The effect of 12 weeks of resistive exercises versus aerobic exercises in overweight hypertensive postmenopausal women

Ghada E. El-Refaye[a], Hanaa A. Younis[b]

[a]Department of Physical Therapy for Women's Health, Faculty of Physical Therapy, Cairo University, [b]Department of Obstetrics and Gynecology Faculty of Medicine (girls), AlAzhar University, Cairo, Egypt

Correspondence to Ghada E. El-Refaye, PhD, Faculty of Physical Therapy, Cairo University 7Ahmed Elzaiat St. Ben Elsaryat, El Dokki-Giza, 12612, Egypt. Tel: +201005572715; e-mail: starmoon2008@yahoo.com

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Background
Hypertension is the most important risk factor that affects women in the early years of postmenopausal period. Approximately 30–50% of the women develop hypertension before starting the age of 60 years, and beginning of hypertension can cause a variety of manifestations that are frequently associated with menopause.
Objective
The aim of this study was to determine and compare the effect of 12 weeks of resistive exercises versus aerobic exercises for the treatment of postmenopausal hypertension.
Participants and methods
A total of 60 postmenopausal women with hypertension were included. Their ages ranged from 50 to 60 years old; their BMI ranged from 30 to 34.9 kg/m^2; and their blood pressure ranged between 140/90 and 170/105 mmHg. They were randomly assigned to group A, which received resistive exercises; group B, which received aerobic exercises; or group C (control group), which received antihypertensive medication (bisoprolol fumarate 5 mg). The three groups followed the treatment program for 12 weeks. Assessment of the systolic blood pressure (SBP) and diastolic blood pressure (DBP) for all participants in the three groups (A, B, and C) was carried out before, after 6 weeks, and after the end of the treatment program through the use of mercury column sphygmomanometer.
Results
All groups (A, B, and C) recorded a significant decrease in both SBP and DBP values (P=0.001, 0.001, and 0.003, respectively, and P=0.001, 0.001, and 0.009, respectively) after the end of the 12 weeks of the treatment program when compared with their corresponding values measured before treatment. However, the participants in group A exhibited a greater reduction in DBP more than groups B and C.
Conclusion
These results suggest that the resistance exercises may be more effective than aerobic exercises in reducing SBP and DBP in postmenopausal women.

Keywords:
aerobic exercises, hypertension, menopause, resistive exercises

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Introduction

Hypertension is the most important risk factor that affects women in the early years of postmenopausal period. Approximately 30–50% of women develop hypertension [blood pressure (BP)>140/90 mmHg] before starting the age of 60 years, and beginning of hypertension can cause a variety of manifestations that are frequently associated with menopause. Mild-to-moderate hypertension may cause complaints such as nonparticular chest discomfort, generalized exhaustion, sleep disturbances, palpitations, apprehension, hot flushes, depression, and migraine. Women with a family history of hypertension and those with a background marked by hypertension during pregnancy are at incremented risk to develop hypertension in this age group [1].

More than 60% of the postmenopausal women were reported to have either prehypertensive or hypertensive classifications unlike the 40% of premenopausal women with abnormal BP classification. High BP, essentially, was found among the postmenopausal women in correlation with their premenopausal counterparts [2]. The etiology of hypertension during postmenopausal period is perplexing and multifactorial. A reduction in the generation of estrogen with the subsequent alterations in the estrogen/androgen proportion is an essential factor. Different variables that cause a predisposal to hypertension during the postmenopausal period include the following: the sympathetic nervous system activation, dysfunction of endothelial cells, oxidative stress, and activation of the rennin–angiotensin–aldosterone system, and absence of physical movement [3].

It was reported that during and after menopause, weight gain in women is a common phenomenon, which is associated with many alterations in the body configuration. Longitudinal correlations of the same-aged premenopausal and postmenopausal women demonstrated a quickened increment in the central adiposity in postmenopausal women owing to a subcutaneous or peripheral redistribution of the visceral fat, increment in the total adiposity, alterations of lipid metabolism, and an accompanying reduction of the lean body tissue [4].

Sex hormones strongly affect the adipocyte differentiation and the body fat distribution. Differentially, estrogens and testosterone influence the physiology of adipocyte; however, the significance of estrogens on the advancement of metabolic disorders during menopause is debated. It was reported that estrogen and estrogen receptors regulate diverse parts of the metabolism of both lipid and glucose. Perturbances of this metabolic signal prompt the advancement of metabolic disorder and a higher cardiovascular hazard in women [5]. Fat concentration in the viscera supports the advancement of insulin resistance and type 2 diabetes mellitus, a proatherogenic lipid profile, and hypertension, prompting expanded cardiovascular disease (CVD) chance and different effects of overweight and obesity in women after menopause [4].

Exercise is a physiological therapy with a wide assortment of positive cardiovascular effects that incorporate changes in lipid digestion, insulin resistance, arterial hypertension, weight, endogenous anabolism, and state of mind. Exercise training programs are recognized basically as an aerobic dynamic exercise (such as the running and bicycling) and the resistive exercise (such as the strength training) [6]. It was reported that performing moderate-intensity aerobic exercise training is suggested as a conservative therapy for the treatment of the high BP in light of the fact that it lessens both systolic blood pressure (SBP) and diastolic blood pressure (DBP) and enhances the blood vessel work preceding the stage 1 of essential hypertension in both sexes [7]. Resistive training is otherwise called as static, strength, or weight training. According to the type of muscle contraction, resistance training was divided into two noteworthy subgroups: dynamic and static resistance training. Dynamic resistance training includes muscles concentric and eccentric contractions as both the muscles length and tension change. Static exertion includes sustained contraction against fixed resistance with no change in muscle length [8].

Resistance exercise has been shown to avoid the advancement of hypertension, diminish circulatory strain in hypertensive individuals, enhance physical working and well-being recognition, and increase limit regarding exercises of everyday life. This is of most extreme significance, particularly for elderly women [9].

Previous studies have demonstrated that regular physical activity can enhance cardiovascular wellness over the span of the life cycle, diminish BP, and reduce the predominance of hypertension, which has additionally been recommended to counteract age-related increments in the arterial stiffness. Exercise training has been appeared to enhance both the sensitivity of baroreflex and the BP in hypertensive patients [10].

It was reported that regular exercise can reduce cardiovascular hazards, and it ought to be empowered for everybody inside the limits of every person. Both aerobic endurance exercise and resistance training can advance generous advantages in physical well-being and health-related factors in elderly people [11].

The underlying mechanisms responsible for BP decrease evoked that exercise training must bringing about total peripheral resistance reduction, cardiac output decrease, and lowering of sympathetic nerve activity and plasma norepinephrine levels [12].

Resistance exercise leads to baroreflex acute stimulation in a physiological endeavor to reestablish the blood flow to the muscles. This and different reactions may create decreases in tissue oxidative stress, enhance vascular endothelial capacity, and bring about better changes in sensitivity of the baroreflex and also autonomic balance over time [13].

There are numerous potential mechanisms in charge of the 'postexercise hypotensive impacts' involving the blood vessels relaxation and vasodilatation, especially in the legs and visceral organ regions. Following each exercise session, the blood vessels may relax as a result of body warming effects and local engenderment of certain chemicals, such lactic acid and nitric oxide [14].

Consequently, the main objective of this work was to compare the effect of 12 weeks of resistive exercises versus aerobic exercises for the treatment of postmenopausal hypertension.

Participants and methods

Study design

The study was designed as a randomized controlled trial. Ethical approval was obtained from the Institutional Review Board of the Faculty of Physical Therapy, Cairo University, before starting of the study (no: P.T.REC/012/002072) and the clinical trial registration in Clinicaltrial.gov with an identifier number NCT03637985. The study followed the guidelines of Declaration of Helsinki on the conduct of human research.

Participants

A total of 60 postmenopausal women participated in this study from the gynecological outpatient clinic, at Al-Zahra Universal Hospital, Al Azhar University. They were first diagnosed as hypertensive in their early postmenopausal period. Their BP ranged between 140/90 and 170/105 mmHg, their ages ranged from 50 to 60 years, and their BMI from 30 to 34.9 kg/m^2. The duration of the study was from September 2017 to August 2018. Inclusion criteria of the study were as follows: all women must have essential hypertension (without medical cause, e.g. renal, thyroid, and suprarenal), they should be under medical treatment for the same antihypertensive medication (bisoprolol fumarate 5 mg), and none of them should have undergone a regular exercise program for at least 12 weeks before.

Exclusion criteria of the study were as follows: lesion to higher centers leading to hypertension (embolism), any CVD, premature menopause, surgical menopause, severe hypertension, diabetic, and under treatment of hormonal therapy.

All participants were subjected to full history taking, clinical examination, and investigation to confirm inclusion criteria and distract excluded cases.

Randomization

Randomization was implemented simply by means of a computer-generated randomized table using the SPSS (version 16 for Windows; SPSS Inc., Chicago, Illinois, USA) program prepared in advance to data collection. A specific identification number was assigned for each participant. These numbers were randomized into three equal groups in the number (n=20). Individual and sequentially numbered index cards were secured in opaque envelopes. Each participant was given a hand-picked envelope by a blinded and independent research assistant who opened the sealed envelope, and the patients were allocated accordingly to their groups. Group A (n=20) participated in the resistance exercise program, group B (n=20) participated in an aerobic exercise program, and group C (n=20) only received antihypertensive medication (bisoprolol fumarate 5 mg). All patients in the three groups (A, B, and C) continued their antihypertensive medication.

Methods

Before the start of the first session, the purpose of the study and the treatment procedures were explained to all participants to obtain their confidence and cooperation, and informed consent form was signed by each woman before participation in the study. Duration of each exercise session was 40 min, three times per week, for 12 weeks.

Resistive exercises for all participants in group A

Resistive exercises were performed using an elastic band (TheraBand, USA). Each patient was trained in the techniques used for each exercise and then performed several sets at minimum resistance to ensure that they were performed correctly [15]. The used TheraBands' were at moderate intensity (green color=3.1 lbs). TheraBand had a nonstretched length of 1.5 m, and each woman trained with the same band. The TheraBand's grip width was varied to adjust the resistance to the repetitions prescribed at each particular moment [16].

Warm up by stretching of muscle groups for 5 min was performed as three to five repetition stretch for the key muscle group, that is, deltoid muscle, gluteus maximus, tibialis anterior, and calf muscle, and then hold for 20–30 s, before the actual muscle strength training session. In actual session, the sets were at moderate intensity, 8–10 repetitions for every motion. There were five forms of motion: upper body strengthening as arm lifting and lower body strengthening as heel raise, hip extension, and ankle dorsiflexion, through a full range of motion, avoiding breath holding and straining (Valsalva maneuver) by exhaling during the contraction or the exertion phase of the lift and inhaling during the relaxation phase [17,18].

Aerobic exercises for all participants in group B

The exercise training program of 40 min consisted of 5 min warming up, 30 min of treadmill walking, and 5 min cooling down three times per week [19].

Warming up by stretching of muscle groups for 5 min was performed as three to five repetition stretch for the key muscle group, that is, iliopsoas muscle, gluteus maximus, quadriceps, tibialis anterior, and calf muscle, and then hold for 20–30 s, before the actual aerobic training session.

In actual session, participants received moderate aerobic exercise training in the form of 30 min of treadmill walking and corresponding to a target heart rate (HR) of 65–75% of HR_{max} (maximum HR=220−age) to be gradually achieved and maintained throughout the training program [20].

Cooling down was in the form of treadmill walking at a very slow speed for 5 min.

Outcome measures

The assessment of the participants in the three groups (A, B, and C) was carried out before, after 6 weeks, and after the end of the treatment program through BP measurement using the mercury column sphygmomanometer. Patients were allowed to sit quietly for 5 min before the BP measurement. The BP was recorded from the sitting position with the back in a good support position. The BP values from the supine lying position have a tendency to be marginally higher around 2–3 mmHg in the SBP and decreased by homogeneous values regarding the diastolic pressure. The arm should be well rested at the heart level. Two measurements were taken 15 min apart, and were reported as the mean of two readings that did not differ by more than 5 mmHg. BP was measured three times at the first visit, in the middle of the treatment, and after completion of the treatment. Measuring of BP was performed at the same time of the day in each time of three measurements, 3 h after a meal. Participants were advised to avoid salty meals and excess caffeine intake.

Sample size determination

Sample size was calculated by assuming difference in the mean value of SBP between the three studied groups in mixed analysis of variance (ANOVA) test, with α value of 0.05, power of 81.9%, and an effect size of 0.19. Assuming a dropout rate of 15%, the study size should be 23 patients in each group (GPower 301, http://www.psycho.uni-duesseldorf.de).

Statistical analysis

Results are expressed as mean±SD. Comparison between the mean values of different variables in the three studied groups was performed using one-way ANOVA followed by the least significant difference test as a post-hoc test, if significant results were recorded. Comparison between mean values of SBP measured at different times of exercises within the same group (before, postexercise 1, and postexercise 2) was performed using repeated measures ANOVA followed by Bonferroni test, if significant results occurred. SPSS computer program (version 16 Windows) was used for data analysis. P value less than or equal to 0.05 was considered significant, and P value less than 0.01 was considered highly significant.

Results

Nine cases was dropped from the study (three per each group) owing to not completing the treatment program or not coming at the exact time of measurement.

Demographic features of the patients in all groups (A, B, and C)

Table 1 shows no statistically significant differences between the mean values of the demographic features of the three studied group (age, weight, height, and BMI) at the start of the study (P=0.967, 0.626, 0.441, and 0.701, respectively).

Systolic blood pressure

Within-group comparison

Comparison between mean values of SBP measured before treatment, after 6 weeks, and after 12 weeks of the treatment program in group A shows the following (Table 2):

(1) There was a statistically significant decrease in the mean values of SBP after 6 weeks and after 12 weeks of the treatment program when compared with their corresponding values measured before treatment.
(2) There was a statistically significant decrease in the mean values of SBP after 12 weeks of the treatment program when compared with its corresponding

Table 1 Demographic features of the participants

Demographic features	Group A (n=20) (mean ±SD)	Group B (n=20) (mean ±SD)	Group C (n=20) (mean ±SD)	Comparison		Significance
				F value	P value	
Age (years)	55.07±3.24	53.91±3.12	54.9±3.22	0.033	0.967	NS
Weight (kg)	78.82±4.68	79.45±6.25	80.27±5.49	0.471	0.626	NS
Height (cm)	163.80±3.34	164.13±4.52	165.75±4.34	0.828	0.441	NS
BMI (kg/m^2)	29.78±2.05	30.40±1.23	30.21±1.29	0.354	0.701	NS

Table 2 Comparison between the mean values of systolic blood pressure measured before treatment, after 6 weeks, and after 12 weeks of the treatment program in groups A, B, and C

Groups	Systolic blood pressure before treatment (mmHg)	Systolic blood pressure after 6 weeks (mmHg)	Systolic blood pressure after 12 weeks (mmHg)	*F* value	*P* value
Group A					
Mean±SD	155.8±9.657	153.74±10.37	150.24±11.02	31.641	0.001**
Difference	–	2.059	5.56		
% change	–	1.32↓↓	3.57↓↓		
P value vs. before	–	0.006**	0.001**		
P value vs. post 1	–	–	0.001**		
Group B					
Mean±SD	156.65±10.35	153.45±10.87	149.58±10.79	68.337	0.001**
Difference	–	3.203	7.072		
% change	–	2.04↓↓	4.51↓↓		
P value vs. before	–	0.001**	0.001**		
P value vs. post 1	–	–	0.001**		
Group C					
Mean±SD	154.034±9.681	153.267±9.562	153.12±9.706	8.475	0.017*
Difference	–	0.7	0.9		
% change	–	0.49↓↓	0.59↓↓		
P value vs. before	–	0.0142*	0.003*		
P value vs. post 1	–	–	0.036*		

*$P<0.05$, significant. **$P<0.01$, highly significant. ↓↓: decrease.

value measured after 6 weeks of the treatment program.

Comparison between mean values of SBP measured before treatment, after 6 weeks, and after 12 weeks of the treatment program in group B shows the following (Table 2):

(1) There was a statistically significant decrease in the mean values of SBP after 6 weeks and after 12 weeks of the treatment program when compared with their corresponding values measured before treatment.
(2) There was a statistically significant decrease in the mean values of SBP after 12 weeks of the treatment program when compared with its corresponding value measured after 6 weeks of the treatment program.

Comparison between mean values of SBP measured before treatment, after 6 weeks, and after 12 weeks of the treatment program in group C shows the following (Table 2):

(1) There was a statistically significant decrease in the mean values of SBP after 6 and 12 weeks of the treatment program when compared with their corresponding values measured before treatment.
(2) There was a statistically significant decrease in the mean values of SBP after 12 weeks of the treatment program when compared with its corresponding value measured after 6 weeks of the treatment program.

Between-group comparison

Comparison between the mean values of SBP in the three studied groups (A, B, and C) at different times of measurement (before-treatment, after 6, and 12 weeks of the treatment program) shows that there was a statistically nonsignificant difference between the mean values of SBP of all three groups (A, B, and C) (Table 3).

Diastolic blood pressure

Within-group comparison

Comparison between mean values of DBP measured before treatment, after 6 weeks, and after 12 weeks of the treatment program in group A shows the following (Table 4):

(1) There was a statistically significant decrease in the mean values of SBP after 6 and 12 weeks of the treatment program when compared with their corresponding values measured before treatment.
(2) There was a statistically significant decrease in the mean values of SBP after 12 weeks of the treatment program when compared with its corresponding value measured after 6 weeks of the treatment program.

Comparison between mean values of DBP measured before treatment, after 6 weeks, and after 12 weeks of

Table 3 Comparison between the mean values of systolic blood pressure in all studied groups (A, B, and C) measured before treatment, after 6 weeks, and after 12 weeks of the treatment program

	Systolic blood pressure group A (*n*=20) (mmHg)	Systolic blood pressure group B (*n*=20) (mmHg)	Systolic blood pressure group C (*n*=20) (mmHg)	*F* value	*P* value
Before	155.8±9.657	156.653±10.351	154.034±9.681	0.418	0.662 (NS)
Post 1 (after 6 weeks)	153.741±10.37	153.45±10.87	153.267±9.562	0.014	0.979 (NS)
Post 2 (after 12 weeks)	150.24±11.02	149.581±10.785	153.12±9.706	0.0484	0.621 (NS)

Data are expressed as mean±SD. $P>0.05$, NS.

Table 4 Comparison between the mean values of diastolic blood pressure measured before treatment, after 6 weeks, and after 12 weeks of the treatment program in groups A, B, and C

Groups	Diastolic blood pressure before treatment (mmHg)	Diastolic blood pressure after 6 weeks (mmHg)	Diastolic blood pressure after 12 weeks (mmHg)	*F* value	*P* value
Group A					
Mean±SD	96.32±4.51	93.47±4.31	88.93±4.74	47.373	0.001**
Difference	–	2.85↓↓	7.384		
% change	–	2.95	7.66↓↓		
P value vs. before	–	0.001**	0.001**		
P value vs. post 1	–	–	0.001**		
Group B					
Mean±SD	97.9±4.23	95.913±4.87	92.65±5.18	60.486	0.001**
Difference	–	1.987↓↓	5.25		
% change	–	2.02	5.36↓↓		
P value vs. before	–	0.001**	0.001**		
P value vs. post 1	–	–	0.001**		
Group C					
Mean±SD	95±5.39	94.1±5.58	93.495±5.89	9.327	0.001
Difference	–	0.9	1.505		
% change	–	0.94↓↓	1.58↓↓		
P value vs. before	–	0.033*	0.009*		
P value vs. post 1	–	–	0.015*		

*$P<0.05$, significant. **$P<0.01$, highly significant. ↓↓: decrease.

the treatment program in group B shows the following (Table 4):

(1) There was a statistically significant decrease in the mean values of DBP after 6 and 12 weeks of the treatment program when compared with their corresponding values measured before treatment.
(2) There was a statistically significant decrease in the mean values of DBP after 12 weeks of the treatment program when compared with its corresponding value measured after 6 weeks of the treatment program.

Comparison between mean values of DBP measured before treatment, after 6 weeks, and after 12 weeks of the treatment program in group C shows the following (Table 4):

(1) There was a statistically significant decrease in the mean values of DBP after 6 and 12 weeks of the treatment program when compared with their corresponding values measured before treatment.
(2) There was a statistically significant decrease in the mean values of DBP after 12 weeks of the treatment program when compared with its corresponding value measured after 6 weeks of the treatment program.

Between-groups comparison

Comparison between mean values of DBP in all studied groups (A, B, and C) measured before treatment, after 6 weeks, and after 12 weeks of the treatment program:

Table 5 Comparison between the mean values of diastolic blood pressure in all studied groups measured before treatment, after 6 weeks, and after 12 weeks of the treatment program

	Diastolic blood pressure group A (*n*=20) (mmHg)	Diastolic blood pressure group B (*n*=20) (mmHg)	Diastolic blood pressure group C (*n*=20) (mmHg)	*F* value	*P* value
Before	96.315±4.51	97.9±4.23	95±5.39	1.728	0.187 (NS)
Post 1 (after 6 weeks)	93.465±4.31	95.913±4.87	94.1±5.58	1.54	0.219 (NS)
Post 2 (after 12 weeks)	88.931±4.74	92.65±5.18	93.495±5.89	4.487	0.015**
P value vs. group A	–	0.033*	0.006**		
P value vs. group B	–	–	0.559 (NS)		

P>0.05, NS. **P*<0.05, significant. ***P*<0.01, highly significant.

Before treatment and after 6 weeks of the treatment program, there was a statistically nonsignificant difference between the mean values of DBP in all three groups.

After 12 weeks of the treatment program:

(1) There was a statistical significant difference between the mean values of DBP in all three groups (A, B, and C) (Table 5), where the mean value of DBP was significantly decreased in group A when compared with its corresponding values in both group B (*P*=0.033) and group C (*P*=0.006).
(2) There was a statistically nonsignificant difference between group B and group C (*P*=0.559) (Table 5).

Discussion

According to the statistical analysis of the result for the study, it was found that all groups (A, B, and C) recorded a significant decrease in both SBP and DBP values (*P*=0.001, 0.001, and 0.003, respectively, and *P*=0.001, 0.001, and 0.009, respectively) after the end of the 12 weeks of the treatment program when compared with their corresponding values measured at pretreatment. Moreover, there was no statistical significance difference in the mean value of both SBP and DBP between the three studied groups in different times of measurements, except for that after treatment, the mean DBP was significantly decreased in group A when compared with its corresponding values in both groups B and C (control).

Thus, it indicates that both aerobic and resistance exercises are effective in reducing DBP in postmenopausal women when used in conjunction with medication. Analyzing the previous data, it shows that resistance exercises together with medication reduce DBP more than aerobic exercises with medication and also more than medication only. However, this reduction in DBP requires relatively long duration (12 weeks).

The obtained results agreed with those obtained by Schroeder [21] who compared the effects of aerobic exercise only, resistive exercise only, and a mix of both on the BP on 69 obese patients with prehypertension or stage 1 hypertension. They reported that use of 2 months of exercise training program did not significantly change the SBP within or between any of the groups (*P*>0.05), and only the mix group reported a huge DBP lessening (−3.7/−2.4 mmHg), and it is nearly the same result of this study. They reported that this reduction of the BP in response to the use of aerobic exercise was owing to decrease of the peripheral vascular resistance and an increase in arterial vasodilation [22].

The results from this study were also supported by those reported by Figueroa *et al.* [23]. They concluded that exercise with a moderate intensity mixed with circuit resistance training and endurance exercise training brought about advantageous effects on the BP, arterial stiffness, BP, HR, and power of muscle in postmenopausal women. This is owing to hormonal and structural alterations. These adjustments are a decrease in the sympathetic nerve activity through decrement in the norepinephrine levels, lessening peripheral vasoconstriction, and an increment in peripheral vasodilation [24].

Our results also agreed with Collier *et al.* [7] who researched the potential sex contrasts of using the aerobic exercise training versus resistance exercise training in 40 hypertensive patients. The outcome for the investigation demonstrated that practicing of aerobic exercise in the form of moderate intensity was suggested as a conservative and safe modality for the treatment of high BP, as it results in reduction of both the SBP and DPB. They concluded that in both sexes, the aerobic exercise and resistance exercise training induces alterations in the arterial stiffness, which were offset by a concurrent improvement in vascular conductance and increases in the blood flow.

Therefore, it can be a beneficial addition to the treatment strategy in both hypertensive men and women [7].

The results for our study are supported by those obtained by Ammar [25] who analyzed the effects of morning and evening aerobic activities on hypertension and lipid profile in overweight 45 hypertensive postmenopausal women. The outcomes demonstrated that there was a statistical significant distinction between all groups in both the SBP and the DPB, in favor of group C; probably, this reduction is owing the exercise-mediated reduction of the peripheral resistance [26].

Our results are in line with those reported by Braze *et al.* [27] who studied the effect of performing the aerobic exercise in elderly hypertensive women on the parameters of cardiovascular system for 12 weeks, similar to the conducted study. Results of this study show that there was a significant contrast between before and after treatment recording, as p value was 0.01 in terms of SPB and DPB [27].

The result of this study is in line with those of Ried *et al.* [28] and with those of Paoli *et al.* [29] who concluded that regular exercise is a very effective method to improve both the physical and the mental health in postmenopausal women. There are numerous advantages of exercise, including ameliorations in the serum lipid levels, weight reduction, and chronic vascular disease avoidance. Women who performed exercise routinely recorded decreased levels of pressure and less menopausal adverse effects. In addition, it positively affects enhancing the body's capacity to utilize insulin, the heart muscle condition, increase levels of defensive HDL cholesterol, and enhance moderate anxiety and stresses, and the BP reduction. Both aerobic training and resistance exercises can advance significant advantages in physical wellness and well-being-related factors in elderly people [30].

Our results are also in agreement with those reported by Turky *et al.* [3] who investigated the effects of ~2 months of doing the moderate form of exercise training on BP and levels of nitric oxide in 30 hypertensive postmenopausal women. BP levels were statistically significantly diminished, as the SBP and DPB were diminished by 16.2 and 9.5%, respectively. The outcomes from this investigation likewise support the fact that physical exercise is a crucial factor to diminish CVDs, as moderate intensity of exercise training builds nitric oxide discharge from the endothelium, which is considered as a vasodilator that builds the flow of blood at the meantime, so it lowers the BP [31].

The results of our study contradict those obtained by Ho *et al.* [32] who researched the effects of aerobic exercise with moderate-level resistive exercise, or conjugated exercise on the arterial stiffness and the high BP in 97 overweight and obese patients in contrast with the nonexercise patients for 2 months. These outcomes demonstrated no critical changes in the arterial stiffness or the BP or between the control and exercise groups at ~2 months when analyzing the data from every one of all 64 participants. In any case, this investigation had a shorter length, influencing its outcomes [33].

Conclusion

The results of this study revealed that resistive training together with medication reduces DBP more than aerobic exercises with medication and also more than medication only. Nevertheless, this reduction in DBP is requires relatively long duration of training (12 weeks). Therefore, it can be concluded that resistive training was an effective adjunct in reducing SBP and DBP in postmenopausal women. Individual variations in fitness level, physical capacity, and trainability may have moreover influenced our study outcomes in spite of all participants being enrolled as a sedentary or just practicing in activities of low levels.

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Conflicts of interest

There are no conflicts of interest.

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