Journal of Human Hypertension (2021) 35:627–637
https://doi.org/10.1038/s41371-020-0371-z

ARTICLE

The influence of foot and back massage on blood pressure and sleep quality in females with essential hypertension: a randomized controlled study

Gürcan Arslan[1] · Özlem Ceyhan[2] · Mukadder Mollaoğlu[1]

Received: 21 January 2020 / Revised: 1 June 2020 / Accepted: 11 June 2020 / Published online: 16 July 2020

Abstract

The present study was conducted with the aim of investigating the influence of foot and back massage on blood pressure and sleep quality in females with essential hypertension. Non-pharmacologic methods like massage may be effective for balancing blood pressure and solving sleep problems. This is a randomized controlled study conducted in accordance with CONSORT rules. Females with essential hypertension were applied a total of six sessions of 30 min of foot and back massage twice weekly during 3 weeks. The study included a total of 90 patients of whom 60 were in intervention group (foot massage group, back massage group) and 30 in control group. Data were collected through personal data form (PDF) which included descriptive characteristics, Pittsburgh Sleep Quality Index (PSQI). Six sessions of foot massage and back massage were detected to lead to a reduction in systolic blood pressure (SBP) and diastolic blood pressure (DBP) values and the difference was statistically significant ($p < 0.001$). A strong statistical difference was found between mean pretest posttest scores of overall and sub-dimensional scores of PSQI in females in intervention group ($p < 0.001$). Foot and back massage was found to be effective in reducing blood pressure and improving sleep quality.

Introduction

Hypertension is a cardiovascular disease which influences 1.13 billion individuals worldwide [1]. According to World Health Organization (WHO) data, while prevalence of hypertension is lower until 45 years in females, it is more frequent in males with increasing age [2]. However females were detected to have problems with side effects of antihypertensive treatment and weight control and have willingness for trying non-pharmacologic treatment methods [3, 4].

Integrated treatment methods are known to be effective for blood pressure control in hypertension treatment. Massage which is one of the integrated treatment methods in hypertension treatment has an important place in practice and responsibilities of nursing care [5].

✉ Gürcan Arslan
gurcansolmaz@hotmail.com

[1] Department of Internal Diseases Nursing, Faculty of Health Sciences, Sivas Cumhuriyet University, Sivas, Turkey

[2] Department of Internal Diseases Nursing, Faculty of Health Sciences, Erciyes University, Kayseri, Turkey

Supa et al. [6] who showed the effect of massage in regulating hypertension detected a significant reduction in systolic blood pressure (SBP) and diastolic blood pressure (DBP) values with massage applied once weekly during 4 weeks. Olney [7] have reported that back massage was an effective method for controlling stress and blood pressure. Osborn et al. [8] reported that back massage caused relaxation and could reduce blood pressure through vasodilator effect and recommended massage as an easy and inexpensive method for hypertension treatment. Foot massage is another massage method used in hypertension treatment. Foot and back massage were used in separate studies and seen to be effective in hypertension control [9].

Hypertension impairs the function of more than one systems including sleep [9]. Management of sleep disorders is among the main strategies of hypertension treatment [10]. Sleep quality was detected to be impaired in the ratio of 70% in hypertensive patients and blood pressure control was found to be positively influence sleep quality [11].

Integrated treatment modalities like progressive relaxation exercises, hypnotherapy, bio feedback, reflexology, yoga, massage, and aroma therapy may be used for management of sleep disorders [12].

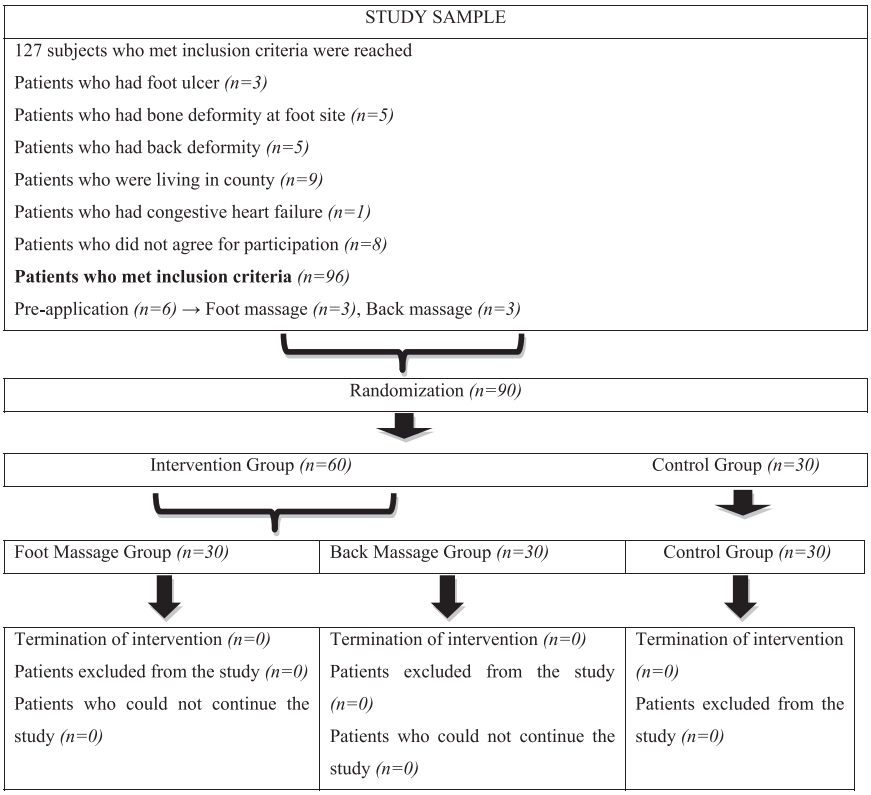

Fig. 1 CONSORT diagram, Consolidated standartds of reporting trials diagram.

Massage is known to improve sleep quality in patients with hypertension, cancer, ischemic heart disease, and who underwent coronary artery bypass grafting surgery [13]. Blood pressure was detected to be reduced 8.5 mmHg with 20 min of foot massage and 1 mmHg with face massage in a study conducted with prehypertensive women. In the same study, massage was also shown to positively affect sleep quality [14]. In another study investigating the influence of aromatic back massage on blood pressure and sleep quality, a significant improvement was found in sleep quality while a significant reduction was detected in SBP [15]. No studies are available investigating the influence of back and foot massage on sleep quality besides the presence of small number of studies investigating the influence of massage on sleep quality and blood pressure.

This study was conducted as a pretest, posttest randomized controlled study with the aim of investigating the influence of 30 min of foot and back massage twice weekly during 3 weeks (six sessions in total) on blood pressure and sleep quality in females with essential hypertension.

Methods

Design and methods

The study is a randomized controlled study in pretest, posttest design conducted in accordance with CONSORT rules. A total of 127 women with essential hypertension who were admitted to Cardiology and Internal Medicine Outpatient Clinics of a Research and Training Hospital of a province were included in the study. Eligibility for inclusion and exclusion criteria was evaluated through patient files and interviews (Fig. 1).

Participants

Inclusion criteria were as follows: (a) being 18 years and above, (b) women diagnosed with essential hypertension, (c) residing in city center, (d) being non pregnant, (e) not diagnosed with congestive heart failure, (e) not receiving any integrated treatment, and (f) receiving antihypertensive treatment for at least 3 months.

Exclusion criteria were as follows: (a) presence of any ulceration, lesion on foot, (b) presence of any ulceration, lesion on back, (c) bone deformity on foot, (d) bone deformity on back, (e) presence of a severe mental disorder, (f) any obstacles for applying massage decided with expert opinion [9, 16].

Eligibility to inclusion and exclusion criteria was evaluated with patient records and interviews with the physician. Afterwards patients were randomized by lot. Intervention was started with foot massage, this was decided by lot. Foot massage was given between 10:00 and 17:00 twice a week (Thursday–Saturday and Friday–Sunday) during 3 weeks.

Back massage was given between 10:00 and 17:00 twice a week (Thursday–Saturday and Friday–Sunday) during 3 weeks.

Sample size

Study sample was calculated with power = 0.80, alpha = 0.05, beta = 0.20 given the data obtained from the study of Ju et al. [15] "Effects of aroma massage on home blood pressure, ambulatory blood pressure, and sleep quality in middle-aged women with hypertension". It was detected that 80% power could be reached if at least 27 subjects would be tested in each group with moderate effect size (ES:0.5), $p < 0.05$ significance level, at 95% confidence interval. As a result, a total of 90 patients (30 patients in each of foot massage group, back massage group, and control group) were included in sample. Under the light of the data obtained from DBP, SBP, and PSQI score, statistical power was found to be 99.9% at alpha = 0.05 level.

Intervention and control conditions

Implementation of research with the intervention group (foot and back massage groups)

The massages were made in a standard order according to the protocol developed by the researcher and to all patients by the researcher herself. Foot and back massage sessions were applied as follows: the patients in intervention group were called on phone and date and time of the first home visit was scheduled. Personal data form (PDF), Pittsburg Sleep Quality Scale (PSQI) and systolic and DBPs were evaluated by using an automated sphygmomanometer. Foot massage was applied as classical massage for 15 min to both feet in accordance with the protocol. Back massage was applied for 30 min as classical massage. Blood pressure was measured before the massage, after the massage following 10 min of resting with 5 min intervals between measurements [17]. Sphygmomanometer was provided by the researcher and the same device was used for all measurements.

Implementation of research with the control group

Patients in control group were called on phone for planning the home visit. PDF, PSQI, and blood pressure measurement education was given at the first home visit. Each patient was given a separate automated sphygmomanometer. The patients made the measurements using the same device during the study. After the first blood pressure measurement had been done at the first home visit, patients were called between 10:00 and 16:00 on Fridays and Sundays and they were remembered to make the measurements in accordance with the instructions [17] and report the blood pressure value to the researcher. The last PSQI assessment was done 1 week after the termination of the study (at 4th week).

Data collection

Data were collected between July and September 2016. Eligibility to inclusion and exclusion criteria was detected by using patient file records and interviews with the physician, and randomization was done thereafter. The selected patient was called on phone and home visits were scheduled. PDF and PSQI forms were filled out through face-to-face interviews. Blood pressures were measured and recorded after massage. PSQI was evaluated twice first at the first home visit and the second 1 week after termination of the study (4th week) (Fig. 2).

Outcome measures

Data were collected by using PDF [9, 18] PSQI [19] and Blood Pressure Level Recording Form which were developed by the researcher based on the literature.

Personal data form (PDF)

The form was prepared by the researcher based on the literature [9, 18] and is composed of 27 questions inquiring into the sociodemographic characteristics of the patients and their knowledge level of hypertension and hypertension control. In this form, data were collected about the BMI levels of the patients and evaluated according to WHO standards (Fig. 3).

Pittsburgh Sleep Quality Index (PSQI)

PSQI is a scale which was developed by Buysse et al. [19]. Turkish reliability and validity study of the index was conducted by Ağargün and Kara [20], cronbach alpha internal consistency coefficient was found to be 0.80 which indicates a high internal consistency. Cronbach alpha internal consistency coefficient was detected to be 0.76 in the present study. PSQI investigates sleep quality during the recent 1 month, is between 0 and 21, while 0–4 indicates a good sleep quality; 5–21 indicates a poor sleep quality.

Blood Pressure Recording Form

This is a form which was created by the researcher in order to record blood pressure levels of the participants.

Data analysis

Data were analyzed by using IBM SPSS 22.0 (IBM Crop. Armonk, NY, USA) statistical package program. Normality

Weeks/ Sessions		Control Group	Experimental Group			
			Foot Massage	Back Massage	Foot Massage	Back Massage
			Before Massage		After Massage	
1 th Week	1th sessin	Personal Data Form Pre-test PSQI Automatic sphygmomanometer training BP measurement	Personal Data Form Pre-test PSQI BP measurement	Personal Data Form Pre-test PSQI BP measurement	Massage application BP measurement	Massage application BP measurement
	2 nd session	Recording of BP measurement by phone call	BP measurement	BP measurement	Massage application BP measurement	Massage application BP measurement
2 nd Week	3 rd session	Recording of BP measurement by phone call	BP measurement	BP measurement	Massage application BP measurement	Massage application BP measurement
	4 th session	Recording of BP measurement by phone call	BP measurement	BP measurement	Massage application BP measurement	Massage application BP measurement
3 rd Week	5 th session	Recording of BP measurement by phone call	BP measurement	BP measurement	Massage application BP measurement	Massage application BP measurement
	6 th session	Recording of BP measurement by phone call	BP measurement	BP measurement	Massage application BP measurement	Massage application BP measurement
Week/Session		Control Group	Experimental Group			
			Foot Massage		Back Massage	
4 th Week	7 th session	BP measurement Post-test PSQI	BP measurement Post-test PSQI		BP measurement Post-test PSQI	

Fig. 2 Application shema, PSQI, Pittsburgh sleep quality index, BP, blood pressure.

distribution was evaluated with Kolmogorov–Smirnov test. Nonparametric tests were applied as data were not normally distributed. While descriptive characteristics were given as number and percent, the difference between groups was evaluated with chi-square test, some data were given with mean values, intergroup variance analyses were evaluated with Kruskal–Wallis test and Mann–Whitney *U* test. While Friedman *F* test was used to test in-group differences, Wilcoxon signed ranks test was used to test the differences between sessions. A p level of <0.05 was evaluated as statistically significant.

Results

Characteristics of participants

Of the women in foot massage group, 40.0% were between the ages of 50 and 59, 46.7% were in obesity class I, 36.7% were hypertensive, 36.7% had been receiving treatment for

WEIGHT STATUS	BMI(kg/m^2)
Underweight	<18.5
Normal weight	<18.5-24.9
Overweight	25.0-29.9
Obesity class I	30.0-34.9
Obesity class II	35.0-39.9
Obesity class III	≥40

Fig. 3 WHO classifiaction of weight status, WHO, World Health Organization, BMI, body mass index.

10–14 years, 53.3% were not compliant to treatment, 37.8% were using the renin–angiotensin group of dugs, 20.0% were walking regularly for a maximum of 2 days weekly, 20.0% were using another method to control their blood pressure, and 20.0% were smokers. Of the women in the back massage group, 36.7% were between the ages of 60 and 69, 53.3% were overweight, 43.3% were hypertensive for 10–14 years, 43.3% had been receiving treatment for 10–14 years, 76.7% were not compliant to treatment, 23.3% were using the renin–angiotensin group of dugs, 33.3%

were walking regularly for a maximum of 2 days weekly, 26.7% were using another method to control their blood pressure, and 26.7% were smokers. Of the women in the control group, 40.0% were between the ages of 50 and 59, 46.7% were overweight, 53.3% had been hypertensive for 10–14 years, 53.3% had been receiving treatment for 10–14 years, 56.7% were not compliant to treatment, 26.7% were using the renin–angiotensin group of dugs, 36.7% were walking regularly for a maximum of 2 days weekly, 46.7% were using another method to control their blood pressure, and 30.0% were smokers. The women in the intervention and control groups were found to be similar with regard to demographic characteristics (Table 1).

The influence of the intervention on blood pressure

Median SBP of the women in foot massage group decreased to 110.00 mmHg from 130.00 mmHg at the end of sixth session. While the difference in SBP was found to be significant, this difference was detected to arise from the difference between fifth and sixth sessions ($p < 0.001$). Median DBP of the women in foot massage group decreased to 70.00 mmHg from 80.00 mmHg at the end of sixth session. While the difference in DBP was found to be significant, this difference was detected to arise from the difference between fifth and sixth sessions ($p < 0.001$) (Table 2).

Median SBP of the women in back massage group decreased to 126.00 mmHg from 140.00 mmHg at the end of sixth session. While the difference in SBP was found to be significant, this difference was detected to arise from the difference between the first session and fourth session, and the difference between fifth and sixth sessions ($p < 0.001$). Median DBP of the women in back massage group decreased to 72.00 mmHg from 88.00 mmHg at the end of sixth session. While the difference in SBP was found to be significant, this difference was detected to arise from the difference between the median value of first session and second, third and sixth session ($p < 0.001$) (Table 2).

Median systolic pressure of the women in control group was measured as 139.00 mmHg at the first session and 135.00 mmHg at sixth session. The difference between median SBP values was not found to be statistically significant ($p > 0.05$). Median diastolic pressure of the women in control group was measured as 80.00 mmHg at the first session and 80.00 mmHg at sixth session. The difference between median DBP values was not found to be statistically significant ($p > 0.05$) (Table 2).

In paired group comparisons, the difference between SBP medians was found extremely significant when foot massage–back massage and foot massage-control group were compared ($p < 0.001$). In paired comparisons of back massage and control group, a statistically significant difference was found between only at fourth, fifth, and sixth sessions with regard to SBP medians ($p < 0.001$). A statistically significant difference was found between foot massage and back massage with regard to DBP medians ($p < 0.05$). In paired comparison of foot massage-control group, the difference between DBP medians was found to be significant ($p < 0.05$). In paired comparisons of back massage and control group, a statistically significant difference was found between only at second, third, fifth, and sixth sessions with regard to DBP medians ($p < 0.05$) (Table 2).

The influence of intervention on sleep quality

In foot massage group, while a similarity was found in only mean scores of "use of sleeping medication" subdimension between mean pre and posttest scores of overall PSQI and subdimensions ($p > 0.05$), a high statistically significance was found in the other subdimensions ($p < 0.001$). In back massage group, while a similarity was found in only mean scores of "use of sleeping medication" subdimension between mean pre and posttest scores of overall PSQI and subdimensions ($p > 0.05$), a high statistically significance was found in the other subdimensions ($p < 0.001$). A significant difference was not found between mean pre and posttest scores of PSQI overall scores and subdimension scores of the women in control group ($p > 0.05$) (Table 3).

When mean values of posttest PSQI overall and subdimension scores were compared between groups, a significant difference was not found in only "use of sleeping medication" subdimension ($p > 0.05$), a statistically significant difference was found between groups with regard to all remaining subdimensions ($p < 0.001$). A statistically significant difference was not detected between groups with regard to mean values of pretest PSQI overall and subdimension ($p > 0.05$) (Table 3).

In paired group comparisons; when median values of pre and posttest PSQI and subdimensions were analyzed, a statistically significant difference was not found between foot massage and back massage groups ($p > 0.05$). While there was not a significant difference between foot massage and control group with regard to median values of pretest PSQI and subdimension ($p > 0.05$), only "use of sleeping medication" mean scores were similar in posttest ($p > 0.05$), the difference in the other subdimensions and between median values of PSQI overall scores was found statistically significant ($p < 0.05$). Similarly, while there was not a significant difference between back massage and control group with regard to median values of pretest PSQI ($p > 0.05$), only "use of sleeping medication" mean scores were similar in posttest ($p > 0.05$), the difference in the other subdimensions and between median values of PSQI overall scores was found statistically significant ($p < 0.05$) (Table 3).

Table 1 Distribution of women in intervention and control group by descriptive characteristic.

Descriptive characteristic	Groups			Total
	Intervention group		Control groups	
	Foot massage group ($n = 30$) *n* (%)	Back massage group ($n = 30$) *n* (%)	($n = 30$) *n* (%)	($n = 90$) *n* (%)
Age group (years)				
30–39	3 (10.0)	2 (6.7)	1 (3.3)	6 (6.7)
40–49	3 (10.0)	1 (3.3)	1 (3.3)	5 (5.6)
50–59	12 (40.0)	9 (30.0)	12 (40.0)	33 (36.7)
60–69	9 (30.0)	11 (36.7)	9 (30.0)	29 (32.2)
70–79	3 (10.0)	7 (23.3)	3 (10.0)	13 (14.4)
80–89	–	–	4 (13.3)	4 (4.4)
p[a] 0.178				
BMI classification (kg/m^2)				
Normal weight (<18.5–24.9)	5 (16.7)	4 (13.3)	3 (10.0)	12 (13.3)
Overweight (25.0–29.9)	8 (26.7)	16 (53.3)	14 (46.7)	38 (42.2)
Obesity class I (30.0–34.9)	14 (46.7)	9 (30.0)	10 (33.3)	33 (36.7)
Obesity class II (35.0–39.9)	3 (10.0)	1 (3.3)	3 (10.0)	7 (7.8)
p[a] 0.463				
Duration of Illness (years)				
1–4 year	6 (20.0)	6 (20.0)	5 (16.7)	17 (18.9)
5–9 year	6 (20.0)	5 (16.7)	4 (13.3)	15 (16.7)
10–14 year	11 (36.7)	13 (43.3)	16 (53.3)	40 (44.4)
15–19 year	5 (16.7)	4 (13.3)	4 (13.3)	13 (14.4)
≥20 year	2 (6.7)	2 (6.7)	1 (3.3)	5 (5.6)
p[a] 0.980				
Receiving treatment (years)				
1–4 year	6 (20.0)	6 (20.0)	5 (16.7)	17 (18.9)
5–9 year	6 (20.0)	5 (16.7)	4 (13.3)	15 (16.7)
10–14 year	11 (36.7)	13 (43.3)	16 (53.3)	40 (44.4)
15–19 year	5 (16.7)	4 (13.3)	4 (13.3)	13 (14.4)
≥20 year	2 (6.7)	2 (6.7)	1 (3.3)	5 (5.6)
p[a] 0.980				
Compliance with antihypertensive treatment				
Compliant to treatment	14 (46.7)	7 (23.3)	13 (43.3)	34 (37.8)
Not compliant to treatment	16 (53.3)	23 (76.7)	17 (56.7)	56 (62.2)
p[a] 0.131				
Antihypertensive drugs[b] ($n = 105$)[c]				
Diuretics	14 (31.1)	9 (30.0)	8 (26.7)	31 (29.5)
Angiotensin-converting enzyme (ACE) inhibitors	9 (20.0)	7 (23.3)	7 (23.3)	23 (21.9)
Renin–angiotensin–aldosterone system (RAAS) inhibitors	17 (37.8)	7 (23.3)	8 (26.7)	32 (30.5)
Calcium-channel blockers	5 (11.1)	7 (5.4)	7 (5.4)	19 (18.1)
p[a] 0.702				
Regular exercise				
Yes—regular walking	6 (20.0)	10 (33.3)	11 (36.7)	27 (30.0)

Table 1 (continued)

Descriptive characteristic	Groups			Total
	Intervention group		Control groups	
	Foot massage group ($n = 30$) n (%)	Back massage group ($n = 30$) n (%)	($n = 30$) n (%)	($n = 90$) n (%)
(maximum 2 days weekly) No	24 (80.0)	20 (66.7)	19 (63.3)	63 (70.0)
p[a] 0.329				
Smoking				
No	24 (80.0)	22 (73.3)	21 (70.0)	67 (74.4)
Yes	6 (20.0)	8 (26.7)	9 (30.0)	23 (25.6)
p[a] 0.664				

[a]Chi-square test.

[b]Drug used in the treatment of hypertension are classified according to 2013 ESH/ESC Guidelines for the management of arterial hypertension.

[c]More than one answer was given and percentages were taken from n.

Discussion

Six sessions of foot massage were found to reduce DBP, and the statistically significance was found to arise from the difference between the first session and the fifth and sixth sessions. Foot massage was also found to reduce SBP, and the difference was found to arise from the difference between the first session and the fourth, fifth, and sixth sessions, and it was extremely significant. The fact that this significant difference developed after fourth session suggests that repeated massages may have an effect on blood pressure control.

Similarly, Houyes et al. [21] applied a total of six sessions of massage (twice weekly) to intensive care patients and detected a significant reduction in blood pressure after the massage. The influence of twelve sessions of massage applied during 4 weeks on blood pressure, quality of life, and anxiety level were investigated in a randomized controlled study in Japan. The authors detected a positive correlation between the reduction in SBP and anxiety level in addition to a significant reduction in SBP and DBP [22]. The influence of foot and face massage, 20 min in duration, on vital signs was investigated in another study conducted by Ejindu [14]. When the alterations in blood pressure in the different sessions were compared, a statistically significant difference was found between median SBP and DBP values starting from the first session. In light of these results, repeated and regular foot massage seems to have a significant effect on SBP and DBP. Similarly, in the present study, foot massage seems to be effective in blood pressure control in paired group comparisons and to lead to a reduction in blood pressure.

The effect of foot massage is that it stimulates the pressure receptors under the skin, enhancing vagal activity, which, in turn, reduces cortisol; this leads to many effects including reduced blood pressure [6–8]. Thus, foot massage, an easy and safe, method may be a good option for a supportive treatment for elevated blood pressure.

Six sessions of back massage were found to reduce DBP, and the statistically significance was found to arise from the difference between the first session and the second, third, and sixth sessions. Back massage was also found to reduce SBP, and the difference was found to arise from the difference between the first session and the fourth, fifth, and sixth sessions, and it was extremely significant. These results suggest that repeated massage is effective for reducing blood pressure because it causes relaxation in the body.

Givi [23] observed that a total of ten sessions of massage done for 15 min three times weekly led to a statistically significant reduction in blood pressure in his study investigating the influence of back massage on blood pressure. Kusumarini and Djuniarto [24] applied a total of ten sessions of back massage for 10 min three times weekly to prehypertensive and stage 1 hypertensive subjects, and blood pressures were evaluated pre- and posttest. The authors found an 8.57 mmHg of reduction in SBP and a 2.93 mmHg reduction in DBP and concluded that back massage had a blood pressure lowering effect and could be effective for controlling blood pressure. Moradi et al. [25] applied massage to the neck, chest, and back and investigated the effect of these massage sessions on blood pressure in their randomized controlled study. SBP was found to be reduced by 6.44 mmHg, and DBP was found to be reduced by 4.77 mmHg. This reduction was more evident when the

Table 2 Distribution of SBP and DBP in pre and after intervention women in the intervention and control group.

Groups/intervention sessions	*n*	Pre intervention SBP Median (min–max)	After intervention SBP Median (min–max)	Pre intervention DBP Median (min–max)	After intervention DBP Median (min–max)
Foot massage					
1st session	30	130.00 (115–165)[a]	120.00 (110–150)[a]	80.00 (60–105)[a]	70.0 (60–90)[a]
2nd session	30	136.50 (110–174)[a,b]	120.00 (100–143)[a,b]	80.00 (60–102)[a,b]	70.0 (60–88)[a,b]
3rd session	30	133.00 (110–155)[a,b]	120.00 (110–157)[a,b]	80.00 (60–92)[a,b]	70.0 (60–91)[a,b]
4th session	30	130.00 (110–165)[b]	115.00 (100–155)[a,b]	80.00 (60–90)[a,b]	70.0 (60–94)[a,b]
5th session	30	125.00 (110–154)[b]	110.00 (110–142)[b]	80.00 (60–92)[b]	70.0 (60–88)[b]
6th session	30	120.00 (110–135)[b]	110.00 (105–140)[b]	80.00 (60–95)[b]	70.00 (60–88)[b]
p*		<0.001	<0.001	<0.001	<0.001
Back massage					
1st session	30	140.00 (130–150)[a]	132.00 (130–145)[a]	88.00 (74–100)[a]	81.00 (60–90)[a]
2nd session	30	142.00 (131–150)[a,b]	132.00 (120–142)[a,b]	92.00 (82–100)[b]	77.50 (60–85)[b]
3rd session	30	148.00 (132–148)[a,b]	130.00 (120–136)[a,b]	87.50 (75–90)[b]	76.00 (60–85)[b]
4th session	30	140.00 (134–145)[b]	128.00 (110–135)[b]	83.50 (74–90)[b]	81.50 (74–88)[a,b]
5th session	30	135.00 (125–138)[b]	125.00 (110–132)[b]	84.00 (72–88)[b]	74.50 (70–84)[a,b]
6th session	30	132.00 (123–138)[b]	126.00 (110–135)[b]	81.00 (75–85)[b]	72.00 (68–82)[b]
p*		<0.001	<0.001	<0.001	<0.001
Control group					
1st session	30	139.00 (100–170)[a]		80.00 (70–105)[a]	
2nd session	30	140.00 (100–200)[a]		81.00 (82–100)[a]	
3rd session	30	139.00 (110–170)[a]		80.00 (70–100)[a]	
4th session	30	135.00 (100–157)[a]		80.00 (70–102)[a]	
5th session	30	135.00 (110–162)[a]		80.00 (68–100)[a]	
6th session	30	135.00 (110–162)[a]		80.00 (68–100)[a]	
p*		0.720		0.630	

*Friedman *F* test.

(the superscripts a, b show in-group differences in each group and measurements with the same letters are similar).

massage was performed on the back region, and this reduction was found statistically significant when compared with the other regions. Cady and Jones [26] investigated the influence of 15 min of back massage on blood pressure and stress level and found a reduction in SBP, DBP, and stress level after massage. The positive effects from the back massage may have occurred because of the stimulation of pressure receptors that ultimately signaled the limbic system including the hypothalamic structures involved in cortisol secretion. Increased vagal activity is associated with blood pressure as well as decreased cortisol levels [6, 7].

Massage is seen to be a very effective method in complementing blood pressure and hypertension treatment. Different reductions occur in SBP and DBP according to the massage sites (head, neck, back, and foot). Massage applied along with antihypertensive therapy was reported to have a reducing effect on SBP and DBP, and massage alone could be more effective than an antihypertensive drug in a systematic review [17]. Obtained data were found to be consistent with the literature [25–27].

While a similarity was found only in the median value of the "use of sleeping medication" subdimension between median PSQI and subdimension pretest/posttest scores of the women in the foot massage group, a highly significant difference was found in the other dimensions. A limited number of studies are available that investigate the influence of foot massage on sleep quality in hypertensive patients. Oshvandi et al. [28] reported that sleep quality scores significantly improved after foot massage was applied for 20 min (10 min on each foot) for six nights (first on consecutive nights and on every other night thereafter) to subjects with ischemic heart disease. Nerbass et al. [29] detected that foot massage had a positive effect on sleep quality and fatigue in patients who underwent coronary artery bypass grafting surgery; these results are similar with those in the present study. Foot massage can cause the body to release endorphins and is endogenous, and it makes the whole body feel relaxed; thus, sleep quality is better [28]. Data from different studies suggest that massage techniques may be easily applied to the foot region, and the proximity

Table 3 Comparison of PSQI total score and subdimensions score of women in intervention and control group.

PSQI subdimensions	Intervention group		Control group	p^a
	Foot massage	Back massage		
Subjective sleep quality				
Pretest (X ± SD)	1.73 ± 0.44	1.76 ± 0.43	1.83 ± 0.46	0.942
Posttest (X ± SD)	1.30 ± 0.46	1.36 ± 0.49	1.80 ± 0.48	0.001
p^b	<0.001	<0.001	0.782	
Sleep latency				
Pretest (X ± SD)	2.10 ± 0.84	2.13 ± 0.86	2.06 ± 0.82	0.982
Posttest (X ± SD)	1.16 ± 0.37	1.13 ± 0.34	2.13 ± 0.82	<0.001
p^b	<0.001	<0.001	0.679	
Sleep duration				
Pretest (X ± SD)	2.06 ± 0.36	2.00 ± 0.37	2.10 ± 0.40	0.719
Posttest (X ± SD)	1.23 ± 0.43	1.30 ± 0.46	1.96 ± 0.41	<0.001
p^b	<0.001	<0.001	0.206	
Habitual sleep efficiency				
Pretest (X ± SD)	2.03 ± 0.18	2.10 ± 0.36	2.13 ± 0.34	1.000
Posttest (X ± SD)	1.56 ± 0.50	1.53 ± 0.50	2.16 ± 046	<0.001
p^b	<0.001	<0.001	0.763	
Sleep disturbances				
Pretest (X ± SD)	1.83 ± 0.64	2.00 ± 0.58	1.96 ± 0.614	0.527
Posttest (X ± SD)	1.20 ± 0.40	1.36 ± 0.55	2.00 ± 0.643	<0.001
p^b	<0.001	<0.001	0.826	
Use of sleeping medication				
Pretest (X ± SD)	1.16 ± 0.37	1.26 ± 0.44	1.36 ± 0.49	0.219
Posttest (X ± SD)	1.10 ± 0.30	1.33 ± 0.47	1.83 ± 0.47	0.077
p^b	0.157	0.317	0.782	
Daytime dysfunction				
Pretest (X ± SD)	2.86 ± 0.50	2.80 ± 0.61	2.60 ± 0.81	0.264
Posttest (X ± SD)	1.60 ± 0.56	1.53 ± 0.62	2.76 ± 0.50	<0.001
p^b	<0.001	<0.001	0.253	
PSQI global score mean				
Pretest (X ± SD)	14.00 ± 2.05	14.23 ± 1.83	14.13 ± 1.61	0.508
Posttest (X ± SD)	9.23 ± 1.54	9.57 ± 1.79	14.17 ± 1.62	<0.001
p^b	<0.001	<0.001	0.942	

[a]Wilcoxon test.

[b]Kruskal–Wallis *H* test.

of nerve networks to the surface of the foot facilitates the effect of the massage [15, 23].

While a similarity was found only in the median value of the "use of sleeping medication" subdimension between the median PSQI and subdimension pretest/posttest scores of the women in the back massage group, a highly significant difference was found in the other dimensions. A limited number of studies is available that investigate the influence of back massage on sleep quality in hypertensive patients [24, 29]. Pınar and Afsar [30] compared the fifth and seventh day outcomes after 15 min of back massage daily for 1 week and found that, while the cortisol level, blood pressure, and heart rate decreased, sleep quality improved in their study investigating the influence of back massage applied by caregivers of cancer patients on vital signs, sleep quality, and cortisol level. Sable et al. [12] reported that back massage techniques (touching, kneading, and applying pressure) relieved pain in patients and significantly improved sleep quality in heart failure patients. Back massage can increase the body's release of serotonin which can relax the body and create physical and psychological relief and relaxation by decreasing cortisol, noradrenalin, and adrenalin levels so as to promote sleep [31].

A significant difference was not detected in SBP and DBP values when median values of weekly blood pressures were compared. Also, a significant difference was not

detected between pretest/posttest PSQI and subdimension median values of the women in the control group; however, an increase was detected in poor sleep quality. These results suggest that controlling hypertension with medications alone is not effective in reducing sleep disorders and the other problems. While sleep disorders lead to blood pressure elevation, antihypertensive medications may impair sleep quality. This condition may arise from the fact that there was no intervention in control group, indicating the effectiveness of massage applications.

Limitations

Our research had some limitations. The first limitation was that an evaluation of the psychosocial status of the women was not made. For an assessment of psychosocial status, an anxiety scale could be used, for example. Another limitation was that this was a short term study. The effect of long-term massage application on blood pressure and sleep quality is unknown.

Conclusions

The present study revealed that a total of six 30 min sessions (twice weekly for 3 weeks) of foot and back massage reduced systolic and DBP and improved sleep quality; it was also found that repeated massages were more effective for reducing SBP and DBP, The massage therapy was easy to apply, was inexpensive, and had no side effects. Long-term prospective studies are needed to investigate the changes in blood pressure and sleep quality as a result of massage applied to individuals with hypertension.

Summary table

What is known about the topic

- In the literature, there is a study that shows the effect of hypertension on men. There is no study on the sleep quality of massage in women with hypertension.
- Massage, effects on lymphedema in different studies were reported.

What does this study add

- This is a unique study as massage was applied differently as foot and back massage.
- The study has provided significant data indicating the effectiveness of massage for hypertension control.
- The study has provided data indicating that massage may be used as a method for solving sleep disturbances in women with hypertension.

Acknowledgements Thanks for all the researchers and participants in this study. The present study was supported by Erciyes University Scientific Researches Projects Unit (project code: TDK-2017-6909).

Author contributions GA and OC contributed to study design. GA carried out the data collection. GA, OC, and MM carried out the data analyses. GA, OC, and MM involved in the paper preparation. All authors have read and approved the final paper.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval Academic council and ethics committee approval were obtained from Erciyes University Medical School (2016/424). The patients included in the study were informed about the study and their verbal and written informed consent was obtained.

References

1. Ioannidis JP. Diagnosis and treatment of hypertension in the 2017 ACC/AHA guidelines and in the real world. Jama. 2018;319:115–6.
2. Lehtimäki T, Uusitalo H. NCD. Contributions of mean and shape of blood pressure distribution to worldwide trends and variations in raised blood pressure: a pooled analysis of 1018 population-based measurement studies with 88.6 million participants. Int J Epidemiol. 2018;47:872–83.
3. Lozano R, Fullman N, Abate D, Abay SM, Abbafati C, Abbasi N, et al. Measuring progress from 1990 to 2017 and projecting attainment to 2030 of the health-related sustainable development goals for 195 countries and territories: a systematic analysis for the Global Burden of Disease Study 2017. Lancet. 2018;392:2091–138.
4. Mollaoglu M, Solmaz G, Mollaoglu M. Adherence to therapy and quality of life in hypertensive patients. Acta Clin Croat. 2015;54:438–43.
5. Jung B, Salfi J, Konigsberg E, Patterson C, Schaible G, Shkimba M. Bridging the divide: interprofessional education in complementary and alternative healthcare. Explore J Sci Heal. 2017;13:129–31.
6. Supa' At I, Zakaria Z, Maskon O, Aminuddin A, Nordin NAMM. Effects of Swedish massage therapy on blood pressure, heart rate, and inflammatory markers in hypertensive women. Evid Based Complement Altern Med. 2013; special issues: 1–8.
7. Olney CM. The effect of therapeutic back massage in hypertensive persons: a preliminary study. Biol Res Nurs. 2005;7:98–105.
8. Osborn KS, Wraa CE, Watson AS, Holleran RS. Medical-Surgical Nursing. Pearson Higher Ed. 2013.

9. Whelton PK, Carey RM, Aronow WS, Casey DE, Collins KJ, Himmelfarb CD, et al. 2017 ACC/AHA/AAPA/ABC/ ACPM/ AGS/APhA/ASH/ASPC/NMA/PCNA guideline for the prevention, detection, evaluation, and management of high blood pressure in adults: a report of the American College of Cardiology/ American Heart Association Task Force on Clinical Practice Guidelines. J Am Coll Cardiol. 2018;71:127–248.
10. Bansil P, Kuklina EV, Merritt RK, Yoon PW. Associations between sleep disorders, sleep duration, quality of sleep, and hypertension: results from the National Health and Nutrition Examination Survey, 2005 to 2008. J Clin Hypertens. 2011;13:739–43.
11. Dimsdale JE. Reflections on the impact of antihypertensive medications on mood, sedation, and neuropsychologic functioning. Arch Intern Med. 1992;152:35–9.
12. Sable A, Sivabalan T, Shetti AN. Effectiveness of back massage on sleep pattern among patients with congestive cardiac failure. Iran J Nurs Midwifery Res. 2017;22:359.
13. Vora CK, Mansoor GA. Herbs and alternative therapies: Relevance to hypertension and cardiovascular diseases. Curr Hypertens Rep. 2005;7:275–80.
14. Ejindu A. The effects of foot and facial massage on sleep induction, blood pressure, pulse and respiratory rate: Crossover pilot study. Complement Ther Clin Pract. 2017;13:266–75.
15. Ju MS, Lee S, Bae I, Hur MH, Seong K, Lee MS. Effects of aroma massage on home blood pressure, ambulatory blood pressure, and sleep quality in middle-aged women with hypertension. Evid Based Complement Alternat Med. 2013;2013:403251.
16. Moeini M, Givi M, Ghasempour Z, Sadeghi M. The effect of massage therapy on blood pressure of women with prehypertension. Iran J Nurs Midwifery Res. 2014;16:61–70.
17. Xiong X, Wang P, Li X, Zhang Y. Shenqi pill, a traditional Chinese herbal formula, for the treatment of hypertension: a systematic review. Complement Ther Med. 2015;23:484–93.
18. Manocchia M, Keller S, Ware JE. Sleep problems, health-related quality of life, work functioning and health care utilization among the chronically ill. Qual Life Res. 2001;10:331–45.
19. Buysse DJ, Reynolds CF III, Monk TH, Berman SR, Kupfer DJ. The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. Psychiatry Res. 1989;28:193–213.
20. Ağargün MY, Kara HAO. Gece Vardiyasında Çalışan Hemşirelerde Öznel Uyku Kalitesi. Van Tıp Derg. 1996;3:1–8.
21. Houyez F, Degoulet P, Cittee J, Fouriaud C, Jacquinet-Salord MC, Lang T, et al. Sleep and hypertension. An epidemiologic study in 7,901 workers. Arch Mal Coeur Vaiss. 1990;83:1085–8.
22. Eguchi E, Funakubo N, Tomooka K, Ohira T, Ogino K, Tanigawa T. The effects of aroma foot massage on blood pressure and anxiety in Japanese community-dwelling men and women: a crossover randomized controlled trial. PloS ONE. 2016;11:0151712.
23. Givi M. Durability of effect of massage therapy on blood pressure. Int J Prev Med. 2013;4:511.
24. Kusumarini P, Djuniarto I. The effect of back massage to decrease blood pressure in elderly with pre-hypertension and stage-1 hipertension in Panti Sosial Tresna Werdha Yogyakarta. J Hypertens. 2015;33:e6.
25. Moradi M, Mehrdad N, Nikpour S. Sleep quality and associated factors among patients with chronic heart failure in Iran. Med J Islam Repub Iran. 2014;16:149:1–7.
26. Cady SH, Jones GE. Massage therapy as a workplace intervention for reduction of stress. Percept Mot Skills. 1997;84:157–8.
27. Diao D, Wright JM, Cundiff DK, Gueyffier F. Pharmacotherapy for mild hypertension. Cochrane Database Syst Rev. 2012;15: CD006742.
28. Oshvandi K, Abdı S, Karampourian A, Moghimbaghi A, Homayounfar S. The effect of foot massage on quality of sleep in ischemic heart disease patients hospitalized in CCU. Iran J Crit Care Nurs. 2014;7:66–73.
29. Nerbass FB, Feltrim MIZ, Souza SA, Ykeda DS, Lorenzi-Filho G. Effects of massage therapy on sleep quality after coronary artery bypass graft surgery. Clinics. 2010;65:1105–10.
30. Pınar R, Afşar F. Back massage to decrease state anxiety, cortisol level, blood pressure, heart rate and increase sleep quality in family caregivers of patients with cancer: a randomised controlled trial. Asian Pac J Cancer Prev. 2015;16:8127–33.
31. Rapsomaniki E, Timmis A, George J, Pujades-Rodriguez M, Shah AD, Denaxas S, et al. Blood pressure and incidence of twelve cardiovascular diseases: lifetime risks, healthy life-years lost, and age-specific associations in 125 million people. Lancet. 2014;383:1899–911.