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Immediate effects of foot massage and reflexology combined with aromatherapy on blood pressure and heart rate in individuals with hypertension: A pilot study

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Abstract

Study aim: Chronic hypertension is a significant health issue that can result in serious adverse cardiovascular events. There is inadequate evidence to confirm the beneficial effects of aroma foot massage and reflexology on blood pressure (BP) and heart rate (HR) in individuals with hypertension. Consequently, this study sought to investigate the immediate impact of a combination of foot massage, reflexology, and aromatherapy on BP and HR in hypertensive patients.

Material and methods: Twenty hypertensive patients (mean age: 48.05 ± 7.88 years) were divided into two groups: a control group (n = 10) and an experimental group (n = 10). The experimental group engaged in self-administered foot massage and reflexology while inhaling lavender essential oil aromatherapy. In contrast, the control group remained in a private room without the use of aromatherapy. Heart rate (HR) and blood pressure (BP) were measured before and after a 15-minute intervention period.

Results: Both BP and HR significantly decreased in both groups after intervention. However, the percentage change of HR in the experimental group was significantly greater than in the control group (p = 0.001).

Conclusions: These results indicated that a single session of self-administered aroma foot massage and reflexology may reduce heart rate in patients with hypertension. This information could help mitigate the risk of cardiovascular events in such patients.

Keywords: Foot massage – Reflexology – Aromatherapy – Hypertension – Blood pressure

Introduction

Hypertension poses a significant public health challenge globally, contributing to the development of cardiovascular diseases, stroke, and premature mortality. The prevalence of hypertension among adults in the WHO European region decreased between 1990 and 2019. However, it increased in Asian regions, particularly in the WHO Southeast Asia region (from 29% to 32%, including countries such as India, Nepal, Indonesia, and Thailand). It is crucial to highlight the importance of controlling hypertension, especially in the WHO South-East Asia region, to reduce the global burden of cardiovascular diseases (Kario et al., 2024).

It is essential to understand that untreated hypertension can lead to several serious consequences. There is a well-established connection between high blood pressure (BP), stress, and anxiety, as well as the potential development of other heart-related conditions (Mucci et al., 2016). A recent study indicated that heart rate (HR) could be an independent risk factor for major adverse cardiovascular events among patients with hypertension. Therefore, maintaining an appropriate HR control level is crucial in the treatment of hypertension (Sun et al., 2021).

While the primary class of medications for hypertension is generally linked to mild side effects, research indicates that over half of patients undergoing treatment for hypertension face challenges with medication adherence due to intolerable adverse effects (Lee et al., 2021; van der Laan et al., 2017). Beyond antihypertensive medications, non-pharmacological approaches are also vital in managing hypertension and preventing its associated complications (Kodela et al., 2023).

Alternatively, various techniques such as exercise, dietary modifications, and stress reduction have been

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demonstrated to effectively reduce the incidence of hypertension and enhance its management (Verma et al., 2021). Some studies indicate that aroma inhalation, particularly with lavender essential oil, can lower HR and BP in both healthy individuals and those diagnosed with hypertension (Eguchi et al., 2016; Koulivand et al., 2013; Rahmadhani, 2022). Furthermore, research has revealed that reflexology and foot massage can positively affect BP and HR (Calisanie & Preannisa, 2022; Fitriani et al., 2019; Kotruchin et al., 2021; Ni Kadek Yuni Lestari et al., 2023).

In studies concerning hypertensive patients, while many previous investigations on aromatherapy involved large sample sizes, most lacked a control group. When it comes to research focused on foot massage or reflexology, although some studies included a control group and had significant sample sizes, the majority primarily considered BP as the sole outcome measure (Calisanie & Preannisa, 2022; Fitriani et al., 2019). One particular study examined both BP and HR before and after two minutes of reflexology (Kotruchin et al., 2021). However, it is important to note that the outcome measurement was not conducted immediately; rather, there was a washout period of 15 to 30 minutes, which could have influenced the results due to potential confounding factors. Additionally, in all prior studies, foot massage and reflexology were provided as passive treatments.

Increasing evidence suggests that patient engagement in self-care, particularly for managing chronic diseases, can improve medical outcomes. It is clear that autonomy and self-management behaviors are essential for individuals living with hypertension and should be prioritized. It is crucial to prevent negative consequences and enhance the quality of life for those with chronic illnesses (Audthiya et al., 2021; Sarasohn-Kahn, 2013). There has not yet been any research on integrative therapy that combines foot massage, reflexology, and aromatherapy for self-care strategies in individuals with hypertension. With this in mind, this present study examined the immediate effects of foot massage and reflexology combined with aromatherapy on BP and HR in individuals with hypertension. It was hypothesized that this combined technique could be utilized as a complementary approach to health for hypertensive patients.

Material and methods

The research was authorized by the Human Ethics Committee of the University of Phayao (HREC-UP-HSST 1.3/021/67) and adhered to the Declaration of Helsinki. Prior to the testing, all participants provided written informed consent. The study involved a total of 20 healthy participants. Convenience sampling was utilized to facilitate data collection. The participants were randomly assigned to either the experimental group (n = 10) or the control group (n = 10) using the simple randomization method.

The individuals were assessed based on the inclusion and exclusion criteria. To fulfill the inclusion criteria, participants must: 1) be aged 30–60, 2) have been diagnosed with hypertension for at least 6 months, 3) consistently take antihypertensive medication, 4) have a normal sense of smell, 5) not have used any essential oils in the past 6 months, 6) not have undergone foot massage or reflexology in the last 6 months, 7) consent to take part in the study, and 8) have normal perception and cognition.

Participants with extremely high BP (systolic blood pressure (SBP) ≥ 180 mmHg and/or diastolic blood pressure (DBP) ≥ 110 mmHg) were excluded from the study (Cohen, 1988). Additionally, individuals with a history of fragrance allergy, sinusitis, respiratory disease, cancer, kidney disease, diabetes mellitus, and lower extremity problems were excluded (Bagetta et al., 2016; Braun & Simonson, 2014, Price & Price, 2007; Salvo, 2016). The study also excluded participants who used sedative drugs (Calvi et al., 2021), were pregnant (Mueller & Grunwald, 2021), experiencing menstrual period (Shankhwar et al., 2024), or had blurred vision (Stacey et al., 2015).

SBP, DBP and HR were measured using a digital BP monitor (HOF BP, HK-803 Robot, Pharmahof Co., Ltd.) before and after the intervention. Following the intervention, participants in the experimental group were asked to indicate their satisfaction level using a Likert scale (with a score of four representing excellent satisfaction and zero indicating no satisfaction).

The experimental group engaged in a 15-minute session of self-administered foot massage and reflexology using specialized equipment shaped like a hemisphere. In addition, they inhaled lavender essential oil (Pure Lavender Essential Oil, Chanaka Dhibesra Damri, Royal Project Agricultural Research and Development Center, Thailand) using an ultrasonic aroma diffuser, with 3 drops of essential oil mixed with 120 mL of water for aromatherapy. Meanwhile, the control group was instructed to sit and relax without taking any action for 15 minutes in a private, peaceful room. The detailed procedure for the experimental group is as follows:

- First, a 10-minute foot massage was performed, followed by 5 minutes of reflexology, totaling 15 minutes, with inhalation of an aromatherapy scent throughout the session.
- The participants were seated in chairs with armrests. The massage began with the right foot placed on the device. The massage targeted the heel, the midsole, and the toes in that sequence, with each area being massaged three times, constituting one round. This process lasted two minutes. Next, the same procedure was applied to the left foot.
- After completing the foot massage while seated on both sides, the participants transitioned to a standing position, continuing the same technique. To ensure stability, they held onto a walker while standing. Once the foot massage

in this position was finished on both sides, the participants were instructed to sit down and rest for 2 minutes.

- To begin, pressure was applied with the right foot onto the device to target acupressure on the plantar aspect of the right foot, specifically at the first metatarsal bone, approximately 1–1.5 cm proximal to the first metatarsophalangeal joint. This pressure was maintained for 15 seconds, followed by a 5-second release. This cycle of holding and releasing was repeated five times, taking a total of 2 minutes. After a 1-minute rest, the same procedure was repeated on the left foot.

The data were analyzed using IBM SPSS Statistics version 26 (IBM Corp., Armonk, NY). All baseline data are presented as mean ± SD. To assess the normality of the variables, the Shapiro-Wilk test was employed. Significant differences in baseline data between groups were evaluated using the independent t-test.

The dependent variables were analyzed using a mixed ANOVA with two factors: one between-subjects factor (group) comprising two levels (exercise and control) and one within-subjects factor (time) consisting of two levels (pre and post). To control for Type I errors, the alpha level was set to 0.025 utilizing the Bonferroni correction. When an interaction was found to be significant, a one-way repeated-measures ANOVA was conducted for the time factor. A conservative cutoff of $p < 0.01$ was established to determine statistical significance for the one-way ANOVAs. According to Cohen's guidelines, effect sizes were categorized as small ($d = 0.2$), medium ($d = 0.5$), and large ($d \geq 0.8$). Additionally, the percentage changes of SBP, DBP, and HR were compared between groups using the independent t-test, with the significance level set at $p < 0.05$.

Results

At baseline, there were no significant differences between groups in participant characteristics (Table 1).

Table 1. General characteristics of participants ($n = 20$)

Variables	Experimental group ($n = 10$) Mean ± SD	Control group ($n = 10$) Mean ± SD	p-value
Gender: Male/Female	5/5	3/7	0.361
Age (years)	49.90 ± 7.78	46.20 ± 7.93	0.306
Weight (kg)	65.60 ± 11.24	62.70 ± 8.08	0.516
Height (cm)	162.00 ± 6.16	163.80 ± 5.45	0.498
Body mass index (kg/m^2)	24.86 ± 2.90	23.01 ± 2.34	0.134
Duration of HT (years)	5.40 ± 0.97	6.10 ± 1.52	0.236

HT: Hypertension

A significant interaction effect was observed only for HR ($F_{1,18} = 18.241$, $p < 0.001$, $\eta_p^2 = 0.503$). There was no significant interaction for SBP ($F_{1,18} = 1.607$, $p = 0.221$, $\eta_p^2 = 0.082$) or DBP ($F_{1,18} = 0.497$, $p = 0.490$, $\eta_p^2 = 0.102$) (Table 2). The time effect was significant with lower HR ($F_{1,18} = 394.79$, $p < 0.001$, $\eta_p^2 = 0.956$) at post-test (Fig. 1).

Table 2. HR and BP in the experimental ($n = 10$) and control groups ($n = 10$) before and after intervention ($N = 20$)

Variables	Group	Time		Group × Time			
		Pre-test Mean ± SD	Post-test Mean ± SD	F	P	η_p^2	Power
SBP (mmHg)	Experimental	146.90 ± 5.78	141.40 ± 8.04 [a]	1.607	0.221	0.08	0.23
	Control	152.60 ± 6.52	148.70 ± 6.98 [b]				
DBP (mmHg)	Experimental	89.00 ± 3.59	85.10 ± 3.84 [b]	0.497	0.490	0.03	0.10
	Control	85.60 ± 4.14	81.20 ± 4.08 [b]				
HR (bpm)	Experimental	78.80 ± 3.85	72.30 ± 4.47 [b]	18.241	< 0.001	0.50	0.98
	Control	81.00 ± 3.83	76.80 ± 3.68 [b]				

For the one-way repeated-measures ANOVA, alpha was set at 0.01, [a] $p < 0.01$ and [b] $p < 0.001$.

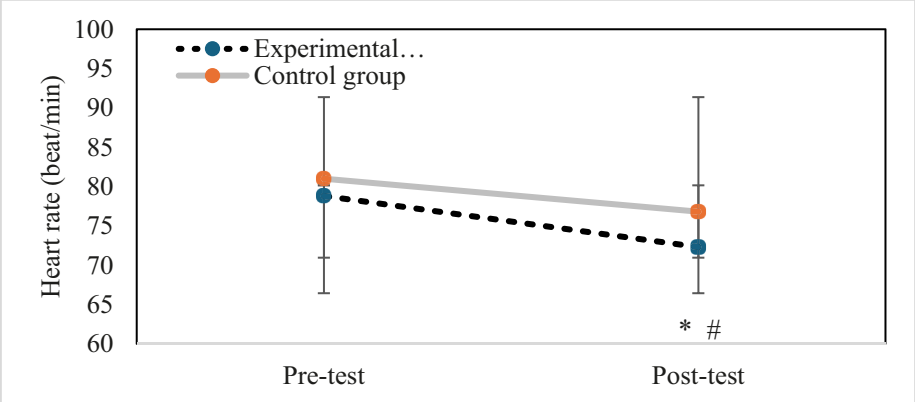

Figure 1. Means and standard deviations of the HR for the experimental and control groups at pre-test and post-test. Asterisk or number sign indicates a significant difference between pre-test and post-test for the experimental group ($^{*}p < 0.001$) and control group ($^{\#}p < 0.001$) respectively

No statistically significant difference was observed between the groups for the percentage change in SBP ($p = 0.192$) or DBP ($p = 0.375$). However, the percentage change in HR in the experimental group was significantly greater compared to the control group ($p = 0.001$) (Table 3). Furthermore, the experimental group reported an average satisfaction level of 3.40 ± 0.70 out of 4, indicating a high level of satisfaction.

Table 3. Percentage change of HR and BP in the experimental and control groups before and after intervention ($N = 20$)

Variables	Group	N	Mean ± SD	P value	Effect sizes	Power
% Change of SBP	Experimental	10	–3.78 ± 2.59	0.192	0.617	0.257
	Control	10	–2.57 ± 0.99			
% Change of DBP	Experimental	10	–4.39 ± 1.53	0.375	0.407	0.139
	Control	10	–5.13 ± 2.07			
% Change of HR	Experimental	10	–8.29 ± 2.00	0.001	1.939	0.984
	Control	10	–5.18 ± 1.07			

In the two-way repeated-measures ANOVA for the group × time interaction, alpha was set at 0.025. Abbreviations: SBP – systolic blood pressure; DBP – diastolic blood pressure; HR – heart rate.

Discussion

This preliminary study aimed to evaluate the immediate effects of combining foot massage, reflexology, and aromatherapy on BP and HR in individuals with hypertension. The results indicated that a single session of self-administered aroma foot massage and reflexology can reduce HR among patients with hypertension. The recent findings demonstrated that this intervention significantly improved HR reduction in the experimental group, which also reported high satisfaction following the treatment. Although both SBP and DBP showed significant decreases, no notable differences were observed between the groups.

To the researchers' knowledge, this study represented the first instance of administering foot massage, reflexology, and aromatherapy to hypertensive patients as part of a proactive self-care approach. Comparing data across studies can be challenging due to variations in tasks and equipment used. In the current study, participants in the experimental group performed self-administered foot massages and reflexology with the aid of dome-shaped equipment in conjunction with an ultrasonic aroma diffuser. The results concerning HR corroborated the findings of Kotruchin et al. (2021), who observed that a single 2-minute session of reflexology led to a significant reduction in HR by 2.6 bpm and 4.1 bpm after 15 and 30 minutes, respectively, despite the change in DBP not being statistically significant. These findings suggested that the combined effects of lavender essential oil, foot massage, and reflexology may induce a parasympathetic response, leading to a reduction in HR following the intervention. Ultimately, an increase in parasympathetic activity is associated with a decrease in HR and peripheral vasodilation (Gordan et al., 2015).

The feet play a crucial role in overall health, as they are regarded as one of the body's major organs (Cai et al., 2023). Reflexology specifically targets areas of the body that are believed to regulate vital energy or qi, according to ancient Chinese traditions (Wang & Xiong, 2013). During reflexology sessions, vagal tone modulation is enhanced by activating a neural baroreflex, which leads to physiological changes in autonomic nerve function, including a reduction in HR (Stanley et al., 2013). In the present study, the reflex point was located at the first metatarsal bone, similar to the methodology used in the research conducted by Kotruchin et al. (2021). Notably, the current findings indicated an 8.29% change, corresponding to a decrease in HR of 6.50 beats per minute in the experimental group. The effect size of 1.939 further suggested a substantial difference in HR outcomes, while the statistical power of 98.1% supports the reliability of this finding.

A study conducted by Sun et al. (2021) revealed that hypertensive patients with HR below 65 bpm and those at or above 80 bpm experienced risks of major adverse cardiovascular events that were 0.45-fold and 0.391-fold higher, respectively, compared to patients whose HR ranged from 70 to 74 bpm. The current findings indicated that HR after the intervention was 72.3 bpm in the experimental group and 76.8 bpm in the control group. This information could be crucial for mitigating the risk of cardiovascular events in hypertensive patients.

Foot massage, which was also incorporated into the intervention, serves as a form of cutaneous stimulation that can assist the body in achieving homeostasis by influencing both extrinsic and intrinsic peripheral blood flow. In extrinsic contexts, the manipulation involved in foot massage triggers vasomotor activity, leading to smooth muscle relaxation and vasodilation in arterioles. Additionally, the psychological effects of foot massage promote a sense of calm and relaxation, which positively affects the autonomic nervous system. Specifically, during a foot massage, parasympathetic nerve fibers release acetylcholine, which acts on nodal cells, resulting in decreased depolarization frequency and reduced HR (Chen et al., 2019). Furthermore, lavender aromatherapy, which was also integrated into the intervention, has been shown to contain linalool, a terpene that effectively reduced sympathetic nervous system activity while enhancing parasympathetic function (Koulivand et al., 2913).

The inability to change BP in this study may stem from the nature of the reflexology implemented. Typically, BP increases during physical activity due to heightened cardiovascular demand and greater oxygen uptake by active muscles (Gordan et al., 2015). However, participants engaged in a 15-minute intervention while in both sitting and standing positions, which may be considered light activity. This might have hindered their ability to achieve a reduction in BP. Nevertheless, the experimental group reported an average satisfaction level of 3.40 ± 0.70 out of 4, reflecting a high degree of contentment with the relaxation experience. After the intervention, the patients were asked about their satisfaction with the treatment regarding how comfortable and relaxed it made them feel. The high satisfaction scores suggested that the intervention effectively promoted a state of relaxation, even if it did not translate into a significant decrease in BP. Importantly, no adverse effects were noted in the present study.

Regarding the BP results, the present study's findings do not align with those of Calisanie et al. (2022), which demonstrated that foot massage can effectively lower BP and reduce anxiety in individuals with hypertension. Specifically, their study reported a change in SBP of 25.54 mmHg in the experimental group compared to 2.68 mmHg in the control group. The changes in DBP were 9.75 mmHg in the experimental group and 3.78 mmHg in the control group. Unfortunately, HR was not examined in their research. Participants in Calisanie et al. (2022)'s study received foot massage from therapists for 30 to 45 minutes per session, three times over three days. In contrast, the current findings revealed changes in SBP after intervention of 5.5 mmHg in the experimental group and 3.9 mmHg in the control group, while the changes in DBP were 3.9 mmHg in the experimental group and 4.4 mmHg in the control group. Furthermore, the results diverge from those of Ramadhani (2022), which suggested that aromatherapy could effectively lower BP in individuals with hypertension. In their study, participants inhaled lavender scent via a steam diffuser for 15 minutes once a day over 6 days. In contrast, participants in the present study engaged in a single 15-minute self-administered foot massage and reflexology session. This may explain why the study found no significant change in BP, potentially due to an insufficient dose of the intervention.

This pilot study exhibits several strengths, notably the use of a mixed-method design that allowed for an in-depth exploration of participants' BP and HR. Additionally, the incorporation of both subjective and objective evaluations to represent a state of relaxation related to the parasympathetic nervous system enhances the study's robustness. However, several limitations must be addressed before drawing generalized conclusions. Firstly, the limited sample size may undermine the reliability of the results, as the study was not adequately powered to assess SBP and DBP outcomes (with statistical power of 22.5% and 10.2%, respectively). Future research should aim to recruit larger samples to strengthen the findings. Secondly, the research design did not facilitate the assessment of long-term effects, indicating that the results need validation in subsequent studies. Moreover, the current study lacked subjective clinical outcome assessments related to stress or anxiety, which is a significant concern given the

well-established connection between these factors, elevated BP, and the risk of various heart-related health issues. Lastly, the study design was not double-blinded, which could introduce bias and potentially inflate the perceived effect. A crossover study design would be more appropriate for future research.

Conclusions

The use of self-administered lavender aroma foot massage and reflexology positively influenced the HR of patients with hypertension. This method may serve as a complementary therapy alongside pharmacological treatments to enhance HR control in individuals suffering from high BP. However, further research is necessary to explore the long-term effects of these interventions on hypertensive patients who depend on lifelong antihypertensive medication. Additionally, incorporating assessments of respiratory rate, brain activity, stress levels, and anxiety may provide a more comprehensive evaluation of the impact of these interventions.

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Conflict of interest: Authors state no conflict of interest

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