Effect of Lavender Oil Leg Massage on Physical, Cognitive, and Psychological Variables of Patients with Hypertension: A Randomized Controlled Trial

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Background: Hypertension (HTN) is one of the most important non-communicable risk factors that cause cardiovascular diseases. Complementary therapies including massage and aromatherapy are widely used in the management of HTN. However, studies on aromatherapy massage in HTN are limited. Thus, this study was conducted to evaluate the effect of lavender oil leg massage on physical (cardiopulmonary function), cognitive, and psychological variables of patients with HTN.

Materials and methods: A parallel-group randomized controlled trial, comprising 100 HTN patients aged 44.99 ± 5.39 years who were recruited and randomly divided into the study group (SG) and control group (CG), was conducted. The SG received lavender oil leg massage, while the CG received supine rest for 20 min. Outcome variables like blood pressure (BP), pulse rate (PR), random blood sugar (RBS) level, oxygen saturation, pulmonary function, oral temperature, trail making test (TMT) A and B, and state anxiety and mindfulness were assessed before and after the intervention.

Results: The within-group analysis showed a significant improvement in systolic blood pressure, diastolic blood pressure, PR, RBS, TMT-A, TMT-B, and state mindfulness both in the SG and CG. However, a significant reduction in state anxiety was observed only in the SG unlike the CG. Moreover, the between-group analysis showed a significant improvement in state mindfulness and state anxiety in the SG compared to the CG.

Conclusion: The results of this study suggest that lavender oil leg massage is effective in reducing BP and RBS, and improving cognitive function in hypertensive patients. In addition, it is more effective in reducing anxiety and improving mindfulness than rest in supine position in patients with HTN.

KEYWORDS: Hypertension; massage; aromatherapy; lavender oil; complementary therapies

INTRODUCTION

Hypertension (HTN) is one of the most important non-communicable risk factors that cause cardiovascular diseases that lead to death and disability.[1] In 2017–2018, HTN prevalence among adults aged 18 years and above was 45.4% and was higher among men (51.0%) than women (39.7%). The prevalence of HTN with age was 22.4% among adults aged 18–39 years, increased to 54.5% among those aged 40–59 years, and was 74.5% among those aged 60 years and above.[2] HTN is typically treated with calcium channel blockers, angiotensin-converting enzyme inhibitors and angiotensin II receptor blockers, beta-blockers, and diuretics. Unfortunately, long-term medications have potent side

effects.[3] In avoidance of real and perceived side effects from conventional HTN treatments, patients often seek complementary therapies. As an important non-pharmacological treatment approach, massage and aromatherapy has received ever-growing attention in managing blood pressure (BP) for hypertensive patients. A systematic review in 2014 involving 24 studies has reported that massage combined with antihypertensive drugs than antihypertensive drugs alone produces beneficial effect in patients with HTN by reducing systolic blood pressure (SBP) and diastolic blood pressure (DBP).[4] Meanwhile aroma oils like lavender oil may be more effective in reducing BP in hypertensive patients on inhalation.[5] Aromatherapy is the use of concentrated essential oils extracted from herbs, flowers, and other plant parts to treat various diseases.[6]

It works by inhaling, massaging, and bathing, and there are other ways to apply aromatic extracts to the human body. Compared with drug therapy, aromatherapy is more economical and simpler to use, and has fewer side effects like skin irritation and contact dermatitis. It is widely used in relieving stress, improving sleep disorders, and the treatment of depression, anxiety, etc.[7,8] Hence, we hypothesize that a combination of lavender oil with leg massage may produce a better improvement in physiological, cognitive, and psychological variables than massage and aromatherapy alone. Since there is a lack of scientific evidence-based study in combination with leg massage and lavender oil, the present study was conducted with the aim and objective to find the short-term effect of leg massage using lavender oil on physiological variables like BP, pulse rate (PR), blood glucose level (random blood sugar; RBS), oxygen saturation (partial pressure of oxygen; PO_2), temperature, pulmonary functions, cognitive functions like attention and memory, and psychological variables like anxiety and mindfulness in patients with HTN.

MATERIALS AND METHODS

Study Design

This is a parallel-group randomized controlled study. All the subjects were randomly (1:1 ratio) divided into either the study group (SG) (n = 50) or the control group (CG) (n = 50). The SG received only one session of leg massage using lavender oil, while the CG received supine rest for 20 min. Baseline and post-test assessments were taken before and after the intervention (Figure 1).

Subjects

A total of 100 subjects aged 44.99 ± 5.39 years were recruited from Government Yoga and Naturopathy Medical College and Hospital, Chennai, India. Male and female participants aged 30 years and above and diagnosed with primary HTN were included in the study. Patients with secondary HTN, those with HTN complications, and females during menstruation, pregnancy, and lactation were excluded from the study. The study protocol was approved by the institutional ethics committee of Government Yoga and Naturopathy Medical College, Chennai, India (ref no. RES/IEC-GYNMC/2021/089). Written informed consent was obtained from all subjects.

Intervention

Study group (SG)

Subjects underwent only one session of leg massage (Swedish massage technique) using lavender oil (3–4 drops) mixed with sesame seed oil (50 ml) individually for the duration of 20 min by a certified massage therapist in the medical hospital. All the participants were massaged by the same massage therapist.

Control group (CG)

Subjects were on rest in supine position for 20 min.

Note: Subjects in both the groups underwent intervention in the morning after 2–3 h of food intake.

Outcome Measures

Participants in both the groups were advised to avoid any kind of vigorous activities, alcohol and caffeine intake, and should have a sound sleep of 6–8 h, before the day of outcome assessments. The physiological, cognitive, and psychological outcome measures were taken before and after the intervention as mentioned below.

Physiological outcome measures

BP and PR were measured using an electronic BP monitor after 10 min of rest

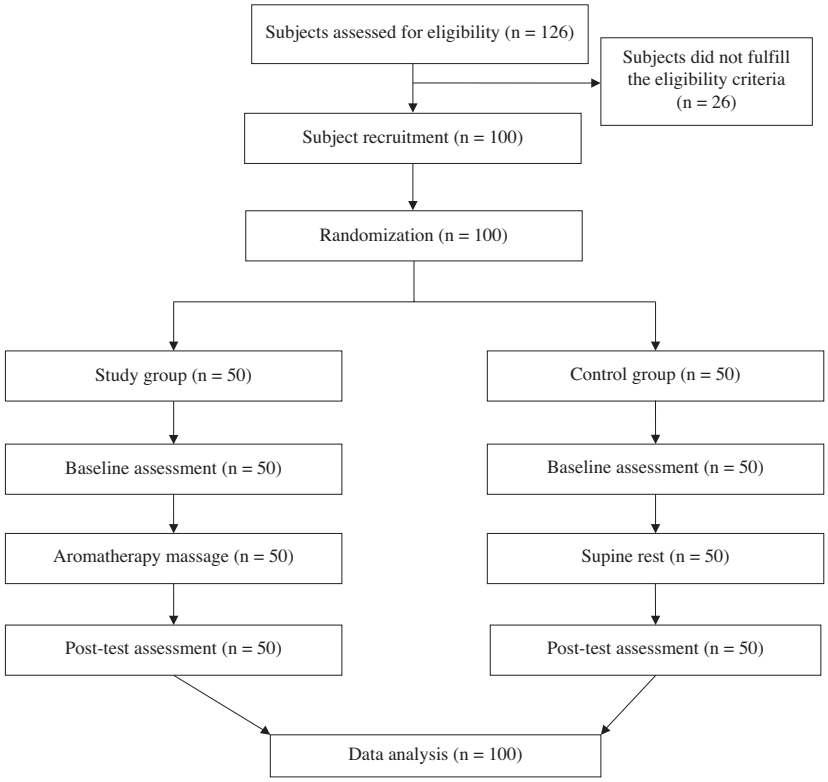

Figure 1. Trial profile.

in a sitting position, in the left arm. RBS was measured using a glucometer. PO_2 was assessed from the left index finger using a finger pulse oximeter. Pulmonary function was assessed using a peak expiratory flow meter. Oral temperature was assessed using a thermometer.

Cognitive outcome measures

Trail making test (TMT) A and B: The TMT is a short and convenient estimate of cognitive functions, principally attention and working memory. The TMT consists of two parts, A and B. Part A had a worksheet of numbers from 1 to 25, and the subject is required to join consecutive numbers. Part B consists of a worksheet of numbers from 1 to 13 and letters A–L, and the participant is required to alternate between numbers and letters in an ascending sequence. The time taken to complete the tests are taken as the subject's score. If the time taken to complete Part A is less than the time taken to complete Part B, the subject is considered to have difficulties in complex conceptual tracking. In general, performance is considered to be impaired if scores exceed 40 s for part A and 91 s for part B.[9]

Psychological outcome measures

Spielberger State-Trait Anxiety Inventory (STAI: Y-6 item): The STAI-6 consists of 6 items, with a 4-point Likert scale, from 1 = not at all to 4 = very much. To calculate the total STAI score (range 20–80), reverse scoring of the positive items (calm, relaxed, content) is done, so 1 = 4, 2 = 3, 3 = 2, and 4 = 1. All the six scores are added, and the total score is multiplied by 20/6. The normal score range varies from 20 to 80. STAI scores are commonly classified as "no or low anxiety" (20–37), "moderate anxiety" (38–44), and "high anxiety" (45–80).[10]

Mindfulness Attention Awareness Scale (MAAS): The state MAAS is a five-item scale designed to assess the short-term or current expression of a core characteristic of mindfulness, namely a receptive state of mind in which attention, informed by a sensitive awareness of what is occurring in the present, simply observes what is taking place. The short-form MAAS consists of 5 items, with 6-point Likert scale, from 0 = not at all to 6 = very much. To calculate the total MAAS score, reverse scoring of all items is done and then all five values are averaged. Higher scores reflect higher state mindfulness.[11]

Sample Size

A total of 100 volunteers with the age varying from 30 to 50 years were recruited. Sample size calculation was not made based on the previous study or pilot study, which is one of the limitations of the study.

Randomization and Blinding

The recruited 100 subjects were randomly allocated to the SG and CG (1:1 ratio) using a simple random method by computerized randomization. Allocation concealment was done in a sequentially numbered opaque and sealed envelope, handled by a researcher who was not involved in the assessment or intervention. Neither the subjects nor the investigator was blinded to the SG or CG.

Statistical Analysis

Data were checked for normality using the Kolmogorov–Smirnov test. Within-group analysis was performed using the paired samples *t*-test (normally distributed data) and Wilcoxon signed-rank test (non-normally distributed data) and between-group analysis was performed using the independent samples *t*-test (normally distributed data) and Mann–Whitney *U* test (non-normally distributed data) with the use of Statistical Package for the Social Sciences, version 16, for Windows (SPSS Inc., Chicago, USA). A p-value < 0.05 was considered as a significant result.

RESULTS

For the process of recruitment, around 180 patients with HTN were approached for the study, out of which 140 patients who turned for screening were assessed for eligibility. Of 140, 100 patients were recruited and were randomly allocated to either the SG (n = 50) or CG (n = 50). None of the subjects dropped out from the study, and thus, all data of the 100 subjects were included for analysis. Baseline demographical details of the study subjects are shown in Table 1.

Within-group analysis showed a significant improvement in SBP (SG: 140.78–131.84 mmHg, effect size = 0.572; CG: 138.84–136.7 mmHg, effect size = 0.151), DBP (SG: 88.66–84.64 mmHg, effect size = 0.463; CG: 88.32–86.26 mmHg, effect size = 0.003), PR (SG: 83.44–80.70 bpm, effect size = 0.216; CG: 84.06–83.66 bpm, effect size = 0.042), RBS (SG: 134.54–132.94 mg/dl, effect size = 0.038; CG: 139.88–139.10 mg/dl, effect size = 0.016), TMT-A (SG: 2.56–2.51, effect size = 0.093; CG: 9.51–2.52, effect size = 0.143), TMT-B (SG: 3.03–2.94, effect size = 0.145; CG: 2.99–2.93, effect size = 0.109), state anxiety (SG: 51.53–45.47, effect size = 0.827; CG: 50.73–49.60, effect size = 0.168), and state mindfulness (SG: 3.15–2.34, effect size = 0.999; CG: 3.21–2.97, effect size = 0.346) in the SG over the CG. Moreover, between-group analysis showed a significant improvement in state mindfulness ($p < 0.001$) and state anxiety ($p = 0.03$) in the SG compared to the CG. No statistically significant difference was obtained in PO_2, peak expiratory flow rate, and forced expiratory volume in 1 s in both groups (Table 2). None of the subjects reported any adverse effect during the study period.

Table 1. Demographic Details of the Study and Control Group

Parameters	*Study Group (n = 50)*	*Control Group (n = 50)*
Age (years)	45.90 ± 5.07	44.16 ± 5.72
Gender	Male (n = 3), female (n = 47)	Male (n = 27), female (n = 23)
Height (cm)	163.02 ± 7.47	167.3 ± 7.59
Weight (kg)	67.06 ± 8.98	67.32 ± 5.99
Body mass index (kg/m^2)	25.78 ± 4.96	25.78 ± 4.96

DISCUSSION

In this study, the effect of lavender oil leg massage on BP, PR, RBS, PO_2, pulmonary functions, temperature, cognitive functions, anxiety, and mindfulness was evaluated in patients with HTN. The state mindfulness and state anxiety in the SG showed a significant improvement compared to the CG in between-group analysis. An increased level of epinephrine, norepinephrine, and cortisol promotes anxiety. Previous studies suggest that massage[12,13] and lavender oil inhalation[14,15] reduces anxiety levels. The anxiolytic effect of linalool (one of the main components of lavender oil) was linked sodium channel action potential-blockage.[16] Lavender oil

TABLE 2. Pre-test and Post-test Assessments of the Study Group and Control Group

Parameter	*Study Group (n = 50)*			*Control Group (n = 50)*			*Between-group Analyses*	
	Pre-test	*Post-test*	*Effect Size (Cohens' d)*	*Pre-test*	*Post-test*	*Effect Size (Cohens' d)*	*t/z Value*	*p-Value*
SBP (mmHg)	140.78 ± 14.00	131.84 ± 16.88*** (z)	0.572	138.84 ± 14.32	136.7 ± 13.93** (z)	0.151	t = 1.571	0.120
DBP (mmHg)	88.66 ± 6.79	84.64 ± 9.77*** (z)	0.463	88.32 ± 5.89	86.26 ± 6.28** (z)	0.003	z = 1.098	0.272
PR (bpm)	83.44 ± 13.00	80.70 ± 12.36* (t)	0.216	84.06 ± 10.02	83.66 ± 9.11 (t)	0.042	t = 1.363	0.176
RBS (mg/dl)	134.54 ± 42.72	132.94 ± 41.46*** (z)	0.038	139.88 ± 48.81	139.10 ± 48.52* (z)	0.016	z = 0.217	0.828
Temp (°C)	36.59 ± 0.83	36.77 ± 0.75* (z)	0.227	36.64 ± 0.75	36.45 ± 1.32 (z)	0.166	z = 0.647	0.518
PO_2 (%)	97.86 ± 0.99	98.02 ± 1.06 (z)	0.156	98.12 ± 0.69	98.12 ± 0.72 (z)	0	z = 0.119	0.905
PEFR (l/min)	263.40 ± 43.37	275.56 ± 63.55 (t)	0.216	267.52 ± 48.70	281.32 ± 54.69 (t)	0.266	t = 0.486	0.628
FEV1	1.87 ± 0.60	1.95 ± 0.62 (t)	0.131	2.00 ± 0.55	2.17 ± 0.60 (z)	0.295	z = 1.431	0.153
TMT-A	2.56 ± 0.50	2.51 ± 0.56** (z)	0.093	9.51 ± 49.14	2.52 ± 0.54** (z)	0.143	z = 0.255	0.798
TMT-B	3.03 ± 0.61	2.94 ± 0.63*** (z)	0.145	2.99 ± 0.55	2.93 ± 0.55** (z)	0.109	z = 0.179	0.858
SA	51.53 ± 7.44	45.47 ± 7.21*** (t)	0.827	50.73 ± 7.14	49.60 ± 6.20 (z)	0.168	t = 3.073	0.003[a]
SM	3.15 ± 0.82	2.34 ± 0.80*** (z)	0.999	3.21 ± 0.75	2.97 ± 0.62*** (z)	0.346	z = 3.978	<0.001[a]

Note: Values are in mean ± standard deviation.
[a]p < 0.01 (between-group analysis).
FEV1 = forced expiratory volume in 1 s; d = Cohens d; DBP = diastolic blood pressure; PEFR = peak expiratory flow rate; PO_2 = partial pressure of oxygen; PR = pulse rate; RBS = random blood sugar; SA = state anxiety; SBP = systolic blood pressure; SM = state mindfulness; *t* = paired *t*-test; Temp = temperature; TMT-A = trail making test A; TMT-B = trail making test B; z = Wilcoxon signed-rank test.
*p < 0.05 (within-group analysis).
**p < 0.01 (within-group analysis).
***p < 0.001 (within-group analysis).

is also known to reduce beta brain wave activity and induces alpha waves in the cortex, which causes relaxation, vigilance, and awareness.[17] The present study also showed a significant reduction in state anxiety and a significant increase in mindfulness after the lavender oil leg massage compared to supine rest in patients with HTN, which is supporting the results of the previous study.

The within-SG analysis showed a significant reduction in SBP, DBP, PR, RBS, and state anxiety and a significant increase in temperature with a significant improvement in cognitive task performance (i.e., reduction in TMT-A and TMT-B scores) and state mindfulness in the post-test assessment compared to pre-test assessments.

Massage increases the high-frequency component, a decrease in the ratio of low-frequency component to high-frequency component of heart rate variability (HRV), which indicates a change from sympathetic activities to parasympathetic activities.[18] Massage stimulates the pressure receptors under the skin and enhances the vagal activity, which in turn reduces the epinephrine, norepinephrine, and cortisol level and produces significant reduction in BP and PR.[12,13,19–21] Shiri hypothesized that massage changes the gradient pressure between the tissues and vessels that consequently facilitates the movement of liquids between tissues and vessels and vice versa, which in turn reduces the BP.[22] Likewise, inhalation of lavender oil enhances vagal activity and produces a significant reduction in BP and PR.[14,15] This literature suggests that lavender oil in combination with leg massage used in this study might reduce the BP by decreasing the stress hormone level and enhancing the parasympathetic activity.

Previous studies suggest that massage reduces fasting blood glucose, postprandial blood glucose, and glycated hemoglobin,[23] while lavender oil massage reduces neuropathic pain in type 2 diabetes patients.[24] It supports the results of our study (i.e., a significant reduction in RBS after the intervention). Lee et al. observed an increase in body temperature by the effect of blood circulation after back massage and foot bath using lavender oil.[25] Thus, increased blood circulation might be attributed to the increased body temperature after lavender oil massage in the present study.

Diego et al. observed that the lavender oil exposure showed increased frontal beta power, reported feeling more relaxed, and performed math computations faster and more accurately.[26] Makeig and Inlow reported that increased beta power may reflect increased alertness and decreased drowsiness.[27] Fung and Tsang in a study suggest that aroma massage with acupressure is as effective as cognitive training and can enhance cognitive training in reducing the severity and distress of behavioral and psychological symptoms of dementia.[28] These studies suggest that aroma massage produces significant improvement in cognitive functions. Likewise, the present study also reported that lavender oil leg massage in hypertensive patients produces improvement in cognitive functions like attention and memory. A study by Sundar et al. reported a significant reduction in BP and doses of antihypertensive drugs after shavasana (supine rest),[29] which is also supporting the present study results.

Limitations

This is the first study evaluating the effect of lavender oil leg massage on physical and psychological aspects of the patients with HTN. However, the research hypothesis is not fully justified without controlling for unscented massage, it is hard to know if lavender has an additional benefit. This is one of the major limitations of the study. So the further studies are directed to the use of an additional group of unscented massage to clearly justify the hypothesis. And the study had a small sample size, and the sample size was not calculated. Assessments such as autonomic function testing (e.g., HRV) and stress hormone testing were not done. Only immediate effect was studied; thus, short-term or long-term effect is unknown. Hence, further studies are recommended with a larger sample size and more objective variables for better understanding.

CONCLUSION

The results of this study suggest that lavender oil leg massage is effective in reducing BP and RBS, and improving cognitive function in hypertensive patients. In addition, it is more effective in reducing anxiety and improving mindfulness than rest in supine position in patients with HTN.

CONFLICT OF INTEREST NOTIFICATION

The authors declare there are no conflicts of interest.

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