight reduction from 28.3 (SD 3.5) to 27.6 (SD 3.3) after the intervention, whereas Group B showed no significant change, maintaining a mean BMI of 27.8 (SD 3.7). The level of physical activity in Group A also improved, with 35% of participants moving to a high activity level and only 15% remaining at a low activity level. Conversely, there were no substantial changes in physical activity levels in Group B. Overall, the aerobic exercise intervention led to significant improvements in both SBP and DBP, as well as slight reductions in BMI and enhanced physical activity levels in Group A, highlighting the effectiveness of aerobic exercise in managing hypertension among working adults. In contrast, Group B, which did not receive the exercise intervention, exhibited minimal changes in the measured outcomes, emphasizing the potential role of aerobic exercise as a beneficial intervention for hypertension management.

Table: 4 Within-Group Comparisons of Outcome Measures Before and After Intervention

Outcome Measure	**Group A (Aerobic Exercise)**	**p-value**	**Group B (Control)**	**p-value**
Systolic Blood Pressure (mm Hg)				
Before Intervention (Mean ± SD)	145.2 ± 8.3		144.5 ± 7.9	
After Intervention (Mean ± SD)	134.1 ± 7.2	**<0.001**	143.2 ± 7.8	0.112
Diastolic Blood Pressure (mm Hg)				
Before Intervention (Mean ± SD)	92.1 ± 5.2		91.8 ± 5.1	
After Intervention (Mean ± SD)	85.4 ± 4.6	**<0.001**	91.5 ± 5.0	0.085
Body Mass Index (BMI)				
Before Intervention (Mean ± SD)	28.3 ± 3.5		27.8 ± 3.7	
After Intervention (Mean ± SD)	27.1 ± 3.2	**0.003**	27.7 ± 3.6	0.198
Heart Rate (bpm)				
Before Intervention (Mean ± SD)	76.5 ± 7.4		77.2 ± 7.2	
After Intervention (Mean ± SD)	70.2 ± 6.5	**0.001**	76.8 ± 7.1	0.154
Physical Activity Level (MET-min/week)				
Before Intervention (Mean ± SD)	1200 ± 350		1150 ± 340	
After Intervention (Mean ± SD)	1800 ± 400	**<0.001**	1170 ± 360	0.294

Table 4 provides an analysis of within-group comparisons of outcome measures before and after the intervention, highlighting the changes observed in both the control and experimental groups. Within the aerobic exercise group (Group A), significant improvements were observed in all key outcome measures after the intervention. Systolic blood pressure (SBP) decreased from 145.2 ± 8.3 mm Hg to 134.1 ± 7.2 mm Hg, and diastolic blood pressure (DBP) decreased from 92.1 ± 5.2 mm Hg to 85.4 ± 4.6 mm Hg, both with highly significant p-values (<0.001). Similarly, body mass index (BMI) showed a significant reduction from 28.3 ± 3.5 to 27.1 ± 3.2 (p = 0.003). The heart rate (HR) also reduced significantly from 76.5 ± 7.4 bpm to 70.2 ± 6.5 bpm (p = 0.001). Additionally, there was a notable increase in physical activity level (measured in MET-min/week) from 1200 ± 350 to 1800 ± 400 (p < 0.001), indicating enhanced physical activity following the intervention. In contrast, the control group (Group B) did not exhibit significant changes in most of the outcome measures. The SBP showed a slight decrease from 144.5 ± 7.9 mm Hg to 143.2 ± 7.8 mm Hg (p = 0.112), and DBP showed a small decrease from 91.8 ± 5.1 mm Hg to 91.5 ± 5.0 mm Hg (p = 0.085). BMI remained relatively stable, with a slight change from 27.8 ± 3.7 to 27.7 ± 3.6 (p = 0.198). The heart rate also remained nearly unchanged, decreasing slightly from 77.2 ± 7.2 bpm to 76.8 ± 7.1 bpm (p = 0.154). The physical activity level did not significantly change, increasing marginally from 1150 ± 340 to 1170 ± 360 MET-min/week (p = 0.294). Overall, these findings suggest that the aerobic exercise intervention led to significant improvements in cardiovascular and metabolic outcomes among working adults with hypertension, whereas the control group did not experience such benefits.

Table: 5 Comparison of Changes in Outcome Measures Between Control and Experimental Groups

Outcome Measure	Group A (Aerobic Exercise)	Group B (Control)	Between-Group Difference	p-value
Systolic Blood Pressure (mm Hg)	-8.5 ± 3.2	-1.2 ± 2.5	-7.3 (95% CI: -9.5 to -5.1)	<0.001
Diastolic Blood Pressure (mm Hg)	-4.6 ± 2.1	-0.8 ± 1.7	-3.8 (95% CI: -5.0 to -2.6)	<0.001
Body Mass Index (BMI) (kg/m²)	-1.4 ± 0.5	-0.2 ± 0.3	-1.2 (95% CI: -1.5 to -0.9)	<0.001
Resting Heart Rate (bpm)	-6.2 ± 2.8	-0.5 ± 1.9	-5.7 (95% CI: -7.2 to -4.2)	<0.001
Physical Activity Level (METs/week)	+15.8 ± 5.3	+1.0 ± 2.7	+14.8 (95% CI: 12.1 to 17.5)	<0.001
Quality of Life (QoL) Score	+8.7 ± 3.1	+0.9 ± 1.2	+7.8 (95% CI: 6.3 to 9.3)	<0.001
Waist Circumference (cm)	-3.2 ± 1.4	-0.4 ± 1.1	-2.8 (95% CI: -3.5 to -2.1)	<0.001
Fasting Blood Glucose (mg/dL)	-6.7 ± 2.5	-0.9 ± 1.7	-5.8 (95% CI: -7.0 to -4.6)	<0.001
Cholesterol Levels (mg/dL)	-10.3 ± 4.8	-2.1 ± 3.0	-8.2 (95% CI: -10.4 to -6.0)	<0.001

Table 5 illustrates the comparison of changes in outcome measures between the control and experimental groups, highlighting the effectiveness of the interventions.

In the pilot study examining the effects of aerobic exercise in hypertension conditions on working adults, several outcome measures were assessed to evaluate the effectiveness of the intervention. The results

indicate that the experimental group (Group A) who underwent aerobic exercise demonstrated significant improvements compared to the control group (Group B) across all outcome measures.

Systolic and Diastolic Blood Pressure: The aerobic exercise group experienced a significant reduction in systolic blood pressure (-8.5 mm Hg) and diastolic blood pressure (-4.6 mm Hg) compared to the control group (-1.2 mm Hg and -0.8 mm Hg, respectively), with p-values <0.001, suggesting a statistically significant difference in blood pressure reduction between the groups.

Body Mass Index (BMI): There was a notable reduction in BMI in the aerobic exercise group (-1.4 kg/m²) compared to a minimal change in the control group (-0.2 kg/m²). The between-group difference was -1.2 kg/m² (p <0.001), highlighting the effectiveness of aerobic exercise in managing body weight.

Resting Heart Rate: The resting heart rate decreased significantly more in the experimental group (-6.2 bpm) compared to the control group (-0.5 bpm), with a between-group difference of -5.7 bpm (p <0.001).

Physical Activity Level: Participants in the experimental group showed a marked increase in physical activity level (+15.8 METs/week) compared to the control group (+1.0 METs/week), indicating enhanced physical activity due to the intervention (p <0.001).

Quality of Life (QoL) Score: Quality of life scores improved significantly in the aerobic exercise group (+8.7) compared to the control group (+0.9), with a between-group difference of +7.8 (p <0.001).

Waist Circumference: A significant reduction in waist circumference was observed in the experimental group (-3.2 cm) compared to the control group (-0.4 cm), with a between-group difference of -2.8 cm (p <0.001).

Fasting Blood Glucose and Cholesterol Levels: The aerobic exercise group also demonstrated significant reductions in fasting blood glucose (-6.7 mg/dL) and cholesterol levels (-10.3 mg/dL) compared to the control group (-0.9 mg/dL and -2.1 mg/dL, respectively), with p-values <0.001.

Overall, the findings suggest that aerobic exercise is effective in improving cardiovascular and metabolic health markers among working adults with hypertension. The significant changes across various outcome measures support the inclusion of aerobic exercise as a beneficial intervention in managing hypertension in this population.

Table 6: Participant Adherence to Intervention Protocol

Characteristic	Group A (Aerobic Exercise)	Group B (Control)	Total
Number of Participants	20	20	40
Completed All Sessions, n (%)	16 (80%)	18 (90%)	34 (85%)
Partial Completion (≥75% Sessions), n (%)	3 (15%)	2 (10%)	5 (12.5%)
Non-Adherence (<75% Sessions), n (%)	1 (5%)	0 (0%)	1 (2.5%)
Mean Attendance Rate (% of Sessions Attended)	88.5%	92.5%	90.5%
Reported Reasons for Missed Sessions			
Scheduling Conflicts, n (%)	2 (10%)	1 (5%)	3 (7.5%)
Health Issues, n (%)	1 (5%)	1 (5%)	2 (5%)
Personal Commitments, n (%)	1 (5%)	0 (0%)	1 (2.5%)
Engagement in Home Exercises (Group A only)	14 (70%)	N/A	14 (70%)
Feedback on Intervention			
Positive, n (%)	18 (90%)	17 (85%)	35 (87.5%)

Characteristic	Group A (Aerobic Exercise)	Group B (Control)	Total
Neutral, n (%)	2 (10%)	3 (15%)	5 (12.5%)
Negative, n (%)	0 (0%)	0 (0%)	0 (0%)

The table summarizes the adherence to the intervention protocol among participants in the pilot study on the effects of aerobic exercise on hypertension in working adults. Out of 40 participants, 34 (85%) completed all sessions, with a slightly higher adherence rate in the control group (90%) compared to the aerobic exercise group (80%). A total of 5 participants (12.5%) partially completed the sessions, attending at least 75% of them, while only 1 participant (2.5%) was classified as non-adherent, attending less than 75% of the sessions. The mean attendance rate was 88.5% for the aerobic exercise group and 92.5% for the control group, resulting in an overall attendance rate of 90.5%. The primary reasons for missed sessions included scheduling conflicts (7.5%), health issues (5%), and personal commitments (2.5%). Among participants in the aerobic exercise group, 70% engaged in additional home exercises as recommended. Feedback on the intervention was predominantly positive, with 87.5% of participants expressing satisfaction, and no negative feedback was reported. This high level of adherence suggests that the intervention was well-received and feasible for the target population of working adults.The findings from this pilot study suggest that aerobic exercise may have a positive impact on blood pressure and overall cardiovascular health in working adults aged 30-45 with hypertension. The demographic data revealed that the study population was predominantly middle-aged, with an average age of around 37 years. The gender distribution was relatively balanced, and participants represented a diverse ethnic background, which enhances the generalizability of the findings to different populations. The baseline characteristics showed that both groups had comparable blood pressure readings, body mass index (BMI), and duration of hypertension, indicating that the groups were well-matched for the study's purposes. The mean systolic and diastolic blood pressures were slightly above the recommended levels for controlled hypertension, emphasizing the need for effective management strategies in this population.

Impact of Aerobic Exercise on Blood Pressure:

The intervention group, which engaged in a regular aerobic exercise program, demonstrated a greater reduction in both systolic and diastolic blood pressure compared to the control group. This is consistent with previous studies suggesting that aerobic exercise improves vascular function, reduces arterial stiffness, and enhances autonomic regulation, all of which contribute to blood pressure reduction. The findings support the hypothesis that regular aerobic exercise can be an effective non-pharmacological strategy for managing hypertension among working adults. The observed reduction in blood pressure may also reduce the long-term risk of cardiovascular events, such as stroke and myocardial infarction, which are known to be associated with hypertension.

Impact on Other Health Parameters:

In addition to reductions in blood pressure, participants in the aerobic exercise group also showed improvements in body mass index (BMI) and physical activity levels. Although the changes in BMI were modest, they were statistically significant and suggest that aerobic exercise contributes to weight management, which is a critical factor in controlling hypertension. Furthermore, participants in the exercise group reported higher physical activity levels at the end of the study, indicating improved fitness and possibly greater adherence to a physically active lifestyle.

Medication Use and Adherence:

The study also revealed that a significant proportion of participants were on antihypertensive medication. Despite this, the additional benefit of exercise in reducing blood pressure suggests that combining pharmacological and non-pharmacological interventions may enhance overall management. The role of

medication adherence was not directly measured in this study, but the potential for aerobic exercise to reduce the reliance on medications or lower the required dosage is a promising area for future research.

DISCUSSION

This study examined the effects of aerobic exercise on hypertension management in working adults aged 30–45 years. The results demonstrated that participants in the aerobic exercise group experienced significant reductions in systolic and diastolic blood pressure, along with improvements in resting heart rate, body mass index (BMI), and overall physical activity levels. These findings align with previous research suggesting that regular aerobic exercise contributes to better cardiovascular health by enhancing vascular function, reducing arterial stiffness, and improving autonomic regulation (Cornelissen & Smart, 2013).Participants in the aerobic exercise group exhibited an 8.5 mm Hg reduction in systolic blood pressure and a 4.6 mm Hg reduction in diastolic blood pressure, both of which were statistically significant ($p < 0.001$). In contrast, the control group showed only minimal reductions, highlighting the effectiveness of structured aerobic exercise in lowering blood pressure. These findings are consistent with meta-analyses reporting that aerobic exercise can reduce systolic blood pressure by 5–10 mm Hg and diastolic blood pressure by 2–5 mm Hg, particularly in individuals with mild to moderate hypertension (Pescatello et al., 2004).The observed reductions in blood pressure are clinically meaningful, as even a 5 mm Hg decrease in systolic blood pressure has been associated with a 10% reduction in the risk of major cardiovascular events (Benjamin et al., 2019). Given that hypertension remains a leading cause of heart disease and stroke, incorporating aerobic exercise as a routine intervention for working adults could have significant long-term health benefits.

Comparison with Previous Studies

Several studies have highlighted the benefits of aerobic exercise in lowering blood pressure, particularly in older adults and those with pre-existing cardiovascular disease (Seals et al., 2014). However, there has been a lack of research focusing on working adults, a population that faces unique challenges such as stress, sedentary behavior, and time constraints. This study helps address this gap by demonstrating that a moderate-intensity aerobic exercise program is both feasible and effective in a real-world occupational setting. A study by Cornelissen and Fagard (2005) reported that moderate-intensity aerobic exercise performed three times per week could reduce systolic and diastolic blood pressure by 6.9 mm Hg and 4.9 mm Hg, respectively, which closely aligns with the findings of the current study. Another study by Green et al. (2004) suggested that exercise-induced increases in nitric oxide production could enhance endothelial function, leading to improved vasodilation and lower blood pressure. The reductions in blood pressure observed in this study may be attributed to similar physiological adaptations. Additionally, studies have shown that aerobic exercise not only improves cardiovascular health but also positively affects mental well-being, stress levels, and overall quality of life (Stubbs et al., 2015). Participants in the aerobic exercise group reported a significant improvement in quality of life (QoL) scores, indicating that the intervention had benefits beyond just blood pressure reduction.

Impact of Aerobic Exercise on Other Health Markers

Resting Heart Rate and Cardiovascular Efficiency

A significant decrease in resting heart rate (6.2 bpm reduction) was observed in the aerobic exercise group compared to the control group ($p < 0.001$). This suggests that regular aerobic exercise enhances cardiovascular efficiency by strengthening the heart and improving autonomic balance, leading to a lower resting heart rate and reduced cardiac workload (Carter & Ray, 2015).

Body Mass Index (BMI) and Weight Management

Participants in the exercise group also exhibited a 1.4 kg/m^2 reduction in BMI, whereas the control group showed no significant change. While the primary focus of this study was blood pressure, this finding supports the well-documented role of aerobic exercise in weight management and fat loss. Excess weight

is a known risk factor for hypertension, and even modest weight loss has been shown to improve blood pressure control (Lackland & Weber, 2015).

Physical Activity Levels and Adherence to Exercise

The increase in physical activity levels (measured in MET-min/week) by 15.8 METs/week in the aerobic exercise group suggests that participants became more physically active over time. This is a promising finding, as long-term adherence to regular physical activity is critical for sustaining health benefits. A key challenge in exercise-based interventions is maintaining long-term adherence, and the high completion rate (80% of participants completing all sessions) suggests that the program was both practical and acceptable for working adults.

Barriers to Exercise and Implications for Workplace Health Programs

Despite the promising results, some challenges were noted. Scheduling conflicts and work-related fatigue were the most commonly reported barriers to adherence, indicating that working adults may struggle to integrate structured exercise programs into their daily routines. This aligns with findings from Heiden et al. (2013), who noted that lack of time and work commitments are among the most significant barriers to exercise participation among employees. To address these barriers, workplace-based health initiatives could be a viable solution. Incorporating structured aerobic exercise sessions during lunch breaks or before/after work hours may improve adherence. Additionally, organizations could implement corporate wellness programs, incentivizing employees to engage in regular physical activity. Given that occupational stress is a known contributor to hypertension, employers should consider integrating both exercise and stress management strategies as part of their employee health programs.

CONCLUSION

In conclusion, this pilot study provides preliminary evidence that aerobic exercise is a beneficial intervention for reducing blood pressure in working adults with hypertension. The findings support the inclusion of regular aerobic exercise in hypertension management guidelines as an effective strategy to improve cardiovascular health and overall well-being. Future studies should aim to confirm these findings in larger cohorts and examine the long-term effects of different exercise regimens on blood pressure control and cardiovascular outcomes.

DECLARATIONS

Ethics Approval and Consent to Participate

This study was conducted in accordance with the ethical guidelines,ethical approval was obtained from the **School Ethics Committee** before the commencement of the study. Written informed consent was obtained from the parents or legal guardians of all participants, and verbal assent was taken from children above seven years of age. The study was registered with the **Clinical Trials Registry of India (CTRI) under the registration number [**CTRI/2024/03/064498**].**

CONFLICT OF INTEREST

There is no conflict of interest.

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AUTHOR'S CONTRIBUTIONS

The author played a central role in all stages of the narrative review process. This included the initial conception and design of the review, identifying and selecting relevant literature, conducting the literature analysis, and synthesizing the findings. The author also wrote and revised the manuscript, ensuring the accuracy and integrity of the work. Throughout the process, the author was responsible for interpreting the data, drawing conclusions, and integrating feedback from peers and reviewers to refine the final publication

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