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Effect of Reflexology versus Aerobic Training on Insomnia Severity Index and Quality of Life in Hypertensive Patients

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ABSTRACT

Introduction: Egypt lacks awareness regarding the positive influence of reflexology along with aerobic training (AT) on the quality of life (QoL) of patients with hypertension (HTN).
Objective: We aim to determine reflexology and AT effects on the insomnia severity index (ISI) and QoL of HTN patients.
Methods: This study enrolled 40 HTN female patients aged 35–45 years who were equally divided into groups A and B. **Groups A and B** participants were provided with medications and peddling training, while **Group B** participants also received reflexology. The treatment protocol consisted of an eight-week program with three sessions per week. After the four-week treatment protocol, a post-evaluation (post-1) was conducted and was repeated after another four-week treatment (post-2). The participants underwent assessment for systolic and diastolic blood pressure, ISI, and a 36-item short-form survey (SF-36), a general QoL measure, pre- and post-treatment.
Results: The results revealed significant discrepancies in the assessed variable between both groups pre- and post-treatment (post-1/2). When comparing the post-treatment values (post-1/2) of the evaluated variable between groups A and B, incorporating reflexology and AT, such as peddling training, into the physical treatment program is recommended.
Conclusion: The study highlights the positive impact of reflexology and AT on the QoL and ISI of female HTN patients, recommending their incorporation into treatment programs.
Keywords: Reflexology; Aerobic training; Insomnia severity index; Quality of life; Hypertensive patients.

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INTRODUCTION

Individuals who have a systolic blood pressure (SBP) ≥ 140 mmHg and/or a diastolic blood pressure (DBP) ≥ 90 mmHg while taking antihypertensive medication are considered to have hypertension (HTN). When left undetected and not well controlled, HTN becomes a prevailing disease that has the potential to result in stroke, heart failure, myocardial infarction, peripheral arterial disorder, aortic aneurysms, renal failure, and fatality [1, 2]. Moreover, HTN is the leading cause of death from cardiovascular disease (CVD); it is a manifestation of a degenerative CVD that predominantly affects older individuals, and its exact cause is not well understood. Pharmaceuticals, together with non-drug and non-pharmaceutical methods, effectively lower blood pressure, thereby minimizing damage to target organs and reducing CVD risk [3].

Aerobic training (AT), particularly walking and swimming, elicits an increased respiration rate and heart rate compared to a resting state. Moreover, AT offers several benefits, such as enhancing cardiovascular health and improving blood flow, reducing HTN, and assisting in regulating blood glucose levels and weight control [4]. A typically employed type of AT involves engaging in activities such as swimming, cycling, or running at a moderate effort for a duration of 30–45 min [5].

Reflexology, a form of complementary medicine, involves the application of massage to specific reflex zones located in the feet and hands [6], which enhances blood circulation by stimulating the nerves in the body. During reflex zone therapy, a term employed in the practice of reflexology, the body is divided into ten zones, starting with the head and ending with the toe [7]. Foot reflexology, a renowned traditional treatment prevalent in various Asian nations, including China, India, and Thailand, holds great potential as a treatment option. Nevertheless, there is currently no agreement on the impact of foot reflexology on SBP and DBP. Despite a trial that has demonstrated the positive impact of foot reflexology on stress response and biofeedback, there is currently a lack of randomized trials that have examined its effects on both blood pressure and heart rate. Furthermore, whereas numerous trials have investigated foot reflexology advantages in patients having chronic diseases and cancer, only a limited number of studies have specifically included individuals with HTN [8].

SUBJECTS AND METHODS

Study design

This comparative study enrolled 40 HTN female patients aged 35–45 years from the Misr Petroleum Company's outpatient clinic in Cairo, Egypt, from January to May 2022. The Faculty Of Physical Therapy Ethics Committee approved the study (P.T.REC/012/003585). The participants were subjected to assessment through SBP and DBP, insomnia severity index (ISI), and a 36-item short-form survey (SF-36), a general measure of QoL. These assessments were conducted three times weekly for eight weeks, pre-and post-treatment. The post-assessment was conducted following the four-week treatment (post-1) and then again after another four weeks (post-2).

The inclusion criteria were: 1) mild HTN female patients aged 35–45 years; 2) clinically and medically good health participants; 3) body mass index (BMI) of 30–34.9 kg/m^2. The

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exclusion criteria included the following: 1) cerebrovascular disease; 2) heart block or complex ventricular arrhythmia; 3) close myocardial infarcts; 4) defects in vision or hearing; 5) lower limb significant tightness, a fixed deformity, or both; 6) balance or mentality-related neurological diseases (epilepsy); 7) congenital or acquired lower limb abnormalities (**Fig. 1**).

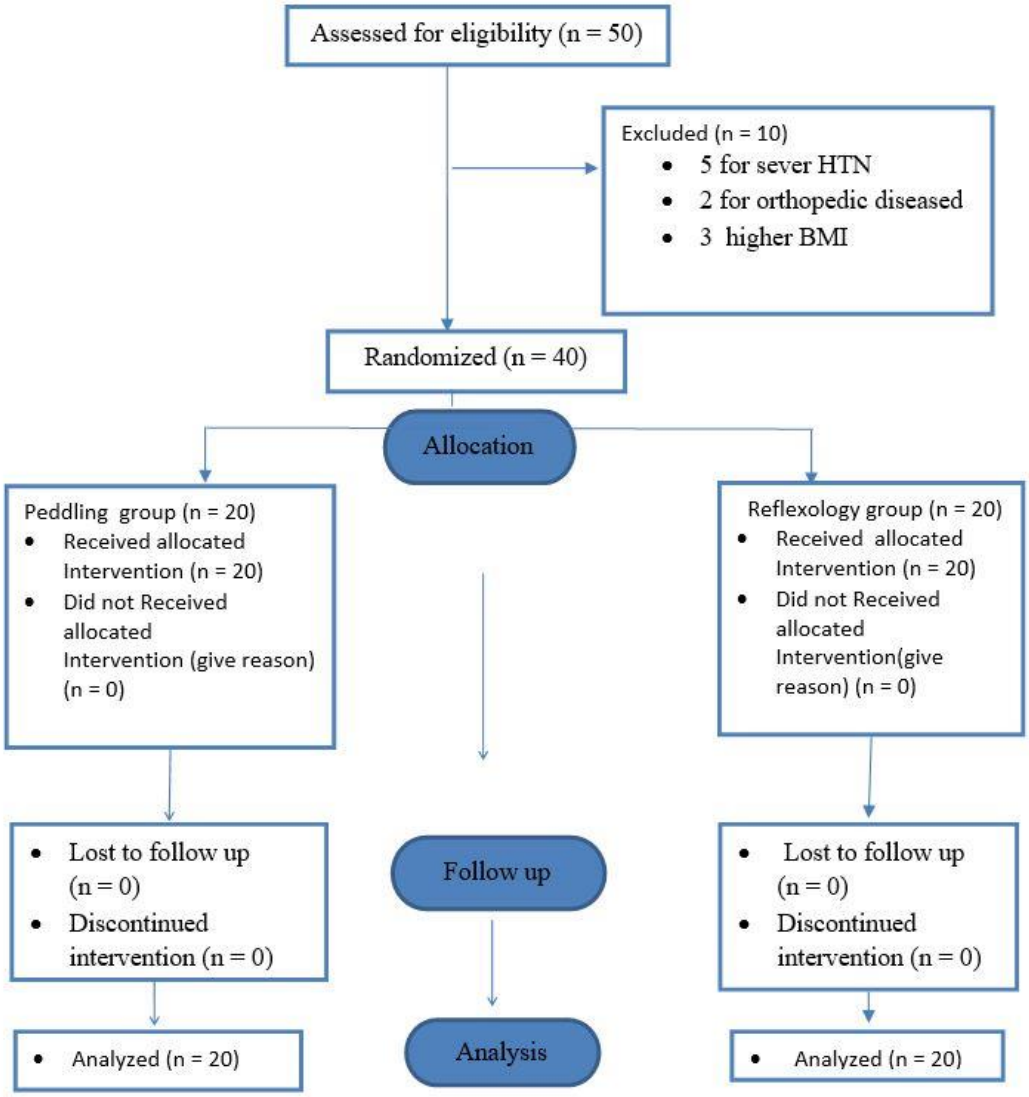

Fig. 1. Study flowchart

Evaluation

SBP and DBP

SBP and DBP were measured using an MCP Conventional Blood Pressure Monitor with a Stethoscope. The normal blood pressure level is 120/80 mmHg.

BMI and Heart rate

Body weight and height scale was utilized to measure height and weight, with the aim of calculating BMI. The BMI was calculated by dividing weight (Kg) by the square of height (m); a normal BMI is 18–25, overweight is 25–30,

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and obese > 30 Kg/m^2. A Fingertip Pulse Oximeter (Zacurate 500 BL, China) was used to measure heart pulse rate.

ISI

The ISI represents a self-report questionnaire of 7 items that evaluate insomnia's characteristics, intensity, and consequences. The typical time frame for recall is the "previous month," the assessed dimensions include sleep initiation severity, sleep maintenance, early morning awakening issues, dissatisfaction with sleep, sleep difficulties impact on daytime functioning, the perception of sleep problems by others, and sleep difficulties-caused distress. The rating for each item is calculated using a 5-point Likert scale (0 = no problem; 4 = very severe problem), resulting in a total score of 0–28 interpreted as follows: absence (0–7), sub-threshold (8–14), moderate (15–21), and severe insomnia (22–28) [8].

SF-36

The SF-36 is commonly utilized to evaluate health-associated QoL [9]. RAND suggests using the following direct method for scoring the RAND 36-Item Health Survey. The scoring system for all questions is based on a scale of 0–100, where 100 indicates the maximum functioning achievable level. The scores obtained from the questions that pertain to each particular aspect of functional health status are subsequently combined and averaged, resulting in a total score for each of the eight dimensions being assessed (discomfort and physical functioning, among others). Given that a score of 100 indicates a high level of energy without any exhaustion, the lower number of 46.7% indicates that the patient is currently experiencing decreased energy and some level of fatigue. All eight categories were evaluated using identical scoring criteria.

Treatment

Participants in both groups were subjected to assessment through SBP and DBP, ISI, and SF-36 three times/week for eight weeks, pre-and post-treatment. The post-assessment was conducted following the four-week treatment (post-1) and then again after an additional four weeks of treatment (post-2).

Group A participants received medical treatment and performed peddler training [10] for 20 min using an Exercise Peddler Machine (USA) that operates on 110–120 volts, with a step-down power converter for the smooth device function. The exercise regimen begins with a 5-min warm-up period at 60-65% of maximum heart rate intensity. This is followed by a 10-min period where the intensity progressively increases to 70-75%. Finally, there is a 5-min cooling down period at 60-65% of maximum heart rate intensity. The heart rates of the participants were monitored after the warm-up and at the conclusion of each training period. Ultimately, if the person had discomfort, loss of consciousness, or difficulty breathing, the training was immediately halted.

Group B administrated the equivalent drugs as Group A besides reflexology [11]. Prior to and following the 20-min foot reflexology session, blood pressure was measured on two occasions. The reflexology point was stimulated to affect the blood pressure, heart rate, and insomnia (**Fig. 2**). Subsequently, the patients were instructed to consume water following the session.

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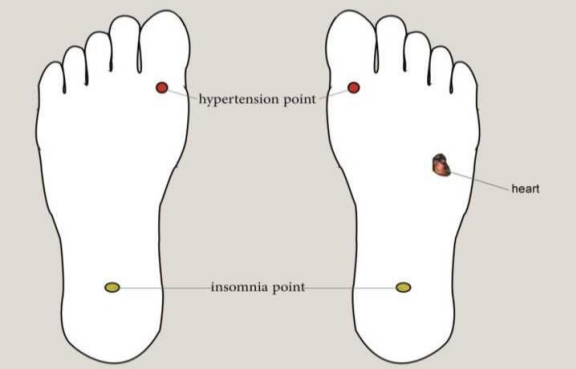

Fig. 2. Application of foot reflexology points

Statistical analysis

The SPSS version 17 was used for statistical analysis, calculating the mean (X) and standard deviation (SD) of each parameter within each group. A paired t-test and MANOVA were employed to compare each parameter's mean values within each group and between both groups pre- and post-treatment, respectively. A non-paired t-test was employed to compare each parameter's mean values between both groups prior to and following three months of treatment. The probability was > 0.05.

RESULTS

Demographic data of the study participants

Participants in both groups exhibited no significant differences in age, height, weight, and BMI (**Table 1**).

Table 1. Participant characteristics of both groups

Variable	Groups	$\overline{X}$ ± SD	t-value	p-value
Age (years)	A	39.8 ± 3.84	0.41	0.687
	B	40.15 ± 2.6		NS
Height (m)	A	1.62 ± 0.02	1.77	0.086
	B	1.63 ± 0.03		NS
Weight (km)	A	83.3 ± 3.53	1.06	0.296
	B	84.6 ± 4.2		NS
BMI (kg/m^2)	A	31.84 ± 1.21	0.91	0.376
	B	34.2 ± 11.7		NS

BMI: body mass index; $\overline{X}$ ± SD: mean and standard deviation; NS: non-significant; t-value: Paired and Un-paired t-test value; p-value: Probability value

Measured variables

SBP (mmHg)

SBP mean values pre- and post-1/2 treatment in both groups

The results revealed that Groups A (p = 0.0001) and B (p= 0.01) significantly differed when comparing SBP mean values pre- and post-1/2 treatment **(Table 2)**.

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Table 2. Systolic blood pressure (SBP) mean values in both groups

SBP (mmHg)	Group A			Group B		
	Pre-treatment	Post-1 treatment	Post-2 treatment	Pre-treatment	Post-1 treatment	Post-2 treatment
X ± SD	149.25 ± 6.54	142.75 ± 4.99	131.25 ± 4.83	148.01 ± 6.57	137.75 ± 5.5	127.75 ± 4.13
f-value		54.71			68.05	
P-value		0.0001			0.0001	
Significance level		S			S	

$\overline{X}$ ± SD: mean and standard deviation; S: Significant; t-value: Paired and Un-paired t-test value; p-value: Probability value

SBP mean values pre- and post-1/2 treatment between both groups

The results showcased that pre-treatment values had a nonsignificant difference (p = 0.55) between both groups. Meanwhile, post-1 (p = 0.005; % of change = 3.63%) and post-2 (p = 0.019; % of change = 2.74%) treatment values significantly differed between both groups (**Table 3**).

Table 3. Systolic blood pressure (SBP) mean values between both groups

Items	SBP (mmHg)					
	Pre-treatmen		Post-1treatment		Post-2 treatment	
Groups	**A**	**B**	**A**	**B**	**A**	**B**
X ± SD	149.25 ± 6.54	148.01 ± 6.57	142.75 ± 4.99	137.75 ± 5.5	131.25 ± 4.83	127.75 ± 4.13
MD	1.24		5		3.5	
% of change	-		3.63 %		2.74 %	
t-value	0.6		3.01		2.46	
p-value	0.55		0.005		0.019	
Significance level	NS		S		S	

$\overline{X}$ ± SD: mean and standard deviation; MD: Mean Difference; NS: non-significant; S: Significant; t-value: Paired and Un-paired t-test value; p-value: Probability value

DBP (mmHg)

DBP mean values pre- and post-1/2 treatment in both groups

The results indicated that Groups A (p = 0.0001) and B (p = 0.0001) exhibited significant differences in the comparison of DBP mean values pre- and post-1/2 treatment (**Table 4**).

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Table 4. Diastolic blood pressure (DBP) mean values pre- and post-1/2 treatment in both groups

DBP (mmHg)	Group A			Group B		
	Pre-treatment	**Post-1 treatment**	**Post-2 treatment**	**Pre treatment**	**Post-1 treatment**	**Post-2 Treatment**
X ± SD	85.75 ± 4.06	83.01 ± 4.1	79.75 ± 3.8	84.75 ± 3.8	79.75 ± 3.79	75.25 ± 3.43
f-value		11.33			33.38	
p-value		0.0001			0.0001	
Significance level		S			S	

$\overline{X}$ ± SD: mean and standard deviation; S: Significant; t-value: Paired and Un-paired t-test value; p-value: Probability value

DBP mean values pre- and post-1/2 treatment between both groups

Pre-treatment values had a nonsignificant difference (p=0.426) between both groups. Meanwhile, post-1 (p=0.013; %of change = 4.09%) and post-2 (p=0.0001; %of change = 5.98%) treatment values significantly differed between both groups (**Table 5**).

Table 5. Diastolic blood pressure (DBP) mean values Pre- and post-1/2 treatment between both groups

Items	DBP (mmHg)					
	Pre treatment		Post-1 treatment		Post-2 treatment	
Groups	**A**	**B**	**A**	**B**	**A**	**B**
X ± SD	85.75 ± 4.06	84.75 ± 3.8	83.01 ± 4.1	79.75 ± 3.79	79.75 ± 3.8	75.25 ± 3.43
MD			3.26		4.5	
% of change	-		4.09 %		5.98 %	
t-value	0.8		2.6		3.93	
p-value	0.426		0.013		0.0001	
Significance level	NS		S		S	

$\overline{X}$ ± SD: mean and standard deviation; MD: Mean Difference; NS: non-significant; S: Significant; t-value: Paired and Un-paired t-test value; p-value: Probability value

SF-36

Comparison of SF-36 mean values between pre-and post-1/2 treatment of both groups

The SF-36 mean values pre- and post-1/2 treatment of Groups A (p = 0.0001) and B (p = 0.0001) demonstrated significant differences (**Table 6**).

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Table 6. Pre- and post-1/2 treatment mean values of 36-item short-form survey (SF-36) of both groups

Items	SF-36					
	Group A			Group B		
	Pre-treatment	**Post-1 treatment**	**Post-2 treatment**	**Pre-treatment**	**Post-1 treatment**	**Post-2 treatment**
$\overline{X}$ **± SD**	40.92 ± 4.23	46.6 ± 4.32	52.57 ± 4.14	41.7 ± 4.09	52.31 ± 4.17	58.76 ± 3.9
f-value		37.91			90.2	
p-value		0.0001			0.0001	
Significance level		S			S	

$\overline{X}$ ± SD: mean and standard deviation; S: Significant; t-value: Paired and Un-paired t-test value; p-value: Probability value

Comparison of SF-36 mean values between pre-and post-1/2 treatment between both groups

The pre-treatment mean values did not significantly differ between both groups (p = 0.556). Post-1 (p= 0.0001; % of change = 12.25%) and post-2 (p= 0.0001; % of change = 11.77%) treatment mean values manifested significant differences in favor of Group B **(Table 7).**

Table 7. Pre- and post-1/2 treatment mean values of 36-item short-form survey (SF-36) between both groups

Items Groups	SF-36					
	Pre-treatment		**Post-1 treatment**		**Post-2 treatment**	
	A	B	A	B	A	B
$\overline{X}$ **± SD**	40.92 ± 4.23	41.7± 4.09	46.6± 4.32	52.31± 4.17	52.57± 4.14	58.76± 3.9
MD	0.78		5.71		6.19	
% of change	-		12.25 %		11.77 %	
t-value	0.59		4.25		4.87	
p-value	0.556		0.0001		0.0001	
Significance level	NS		S		S	

$\overline{X}$ ± SD: mean and standard deviation; MD: Mean Difference; NS: non-significant; S: Significant; t-value: Paired and Un-paired t-test value; p-value: Probability value

ISI

ISI mean values pre- and post-1/2 treatment in both groups

The results depicted a significant difference in Groups A (p = 0.0001) and B (p = 0.0001) when comparing ISI mean values pre- and post-1/2 treatment (**Table 8**).

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Table 8. Insomnia severity index (ISI) mean values pre- and post-1/2 treatment

ISI	Group A			Group B		
	Pre treatment	Post-1 treatment	Post-2 Treatment	Pre treatment	Post-1 treatment	Post-2 Treatment
X ± SD	16.65 ± 1.27	13.05 ± 1.1	9.35 ± 1.18	16.1 ± 1.37	11.85 ± 1.35	8.01 ± 1.38
f-value		89.74			75.97	
p-value		0.0001			0.0001	
Significance level		S			S	

$\overline{X}$ ± SD: mean and standard deviation; S: Significant; t-value: Paired and Un-paired t-test value; p-value: Probability value

ISI mean values pre- and post-1/2 treatment between both groups

The pre-treatment mean values did not significantly differ between both groups (p = 0.196). Post-1 (p = 0.004; % of change = 10.13%) and post-2 (p= 0.002; % of change = 16.72%) treatment exhibited significant differences between Groups A and B (**Table 9**).

Table 9. Pre- and post-1/2 treatment mean values of insomnia severity index (ISI) between Groups A and B

Items	ISI					
	Pre-treatment		Post-1 treatment		Post-2 treatment	
Groups	**A**	**B**	**A**	**B**	**A**	**B**
X ± SD	16.65± 1.27	16.1± 1.37	13.05± 1.1	11.85± 1.35	9.35 ± 1.18	8.01 ± 1.38
MD	0.55		1.2		1.34	
% of change	-		10.13 %		16.72 %	
t-value	1.32		3.08		3.33	
p-value	0.196		0.004		0.002	
Significance level	NS		S		S	

$\overline{X}$ ± SD: mean and standard deviation; MD: Mean Difference; NS: non-significant; S: Significant; t-value: Paired and Un-paired t-test value; p-value: Probability value

DISCUSSION

The effectiveness of both dynamic and AT in reducing blood pressure has been thoroughly examined [12]. The main mechanism via which resting blood pressure is lowered following exercise training is suggested to be a decrease in total peripheral resistance. The activity of sympathetic nerves, alterations in vascular responsiveness, and alternations in vascular structure all contribute to a decrease in vascularity resistance that occurs after training [13, 14]. Aerobic activity caused an elevation in SBP, a reduction in

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vascular resistance caused by vasodilation in the muscles being exercised, and no change or a slight drop in DBP [15]. Swimming consistently reduced SBP and DBP in HTN rats across most, if not all, of the experimental trials. Several potential pathways have been proposed, including enhanced muscle insulin sensitivity, sympathetic system suppression, and decreased vasoconstrictor prostaglandin levels [10]. Accordingly, we explored the effect of reflexology and AT on HTN patients' QoL.

Herein, upon comparing the pre-and post-treatment results of Group A, a significant disparity was observed, consistent with the findings of Neto et al. [16], demonstrating that SBP and DBP exhibited an immediate increase following the three exercise protocols, followed by a decrease after a 30-minute recovery period (in comparison to immediately after exercise). Following a 30-min recovery period, we observed that both SBP and DBP were lower compared to the initial resting levels, indicating the occurrence of post-effort hypotension. Several other studies have examined different exercise regimens and consistently observed exercise-induced hypotension.

Our results regarding Group A align with those of Bouzid et al. [17], who conducted a study using acute AT without blood flow restriction, revealing increased enzyme activity in participants following hard exercise and recovery. Considering that HTN individuals should engage in physical activity, it is worth noting that low-intensity exercise may not offer substantial benefits in comparison to moderate or high-intensity exercise [18]

Our findings were corroborated by Figueroa et al. [19], showing that a combination of moderate-intensity AT, circuit resistance training, and endurance exercise training had positive impacts on arterial stiffness, blood pressure, muscle power, and heart rate in postmenopausal women. The cause can be attributed to both hormonal and structural alterations. The alterations consist of a decrease in sympathetic nerve activity caused by decreased levels of norepinephrine, a decrease in peripheral vasoconstriction, and an increase in peripheral vasodilation [20].

Our findings coincide with those of Collier et al.[21], who investigated the potential sex differences in the effectiveness of AT compared to resistance exercise training in 40 HTN patients. Their study showcased that moderate-intensity AT is a conservative and safe treatment option for HTN, as it reduces SBP and DBP.

The comparison of group B results before and after treatment revealed a significant discrepancy, similar to the findings of Hyeon-Soon and Dong [22], who studied the positive effects of six-week foot reflexology on blood pressure in 71 elderly HTN patients. This indicates that foot reflexology has a beneficial impact on lowering blood pressure.

An evaluation has been conducted on the impact of non-pharmacological foot reflexology on SBP and DBP in individuals who have experienced a stroke. The experimental group experienced a significant reduction in blood pressure after getting foot reflexology. The mean SBP of the experimental group was significantly reduced after 10 and 30 min of massage, as was the DBP [23].

The results of this study align with the findings of Elmahy et al. [24], who examined laser treatment impact on acupuncture points for HTN in obese individuals. Laser therapy has a significant impact on reducing blood pressure. The results were consistent with those

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reported by Zhang et al. [25], who conducted a study that included 55 participants who received laser acupuncture treatment. Following a 12-week course of treatment, significant alterations in blood pressure were observed.

Foot reflexology has been found to be an effective method for reducing SBP and triglycerides and has a notable influence on cardiovascular parameters, making it particularly beneficial for those with foot issues, particularly those with type 2 diabetes [26].

Conclusion

Both AT, particularly pedaling, combined with reflexology, can be incorporated into a physical treatment regimen. It has been observed that reflexology is more advantageous than AT in enhancing the QoL for HTN individuals.

Data Availability Statement

To receive the data that corroborates the results of this study, one can contact the corresponding author.

Conflict of Interest

The authors affirm that they have no conflicts of interest.

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Data Access Statement.

Trial registration number. The trial (NCT06315764) data were prospectively registered in detail on www.clinicaltrials.gov.

Author contributions

Asmaa Sharbash, Heba Ghaleb, Maha Salem, and Emad Taha contributed to the manuscript's conceptualization, methodology, investigation, and drafting. Asmaa Sharbash, Heba Ghaleb, and Emad Taha contributed to supervising and reviewing the manuscript. All authors read and approved the final manuscript.

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