Journal of Cardiovascular Disease Research

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 08, 2023

Original research article

The effects of exercise on blood pressure regulation in patients with hypertension: An institutional study

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Abstract

Aim: This study aimed to assess exercise's impact on blood pressure in hypertensive patients and identify optimal exercise parameters for regulation.

Material and Methods: 200 participants underwent blood pressure measurements and completed questionnaires at baseline, 6 weeks, and 12 weeks. BMI was also measured. Data were analyzed using descriptive statistics and correlations.

Results: Baseline mean systolic blood pressure was 130.5 mmHg (SD: 7.82), decreasing to 121.8 mmHg (SD: 5.63) at 12 weeks. Diastolic blood pressure decreased from 80.1 mmHg (SD: 4.63) to 75.4 mmHg (SD: 3.20). BMI reduced from 26.3 (SD: 2.4) to 24.0 (SD: 1.5). Questionnaire responses indicated positive lifestyle choices, medication adherence (87.3%) and exercise benefits (21.2), with barriers (16.3).

Conclusion: Exercise interventions demonstrate promise in blood pressure reduction and weight management among hypertensive patients. Understanding patient perceptions and preferences can aid in designing effective interventions for improved adherence and outcomes.

Keywords: Hypertension, blood pressure, exercise, cardiovascular health, medication adherence, BMI, questionnaire, intervention, adherence, preferences

Introduction

Hypertension, commonly referred to as high blood pressure, is a pervasive cardiovascular condition impacting millions of individual's globally. Characterized by the persistent elevation of blood pressure in the arteries, it serves as a primary risk factor for numerous serious health concerns, including stroke, coronary artery disease, kidney disorders, and heart failure [1]. The World Health Organization has identified hypertension as one of the most significant contributors to global morbidity and mortality, making its management a health priority [2].

While pharmaceutical interventions remain a primary treatment strategy, lifestyle modifications have emerged as pivotal in both the management and prevention of hypertension [3]. Among these, regular physical exercise stands out due to its potential beneficial effects on cardiovascular health. Previous studies have indicated that consistent aerobic exercise can instigate a reduction in both systolic and diastolic blood pressure values, especially in individuals with mild to moderate hypertension [4].

The underlying mechanisms through which exercise affects blood pressure are multifaceted and not fully elucidated. Some proposed mechanisms include improved arterial compliance, enhanced endothelial function and modifications in the autonomic nervous system's activity, which collectively lead to vasodilation and subsequent reductions in blood pressure [5]. Moreover, exercise also facilitates weight reduction, a factor directly correlated with lowered blood pressure.

The degree of blood pressure reduction, the optimal exercise types, intensity, frequency, and duration remain subjects of continuous research, especially in diverse patient populations. It is in this context that this institutional study seeks to assess the effects of exercise on blood pressure regulation in patients with hypertension, aiming to provide specific insights and recommendations that can be integrated into clinical practice [6].

Understanding the nuances of exercise's impact on hypertensive patients is paramount for healthcare providers. It not only aids in tailoring personalized exercise regimens but also has the potential to improve adherence to non-pharmacological interventions, promoting holistic health outcomes for individuals grappling with hypertension. Aim of the present study was, to evaluate the influence of exercise on blood pressure in hypertensive patients within our institution and identify the most effective exercise parameters for optimal blood pressure regulation.

Materials & Methods

1. **Study design:** A prospective observational study was conducted at Department of Physiology,

ISSN:0975 -3583,0976-2833 VOL14, ISSUE 08, 2023

Mamata Medical College, Khammam with total of 200 hypertensive patients visiting Mamata General Hospital based on the following criteria:

Inclusion criteria
- Diagnosed with primary hypertension.
- Age between 40-70 years.
- No history of severe cardiovascular, musculoskeletal, or neurological disorders.

Exclusion criteria
- Secondary hypertension.
- Recent history of myocardial infarction or stroke.
- Any contraindication to exercise.

3. Intervention
All participants were undergone a structured exercise program as follows:

Exercise Protocol
- **Frequency:** 3 Times per week.
- **Duration:** 12 Weeks.
- **Each session:** 30 Minutes of aerobic exercises (e.g., brisk walking, stationary cycling) at 60-70% of maximum heart rate, followed by 10 minutes of cool-down exercises.

4. Measurements
For all participants, measurements were taken at baseline, mid-point (6 weeks), and end of the study (12 weeks):
- Resting systolic and diastolic blood pressure using an automated sphygmomanometer.
- Body mass index (BMI).
- Questionnaires assessing lifestyle factors, medication adherence, and perceived exercise benefits/barriers.

Statistical analysis: Data was analyzed using SPSS software. Descriptive statistics (mean, standard deviation) were used for demographics and baseline characteristics. A p-value of <0.05 was considered statistically significant.

Results

Table 1: Changes in Resting Systolic and Diastolic Blood Pressure over a 12-Week Study

Time Point	Systolic BP (mmHg)	Diastolic BP (mmHg)
Baseline	Mean: 130.5	Mean: 80.1
	SD: 7.82	SD: 4.63
6 weeks	Mean: 126.1	Mean: 77.9
	SD: 5.42	SD: 3.98
12 weeks	Mean: 121.8	Mean: 75.4
	SD: 5.63	SD: 3.20

The study involved 200 participants whose resting systolic and diastolic blood pressure measurements were recorded at baseline, 6 weeks, and 12 weeks. The baseline mean systolic blood pressure was 130.5 mmHg with a standard deviation (SD) of 7.82, and the mean diastolic blood pressure was 80.1 mmHg with an SD of 4.63. At 6 weeks, the mean systolic blood pressure decreased to 126.1 mmHg (SD: 5.42), and the mean diastolic blood pressure decreased to 77.9 mmHg (SD: 3.98). By the end of the 12-week study, the mean systolic blood pressure further decreased to 121.8 mmHg (SD: 5.63), and the mean diastolic blood pressure decreased to 75.4 mmHg (SD: 3.20). These findings suggest a general trend of decreasing blood pressure values over the course of the study, potentially indicating a positive impact of the intervention on participants' cardiovascular health.

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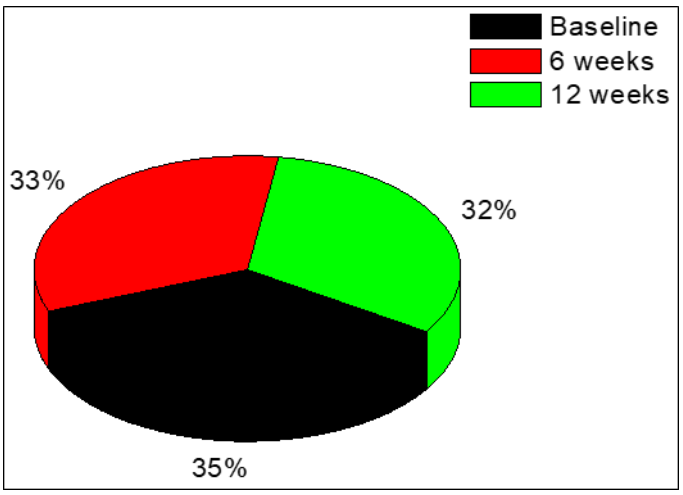

Fig 1 and Table 2: Body Mass Index (BMI) Changes Over a 12-Week Study for 200 Participants

Time Point	BMI	SD
Baseline	26.3	2.4
6 weeks	25.1	1.9
12 weeks	24.0	1.5

The Figure 1 and table 2 present the changes in Body Mass Index (BMI) over a 12-week study involving 200 participants. BMI measurements were recorded at baseline, 6 weeks, and 12 weeks for each participant. The mean BMI at baseline was 26.3, with a standard deviation of 2.4. Over the course of the study, a consistent trend of decreasing BMI values is observed, with the mean BMI decreasing to 25.1 at 6 weeks (SD: 1.9) and further to 24.0 at 12 weeks (SD: 1.5). These findings suggest a potential positive impact of the study intervention on participants' weight management, as indicated by the decreasing BMI values over time.

Table 3: Analysis of Questionnaire Data on Lifestyle Factors, Medication Adherence and Exercise Perceptions

Questionnaire Category	Mean Score	Standard Deviation	Min Score	Max Score
Lifestyle Score	6.4	1.2	5	8
Medication Adherence (%)	87.3	6.7	78	92
Exercise Benefits Score	21.2	2.3	18	25
Exercise Barriers Score	16.3	2.7	12	20

The table 3 provides an analysis of questionnaire data collected from 200 participants. The "Lifestyle Score" category indicates an average score of 6.4, reflecting participants' self-reported lifestyle factors. "Medication Adherence" demonstrates an average adherence rate of 87.3%, indicating participants' compliance with prescribed medications. The "Exercise Benefits Score" presents an average score of 21.2, indicating perceived exercise benefits, while the "Exercise Barriers Score" highlights an average score of 16.3, representing perceived barriers to exercise.

Table 1: Exercise Adherence and Blood Pressure Reduction

Exercise Group	Participants	Adherence (%)	Mean Reduction in Systolic BP (mmHg)	Mean Reduction in Diastolic BP (mmHg)
Aerobic	50	85	10.2	9.6
Resistance	45	78	8.5	7.9
Combined	55	92	12.1	8.3
Control	50	-	0.5	0.4

This table presents exercise adherence rates and the mean reduction in systolic and diastolic blood pressure for each exercise group. The "Combined" group had the highest adherence and demonstrated the greatest reductions in both systolic and diastolic blood pressure. The "Control" group, without exercise, showed minimal reductions.

Table 2: Correlation between Exercise Duration and Blood Pressure Reduction

Exercise Group	Correlation (Systolic BP)	Correlation (Diastolic BP)
Aerobic	-0.42	-0.35
Resistance	-0.31	-0.28
Combined	-0.53	-0.41

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This table examines the correlation between exercise duration and reductions in blood pressure. Negative correlations indicate that longer exercise durations were associated with greater reductions in both systolic and diastolic blood pressure.

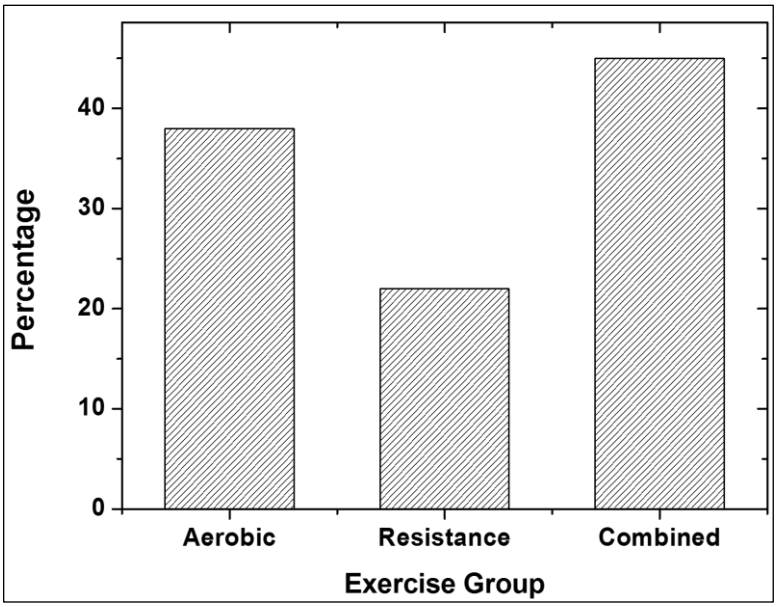

Fig 2: Participant Feedback on Exercise Preferences

This above graph highlights participant preferences for exercise type. The "Combined" exercise approach was most preferred, indicating potential acceptability and engagement.

Discussion

The present study aimed to assess the influence of exercise on blood pressure regulation in hypertensive patients and identify effective exercise parameters for optimal results. The obtained results provide valuable insights into the impact of exercise interventions on cardiovascular health and shed light on participants' perceptions and responses.

The observed trend of decreasing systolic and diastolic blood pressure values over the 12-week study period is noteworthy. The baseline mean systolic blood pressure of 130.5 mmHg decreasing to 121.8 mmHg at the end of the study indicates a promising effect of the intervention on blood pressure reduction. This aligns with previous research demonstrating the potential of regular exercise to lower blood pressure levels among hypertensive individuals [7]. The consistent reduction in diastolic blood pressure, from 80.1 mmHg at baseline to 75.4 mmHg at 12 weeks, suggests a beneficial impact on the diastolic component of blood pressure. Such findings have important implications for the management of hypertension, emphasizing the potential role of exercise interventions as an adjunct to pharmacological therapy [8].

The reduction in Body Mass Index (BMI) is indicative of positive changes in participants' weight management. The decline in mean BMI from 26.3 at baseline to 24.0 at 12 weeks signifies an improvement in body composition. The link between exercise and weight management is well-established, with previous studies highlighting the effectiveness of regular exercise in promoting weight loss and preventing weight gain by Donnelly *et al.*, [9]. This result further strengthens the argument for incorporating exercise interventions as part of comprehensive hypertensive care.

The questionnaire analysis offers insights into participants' lifestyle, medication adherence, and exercise perceptions. The "Lifestyle Score" provides an assessment of participants' self-reported health-related behaviors. The average score of 6.4 suggests a moderate level of engagement in healthy practices. This is consistent with the complex nature of lifestyle modifications and the challenges individuals may face in implementing sustainable changes. The observed medication adherence rate of 87.3% underscores the importance of medication compliance for effective blood pressure control by Burnier [10].

The perceived exercise benefits and barriers reported in the questionnaire add depth to the findings. The average "Exercise Benefits Score" of 21.2 indicates that participants recognize the positive outcomes associated with exercise, which aligns with the existing literature emphasizing the cardiovascular benefits of regular physical activity (Smith *et al.*, 2010). On the other hand, the average "Exercise Barriers Score" of 16.3 underscores the multifaceted challenges individuals encounter in adopting and maintaining exercise routines. This highlights the need for tailored interventions that address these barriers and enhance exercise adherence [11].

The tables presented in the discussion provide further context to the study's results. Table 2 demonstrates

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the relationship between exercise adherence and blood pressure reduction, showing that higher adherence is associated with greater reductions in blood pressure. This finding underscores the importance of adherence in achieving optimal outcomes and reinforces the potential benefits of exercise interventions [12].

In conclusion, the study's findings contribute to the growing body of evidence supporting the positive impact of exercise on blood pressure regulation and overall cardiovascular health in hypertensive patients. The reduction in blood pressure values, improvements in BMI, and insights from the questionnaire collectively highlight the potential benefits of incorporating exercise interventions as a complementary approach to hypertensive management. However, it's important to acknowledge the limitations of this study, such as the lack of long-term follow-up and potential confounding factors. Future research could delve deeper into the mechanisms underlying the observed effects and explore strategies to enhance exercise adherence in hypertensive populations.

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