Effects of Music Embedded with Binaural and Superimposed Beats Controlling Hypertension in Older Adults: A Quasi Experimental Study

Sureerat Na Wichian, Jakkrit Klaphajone, Duangjai Phrompayak*

Abstract: Hypertension is a leading cause of premature death and disability worldwide. Controlling blood pressure to within normal limit is the most desirable goal but difficult to achieve. This quasi-experiment study aimed to test the effects of music embedded with binaural and superimposed beats on control of hypertension. Fifty-two older Thai adults with hypertension were allocated into either the experimental (n = 26) or control (n = 26) group. The experimental group received music embedded with binaural and superimposed beats at home during the day for 30 minutes per day, for at least 3 days a week over 4 consecutive weeks, while the control group did not. Systolic blood pressure and diastolic blood pressure were measured 4 times; before the intervention and 30 minutes after, at the third week of the intervention, and one week after complete the intervention. Data were analyzed using descriptive statistics, mixed model ANOVA, independent t-test, and one-way repeated measures ANOVA.

Results indicated that after one week of completion the program, participants in the experiment group had significantly lower systolic and diastolic blood pressure than those in the control group, and participants in the experimental group had significantly lower systolic and diastolic blood pressure than before receiving the intervention program. These results indicate that music embedded with binaural and superimposed beats is an efficient complementary treatment to improve blood pressure control among older adults with hypertension. Nurses and other health care personnel can use this intervention program along with medications to help older adults with hypertension to better control their blood pressure but research with a wider sample in different parts of Thailand is recommended.

Pacific Rim Int J Nurs Res 2021; 25(3) 345-358

Keywords: Binaural beats, Blood pressure control, Hypertension, Music therapy, Older adults, Superimposed binaural beats

Received 5 April 2020; Revised 18 July 2020; Accepted 8 November 2020

***Correspondence to: Sureerat Na Wichian**, MNS., RN, (Teaching), Boromarajonani College of Nursing Buddhachinaraj, Phitsanulok, Thailand. E-mail: taptim17@hotmail.com*

***Jakkrit Klaphajone**, MD. Associate Professor, Faculty of Medicine, Chiang Mai University, Chiang Mai, Thailand.*

***Duangjai Phrompayak**, MNS., RN (Teaching), Boromarajonani College of Nursing Buddhachinaraj, Phitsanulok, Thailand.*

Introduction

Hypertension is a leading cause of premature death worldwide.[1] Many people have this condition without realizing it, for high blood pressure also brings about other diseases such as myocardial infarction and stroke[1] with escalating trend worldwide. According to a survey of 180,335 people, there were 39.8% with

high blood pressure among those 45-54 years old whereas the prevalence in the age group of 65-74 and over 75 years old was 51.5% and 52%, respectively.[2] Hypertension is a major problem in the older adults that should be extensively managed.

There are two major types of treatments for high blood pressure among the older adults: pharmacological and non-pharmacological. In most cases, people will be treated with antihypertensive drugs. Some experience the benefits of adjuvant non-pharmacological intervention to the point where they can stop taking medication.[3] This will help reduce possible side effects such as liver or kidney problems, metabolism alteration, and interrupted nutrient absorption.[4] Complementary therapy such as praying, meditating,[5] slow breath training program,[6] or using folk music are recommended.[3] It has been found that sound therapy is simple, practical, easy to learn, and does not have side effects.

Sound therapy is generally the use of music or sounds with music elements (melody, rhythm, tempo, volume, pitch, tone, and harmony) as a therapeutic tool to achieve individual treatment goal. Ideally the songs and melodies have to be approved by experts.[7] Sound therapy also includes rearranging songs and melodies or creating new playlist of songs with changing elements.

Various types of music can be used in music therapy. A previous study using sound therapy to control blood pressure in the older adults reported only music effects on controlling blood pressure such as folk music,[3] popular music, instrumental, and classical Thai music.[8] A study using binaural beats in older adults with insomnia[5] and superimposed binaural beats in student revealed more decreased anxiety.[9] Therefore, in this study, the combined music with the binaural beats and superimposed binaural beats as a therapeutic sound was applied for 30 minutes per day to control blood pressure in older persons. This method of study has never been conducted in Thailand and could pave the way for a specific adjuvant therapy for treating high blood pressure in the future.

Review of Literature and Conceptual Framework

The benefit of sound therapy can be explained by the entrainment theory of binaural beats, superimposed binaural beats and mechanism of sound therapy. This is using waves with a specific frequency to stimulate the brain can induce brainwave frequency changes following to those waves. The wave sources can be light or sound. Various research articles have applied isochronic tones, monaural beats and binaural beats or both (audiovisual stimulation).[10] This study used a combination of binaural beats, superimposed binaural beats and sound music.

Mechanism of sound therapy: When the ears perceive a sound, its energy is changed to electrical energy in the brainstem and temporal lobe of cerebral cortex.[11] While the electrical energy is moving into the brain, it stimulates a physiological response related to sound waves, namely music sound and binaural beats.[11] When the rhythm of binaural beats and superimposed binaural beats is perceived with different frequencies, they will interact with each other.[9] A music with a slow tempo makes the body adjust to save energy and consequently lower pulse and blood pressure.[12] Moreover, slow tempo music also enhances the alpha brainwave level which leads to relaxation, stimulates pituitary gland to secrete endorphin.[13] This makes a person happy and experience less pain. Music also affects the parasympathetic nervous system which brings about muscle relaxation, reduced heart rates, deeper and more consistent breathing, reduced oxygen consumption and blood pressure.[13]

Binaural beats (BB): The mechanism of BB beats effect arises from bilateral input of slight sound frequency difference via the ascending auditory pathway. BB act on the limbic system causing effects to mood, and on the brainstem changing the physiological response including the brainwave entrainment. BB can be created from the difference in the two pure

tones of constant frequency of less than 35 Hz.[14] BB are low-frequency sounds produced by the interference of two carrier sounds with few different frequencies and can stimulate the brain through listening and by conducting sound waves through the skull. If the frequency of sound presented to the left ear or passing through the skull is 305 Hz, and 295 Hz on the right, the intracranial binaural beat frequency will be approximately 10 Hz (305 - 295 Hz).[14] The brain wave at any active or awake state shows a majority of 30 Hz or beta wave in most parts of the brain, whereas during a relaxed state, brain wave frequency is mainly in the alpha wave level or 10 Hz. In order to change the awake state to relaxed state, initial attunement with a sound therapy with the beat frequency of about 30 Hz is preferred and then the beat frequency is gradually changed to 10 Hz at the end of the song.[9,15]

Superimposed binaural beats (SBB) is a new binaural beat which is synthesized on the basis of frequent shifting of the sound waves from each musical instrument, except for drum sounds (due to their extremely low frequency), in addition to the original BB created by the standard method of pure tone sine wave-frequency differentiation. The binaural frequency difference is kept constant despite changing frequencies of the carrier sound waves.[9]

Mixed BB and SBB have been shown to effectively reduce anxiety and blood pressure.[9] In a previous study, SBB was tested in 134 university students and resulted in more anxiety reduction than ordinary music listening and general relaxation methods.[9] A study in older adults with Alzheimer's disease revealed a hierarchical improvement of the motivation for rehabilitation activities and mood disorder with music therapy.[16] Previous studies, including pilot studies, revealed superior results over control when music therapy with embedded BB was used in older persons with insomnia[4] and patients undergoing cataract surgery[17]. A study on newly developed SBB in university students also revealed an enhanced decrease in anxiety level[9].

Apart from music embedded with BB and SBB which could induce alpha brainwaves leading to improve quality of rest and reduce blood pressure,[15] having older adults sit in a comfortable position during sound therapy session for 30 minutes once a day, at least 3 days a week for 4 weeks would be likely to have pronounced balancing in their blood pressure.

Study Aim and Hypothesis

This study aimed to test the effectiveness of music embedded with BB and SBB on blood pressure among older adults with hypertension. The following hypothesis was set: one week after completion of the intervention, both systolic and diastolic blood pressure of the experiment group would be significantly lower than those in the control group, and be significantly lower than before receiving the intervention.

Method

Design: A quasi-experimental design was used.

Sample and sample size: The population of this study consisted of both male and female older adults >60 years with essential hypertension. The sample size was calculated by using a power analysis in which the power was set to 0.80. The significance level was set at 0.05. A medium effect size d = .6 was applied. Estimation of sample size on a two-tailed basis yielded 44 participants[18] based on previous studies.[19] However, an additional sample to keep the risk of type II error down to 20% was recommended to compensate for the attrition rate or in case some participants could not participate in the study (n = 8).[18] Finally, the total sample size was set to 52, which was equally divided into the control group (n = 26) and the experimental group (n = 26).

Two community health centers having clubs for older people were randomly selected from one province in the lower northern part of Thailand. Each club was randomly assigned to the experiment or

control group, then convenience sampling and matching were used to select 26 older persons from each club. The inclusion criteria of the participants were (1) able to communicate in Thai language; (2) having good consciousness and normal awareness with a score of at least 8 out of 10 tested by the Short Portable Mental Status Questionnaire (SPMSQ) of Pfeiffer[20]; and (3) no hearing problems. The latter was evaluated by whispered voice test as a screening tool to check their ability to hear the quietest sound that human ears can perceive, (around 20-35 dB).[21] Participants were asked to listen to the noise from the application "Sound Meter" and had to respond with at least 3 correct words or numbers out of 6 in order to pass the test. The other inclusion criteria were: (4) physically able to participate in the research; (5) diagnosed with controlled hypertension (SBP ≤ 160 mmHg and DBP ≤ 100); and (6) currently taking antihypertensive drugs but not having to be admitted to the hospital. The two groups were matched for the following similarity criteria; (1) age (between 60-69, 70-79 and over 80 years), (2) gender (male and female), and (3) number of chronic comorbid conditions. The potential participants would be excluded if they (1) had been admitted to a hospital, (2) requested to withdraw from the study, (3) failed to stay in touch, (4) used music therapy less than three times per week, and (5) did not have blood pressure measured 4 times measured by the PI. In this study no one was excluded from the study. (**Figure 1**)

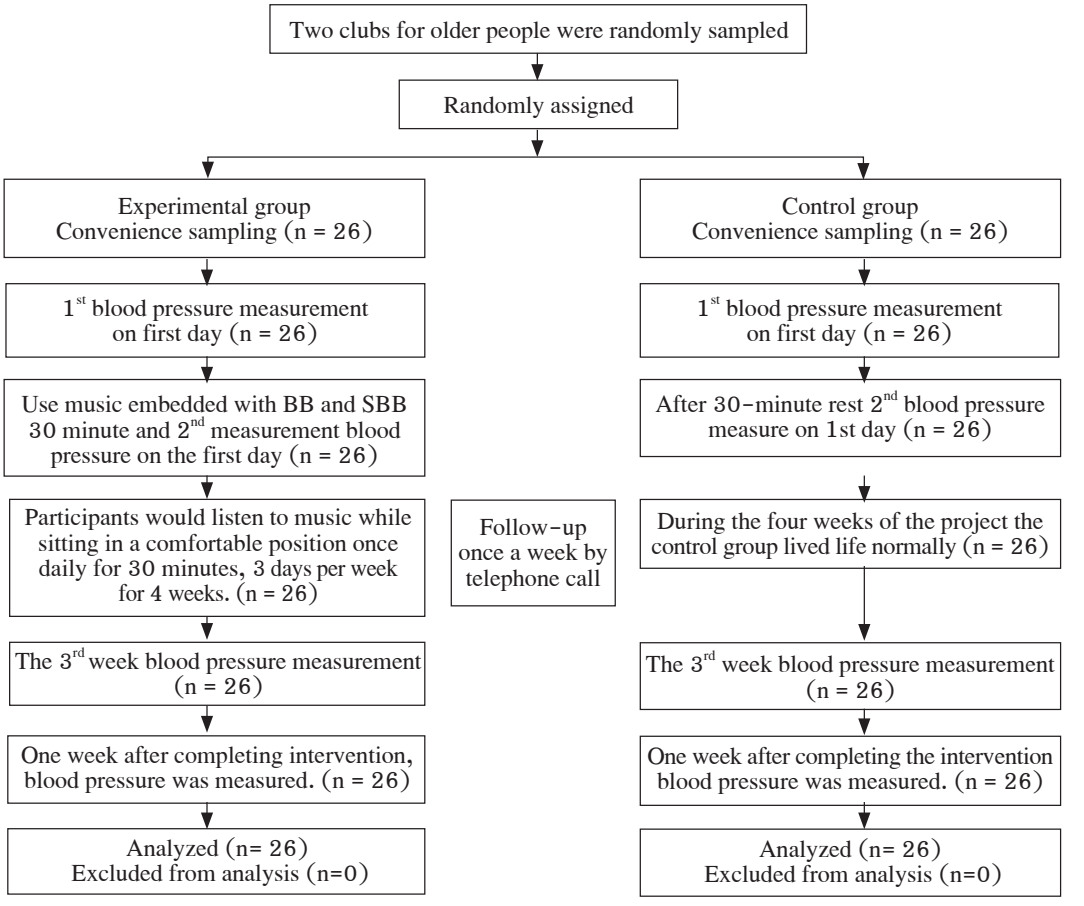

Figure 1 Flow diagram of participants through each stage of the study

Ethical Considerations: This study was approved by the Ethics Committee for Human Research, Regional Network, Naresuan University (Project number: 029/62, Approval letter number: NU-PREC/595). The rights of participants were protected prior to collecting the data by explaining the objectives, potential benefits, procedures, methodology, data collection method, and duration of the study. Participants were also informed that they had the right and liberty to accept or decline the invitation to participate without negative consequences, and all signed a consent form. All data were treated confidentially and participants could ask questions or raise concerns to the researcher anytime throughout the study.

Research Instruments: These comprised the instrument for collecting the data, and the music therapy intervention. The instrument for collecting the data including a personal information questionnaire, blood pressure observation charts, and a digital blood pressure monitor.

The personal information questionnaire included gender, age, marital status, religion, educational level, occupation, underlying disease, medication used and health coverage, and *the blood pressure observation charts* consisted of 4 blood pressure recordings. The questionnaire and blood pressure observation charts were validated by three experts including three nurses; one in adult nursing and two in gerontological nursing. This test validation helped to ensure that these tools were appropriate to be used with the older adults.

The digital blood pressure monitor: "Sanitas SBM50" model (standard medical devices number SN: W33/042732) was used. We used the same digital blood pressure monitor for all participants throughout the study and compared results with a mercury sphygmomanometer (the difference being within the range of ± 5 mmHg) and triplicated measurements to average the values.

The music embedded with BB and SBB intervention including instruction pamphlet, sound therapy audio, portable mp3 player, data backup tool, speakers, chargers, and an instruction CD. *The instruction pamphlet* described the sound therapy and blood pressure form that the PI had created. The music embedded with BB and SBB intervention and the instruction pamphlet were tested in a pilot study for clarity with 5 pilot participants not included in the actual study. This effort was made to ensure that the experiment protocol could be executed consistently among all participants, especially when sound therapy was applied at home on a daily basis. The result of a pilot study with 5 participants indicated that the music embedded with BB and SBB intervention and the instruction pamphlet were acceptable for use.

The therapeutic sound in this study was developed by the PI and the second author. It included music, binaural beats and superimposed binaural beats.[9] The 30-minute sound therapy session comprised music with slow and continuous rhythms, low to medium pitch and low volume with slowly changing melodies. Two types of binaural beats were applied, one being binaural beats with constant 10 Hz difference in frequency between left and right ears and the other being superimposed binaural beats with simultaneously changing frequency in the left and right ears despite constant 10 Hz binaural difference. The binaural effects started at the fifth minute of the sound therapy session until the end of the playlist. The participants were asked to listen to the sound while sitting in a comfortable position during the day for 30 minutes, once a day, 3 days per week for 4 weeks. The participants recorded their having listened to the music therapy after each session.

Data Collection: After receiving the approval from the study sites, the PI set meetings with the presidents of the two clubs to introduce the study and recruit participants.

The control group: The PI measured participants' blood pressure twice on the first day (the first visit and the second after a 30-minute rest). Participants performed their usual normal lives over the next four weeks, with the control group queried about their health condition and medication by phone. The PI

met with the control group to measure blood pressure on the third week and the one week after the completion of the intervention program.

The experimental group was given instructions how to use the music and to record blood pressure on the form. They were asked to record the date and their feelings after each session as well. MP3 players with sound therapy audio data backup equipment along with accessories such as charger cable, charger plug and instructional pamphlets were given out so participants could continue at home. The participants were requested to use sound therapy for 30 minutes at home at least 3 times a week for 4 weeks, whilst sitting in a comfortable position, and to avoid listening to similar music which includes music sound, binaural beat and superimposed binaural beat. Participants were also told not to engage in other activities while listening. Music from a TV Talent show was allowed as this had different rhythms from music in this study. Their blood pressure was measured four times during the first meeting, the second time after music was used, in the third week and one week after completion of the intervention program. The PI called each participant once a week for follow-up on health conditions, medication used, challenges in following the treatment and answered any questions the participants asked. Some participants had problems about protocol. The PI immediately helped the participants by phone or went to their home. Data from both groups were reviewed by the PI for completeness. (See **Figure 1**)

Data Analysis: A statistical software package was used to analyze the data. The personal data were analyzed by using descriptive statistics; Chi-square test and Fisher's exact test were used to compare the different in personal data between the two groups. The Komogorov-Sminov test (KS) was used to test blood pressure data scatter and findings indicated that the scatter of data was in a normal curve. Then the differences of blood pressure between the experimental group and control group were analyzed using a mixed model ANOVA. An independent t-test was used to test the differences of blood pressure in each phase between the 2 groups. A one-way repeated measures ANOVA was used to analyze the differences of blood pressure between the 2 groups before and after participating in the program. A significance level of .05 was set.

Results

There were 52 participants with 26 in each group. Most participants in both groups were female, ages ranging 70-79 years, and having two comorbidities. The average age of the control group (71.92) was similar to the experimental group (73.23). Chi-square testing indicated no significant difference in age, marital status, religion, education level, occupation, comorbidity, or health care coverage. Also, Fisher's exact test showed no significant difference in gender, congenital disease, and medication used between the two groups (see **Table 1**).

Comparing blood pressure levels after the intervention with testing the assumptions of mixed model ANOVA being normality, yielded no significance in any subgroup. Levene's test of equality of error variances showed no significance in all variables, tested between-subjects effects group (F=4.08, p=.04), and Mauchly's test of sphericity revealed significance, thus further testing with Greenhouse-Geisser was performed. Results showed that both means of systolic and diastolic blood pressure in the experimental group were significantly lower than those in the control group at $p < .05$ (see **Table 2**). It was also found that systolic and diastolic blood pressure had an interaction effect (the profile plot having line graph intersected and being in an opposite direction). After considering the result of profile plot throughout the study, the trend of the systolic and diastolic blood pressure in the experimental group tended to be decreased while those of the control group tended to be increased (Sees **Figures 2 and 3**). The result from the independent t-test indicated that the blood pressure at the first and second measurements was not significantly different ($p > .05$), while that at the third and

fourth measurement was significant at $p < .05$, indicating that the experimental group had lower systolic and diastolic blood pressure than those in the control group (see **Table 3**).

For comparing blood pressure level before and after music embedded with BB and SBB intervention using one-way repeated measures ANOVA, both mean systolic and diastolic blood pressures of the participants in the experimental group were significantly lower, whereas they were significantly higher in the control group after measurements 2-4 (see **Table 4** and **Figures 2** and **3**).

Table 1 Comparing personal data of participants in control and experimental groups

Personal data	Control group (n = 26)				Experimental group (n = 26)				p-value
	Mean	S.D.	n	%	Mean	S.D.	n	%	
Gender									1.00[b]
male			5	19.23			5	19.23	
female			21	80.77			21	80.77	
Age (year)	71.92	6.79			73.23	7.14			1.00[a]
60-69			8	30.77			8	30.77	
70-79			13	50.00			13	50.00	
≥ 80			5	19.23			5	19.23	
Marital status									.10[a]
Single			8	30.76			4	15.39	
Married			9	34.62			10	38.46	
Widowed or divorced			9	34.62			12	46.15	
Religion									.22[a]
Buddhism			25	96.15			24	92.30	
Christianity			1	3.85			2	7.70	
Education level									.51[a]
Uneducated			1	3.85			3	11.54	
Primary education			13	50.00			12	46.15	
Secondary education			4	15.38			6	23.08	
Bachelor's degree			7	26.92			4	15.38	
Postgraduate			1	3.85			1	3.85	
Occupation									.05[a]
Unemployed			7	26.92			20	76.92	
Employed			18	69.23			0	0.00	
Private business			0	0.00			5	19.23	
Official			1	3.85			1	3.85	
Congenital disease									1.00[b]
Yes			26	100			26	100	
No			0	0.00			0	0.00	
Comorbidity									1.00[a]
1 chronic disease			9	34.62			9	34.62	
2 chronic diseases			12	46.15			12	46.15	
3 chronic diseases			5	19.23			5	19.23	
More than 3 chronic diseases			0	0.00			0	0.00	
Medication used									
Yes			26	100			26	100	1.00[b]
No			0	0.00			0	0.00	
Health Care Coverage									
Government officials			11	42.30			8	30.77	.37[a]
Social security rights			1	3.85			0	0.00	
Reimbursed via the universal coverage scheme			14	53.85			18	69.23	

[a] = Chi-square test. [b] = Fisher's exact test.

Table 2 Mixed-design ANOVA, comparing 4 measurements of systolic blood pressure (SBP) and diastolic blood pressure (DBP) of participants after the music embedded with BB and SBB between control and experimental groups

source	SS	df	MS	F	p-value
Systolic blood pressure (SBP)[a]					
Within subjects					
Time	768.82	2.49	308.63	10.17	.00
Time*Group	5033.09	2.49	2020.48	66.63	.00
Error time	3776.83	124.55	30.32		
Between subjects					
Group	2499.23	1	2499.23	4.08	.04
Error	30571.12	50	611.42		
Diastolic blood pressure (DBP)[a]					
Within subjects					
Time	93.90	2.37	39.51	1.60	.20
Time*Group	1717.07	2.37	722.52	29.26	.00
Error time	2933.51	118.82	24.68		
Between subjects					
Group	4176.07	1	4176.07	14.59	.00
Error	14309.40	50	286.18		

[a]= Greenhouse-Geisser, $p < .05$

Table 3 Independent t-test comparing the 1,st 2,nd 3,rd and 4th measurements of blood pressure among older persons with hypertension between control and experimental groups

Blood pressure \ Group	Control group (n=26)		Experimental group (n=26)		t	p-value
	Mean	SD.	Mean	SD.		
Systolic blood pressure						
1st	138.08	15.60	143.54	12.26	1.40	.17
2nd	139.00	13.13	136.38	13.98	.70	.49
3rd	141.96	13.07	132.81	12.72	2.56	**.01**
4th	146.15	12.35	124.73	11.28	6.53	**.00**
Diastolic blood pressure						
1st	79.50	10.32	76.31	10.39	1.11	.27
2nd	79.73	9.45	74.62	9.73	1.92	.06
3rd	82.42	9.03	73.00	7.69	4.05	**.00**
4th	85.23	8.35	67.12	8.99	7.52	**.00**

$p < .05$

Table 4 One-way repeated measured ANOVA comparing blood pressure before and after the music embedded with BB and SBB in control group and experimental group

source	SS	df	MS	F	p-value
Control group					
Systolic blood pressure (SBP)[a]					
Within subjects					
SBP	1031.56	1.69	608.65	20.30	.00
Error	1270.18	42.371	29.97	3015.53	.00
Between subjects					
Intercept	2076375.24	1	2076375.24		
Error	17214.01	25	688.56		
Diastolic blood pressure (DBP)[a]					
Within subjects					
DBP	564.337	2.17	260.09	15.59	.00
Error	904.91	54.24	16.68		
Between subjects					
Intercept	694548.08	1	694548.08	2234.23	.00
Error	7771.66	25	310.86		
Experimental group					
Systolic blood pressure (SBP)[b]					
Within subjects					
SBP	4770.34	3	1590.15	47.57	.00
Error	2506.65	75	33.42		
Between Subjects					
Intercept	1877621.88	1	1877621.88	3514.27	.00
Error	13357.11	25	534.28		
Diastolic blood pressure (DBP)[b]					
Within subjects					
DBP	1246.644	3	415.54	15.36	.00
Error	2028.60	75	27.04		
Between subjects					
Intercept	550572.01	1	550572.01	2105.36	.00
Error	6537.74	25	261.51		

[a]= Greenhouse-Geisser, b= Sphericity Assumed, $p < .05$

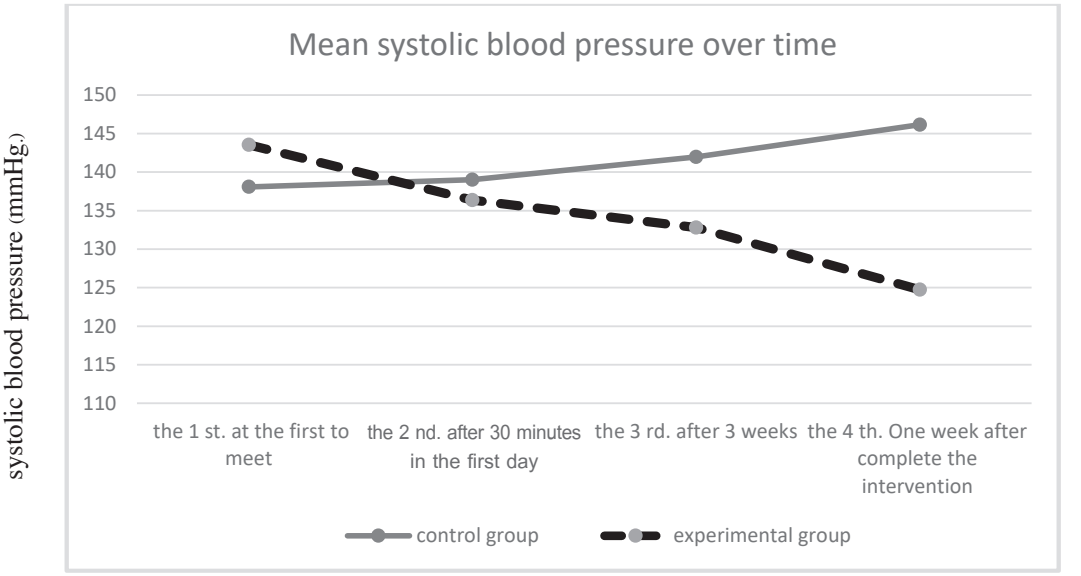

Figure 2 Average systolic blood pressure over time in the experimental and control groups.

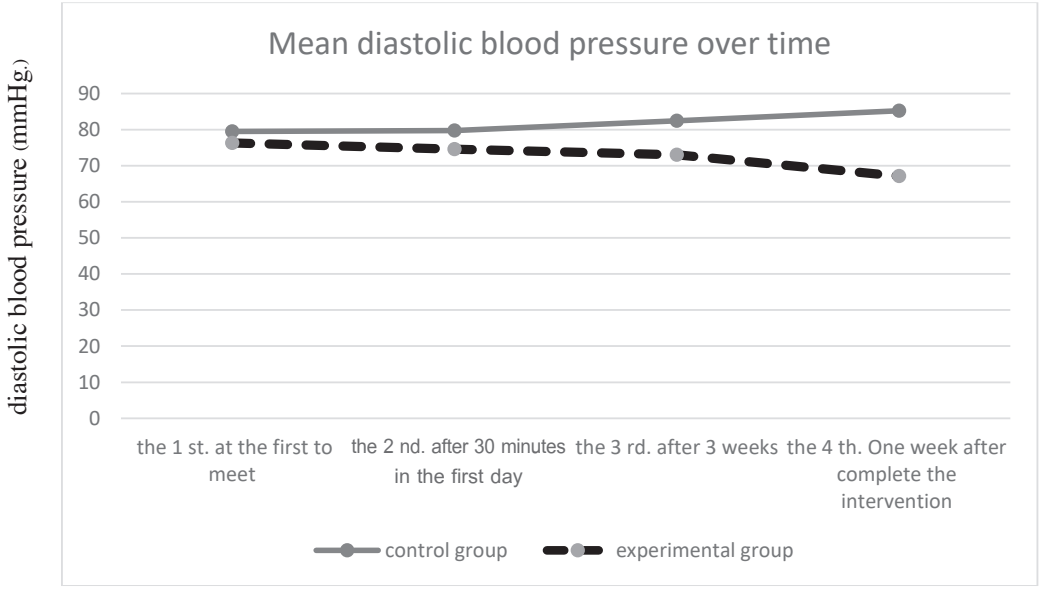

Figure 3 Average diastolic blood pressure over time in the experimental and control groups.

Discussion

According to our results, the music embedded with BB and SBB could reduce both systolic and diastolic blood pressures in older persons with hypertension as hypothesized. Music sound for the duration of 30 minutes was designed with slow, continuous melody with medium to low pitch and low volume. This music has been shown to generally induce alpha brainwaves leading to a relaxing physical response, and stimulate the parasympathetic nervous system to relax muscles. During the therapy, the heart rate becomes slower; breathing becomes deeper and more constant which reduces oxygen consumption. The combination of these helps reduce blood pressure.[1] The sound waves of music by itself causes vibrations which tend to merge with vibrations in the body. Slow tempo music makes the body conserve energy and reduce pulse and blood pressure.[12-13]

This experiment used two types of beat sound: binaural and superimposed binaural beats. Binaural beats were created with a constant difference between left and right ears at 10 Hz whereas superimposed binaural beats were synthesized at 10 Hz with simultaneously changing sound frequencies between left and right ears. Our study applied binaural and superimposed binaural beats to be started from the fifth minute to the end of the sound therapy session. Binaural and superimposed binaural beats are actually auditory processing artifacts. Previous studies revealed that the beats create physical interactions between the rhythm of sound waves and blood pressure. The binaural beats mechanism influences the brain status through entrainment of brainwaves (frequency following response) and had been used to reduce anxiety, leading to a better rest.[17] When the body relaxes, decreased total peripheral resistance due to vasodilatation would cause reduced blood pressure.[11] When participants used sound therapy when sitting in a comfortable position once a day for 30 minutes, 3 days a week for 4 weeks, it enhanced blood pressure reduction. This result was consistent with the findings on a systematic review that sound therapy application could reduce blood pressure,[22] especially systolic blood pressure, in experimental groups when compared with control groups.[22]

Our study revealed that mean blood pressure levels of the experimental group were lower than that of the control group and lower than at the beginning of the study. When looking at each phase of systolic and diastolic pressure, it was found that both systolic and diastolic blood pressure in the experimental group decreased, while those of the control group increased. This result was compatible with the use of folk music to control blood pressure in patients with level two hypertension.[23] Another comparable study applied Turkish classical music in women who had hypertension during pregnancy for 30 minutes every day for 7 days and found that music effects reduced the pulses of the fetuses and the blood pressure of the pregnant women.[24] This confirmed that music therapy can help control blood pressure.

Moreover, our study suggested that sound therapy was very feasible for the older adults. The members of the experimental group were older (average age = 73.23 with *S.D.* = 7.14) and 76.92% were unemployed. For them music therapy application was not complicated and was practical with no side effects as it was non-pharmaceutical. The older adults could use equipment that we provided and instructions pamphlets with illustrations were helpful, since they helped to overcome age-related challenges, such as memory loss and indecision.[25] Our study was supported by a previous systematic review, which indicated the simplicity of music therapy with no adverse effects and could be used in all age groups even with the older adults.[26] In addition, the participants in the experimental group further reported that after 4 weeks of the sound therapy, they continued to feel calm and relaxed. When measuring blood pressure at home, many still had reduced blood pressure. Most participants had good compliance with the sound therapy as an adjuvant

treatment and more older adults seem likely to use it anywhere and anytime.

In this study, the external factors regarding antihypertensive drug use was also explored. The participants could take their own antihypertensive drug consistently and continuously and neither medication dosage nor treatment change was reported during the study on each week telephone follow up.

Limitation

This study was only conducted on older adults with underlying hypertension who used medication to control their blood pressure in the range of systolic blood pressure of <160 mmHg and diastolic blood pressure of <100 mmHg Therefore, generalization is limited.

Conclusions and Implications for Nursing Practice

This study demonstrates the benefit of music embedded with binaural beats (BB) and superimposed binaural beats (SBB) in reducing blood pressure among people with hypertension. Thus, nurses can use this music to promote blood pressure control to the general public, especially older adults with hypertension. This research can assist with the drawing up of guidelines for health personnel and others involved in caretaking to use additional music embedded with BB and SBB to help control blood pressure along with medications. Skills training would be necessary for nurses prior to using the music embedded with BB and SBB in real situations. Future studies should address other groups such as in-patients in hospital settings with the randomized controlled trial design.

Acknowledgments

This study was supported by Boromarajonani College of Nursing Buddhachinaraj 2018. We thank the participants in this study.

References

1. Public Health System Development Group, Bureau of Non-Communicable Diseases Department of Disease Control [Internet]. Campaign issues for world hypertension day of 2018. 2018 [cited 2018 October 22]. Available from: http://www.thaincd.com
2. Ramakrishnan S, Zachariah G, Gupta K, Rao JS, Mohanan PP, Venugopal K, et al. Prevalence of hypertension among Indian adults: results from the great India blood pressure survey. Indian Heart J. 2019;71(4):309-13. https://doi.org/10.1016/j.ihj.2019.09.012
3. Imoun S, Kotruchin P, Techa-atik P, Mitsungnern T. Effectiveness of local folk musical therapy for blood pressure control in hypertension patients. NSH. 2018; 41(1):12-23. https://he01.tci-thaijo.org/index.php/nah/article/view/109704
4. Khieophung J, Nicharojana LO, Intarasombat P, Krairit O. The effect of foot reflexology on quality of sleep in older persons with insomnia. RNJ. 2013;17(1):90-107 [in Thai].
5. Members AF, Mancia G, Fagard R, Narkiewicz K, Redon J, Zanchetti A, et al. ESH/ESC Guidelines for the management of arterial hypertension. Eur Heart J. 2013;34(28):2159-219. https://doi.org/10.1093/eurheartj/eht151
6. Khaicharoen S, Phithaksilp M, Jaidee W, Prueksaritanond S. Effect of slow breath training program on the blood pressure in hypertensive patient, randomized controlled trials. BJM. 2017;4(1):9-20 [in Thai].
7. American Music Therapy Association. What is music therapy? 2018 [cited 2018 October 22]. Available from: http://www.musictherapy.org
8. Chotpanang A, Pattrapakdikul U. The effects of listening to favorite music on pain and vital signs in gynecologic patients after abdominal surgery. NJPH. 2016;26(2):43-53 [in Thai].
9. Chairinkam W, Thaikruea L, Klaphajone J, Lerttrakarnnon P. Effects of newly-developed superimposed binaural beat on anxiety in university students in Thailand: a randomised controlled trial. CMU J Nat Sci. 2019;18(1): 122-30.
10. Huang TL, Charyton C. A comprehensive review of the psychological effects of brainwave entrainment. Altern Ther Health Med 2008; 14: 38-50.
11. Mofredj A, Alaya S, Tassaioust K, Bahloul H, Mrabet A. Music therapy, a review of the potential therapeutic benefits for the critically ill. J Crit Care. 2016;35:195-9. doi:10.1016/j.jcrc.2016.05.021.

12. Seaward BL. Managing stress: principles and strategies for health and wellbeing. Boston: Jones and Bartlett Publishers; 2011.
13. Salamon E, Kim M, Beaulieu J, Stefano GB. Sound therapy induced relaxation: down regulating stress processes and pathologies. Med Sci Monit. 2003;9(5):RA96-101.
14. Oster G. Auditory beats in the brain. Sci Am. 1973; 229(4): 94-102. http://doi.org/10/12982/CMUJNS.2019.0010
15. Klaphajone J. Music therapy, overview and neurologic music therapy. 2018 [cited 2018 October 23]. Available from: http://www.med.cmu.ac.th/dept/rehab/2010/index.php?option=com_content&view=article&id=111&Itemid=82&lang=th
16. Bajantri MR, Prasad BV, Kori A. Music therapy: an intervention in alzheimer's disease. In: handbook of research on geriatric health, treatment, and care. Hershey: IGI Global; 2018.
17. Wiwatwongwana D, Vichitvejpaisal P, Thaikruea L, Klaphajone J, Tantong A, Wiwatwongwana, A. The effect of music with and without binaural beat audio on operative anxiety in patients undergoing cataract surgery: a randomized controlled trial. Eye. 2016;30(11):1407-14. https://doi:10.1038/eye.2016.160
18. Polit DF, Beck CT. Nursing research: principles and methods. 7th ed. Philadelphia: Lippincott Williams & Wilkins; 2004.
19. Na Wichian S, Chintanawat R, Klaphajone J, Nanasilp P. Effect of music therapy on sleep quality in older persons. JTNMC. 2018; 33(3): 36-50.
20. Pfeiffer E. A short portable mental status questionnaire of the assessment of organic brain deficit in elderly patients. J Am Geriatr Soc. 1975;23(10):433-41. https://doi.org/10.1111/j.1532-5415.1975.tb00927.x
21. Pirozzo S, Papinczak T, Glasziou P. Whispered voice test for screening for hearing impairment in adults and children: a systematic review. Br Med J Int Ed. 2003;327 (7421): 967-70. https://doi:10.1136/bmj.327.7421.967
22. Do Amaral MAS, Neto MG, De Queiroz JG, Martins-Filho PRS, Saquetto MB, Carvalho VO. (2016). Effect of music therapy on blood pressure of individuals with hypertension: a systematic review and meta-analysis. Int J Cardiol. 2016; 214:461-4. https://doi:10.1016/j.ijcard.2016.03.197
23. Im-oun S, Kotruchin P, Thinsug P, Mitsungnern T, Techa-atik P, Pongchaiyakul C. Effect of Thai instrumental folk music on blood pressure: a randomized controlled trial in stage-2 hypertensive patients. Complement Ther Med. 2018;39: 43-8. https://doi:10.1016/j.ctim.2018.05.014
24. Toker E, Kömürcü N. Effect of Turkish classical music on prenatal anxiety and satisfaction: a randomized controlled trial in pregnant women with pre-eclampsia. Complement Ther Med. 2017;30:1-9. doi:10.1016/j.ctim.2016.11.005.
25. Meiner SE. Gerontologic Nursing-E-Book. New York: Elsevier Health Sciences; 2013.
26. Wang CF, Sun YL, Zang HX. Music therapy improves sleep quality in acute and chronic sleep disorders: a meta-analysis of 10 randomized studies. Int J Nurs Stud. 2013;51(1):51-62. https://www.ncbi.nlm.nih.gov/books/NBK132939/

ผลของชุดเพลงผสมคลื่น Binaural และ Superimposed beats ต่อการควบคุมความดันโลหิตสูงในผู้สูงอายุ : การศึกษาแบบกึ่งทดลอง

สุรีรัตน์ ณ วิเชียร จักรกริช กล้าผจญ ดวงใจ พรหมพยัคฆ์*

บทคัดย่อ: ความดันโลหิตสูงเป็นหนึ่งในสาเหตุสำคัญของการเสียชีวิตก่อนวัยอันควรและเกิดความพิการในประชาชนทั่วโลก การควบคุมความดันโลหิตให้อยู่ในเกณฑ์ปกติเป็นเป้าหมายที่พึงปรารถนาที่สุด แต่ยากที่จะบรรลุเป้าหมายนั้น การศึกษากึ่งทดลองนี้มีวัตถุประสงค์เพื่อทดสอบผลของชุดเพลงผสมคลื่น BB และ SBB ต่อการควบคุมความดันโลหิตในผู้สูงอายุที่มีความดันโลหิตสูง ผู้สูงอายุจำนวน 52 คนที่เป็นโรคความดันโลหิตสูงแบ่งเป็นกลุ่มทดลอง (กลุ่มละ 26 คน) และกลุ่มควบคุม (กลุ่มละ 26 คน) กลุ่มทดลองได้รับชุดเพลงผสมคลื่น BB และ SBB ที่บ้านในช่วงเวลากลางวัน เป็นเวลา 30 นาทีต่อวัน อย่างน้อย 3 วันต่อสัปดาห์ เป็นระยะเวลาติดต่อกัน 4 สัปดาห์ ในขณะที่กลุ่มควบคุมไม่ได้รับชุดเพลงผสมคลื่น BB และ SBB และทั้ง 2 กลุ่มได้รับการวัดความดันโลหิตซิสโตลิกและความดันโลหิตไดแอสโตลิก 4 ครั้ง คือ ครั้งที่ 1 ก่อนเข้าร่วมโครงการและ 30 นาทีหลังจากนั้น ครั้งที่ 3 ในสัปดาห์ที่ 3 และ 1 สัปดาห์หลังจากเสร็จสิ้นการทดลอง วิเคราะห์ข้อมูลโดยใช้สถิติเชิงพรรณนา, Mixed model ANOVA, Independent t-test และ One-way repeat measures ANOVA

ผลการศึกษาพบว่าหลังจากเสร็จสิ้นโปรแกรมหนึ่งสัปดาห์ ผู้เข้าร่วมในกลุ่มทดลองมีความดันโลหิตทั้งซิสโตลิกและไดแอสโตลิกต่ำกว่ากลุ่มควบคุมอย่างมีนัยสำคัญและผู้เข้าร่วมในกลุ่มทดลองมีความดันโลหิตทั้งซิสโตลิกและไดแอสโตลิกต่ำกว่าก่อนการทดลองอย่างมีนัยสำคัญ ผลการวิจัยเหล่านี้บ่งชี้ว่าชุดเพลงผสมคลื่น BB และ SBB เป็นการรักษาเสริมที่มีประสิทธิภาพเพื่อปรับปรุงการควบคุมความดันโลหิตในผู้สูงอายุที่เป็นโรคความดันโลหิตสูง พยาบาลและบุคลากรทางการแพทย์อื่นสามารถใช้โปรแกรมชุดเพลงผสมคลื่น BB และ SBB นี้ร่วมกับยารับประทานเพื่อช่วยให้ผู้สูงอายุที่มีความดันโลหิตสูงสามารถควบคุมความดันโลหิตได้ดีขึ้น

Pacific Rim Int J Nurs Res 2021; 25(3) 345-358

คำสำคัญ: Binaural beats ควบคุมความดันโลหิต ความดันโลหิตสูง เพลง ผู้สูงอายุ Superimposed binaural beats

ติดต่อที่ : สุรีรัตน์ ณ วิเชียร*, *RN, MNS. วิทยาลัยพยาบาลบรมราชชนนี พุทธชินราช จังหวัดพิษณุโลก E-mail: taptim17@hotmail.com, sureerat@bcnb.ac.th*

จักรกริช กล้าผจญ, *M.D. รองศาสตราจารย์คณะแพทยศาสตร์ มหาวิทยาลัยเชียงใหม่*

ดวงใจ พรหมพยัคฆ์, *RN, MNS. วิทยาลัยพยาบาลบรมราชชนนี พุทธชินราช จังหวัดพิษณุโลก*