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Research Article

Effect of Endurance and Breathing Training Versus Circuit and Breathing Training On Blood Pressure in Prehypertensive Overweight Adults

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Abstract: Hypertension is one among the leading risk factor for mortality and it is called as "the silent killer". The new creation of the term 'prehypertension' classification by the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure JNC 7 guidelines has provided a new path to the researchers to examine this group separately as it decreases the average life expectancy by as much as five years. Physical activity in the form of regular aerobic exercise has been proven in prevention of high blood pressure as well as the lowering of blood pressure among all levels of hypertension. The circuit training and endurance training exercises are known to reduces both systolic and diastolic arterial blood pressure along with improvement of health related quality of life. Breathing training exercises is the only simple method to improve respiratory control to reduce the blood pressure in prehypertensive individuals. The aim of this study is to examine the effects of endurance and breathing training versus circuit and breathing training on blood pressure, body mass index, waist circumference and quality of life in pre hypertensive overweight adults. This is an experimental design with pre and post comparative study. The subjects of 25-40 years of overweight both male and female, clinically diagnosed with prehypertension were included in the study. Those with known cardiac, pulmonary, neurological and musculoskeletal disorders were excluded in the study.40 subjects were randomly assigned into two groups, Group A received endurance training with breathing exercise while Group B received circuit training and breathing exercise for 12 weeks and 5 sessions per week. The outcome measures were blood pressure, BMI, waist circumference and quality of life. The outcome tools were sphygmomanometer, weighing machine, Stadiometer, inch tape and SF 36 Short-Form 36 Questionnaire. On comparing Pre-test and Post-test within Group A and Group B on blood pressure, body mass index, waist circumference and quality of life shows a significant difference in mean values at $P<0.001$. Thus this study concludes that 12 weeks of circuit training and breathing exercise reduces blood pressure, body mass index, waist circumference and improves the quality of life in pre hypertensive overweight adults.

Keywords: Blood Pressure, Prehypertension, Circuit Training, Endurance Training and Overweight

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1. INTRODUCTION

Cardiovascular diseases(CVDs)are the main cause of mortality and the most common reason of permanent disability in the western countries[1]. Several risk factors contribute to the development of CVDs such as age, elevated blood cholesterol, diabetes, obesity, tobacco use, sedentary lifestyle and hypertension [2]. Hypertension, the most common non-communicable disease affecting a billion of the world's population, is the most important factor in the development of cardiovascular and renal diseases [3] with many of the individuals being unaware of their status[4]. Hypertension has been identified as one of the leading risk factor for mortality and has earned reputation as "the silent killer"[5]. Also hypertension is responsible for 57% of stroke deaths and 24% of coronary heart disease deaths in India [6]. Cardiovascular disease may be the largest cause of death and disability in India after 2020 is a right prediction and hypertension is emerging as a major health disease [7] .The creation of the term 'prehypertension' classification by the JNC 7 guidelines in 2004,defined as Systolic blood pressure of 120 to 139 mmHg or diastolic blood pressure of 80 to 89 mmHg invites additional efforts on the part of researchers to study this group separately both because it is estimated to decrease average life expectancy by as much as five years[8,9]. Two major studies in India were

(a)World Health Organisation and Indian Council of Medical Research: Non-Communicable Disease WHO – ICMR: NCD risk factor surveillance that used JNC 6 guidelines[10] and it did not have the category of pre hypertension.

(b) Integrated Disease Surveillance Project (IDSP) of ICMR, which used the prehypertension category in its analysis. Various studies conducted in India have shown the prevalence of prehypertension in the age group 20 to 30 years to be ranging from 24.6 to 65% [11 – 16].

A large population of prehypertension have at least one cardiovascular risk factor and there is a moderate to high risk of pre hypertensives progressing to hypertension [17,18]. Prevalence of prehypertension rate was high in adults ranging from 20 – 40 years as 12.2% as concluded by Tadvi AY et al,2016 [19]. Sanjay Kini,et al,(2016) in their study on prevalence of prehypertension among young adults (20 – 30 years) in coastal villages of Udupi District in Southern India on 1,152 young adult subjects (20-30 years of age group)has concluded that the prevalence rate was as high as 45.2%. Both biological (age, pre- obesity and obesity) and behavioral factors like sedentary occupation, high salt intake were associated with prehypertension and the study also emphasizes the need of community based screening of prehypertension under National Rural Health Mission[20].Pharmacological treatment of hypertension includes anti hypertensives like beta blockers, calcium channel blockers etc. and that of with prehypertensive individuals remains a matter of debate[21]. Non pharmacological measures include lifestyle modifications like dietary changes, stress management, cessation of smoking and regular physical activity [22]. Physical activity in the form of regular aerobic exercise has been recommended for the prevention of high blood pressure as well as the lowering of blood pressure among all levels of hypertension. The circuit training exercises may beneficially lower the blood pressure in borderline hypertensives. The endurance training exercises are given for hypertensives in order to reduce both systolic and diastolic arterial blood pressure along with improvement of health related quality of life. Breathing training exercises is a simple method to improve the autonomic balance, respiratory control and consequently to reduce blood pressure in hypertensives[23]. Hypertension is ranked as a third cause of disability and is a major predictor of CVD, CVA and deaths. Management of prehypertension in earlier stages can prevent its progression in to Hypertension and these subsequent risks can also be prevented. Researches have proved that regular aerobic and resisted exercises have their effect on lowering Blood Pressure levels in hypertensives. This study is a continuation of research on what type of exercise and which is effective in reducing Blood Pressure in prehypertension individuals as studies regarding specific exercise interventions for the specific prehypertensive group are scarce. The main objective of the study is to study the effectiveness of endurance training, circuit training and breathing exercise on blood pressure in overweight adults with prehypertension and also to compare the effectiveness of endurance training and breathing exercise Vs circuit training and breathing exercise on blood pressure in prehypertensive overweight adults.

2. MATERIALS AND METHODS

In the present study, a screening of volunteers from BP Awareness Camp conducted in the physiotherapy outpatient department of Faculty of physiotherapy, Dr. MGR Educational and Research institute, Chennai, of which 50 subjects were clinically diagnosed as pre hypertensives and then screened by using the detailed evaluation form for cardiorespiratory conditions in which Remaining 5 did not match the inclusion citeria so only 45 were selected according to the inclusion criteria and then divided into two groups by simple random sampling method as 23 subjects in group A and 22 subjects in group B .Simple random sampling method was used in this study and the sample size was calculated using the formula (no. of variables x 10 =) and the age factor was set only between 25 – 45 years and controlled not more than or less than that.

INCLUSION CRITERIA	EXCLUSION CRITERIA
Individuals in the age group of 25-45 years.	Individuals with Cardiac arrhythmias
A Blood Pressure ranging from a. Systolic Blood Pressure between 120 – 139 mm Hg. b. Diastolic Blood Pressure ranging between 80 – 89 mm Hg (According to conventional WHO classification)	Individuals with Chronic Obstructive Pulmonary diseases.
A Body Mass Index ranging from 25-29.9 kilogram/meter square as overweight individuals. (According to conventional WHO classification)	Individuals with Coronary artery diseases
Waist circumference 35-40 inches	Individuals who are not willing to participate in the study
	Individuals Under medications for hypertension

2.1 Participants

Initially 45 volunteers were included in the study later on during the study 5 (2 females in group A and 3 females in Group B) discontinued due to some personal reasons so finally the study was completed with 40 participants only. Forty participants (20 males and 20 females; age range 25–35 years), who were clinically diagnosed with prehypertension corresponding to a mean systolic and diastolic blood pressure of 120–139 and 80–89 mmHg, respectively, volunteered in the study and signed a written informed consent form after Ethical registration and clearance from the Institutional Ethical committee. At the time of recruitment, all the participants' body weight, height, BMI and Waist circumference were measured and calculated. Participants' characteristics are listed in Table 1.

Table 1: Participants' Characteristics

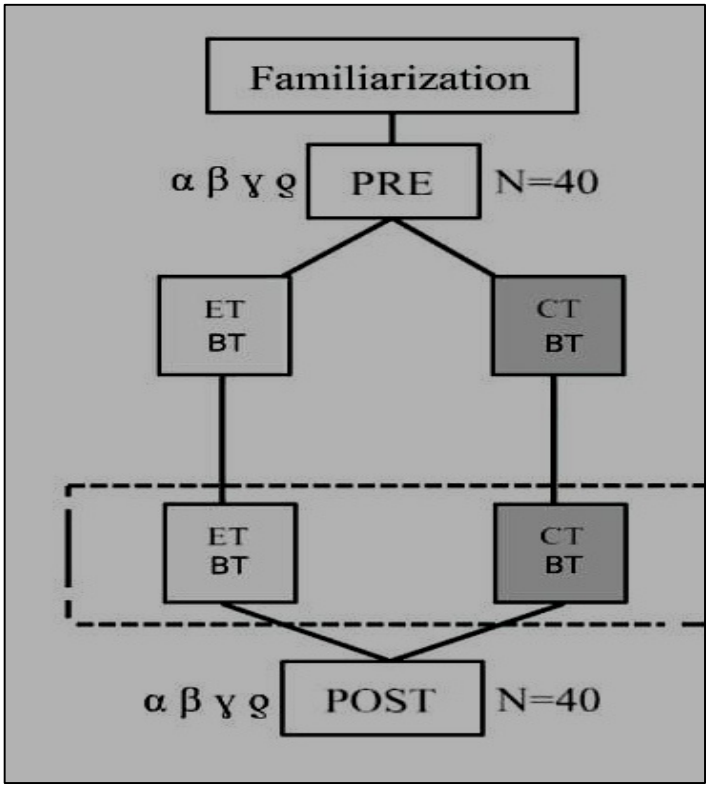
GROUP	ETBT	CTBT
Age (years)	25 - 45	25 - 45
Gender (M/F)	10/10	10/10
BMI (kg/m^2)	25-29.9	25-29.9
Waist circumference(inches	35-40	35-40

ET endurance training, CT circuit training, BT breathing training, M male, F female, BMI body mass index. The mean age is 35 years and mean WC is 40 inches.

The study subjects were given a written consent form and a detailed explanation of the procedure and the purpose of the study was explained to all the participants. Only 45 volunteers fulfilled the inclusion critera after an awareness camp on blood pressure conducted in the institution. final 45 subjects of two group A 23 (11 males 12 females) and 22 (12 males and 11 females) in group B. Group A was given circuit training and breathing training and Group B was given endurance training and breathing training to perform for a duration of 12 weeks. Later all the standard outcome measures were measured after the study duration as pre-test and post-test values of blood pressure, BMI, waist circumference and the last quality of life by using the SF-36 questionnaire. During the study 5 subjects 2 females in group A and 3 females in group B withdrew due to some personal reasons so finally the study was completed with 40 participants only. Group A received 12 weeks of Circuit and Breathing training exercises thrice weekly. Before the training period all the participants underwent an exercise familiarization session to ensure proper execution of the technique [24]

2.2 Experimental Design and Training Protocols

The experimental design, with the proposed interventions, is represented in Fig. 1. All volunteers participated in a series of sessions to familiarize themselves with the exercise proto-cols and interventions.



α = Blood Pressure, β = BMII, γ = Waist Circumference , ϱ = Health Related quality of life

Fig. 1 Experimental design: After baseline evaluations, participants were assigned into two different groups. ET & BT Group, endurance exercise training on ergometer and breathing training; CT & BT Group, short bouts of dynamic exercises and breathing training.

2.3 Blood Pressure

Two different physicians measured blood pressure with standard auscultatory and mercury sphygmomanometer techniques at about the same time of the day to minimize the effect of circadian rhythm on the measurement, because of its stronger accuracy standards supported by the study on Accuracy of Cuff-Measured Blood Pressure: Systematic Reviews and Meta-Analyses by DS Picone, Journal of American college of cardiology,2017 [24]. Both operators repeated the ambulatory blood pressure evaluation 3 times both before and after intervention. At each time three measurements of blood pressure were taken on the right arm at 1-minute intervals after a rest of at least 3 minutes, in a seated position. Data reported in the text report the average of the four evaluations.

2.4 Circuit Training

Circuit training consisting of total body exercises like squat jumps, skipping squat thrusts, fast feet on the box, squat to presses [25-26] all done for a frequency of 8-12 repetitions for a duration of 40 minutes of exercise including initial 5 minutes of warm up as jogging and last 5 minutes of cool down stretches[27] for 5 days a week basis, which is then followed by breathing training exercises. All the exercises were performed at 1 Hz at 70 % of the maximal mechanical power [28-31]. The duration of a single bout of CT exercise was 60 seconds with 60 s of recovery in between.

Holding a relatively light dumbbell in each hand by the side, squat down until the knees are bent just above 90 degrees. As the legs are extended push the dumbells overhead and extend the arms fully. Lower the weights on squatting down again.

Fig: 2 Subject Performing circuit training exercises - squat to presses

2.5 Breathing Training

Diaphragmatic breathing exercise by lying supine on the couch with one hand on the chest and other in the belly with the knees supported by pillow below which means, lying on your back on a flat surface (or in bed) with your knees slightly bent. Breathe in slowly through your nose, letting the air in deeply, towards lower belly. The hand on chest should remain still, while the one on belly should rise. Tightening the abdominal muscles and let them fall inward during exhalation through pursed lips. The hand on belly should move down to its original position .and stopped in case of any discomfort of the subject performing ,on the total for a frequency of 5 -6 cycles per minute for a duration of 20 minutes 5 days a week for 12 weeks as supported by the studies of Yokogawa M,et al, Comparison of two instructions for deep breathing exercise: non-specific and diaphragmatic breathing (2018) and Tomich M,Franca,et al, Breathing pattern, thoraco abdominal motion and muscular activity during three breathing exercises (2007) [32,33].

2.6 Endurance Training

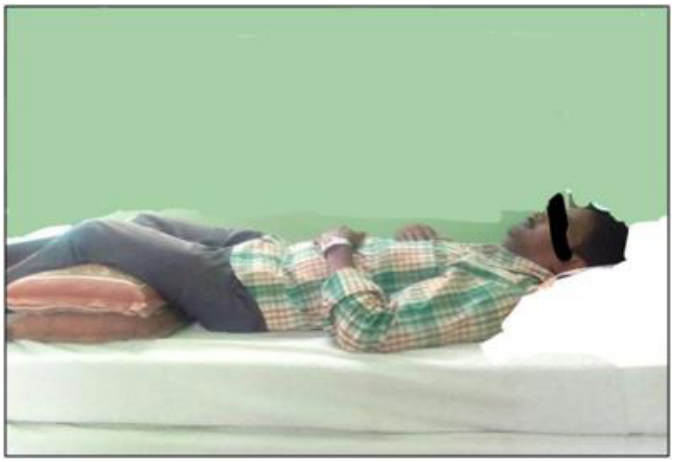
Group B received a 12 week duration of moderate intensity endurance training exercise as static cycling without any resistance of moderate intensity for a duration of 40 minutes including warm up and cool down exercises like stretching of major muscles and jogging on the spot was performed for 5 minutes each before and after the session for 5 days a week (fig.3)[34,35]

On an Ergometer in upright seated position with the knees bent foot over the pedal, hands supported on the monitor and performed for a duration of 30 minutes in the moderate intensity level without any resistance.

Fig: 3 Subject Performing static cycling exercise

2.7 Breathing Training

It is then followed by a session of breathing training exercise for 10 minutes' duration by lying supine on the couch with one hand on the chest and other in the belly with the knees supported by pillow below which means, lying on your back on a flat surface (or in bed) with your knees slightly bent. Breathe in slowly through your nose, letting the air in deeply, towards lower belly. The hand on chest should remain still, while the one on belly should rise. Tightening the abdominal muscles and let them fall inward during exhalation through pursed lips. The hand on belly should move down to its original position and stopped in case of any discomfort of the subject performing for a frequency of 5 -6 cycles per minute for a duration of 20 minutes 5 days a week for 12 weeks as in Fig : 4[36,37].



In supine lying position with one hand on the chest and other in the belly with the knees supported by pillow below followed by a gentle inspiration and expiration.

Fig: 4 Subject performing Diaphragmatic breathing exercise

2.8 Health-Related Quality of Life

The SF 36 Questionnaire, because of its high reliability and validity was administrated before and after the interventions. Briefly, the first four items of the SF-36: physical functioning, role- physical, bodily pain, general health were assessed and categorized in the physical component of the SF-36[38-42].

3. DATA ANALYSIS

In this study, the sample data includes either categorical (or nominal) and scale (or quantitative) variables. Both descriptive statistics and inferential statistics (i.e., hypothesis tests) have been performed to analyse the sample data. The dataset includes 12 variables and 40 observations. All the parameters were assessed using the statistical package for social science (SPSS) IBM statistical package for social science (SPSS) version 24. Paired t-test was adopted to find the statistical difference within the groups & Independent t-test (Student t Test) was adopted to find statistical difference between the groups. The dataset includes 12 variables and 40 observations.

4. RESULTS

On comparing the Mean values of Group A & Group B on BP SYS due to "Endurance Training and Breathing Training (Group-B)" (M = 5.50) (Table 2) is greater than that of " Circuit Training and Breathing Training (Group-A)". (Graph 1) and the evidence is sufficient to conclude that the null hypothesis is rejected at 5% level ($t(19) = 4.492$, $p = 0.000 < 0.05$).

Table 2: Comparing the effect of Treatments Group A and B Independent Samples Test in terms of all measures

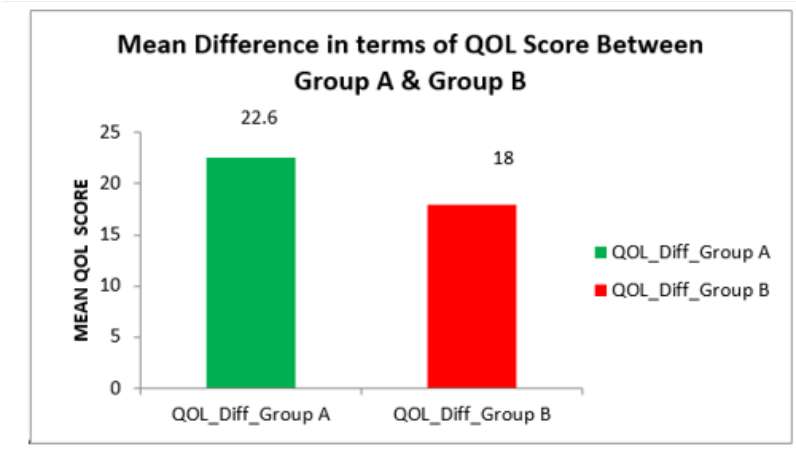
Independent Samples Test					
	t-test for Equality of Means				
	Mean Difference	Std. Error Difference	T	df	Sig. (2-tailed)
BP_SYS_Diff	1.30	1.30	-1.11	38	.274
	1.30	1.30	-1.11	37.91	.274
BP_DIA_Diff	1.05	1.05	1.13	38	.262
	1.05	1.05	1.13	37.99	.262
BMI_Diff	.24	.24	3.66	38	.001
	.24	.24	3.66	25.74	.001
WC_Diff	.46	.46	4.59	38	.000
	.46	.46	4.59	37.95	.000
QOL_Diff	3.42	3.42	1.34	38	.187
	3.42	3.42	1.34	35.21	.188

Graph: 1 Cardiovascular variable: Average resting systolic (SBP) and diastolic (DBP) blood pressures in the two groups before and after interventions. * = in-group P < 0.05

Going by the mean values, we conclude that the average reduction in this BP DIA Score due to " Circuit Training and Breathing Training (Group-A)" (M = 4.1500) (Table 2) is greater than that of "Endurance Training and Breathing Training(Group-B)" (M = 2.950) (Graph: 2 BMI score and waist circumference score between the groups $P < 0.05$.

➢ There is a significant difference between Group A and Group B in terms of average reduction in BMI Score (t(38) = 3.668, p = .001< 0.05). Going by the mean values, we conclude that the average reduction in this BMI Score due to "Circuit Training and Breathing Training(Group-A)" (M = 1.6250) (Table 2) is greater than that of "Endurance Training and Breathing Training(Group-B)" (Graph 2).

➢ There is a significant difference between Group A and Group B in terms of average reduction in Waist Circumference Score (t(38) = 4.596, p = .000 < 0.05). (Table 2) Going by the mean values, we conclude that the average reduction in this Waist Circumference Score due to "Circuit Training and Breathing Training (Group-A)" (M = 3.7000) is greater than that of "Endurance Training and Breathing Training (Group-B)"(Graph 2).



Graph: 3 SF-*36* physical and mental component of health related quality of life between the groups *P* < 0.05.

➢ There is no significant difference between Group A and Group B in terms of average increase in Quality of Life Score (t(38) = 1.343, p = .187 > 0.05). Going by the mean values, we conclude that the average increase in this Quality of Life Score due to "Circuit Training and Breathing Training(Group-A)" (M = 22.6000) (Table 1) is greater than that of "Endurance Training and Breathing Training(Group-B)" (M = 18.0000). (Graph 3)

➢ Going by the results of the analysis, this study shows that the pre and post-test of Group A is effective based on the Circuit Training and Breathing Training on subjects with overweight pre-hypertensive adults in terms of all standard measures. Similarly, the Group B is effective based on Endurance and Breathing Training on subjects with overweight pre-hypertensive adults in terms of all standard measures. In addition, the difference between Group A and Group B was found to be statistically non-significant in terms of BP SYS Score, BP DIA Score, QOL Score. But the difference between Group A and Group B was found to be statistically Significant in terms of BMI Score and WS Score. However, the result showed that the mean difference of Group B "Endurance Training and Breathing Training" is slightly more effective than Group A "Circuit Training and Breathing Training" in terms of BP SYS Score on subjects with overweight pre-hypertensive adults. But in terms of BP DIA Score, BMI Score, WS Score, QOL Score components which is slightly more effective for Group A "Circuit Training and Breathing Training.

➢ " On the whole, this study concludes that Group A "Circuit Training and Breathing Training" is slightly more effective that Group B "Endurance Training and Breathing Training" for subjects with overweight pre-hypertensive adults in terms of all standard measures.

5. DISCUSSION

Arterial blood pressure is a function of the product of cardiac output and total peripheral resistance. The reductions in arterial blood pressure observed after exercise must result from reductions in cardiac output, total peripheral resistance or both.The underlying mechanisms responsible for reduction in blood pressure elicited by exercise training remain elusive and controversial[43,44]. The current opinion of the researchers is that exercise training must act upon a number of mechanisms resulting in reduction of total peripheral resistance, cardiac output or both. Hypertensives are encouraged to participate in endurance training (ET) programs to reduce both systolic and diastolic arterial blood pressure[45]. This ET-induced reduction in arterial pressure is generally accompanied by improvements in central and peripheral hemodynamic factors. Additional benefits of ET are the improvement of health-related quality of life [46]. Also other emerging exercise-based treatments for HYP may reduce resting arterial blood pressure and improve health-related quality of life. Nowadays, circuit-training (CT) physical exercise is becoming one of the most popular fitness programs in healthy old individuals because of its greater enjoyment with respect to standard ET [47,48]. However, limited data are available on the effectiveness of this exercise approach on the reduction of blood pressure in prehypertensive overweight adults. Besides the potential appeal of CT it is important to note that the physiological mechanisms activated by CT are different to those involved in ET in terms of central hemodynamics stimulation. Remarkably, a reduction in arterial blood pressure and the amelioration of health-related quality of life has been observed also after training based on breath control in breathing training [49]. The aim of this study was to elucidate if other exercise-based interventions, based upon CT (mainly peripheral stimulation) or RT (no central or peripheral hemodynamic involvement), are equally successful with respect to ET (both central and peripheral stimulation). Prehypertension is associated with overweight/obesity suggesting that prevalence of this condition will increase over time if the obesity epidemic continues to grow. Individuals aged ≥60 years of age are less likely to have prehypertension than younger individuals (24% versus 34%), probably because the majority of individuals in the older age group (65%) have progressed to clinical hypertension. Like hypertension, prehypertension tends to cluster with other CVD risk factors such as dyslipidemia and obesity. The proportion of prehypertensive individuals with ≥1 other risk factor is >85% (adjusted relative risk, 1.65 for prehypertension compared with normal [50,51]. Previous studies have shown that by reducing systolic blood pressure by 5 mmHg , the deaths from strokes can be reduced by 14% and deaths from cardiac disease can be reduced by 9% which is proved according to a study done by San Francisco Burden of disease and injury study -- the determinants of health , high blood pressure: what can be done [52].A previous study by Veronique A. Cornelissen and Neil (2013)consisting of a randomized controlled trail, lasting more than or equal to 4 weeks investigating the effects of exercise on blood pressure in adults has showed a reduction of – 3.5 mmHg in systolic blood pressure after endurance training exercises and also a reduction of – 2.1mmHg in diastolic blood pressure of 50 groups of prehypertensive adults. A study by Cornelissen and Smart (2013) included 105 trails with 3957 participants, moderate aerobic exercise like walking, jogging and cycling for 3- 5 times a week 30 – 60 minutes per session for 4 – 52 weeks has resulted in a reduction of systolic blood pressure of 3.5 mmHg and diastolic blood pressure of 2.5 mmHg [53]. According to Laura P. Svetkey,in the management of hypertension,Journal of Hypertension(2005) patients with prehypertension are also associated with poor Quality of Life and Overweight,to improve their quality of life based on health by means of changing a healthy lifestyle pattern plays a major role in its treatment as the risks associated with prehypertension are related to the tendency of BP to increase with age.Thus, prehypertension is a precursor of clinical hypertension and consequently of the cardiovascular disease (CVD) and renal risks associated with elevated BP (ie, SBP ≥140 or DBP ≥90 mm Hg)[54]. In addition, the relationship between BP and CVD risk is continuous over the whole range of BP, and therefore, prehypertension itself is associated with BP-related morbidity and mortality. Thus, the goals of treating prehypertension are to prevent hypertension and to reduce the excess CVD risk associated with BP in this preclinical range [56]. Exclusion criteria of the present study including Individuals with known cardiovascular diseases, pulmonary diseases,metabolic diseases,neuropathies ,patients under medications for low blood pressure, stroke ,cancer, with BMI less than 25,previous history of any surgery/disability and cardiac arrhythmias were excluded from the study after screening, which is supported by studies done by Massimo Venturelli,et al , Amit Jaiswal,et al, and Elizabeth C.Schroeder,et al to avoid the other effects of medications and other comorbidities after the treatment session.In a study by Assimo Venturelli, Emilianco Ce,et al, Effects of endurance, circuit and relaxing training on cardiovascular risk factors in hypertensive elderly patients (2015),which was a study on effects of endurance, circuit and relaxing training on cardiovascular risk factors in 40 elderly patients in which the result showed that endurance and circuit training were both appropriate interventions to reduce the cardiovascular disease risk factors, because blood pressure reduction was accompanied by decreases in blood glucose and cholesterol levels, also increases in Vo2 peak ,mechanical efficiency and quality of life. The study also concludes that the relaxation training, involving breathing training exercises would be an attractive alternative for old individuals who are unable or reluctant to carry out the endurance or circuit training[55]. The prevalence of prehypertension and associated cardiovascular risk profiles among young Israeli adults by Itamar Grotto ,et al (2006) has proved that body mass index was the strongest predictor of prehypertension among both adult males and females [56] . Some other characteristics that we cannot control such as age ,race or ethnicity can affect the risk for high blood pressure.These findings are supported by the study done by Benjamin EJ, et al (2019) on heart disease and stroke statistics -- 2019 update : a report from the American Heart Association,2019[57].A study by Allyson K. Getty,et al(2018) on the effects of circuit training exercises on vascular health and blood pressure has concluded that the central blood pressure reduced with exercise showing a more significant improvements ($p < 0.05$) in this 4 weeks of circuit training exercise program on adults working as fire fighters [58] .More significantly a study by Richa Sinha,et al (2013),on the validity and reliability of SF- 36 health survey questionnaire for use in Indian community has statistically proved for its use in India is the reason for selecting this form as outcome measure in the

present study[59]. In a study by Amit V.Jaiswal (2015) on effectiveness of interval training Vs .circuit training exercise on blood pressure ,heart rate and rate of perceived exertion in prehypertensive individuals, has concluded that both the methods are equally effective in reducing blood pressure levels after 6 weeks of training [60] . Breathing training is a simple method to improve autonomic balance, respiratory control, and, consequently, to reduce blood pressure in hypertensive individuals. Given the clear evidence of ET effectiveness on the amelioration of several CVDs risk factors, exercise capacity, and quality of life in prehypertensive patients. Also in a study by Chacko N.Joseph et al ,Slow Breathing Improves Arterial Baroreflex Sensitivity and Decreases Blood Pressure in Essential Hypertension, has proved that slow breathing at ~6 cycles/min increases baro reflex sensitivity, reduces muscle sympathetic nerve activity and chemoreflex activation . Thus, the significant reduction in blood pressure observed after the breathing training intervention was likely due to these mechanisms [61]. In a study by Bartlett,et al,(2011) naming high intensity interval running is perceived to be a more enjoyable one than moderate intensity continuous exercises aiming at the implications for exercise adherence,has concluded that the circuit training is becoming one of the most popular fitness programs because of its greater enjoyment with respect to the standard endurance training supports the results of our study.A guideline published in 2011 , recommends the accumulation of 30 – 60 minutes of moderate intensity dynamic exercise (eg :- walking cycling and jogging) 4 – 7 days per week in addition to the routine activities of daily living for the prevention and treatment of hypertension [62]. Also a guideline recommended by American Heart Association (AHA) includes a moderate intensity of aerobic exercise most preferably all days of the week for duration of 30 – 60 minutes continuous or accumulated in bouts. 10 minutes each has an evidence category of A for the prevention, treatment and control of hypertension in adults [63]. Also by Brook RD, et al,(2013) beyond medications and diet: alternative approaches to lowering blood pressure: a scientific statement from the American Heart Association (AHA) in 2013 [64]. According to a study by Gill A,et al,(2017) on the psychological effects of strengthening exercise in people who are overweight or obese, a systematic review in the Journal of Women's health and safety has concluded that exercises have possible positive effects on a number of psychological outcome measures eg :- self- efficacy, self- esteem, inhibition and psychological disorders such as anxiety and depression in overweight or obese adult population[65]. In this present study according to statistical results on waist circumference the difference in mean value was 46.75 pre-test and 37.05 post test for Group A and for Group B pre was 38.60 and post was 37.05 respectively ,again there is a significant difference (p value was 0.000 which is < 0.05) between two groups but in terms of average to the mean values the group A which received the circuit training and breathing training is effective in reducing the waist circumference in prehypertensive overweight adults. In Quality of life, the last outcome measure, here the difference between the mean values of pre and post attest was 72.85 and post was 95.45 for Group A and Group B it was 73.50 and 91.50 pre and post-test respectively in which there is no significant difference(p value was .187 which is > .005)between the groups in terms of average increase in quality of life scores but according to the mean values the group A which received circuit training and breathing training is effective in improving the quality of life in prehypertensive overweight adults. In addition, the difference between Group A and Group B was found to be statistically non-significant in terms of BP SYS Score, BP DIA Score, QOL Score. But the difference between Group A and Group B was found to be statistically Significant in terms of BMI Score and WS Score. However, the result showed that the mean difference of Group B "Endurance Training and Breathing Training" is slightly more effective than Group A "Circuit Training and Breathing Training" in terms of BP SYS Score on subjects with overweight pre-hypertensive adults. But in terms of BP DIA Score, BMI Score, WS Score, QOL Score components which is slightly more effective for Group A "Circuit Training and Breathing Training".

6. CONCLUSION

The statistical analysis proves that there is a significant decrease in blood pressure, body mass index, waist circumference and a good improvement in quality of life in both groups of the study. Thus we conclude that a 12 weeks of circuit training and breathing training is effective in reducing blood pressure, body mass index, waist circumference and a significant improvement in quality of life of pre hypertensive overweight adults. Hence circuit training and breathing training can be used to reduce both systolic, diastolic, BMI, waist circumference and improve the quality of life in prehypertensive overweight adults.

7. LIMITATION OF THE STUDY

The limitation of this current study is the relatively small sample size, which may have influenced the differences induced by the training adopted in the old hypertensive participants. However, due to the complexity of the study and the limited availability of the participants eligible for the present investigation, the sample size was restricted to the actual dimension. Further limitations are the mixed gender of the sample, and the potential effects of comorbidities, such as type II diabetes. However, with respect to the latter issues, the old male and female participants, as well as individuals with type II diabetes were normally distributed in the four group.

8. ACKNOWLEDGEMENT

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9. AUTHORS CONTRIBUTION STATEMENT

K.Saraswathi & N.Koushik kumar Nandhagopal conceptualized,designed and gathered data. G.Rajalakshmi G.Thirulogachandar analyzed these data and inputs were given. K.Muthulakshmi, P.Revathi & B.Aishwarya discussed the methodology, results and contributed to the final manuscript.

10. CONFLICT OF INTEREST

Conflict of interest declared none.

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