

# Effects of a Mindfulness Meditation on Blood Pressure in Prehypertension Patients: A Randomized Controlled Trial

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**Objective:** To test the effectiveness of mindfulness training on blood pressure reduction in pre-hypertension people.

**Materials and Methods:** A randomized control trial was used. Pre-hypertension people with systolic blood pressure (SBP) 130 to 139 and diastolic blood pressure (DBP) 80 to 89 mmHg were randomly assigned to either the intervention with 35 people or the control group also with 35 people. A mindfulness-based brief intervention program (MBBI) was performed for eight weeks. The authors measured the blood pressure at baseline, week 8, 12, and 20. Mixed linear regression was used to test the effect of MBBI.

**Results:** Seventy participants were included and allocated equally to either the intervention or the control group with 35 participants each. MBBI had the effect of lowering SBP compared to the control group at week 8 (mean difference -3.50, 95% confidence interval -5.13 to -1.87), week 12 (mean difference -5.63, 95% confidence interval -7.25 to -3.99), and week 20 (mean difference -7.81, 95% confidence interval -9.44 to -6.18). For DBP, the authors observed statistically significant decreases only at week 12 (mean difference -3.09, 95% confidence interval -6.15 to -0.02).

**Conclusion:** The authors observed the effect of a MBBI on decreasing SBP and DBP.

**Keywords:** Pre-hypertension; Mindfulness based brief intervention; Blood pressure

Received 15 May 2023 | Revised 7 August 2023 | Accepted 9 August 2023

**J Med Assoc Thai 2023;106(9):843-8**

**Website:** <http://www.jmatonline.com>

Hypertension is a major public health problem as the leading cause of death from chronic non-communicable diseases<sup>(1)</sup>. There is a global burden of hypertension with 973 million people reported to have high blood pressure. This is projected to increase to 1.56 billion by 2025<sup>(2)</sup>. In Southeast Asian countries, the prevalence of hypertension is 27%, and more common in urban communities than rural areas<sup>(3)</sup>. Hypertension is caused by factors such as genetics, inappropriate lifestyle behaviors, consumption of salty high-fat foods, insufficient intake of fruits and vegetables, lack of exercise, alcohol consumption, smoking, and stress<sup>(1,4)</sup>. For controlling blood pressure to a normal range, the best way is health

behavior modifications including weight reduction in overweight people, modifying food intake, and reducing salty foods<sup>(5,6)</sup>. There are behavioral interventions for reducing blood pressure including mindfulness meditation. Mindfulness is defined as paying attention on purpose, in the present moment, and non-judgmentally to the unfolding of experience moment by moment<sup>(7)</sup>. Systematic reviews and meta-analysis show that there are benefits of mindfulness meditation in reducing blood pressure<sup>(8,9)</sup>. In Thailand, mindfulness is popular for use on occasions such as before sleeping or in the temples.

Therefore, the present study aimed to test the mindfulness-based brief intervention (MBBI) on reducing blood pressure in pre-hypertension people.

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## How to cite this article:

Pukdeesamai R, Srihatrai P, Intarut N. Effects of a Mindfulness Meditation on Blood Pressure in Prehypertension Patients: A Randomized Controlled Trial. *J Med Assoc Thai* 2023;106:843-8.

DOI: 10.35755/jmedassocthai.2023.09.13886

## Materials and Methods

Ethical approval for the present study was obtained from the Human Research Ethics Committees of Maharakham University number 202/2563 and requested for permission to conduct clinical research by registering clinical research in Thailand (Thai Clinical Trials Registry, TCTR) number TCTR20210417002.

## Design and population

A single-blinded randomized control trial with follow up assessment was conducted to evaluate the effectiveness of mindfulness training between September 1, 2021 and April 30, 2022. The study setting was the adult population in Junghan District, Thailand. The target population consisted of adults diagnosed with pre-hypertension that was defined as systolic blood pressure (SBP) between 130 to 139 mmHg and diastolic blood pressure (DBP) between 85 to 89 mmHg. The authors excluded non-communicable disease patients. The present study was conducted in two phases. Phase I studied the relationship of variables affecting blood pressure in the pre-hypertension group. The second phase was to evaluate the effect of mindfulness training on reducing blood pressure in the pre-hypertension people.

Participants were enrolled by a trained nurse at a primary health care center. All participants who met the study criteria and were willing to participate, provided written consents, and were randomly allocated to the intervention and the control arm.

## Measurements

Primary outcome: Blood pressure was measured using an automated oscillometric device (Microlife B3 AFIB, Microlife Corp, Taiwan). The authors measured the blood pressure about three times at 1-minute intervals with a following 5-minutes rest. The mean of the three blood pressure measurements was used as the blood pressure<sup>(10)</sup>.

Secondary outcome: Pulse rate was recorded, and body mass index (BMI) was calculated as the body weight (in kg) divided by squared body height (in meters). Waist circumference (cm), heart rate, stress, depression, and anxiety were measured by DASS-21 which comprised 21 questions<sup>(11)</sup>.

Other covariates: The authors also collected data on the following variables, gender (male, female), marital status (married, single/divorced), education (primary school, secondary school, or higher), monthly income (less than 5,000, 5,000 or more, in Thai Baht), smoking status (yes, no), and alcohol consumption (yes, no).

## Intervention program

The mindfulness training on the blood pressure reduction intervention program was designed based on self-efficacy theory. The present study used a short mindfulness training program (MBBI) to modify health behaviors for people with behavioral

problems<sup>(12)</sup>. All activities were organized for eight weeks divided as follows, Week 1, orientation, activities to educate about diseases, causes, and prevention. Week 2, basic meditation practice. Week 3, mindfulness training/appropriate physical activity. Week 4, mindfulness practice in Eating/Food Knowledge. Week 5, practice mindfulness to control emotions. Weeks 6 to 7 continue the practice. At week 8, the practice was reviewed. In each week, participants were trained by MBBI for 1.30 to 2 hours and recorded in the training form. The training program used the Thai Mindfulness in Organization (MIO) application for warning to mindfulness practice. After the end of the activity, results were followed up on week 12 and week 20.

The authors allocated participants to receive either the MBBI or the control groups. For control groups, the authors educated participants about diseases, causes, prevention eating, and exercise, by providing an information brochure.

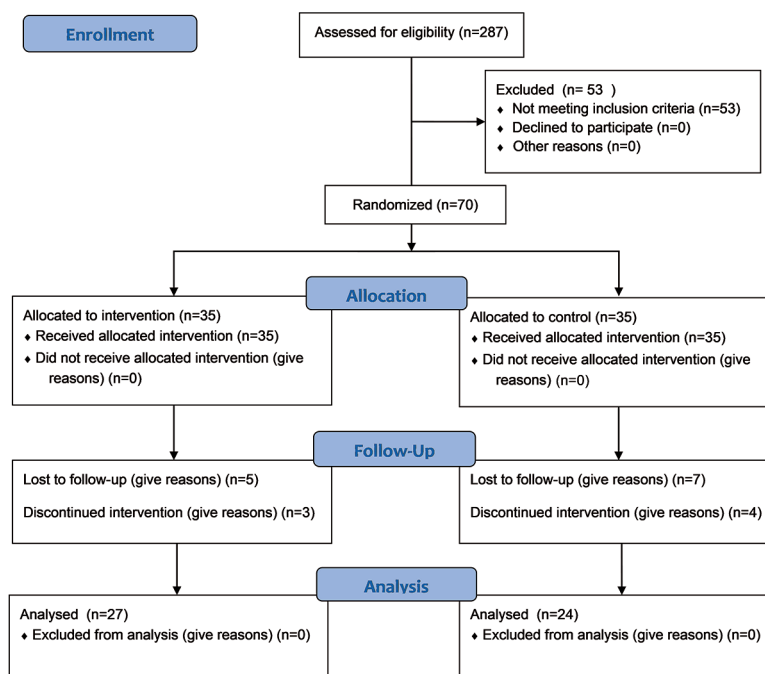
## Data analyses

The data were described by using mean and standard deviation, or frequency (percentage). The authors used the unpaired t-test to compare the mean difference of blood pressure between MBBI and control groups. In multivariate analysis, the authors used mixed linear regression for testing the effect of MBBI on blood pressure. The interaction term between time of follow up and groups was also assessed. A p-value of less than 0.05 was considered as statistical significance. Mean difference and 95% confidence interval (CI) were also reported. All statistical analyses were performed using the R program<sup>(13)</sup>.

## Results

Out of 287 people, 70 participants were found eligible and included in the present study. Participants were randomized to either the intervention with 35 participants or control groups, also with 35 participants. In the intervention group, five participants failed to follow up and three participants left the study. In the control group, seven participants failed to follow up and four participants left the study. Eventually, the remaining 27 participants in the intervention groups and 24 participants in the control group were analyzed. The consort diagram is shown in Figure 1.

Table 1 shows the baseline characteristic. There was no difference in baseline characteristics between the intervention and the control groups. There were



**Figure 1.** Consort flow diagram.

**Table 1.** Database and health behavior of interventions and controls group

	Intervention (n=27)	Control (n=24)	p-value
Age (years); mean [SD]	50.74 [6.18]	49.50 [5.44]	0.453
Sex; n (%)			0.291
Female	5 (18.51)	2 (8.33)	
Male	22 (81.45)	22 (91.67)	
Marital status; n (%)			0.415
Married	25 (92.60)	19 (79.17)	
Single/divorced	2 (7.40)	5 (20.83)	
Education; n (%)			0.649
Primary or no education	8 (29.62)	8 (33.33)	
Secondary or higher	19 (70.38)	16 (66.67)	
Income per month (Thai Baht); n (%)			0.541
<5,000	24 (88.89)	21 (87.50)	
≥5,000	3 (11.11)	3 (12.50)	
Smoke status; n (%)			0.902
No	25 (92.60)	22 (91.67)	
Yes	2 (7.40)	2 (8.33)	
Alcohol consumption; n (%)			0.542
No	25 (92.60)	21 (87.50)	
Yes	2 (7.40)	3 (12.50)	

SD=standard deviation

mean of difference (MD) between the intervention and the control at week 8 (MD  $-3.35$ , 95% CI  $-4.15$  to  $-2.56$ ), week 12 (MD  $-6.02$ , 95% CI  $-7.24$  to

$-4.79$ ), and week 20 (MD  $-7.84$ , 95% CI  $-9.47$  to  $-6.21$ ). The authors also observed the statistically significant mean difference between intervention and control group at week 8 (MD  $-2.61$ , 95% CI  $-3.86$  to  $-1.36$ ), week 12 (MD  $-4.84$ , 95% CI  $-6.46$  to  $-3.23$ ), and week 20 (MD  $-6.90$ , 95% CI  $-8.67$  to  $-5.13$ ). In the secondary outcomes, there were statistical significances in pulse rate, body mass index, waist circumference, heart rate, stress, depression, and anxiety. The results of univariate analysis are shown in Table 2. The trend of SBP and DBP was plotted as graphs in Figure 2 and 3.

Mixed linear regression was performed in the multivariate analysis. There was statistical significance of the interaction effect among the intervention group and follow up time. Table 3 shows the statistical significance, mean difference, and SBP difference between intervention and control group at week 8 (MD  $-3.50$ , 95% CI  $-5.13$  to  $-1.87$ ), week 12 (MD  $-5.63$ , 95% CI  $-7.25$  to  $-3.99$ ), and week 20 (MD  $-7.81$ , 95% CI  $-9.44$  to  $-6.18$ ). For the DBP, there was statistical significance only at week 12 (MD  $-3.09$ , 95% CI  $-6.15$  to  $-0.02$ ).

## Discussion

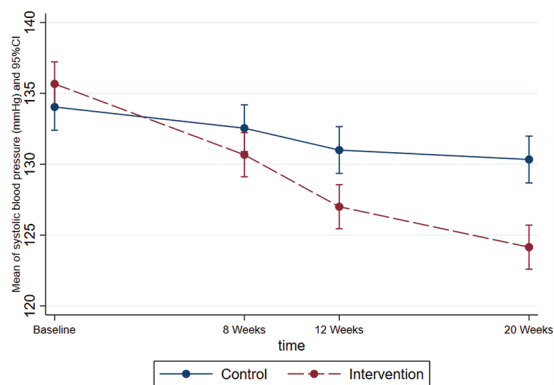
In the present study, MBBi was found to significantly lower SBP when compared to the control at week 8, 12, and 20. However, MBBi did

**Table 2.** Mean difference among intervention and control groups at baseline, week 8, week 12, and week 20

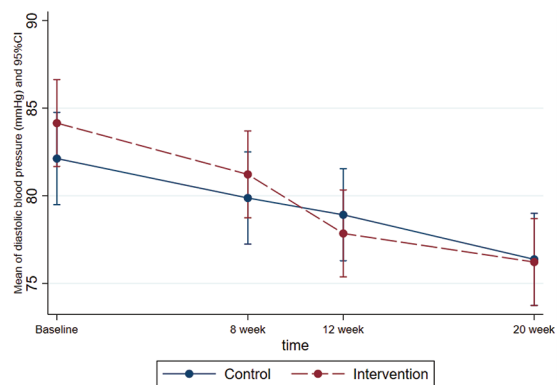
	Baseline	Week 8	Mean difference (95% CI)	Weeks 12	Mean difference (95% CI)	Week 20	Mean difference (95% CI)
Primary outcome			$I_{8-b} - C_{8-b}$		$I_{12-b} - C_{12-b}$		$I_{20-b} - C_{20-b}$
<b>Systolic blood pressure</b>							
• Intervention	135.67 (2.95)	130.67 (4.29)	-3.35 (-4.15 to -2.56)	127.00 (5.42)	-6.02 (-7.24 to -4.79)	124.51 (6.27)	-7.84 (-9.47 to -6.21)
• Control	134.04 (3.18)	132.54 (2.99)		131.00 (2.90)		130.33 (3.01)	
<b>Diastolic blood pressure</b>							
• Intervention	84.15 (4.43)	81.22 (5.33)	-2.61 (-3.86 to -1.36)	77.85 (7.04)	-4.84 (-6.46 to -3.23)	76.22 (6.40)	-6.90 (-8.67 to -5.13)
• Control	82.13 (6.13)	79.88 (7.63)		78.92 (7.29)		76.38 (7.89)	
<b>Secondary outcomes</b>							
<b>Pulse rate</b>							
• Intervention	78.56 (11.11)	77.74 (9.65)	-1.25 (-3.56 to 1.05)	79.41 (8.72)	-0.53 (-3.14 to 2.08)	76.04 (14.16)	-2.35 (-5.60 to 0.89)
• Control	82.00 (11.45)	80.25 (11.13)		79.92 (11.58)		79.83 (10.51)	
<b>Body mass index</b>							
• Intervention	25.20 (3.15)	25.17 (3.17)	-0.08 (-0.14 to -0.02)	24.84 (3.16)	-0.11 (-0.43 to 0.22)	24.62 (3.16)	-0.45 (-0.57 to -0.33)
• Control	25.18 (3.17)	25.15 (3.17)		25.36 (3.73)		24.87 (3.20)	
<b>Waist circumference</b>							
• Intervention	85.00 (6.13)	85.00 (6.13)	-0.29 (-0.52 to -0.05)	85.00 (6.13)	-1.09 (-1.52 to -0.67)	85.00 (6.13)	-1.74 (-2.31 to -1.16)
• Control	81.58 (7.60)	81.58 (7.60)		81.58 (7.60)		81.58 (7.60)	
<b>Heart rate</b>							
• Intervention	20.89 (1.01)	19.70 (0.72)	-0.67 (-1.08 to -0.25)	20.15 (0.53)	-0.59 (-0.95 to -0.23)	20.07 (0.38)	-0.59 (-0.91 to -0.26)
• Control	20.50 (1.35)	20.42 (1.02)		20.08 (0.71)		20.17 (0.56)	
<b>Stress</b>							
• Intervention	18.15 (6.93)	12.56 (6.31)	-3.35 (-4.29 to -2.42)				
• Control	16.13 (9.66)	15.29 (10.21)					
<b>Depression</b>							
• Intervention	7.33 (3.22)	4.07 (2.64)	-2.49 (-2.94 to -2.04)				
• Control	9.29 (6.53)	7.67 (5.91)					
<b>Anxiety</b>							
• Intervention	5.67 (2.52)	2.78 (1.97)	-1.76 (-2.19 to -1.33)				
• Control	8.58 (1.31)	8.08 (1.38)					

CI=confidence interval

The mean difference between intervention and control groups was tested by unpaired t-test



**Figure 2.** Mean of systolic blood pressure and follow up time.



**Figure 3.** Mean of diastolic blood pressure and follow up time.

not significantly lower pool SBP when compared to the control group. In addition, MBBi did significantly

lower DBP compared to control at 12 weeks.

The present study results were similar to those

**Table 3.** Mixed linear regression for systolic blood pressure and diastolic blood pressure

	Systolic blood pressure			Diastolic blood pressure		
	Estimate	95% CI	p-value	Estimate	95% CI	p-value
Intercept	129.25	110.29 to 148.19	<0.001	101.34	73.68 to 129.00	<0.001
Group (Intervention vs. Control)	1.89	-0.57 to 4.34	0.132	2.11	-1.66 to 5.88	0.272
Time						
8 weeks vs. baseline	-1.50	-2.68 to -0.32	0.013	-2.25	-4.48 to -0.019	0.048
12 weeks vs. baseline	-3.04	-4.23 to -1.86	<0.001	-3.21	-5.44 to -0.98	0.005
20 weeks vs. baseline	-3.71	-4.89 to -2.52	<0.001	-5.75	-7.98 to -3.52	<0.001
Groups x time (Control and baseline)						
Intervention vs. 8 weeks	-3.50	-5.13 to -1.87	<0.001	-0.68	-3.74 to 2.39	0.666
Intervention vs. 12 weeks	-5.63	-7.25 to -3.99	<0.001	-3.09	-6.15 to -0.02	0.048
Intervention vs. 20 weeks	-7.81	-9.44 to -6.18	<0.001	-2.18	-5.24 to 0.89	0.164

CI=confidence interval

Adjusted gender, age, marital status, education, income, smoking, and alcohol drinking

of Ponte Márquez et al., who evaluated mindfulness meditation for controlling ambulatory blood pressure in a Mediterranean population. The results showed that at week 8, the mindfulness group had lower clinically measured SBP, 24-hour SBP, at-rest SBP, and DBP values<sup>(14)</sup>. This finding is consistent with the results of An et al., who found that mindful awareness practices could improve blood pressure and lifestyle behaviors associated with hypertension when compared to control groups<sup>(15)</sup>. However, these findings were different from a study of Blom et al. testing the effect of a mindfulness-based stress reduction (MBSR) program for blood pressure lowering among stage 1 hypertensive participants. It was found that MBSR did not lower ambulatory blood pressure by a statistically significant amount when compared with a control group<sup>(16)</sup>.

MBBI decreased stress, depression, and anxiety scores. The present study findings were similar to Lengacher CA et al. who evaluated the effect of MBSR for survivors of breast cancer and found that MBSR program showed a significant improvement in psychological status compared with usual care<sup>(17)</sup>. In addition, Sadooghiasl et al. assessed the effect of a MBSR program on the mental well-being of patients with coronavirus disease 2019, and the results showed the improvement of psychological status<sup>(18)</sup>.

### Strength and limitation

One of the limitations of the present study was that it was performed in rural areas, which might limit generalizability. Participants were also self-selected, so the results may have been influenced by selection bias. Furthermore, the authors do not know if after

finishing the intervention, the participants continued to practice or were looking for other mindfulness training.

### Conclusion

The present study finding shows that the MBBI program was effective in improving blood pressure and psychological factors. These findings could provide a basis to design the intervention for controlling high blood pressure in a rural community.

### What is already known on this topic?

People with a SBP between 130 to 139 mmHg and DBP between 85 to 89 mmHg, or in the pre-hypertension category, which have been educated by a health officer about physical activity, eating, sleeping can lower their blood pressure.

### What does this study add?

Mindfulness meditation could be a useful way for pre-hypertensive people to reduce their blood pressure.

### Acknowledgement

The authors would like to thank all participating in this study and the MBBI trainers who taught the classes.

### Funding disclosure

The present study was funded by Faculty of Medicine, Mahasarakham University.

### Conflicts of interest

The authors declare no conflict of interest.

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