Classical Music and its Effects on Physiological Responses: A Study on Pre-Pubescent Blood Pressure and Heart Rate

Mona-Pi P. Parrocha and Nercel C. Cortez[1]

Abstract

This study aimed to determine if listening to classical music can affect physiological responses in students, specifically in their diastolic blood pressure (DBP), systolic blood pressure (SBP), and heart rate (HR). The participants were 40 randomly selected grade-7 students from a school in Alabang, Philippines. Descriptive results revealed that when grouped according to sex and age, males had higher DBP, SBP, and HR before and after listening to classical music than females. Similarly, when grouped according to age, 13-year-olds had higher DBP, SBP, and HR before and after listening to classical music than 12-year-olds Comparison between the overall DBP, SBP, and HR before and after listening to classical music indicated no significant difference ($p=0.14$, $p=0.52$, $p=0.58$ respectively) at 0.05 alpha level, suggesting that listening to classical music did not affect the physiological responses in the students. The study recommends testing another classical piece, including more specific physiological measures and increasing the sample size.

Keywords: *Classical Music, Physiological Response Measures, Diastolic & Systolic Blood Pressure, Heart Rate*

Introduction

The relationship between music and physiological responses has been a subject of interest in medical and psychological research. Numerous studies have demonstrated that classical music can reduce heart rate and blood pressure. For instance, a study by Trappe & Voit (2016). indicated that classical pieces, particularly those by composers like Mozart and Strauss, resulted in statistically significant decreases in systolic and diastolic blood pressure and heart rate. The study had 60 subjects randomly assigned to three groups that listened to various compositions by W. A. Mozart, J. Strauss Jr., or ABBA. Their serum cortisol concentrations, heart rate, and blood pressure were measured before and after the listening session. The same variables were measured in a control group of 60 subjects who did not listen to music but rested in silence. Similar findings by Siritunga et al. (2013) showed that Indian classical music significantly reduced systolic and diastolic blood pressure, pulse rate, and respiratory rate in individuals. These studies suggest a calming effect on the cardiovascular system (Darki et al., 2022).

The mechanisms behind these effects involve activating the parasympathetic nervous system, which promotes relaxation and reduces stress responses. Moreover, the impact of music on health is increasingly recognized as a potential preventive measure against cardiovascular diseases, which are a leading cause of morbidity and mortality worldwide. The physiological benefits observed from listening to classical music may contribute to broader public health initiatives aimed at stress reduction and cardiovascular health improvement (Siritunga et al., 2013; Darki et al., 2022).

[1] **Corresponding Author:** pieparrocha.mac@gmail.com

In the Philippines, the prevalence of hypertension and cardiovascular diseases is rising, with significant implications for public health. According to the Philippine Statistics Authority (PSA), cardiovascular diseases are among the top causes of death in the country (Philippine Statistics Authority, 2023). The integration of non-pharmacological interventions, such as music therapy, is gaining traction as a complementary approach to managing blood pressure and heart rate among Filipinos. Research specific to the Philippine context is limited but growing. Local studies have begun to explore the effects of various music genres on physiological responses, indicating that music can serve as an accessible and cost-effective intervention for stress management and cardiovascular health. The cultural affinity for music in the Philippines may enhance the acceptance and effectiveness of such interventions, particularly among students who often experience high-stress levels due to academic pressures (Kim, 2015).

The influence of classical music on diastolic pressure, systolic pressure, and heart rate presents a compelling area of research with significant implications for student health, especially for minor individuals, since studies on the effects of classical music on physiological responses only focused on the adult population which leaves a gap in the literature. Hence, this study was conducted to determine if listening to classical music can influence physiological responses such as diastolic pressure, systolic pressure, and heart rate of grade-7 students. Specifically, this study examined their demographic profiles (age and sex) and their physiological responses (diastolic pressure, systolic pressure, and heart rate) before and after listening to classical music. Conducting this study is essential as it looks into how integrating music therapy in educational settings could serve as a valuable tool for promoting student well-being and cardiovascular health, addressing immediate and long-term health concerns.

Methods

Participants

The participants comprised 40 Grade-7 students from two (2) sections in a high school in Alabang, Philippines. They were randomly selected using the fishbowl method.

Materials

An automatic blood pressure monitor was used to determine the psychological measures, systolic blood pressure (SBP), diastolic blood pressure (DBP), and heart rate (HR). The intervention music piece used was Wolfgang Amadeus Mozart's Piano Concerto No. 23 in A Major K. 88.

Procedure

The researchers first secured departmental approval by asking permission to conduct the study. The same approval was secured from the school's principal, where the study was conducted. After approval, the researchers gave Informed Consent Forms (ICF) to the participants' parents. Also, the researchers gave assent forms to the participants, asking them to be part of the study. The researchers ensured that everyone understood the study and emphasized that they would be anonymized in the paper and free to withdraw from the study at any time.

In collecting the data, the researchers used the methods from Siritunga et al. (2013) with some modifications. Their study included 252 samples screened after applying the inclusion and exclusion criteria. The parameters were measured using digital meters after the participants rested for about 30 minutes. Afterward, the participants were allowed to listen to

the Indian classical Rag Darbari Kanada, and physiological responses were measured similarly after three minutes.

In the present study, the participants were allowed to sit for one (1) minute and were asked for their age and sex. Then, the participants' resting heart rate and blood pressure were measured using an automatic digital blood pressure monitor. The participants then listened to the music piece (Wolfgang Amadeus Mozart's Piano Concerto No. 23 in A Major K. 88). The participants' heart rate and blood pressure were recorded right after the music was played.

Data Analysis

Frequency distribution and percentage were used to describe the participants' demographic profiles, while the mean was used to describe the physiological responses. Paired T-test was used to determine if there was a significant difference in the physiological responses of the participants before and after listening to classical music at 0.05 alpha level.

Results

Demographic Profiles of the Participants

The first objective of this study was to determine the students' demographic profiles. The results are found in Table 1.

The results indicate a higher representation of females (24/16) in the study. Moreover, most students were 13 years old (23/17).

Physiological Response Measures of the Participants Before Listening to Classical Music

The second objective of this study was to determine the students' average diastolic pressure, systolic pressure, and heartbeats before listening to classical music, which are presented according to their demographic profiles. Figure 1a shows the students' average diastolic pressure, systolic pressure, and heartbeats before listening to classical music in terms of their sex. The results revealed that the average diastolic blood pressure for males (73.19 mmHg) is slightly higher than that for females (71.5 mmHg). Similarly, the systolic blood pressure is higher in males (108.63 mmHg) compared to females (106.63 mmHg). On the same note, the heart rate indicates that males have a marginally higher average heart rate (78.94 BPM) than females (78 BPM).

Figure 1b shows the students' average diastolic pressure, systolic pressure, and heart rates before listening to classical music, according to their age. The results revealed that the average diastolic blood pressure for 12-year-olds (71.53 mmHg) is slightly lower than for 13-year-olds (72.65 mmHg). Similarly, the systolic blood pressure is lower in 12-year-olds (105.76 mmHg) compared to 13-year-olds (108.65 mmHg). On the other hand, heart rate results show that 12-year-olds had lower heart rates (77.18 BPM) than 13-year-olds (79.26 BPM).

Physiological Response Measures of the Participants After Listening to Classical Music

The third objective of this study was to determine the students' average diastolic pressure, systolic pressure, and heartbeats after listening to classical music, which are presented according to their demographic profiles.

Table 1. Demographic Profiles of the Participants

Profile	Frequency	Percentage
Sex		
F	24	60
M	16	40
Age		
12	17	42.5
13	23	57.5

Figure 2a. Physiological Anxiety Measures of the Students Before Listening to Classical Music in Terms of Sex

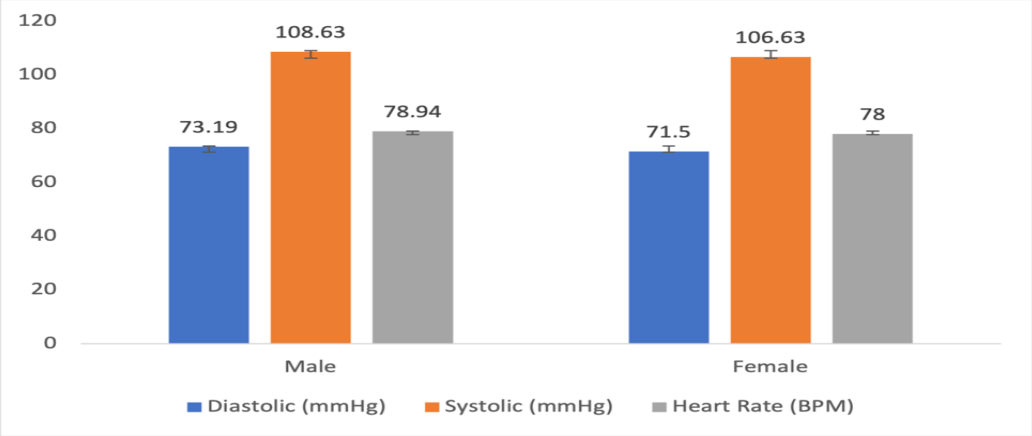


Figure 1b. Physiological Anxiety Measures of the Students After Listening to Classical Music in Terms of Age

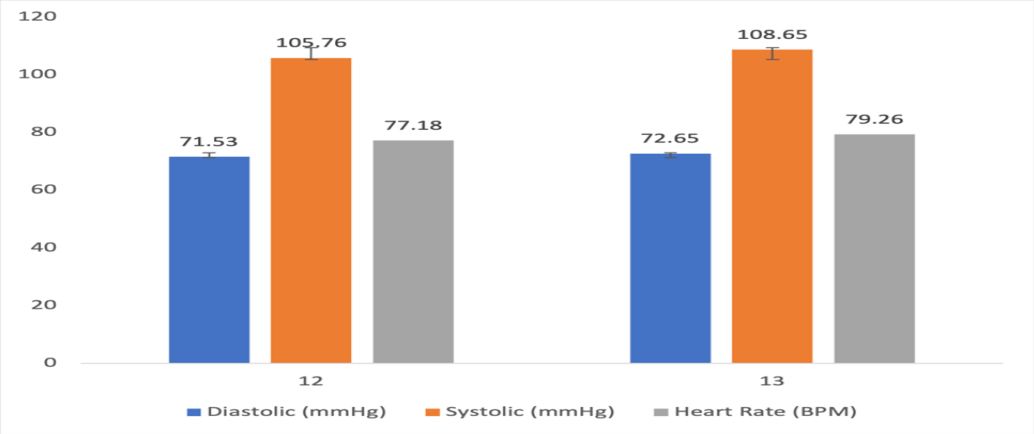


Figure 2a shows the students' average diastolic pressure, systolic pressure, and heartbeats after listening to classical music in terms of their sex. The results show that the average diastolic blood pressure for males (73.94 mmHg) is higher than that for females (72.17 mmHg). Systolic blood pressure is similarly higher in males (109 mmHg) compared to females (106.96 mmHg). The heart rate data, on the other hand, reveals that males have a higher average heart rate (79 BPM) than females (78.33 BPM).

Table 2. Paired T-test Results of the Comparison of the Physiological Measures Before and After Listening to Classical Music

Measure	Phase	Mean	SD	t	df	p	Interpretation
Diastolic Pressure	Before	72.18	6.71	-1.52	39	0.14	There is no significant difference
	After	72.88	8.42				
Systolic Pressure	Before	107.43	13.64	-0.65	39	0.52	There is no significant difference
	After	107.78	14.95				
Heart Rate	Before	78.36	14.60	-0.55	39	0.58	There is no significant difference
	After	78.60	7.43				

**0.05 alpha level*

Effect of Listening to Classical Music on the Physiological Response of the Students

The last objective of this study was to determine if listening to classical music can significantly influence physiological responses in students.

Table 2 shows the paired t-test results on the comparison of the diastolic pressure, systolic pressure, and heart rates of the students before and after listening to classical music. The results show that the mean diastolic pressure measurement before the intervention was 72.18 mmHg. After the intervention, the mean increased to 72.88 mmHg. While the mean diastolic pressure measurement showed a slight increase post-intervention, the statistical analysis reveals that this difference is insignificant ($p = 0.14$). Therefore, the null hypothesis was failed to be rejected, suggesting that listening to classical music did not produce a statistically meaningful effect on the diastolic pressure of the grade 7 students.

Figure 2a. Anxiety Measures of the Students After Listening to Classical Music in Terms of Sex

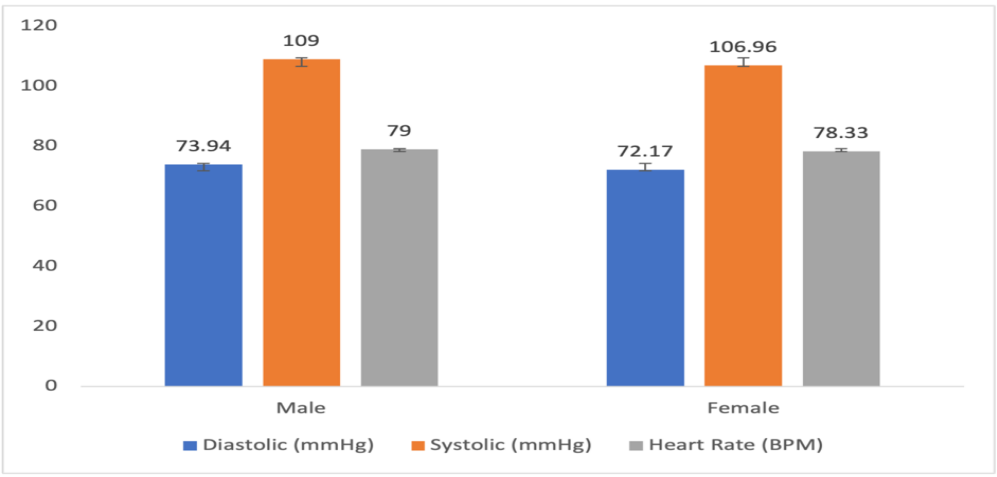
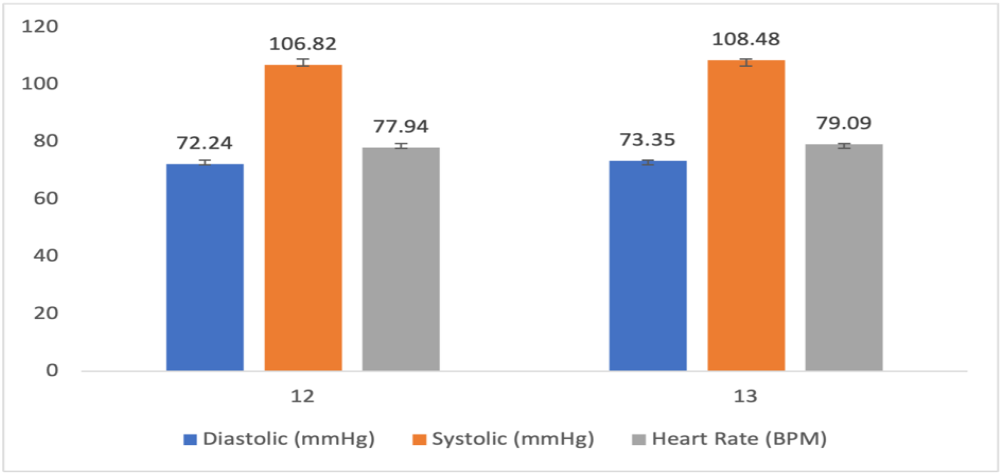


Figure 2b. Anxiety Measures of the Students After Listening to Classical Music in Terms of Age



The results show that the mean systolic pressure measurement before the intervention was 107.43. Following the intervention, the mean increased slightly to 107.78. While there is a minor increase in the mean systolic pressure measurement after listening to classical music, the statistical analysis indicates that this difference is insignificant ($p = 0.52$). Consequently, the results indicate a failure to reject the null hypothesis, suggesting that listening to classical music did not produce a statistically meaningful effect on the systolic pressure of the grade-7 students.

The results also show that the mean heart rate measurement before the intervention was 78.36. After the intervention, the mean increased slightly to 78.60. Similar to the other parameters, while there is a slight increase in the mean heart rate measurement following the intervention, the statistical analysis reveals that this change is insignificant ($p = 0.58$). Therefore, this indicates a failure to reject the null hypothesis, suggesting that listening to

classical music did not yield a statistically meaningful effect on the heart rate of the grade-7 students.

Discussion

This difference in the students' diastolic, systolic, and heart rates may reflect underlying physiological variations, including hormonal influences and vascular resistance. Research indicates that males typically exhibit higher DBP values due to greater muscle mass and differences in vascular compliance (Alhawari et al., 2018; (Wu et al., 2023). Similarly, males often have higher SBP due to increased cardiac output and systemic vascular resistance (Wu et al., 2023). On the same note, higher heart rates in males are consistent with studies that report males often exhibit higher resting heart rates, potentially due to differences in autonomic regulation and cardiovascular fitness levels (Prabhavathi et al., 2014). Another reason could be the physiological changes in growth and maturation during early adolescence. Hormonal fluctuations and increases in body mass may contribute to vascular resistance and compliance alterations, critical factors influencing DBP (St Pierre et al., 2022).

On the other hand, there are consistent differences in the physiological response measures when grouped according to age in pediatric populations, where SBP tends to rise with age due to enhanced cardiac output and increased peripheral vascular resistance (Hardy & Urbina, 2021). Similarly, the increase in diastolic blood pressure in 13-year-olds may be attributed to increased physical activity levels and metabolic demands associated with growth spurts common in this age group (Nagata et al., 2023). Contrastingly, the heart rate values results negate the findings of Cavarretta (2022), as cited by Turcanu et al. (2023), which mentioned that heart rate in individuals aged 6-18 decreases as they age. This discrepancy might be due to the sample size considered in the present study.

However, there is no significant difference in results in the physiological response measures before and after listening to classical music, which negates the results of previous studies. For instance, a study by Darki et al. (2022) found that listening to Beethoven's "*Moonlight Sonata*" decreased systolic blood pressure by 5.5 mmHg and diastolic blood pressure by 2.5 mmHg, compared to baseline. The calming effect of slow music allows the body to relax, leading to lower cardiovascular activity.

In contrast, listening to fast-paced classical music has the opposite effect, causing an increase in systolic blood pressure, diastolic blood pressure, and heart rate (Siritunga et al., 2013; Darki et al., 2022). A similar study by Darki et al. (2022 observed a 6.4 mmHg increase in systolic blood pressure and a 6.5 bpm increase in heart rate when participants listened to Beethoven's "*Symphony of Fate."* The more stimulating nature of fast music triggers a physiological stress response, elevating cardiovascular parameters.

Similarly, the study by Trappe and Voit (2016) also indicated that listening to classical music, specifically Mozart and Strauss, significantly reduced both systolic and diastolic blood pressure, as well as heart rate. The reductions in blood pressure were statistically significant for classical music (Mozart: -4.7 mm Hg systolic, -2.1 mm Hg diastolic; Strauss: -3.7 mm Hg systolic, -2.9 mm Hg diastolic; $p<0.001$). Similar trends were observed in heart rate, reinforcing the physiological impact of classical music. Notably, no such changes were observed in the control group, indicating that the observed cardiovascular effects were music-induced rather than incidental.

The non-significance findings in the present study may be attributed to the variations in methodology, particularly in the choice of music, measurement timing, and potential carryover effects. The reference study by Darki et al. (2022) used two contrasting classical pieces—one fast and one slow—allowing for a comparative assessment of physiological responses to different tempos. Additionally, heart rate was recorded during the music rather

than after, capturing real-time changes. In contrast, the present study used only one piece, which was relatively moderate in tempo, and recorded heart rate and blood pressure only after the music had ended, potentially missing immediate physiological fluctuations. The absence of a comparative fast-paced piece may also limit the potential for detecting significant changes. Furthermore, the use of an electrocardiogram (EKG) system in the reference study may have provided more precise measurements compared to an automatic blood pressure monitor, which may not have been as sensitive to subtle heart rate variations.

On the other hand, the study by Trappe and Voit (2016), a randomized controlled trial with 120 participants, including strict inclusion criteria ensuring cardiological health and medication-free status, whereas the current study does not specify such criteria, potentially introducing variability in baseline cardiovascular responses. Additionally, the reference study used multiple musical pieces from different genres, while the current study focused solely on Mozart's Piano Concerto No. 23 in A Major K. 488. The reference study also maintained a controlled, relaxing environment with participants lying on a lounger in a temperature-regulated room, whereas the current study had participants simply sit for one minute before listening to music. Furthermore, the reference study measured blood pressure and heart rate before and after a 25-minute music session, while the current study recorded these variables only after a shorter listening period. These methodological differences likely contributed to variations in findings, particularly regarding the impact of music on cardiovascular parameters.

The discrepancies in the results of whether music therapy, for instance, classical music, can affect the physiological responses in pre-pubescent individuals, particularly on their blood pressure and heart rates, need further research and thorough investigation.

Conclusion and Recommendations

The results show that listening to classical music did not influence any physiological measures, particularly the grade-7 students' diastolic pressure, systolic pressure, and heart rate. While previous research has indicated the potential for classical music to reduce physiological measures and improve cardiovascular parameters, the current findings do not support these effects in this specific context.

While the results did not show any difference, the study recommends using a different piece as the selected composition may not have been optimally effective in influencing the physiological measures in the study. Moreover, future research should consider larger sample sizes and alternative methodologies to investigate classical music's potential impacts on physiological measures.

Competing Interests

The researchers declare no conflict of interest.

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AUTHOR INFORMATION

Mona-Pi P Parrocha is a recent graduate from FEU's M.A. in Clinical Psychology. She works with the Armed Forces of the Philippines and has research interests in Educational and Experimental Psychology.

Nercel C. Cortez is also completing her M.A. in Clinical Psychology with the Far Eastern University. Currently, she serves as Area President of the Church of Jesus Christ of Latter-Day Saints. Her research interests are Educational and Clinical Psychology.

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Grammarly was used to correct the grammar and assist in writing the paper.