

# Effect of Gamelan and progressive muscle relaxation on blood pressure in hypertensive patients

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## Abstract

Chronically elevated blood pressure was a prominent risk factor for cardiovascular diseases. The management of hypertension, especially in community settings, should combine pharmacological and non-pharmacological interventions. This study aimed to evaluate whether music-assisted progressive muscle relaxation (PMR) using *Gamelan*, Javanese classical music, could reduce blood pressure more effectively in hypertensive elderly individuals in Malang, Indonesia, than PMR alone. This study employed a

pre-test and post-test study design with a control group. Fifty-eight respondents were randomly assigned to the intervention group (n=31) and the control group (n=27). Three respondents in the control group did not complete the study; thus, they were excluded from the analysis. The intervention group was trained and guided to perform PMR while listening to *Gamelan*. Meanwhile, the control group only received PMR. The intervention was conducted twice a week for 20 minutes for eight weeks. Dependent variables in this study were systolic and diastolic blood pressure, which were measured using an aneroid sphygmomanometer. Data were analyzed using descriptive statistics, paired t-tests, independent t-tests, and Mann-Whitney test. We found a significant decrease in systolic and diastolic blood pressure in both groups. A Mann-Whitney test showed that there was a significant difference in the reduction of systolic blood pressure in the intervention group compared to the control group (p=0.000). Meanwhile, the independent t-test showed that the diastolic blood pressure in the intervention group reduced more significantly than that in the control group. The efficacy of *Gamelan*-assisted PMR in significantly reducing both systolic and diastolic blood pressure showcases the potential of such combined interventions in managing hypertension. We recommend *Gamelan*-assisted PMR as a complementary therapy for the elderly with primary hypertension.

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## Introduction

Elevated blood pressure is a significant risk factor for critical diseases, including heart, kidney, and cerebral diseases, as well as many other serious conditions.<sup>1</sup> The incidence of hypertension is consistent with trends related to increasing age span and life expectancy.<sup>2</sup> Recent studies have found that hypertension increases the risk of poor outcomes in patients with COVID-19. Globally, hypertension affects 1.13 billion people, with two-thirds of them residing in underdeveloped and developing countries.<sup>3</sup> Globally, hypertension affects 1.13 billion people, with two-thirds of them residing in underdeveloped and developing countries.<sup>4</sup> In 2018, approximately 34.1% of Indonesians aged over 18 years had hypertension, and only 54.4% of them had adequately controlled blood pressure.<sup>5</sup> Although hypertension is commonly asymptomatic, it can cause complications that account for about eight million deaths each year, 88% of which occur in underdeveloped and developing countries.<sup>6</sup> Hypertension is generally asymptomatic and goes unnoticed, but sometimes patients report dizziness, headaches, nosebleeds, chest pain, and palpitations.<sup>7</sup>

Behavioral risk factors for hypertension are well-studied. These factors include physical inactivity, regular alcohol consumption, tobacco use, caffeine intake, and stress.<sup>8-11</sup> In older people, physiological changes in the blood vessels increase the risk of primary hypertension, especially in individuals who lack physical activity.<sup>7</sup> The management of hypertension, especially in commu-

nity settings, should encompass both pharmacological and non-pharmacological interventions.<sup>12</sup> In general, hypertension treatment involves the use of a class of drugs that block the angiotensin-converting enzyme, calcium channel blockers, diuretics, beta-blockers, alpha-blockers, and angiotensin II receptor antagonists.<sup>13</sup> It has been proven that non-pharmacological interventions can effectively control blood pressure, so these interventions should be considered a complement to pharmacological therapies.<sup>14</sup> In addition, the use of antihypertensive drugs to manage hypertension has not proven to be efficacious due to the long-term side effects of these drugs. A study has revealed that the use of Angiotensin-converting enzyme (ACE) inhibitors, which are commonly prescribed antihypertensive drugs for the elderly with hypertension, can significantly increase the risk of new-onset osteoporotic fractures (NOF)<sup>15</sup>. Studies have also found that the incidence of new-onset osteoporotic fractures (NOF) and osteoporosis had increased in patients with hypertension and chronic heart failure (CHF) who used loop diuretics.<sup>16,17</sup>

Due to the various adverse effects of drugs and the presence of drug-resistant hypertensive patients, non-pharmacological therapies should be widely implemented as adjuvants to classical therapies. Progressive muscle relaxation (PMR) is one of the oldest non-pharmacological interventions for reducing blood pressure in hypertensive patients. However, this exercise has not been routinely implemented in community health care as part of the management of patients with hypertension. PMR decreases muscle tension, blood pressure, and anxiety in both patients and healthy individuals by reducing sympathetic nervous system activity. Studies have suggested that a combination of two or more non-pharmacological methods is more effective in achieving goals than individual therapy.<sup>18,19</sup> Studies have found that music can have beneficial effects on blood pressure.<sup>20-22</sup> However, most studies included a broad range of ages and exclusively used Mozart classical music.<sup>23</sup> Only a few studies have been conducted to analyze the effect of music on blood pressure in the pre-elderly and elderly population, especially in Indonesian settings. Therefore, research is needed to understand music preferences among pre-elderly and elderly individuals in Indonesia and whether it could help control blood pressure among hypertensive elderly patients. *Gamelan* is one of Indonesia's traditional music forms that is famous and appreciated, especially among Javanese older people. In this study, we aim to investigate whether a combination of PMR and *Gamelan* music has more positive effects on blood pressure and therapy adherence in hypertensive elderly patients compared to PMR alone.

## Materials and Methods

This experimental study employed a pre-test and post-test study design and was conducted in Krajan Village, Malang District, from July to November 2022. Elderly individuals with primary hypertension who met the inclusion criteria and willingly participated in this research were recruited. All the respondents were regular members of The Integrated Development Post Program, known as posbindu in Indonesia, a facility that provides community health services for the elderly in Krajan Village. The inclusion criteria in this study include people aged above 45 years old, diagnosed with primary hypertension, fully conscious, and able to communicate. Elderly individuals with significant health problems such as heart diseases and chronic kidney diseases were excluded from this study. Initially, a total of 58 respondents participated in this study and were randomly assigned to the intervention

and control groups. The intervention group comprised 31 respondents were initially assigned to the intervention and control groups, with the intervention group comprising 31 individuals who received a combination of progressive muscle relaxation and *Gamelan* Javanese music, while 27 in the control group received only progressive muscle relaxation therapy. Three respondents in the control group did not complete the intervention, so they were excluded from the statistical analysis. The control group received only progressive muscle relaxation therapy. The instruments used in this study included MP3 Players and headphones for listening to *Gamelan* music, an aneroid sphygmomanometer and stethoscope for measuring blood pressure, and scoring sheets for recording blood pressure measurements. Each respondent in the intervention group was trained and guided to perform progressive muscle relaxation while listening to *Gamelan*, Javanese classical music, twice a week for 20 minutes over eight weeks. Meanwhile, the control group was trained and guided with the same technique but without *Gamelan* music. Each intervention session lasted about 30 minutes. In addition, respondents were instructed to independently perform PMR and musical therapy every day for eight weeks on their own. The independent variables in this study were PMR and *Gamelan* music, while the dependent variable was blood pressure. Blood pressure was measured before and after the interventions by a registered nurse using an aneroid sphygmomanometer and a stethoscope. Ethical approvals were obtained from Politeknik Kesehatan Kementerian Kesehatan Malang (State Polytechnic of Health) in Malang with ethical certificate Number 546/KEPK-POLKESMA. All participants signed a consent form to participate in this study.

Data were analyzed using IBM SPSS Statistics 25. Demographic data were analyzed descriptively. A paired-sample t-test was conducted to compare systolic and diastolic blood pressure before and after interventions in each group. A Mann-Whitney test was used to compare the reduction in systolic blood pressure between the intervention group and the control group. Meanwhile, an independent t-test was performed to determine whether the reduction in diastolic blood pressure in the two groups was statistically significant ( $p < 0.05$ ; Figure 1).

## Results

### Characteristics of the respondents

The majority of the respondents in the intervention group were female (77%), aged above 55 years old (74.2%), and had a family history of hypertension (83.9%), but only 19.4% of the respondents were active smokers. Similar to the intervention group, most of the respondents in the control group were female (79.1%), aged above 55 years old (83.3%), had a family history of hypertension (79.1%), and were non-smokers (83.3%). All of the respondents in the intervention group completed the interventions for eight weeks with zero dropout rates. Meanwhile, three respondents in the control group did not complete the study for eight weeks, resulting in an 11% dropout rate. The demographic data of the respondents are shown in Table 1.

Table 2 reveals a noteworthy reduction in both systolic and diastolic blood pressures within the intervention group, registering substantial declines of 18.87 and 14.44, respectively, following an eight-week intervention period. In contrast, the control group exhibited more modest decreases, with systolic and diastolic blood pressures diminishing by 6.56 and 4.06, respectively, over the

same eight-week treatment period. A comprehensive overview of these findings is presented in Table 3 for clarity and comparison.

Mann-Whitney test was conducted to compare the difference in the reduction of systolic blood pressure between the intervention and control groups. The results of this test are presented in Table 3.

The difference in the reduction of diastolic blood pressure between the intervention and control groups was tested with the independent t-test. The results of this test are presented in Table 4. Asymp. Sig. (2-tailed) of  $0.000 < 0.05$  indicates a significant difference in diastolic blood pressure reduction between the intervention and control groups ( $p < 0.05$ ).

## Discussion

This study showed that blood pressure reduced by 18.871 mmHg (systolic) and 14.452 mmHg (diastolic) among respondents who received PMR while listening to *Gamelan* music. Meanwhile, in the group who only received PMR, the systolic blood pressure dropped by 6.583 mmHg, and diastolic blood pressure dropped by 5. mmHg. Similar studies have revealed that progressive muscle relaxation reduced blood pressure in hypertensive respondents by 5.1 mmHg (systolic) and 3.6 mmHg (diastolic) after a four-week intervention of daily 30 minutes PMR<sup>18,24</sup> and 24.54 mmHg (systolic) and 16.54 mmHg (diastolic) after seven days of daily PMR<sup>25</sup>. In the latter, the respondents were also taking daily antihypertensive drugs. Progressive muscle relaxation is a well-known non-pharmacological intervention for reducing stress, anxiety, and excessive tension in the body. Progressive muscle relaxation is total relaxation that achieved by contracting and relaxing various muscles in the body.<sup>26</sup> These activities may lower blood pressure

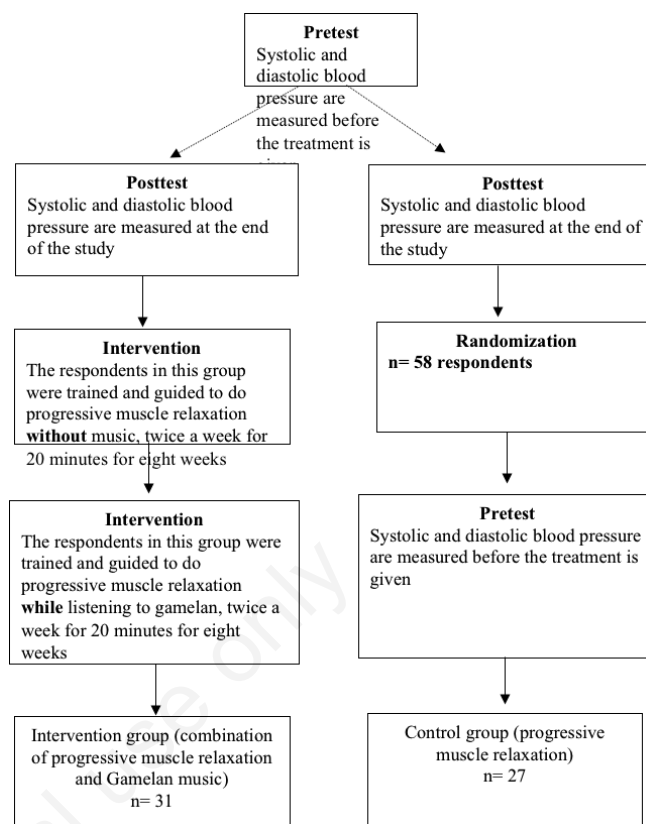


Figure 1. Flow of the intervention.

Table 1. Characteristics of the respondents.

Characteristics	Intervention group (n = 31)		Control group (n=24)	
	No	%	No	%
Sex				
Male	7	22.6	5	20.8
Female	24	77.4	19	79.1
Age				
45-55	8	25.8	4	16.6
56-60	13	41.9	9	37.5
61-65	10	32.3	11	45.8
Currently Smoking				
Yes	6	19.4	4	16.6
No	25	80.6	20	83.3
Family history of hypertension				
Yes	26	83.9	19	79.1
No	5	16.1	5	20.8

Table 2. Comparison of mean blood pressure before and after interventions in the intervention and control groups.

Groups	Variables	Pre-intervention		Post intervention		Mean difference	Sig (2- tailed)
		Mean	SD	Mean	SD		
Intervention group	Systolic blood pressure	163.71	12.039	144.84	10.605	18.871	0
	Diastolic blood pressure	96.71	5.599	82.26	6.434	14.452	0
Control group	Systolic blood pressure	151.25	6.456	144.67	7.631	6.583	0.001
	Diastolic blood pressure	92.21	4.818	86.71	4.506	5.500	0.004

by reducing sympathetic nervous activity in response to a decrease in the secretion of corticotropin-releasing hormone (CRH) and adrenocorticotrophic hormone (ACTH) by the hypothalamus. This results in a reduced heart rate, vasodilated blood vessels, decreased respiration and metabolic rate, and lower blood pressure.<sup>24,27,28</sup>

Systolic and diastolic blood pressure significantly reduce when progressive muscle relaxation is combined with another relaxation technique, such as musical therapies. A study that combined the effects of PMR and musical therapy using a piece of instrumental music, showed that systolic blood pressure reduced by as much as 29.2 mmHg, and diastolic blood pressure was lowered by 16.2 mmHg.<sup>18</sup> However, in this study, the dropout rate was high (20.6%). In our study, we combined PMR with *Gamelan*, which is one of the famous traditional music forms in Indonesia. The dropout rate in our study was zero, which could be influenced by the type of music we chose. All the respondents in this study were Javanese older adults, who might be more familiar with and prefer *Gamelan* over other types of relaxing music. Listening to their preferred musical instrument brings greater benefits to the respondents and improves their hemodynamic status.<sup>29,30</sup>

Studies have shown that music therapy has beneficial effects on patients' physical and psychological outcomes in various clinical settings.<sup>22,31,32</sup> However, not all types of music can effectively improve the hemodynamic and psychological status of the respondents.<sup>33</sup> Several studies have shown no statistical difference in the reduction of blood pressure between respondents who receive music therapy and those who only rest.<sup>33,34</sup> Music that might positively affect cardiovascular parameters includes classical music because it is associated with calm and relaxation. Musical pieces chosen by or more familiar to respondents are often more effective and can lead to positive hemodynamic changes.<sup>35,36</sup> To produce positive changes, music therapy should be played in a quiet environment for a minimum of 20-25 minutes for at least four weeks.<sup>37</sup> Listening to music activates the hypothalamus and nucleus accumbens (NAc), which are two of the main brain areas involved in processing rewarding and pleasure-evoking stimuli, resulting in

increased pleasure response and changes in heart rate and respiration rate.<sup>38</sup> Music therapy might also decrease the activity of the sympathetic nervous system and stimulate endorphin release.<sup>39</sup> Furthermore, a study investigating the effect of music on blood pressure found that exposure to classical music increased serum calcium levels and brain dopamine synthesis, which reduced blood pressure.<sup>40,41</sup> Indeed, music therapy is one of the non-pharmacological interventions that can be used to help reduce blood pressure with low cost and minimal side effects.<sup>42</sup>

Our study found a statistical difference in the reduction of systolic and diastolic blood pressure between the respondents who received a combination of PMR with musical therapy using *Gamelan* compared to the control group who only received PMR (Tables 3 and 4). Several studies have suggested that combining PMR with other non-pharmacological therapies has better effects on the respondents' outcomes, such as decreasing stress, enhancing academic performance, reducing chronic pain and fatigue, and improving coping styles.<sup>19,43,44</sup> This study shows that *Gamelan*-assisted PMR can effectively reduce the blood pressure of hypertensive elderly individuals. This result is similar to that of another study which combines PMR with classical music therapy.<sup>18</sup> Music-assisted PMR should be regularly provided to the respondents to help maintain their blood pressure within the normal range. Additionally, the choice of instrumental music used should be relaxing and familiar to the respondents.

This study has several limitations. We employed a relatively small sample size, which may limit the generalizability of the study. Further studies with a large sample size and multi locations are needed to ensure the quality of the study.

**Table 3.** Difference of systolic blood pressure reduction between the two groups.

Statistics test <sup>a</sup>	Systolic blood pressure
Mann-Whitney U	65.500
Wilcoxon W	561.500
Z	-5.209
Asymp. Sig. (2-tailed)	0

<sup>a</sup>Grouping Variable: Group. Asymp. Sig. (2-tailed) of 0<0.05 illustrates a significant difference in systolic blood pressure reduction between the intervention and control groups (p<0.05).

## Conclusions

This study was the first to investigate the effect of music-assisted progressive muscle relaxation using Javanese classical music to reduce the blood pressure of Javanese elderly individuals. We discovered that respondents receiving *Gamelan*-assisted PMR had better outcomes in blood pressure than those only receiving PMR. Based on the result of this study, it is recommended that health workers or other medical personnel can apply music *Gamelan* therapy regularly as adjuvant therapy in managing hypertensive older patients, especially in community settings.

**Table 4.** Difference of diastolic blood pressure reduction between the two groups.

Independent sample test		Levene's test for equality of variances		t-test for equality of means		Sig. (2-tailed)	Mean difference	Std. error difference	95% Confidence interval of the difference	
		F	Sig.	t	df				Lower	Upper
Diastolic blood pressure	Equal variances assumed	0.938	0.337	-9.140	53	0.000	-8.952	0.979	-10.916	-6.987
	Equal variances not assumed			-9.278	51.904	0.000	-8.952	0.965	-10.888	-7.015



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