Clinical and Experimental Hypertension, Early Online: 1–7, (2011)

ISSN 1064-1963 print /1525-6006 online
DOI: 10.3109/10641963.2011.618195

informa
healthcare

The Effect of Cognitive Behavior Therapy-Based "Forest Therapy" Program on Blood Pressure, Salivary Cortisol Level, and Quality of Life in Elderly Hypertensive Patients

Jidong Sung,[1,2] Jong-Min Woo,[3,4] Won Kim,[3,4] Seoung-Kyeon Lim,[4,5] Eun-Joo Chung[4]

[1]*Division of Cardiology, Department of Medicine, Cardiac and Vascular Center, Seoul, Republic of Korea*, [2]*Health Promotion Center, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul, Republic of Korea*, [3]*Department of Psychiatry, Seoul Paik Hospital, Inje University School of Medicine, Seoul, Republic of Korea*, [4]*Stress Research Institute, Inje University, Seoul, Republic of Korea*, [5]*Korea Employee Assistance Professionals Association, Seoul, Republic of Korea*

Abstract

Objective: This article aimed to develop the "forest therapy" program, which is a cognitive behavior therapy (CBT)-based intervention program using forest environment, and investigate its effects on blood pressure (BP), salivary cortisol, and quality of life (QoL) measures in patients with hypertension. *Methods*: A total of 56 men and women were enrolled for this study, being referred from local health centers in Republic of Korea, from April to October 2009. They were conveniently assigned to either "forest" group participating in the forest therapy program or control group doing self-monitoring of BP. Measurements of salivary cortisol level and QoL were done at initial visits and at 8-week final visits. *Results*: Both groups did not differ significantly in baseline clinical characteristics. The BP change at week 4 and week 8 did not differ between the two groups. Salivary cortisol level reduction was significantly larger and QoL measures improved significantly more in the forest group at week 8 compared with the control group. *Conclusions*: The forest therapy program did not induce prolonged systolic blood pressure (SBP) reduction. However, considering the significant decrease in cortisol level and improvement in QoL measures, this may be a useful model of community hypertension management program.

Keywords: hypertension, forest therapy, quality of life, salivary cortisol

INTRODUCTION

Forest environment is known to have favorable influence on human body and mind. According to the attention restoration theory, interacting with nature has refreshing effect on the directed-attention abilities by abundant intriguing stimuli (1). These restorative effects can be explained by psycho-evolutionary theory, that is, forest environment provides psychologically familiar and thus comfortable milieu to human beings because they have underwent evolutionary process in it (2). Several studies reported the benefits of psychological intervention program in a forest environment, such as improved self-control and social adjustment (3) and quantitatively and qualitatively enhanced social relationship (4). Recent studies by authors' group showed that cognitive behavior therapy (CBT)-based psychotherapy applied in a forest environment on major depressive disorder had superior effect than the comparable intervention in the usual outpatient setting (5).

Similar interventional programs have been shown to have bodily effects also. Park et al. (6) reported that "forest bathing", that is, walking or even just staying in the forest environment resulted in lower concentrations of cortisol, lower pulse rate, lower blood pressure (BP), greater parasympathetic nerve activity, and lower sympathetic nerve activity than during equivalent activities in urban environment. Tsunetsugu et al. (7) reported similar findings.

While it is well known that BP is influenced by lifestyle factors such as diet and exercise, and there is a need for an implementation of proper education program to improve it (8), there has been little example of the interventional program integrating proper educational session and forest environment. Favorable psychological and physical changes from forest environment can provide a strong enforcement of the effect of lifestyle modification program.

The authors developed CBT-based community program, so-called forest therapy program, which was

Address correspondence to Jong-Min Woo, MD, MPH, PhD, Department of Psychiatry, Seoul Paik Hospital, Inje University School of Medicine, 85, Jeo-Dong-2-Ga, Jung-Gu, Seoul 100-032, Republic of Korea. E-mail: jongmin.woo@gmail.com

Received 7 December 2010; *revised 1 April 2011*; *accepted 6 April 2011*.

based on the protocol previously published (5) and with some modification for hypertensive patients. It was intended to provide proper knowledge, improve stress management technique, and induce therapeutic lifestyle change and investigated whether it can favorably influence BP, salivary cortisol level, and quality of life (QoL) measures in elderly patients with mild hypertension.

METHODS

Subjects

A total of 56 men and women were enrolled for this study, being referred from two local health centers. Inclusion criteria were (i) patients with stage 1 hypertension, that is, systolic blood pressure (SBP) 140–159 mm Hg or diastolic blood pressure (DBP) 90–99 mm Hg, (ii) patients being observed to be in the higher range of prehypertension, that is, SBP 130–139 mm Hg or DBP 85–89 mm Hg, or (iii) patients who were on antihypertensive medication. Exclusion criteria were (i) stage 2 hypertension, (ii) any condition that needs urgent BP control or urgent change of antihypertensive regimen, and (iii) comorbidity that precluded the participation in the program.

They were assigned to either the experimental group who participated in the program or the control group who did only self-monitoring of BP for 8 weeks without participating in the program. This was done by convenient assignment and not true randomization, considering the subjects preference and feasibility to actual participation of program. Participants underwent interview for evaluation of current health status and informed written consents were obtained. They were instructed not to change their antihypertensive medication during the program participation, and if there were requests from prescribing local physician for the need of change of their regimen, the patient was dropped out. Finally, 28 persons in each group finished 8-week follow-up schedule.

Informed written consents were obtained from all the subjects before participation in this study. This study was approved by the Institutional Review Board of Seoul Paik Hospital, Inje University, Seoul, Republic of Korea.

Blood Pressure Measurements

At initial visit and after completing the program (at day 3 in the control group), manual BP measurements by mercury sphygmomanometers were done in the local health centers by a research nurse, maintaining the same environment in both groups. The method is as follows: office BP measurements were done in a quiet room in a local health center by mercury sphygmomanometer, preferably by the same research nurse throughout this study. Subjects took rest in a sitting position for at least 5 minutes. Blood pressures were measured three times with arm resting on the top of the desk at 1-minute interval. In case the discrepancy of SBP between the first and the last measurements exceeded 20 mm Hg, additional measurement is done and the first reading was discarded. Average of three-time measurements was taken. Blood pressures were obtained from both arms and when the difference of SBPs between arms was greater than 10 mm Hg, the arm with higher SBP was used for further measurements, otherwise non-dominant arm was used. Baseline and day 3 measurements were done at the clinic maintaining the same environment.

Self-monitoring of BP was done from the first day of forest therapy program in the forest group and equivalent enrollment day in the control group. Self-measured BP monitoring protocol is as follows: After 5 minutes rest, seated, three measurements at 1-minute intervals were done in the morning before drug intake (6 am–10 am) and in the evening (6 pm–10 pm) with designated BP monitor (UA-767, A&D, Tokyo, Japan) and recorded by patients. Measurements on the other timings were not prohibited. Weekly average of all valid measurements was used as an outcome variable excluding the first day of that week.

Salivary Cortisol Level

Commercialized measurement kit (ER HS Salivary Cortisol, Salimetrics LLC, State College, PA, USA) was used for measurement of salivary cortisol. Subjects washed their mouth and nil per os (NPO) state was maintained thereafter for at least 15 minutes until the measurements. Cotton ball contained in the kit was chewed for more than 1 minute and then collected, frozen, and stored in a refrigerator for later analysis. Collected samples were analyzed at the same batch. Samples were centrifuged for 2 minutes at 2500 rpm, 25 μL of assay diluents were infused, and then analyzed using assay kit as described by Chiu et al. (9) Measurements were done at initial visits and at 8-week final visits.

Quality of Life

A QoL measurement tool developed by Kim et al. (10) was used, which is based on widely used existing QoL tools such as the medical outcome study: 36-Item short-form health survey (MOS SF-36) and Duke-UNC Health profile (DUHP). This consists of five domains which are general health (GH), physical dimension (PD), mental dimension (MD), social dimension (SD), and hypertension-related dimension (HTN). The number of questions is 23 and each question has 5-point Likert scale. The total score is ranging from 23 to 115; the higher the score, the better the QoL.

Measurements were done at initial visits and at 8-week final visits.

Forest Therapy Program

Forest therapy program was developed by the investigator group including educational sessions and guided activity program in the forest. Objectives of the program

were (i) obtaining basic knowledge for the management of hypertension; (ii) enhancement of self-efficiency for self-care; (iii) motivation for long-term therapeutic lifestyle change; and (iv) learning relaxation technique in the forest environment. Detailed agenda for 3-day program is shown in Table 1. Subjects in the forest group participated in the program which underwent in two recreation forest sites, Hoengseong and Saneum, in Kangwon-do, Republic of Korea, according to the same agenda. The control group was provided with printed educational materials for hypertension management and instructed to self-monitor their BPs during the study period.

Saneum forest mainly consists of Korean pine (*Pinus koraiensis*) and other broadleaf trees mixed. The age of the trees is approximately more than 30 years. Hoengseong forest is mainly composed of Japanese Larch (*Larix kaempferi*) and other broadleaf trees mixed. Both forests are "recreation forest" with lodging facilities and walkways of varying degree of inclination through the forest. These are located in mountainous region of Republic of Korea and managed by the government.

Statistical Analysis

Continuous variables were described as mean ± standard deviation or median (25–75 percentile) if a variable is not normally distributed. Salivary cortisol and majority of QoL measures were significantly deviated from normal distribution. Comparisons of means between the two groups were done by Student *t* test or Wilcoxon rank-sum test in variables not normally distributed. All comparisons were done by two-tailed tests. In *t* test with unequal variances between the groups, Satterthwaite degrees of freedom were used. To compare overall longitudinal BP change between two groups, repeated measure analysis of variance (ANOVA) was used with addition of interaction term between group and measurement timing. *P* value below .05 was considered as being statistically significant. The statistical package used for the analysis was STATA/MP 11.1 for Windows (32 bit) (StataCorp LP, College Station, TX, USA).

Table 1. Forest therapy program for hypertension was devised based on combined cognitive interventions and behavioral techniques using forest environment

Agenda	
First	• Building relationships among participants and motivation enhancement for active participation in the program • Obtaining basic knowledge for the better management of hypertension
Second	• Understanding the relationship between stress and blood pressure and learning how to manage stress • Experiencing forest by activating and applying all five senses • Obtaining relaxation using mindfulness-based meditation in the forest • Setting goals toward long-term lifestyle change using behavioral techniques • Promoting positive emotion and enhancing self-efficiency through "gratitude meditation" with keeping silence in the forest
Third	• Encouraging maintenance of newly learned behaviors by using a reminder
8 wk	• Self-monitoring of blood pressure and keeping journals

RESULTS

Baseline Characteristics

Baseline demographic and clinical characteristics did not differ between the two groups (Table 2). The control and forest groups consisted of mainly elderly patients with mean age of 63 ± 11 and 66 ± 7 years, respectively. Male proportion was higher and the number of antihypertensive medications was smaller in the forest group, but it did not reach statistical significance. Almost half of the subjects were overweight, and BP control status seemed to be good in the majority of patients with mean SBP and DBP in 130s and 70s, respectively. Baseline salivary cortisol level and measurements of QoL did not differ between the groups. Subjects in both groups were enrolled from two local health centers in Kangwon-do, Republic of Korea, and the distribution of their living area the location in which they underwent the program was not significantly different between groups (data not shown).

Change in the BPs

Table 3 shows BP changes in both groups compared with the initial measurements. Clinic SBP at day 3 (immediately after completing the program) showed larger decrease from initial measurement in the forest group compared with the control group, but statistical significance was marginal (changes of SBP, forest vs. control group: −10.3 ± 2.0 vs. −1.7 ± 4.0 mm Hg, $P = .06$). Clinic DBP at the same measurement did not show significant change from the baseline, and self-measured SBP and DBP at week 4 and week 8 did not differ from the baseline measurements.

Self-measured SBP at day 1 (average of morning and evening) was significantly lower than initial clinic SBP (123.8 ± 14.2 vs. 134.0 ± 14.2 mm Hg, $P < .0001$) and the decremental change of self-measured SBP at day 3 compared with day 1 was not statistically significant and not different between the forest therapy and the control groups (−2.26 ± 9.9 vs. −1.5 ± 17.4 mm Hg, $P = .86$).

Both groups showed significant decrease in SBP over time (P for the control group $< .005$, P for the forest group $< .0001$). While the forest group showed SBP reduction immediately after the program, the change in the control group is more gradual. Overall difference of longitudinal SBP changes between groups was not statistically significant by repeated measure ANOVA ($P = .16$, Figure 1).

Table 2. Baseline demographic and clinical characteristics

	Control ($n = 28$)	Forest ($n = 28$)	P
Gender (male %)	50	28	.10
Age (y)	63 ± 11	66 ± 7	.30
Number of antihypertensive medication	1.9 ± 0.8	1.5 ± 0.7	.07
BMI (kg/m^2)	24.6 ± 2.9	24.3 ± 2.9	.72
Baseline BP (mm Hg)			
Systolic	134.2 ± 20.9	132.3 ± 7.6	.68
Diastolic	78.0 ± 17.0	76.6 ± 6.3	.69
Salivary cortisol (μg/dL)	0.10 (0.06–0.14)	0.10 (0.06–0.15)	.65
Quality of life			
Total score	47 (39–55)	49 (40–55)	.51
GH	3 (1–4.25)	3 (2–4)	.88
PD	8 (5.75–10)	8 (7–13)	.15
MD	7 (5–9.25)	7 (5–9)	.55
SD	20 (11–23)	17 (15–26)	.96
HTN	8 (6–10.5)	8 (6–9)	.82

Baseline BPs were measured at clinic. Abbreviations: BMI – body mass index; BP – blood pressure; GH – general health; PD – physical dimension; MD – mental dimension; SD – social dimension; HTN – hypertension-related dimension.

Table 3. Changes of blood pressure compared with the initial measurements

	Control ($n = 28$)	Forest ($n = 28$)	P
Day 3			
Systolic	−1.7 ± 18.3	−10.4 ± 10.3	.03
Diastolic	1.3 ± 13.3	−0.1 ± 7.8	.34
Week 1			
Systolic	−12.2 ± 16.1	−10.8 ± 11.3	.74
Diastolic	−3.2 ± 12.0	−1.4 ± 6.7	.73
Week 4			
Systolic	−9.7 ± 18.4	−6.2 ± 22.3	.69
Diastolic	−4.3 ± 12.1	−1.3 ± 6.6	.84
Week 8			
Systolic	−11.5 ± 19.9	−12.0 ± 9.2	.46
Diastolic	1.3 ± 13.3	−0.1 ± 7.8	.34
Salivary cortisol (μg/dL)	0.03 (−0.02 to 0.08)	−0.03 (−0.11 to 0.01)	.02

Blood pressures at day 3 were measured at the clinic immediately after completing the program in the forest group and at equivalent timing in the control group, in the same measuring environment as baseline measurements. All BP values thereafter were obtained from self-measurements.

Change in Salivary Cortisol Level

Salivary cortisol level reduction was significantly larger in the forest group (changes control vs. forest group, median (25–75 percentile): 0.03 (−0.02 to 0.08) vs. −0.03 (−0.11 to 0.01) μg/dL, $P < .05$). While the control group showed slightly increased level at follow-up, the level in the forest group decreased significantly (Figure 2).

Changes in QoL Measures

The forest group showed significantly increased total score of QoL measures. Among the domains of measures, the forest group showed prominent increase in MD and HTN, and GH and SD domains remained at the same level. Quality of life improved in both groups, but the changes in the control group are not statistically significant while the forest group showed prominent improvement (Table 4 and Figure 3).

DISCUSSION

This study is a non-randomized controlled trial to investigate the effect of "forest therapy" program on patients with mild hypertension. Marginally significant SBP reduction was seen at the measurement immediately after the program but the control group also showed decrease in BP thereafter, so overall BP reduction level was not different between the two groups. However, salivary cortisol level decreased more in the forest group at eighth week, which suggests attenuated stress response. Moreover, QoL measures showed more improvement in the forest group.

Because hypertension is an extremely common health problem and its awareness, treatment, and control rates are known to be inadequate (8), community programs to motivate and educate patients have an importance in controlling hypertension from a public health perspective. Various approaches have been

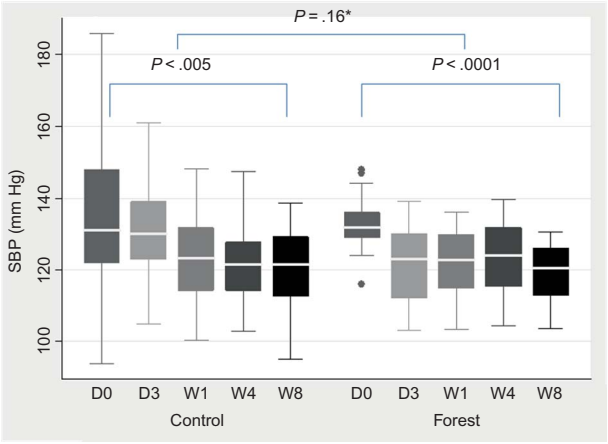

Figure 1. Systolic blood pressure change in control and forest groups. Abbreviations: D0 – baseline; D3 – day 3, immediately after the program; W1 – week 1; W4 – week 4; W8 – week 8; SBP – systolic blood pressure.
**P* for the overall difference of changes of systolic blood pressure level between two groups.

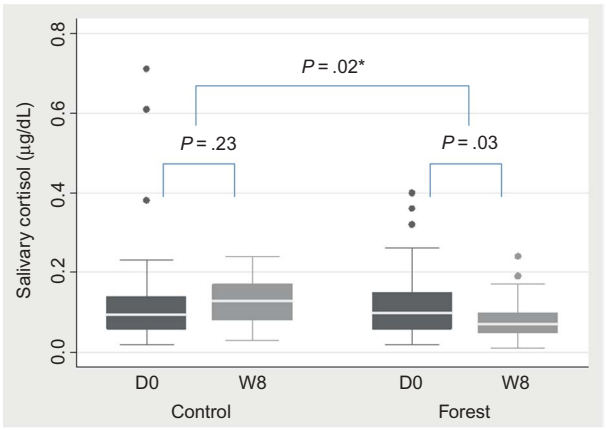

Figure 2. Change of salivary cortisol levels in control and forest groups. Abbreviations: D0 – baseline; W8 – week 8.
**P* for the difference of changes of cortisol level between two groups.

tried as a model of community program for hypertension management (11–14). A community program to aid hypertension management was developed, which is underwent in the forest environment, taking advantage of Republic of Korea's natural environment because high proportion (63.8% in 2010 statistics) of the land is mountainous and forest area (15). Similar programs have been studied in previous studies (3,6,7,16,17) but the authors tried to make this program more comprehensive by integrating "forest bathing", that is, exposure to forest environment by light walking, breathing, and staying in forest, educational sessions, and relaxation technique using meditation, and studied not only the physiological parameters such as BP and cortisol level but also the QoL measures.

It should be noted that the control group also showed significant SBP reduction, thus making the difference between the two groups statistically insignificant during

Table 4. Changes in quality of life measures compared with the baseline

	Control ($n = 28$)	Forest ($n = 28$)	P
Total score	9 (−1.75 to 34.5)	42 (31 to 48)	<.001
GH	−0.5(−1 to 0)	0 (−1 to 1)	.64
PD	1.5 (0 to 9.75)	9 (4.5 to 11)	.03
MD	0 (−0.75 to 13)	16 (11.5 to 18.25)	<.001
SD	0 (−7 to 7.75)	3.5 (−6.5 to 8)	.41
HTN	3.5 (0 to 17)	18 (13.75 to 20)	<.001

Abbreviations: GH – general health; PD – physical dimension; MD – mental dimension; SD – social dimension; HTN – hypertension-related dimension.

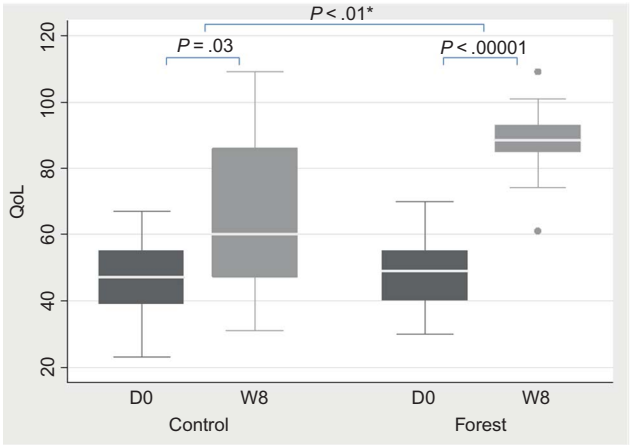

Figure 3. Change of quality of life (total score) in control and forest groups. Abbreviations: D0 – baseline; W8 – week 8; QoL – quality of life.
**P* for the difference of changes of score between two groups.

the follow-up period. Change in DBP was not significant but SBP decreased about 10 mm Hg. The total amount of the change is comparable with that which can be achieved by therapeutic lifestyle change (8). This change probably reflects a mixture of various effects such as therapeutic lifestyle change taken by the patients and "regression to mean" from the initially higher BP level due to the arousal from unfamiliar environment. The authors tried to minimize white coat effect and bias by making all the office measurements done by a research nurse and not by physicians and by taking BPs at the same place (a local health center) in both groups. Study subjects were relatively in the older age group, which explains the observation that the BP change was mainly systolic and diastolic BP change was negligible.

The moderate difference in BP change between groups was that the forest group showed significant SBP reduction at the office measurements after the program was completed. The authors speculate that relaxation obtained in the forest environment helps to alleviate the alarming reaction from the office BP measurement in the forest group, while the control group was still experiencing it. However, considering the observation that the self-monitored BPs did not differ between groups, the short-term exposure to the forest environment does not

seem to be powerful enough to induce prolonged and sustained BP reduction. Because the moderate and transient decremental change of SBP occurred only in clinic BP and not in self-measured BP, it can be interpreted that forest environment had an effect of alleviating white coat effects.

Although BP change was largely not different between groups, another biological parameter measured, salivary cortisol level was significantly more decreased in the forest group, suggesting favorable stress response. This observation can be at least partially explained by the effect of the forest program itself, exposure to forest environment, and relaxation technique using meditation (18). However, it is probably not feasible that the effect of 3-day program lasted for 8 weeks. Another factor in the decrease of cortisol level may be educational sessions to improve the knowledge for hypertension and coping strategy for stress and its positive influence to alleviate anxiety for the disease, which is probably reflected in the improvement of QoL. Anxiety is a common symptom in patients with hypertension (19,20), which may be lessened by improved knowledge of the disease and managed better by coping skill and relaxation technique.

It is well known that hypertension is caused by multiple mechanisms and relative degree of contribution of each mechanism is probably quite different from person to person. Favorable effects on autonomic nervous system by itself may not be adequate to lower BP in everyone, thus explaining the discrepancy between the salivary cortisol change and the BP level. Selected subset of patients with increased sympathetic tone, that is, with high level of anxiety and/or psychological stress, may be more responsive to this type of intervention. Additionally, analysis using heart rate variability may reveal supportive findings for the favorable effects to autonomic balance, which was not done in this study.

Total score of QoL improved in both groups but more prominently in the forest group. The increased scores in PD, MD, and HTN were significant. Previous studies from the authors' group reported favorable effects of forest therapy program on patients with depression (5). This favorable effect on mental status largely explains the effect to MD. Improved knowledge of the disease achieved by educational session probably contributed to increased score in HTN and PD, mainly through the enhanced self-efficacy.

Limitations

This study has several limitations: (i) true randomization was practically impossible because personal preference and feasibility for participation in the forest therapy program could not be neglected in assignment of the subjects. Participation in the forest therapy program definitely needs motivation from the patient's side and assigning an unwilling patient to the forest group was practically not feasible. The motivation for participation, probably related to desire to be healthy, might have a strong "placebo" effect, but it was considered as a part of the "real" effect of the program. Motivation of patients who are not willing to actively participate in the program will be another important but challenging task; (ii) small sample size might have resulted in relative lack of statistical power, especially for BP changes; (iii) the number of interventions may probably be too small to induce persistent effects. Considering the suggestive findings in this study, long-term follow-up study with more frequent intervention is needed; (iv) lifestyle change, such as diet and exercise habit, during the study period was not measured; and (v) because salivary cortisol level has wide individual variance, interpretation of single measurement may be difficult.

Lastly, it is unclear whether there was significant interaction between the effect of forest therapy program and the antihypertensive medication used. The antihypertensive regimen was maintained through the study period but the control group was using slightly larger number of antihypertensive agents and the P value for the difference between the groups was marginal ($P = .07$). This might be a confounding factor for the negative results in BP changes. In another aspect, the authors expect that the motivation obtained in the forest therapy program may help to improve the adherence to the antihypertensive regimen, but because of the lack of data on adherence, it was impossible to compare the two groups in that aspect.

CONCLUSION

Forest therapy program induced moderate SBP reduction but the effect was only transient. Short-term, transient program seems to be inadequate to achieve significant and persistent BP reduction. However, considering the significant decrease in salivary cortisol level and the improvement in QoL measures, long-term frequent exposure to intervention programs using forest environment may induce beneficial psychological and physiological effects to hypertensive patients. This forest therapy program can be a useful model of a community program to improve hypertension management.

ACKNOWLEDGMENT

Financial support came from "Forest Science & Technology Projects (S110709L030110)" from Republic of Korea Forest Service (PI, Woo).

Declaration of interest: The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

REFERENCES

[1] Berman MG, Jonides J, Kaplan S. The cognitive benefits of interacting with nature. Psychol Sci 2008; 19:1207–1212.

[2] Shin WS, Yeoun PS, Yoo RW, Shin CS. Forest experience and psychological health benefits: the state of the art and future prospect in Korea. Environ Health Prev Med 2010; 15:38–47.

[3] Porter W. The development and evaluation of a therapeutic wilderness program for problem youth. MA thesis, University of Denver, Denver, CO, USA, 1975.

[4] Polenz D, Rubitz F. Staff perceptions of the effect of therapeutic camping upon psychiatric patients' affect. Ther Recreation J 1977; 11:70–73.

[5] Kim W, Lim SK, Chung EJ, Woo JM. The effect of cognitive behavior therapy-based psychotherapy applied in a forest environment on physiological changes and remission of major depressive disorder. Psychiatry Investig 2009; 6:245–254.

[6] Park BJ, Tsunetsugu Y, Kasetani T, Kagawa T, Miyazaki Y. The physiological effects of Shinrin-yoku (taking in the forest atmosphere or forest bathing): evidence from field experiments in 24 forests across Japan. Environ Health Prev Med 2010; 15:18–26.

[7] Tsunetsugu Y, Park BJ, Ishii H, et al. Physiological effects of Shinrin-yoku (taking in the atmosphere of the forest) in an old-growth broadleaf forest in Yamagata Prefecture, Japan. J Physiol Anthropol 2007; 26:135–142.

[8] 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; 289:2560–2572.

[9] Chiu SK, Collier CP, Clark AF, Wynn-Edwards KE. Salivary cortisol on ROCHE Elecsys immunoassay system: pilot biological variation studies. Clin Biochem 2003; 36:211–214.

[10] Kim KY, Chun BY, Kam S, et al. Development of measurement scale for the quality of life in hypertensive patients. J Prev Med Public Health 2005; 38:61–70.

[11] Bunting BA, Smith BH, Sutherland SE. The Asheville Project: clinical and economic outcomes of a community-based long-term medication therapy management program for hypertension and dyslipidemia. J Am Pharm Assoc 2008; 48: 23–31.

[12] Eakin EG, Reeves MM, Lawler SP, et al. The Logan Healthy Living Program: a cluster randomized trial of a telephone-delivered physical activity and dietary behavior intervention for primary care patients with type 2 diabetes or hypertension from a socially disadvantaged community—rationale, design and recruitment. Contemp Clin Trials 2008; 29: 439–454.

[13] Jones C, Simpson SH, Mitchell D, et al. Enhancing hypertension awareness and management in the elderly: lessons learned from the Airdrie Community Hypertension Awareness and Management Program (A-CHAMP). Can J Cardiol 2008; 24:561–567.

[14] Yosefy C, Dicker D, Viskoper JR, et al. The Ashkelon Hypertension Detection and Control Program (AHDC Program): a community approach to reducing cardiovascular mortality. Prev Med 2003; 37:571–576.

[15] Korea Forest Service. Forestry Statistics at a Glance. Daejeon: Korea Forest Service, 2010.

[16] Tsunetsugu Y, Park BJ, Miyazaki Y. Trends in research related to 'Shinrin-yoku' (taking in the forest atmosphere or forest bathing) in Japan. Environ Health Prev Med 2010; 15: 27–37.

[17] Yamaguchi M, Deguchi M, Miyazaki Y. The effects of exercise in forest and urban environments on sympathetic nervous activity of normal young adults. J Int Med Res 2006; 34: 152–159.

[18] Cho M-C. New strategies in the treatment of hypertension. Korean J Med 2009; 76:409–415.

[19] Wei TM, Wang L. Anxiety symptoms in patients with hypertension: a community-based study. Int J Psychiatry Med 2006; 36:315–322.

[20] Hildingh C, Baigi A. The association among hypertension and reduced psychological well-being, anxiety and sleep disturbances: a population study. Scand J Caring Sci 2010; 24: 366–371.