Original Article

Preliminary study of Slow Deep Breathing in Mindfulness Exercise Effects on Physical Health Outcome among Hypertensive Patients

Pantip Sangprasert, MNS[1] ; Srimuang Palangrit, PhD[2] ; Junya Pattaraarchachai, DSc[3] ; Natima Tiyoa, MD[2]

Pantip Sangprasert, MNS,
PhD Candidate

[1] Doctor of Philosophy Program in Community and Family Medicine, Faculty of Medicine, Thammasat University, Pathumthani, Thailand.
[2] Department of Community and Family Medicine, Thammasat University, Pathumthani, Thailand.
[3] Chulabhorn International College of Medicine, Thammasat University, Pathumthani, Thailand.

*Address Correspondence to author:
Associate professor Pantip Sangprasert
Faculty of Medicine,
Thammasat University, Rangsit,
Pathumthani, 12121, Thailand.
email: pantips162@gmail.com

Received: May 29, 2018
Revision received: June 1, 2018
Accepted after revision: June 25, 2018
BKK Med J 2018;14(2): 48-54.
DOI: 10.31524/bkkmedj.2018.09.009
www.bangkokmedjournal.com

Abstract

OBJECTIVE: The aim of this study is to examine the effect of slow deep breathing in mindfulness exercises on physical health outcome among hypertensive patients.

MATERIALS AND METHODS: Two primary health care units (PCU) were selected as control and intervention groups. Samples were patients aged 35 - 59 years old, diagnosed with stage I hypertension. Both groups received the standard for hypertension guidelines treatment. The experimental group was added as a drill in observational breathing in mindfulness skills, which recognizes the feeling of adaptation to everyday life.

RESULTS: The physical outcomes were measured on the 6th week as follows: respiratory rate (RR); blood pressure (BP); and heart rate (HR) test. Those that were statistically significantly different in RR 4.7 ($p = 0.007$), diastolic blood pressure (DBP) 6.7 ($p = 0.008$), HR 7.1 ($p = 0.018$), on the 12th week RR 9.0 ($p < 0.001$), and DBP 5.6 ($p = .002$) when compared to the control group. However there was no statistically significant difference in systolic blood pressure (SBP) (6th and 12th week) and heart rate (HR) (12th week).

CONCLUSIONS: Slow breathing in mindfulness training should be introduced as a counterpart to modern medicine and promoted to stage I hypertensive patients for resting cardiovascular and blood pressure disease.

Keywords: slow breathing, mindfulness, physical health outcome, hypertension

Hypertension from major vital organ complications in cardiovascular, cerebrovascular diseases, retinopathy and nephropathy, are major causes of morbidity and mortality.[1-3] Most hypertensive patients have uncontrolable hypertension and need support to reach their goal of blood pressure [3,4] which poses a high risk of side effects and drug interaction from long term drugs therapy. Recently nonpharmocological treatment observed that slow breathing in mindfulness has been used to promote an alternative complementary treatment and has managed to lower blood pressure based on scientific data. The definition of consciousness is that the mind recognizes and accepts experience that arrives mentally, it is a form of concentration with a relaxed and clear mind in conjunction with brain processes.[5-7] However, its effects on the reduction of physical health outcome is still seen as controversial with BP and HR. For example, D'Silva et al.[8] found that there was no significant reduction in BP and HR after deep breathing exercise for patients with hypertension, coronary disease and diabetes mellitus. Meanwhile, other studies revealed that slow breathing was linked to beneficial effects on resting BP and HR in hypertensive patients.[9]

Slow deep breathing affects the bio-physical scientific mechanism.[10] It is integrated in mindfulness-based stress reduction that is useful for BP and HR. These benefits of mindfulness showed in vascular disease studies such as hypertension, heart disease, stroke and diabetic mellitus.[11,12] Moreover, the mental benefit of relaxation for hypertension response was reported by Benson H et al.[13] Although, slow deep breathing has benefits for both mental and physical health outcomes, the results of studies are controversial that slow deep breathing can control in BP and HR. There are few studies on the effect of mindful-group conversation about awareness in breathing based on PCU treatment.

Thus, the purpose of the current study was to see how hypertensive patients could perform slow breathing by observing mindfulness. From the result of the review, we hypothesized that after intervention, hypertensive patients would promote slow deep breathing, and this would lead to better physical health-related outcomes.

Materials and Methods

A quasi-experimental research was conducted with two-group three repeated measures design for this study. The area of study was from two PCU in two districts of Pathumthani province from July 2017 to September 2017. All subjects met the following inclusion criteria:

1. Aged 35 - 59 years old [14]
2. Stage I hypertension [3] (SBP140–159 mmHg and/or DBP 90–99 mmHg)
3. Taking antihypertensive drugs
4. No underlying complication of hypertension[3,15]
5. Understanding Thai

Participants who had limit learning processing, organic brain syndrome, or a history of psychiatric problems were excluded from this study.

The sample size was predetermined based on power analysis using G*Power statistics[16] with an effect size at 0.4, statistical power at 0.80, and obtaining a sample at least of 23 participants per group. Approximately 10% were added for drop out, obtaining the final sample of 26 participants per group. However, at the follow up on 12th week there were 4 participants (experiment group) and 10 participants (control group) who were excluded (Figure 1).

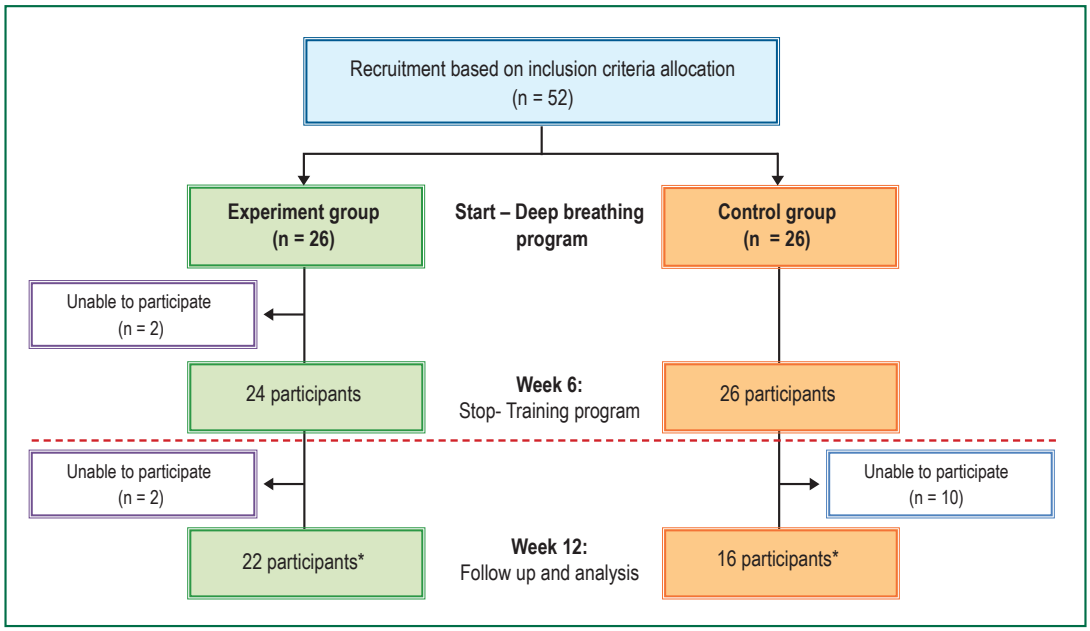

Figure 1: Sample flow through the study.

Instruments

The demographic data questionnaires of hypertensive patients were categorized by gender, age, duration of hypertension history and educational level.[3,15,17-20] The physical assessment recorded RR, BP, and HR measured on before (0 week), after (6th week), and at follow-up (12th week). All of the measurements were performed by registered nurse practitioners who passed an evaluated training in accordance with standard guidelines.[3,15]

Data collection

The protocol and the informed consent were approved by the Research Ethics Committee of the Thammasat University, MTU-EC-ES-2-218/59, with the approval date of 18 January 2017, and all patients received the research objectives and submitted their written informed consents before any study related procedure was undertaken.

Instructors training: Mindful contemplation training was obtained at Mahidol and Thammasat Universities for nine days and the Willpower Institute for six months. Meanwhile, a systematic review of the principle strategies in mindfulness were summarized. Then, the methods of breathing exercises of test-retest reproducibility were included in similar sample programs by following an expert's advisory. The instructor produced an intervention, comprising the principle observed in slow deep breathing in mindfulness lasting 1.5 hours per session. Weekly group meeting conversations were included. Participants were put into equal groups in morning and afternoon sessions. Six-coherence practices were observed. Feelings were recognized and adapted to everyday life, and daily individual practice continued at home and were recorded throughout until the follow up on the 12th week.

The control group received hypertension guideline treatment [3] and participants were measured at the physical assessment appointment on the 0, 6th, and 12th week.

The experiment group received hypertension guideline treatment [3]and participants were measured at the physical assessment appointment on 0, 6th, and 12th week. In addition, the six-week program was implemented by adding the six steps of observational breathing exercises to mindfulness skills with a group conversation to create the intention, attention, and attitudes through careful listening, non- judgmentally accepting, and respecting relationships. To beging with, peace in the environment was created, with no noise, and increased relaxation in body and mind. The six steps of breathing are as follows:

- **Step 1:** Induce awareness of breathing, learning a new style with a scientific mechanism which is not only beneficial for the physical body but also for relaxation. The first step consists of a deep exhale (count 1, 2, 3, 5, and 6) followed by a deep inhale (count 1, 2, 3, and 4).
- **Step 2:** To observe the differences in feeling when the breath is blown through the throat, chest, and abdomen. The awareness feeling is found during the breath as it blows in and out. (i.e., know how the breath is blowing: short, long, deep or shallow).
- **Step 3:** To discover the natural physical and mental symptoms from breathing observation (i.e., a feeling of relaxation or feeling uncomfortable) , with no breath counting and holding.
- **Step 4:** To discover the transience of negative or positive emotions in cognitive feeling that comes back and goes out while breathing.
- **Step 5:** To discover deep breathing with prolong inhale-exhale and how it induce a consistently slowed breathing rhythm which leads to relaxation in body and mind.
- **Step 6:** Induce the emotional feeling reflected during the mindful group conversation.

Data collection and how each intervention was implemented is shown in Figure 2.

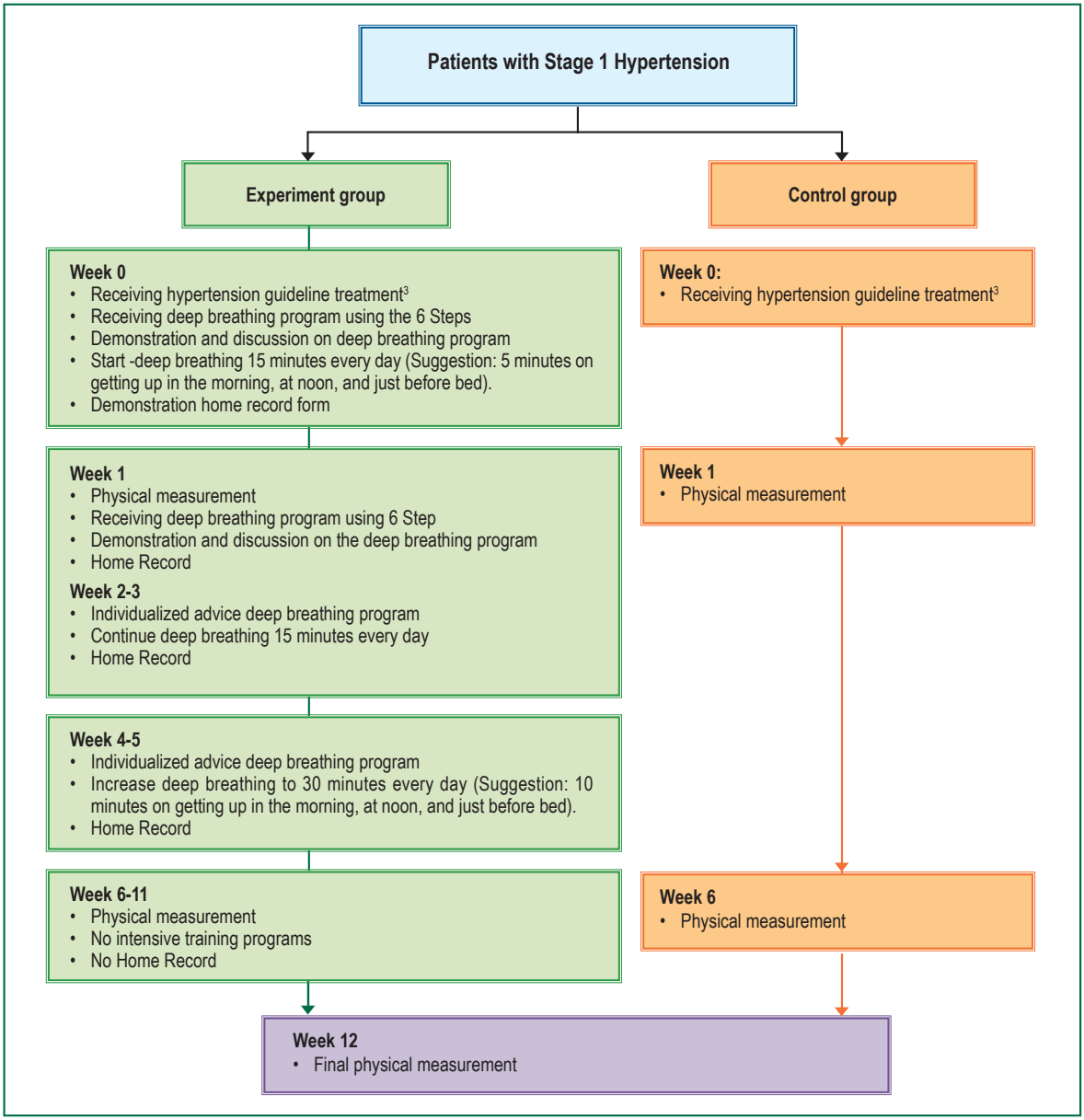

Figure 2: Data collection and intervention process.

ISSN 2287-0237 (online)/ 2287-9674 (print)

Statistical analysis

We used SPSS (version 22 for windows) with Chi-square test at the baseline of demographic data. The physical health data was tested by a normal probability plot and handling missing data, we used an intention-to-treat analyse on before (0 week), after (6th week), at follow-up (12th week) via a Generalized Linear Model (GLM) for repeated measures in order to estimate effect. The comparison and adjustment to the means score, and standard error, resulted in a 95% CI between the groups.

Results

There is a similarity in frequency distribution in demographic data between control and experiment group. Table 1 shows that both have high number of female participants (76.9-80.0%), age range (52.5-54.2years), duration of hypertension history (5.9-7.2 years). For the educational level, there was a high number of participants with primary school education in the control group, whereas this level was lower in the experiment group.

When comparing each group post intervention, a physical on the 6th week outcome was statistically significant different with a decrease in RR 4.7 breaths/min ($p = 0.007$), DBP 6.7 mmHg ($p = 0.008$), HR 7.1 beats/min ($p = 0.018$), meanwhile, there was no statistical difference in systolic blood pressure (SBP) 1.0 ($p = 0.783$). At the follow up on the 12th week, there was a statistically significant in RR 9.0 ($p < 0.001$), and DBP 5.6 ($p = 0.002$), meanwhile, there was no statistically significant difference in SBP 1.9 ($p = 0.600$), and HR 0.2 ($p = 0.959$) respectively, as show in Table 2 and Figure 3.

Discussion

There is a statistical significance at baseline in the physical outcome in DBP and HR but no significant difference in SBP between groups. However, the adjusted mean for this effect by GLM for repeated measure was used and the result found was that the observed breathing in mindfulness had been directly induced for a normal reduction of RR (19.4 ± 1.2, 13.6 ± 1.2, and 11.0 ± 1.3 breaths/min respectively). This mechanism began with 15 minutes going up to 30 minutes per day and had enhanced inner self-efficacy empowerment. The DBP and especially HR were lower and this reduction was statistically significant.[21-22] Although the non intensive training for follow up at 3 weeks may be affecting minimal increase in DBP there was no detemination of HR. This study showed that the principal of slow and deep breathing with a natural breath flow approach had been created by individual intention, attention and attitude. The opened-heart in group conversation about mind and body symptoms also helped. This experience of everything happened in everyday life, experienced by the participants' themselves.[5-7] When there was a feeling of any thoughts, which come back and go out through the mind, the participants were able to understand and to see more clearly and come back to the new breathing. This breathing is based on true physical and affective states. An opened-heart discussion in a group process allows for an individual self-reflection progress that ultimately increased the basic performance levels of concentration.[7]

Table 1: The general demographic data between control and experiment group

General data	Control (n = 26)	Experiment (n = 26)	*p**
Gender			
- male	6 (23.1)	5 (19.2)	0.734
- female	20 (76.9)	21 (80.8)	
Age (yrs.)			
- mean±SD	52.5 ± 5.2	54.2 ± 4.8	0.239
Educational level			
- primary	17 (65.4)	12 (46.2)	0.163
- secondary and over	9 (34.6)	14 (53.8)	
Duration of hypertension history (yrs.)	7.2 ± 4.9	5.9 ± 4.0	0.346

**p* from Chi-square test for two group and independent *t-test* for age and duration of hypertension history

Table 2: Adjusted means and standard error of physical health outcomes between control and experimental group

Physical variance		Control Adj.means ± SE (n = 26)	Experimental Adj.means ± SE (n = 26)	mean diff. (95% CI)	*p** (2-tailed)
1. RR (breaths/min)	Before	19.2 ± 1.2	19.4 ± 1.2	-0.2 (-3.76, 3.26)	0.887
	After	18.2 ± 1.2	13.6 ± 1.2	4.7 (1.34, 7.98)	0.007**
	Follow-up	20.0 ± 1.3	11.0 ± 1.3	9.0 (5.43, 12.63)	0.000***
2. SBP (mmHg)	Before	131.9 ± 2.8	129.3 ± 2.8	-2.6 (-5.42, 10.60)	0.519
	After	125.6 ± 2.6	124.6 ± 2.6	-1.0 (-6.32, 8.34)	0.783
	Follow-up	125.7 ± 2.5	123.8 ± 2.5	1.9 (-5.24, 8.98)	0.600
3.DBP (mmHg)	Before	83.7 ± 1.8	75.9 ± 1.8	7.8 (2.70, 12.78)	0.003**
	After	80.6 ± 1.7	73.9 ± 1.7	6.7 (1.85, 11.61)	0.008**
	Follow-up	80.6 ± 1.6	75.0 ± 0.7	5.6 (0.83, 10.31)	0.022*
4. HR (beats/min)	Before	81.7 ± 2.2	88.2 ± 2.2	-6.5 (-12.66, -0.33)	0.039*
	After	78.6 ± 2.1	85.7 ± 2.1	-7.1 (-13.02, -1.28)	0.018*
	Follow-up	81.9 ± 2.4	81.7 ± 2.4	0.2 (-6.57, 6.92)	0.959

*Estimated mean adjusted from GLM for repeated measure *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

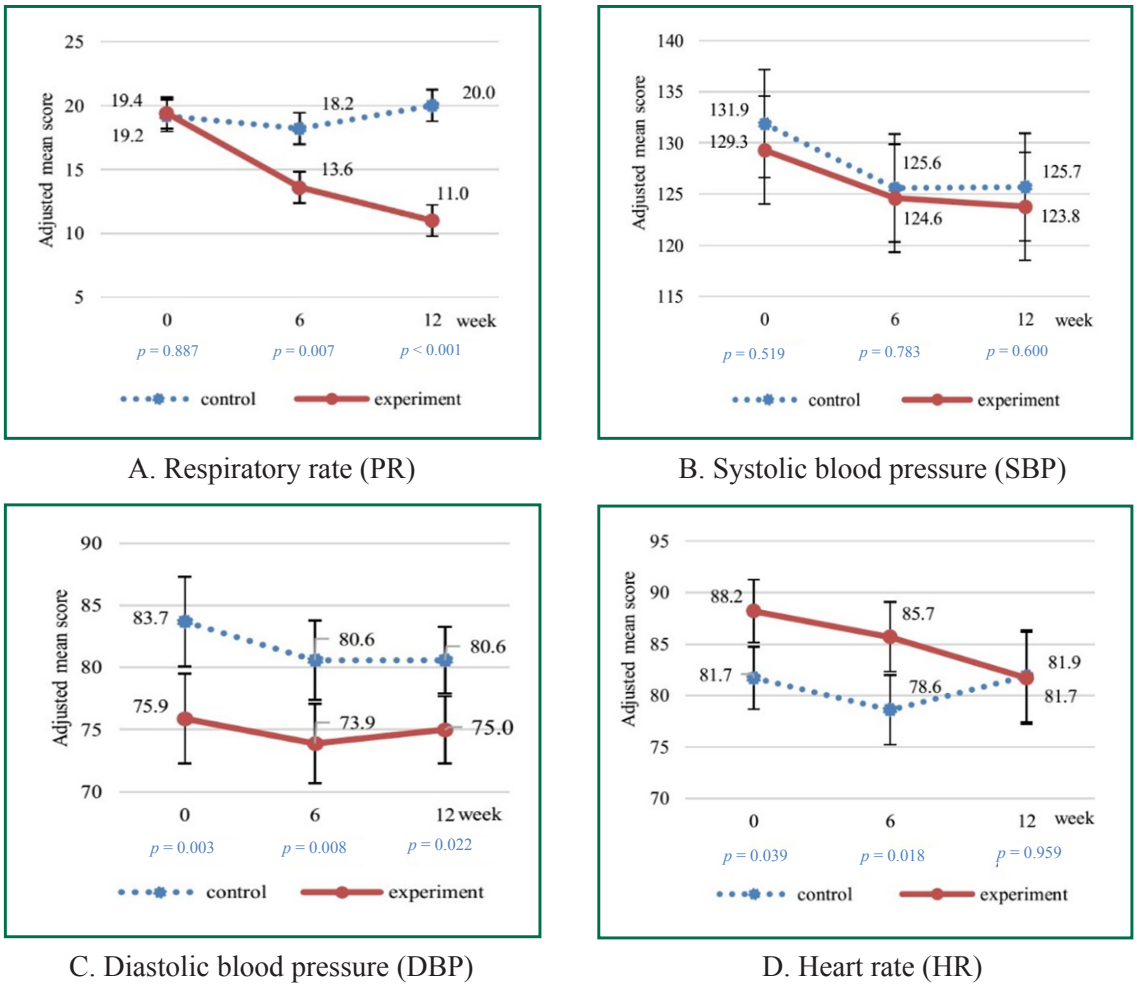

Figure 3: Charts A, B, C, and D presented the effects of slow deep breathing in mindfulness for an improved physical health outcome. Data are presented as means and SE for experiment and control group.

Focused breathing may produce a flexibility of cognitive ability and self management in breathing behavior. The inner awareness and acceptance was opened from experience-inducing compassion for others as the mind.[6,7] The conscious mechanism was to observe slow breathing with induced diaphragm movement rather than the chest breathing pattern.[21,22] Thus, this linked to the system of the body, the effect of chemical central nervous system[23] and the autonomic nervous system[24] such as baroreceptors, the parasympathetic nervous system, and many other factors including improved endothelium-dependent vasodilatation, enhancement of baroreceptor sensitivity, and arterial compliance which may also be involved.[23,24]

The American Heart Association group showed the device-guided slow breathing at a standard level Class IIA, and the level of evidence B which is recommended for BP-lowering efficacy.[25] According to previous studies, the benefits researched were BP and HR reduction in normal people as well as in hypertensive patients. [26,27] From the six studies researched in meta-analysis from 1974 – 2016, it was revealed that 269 cardiovascular patients involved hypertensive patients, who had decreased BP and HR by slow breathing training.[28] A consistant aspect in the study showed the importance of the addition of relaxation, mindfulness-based stress reduction, and meditation in hypertensive patients.[29] The report showed that 10 minutes of focused attention on breathing movement at the lower abdomen is associated with significanly increased pressure levels of oxygenated haemoglobin as measured by near infrared spectroscopy. These was a significant increase in serotonin levels at 5 minutes and 30 minutes after attention was paid to conciousness through attentive breathing.[30] The consistant research shows that breathing less than 10 times than the usual rate of 16.6 ± 2.8 times/minute involved deep exhaling at regular intervals of at least 15 minutes a day which led to reduced BP levels.[26,30,31] The findings of breathing awareness meditation research measured office-BP measuring and this was more wildly statistically significant than Ambulatory Blood Pressure Measuring (ABPM). Indeed, the participants might be uncomfortable with ABPM measuring in a 24 hour period.[32,33]

ISSN 2287-0237 (online)/ 2287-9674 (print)

In this study, the DBP on the 12th week increased more than the 6 th week. Perhaps this was because after the 6th week the participants had non-continuous and intensive practice intervention at PCU. Furthermore, the SBP on 6th, 12th week and HR on 12th week were reduced but this was not statistically significant. This variety of factors might influence the physical health outcomes such as exercise or sodium consumption and medication compliance: these should be investigated in an intensive or randomized control trial for further study.

Furthermore, there were some special qualitative data during the group conversation meeting: in daily life, the consciousness of body symptoms observation is useful for physical feeling (i.e., headache, chest pain, cardiac arrhythmias, dizziness). The psychological feeling (i.e., angry, distraction) is also important. In addition, there were an extended data in the final 12th week follow up. They showed that physicians had stopped medication for 2 persons. Moreover they had reduced antihypertensive medication for 2 persons. Thus, these events possibly prevented polypharmacy and side effect of drugs.

Study limitations

The number of samples who missed the follow up was found more in the control group than in the experiment group. Thus, a normality plot was tested and we used the intention-to-treat analysis comparing the adjusted means score, standard error, at 95 % CI between groups in order to handle missing data. The allocation was not a truly experimental design according to the limitations of suburban PCU areas.

Conclusions

Slow deep breathing in mindfulness has a positive effect on HR and DBP in physical health outcome as an intervention in lifestyle modification should complement treatment for stage I hypertensive patients. Furthermore, patients can benefit from group processing to raise awareness and to ease acceptance of physical and psychological effects of hypertension. Moreover, the mindfulness-group conversation experience in breathing should be based in the context of the participating PCU.

Conflict of interest: The authors declare no conflict of interest.

Acknowledgements

The authors express their gratitude to Associate Professor Chatchawan Silpakit, MD, PhD, Assistant Professor Lampu Kosulwit, MD, Professor Peera Burankitjaroen, MD, Associate Professor Sutreera Phatrayuthawan, PhD, and Assistant Professor Somkiat Sangwatanaroj, MD, MSc, FRCP(T). This study was supported by a grant from Thammasat University and National Science and Technology Development Agency; NSTDA Thailand.

References

1. Centers for disease control and prevention. A public health action plan to prevent Heart disease and stroke fact sheet, [Internet]. National center for chronic disease prevention and health promotion, Division for Heart Disease and Stroke Prevention, 2016. (Accessed May 26, 2018, at https://www.cdc.gov/dhdsp/data_statistics/fact_sheets/fs_bloodpressure.htm).
2. Centers for disease control and preventions. Healthy People 2020. CDC/National for health Statistics, 2011. (Accessed April 10, 2018, at https:/ /www. cdc.gov/dhdsp/hp2020.html).
3. Mancia G, De Backer G, Dominiczak A, et al. ESH and ESC. 2007 Guidelines for the Management of Arterial Hypertension: The Task Force for the Management of Arterial Hypertension of the European Society of Hypertension (ESH) and of the European Society of Cardiology (ESC). *J Hypertens* 2007;25(6) :1105-87.
4. Bureau of Epidemiology, Department of Disease Control, Ministry of Public Health Epidemiological surveillance report weekly: Chronic non-communicable disease surveillance report 2011. 2013:44(10):146-59.
5. Kabat-Zinn J. Mindfulness-Based Interventions in Context: Past, Present, and Future.2003:144-56.
6. Siegel RD, Germer CK, Olendzki A. Mindfulness: What Is It? Where Did It Come From? In F. Didonna (Ed.), *Clinical handbook of mindfulness* 2009:17-35.
7. Silpakit O, Silpakit C, Chomchan R. Mindfulness-based care for dementia. *J Mental Health Thailand* 2014;22(1):26-37.
8. D'Silva F, Vinay H, Muninarayanappa NV. Effectiveness of deep breathing exercise (DBE) on the heart rate variability, BP, anxiety & depression of patients with coronary artery disease. *NUJHS* 2014;4:35-41.
9. Yan Zou., Xin Zhao, Yun-Ying Hou, et al. Meta-analysis of effects of voluntary slow breathing exercise for control of heart rate and blood pressure in patients with cardiovascular disease. *Am J Cardilol* 2017;120:148-53.
10. Oneda B, Ortega KC, Gusmao JL, et al. Sympathetic nerve activity is decrease during device-guided slow breathing. *Hypertens Res* 2010;33:708-12.
11. Rebecca A, Abbott A, Whear A, et al. Effectiveness of mindfulness based stress reduction and mindfulness based cognitive therapy in vascular disease: A systematic review and meta-analysis of randomized controlled trials. *J Psychosom Res* 2014;76(5):341-51.
12. Sangprasert P, Palangrit S, Buranatrevedh S, et al. A systematic review of the effectiveness of mindfulness meditation and contemplation upon vascular disease patients. *Thammasat Med J* 2018;18(1):79-92.
13. Benson H, Rosner BA, Marzetta BR, Klemchuk HM. Decrease blood pressure in pharmacologically treated hypertensive patients who regularly elicited the relaxation response. *Lancet* 1974;1:289-291.

14. Nyklicek I, Dijksman SC, Lenders PJ, et al. A brief mindfulness based intervention to increase emotional well-being and quality of life in percutaneous coronary intervention (PCI) patients: the Mindful Heart randomized controlled trial. *J Behav Med* 2014 Feb;37(1): 135-44.
15. Chobanian AV, Bakris GL, Black HR, et al. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC 7 report. *JAMA* 2003;289(19):2560-72.
16. Faul F, Erdfelder E, Lang A, et al. G*power 3: a flexible statistical power analysis program for the social, behavior and biomedical sciences. *Behav Res Methods* 2007;39(2):175-91.
17. Townsend RR, Sica DA. Beyond conventional considerations: newer devices used in blood pressure measurement and management. *Adv Chronic Kidney Dis* 2011;18(1):48-54.
18. Bloom B. The Properties of Bloom's Taxonomy of Educational Objectives for the cognitive domain. Seddon. *JSTOR* 1978;48(2):303-423.
19. Sangprasert P, Wiroj J. The predict factors of health promotion behaviors among a population living in the urban community metropolitan Bangkok. *Thammasat Science Tech* 2014; 23(1):113-26.
20. Thongkhum K, Ruchiwit M, Somprasert C. The Effect of Meditation Training together with a Biofeedback Training Program on the Stress Levels of Chronic Disease Patients. *Nurs J* 2015;42(1):24-37.
21. Tobin MJ, Chadha TS, Jenouri G, et al. Breathing patterns. Part 1: Normal subjects. *Chest* 1983;84:202-5.
22. Schelegle ES, Green JF. An overview of the anatomy and physiology of slowly adapting pulmonary stretch receptors. *Respir Physiol* 2001;125:17-31.
23. Unger T, Paulis L, Sica DA. Therapeutic perspectives in hypertension: novel means for renin-angiotensin-aldosterone system modulation and emerging device-based approaches. *Eur Heart J* 2011;32(22):2739-47.
24. Oneda B, Ortega KC, Gusmao JL, et al. Sympathetic nerve activity is decreased during device-guided slow breathing. *Hypertens Res* 2010;33(7):708-12.
25. Brook RD, Apple LJ, Rubenfire M, et al. Beyond medications and diet: alternative approaches to lowering blood pressure: a scientific statement from the american heart association. *Hypertension* 2013;61(6):1360-83.
26. Elliott WJ, Lzzo JL. Device-Guided Breathing to Lower Blood Pressure: Case Report and Clinical Overview. *Med Gen Med* 2006;8(3):23.
27. Elliott WJ, Lzzo JL, WhiteWB, et al. Graded blood pressure reduction in hypertensive outpatients associated with use of a device to assist with slow breathing. *J Clin Hypertens* 2004;6(10):553-9.
28. Zou Y, Zhao X, Hou YY, et al. Meta-analysis of effects of voluntary slow breathing exercise for control of heart rate and blood pressure in patients with cardiovascular disease. *Am J Cardiol* 2017;120(1):148-53.
29. Irvine MJ, Johnston DW, Jenner DA, et al. Relaxation and stress management in the treatment of essential hypertension. *J Psychosom Res* 1986;30(4)437-50.
30. Yu X, Fumoto M, Nakatani Yet, et al. Activation of the anterior prefrontal cortex and serotonergic system is associated with improvements in mood and EEG changes induced by Zen meditation practice in novices. *Int J Psychophysiol* 2011;80(2):103-11.
31. Hughes JW, Fresco DM, Myerscough R, et al. Randomized controlled trial of mindfulness-based stress reduction for prehypertension. *Psychosom Med* 2013;75:721-8.
32. Barnes VA, Davis HC, Murzynowski JB, et al. Impact of meditation on resting and ambulatory blood pressure and heart rate in youth. *Psychosom Med* 2004;66:909-14.
33. Gregoski MJ, Barnes VA, Tingen MS, et al. Breathing awareness meditation and LifeSkills Training programs influence upon ambulatory blood pressure and sodium excretion among African American adolescents. *J Adolesc Health* 2011;48(1):59-64.

ISSN 2287-0237 (online)/ 2287-9674 (print)