Relaxing music reduces blood pressure and heart rate among pre-hypertensive young adults: A randomized control trial

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Abstract

Prevalence of pre-hypertension is higher among young adults and may increase the risk for hypertension and cardiovascular morbidity. Music therapy has been investigated to reduce the blood pressure in the hypertensive population; however, its efficacy on blood pressure in pre-hypertensive young adults is not known. Thirty pre-hypertensive (systolic blood pressure [SBP] = 120-139 mmHg and diastolic blood pressure [DBP] = 80-89 mmHg) young adults were recruited and randomly assigned into two groups. Music group (N = 15) received music therapy by passive listening to music for 30 minutes/day, 5 days/week for 4 weeks, along with Dietary Approaches to Stop Hypertension (DASH) eating plan (a diet rich in fruits and vegetables, low-fat dairy or unsaturated fat) and limit the daily sodium intake less than 100 mmol/day. The control group (N = 15) practiced only DASH eating plan and sodium restriction. The SBP, DBP, and heart rate (HR) were measured before and after 4 weeks of intervention. There was a significant reduction in SBP (8.73 mmHg, \( p < .001 \)) and HR (6.42 beats/minute, \( p = .002 \)); however, the reduction in DBP (1.44 mmHg, \( p = .101 \)) was not statistically significant in the music group. Control group did not exhibit any significant reduction in SBP (0.21 mmHg, \( p < .836 \)), DBP (0.81 mmHg, \( p < .395 \)) and HR (0.09 beats/minute, \( p < .935 \)). In conclusion, music therapy reduced significantly SBP and HR suggesting that it could be a promising tool to prevent the progression of pre-hypertension toward hypertension among young adults.
1 | INTRODUCTION

People with pre-hypertension have a twofold higher risk of developing hypertension compared to people with normal blood pressure (BP) and is considered as a preliminary stage of hypertension. Progression of pre-hypertension to hypertension was found to be as high as 19% over 4 years. In fact, during the past 10 years, the prevalence of hypertension has increased by 10% approximately. A study among university students observed that the prevalence of pre-hypertension was 42.9%.

Pre-hypertension is highly related to cardiovascular morbidity which decreases life longevity, quality of life, and increases hospitalization. Thus, it is very important to identify the pre-hypertension at an early stage to prevent its progression to hypertension. Several studies have reported the benefits of music therapy on BP. A recent systematic review stated that music therapy significantly decreased systolic BP (SBP) in hypertensive population and a randomized control trial on hypertension revealed that music along with lifestyle changes reduced stress levels and diastolic BP (DBP). The effect of music on heart rate (HR) and HR variability by relaxing music was found to decrease the HR significantly. Over the years, studies focused on the effect of music therapy on hypertensive adults, pre-hypertensive pregnant women, and pre-hypertensive elderly. However, no research has targeted the pre-hypertensive young adults. Thus, this research was designed for the first time to study the effect of music therapy on BP and HR in pre-hypertensive young adults in Malaysia.

2 | METHODS

2.1 | Subjects

Thirty pre-hypertensive young adults were recruited by the quota sampling method and randomly assigned into two groups; music group (n = 15) and control group (n = 15) in a 1:1 ratio. Inclusion criteria were: (a) either gender aged 18 to 25 years old, (b) SBP between 120 to 139 mmHg and/or DBP between 80 to 89 mmHg, (c) willing to participate in this study, (d) not having any hearing impairment which decreases life longevity, quality of life, and increases hospitalization. Thus, it is very important to identify the pre-hypertension at an early stage to prevent its progression to hypertension. Several studies have reported the benefits of music therapy on BP. A recent systematic review stated that music therapy significantly decreased systolic BP (SBP) in hypertensive population and a randomized control trial on hypertension revealed that music along with lifestyle changes reduced stress levels and diastolic BP (DBP). The effect of music on heart rate (HR) and HR variability by relaxing music was found to decrease the HR significantly. Over the years, studies focused on the effect of music therapy on hypertensive adults, pre-hypertensive pregnant women, and pre-hypertensive elderly. However, no research has targeted the pre-hypertensive young adults. Thus, this research was designed for the first time to study the effect of music therapy on BP and HR in pre-hypertensive young adults in Malaysia.

2.2 | Implementation of music therapy

The music used in this study was "The Best Relaxing Piano and Flute Music Ever," which was administered 5 days per week for a period of four weeks with each session lasting for 30 minutes. All music sessions were held in the morning between 9 AM and 11 AM. Participants were given 5 minutes rest in a sitting position before and after each music therapy session. Participants listened to the music with eyes closed, sitting with back supported in a comfortable position on a chair in a room with the door and curtains closed and the temperature of the room maintained between 20 and 22ºC. Participants were instructed to abstain from talking, thinking of other things, and falling asleep during the music sessions. They were allowed to adjust the volume of the sound to the extent which they were comfortable with.

Control group was instructed not to listen to any kind of music throughout this study period. Groups were not blinded as participants knew which type of intervention they were receiving, although randomization was carried out to minimize the bias.

2.3 | Implementation of lifestyle modification

A clear and detailed handout of lifestyle modification according to the JNC VIII report guidelines was given to all the participants in both groups and an explanation of each component was provided. They were instructed to follow only two components of lifestyle modification, DASH eating plan (a diet rich in fruits and vegetables, low-fat dairy, or unsaturated fat), and limit the daily sodium intake to less than 100 mmol/day. The participants in both groups were reminded about the DASH eating plan and sodium restriction once weekly; participants in the control group were reminded via telephone calls whereas the music group was reminded verbally in person when they came for music intervention to ensure both groups comply and adhere with the DASH guidelines without being directly supervised. In addition, participants in both groups were clearly instructed not to engage in any form of physical activity.

2.4 | Outcome measures

SBP, DBP, and HR were used as outcome measures for this study. BP was measured by Digital Blood Pressure Measuring Device (Omron Sem-1 Model). All the participants were allowed to rest for 5 minutes before measuring their BP. BP was measured with each participant sitting in chair comfortability with the left arm supported on a table at heart level. Three BP measurements were taken with a gap of 5 minutes between each recording and if a difference of more than 10 mmHg was noticed in the SBP or DBP, the 4th measurement was taken until 3 lowest BP readings that did not differ by more than 10 mmHg were obtained. The average of these 3 readings was recorded as the final measurement. HR was measured using the same method as BP measurement, and an average of 3 HRs was taken as the final outcome. All the measurements were recorded at baseline and 1-day post-4-week of intervention in both groups.

2.5 | Statistical analyses

Data were analyzed with Statistical Package for Social Science (SPSS) version 22.0. Results are presented as mean ± standard deviation (SD)
for continuous variables and percentages for categorical variables. All reported probability values were two-sided, and a probability value of <.05 was considered statistically significant. Categorical variables were compared by means of the chi-square test and continuous variables by using paired sample t test and independent sample t test.

3 | RESULTS

The mean age of the music group and control group was 20.73 ± 1.94 years old and 21.36 ± 1.28 years old, respectively, indicating no statistical difference (p-value = .320) in terms of age between the groups. The prevalence of family history of hypertension was higher among the control group (52.94%) compared to the music group (47.06%) (Table 1) and this difference was not statistically significant (p-value = .550) between the two groups.

3.1 | Effects of music therapy and lifestyle modification on BP and HR

The mean difference in the music group with regards to SBP was 8.73 ± 6.03 (p-value < .001), mean DBP was 1.44 ± 3.19 (p-value = .101) and mean HR was 6.42 ± 6.63 (p-value = .002), showing a significant difference in SBP and HR where as non-significant difference in DBP after the 4 weeks of intervention (Table 2). In contrast, control group did not exhibit any significant changes in any of the 3 outcomes (Table 2); the mean SBP (0.21 ± 3.79, p-value = .836), mean DBP (0.81 ± 3.44, p-value = .395) and mean HR (0.09 ± 4.31, p-value = .935).

3.2 | Comparison between the groups

Between-group comparison showed statistically higher reduction in the mean SBP (p-value < .001), mean HR (p-value = .006) in the music group compared to the control group, but the difference in DBP was not significant (p-value = .667) between the groups as indicated in Table 2.

4 | DISCUSSION

We observed a positive effect of music therapy among pre-hypertensive young adults. It is evident from this study that music therapy can reduce SBP and HR significantly. Additionally, DBP was reduced but failed to achieve statistical significance.

Higher Incidence of family history of hypertension is well-known among the hypertensive population. Positive family history could be an expected outcome for the cases of pre-hypertensive young adults. A study was done by Rampal et al15 concluded that the incidence of pre-hypertension and hypertension had a significant association with family history. Similarly, seventeen (58.6%) of the 29 participants of the present study had a family history of hypertension, suggesting a positive correlation of family history of hypertension and development of pre-hypertension among young adults.

Several studies including randomized control trial and systematic review revealed that relaxation music employed for 6 weeks to 6 months can reduce SBP in the elderly population, BP of hospitalized pre-hypertensive pregnant women during 3rd trimester, and even significant reduction in SBP among the patients with stage 2 hypertension.11-14 The current study demonstrates that after 4 weeks of music therapy, the SBP reduced from 128.67 mmHg to 119.94 mmHg, with a significant reduction of 8.73 mmHg (p < .001) in the experimental group suggesting music could be a tool to reduce SBP among pre-hypertensive young adults.

In our study, DBP reduced slightly from 73.33 mmHg to 71.89 mmHg after 4 weeks of music therapy among the pre-hypertensive young adults; however, the reduction of 1.44 mmHg was not statistically significant. Results of our study in terms of DBP matched with the meta-analysis carried out by Amaral et al,6 they reported a non-significant difference in DBP between the music groups compared to controls. Kunikullaya et al7 found that music therapy along with lifestyle change can significantly reduce the DBP in both hypertensive and pre-hypertensive adults, this statement disagrees with the findings of this study. Additionally, Teng et al and Pal et al reported that relaxation music therapy reduced the DBP significantly in young adults and the elderly, respectively.11,12 Teng et al and Pal et al employed a longer duration of their relaxation music therapy, which was for 6 months compared to 4 weeks of music intervention used in the current study.12 Sobana et al study demonstrating another significant reduction of SBP utilized 40 days of music relaxation among pre-hypertensive adults.13 Therefore, a non-significant reduction of DBP in our study could be possibly due to the duration of given music therapy.

Higher HR is known to be associated with cardiovascular damage. In this study, music therapy significantly decreased the HR from 76.27 ± 11.31 beats/minute to 69.85 ± 12.46 beats/minute, with 6.42 ± 6.63 beats/minute of reduction. It is consistent with the

| Variables          | Music group (N = 15) | Control group (N = 14) | χ²  | df  | p-Value |
|--------------------|----------------------|------------------------|-----|-----|---------|
| Family history     |                      |                        |     |     |         |
| Yes (%)            | 8 (47.06)            | 9 (52.94)              | 0.358 | 1  | .550    |
| No (%)             | 7 (58.33)            | 5 (41.67)              |     |     |         |

*Pearson Chi-square test was performed, level of significance at p < .05.
**TABLE 2**  Within group and between-group differences in SBP, DBP and HR

|                  | SBP (Music) | SBP (Control) | DBP (Music) | DBP (Control) | HR (Music) | HR (Control) |
|------------------|-------------|---------------|-------------|---------------|------------|--------------|
|                  | Pre         | Post          | Pre         | Post          | Pre        | Post         |
| Mean (SD)        | 128.67 (5.77) | 119.94 (8.35) | 127.26 (4.42) | 127.05 (5.14) | 76.27 (11.31) | 78.79 (7.89) |
| Changes          | Mean (SD) = 8.73 (6.03) | Mean (SD) = 0.21 (3.79) | Mean (SD) = 1.44 (3.19) | Mean (SD) = 0.81 (3.44) | Mean (SD) = 6.42 (6.63) | Mean (SD) = 0.09 (4.31) |
| 95% CI           | 5.4-12.0 | -2.0-2.4 | -0.3-3.2 | -1.2-2.8 | 2.7-10.1 | -2.391-2.581 |
| \( p \)-Value    | <.001*  | .836 | .101* | .395 | .002* | .935 |

**Independent sample t test**

|                  | SBP        | DBP       | HR        |
|------------------|------------|-----------|-----------|
|                  | Music group | Control group | Music group | Control group | Music group | Control group |
| Mean (SD)        | 8.73 (6.03) | 0.21 (3.79) | 1.44 (3.19) | 0.81 (3.44) | 6.42 (6.63) | 0.09 (4.31) |
| 95% CI           | 4.7-12.6 | -2.0-3.1 | 2.0-10.7 |
| \( t \)-Value    | 7.540* | 0.435 | 3.006 |
| \( p \)-Value    | <.001* | .667* | .006* |

Abbreviations: BP, blood pressure; bpm, beats per minute; CI, confidence interval; DBP, diastolic blood pressure; HR, heart rate; SBP, systolic blood pressure; SD, standard deviation.

*Paired sample t test and independent sample t test were performed, level of significance at \( P < .05 \).
previous studies involving young adults, and the elderly population. In addition, a systematic review by Loomba et al also supports our findings that music therapy greatly reduces the heart rate.\textsuperscript{24} Therefore, music could be used to reduce HR to prevent further cardiovascular damage among pre-hypertensive young adults. The music that was used in this study was instrumental music with flute and piano, combined with the natural sound of the ocean which was selected based on the cultural background, preference, and familiarity of the participants. The sound from nature could induce deep relaxation to the body and mind. The music therapy could alter the autonomic nervous system and decrease the activity of the sympathetic nervous system by balancing the activity of the sympathetic nervous system and parasympathetic nervous system by increasing the brain dopamine level.\textsuperscript{15}

In addition, music therapy also alters the limbic system by slowing down the activity of the brain.\textsuperscript{17,18} The changes in psychological status such as mood, anxiety, and stress level may also induce physiological responses of the body which are the changes in BP and HR.\textsuperscript{7} The reduction in SBP was more statistically significant than the reduction in DBP in this study. This might be due to the fact that SBP is more influenced by stress experience and activation of sympathetic nervous system stimulation as claimed by Ramesh et al which supports the findings of this study\textsuperscript{19} while the factors that affect DBP are multifactorial.\textsuperscript{12}

Previous studies demonstrated a significant effect of the DASH diet and sodium restriction on SBP, DBP, and HR reduction among hypertensive patients.\textsuperscript{20,21} Recent meta-analyses supported previous observations.\textsuperscript{22} In this study, the music group showed a significant decrease in SBP and HR and a non-significant reduction in DBP whereas the control group had a non-significant reduction of SBP, DBP, and HR although both groups were instructed to follow DASH diet and Sodium restriction. However, DASH diet plan was not scored and adherence to the DASH eating guidelines among participants in both music and control groups was not directly observed. Therefore, lack of rigorous control on diet and sodium restriction could be one of the reasons of non-significant reduction of SBP, DBP, and HR among the control group.

There was a statistically significant positive correlation between the reduction in SBP and HR. This is because increased BP is associated with increased HR and vice-versa. Increased HR is also associated with hypertension, and hypertensive individuals are most likely to have high HR.\textsuperscript{23} We found no correlation between the reduction in HR and DBP, possibly due to the fact that changes in the DBP take a long duration to develop since the music therapy used was only for 4 weeks; more time was needed to observe these changes.

All of the subjects that were involved in this study were male, although the inclusion criteria were to recruit subjects from either gender. The female students who showed interest in music therapy and were willing to participate in this study had normal BP, therefore, could not be included in this study. Stratification of participants into either group during the process of the assignment was not performed based on the confounding factors such as age, gender, and family history or BP range. Therefore, in order to assess whether there was statistical difference in the baseline parameters between the music group and control group, an independent $t$ test was performed and it showed that there were no significant differences in the baseline characteristics between the two groups. In addition, participants from both groups were instructed not to participate in any kind of physical activity and not to listen to any form of other music at home during this study. Besides, they were asked to report if they took any medication or attended any other treatment to lower the BP, in order to eliminate other factors that cause a reduction in BP.

5 | LIMITATIONS AND RECOMMENDATIONS

The sample size was small and we only provided 4 weeks of music intervention for the participants. Furthermore, confounding factors such as the lifestyle of the participants, stress, and sleeping pattern may affect the result. Compliance on DASH diet and sodium restriction was not scored/and or directly observed. We recommend conducting future studies with bigger sample size, longer duration, using a scoring system to assess the control of DASH diet plan and further stringent control of the confounding factors.

In conclusion, the findings of the study suggest that music therapy significantly reduced SBP and HR in pre-hypertensive young adults. Therefore, music therapy could be a promising alternative intervention to reduce BP and HR and thus could be useful to prevent the progression of pre-hypertension toward hypertension among young adults.

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CONFLICT OF INTEREST

The authors have no conflicts of interest.

AUTHOR CONTRIBUTIONS

The study was designed by Imtiyaz Ali Mir & Dr Moniruddin Chowdhury. Data collection was performed by Goh Yee Ling. Data analyses and interpretation were done by Imtiyaz Ali Mir, Dr Moniruddin Chowdhury, Md. Rabiul Islam, Goh Yee Ling, Dr ABM Alauddin Chowdhury, Dr Md Zobaer Hasan, Prof Yukihito Higashi. Manuscript drafting and critical review were performed by Dr Moniruddin Chowdhury, Imtiyaz Ali Mir, Md. Rabiul Islam, Dr ABM Alauddin Chowdhury, Dr Md Zobaer Hasan, and Prof Dr Yukihito Higashi.

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REFERENCES

1. Vasan RS, Larson MG, Leip EP, et al. Impact of high-normal blood pressure on the risk of cardiovascular disease. N Engl J Med. 2001;345:1291-1297.

2. Chia Y. Pre-hypertension: what is the current status? Malays Fam Physician. 2008;3:72-76.
3. Wang Y, Wang QJ. The prevalence of pre-hypertension and hypertension among us adults according to the new joint national committee guidelines: new challenges of the old problem. Arch Intern Med. 2004;164:2126-2134.

4. Lee P, Ong T, Muna S, et al. Brief report do university students have high cardiovascular risk? A pilot study from universiti malaysia sarawak (unimas). Malays Fam Physician. 2010;5:41-43.

5. Urbina EM, Khoury PR, McCoy C, Daniels SR, Kimball TR, Dolan LM. Cardiac and vascular consequences of pre-hypertension in youth. J Clin Hypertens (Greenwich). 2011;13:332-342.

6. Amaral MA, Neto MG, de Queiroz JG, Martins-Filho PR, Saquetto MB, Carvalho VO. Effect of music therapy on blood pressure of individuals with hypertension: a systematic review and meta-analysis. Int J Cardiol. 2016;214:461-464.

7. Kunikullaya KU, Goturu J, Muradi V, et al. Music versus lifestyle on the autonomic nervous system of prehypertensives and hypertensives—a randomized control trial. Complement Ther Med. 2015;23:733-740.

8. Tan YZ, Ozdemir S, Temiz A, Celik F. The effect of relaxing music on heart rate and heart rate variability during eeg gated-myocardial perfusion scintigraphy. Complement Ther Clin Pract. 2015;21:137-140.

9. Escher J, Evequoz D. Music and heart rate variability. Study of the effect of music on heart rate variability in healthy adolescents. Praxis. 1999;88:951-952.

10. Rampal L, Ng KC, Izzati IN, et al. Prevalence of hypertension among malay adolescents in putrajaya secondary schools, malaysia, 2010. Malaysian J Med Health Sci. 2011;7:53-60.

11. Teng X, Wong MYM, Zhang Y-T. The effect of music on hypertensive patients. Conf Proc IEEE Eng Med Biol Soc. 2007;2007:4649-4651. https://doi.org/10.1109/IEMBS.2007.4353376

12. Pal GK, Ganesh V, Karthik S, Nanda N, Pal P. The effects of short-term relaxation therapy on indices of heart rate variability and blood pressure in young adults. Am J Health Promot. 2014;29:23-29.

13. Sumathy S, Bhuvaneswari R, Anandraj R. Effect of relaxing music on blood pressure and heart rate in hospitalized pre-hypertensive women in the third trimester of pregnancy: a randomized control study. Asian J Pharm Clin Res. 2015;5:179-181.

14. Loomba RS, Arora R, Shah PH, Chandrasekar S, Molnar J. Effects of music on systolic blood pressure, diastolic blood pressure, and heart rate: a meta-analysis. Indian Heart J. 2012;64:309-313.

15. Sobana R, Jaganaesh K, Barathi P. Role of rag ahirbhairav as complementary and alternative medicine (cam) on blood pressure in prehypertensive adults. J Med Sci Tech. 2013;2:66-70.

16. Kühlmann AY, Etnel JR, Roos-Hesselink JW, Jeekel J, Bogers AJ, Takkenberg JJ. Systematic review and meta-analysis of music interventions in hypertension treatment: a quest for answers. BMC Cardiovasc Disord. 2016;16:69.

17. Crowe BJ. Music and soulmaking: Toward a new theory of music therapy. Lanham, MD: Scarecrow Press; 2004.

18. Krout RE. Music listening to facilitate relaxation and promote wellness: Integrated aspects of our neurophysiological responses to music. Arts Psychotherapy. 2007;34:134-141.

19. Ramesh B, Sundar S, Rajasekaran A. Effect of relaxing music on blood pressure and heart rate in hospitalized pre-hypertensive women in 3rd trimester of pregnancy: a randomized control study. Asian J Pharm Clin Res. 2015;8:179-181.

20. Juraschek SP, Miller ER, Weaver CM, Appel LJ. Effects of sodium reduction and the DASH diet in relation to baseline blood pressure. Randomized controlled trial. J Am Coll Cardiol. 2017;70:2841-2848. https://doi.org/10.1016/j.jacc.2017.10.011

21. Paula TP, Viana LV, Neto AT, Leitão CB, Gross JL, Azevedo MJ. Effects of the DASH Diet and walking on blood pressure in patients with type 2 diabetes and uncontrolled hypertension: a randomized controlled trial. J Clin Hypertens (Greenwich). 2015;17:895-901. https://doi.org/10.1111/jch.12597

22. Filipou CD, Tsioufis CP, Thomopoulos CG, et al. Dietary approaches to stop hypertension (DASH) diet and blood pressure reduction in adults with and without hypertension: a systematic review and meta-analysis of randomized controlled trials. Adv Nutr. 2020;11:1150-1160. https://doi.org/10.1093/advances/nmaa041

23. Wannamethee G, Shaper AG. The association between heart rate and blood pressure, blood lipids and other cardiovascular risk factors. Cardiovasc Risk. 1994;1:223-230.

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