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Combined effect of autogenic relaxation and aerobic exercise on postmenopausal hypertension: A randomized clinical trial

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***Abstract*---Background**: Hypertension and stress are among the most common problems after menopause. Both aerobic exercises and autogenic relaxation are effective in reducing stress and hypertension. **Purpose:** The study aimed to ascertain whether autogenic relaxation training and aerobic exercise had a more significant impact on postmenopausal stress and hypertension than aerobic exercise alone. **Methods:** The study included 45 postmenopausal women who were randomly allocated from the Outpatient Clinic at Zagazig General Hospital, had a BMI of no more than 35 kg/m², and were diagnosed with moderate hypertension and moderate stress determined by a perceived stress scale. The participants were split into three equal-number groups. For six weeks, group (A) was given 25 mg of captopril twice a day; group (B) was given the same medication twice a day along with aerobic exercise three times weekly for 30 minutes each, and Group (C) was given the same medication twice a day along with 30 minutes of aerobic exercise per session, and 20 minutes of

autogenic training three times a week. Evaluations were done by measuring blood pressure (BP), stress degree, and serum cortisol levels before and following the treatment. **Results**: Systolic and diastolic BP, stress level, and cortisol level were found to have improved statistically significantly in group C compared to groups A and B. **Conclusion:** Integrating autogenic training with aerobic exercise provides a better reduction of hypertension and stress than aerobic exercise alone.

***Keywords*---**Hypertension, Stress, Autogenic Training, Aerobic Exercises.

Introduction

During menopause, women's menstrual cycles permanently cease, and they lose their ability to conceive. The menopause usually happens between the ages of 49 and 52. A woman is confirmed to have entered menopause when she has not experienced monthly bleeding for a year. Another way to describe it would be a reduction in the ovaries' ability to produce feminine hormones (**Takahashi & Johnson, 2015).** Menopause is often accompanied by vasomotor symptoms, such as hot flashes and sweating at night, which affect 75% of women. Fatigue, palpitations, and headaches are typical. The menopausal genitourinary syndrome involves vulvovaginal atrophy, or vaginal dryness, which results in severe dyspareunia and vaginal pain, itching, and burning. Menopausal urgency, nocturia, sexual problems, and mood swings such as agitation, difficulty concentrating, loneliness, forgetfulness, sleeplessness, worry, and depression are also included (**Shaikh & Nasreen, 2019).** Regardless of their ethnicity, menopausal women have a significant frequency of hypertension (HTN), according to epidemiological studies. Recent research has indicated that menopausal women have elevated sympathetic tone, which may raise arterial blood pressure (BP) and cause kidney impairment, but the exact mechanisms causing this increased vulnerability are yet unknown. The pathophysiology of HTN involves both oxidative stress and persistent inflammatory processes (**Zilberman *et al.* 2015).**

Menopause is a stressful time for many females, and prolonged stress is harmful to everyone's health. It may result in elevated heart rate and BP, headaches, stomach reflux, anxiety, depression, and, in the long run, a higher risk of heart disease. Chronic stress, according to some, may weaken our immune systems, leaving us more vulnerable to infections, disease, and even cancer. **Richardson (2012).** Exercise is a crucial non-pharmacological approach for both preventing and treating HTN. Aerobic exercise reduces inflammation, oxidative stress, arterial BP, and sympathetic tone. It has been suggested that exercise can lessen postmenopausal symptoms by raising endorphin levels, which fall when estrogen release declines (**Grindler & Santoro, 2015).**

Numerous psychotherapy approaches, including methods for relaxation, have shown that, on average, autogenic training can reduce high BP by 5 mmHg (diastolic) and 10 mmHg (systolic). A more health-conscious lifestyle may also be

prompted by this "secondary effect" for HTN. In addition to treatment therapy, it is employed as an alternate therapy for older patients with BP problems. This study aimed to ascertain whether autogenic relaxation training and aerobic exercise had a more significant impact on postmenopausal stress and hypertension than aerobic exercise alone.

2. Patients and Methods

2.1. Design of the study:

It was a randomized controlled trial. The study was carried out between February 2021 and August 2021. The Faculty of Physical Therapy's Ethical Committee approved the study **(No: P.T.REC/012/003276)**. The study conducted human research in accordance with the Declaration of Helsinki's guidelines. After being fully informed about the purpose, nature, and possible advantages of the study, each participant gave their informed consent. They were also promised that the information they submitted would be kept confidential and that they could refuse to participate or withdraw at any time.

2.2. Study participants and recruitment criteria:

Subjects: The study included 45 postmenopausal women who were clinically diagnosed with moderate hypertension (range: 160-179/100-109), as well as a moderate level of stress based on PSS (**Blocker et al., 2020).** From the Zagazig General Hospital's Outpatient Clinic of Obstetrics and Gynaecology, they were chosen at random. They had a body mass index (BMI) of less than 30 kg/m^2 and had not had a period for more than 12 months. They were between the ages of 45 and 55. Exclusion criteria comprised a history of neurological disorders, cigarette smoking, severe hypertension, musculoskeletal or cardiovascular conditions, or cessation of menstruation for less than 12 months. They were distributed into three equal groups. Group (A) (Control group): 15 women took 25 mg of captopril twice daily for six weeks. Group (B) (Study group): 15 women were given the same medication twice a day alongside 30 minutes of aerobic exercise three times weekly for six weeks. Group C (study group) comprised 15 women who got the same medication twice a day for six weeks, along with 30 minutes of aerobic exercise and 20 minutes of autogenic training three times a week.

Randomization:

Using the coin toss approach, the participants were randomly split into three equal-sized groups, Group A, Group B, and Group C. No withdrawals or dropouts from the research occurred after randomization, as shown in **Figure (1).**

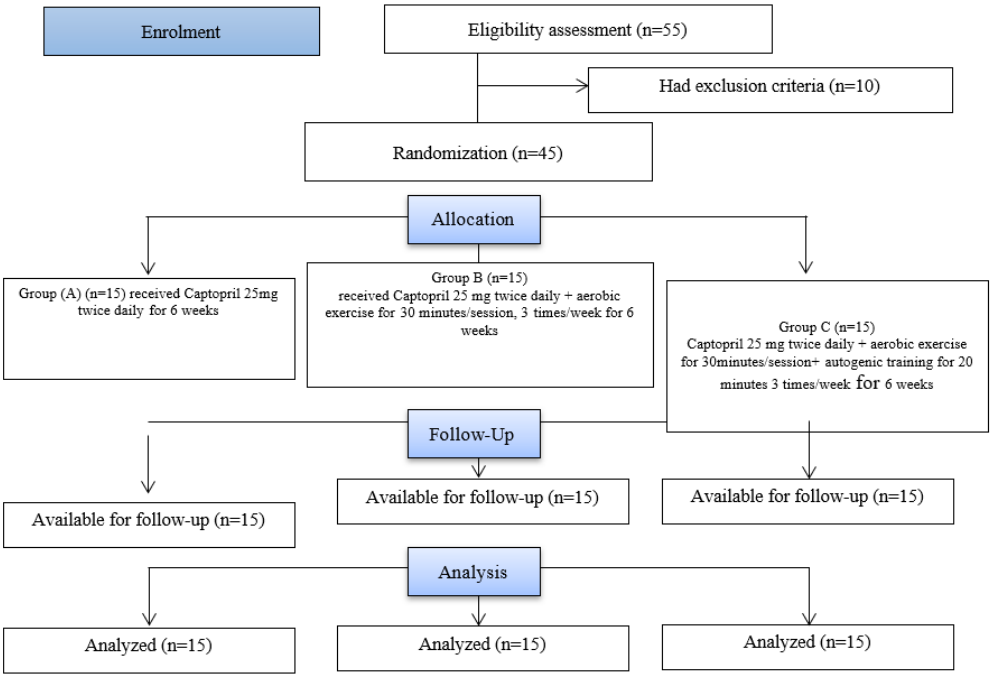

Figure 1: Flow chart of the study

2.3. Methods

Aerobic exercises: Every woman in groups B and C engaged in three phases of aerobic exercise on the treadmill for thirty minutes. A five-minute warm-up with low intensity (40 percent of maximum heart rate, or MHR), an actual phase that involved 20 minutes of moderate intensity (60 to 75 percent of MHR) walking on the treadmill, and a cooling phase that involved five minutes of low intensity (40 percent of MHR) walking on the treadmill. MHR was computed using the formula (220 - age in years). Every three weeks for six weeks **(Whelton, 2002).** To prevent excess body water loss throughout the exercise session, the participants were instructed to drink lots of water prior to and following the session.

Autogenic relaxation: Every woman in group C engaged in autogenic training along with aerobic exercise, just like group B. The six standard exercises in autogenic relaxation training cause the body to feel calm, warm, and heavy. Each exercise involves the patient lying down, focusing without any particular objective, and then using verbal cues and visual imagination to relax her body in a particular way. The woman relaxed in a half-lying position with a supported back and both arms relaxed at her sides during the six-week autogenic relaxation training, which lasted 20 minutes, three sessions each week **(Singh et al., 2018).** The woman was advised to focus on her breathing and identify if it was shallow or rapid. Then start to visualize anything in her thoughts. This item should be easy for her to use and enjoyable.

Two phases of autogenic relaxation training were carried out: Stage 1: Meditation and deep breathing exercises:

The woman was instructed to close her eyes, inhale deeply through her nose, and gradually fill her belly like a balloon until it was full, counting to four. She was then instructed to exhale the air from her mouth. Four repetitions of this process would be performed: taking deep breaths until the count reached four and then exhaling at the same time.

Stage 2—Imagination and affirmation stage

The woman would be requested to provide herself affirmations in six typical verbal steps, as illustrated below, after engaging in deep breathing and meditation.

Step 1:

- *Specifically, my right arm, left arm, and both arms are heavy.*
- *My right leg, left leg, and both of my legs are heavy.*
- *My arms and legs are heavy.*

Step 2:

- *My right arm, left arm, and both of my arms are warm.*
- *My right leg, left leg, and both of my legs are warm.*
- *I have warm arms and legs.*

Step 3

- *My right arm and left arm are both warm and heavy.*
- *My right and left legs are warm and heavy.*
- *My heart is steady and calm.*

Step 4

- *My heartbeat is calm and regular.*
- *My forehead is cool.*

Step 5

- *I feel peaceful.*
- *I am relaxed and at ease.*

Step 6

- *My mind is calm, and I can picture my sense of relaxation.*
- *My entire body feels calm, heavy, and relaxed.*

2.4. Outcome measures:

1) Blood pressure: Prior to and after the treatment program, a mercury sphygmomanometer and stethoscope were utilized to measure BP in mmHg (systolic (SBP) and diastolic (DBP). Three readings were taken then their means were recorded for analysis.

2) Perceived stress scale: Each woman in three groups had her stress level measured before and after treatment. Klein et al. (2016) translated and standardized the German version of the PSS-10. A typical translation/back-translation process was used to translate the PSS-10 into German. There was a significant positive association between perceived stress and life, but not between perceived stress and sadness, anxiety, exhaustion, or procrastination. On a 5-point Likert scale, respondents indicate how unpredictable, unmanageable, and overwhelming they feel that certain occurrences in their lives have been within the last month. Based on the psychological definition of stress, the PSS is a

widely used self-report tool. The German version of the PSS was developed based on a representative survey of the German population.
3) **Blood analysis:** Before and after treatment, a 5 cm blood sample was taken from each woman at 8 a.m. to measure the plasma cortisol level.

3. Data Analysis:

Calculation of sample size:
Using blood pressure as reported from the pilot study, the sample size was estimated using the F test, MANOVA repeated measures, within and between interactions, 80% power at the α = 0.05 level, three groups, and two assessments. The effect size was 0.51. The minimal appropriate sample size is 41 subjects. After adding 4 people (10% as dropouts), the final sample size was 45 subjects, with 15 subjects in every group. Using G*Power software (version 3.0.10), the sample size was determined.

Statistical analysis:
The subject characteristics were compared across groups utilizing the ANOVA test. The normality of the data was confirmed using the Shapiro-Wilk test. Levene's test for homogeneity of variances was employed to assess group homogeneity. To compare BP, PSS, and cortisol levels between groups, a one-way MANOVA was used. For the subsequent multiple comparisons, post-hoc analysis was conducted using the Tukey test. To compare each group's pre- and post-treatment values, a paired t-test was employed. The significance level was established at $p < 0.05$. The statistical package for social studies (SPSS) version 25 for Windows (IBM SPSS, Chicago, IL, USA) was employed for all statistical analyses.

Results

Subject characteristics: The subject characteristics of all groups are displayed in **Table (1).** Age and BMI did not significantly differ across groups ($p > 0.05$).

Table (1): Comparison of age and BMI across all groups:

	Group A	**Group B**	**Group C**	**F-value**	**p-value**	**Sig**
	Mean±SD	**Mean±SD**	**Mean±SD**			
Age (years)	48.8 ± 2.93	47.66 ± 2.19	48.06 ± 2.86	0.68	0.51	NS
Mean	30.93 ± 1	31.84 ± 1.73	31.04 ± 1.16	2.06	0.14	NS
BMI (kg/m^2)						

Mean SD: Standard deviation p value: Probability value NS: Non significant S: Significant.

Impact of treatment on BP, PSS and cortisol level

Within-group comparison

The SBP, DBP, PSS, and cortisol levels of groups A, B, and C were significantly lower after therapy than before ($p < 0.01$). The corresponding percentage changes

in group A's SBP, DBP, PSS, and cortisol levels were 8.59, 5.86, 6.73, and 10.87%; group B's were 11.64, 9.14, 21.59, and 23.52%; and group C's were 17.35, 14.41, 41.71, and 36.42% **(Table 2).**

Between-group comparison: All measurements showed a non-significant change between groups when compared before treatment ($p > 0.05$). Following therapy, group C's SBP, DBP, PSS, and cortisol levels significantly decreased when compared to groups A ($p < 0.001$) and B ($p < 0.05$). After therapy, group B's SBP, DBP, PSS, and cortisol levels significantly lowered compared to group A ($p < 0.05$).

Table 2. Comparison of before and after treatment mean values of SBP across the three groups

	SBP (mmHg) ±SD			F- value	p- value	s	Sig
	Group A	Group B	Group C				
Before ttt	168.26±3.88	166.06±4033	166.86±2.94	1.31	0.28	NS	
After ttt	153.8 ± 8.53	146.73 ± 6.76	137.86 ± 5.23	19.63	0.0001	S	S
	Multiple comparison (Tukey)						

	MD	p- value	Sig
Group A - Group B post ttt	7.07	0.02	s
Group A - Group C post ttt	15.94	0.0001	s
Group B - Group C post ttt	8.87	0.003	s

Mean SD: Standard deviation p value: Probability value NS: Non significant S: Significant MD: Mean difference.

Table 3. Comparison of before and after treatment mean values of DBP across the three groups

DBP (mmHg) ±SD				F- value	p- value	Sig
	Group A	Group B	Group C			
Before ttt	103.6± 2.5	102.8± 1.69	102.73± 1.53	0.91	0.41	NS
After ttt	97.53 4.94±	93.4 ± 2.97	87.93 ± 4.25	20.33	0.0001	S
Multiple comparison (Tukey)						

	MD	p- value	Sig
Group A - Group B post ttt 4.13		0.02	s
Group A - Group C post ttt	9.6	0.0001	s
Group B - Group C post ttt	5.47	0.002	s

Mean SD: Standard deviation p value: Probability value NS: Non significant S: Significant MD: Mean difference.

Table 4. Comparison of before and after treatment mean values of PSS across the three groups

PPS level ±SD				F- value	p- value	Sig
Group A		Group B	Group C			
Before ttt	20.8± 5.14	20.06 ± 4.31	20.93± 5.5	0.13	.87	NS
After ttt	19.4 ± 4.51	15.73 ± 3.63	12.2 ± 3.09	13.49	0.0001	S
Multiple comparison (Tukey)						
Group A - Group B post ttt		MD	p- value	Sig		
		3.67	0.03	s		
Group A - Group C post ttt		7.2	0.0001	s		
Group B - Group C post ttt		3.53	0.03	s		

Mean SD: Standard deviation p value: Probability value NS: Non significant S: Significant MD: Mean difference.

Table 5. Comparison of before and after treatment mean values of cortisol level across the three groups

Cortisol level(mcg/dl) ±SD				F- value	p- value	Sig
G roup A		Group B	Group C			
Before ttt	17.2± 1.47	1 7.6±1,55	17,93± 1,48	0.89	0.41	NS
After ttt	15.33 ± 2.09	13.46 ± 2.16	11.4 ± 1.12	16.85	0.0001	S
	Multiple comparison (Tukey)					
Group A - Group B post ttt		MD	p- value	Sig		
		1.87	0.02	s		
Group A - Group C post ttt		3.93	0.0001	s		
Group B - Group C post ttt		2.06	0.01	s		

Mean SD: Standard deviation p value: Probability valueNS: Non significant S: Significant MD: Mean difference.

Discussion

This study was carried out to find out if AT plus aerobic exercises had a greater impact on treating postmenopausal stress and hypertension (HTN) than aerobic exercises alone. Forty-five postmenopausal women with moderate HTN and stress determined by PSS, aged between 45 and 55, and with a BMI less than 35 kg/m² were randomly chosen from Zagazig General Hospital's outpatient clinic. The women were randomly assigned to three equal groups: group A (antihypertensive medication) consisted of 15 patients who received treatment with 25 mg of captopril twice daily for 6 weeks; group B consisted of 15 patients who received the same medications and aerobic exercises on a treadmill for 30 minutes per session, three times weekly for six weeks; and group C consisted of 15 patients who received the same medications and aerobic exercises for 30 minutes per session plus AT for 20 minutes three sessions per week for 6 weeks.

The study's findings revealed that, in all three groups, the SBP.DBP, PSS stress level, and cortisol level decreased statistically significantly after treatment compared to before (p value=0.0001*). The posttest mean values for groups A and B differed significantly from one another (p=0.0001*), and the mean values for groups B and C differed significantly from one another (p=0.01*). Additionally, group C's mean values were significantly reduced than those of groups B and A.

Improvements in BP, autonomic tone, baroreflex sensitivity, oxidative stress (OS), nitric oxide (NO) bioavailability, lipid profiles, cardiovascular function, and cardiorespiratory fitness can all be used to explain the significant impact of aerobic exercise training in reducing stress and HTN (**Lee and Lin, 2018).**

The study's findings concurred with those of **Da Palma et al. (2016),** who demonstrated three key findings. First, combined exercise lowers resting heart rate and artery pressure. Exercise lowers cardiovascular risk in a number of ways, including helping obese individuals lose weight and raising HDL cholesterol while lowering LDL cholesterol **(Cao et al., 2019).** Secondly, it encourages advantageous adaptation in cardiovascular autonomic regulation and baroreflex sensitivity. Third, lower OS and cardiovascular inflammation in hypertensive individuals.

Additionally, **Pagonas et al. (2014)** provided support for the findings by showing that regular exercise lowers BP without lowering BP variability. Following treatment, the group that received combined interventions had significantly lower BP, PSS, and cortisol levels than the group that received only aerobic exercise because AT and aerobic exercise reduce sympathetic tone, which affects both beta and alpha adrenoceptors, along with alleviating OS and increasing parasympathetic activity **(Cao et al., 2019).**

Due to the loss of endogenous estrogen's protective action, which maintains NO bioavailability, elderly hypertensive women are more difficult to manage. They may also have more impairment in peripheral vasodilation. Because of its effects on relaxation and muscle function, aerobic training has been suggested as part of a worldwide exercise program for older adults along with other relaxing techniques. Since relaxing significantly increases resting forearm blood flow without causing an increase in arterial stiffness, it is a more effective therapy choice for HTN in older women (**Dantas, 2016).** Additionally, the effect of relaxing techniques in lowering somatic and cognitive anxiety and boosting self-confidence may account for the considerable decrease in stress in the group that participated in both aerobic and AT exercise compared to the group that participated in aerobic exercise alone. Relaxation reduces autonomic and central nervous system arousal and increases parasympathetic activity, which lowers cardiovascular and musculoskeletal tone and restores normal neuroendocrine function (**Rizal *et al.*, 2019).**

This study's findings are consistent with those of **Mansour & Amini (2020)**, who demonstrated that relaxation may be a useful non-pharmacological strategy for lowering perceived stress. Stress, fear, and anxiety can be effectively reduced by using the safe, simple, and inexpensive relaxation technique in conjunction with medication and other therapies.

Li et al. (2015) reported that "exercise is a cornerstone therapy for the early detection, management, and control of HTN," which is consistent with the findings of this study. Aerobic and relaxation exercises improve cardiovascular risk factors and boost overall health in patients with hypertension. According to **Awad et al. (2019)**, the AT mechanism's ability to lower BP may be related to its ability to lessen the hypothalamic sympathetic response, which is predicted to lower BP. Slower, deeper breathing results from the relaxation induced skeletal muscles tension release, which increases peripheral blood flow and lowers BP and heart rate.

However, this study's findings contradict those of **Seo and Kim (2019)**, who found that AT had little effect on hypertensive individuals under stress. Even while AT is being used more and more to treat stress and HT, it has been found that its effectiveness has not yet been proven.

The findings of this research also contradict those of **Ferianto (2020)**, who came to the conclusion that there had been insufficient research into the connection between cardiovascular alterations and stress alleviation facilitated by AT. Patients with HTN benefit from AT in terms of their ambulatory BP and heart rate. Nevertheless, the efficacy of varying treatment durations remains unclear, and while AT is seen as a simple procedure to implement in certain conditions, its mechanism of action is not well understood.

Strengths and Limitations

There are numerous benefits to the current research.
Since it is the first to examine the effects of a 6-week program that combines aerobic and autogenic training on lowering stress and HTN following menopause in Egypt. The study's precise measurement of BP, stress level, and serum cortisol levels before and after therapy to evaluate changes and provide important insights is one of its main strengths. Additionally, the authors carefully planned the study by estimating the necessary number of participants. This thoughtful methodology enhances the credibility and reliability of the study's results. While exhibiting strengths, this study has some limitations. Participants were evaluated for a relatively short duration (6 weeks). So, Patient follow-up is needed to find out whether the effects persist over time.

Conclusion

The study results suggest that AT when integrated with aerobic exercises, can be an effective and safe treatment for reducing hypertension and stress after menopause. It plays a significant role alongside medication in managing HTN and alleviating stress.

Conflict of Interest: No conflicts of interest.

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