



**EFFECTIVENESS OF AEROBIC EXERCISES AND RESISTANCE
EXERCISES ON BLOOD PRESSURE IN STAGE I HYPERTENSION
PATIENTS – A COMPARATIVE STUDY**

Dissertation work submitted to

THE TAMIL NADU DR. M. G. R. MEDICAL UNIVERSITY,

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Submitted by

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Dissertation work entitled
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Dissertation submitted to

THE TAMILNADU DR. M. G. R. MEDICAL UNIVERSITY,
CHENNAI-32.

Dissertation work evaluated on -----

Internal Examiner

External Examiner

CERTIFICATE I

This is to certify that the dissertation work entitled

**EFFECTIVENESS OF AEROBIC EXERCISES AND RESISTANCE
EXERCISES ON BLOOD PRESSURE IN STAGE I HYPERTENSION
PATIENTS – A COMPARATIVE STUDY**

Was carried out by **Reg. no.27102326** P.P.G College of physiotherapy, Coimbatore-35, affiliated
to The Tamilnadu Dr. M.G.R medical university, Chennai-32, under my guidance

Prof. K. RAJA SENTHIL M.P.T (Cardio-Resp), MIAP., PhD

Principal

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ABSTRACT

Subject objective: It is an experimental study design to determine the effectiveness of aerobic exercises and resistance exercises on blood pressure in stage I hyper tension patients. .

Participants: A sample of 40 stage I hyper tension patients were divided in to 2 groups: Group A: Experimental group: Treated with aerobic and resistance exercises. Group B: Control Group: Treated with resistance exercises.

Outcome measures: Systolic blood pressure and diastolic blood pressure- measures by sphygmomanometer.

Results: Statistically group A was significant when compared to group B received normal blood pressure.

Conclusion: The study concludes aerobic and resistance exercises in patients with stage I hyper tension. Thus, this study accepts the alternate hypothesis and rejects the null hypothesis.

CHAPTER I

INTRODUCTION

1.1 Introduction

Hypertension is when mean arterial pressure is greater than the upper range of the accepted normal measure. A mean arterial pressure greater than 110 mm Hg (normal is about 90 mm Hg) is considered to be hypertensive. This level of mean pressure occurs when the diastolic blood pressure is greater than 90 mm Hg and the systolic pressure is greater than about 135 mm Hg. In severe hypertension, the mean arterial pressure can rise up to 150 to 170 mm Hg, with diastolic pressure as high as 130 mm Hg and systolic pressure occasionally as high as 250 mm Hg. The seventh report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (**JNC-VII report**) has recommended a new classification for adults – 18 years or older.

- Normal: < 120/80 mm Hg.
- Pre-hypertension: 120-139/80-90 mm Hg.
- Hypertension – stage 1: 140-159/90-99 mm Hg.
- Hypertension – stage 2: $\geq 160/\geq 100$ mm Hg.

According to **National Cardiovascular Disease Database**, supported by **Ministry of Health & Family Welfare, Government of India and World Health Organization**, the prevalence of hypertension is gradually raising now a days, which leads to coronary heart disease which constitutes 54.1% of all cardiovascular disease deaths. The prevalence of hypertension rises in men than in women and in blacks Compared with white. Hypertension is the most common disorder encountered in outdoor patients. In a Meta - analysis of 34 epidemiological studies from rural and urban populations of India, it was concluded that hypertension is emerging as a major health problem in India and is more in urban than in rural subjects. Based on the high number of exercise related benefits and low risk of morbidity and mortality, it is reasonable to recommend exercise as part of initial treatment strategy for individual with hypertension. Physical inactivity is a major risk factor for cardiovascular disease, and persons who are less

active and less fit have a 30% to 50% greater risk for high blood pressure. Several recent clinical trials have demonstrated that physical activity reduces blood pressure in hypertensive and normotensive persons, independent of weight loss. However, evidence regarding the magnitude of exercise-related reductions in blood pressure is inconsistent, both in general and among subgroups of the population. Pooling results from individual clinical trials provides more precise and accurate information on the effect of particular has been shown to lower conventional and daytime blood pressure readings among hypertensive patients. Moderately intense aerobic exercise at 40% to 60% of maximum oxygen consumption such as 30 to 45 minutes brisk walking on most days of the week. It has been also suggested that resistance exercises may also lower resting blood pressure, possibly by reducing resistance at rest.

The available data suggest that moderate intensity resistance training is not contraindicated in healthy adults and strength training does not chronically increase BP. Indeed, when progressive resistance exercises are performed according to American College of Sports Medicine guidelines, a small ($\approx 3/3$ mmHg) but significant decrease in BP may be achieved. In general these guidelines recommend that dynamic resistance exercises be performed in a rhythmical fashion, through the full range of motion, at a Moderate-to-low and controlled speed with emphasis on eccentric (**lengthening**) contractions and maintenance of a normal breathing pattern (**no breath holding**). Heavy weight lifting of an intensive, isometric nature has a pronounced vasopressor effect (**BP raising**) and should be avoided.

Aerobic exercise on blood pressure and allows exploration of variation in intervention effect among subgroups of interest. Physical exercise can be divided into two broad categories namely dynamic aerobic endurance training and resistance training. Two other advantages of exercise as a therapeutic intervention are its positive effect on multiple cardiovascular disease risk factors. Mild to moderate exercise has low risk and very few contraindications for most people.

Dynamic aerobic training, in particular, has been shown to lower conventional and daytime blood pressure readings Among hypertensive patients. Moderately intense aerobic exercise at 40% to 60% of maximum oxygen consumption such as 30 to 45 minutes brisk walking on most days of the week. It has been also suggested that resistance exercises may also lower resting blood pressure, possibly by reducing resistance at rest. The available data suggest that moderate intensity resistance training is not contraindicated in healthy adults and strength

training does not chronically increase BP. Indeed, when progressive resistance exercises are performed according to American College of Sports Medicine guidelines, a small ($\approx 3/3$ mmHg) but significant decrease in BP may be achieved. In general these guidelines recommend that dynamic resistance exercises be performed in a rhythmical fashion, through the full range of motion, at a moderate-to-low and controlled speed with emphasis on eccentric (**lengthening**) contractions and maintenance of a normal breathing pattern (**no breath holding**). Heavy weight lifting of an intensive, isometric nature has a pronounced vasopressor effect (**BP raising**) and should be avoided.

1.2 NEED OF THE STUDY:

Hypertension is a common risk factor and the prevalence of hypertension rises sharply with age. Its common risk factors in myocardial infarction, stroke, varicose vein. Many studies have done for finding the alone and combined efficacy of aerobic exercise and resistance exercise but very few studies compared both. There are many studies supporting the effectiveness of aerobic exercise training and resistance exercise training is achieving normal blood pressure in hypertensive patient. **There is need to do further study to find out the effectiveness between aerobic exercise and resistance exercise on blood pressure in stage – 1 Hypertension patients.**

1.3 AIM OF THE STUDY:

To compare the effectiveness of Aerobic exercise and Resistance exercise on blood pressure in Stage-1 Hypertension patients.

OBJECTIVES OF THE STUDY:

- To find the effects of aerobic exercise and Resistance exercise on blood pressure in stage-1 Hypertension patients.
- To find the effects of resistance exercise on blood pressure in stage-1 Hypertension patients.
- To compare the effects between aerobic exercises and resistance exercise on blood pressure in stage-1 Hypertension patients.

1.4 OPERERATIONAL DEFINITION

BLOOD PRESSURE:

Arterial blood pressure is defined as the Lateral pressure exerted by the contained column of blood on the wall of arteries

- K.Sembulingam.

AEROBIC EXERCISE:

It is defined as “Sub maximal, rhythmic, repetitive, exercise of large muscle groups during which the needed energy is supplied by inspired oxygen”

-Katch and katch.

RESISTANCE EXERCISE:

It is defined as any external force may be applied to the body to oppose the force of muscular contraction.

-Dena Gardiner.

1.5 HYPOTHESIS

NULL HYPOTHESIS:

There is no significant difference between aerobic exercises and resistance exercise on blood pressure in stage-1 Hypertension patients.

EXPERIMENTAL HYPOTHESIS:

There is a significant difference between aerobic exercises and resistance exercise on blood pressure in stage-1 Hypertension patients.

CHAPTER II

REVIEW OF LITERATURE

C.G. Cardoso, e tal: (2010)

It has been conclusively shown that a single episode of aerobic exercise reduces ambulatory blood pressure in hypertensive patients. Similarly, regular aerobic training also decreases ambulatory blood pressure in hypertensive individuals. In contrast, data on the effects of resistance exercise is both scarce and controversial. Nevertheless, studies suggest that resistance exercise might acutely decrease ambulatory blood pressure after exercise, and that this effect seems to be greater after low-intensity exercise and in patients receiving anti-hypertensive drugs.. Thus, based on current knowledge, aerobic training should be recommended to decrease ambulatory blood pressure in hypertensive individuals, while resistance exercise could be prescribed as a complementary strategy.

Battagin A.M, e tal: (2010)

States that resistance exercise in different body segments promoted similar increases and safe levels of systolic blood pressure; although with a tendency toward greater response of it when large muscle groups at high loads are exercised.

Rehman Shahidur, et al: (2009)

He carried out a review study on role of exercise as a therapeutic intervention for Hypertension. The aim of this review study is to delineate the effect of exercise in the control of elevated blood pressure and to emphasise the importance of exercise as therapeutic intervention for the control of hypertension. Exercise testing and monitoring is not necessary for pre hypertensive or stage one or two Hypertensive who are less than 50 years and have no CVD risk Patients. In conclusion, exercise and lifestyle modification as therapeutic intervention for the control of Hypertension has proved efficacy found in many controlled studies.

Mota, et al: (2009)

Carried out a study on the effects of treadmill running and resistance exercise, on lowering blood pressure during the daily work of hypertensive subject. In conclusion, both 20 minutes of TR and RE resulted in post exercise hypotension, and were able to reduce BP throughout 7 hours after exercise, even throughout the subject's regular occupational activities. Also, the RE promoted higher cardiac protection and can be a useful model of physical exercise prescription for hypertension individuals.

A Kimberly, et al: (2009)

Have done a study on exercise prescription for the prevention and management of hypertension. However, the frequency, intensity, duration, and mode of activity play a role in the magnitude and duration of blood pressure reduction. Aerobic activity is the preferred type of activity to lower blood pressure. Acute, moderate-intensity aerobic activity (40%-60% VO₂max can decrease blood pressure by 5 to 7 mm Hg for up to 22 hours post exercise, so participation in aerobic activity is recommended on most, if not all, days of the week. The recommended duration for aerobic activity is 30 to 60 minutes of continuous or intermittent activity. Resistance activity results in a 3-mm Hg decrease in blood pressure and should supplement the aerobic activity. Low- to moderate intensity resistance training (30%-40% of a 1—repetition maximum [1RM] for upper body exercises and 50%-60% 1RM for lower body exercises) is recommended 2 to 3 d/wk. The volume of resistance training for blood pressure reduction is 1 to 3 sets of 10 to 15 repetitions for 8 to 10 exercises that target large muscle groups.

Sharmana James E, et al: (2009)

Lifestyle modification that includes regular physical activity is often recommended to patients with hypertension as one of the first line treatments for lowering BP, as well as improving overall risk for Cardiovascular events.. The minimum amount of exercise that is recommended in patients with hypertension comprises a mix of moderate to vigorous aerobic (endurance) activity (up to 5 days/week) in addition to resistance (strength) training (on 2 or more non-consecutive days/week). However, due to the dose-response relationship between

physical activity and health, exercise levels performed beyond the minimum recommendations are expected to confer additional health benefits.

V Richard, et al: (2009)

have done a study on modulator effect of inflammation on blood pressure reduction via therapeutic lifestyle change, since inflammatory status, as determined by Creatine protein (CRP) levels, is correlated with many cardiovascular (CV) disease risk factors and major CV events, they sought to determine if median levels of CRP can modulate blood pressure changes as well as other CV risk factors that are typically improved by therapeutic lifestyle changes with formal cardiac rehabilitation and exercise training (CRET) programs. However, systolic, diastolic, and mean arterial blood pressure improved in patients with low CRP levels (each by 24%) but did not change significantly in patients with high CRP levels. In multiple regression models, only young age, low CRP levels, and low body mass index were significant independent predictors of improved mean arterial blood pressure after CRET. In conclusions, in contrast to patients with coronary artery disease and low levels of CRP, patients with high baseline CRP levels did not demonstrate significant reductions in blood.

H Robert, et al: (2007)

Have performed meta-analyses of randomized controlled trials involving dynamic aerobic endurance training or resistance training. Endurance training decreases blood pressure through a reduction in systemic vascular resistance, in which the sympathetic nervous system and the renin–angiotensin system appear to be involved, and favourably affects concomitant cardiovascular risk factors. The few available data suggest that resistance training can reduce blood pressure.

Okamoto Takanobu, et al: (2007)

Have done a study on Combined aerobic and resistance training and vascular function: effect of aerobic exercise before and after resistance training. Might prevent the deterioration of vascular function. However, how aerobic exercise performed before or after a bout of RT affects vascular function is unknown. The present study investigates the effect of aerobic exercise before and after RT on vascular function. These results suggest that although vascular function is not

improved by aerobic exercise before RT, performing aerobic exercise thereafter can prevent the deteriorating of vascular function.

Bhatt S P, e tal: (2007)

Mentioned in his study that Hypertension is a silent killer.. Lifestyle modifications that effectively lower blood pressure are increased physical activity, weight loss, limited alcohol consumption, reduced sodium intake and the Dietary Approaches to Stop Hypertension diet. Lifestyle modification is recommended as initial therapy in stage 1 hypertension before initiation of drug therapy and as an adjunct to medication in persons already on drug therapy. In pre-hypertensive, it can reduce the incidence of hypertension and lower end-organ damage.

PG Peters, et al: (2006)

Performed a study where a short-term isometric exercise protocol was tested in ten hypertensive individuals to determine its efficacy as a high blood pressure-reducing intervention. The study was a prospective case study of 10 hypertensive individuals (8 men, 2 woman, mean age = 52 ± 5 years) who underwent six weeks of isometric exercise training (three sessions/week). After six weeks, systolic blood pressure decreased an average 13 mm Hg ($p < 0.05$) from a mean blood pressure of 146 to 133 mm Hg. They concluded that six weeks of isometric exercise training was effective in lowering systolic but not diastolic blood pressure in pre-hypertensive and hypertensive individuals, and enhanced antioxidant protection is a likely underlying mechanism.

W Jason, et al: (2006)

Have done a study on the effects of exertion hypertension evolved by weight lifting on vascular endothelial function. They have taken 30 subjects, 9 men and 5 women, age 28 ± 2 years who engaged in regular weight lifting. 11 men and 5 women age 33 ± 2 years, who did not regularly engaged in exercise, constitute the non weight lifter group. Effect of exercise -induced hypertension induced by resistance exercise on endothelium dependent flow-mediated vasodilatation (FMD) in conditioned weight-lifters (CWL) and non conditioned weight-lifters (NWL). There was no difference in the brachial artery responses to flow before and after exercise in CWL. While there was a significant reduction in FMD after compared to before

resistance exercise in NWL. There was no difference in the brachial artery responses to endothelium-independent nitro-glycerine between groups.

J.Steward. e tal: (2005)

Have done a study on Effect of exercise on blood pressure in older persons. This was a 6-month randomized controlled trial of combined aerobic and resistance training; They concluded that a 6-month program of aerobic and resistance training lowered DBP but not SBP in older adults with mild hypertension more than in controls. The concomitant lack of improvement in aortic stiffness in exercisers suggests that older persons may be resistant to exercise-induced reductions in SBP. Body composition improvements were associated with BP reductions and may be a pathway by which exercise training improves cardiovascular health in older men and women.

J.P Wallace. (2003)

Mentioned in his study that the current exercise prescription for the treatment of hypertension is: cardiovascular mode, for 20-60 minutes, 3-5 days per week, at 40-70% of maximum oxygen uptake (VO_2 (max)). Cardiovascular exercise training is the most effective mode of exercise in the prevention and treatment of hypertension. Resistance exercise is not the preferred mode of exercise treatment,. Evidence still exists that high intensity exercise ($>75\% VO_2$ (max)) may not be as effective as low intensity exercise ($<70\% VO_2$ (max)) in reducing elevated blood pressures. Exercise can be effective without a change in bodyweight or body fat.

J William, et al: (2002)

performed a randomized trial to compare the effects of aerobic and resistance training regimens on coronary risk factors. Twenty-six volunteers who exhibited android obesity and at least one other risk factor for coronary artery disease were randomized to aerobic or resistance training groups. Both groups showed a significant reduction in waist-to-hip ratio and the resistance training group also showed a Reduction in total body fat. There was no significant change in mean arterial blood pressure in either group. In conclusion, resistance training was effective in improving body composition of middle-aged obese sedentary males. Only aerobic training was effective in raising HDL cholesterol.

P Seamus, et al: (2002)

Have done a randomized control trails study to determine the effect of aerobic exercise on blood pressure. In conclusions, Aerobic exercise reduces blood pressure in both hypertensive and nor motensive persons. An increase in aerobic physical activity should be considered an important component of lifestyle modification for prevention and treatment of high blood pressure.

A George, et al: (2001)

Have done a randomized control trails study. Their study used the meta-analytic approach to examine the result of aerobic exercise for reducing the systolic blood pressure and diastolic blood pressure in older adults. They have taken 802 subjects (563 exercises and 239 controls). In conclusion the study support the efficacy of aerobic exercises for reduce in older adults, however a need exists for studies that address the effectiveness of thin intervention for reducing blood pressure in older adults.

Kokkinos, et al: (2000)

Have done a randomized well control exercise intervention studies have shown consistently that regularly performed aerobic exercise significantly lower blood pressure in patient with essential hypertension.

V. Papademetriou, e tal: (1999)

Exercise Training and Blood Pressure Control in Patients With Hypertension.. Exercise induced reductions in resting blood pressure and the prevention of an abnormal rise in blood pressure during physical exertion can lead to fewer cardiovascular events. It may also reduce antihypertensive medication requirements, cost, medication related side effects, and improve quality of life.

J.A Halbert, et al: (1997)

Have done a randomized control trial of aerobic or resistance exercise to reduce blood pressure. A total number of 29 studies (1533 hypertension and normotensive participants) were included 26 used aerobic exercise training, to trial use resistance training and one study had both resistance and aerobic training group. The studies show that aerobic exercise training reduces systolic blood pressure by 4.7 mm of Hg and diastolic blood pressure by 3.1 mm of Hg. But the evidence for the effects of Resistance exercise training was in conclusion.

Kelley G. (1997)

Performed a study on Dynamic resistance exercise and resting blood pressure in adults: a meta-analysis. With the use of the meta-analytic approach, the purpose of this study was to examine the effects of dynamic resistance exercise, i.e., weight training, on resting systolic and diastolic blood pressure in adults. A total of nine studies consisting of 259 subjects (144 exercises, 115 controls) and 18 groups (9 exercises, 9 controls) were included in this analysis. With the use of the bootstrap technique (10,000 samples), significant treatment effect (D3) reductions were found across all designs and categories for both systolic and diastolic blood pressure [systolic, mean 6 SD524.55 6 1.75 mmHg, 95% confidence interval (CI) 5 21.56 to 28.56; diastolic, mean 6 SD523.79 1 1.12 mmHg, 95% confidence interval CI521.89 to 26.33]. D3 changes corresponded with Relative decreases of, 3 and 4% in resting systolic and diastolic blood pressure, respectively. In conclusion, meta-analytic review of included studies suggests that dynamic resistance exercise reduces resting systolic and diastolic blood pressure in adults.

E.John, e tal: (1990)

Conducted a study to determine the antihypertensive efficacy of aerobic exercise training in mild essential hypertension, a prospective randomized controlled trial was conducted comparing an aerobic exercise regimen to a placebo exercise regimen, with a crossover replication of the aerobic regimen in the placebo exercise group. BP changes were not associated with any significant changes in weight, body fat, urinary electrolytes, or resting heart rate. This randomized controlled trial provides evidence for the independent BP lowering effect.

CHAPTER III

MATERIALS AND METHODOLOGY

3.1. MATERIALS USED FOR STUDY:

1. Mat
2. Treadmill
3. Dumb bells
4. Sphygmomanometer
5. Stethoscope

3.2 METHODOLOGY:

3.2.1 STUDY DESIGN:

The study was an experimental study design with pre test and post test evaluation both in experimental group and control group.

3.2.2 SAMPLING DESIGN:

The subject are selected by Random sampling technique.

3.2.3 POPULATION:

The sample size consist of 40 Subjects with Stage-1 Hypertension were selected and assigned in to Group A experimental group and Group B control group.

Experimental group: consist of 20 Stage-1 Hypertension subjects treated with aerobic and resistance exercise.

Control group : consist of 20 Stage-1 Hypertension subjects treated with resistance exercise.

3.2.4 SAMPLE:

40 Subjects were included in the study.

3.2.5 SELECTION CRITERIA:

INCLUSION CRITERIA:

- Patients with Stage -1 Hypertension.
- Gender – Male and female.
- Age – 30 to 45 years.
- Patient under anti hypertensive medications.

EXCLUSION CRITERIA:

- Diabetes mellitus.
- Any other cardiac risk factors.
- Any orthopaedic and neurological disorders.
- Patient not willing for follows up.

3.2.6 STUDY SETTING:

This study was conducted in Ashwin Multi Specialty hospital, Coimbatore.

3.2.7 STUDY METHOD:

Subjects were divided in to control and experimental group.

EXPREMENTAL GROUP:

20 Subjects were treated with aerobic exercises and resistance exercises.

CONTROL GROUP:

20 Subjects were treated with resistance exercises.

3.2.8 STUDY DURATION:

The study is proposed to be carried out for the period of 6 months

3.2.9 OUT COME MEASURE:

Blood pressure (BP)

BP was measured by a sphygmomanometer.

3.2.11 STATISTICAL TOOL

Paired 't' test

The following statistical tool is used to compare pre test and post test values within the groups.

Formula: Paired t-test

$$S = \sqrt{\frac{\sum d^2 - \frac{(\sum d)^2}{n}}{n-1}}$$

$$t = \frac{\bar{d}\sqrt{n}}{S}$$

Where,

d = difference between the pre test versus post test

\bar{d} = mean difference

n = total number of subjects

S = standard deviation

Unpaired 't' test:

The unpaired 't' test was used to compare the pre test and post test values between the two groups.

Formula: Unpaired t-test

$$S = \sqrt{\frac{\sum(X_1 - \bar{X}_1)^2 + \sum(X_2 - \bar{X}_2)^2}{n_1 + n_2 - 2}}$$

$$t = \frac{\bar{X}_1 - \bar{X}_2}{S} \sqrt{\frac{n_1 n_2}{n_1 + n_2}}$$

Where,

\bar{x}_1 = Mean of Group A

\bar{x}_2 = Mean of Group B

Σ = sum of the value

n_1 = number of subjects in Group A

n_2 = number of subjects in Group B

S = standard deviation

Level of significance: 5%

3.2.11 TREATMENT TECHNIQUE:

GROUP – A: AEROBIC EXERCISES AND RESISTANCE EXERCISES:

(1) AEROBIC EXERCISES:

Aerobic exercises were given to group A subjects. Initially warm up exercises for 10 minutes were given which included stretching of biceps, triceps, and pectorals, lateral flexors of trunk, quadriceps, hamstring and calf muscles. Following which treadmill walking was given for a period of 30 minutes. Later cool down period for 10 minutes were given which included stretching of same muscles mentioned above in the warming up procedure. Exercise testing and monitoring is not necessary for pre hypertensive or 24 Stage one or two hypertensive that are less than 50 years and have no CVD risk Patients. The intensity selected for this group is 40%-70% of the age predicted maximum heart rate at a frequency of alternative 3 days in a week for 7 weeks. The subjects' blood pressure was monitored as pre and post 7 weeks of training intervention and recorded.

1. WARM – UP FOR 10 MINUTE WHICH INCLUDES STRETCHING OF:

- **Biceps:** standing straight with hands placed over stretched in front of the wall and the whole body was turned facing the opposite side. Turning the whole body was stopped when a stretch was felt in the biceps and the subjects were asked to hold for 15 seconds and then repeat it on the other side.
- **Triceps:** standing straight with both arms over head and gently pulling behind the elbow to slide and palm down the middle of the back and the subjects were asked to hold for 15 seconds and then repeat it on the other side.
- **Pectorals:** standing in a corner with both arms on the wall slightly above the head and leaned forward slowly until a stretch was felt in front of shoulders and the subjects were asked to hold for 15 seconds and then repeat it on the other side

- **Lateral flexors:** standing straight with legs apart and outstretched hands and touch the same side foot with same hand and the subjects were asked to hold for 15 seconds and then repeat it on the other side.
- **Quadriceps:** standing with hand held on a table for support. Bending the knee and bringing the heel towards the buttock. A stretch was felt in the front of the thigh and the subjects were asked to hold for 15 seconds and then repeat it on the other side.
- **Hamstrings:** started by having the legs straight in standing position and lowering the body while keeping the legs straight and coming down and touching the feet or until the stretch was felt.
- **Calf muscle:** standing with keeping back leg straight with heel on the floor and leaned forward until a stretch was felt in the calf and hold for 15 seconds and repeated on the other leg.

2. AEROBIC PERIOD FOR 30 MINUTES – which included treadmill walking. The intensity selected for this group was 40%-70% of the age predicted maximum heart rate.

3. COOL DOWN PERIOD FOR 15 MINUTES – which included stretching of biceps, triceps, pectorals, lateral flexors, quadriceps, hamstrings and calf.

(2) RESISTANCE EXERCISES

Resistance exercises - dumbbell exercises for the upper and lower extremities, Repetition maximum was one of the safest ways of determining base line strength of particular muscle group and to determine training load for resistive exercises in the clinical set up. 1 repetition maximum is the greatest amount of weight that a person could lift through the full ROM just one time. However, many consider the risk of injury when attempting a 1RM to be equal to or higher than when performing multiple repetition sets. Therefore, there have been various Proposals for ways to calculate an approximation of the 1RM. The common formulas used to calculate the one repetition maximum. If r is the number of repetitions performed and w is the amount of weight used, then Subjects were given dumbbell exercises for biceps, triceps, deltoids, gluteus maximus, quadriceps, hamstrings. Low to moderate-intensity resistance training (30%-40% of a 1-repetition maximum [1RM] for upper body exercises and 50%-60% 1RM for lower body exercises) is recommended 2 to 3 d/wk. one set consisted of exercises for all the above muscles.

Likewise 3 sets of 10 repetitions were provided, for 40 minute per session in a Day, at a frequency of alternative three days in a week for 7 weeks The subjects' blood pressure was monitored before and after the 7 weeks of Intervention & recorded.

1. BICEPS CURLS:

Standing erect with feet shoulder width apart and knees slightly bent. Dumb bells grasped with a closed, supinated grip that was slightly wider than shoulder width apart. Dumb bells were raised in an arc by bending arms at the elbow moving upward to the front of the shoulders and then it was lowered until the arms are fully extended.

2. TRICEPS CURLS:

One hand placed on a bench for support with the other leg on the floor for Stability. Dumb bell were raised to the front of the body at hip height by bending the arm at the elbow and elbow straightened so that the weight was at the back of the body. Repeated on the other side also.

3. DELTOID EXERCISES:

a. FORWARD RAISE: in standing position, subjects started with their hands by sides, facing their thighs, with elbows straight. The subjects were asked to keep their arms parallel and raise them in a frontal plane so that their hands end up directly in front of their shoulder joints. The subjects were asked to keep their elbows locked, shoulder down, and chest high chest up and shoulders retracted and depressed throughout the Movement, pulling their abdominal muscle up and in, keeping their legs and gluteus firm and motionless.

b. LATERAL RAISE: subjects started with their hands at the sides and elbows and knees slightly bend. The subjects were asked to grasp the dumbbells with palms facing sides and elevate hands at the sides until in a horizontal position. During this their palms should face the ground and arms should be slightly bent. The subjects were then asked to raise their arms

laterally from the sides of body, keeping elbows in a fixed position, Keeping their spine in a neutral position and hips and knees slightly bent.

4. HAMSTRING CURLS:

Prone lying, the knee was bent slowly, so that the foot with the weight cuff was lifted up behind (or heel moved towards the buttock). The subjects were asked to hold the position and then the foot was lowered slowly all the way back down. The same procedure was repeated with the other leg.

5. QUADRICEPS CURLS:

Sitting on the chair with back support, the subject was asked to rest the balls of the feet & toes on the floor. The hands were kept on the thigh, and then the right leg with the weight cuff was extended slowly in front. With right leg in that position, the foot was flexed so that the toes are pointing towards head; the foot was held in that position for 1-2 seconds. Duration of 3 seconds was taken to lower the leg back to the starting position, so that the balls of the foot rested on the floor again. The same procedure was repeated with the other leg.

GROUP – B: RESISTANCE EXERCISES

Resistance exercises group received dumbbell exercises for the upper and lower extremities, Repetition maximum was one of the safest ways of determining base line strength of particular muscle group and to determine training load for resistive exercises in the clinical set up. 1 repetition maximum is the greatest amount of weight that a person could lift through the full ROM just one time. However, many consider the risk of injury when attempting a 1RM to be equal to or higher than when performing multiple repetition sets. Therefore, there have been various Proposals for ways to calculate an approximation of the 1RM. The common formulas used to calculate the one repetition maximum. If r is the number of repetitions performed and w is the amount of weight used, and then Subjects were given dumbbell exercises for biceps, triceps, deltoids, gluteus maximus, quadriceps, hamstrings. Low to moderate-intensity resistance training (30%-40% of a 1- repetition maximum [1RM] for upper body exercises and 50%-60% 1RM for lower body exercises) is recommended 2 to 3 d/wk. one set consisted of exercises for

all the above muscles. Likewise 3 sets of 10 repetitions were provided, for 40 minute per session in a Day, at a frequency of alternative three days in a week for 7 weeks The subjects' blood pressure was monitored before and after the 7 weeks of Intervention and recorded.

1. BICEPS CURLS:

Standing erect with feet shoulder width apart and knees slightly bent. Dumb bells grasped with a closed, supinated grip that was slightly wider than shoulder width apart. Dumb bells were raised in an arc by bending arms at the elbow moving upward to the front of the shoulders and then it was lowered until the arms are fully extended.

2. TRICEPS CURLS:

One hand placed on a bench for support with the other leg on the floor for Stability. Dumb bell were raised to the front of the body at hip height by bending the arm at the elbow and elbow straightened so that the weight was at the back of the body. Repeated on the other side.

3. DELTOID EXERCISES:

a. FORWARD RAISE: in standing position, subjects started with their hands by sides, facing their thighs, with elbows straight. The subjects were asked to keep their arms parallel and raise them in a frontal plane so that their hands end up directly in front of their shoulder joints. The subjects were asked to keep their elbows locked, shoulder down, and chest high chest up and shoulders retracted and depressed throughout the Movement, pulling their abdominal muscle up and in, keeping their legs and gluteals firm and motionless.

b. LATERAL RAISE: subjects started with their hands at the sides and elbows and knees slightly bend. The subjects were asked to grasp the dumbbells with palms facing sides and elevate hands at the sides until in a horizontal position. During this their palms should face the ground and arms should be slightly bent. The subjects were then asked to raise their arms laterally from the sides of body, keeping elbows in a fixed position, Keeping their spine in a neutral position and hips and knees slightly bent.

4. HAMSTRING CURLS:

Prone lying, the knee was bent slowly, so that the foot with the weight cuff was lifted up behind (or heel moved towards the buttock). The subjects were asked to hold the position and then the foot was lowered slowly all the way back down. The same procedure was repeated with the other leg.

5. QUARDRICEPS CURLS:

Sitting on the chair with back support, the subject was asked to rest the balls of the feet & toes on the floor. The hands were kept on the thigh, and then the right leg with the weight cuff was extended slowly in front. With right leg in that position, the foot was flexed so that the toes are pointing towards head; the foot was held in that position for 1-2 seconds. Duration of 3 seconds was taken to lower the leg back to the starting position, so that the balls of the foot rested on the floor again. The same procedure was repeated with the other leg.

3.2.12 PROCEDURE:

forty subjects clinically diagnosed as stage-1 Hypertension were selected According to inclusion and exclusion criteria and were divided conveniently into two groups; namely group A and group B, consisting of 20 subject each. Both the groups were explained about the purpose of the study. Informed Consent was obtained from the subjects. A brief explanation about the treatment session was explained to both Group-A (Aerobic exercise and Resistance exercises group) and Group-B (resistance exercise group).

CHAPTER IV

TABLE 1 - EXPERIMENTAL GROUP - (GROUP A)

S.NO	SYSTOLIC PRESSURE		DIASTOILIC PRESSURE	
	PRE TEST	POST TEST	PRE TEST	POST TEST
1	145	138	96	89
2	148	136	99	87
3	147	138	98	84
4	143	135	94	86
5	146	132	99	81
6	151	137	101	87
7	154	139	93	80
8	142	131	95	84
9	144	128	95	80
10	141	130	92	82
11	148	135	94	82
12	145	129	93	81
13	149	137	98	83
14	141	131	92	80
15	144	127	100	96
16	148	136	96	89
17	147	134	91	81
18	142	130	95	83
19	155	138	97	85
20	153	132	99	86

TABLE 2
CONTROL GROUP (GROUP B)

S.NO	SYSTOLIC PRESSURE		DIASTOILIC PRESSURE	
	PRE TEST	POST TEST	PRE TEST	POST TEST
1	143	139	94	90
2	149	140	100	91
3	151	138	101	87
4	155	139	97	84
5	148	137	91	86
6	143	139	101	97
7	154	140	92	84
8	141	136	96	91
9	145	130	96	87
10	147	132	98	90
11	147	136	96	90
12	152	140	98	89
13	155	142	100	87
14	149	140	93	85
15	151	137	97	83
16	146	131	91	85
17	143	138	99	91
18	141	139	101	89
19	150	139	92	84
20	142	138	95	86

CHAPTER V
DATA ANALYSIS AND INTERPRETATION

TABLE-3
POST- POST ‘t’ TEST VALUES OF SYSTOLIC BLOOD PRESSURE
BETWEEN EXPERIMENTAL AND CONTROL GROUP

S. NO	GROUP	MEAN	MEAN DIFFERENCE	STANDARD DEVIATION	“T” VALUE
1.	EXPERIMENTAL GROUP (A)	133.4	4.1	3.39	3.821
2.	CONTROL GROUP(B)	137.5			

For 38 degrees of freedom at 5% level of significance, calculated post test values between control and experimental group in systolic blood pressure was 3.821 and critical values was 2.021 which states that there is significant difference between groups

TABLE-4

**PRE -POST ‘t’ TEST VALUES OF SYSTOLIC BLOOD PRESSURE IN
EXPERIMENTAL GROUP**

S. NO	TEST	MEAN	MEAN DIFFERENCE	STANDARD DEVIATION	“T” VALUE
1.	PRE TEST	146.65	13.25	3.25	18.22
2.	POST TEST	133.4			

For 19 degrees of freedom at 5% level of significance, calculated pre – post test values in systolic blood pressure was 18.22 and critical values was 2.093 which states that there is significant in experimental groups

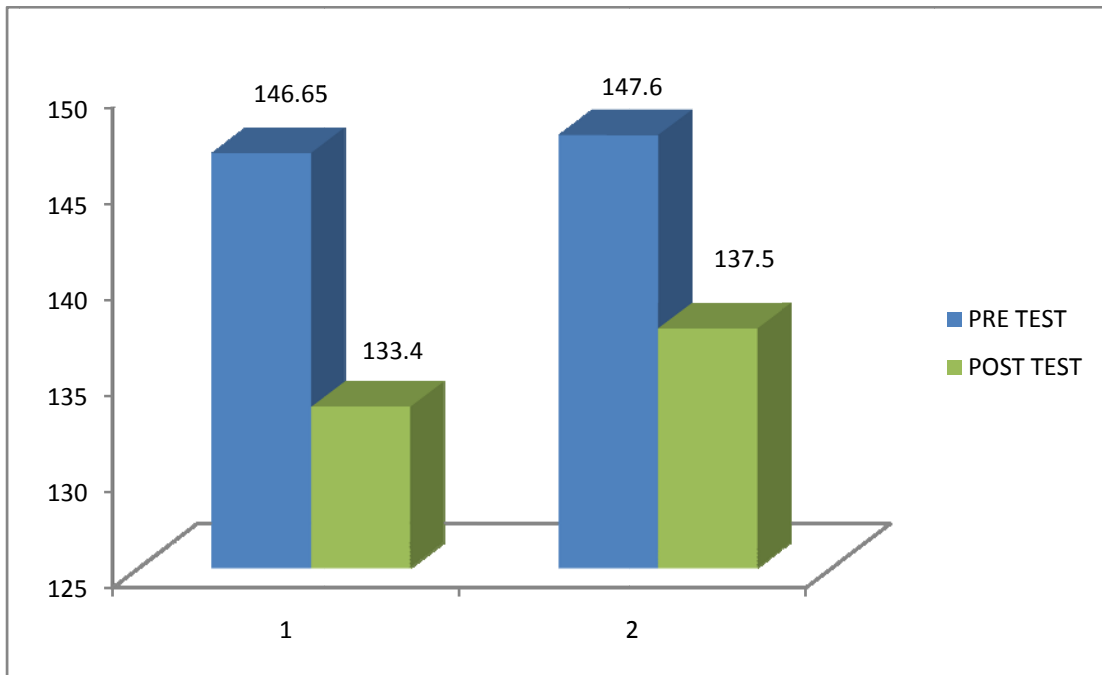
TABLE-5
PRE –POST ‘t’ TEST VALUES OF SYSTOLIC BLOOD PRESSURE IN
CONTROL GROUP

S. NO	TEST	MEAN	MEAN DIFFERENCE	STANDARD DEVIATION	“T” VALUE
1.	PRE TEST	147.6	10.1	4.06	11.34
2.	POST TEST	137.5			

For 19 degrees of freedom at 5% level of significance, calculated pre – post test values in systolic blood pressure was 11.34 and critical values was 2.093 which states that there is significant in control groups

GRAPH-1

SYSTOLIC BLOOD PRESSURE



1. EXPERIMENTAL GROUP

2. CONTROL GROUP.

TABLE-6

**POST- POST 't' TEST VALUES OF DIASTOLIC BLOOD PRESSURE BETWEEN
EXPERIMENTAL AND CONTROL GROUP**

S. NO	GROUP	MEAN	MEAN DIFFERENCE	STANDARD DEVIATION	"T" VALUE
1.	EXPERIMENTAL GROUP (A)	83.9	6.1	3.21	3.83
2.	CONTROL GROUP(B)	87.8			

For 38 degrees of freedom at 5% level of significance, calculated post test values between control and experimental group in diastolic blood pressure was 3.83 and critical values was 2.021 which states that there is significant difference between groups.

TABLE-7
PRE -POST‘t’ TEST VALUES OF DIASTOLIC BLOOD PRESSURE IN
EXPREMENTAL GROUP

S. NO	TEST	MEAN	MEAN DIFFERENCE	STANDARD DEVIATION	“T” VALUE
1.	PRE TEST	95.85	11.95	2.95	18.10
2.	POST TEST	83.9			

For 19 degrees of freedom at 5% level of significance, calculated pre – post test values in diastolic blood pressure was 18.10 and critical values was 2.093 which states that there is significant in experimental groups.

TABLE -8

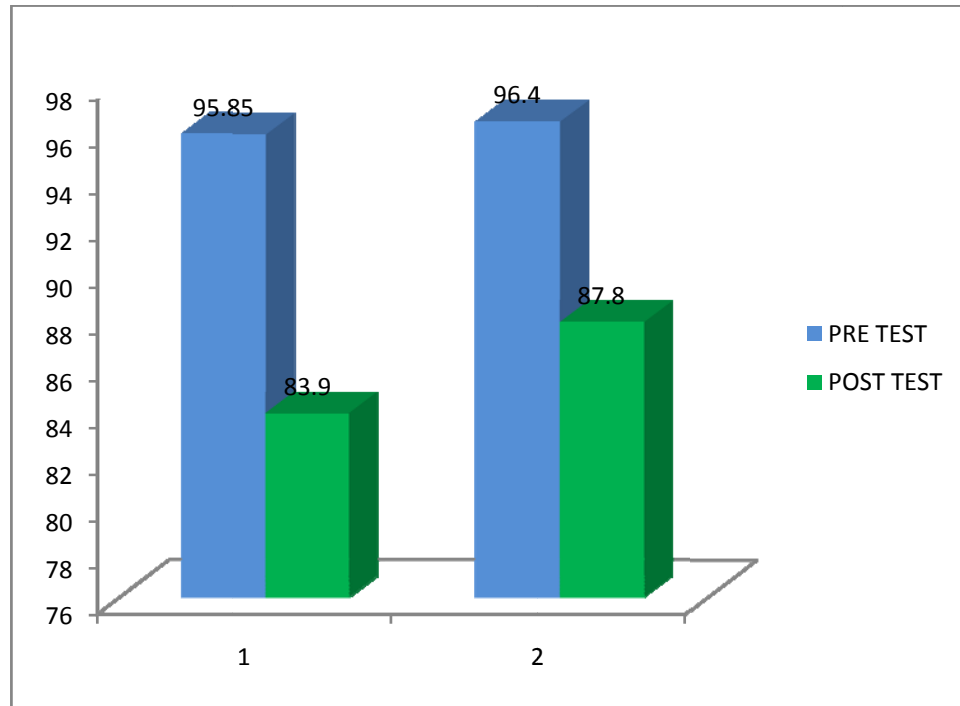
**PRE –POST ‘t’ TEST VALUES OF DIASTOLIC BLOOD PRESSURE IN
CONTROL GROUP**

S. NO	TEST	MEAN	MEAN DIFFERENCE	STANDARD DEVIATION	“T” VALUE
1.	PRE TEST	96.4	8.6	3.18	12.08
2.	POST TEST	87.8			

For 19 degrees of freedom at 5% level of significance, calculated pre – post test values in diastolic blood pressure was 12.08 and critical values was 2.093 which states that there is significant in control groups

GRAPH-11

DIASTOLIC BLOOD PRESSURE



1. EXPERIMENTAL GROUP

2. CONTROL GROUP

RESULTS

Effectiveness of control group was measured by comparing pre test and post test values in systolic blood pressure and diastolic blood pressure checked by using sphygmomanometer. The calculated 't' values is greater than the critical value 2.093 which states that there is significant difference in between the groups.

Effectiveness of experimental group was measured by comparing pre test and post test values in systolic blood pressure and diastolic blood pressure checked by using sphygmomanometer. The calculated 't' values is greater than the critical value 2.093 which states that there is significant difference in between the groups.

By comparing the 't' values of experimental and control group 't' values of experimental group is greater than 't' values of control group which states there exists a significant difference in improvement between two groups.

Stage I hyper tension is a major cardio vascular disorder and its management varies from one stage to another. This focuses on achieving normal blood pressure in systolic blood pressure and diastolic blood pressure level.

The technique used was achieving normal blood pressure in systolic blood pressure and diastolic blood pressure level. Finally statistical significance of 5% level of significance in this study states that there exists a significance of 5% level of significance in this study states that there exists a significant achievement in normal blood pressure in systolic blood pressure and diastolic blood pressure level measured by sphygmomanometer.

CHAPTER VII

DISCUSSION

The purpose of this study was to compare the effectiveness of aerobics and Resistance exercises versus Resistance exercises only in type-1 Hypertension patients. The comparison demonstrated that exercise program of type-1 Hypertension patients with 7 weeks duration of aerobic and Resistance exercises were efficacious. In this study General Blood pressure apparatus was used as the primary outcome measure to find out the self efficacy in type-1 Hypertension patient as used in a previously published study by **Rahman MS, et al (2009)**,

Efficacy of exercise in Hypertension was found in systemic reviews done by **Rahman MS, et al (2009)** , **C.G. Cardoso, e tal (2010)** and **Kahn et al(2002)**. Many of the studies have proved that aerobics and Resistance exercises are effective in Hypertension but none of the studies has compared the effectiveness of both. Hence efforts were made in this study to compare both the treatment. A 7 weeks duration of treatment was given in both experimental and control groups and there was equal improvement in both the groups. This may be due to the fact that aerobic endurance training decreases blood pressure through a reduction in systemic vascular resistance in which the sympathetic nervous system and the renin–angiotensin system appear to be involved, and favourably affects cardiovascular risk factors by **Rahman MS, et al (2009)**.

One theory proposes that exercise enhances shear stress (a force acting parallel to blood vessels) stimulating the production of nitric oxide (NO) by the endothelium. In healthy blood vessels NO enhance smooth muscle relaxation and maintains the blood vessel in the normal resting state⁴¹. Small changes in vessel diameter profoundly impacts vascular resistance. There are also vascular structural changes such as increased length, cross sectional area, and/or diameter of existing arteries and veins in addition to new vessel growth⁴² Endurance trained subjects, for example, have larger arterial lumen diameter in conduit arteries than untrained controls. Aerobic based training also appears to increase large artery compliance.⁴³ Studies suggest that the operating point of the arterial baroreflex is set to a lower BP after an acute bout of exercise. The change in blood pressure cannot be attributed to pure static training. In all but

one study, most exercises were dynamic and, therefore, involved movements of the arms, legs or trunk, or both. Furthermore, the training intensity was not always high and ranged from 30 to 60% of one repetition maximum in half of the study groups and from 70 to 80% of one repetition maximum in the others **H Robert, et al: (2007)**. Although there are fewer data on resistance training, the data suggest that resistance training of moderate intensity is able to reduce blood pressure. Various approaches have been used to increase physical activity and maintain adherence. The effectiveness of these methods has been reviewed by **Kahn et al(2002)**.

More important than the finding that dynamic resistance exercise may reduce resting blood pressure is the fact that this investigation did not show an increase in either resting systolic or diastolic blood pressure. Efficacy of aerobics was found in a study done by, which supports our result showing Aerobic exercise intervention significantly reduced Blood Pressure. According to a study done by **C.G. Cardoso, et al; (2010)** hypotension was usually observed during waking periods, According to results of resisted exercise, the real importance regarding the role of resistance training in lowering blood pressure is whether it does so in individuals with high blood pressure. It is generally believed that aerobic exercise training lowers resting blood pressure more in patients with moderate-to-severe hypertension, compared with individuals with mild hypertension. The least effects usually occur in subjects with normal blood pressure.

Thrice – weekly participation of aerobics or strength training for three months may be sufficient for reducing Blood pressure. Most of the studies followed the American College of Sports Medicine guidelines for aerobic exercise, it would appear plausible that adherence to these guidelines is appropriate for reducing resting SBP31. This includes exercising 3 to 5 d/wk at an intensity of 40% to 85% of maximum oxygen consumption for 20 to 60 minutes per session. When intra group comparison was done using paired‘t’ test, it showed statistically significant result at $p < 0.05$ for reducing Blood pressure. Thus, indicating that both the groups were effective in reducing Blood pressure. An independent‘t’ test was done to find out the significance of the data between the two groups .The results analyzed between groups showed values statistically were insignificant at $p > 0.05$, thus accepting null hypothesis and rejecting the alternative hypothesis stating that There are no significant differences between aerobic exercises and

resistance exercises versus resistance exercise in reducing the blood pressure of stage-1 Hypertension. There is statistically no significant difference in efficacies of treatment A and B.

This study led to the inference that both aerobic exercise and Resistance exercises can equally reduce Blood pressure. Hence, both exercise programs may be suggested as an important component in the management of Type-1 Hypertension. Further studies could focus on long term benefits of physical therapy in this condition.

CHAPTER VIII

SUMMARY AND CONCLUSION

SUMMARY:

Forty stage-1 Hypertension patients were subjected to aerobic and resistance exercise. These Forty subjects were divided in to two equal groups based on convenient sampling. Group A was given aerobic and resistance exercises Group B was given resistance exercise and both groups' shows reduction in Blood pressure. The data collected was analyzed using SPSS – 17 and significant difference between pre and post treatment was done by paired t test. Independent-t test was used to analyze the post treatment value of B.P between group A and B. From data analysis it was found that difference between pre and post treatment score in both aerobic and Resistance exercise is highly significant with p value <0.001 . The p value of intergroup comparison was found to be >0.05 indicating that there is no significant difference between post treatment value of group A and group B. Thus, it was found that group A in which aerobic and Resistance exercise were used reduced Blood Pressure significantly.

CONCLUSION

The pre test and post test scored are noted and analysis was done using independent 't' test which favored the alternate hypothesis.

The intra group analysis was done results were analysis using paired 't' test, which favored the alternate hypothesis.

The study concludes that aerobic and resistance exercises is achieving normal blood pressure level in patients with stage I hyper tension. Thus, this study accepts the alternate hypothesis.

CHAPTER IX

LIMITATIONS AND SUGGESTIONS

LIMITATIONS OF THE STUDY:

1. This study was limited in the age group between 30 – 45 years.
2. The sample size in this study was small.
3. Long term effects of treatment were not assessed due to short duration of time.
4. Mean arterial pressure was not included in the study.

SUGGESTIONS FOR FURTHER STUDY:

1. The sample of this study design was small and it can be done on bigger samples.
2. This study focuses on type-1 hypertensive patients alone which can be done Further with type-2 hypertensive patients.
3. This study can be done along with mean arterial pressure which enhances long term effect in hypertensive patients.

CHAPTER X

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CHAPTER XI

APPENDIX - I

ASSESSMENT CHART

NAME :

AGE :

ADDRESS :

GENDER :

OCCUPATION :

1.HISTORY :

PAST

PRESENT

FAMILY

2.ON OBSERVATION :

BUILT

POSTURE

GAIT

ANY EXTERNAL APPLIANCE

3.ON EXAMINATION :

BP

PULSE

RESPIRATORY RATE

HEART RATE

DATA COLLECTION TABLE

GROUP

A

(OR)

B

S.NO	VARIABLES	PRE TEST VALUES	POST TEST VALUES
1	SYSTOLIC BLOOD PRESSURE		
2	DIASTOLIC BLOOD PRESSURE		

MANAGEMENT OR TRAINING PROTOCOL

1. GROUP A - AEROBIC EXERCISES AND RESISTANCE EXERCISE

2. GROUP B - RESISTANCE EXERCISE

APPENDIX – II
PATIENT CONSENT FORM

**TITLE: EFFECTIVENESS OF AEROBIC EXERCISES AND RESISTANCE
EXERCISES ON BLOOD PRESSURE IN STAGE I HYPERTENSION
PATIENTS – A COMPARATIVE STUDY**

INVESTIGATOR: _____

PURPOSE OF THE STUDY:

I _____, have been informed that this study will work towards achieving
on the normal blood pressure in stage I hypertension for me and other patients.

PROCEDURE:

Each term of the study protocol has been explained to me in detail. I understand that during the
procedure, I will be receiving the treatment for one time a day. I understand that I will have to
take this treatment for four weeks.

I understand that this will be done under investigator, _____ supervision. I
am aware also that I have to follow therapist's instructions as has been told to me.

CONFIDENTIALITY:

I understand that medical information provided by this study will be confidential. If the data are used for publication in the medical literature or for teaching purposes, no names will be used and other literature such as audio or video tapes will be used only with permission.

RISK AND DISCOMFORT:

I understand that there are no potential risks associated with this procedure, and understand that investigator will accompany me during this procedure. There are no known hazards associated with this procedure.

REFUSAL OR WITHDRAWAL OF PARICIPATION:

I understand that the decision my participation is wholly voluntary and I may refuse participate, may withdraw consent at any time during the study.

I also understand that the investigator may terminate my participation in the study at anytime after researcher has explained me the reasons to do so.

I _____ have explained to the purpose of the research, the procedures required and the possible risks and benefits, to the best of my ability.

.....

.....

investigator

Date

I Confirm that researcher has explained me the purpose of the research, the study procedure and the possible risks and benefits that I may experience. I have read and I have understood this consent to participate as a subject in this research project.

.....

.....

Subject

Date

.....

.....

Signature of the Witness

Date

APPENDIX- III
NORMAL VALUES OF BLOOD PRESSURE

NORMAL BLOOD PRESSURE :

SYSTOLE	: 110 to 120 mmHg
DIASTOLE	: 70 to 80 mmHg