EFFECT OF MUSIC ON BLOOD PRESSURE, RESPIRATORY AND PULSE RATE IN PATIENTS UNDERGOING TOOTH EXTRACTION AT UGDS DENTAL CLINIC, ACCRA-GHANA

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ABSTRACT

BACKGROUND: Fear and anxiety **are** known to be associated with dental treatment. Reasons include fear of injection and pain associated with tooth extraction. In addition, the fear sometimes leads to increased blood pressure, respiratory and pulse rates. One method of relieving dental anxiety is listening to music. Therefore, the study assesses the impact of classical music on the blood pressure, respiratory, and pulse rates of the patients undergoing tooth extraction.

MATERIALS AND METHODS: A **total** of 124 patients for tooth extraction at the University of Ghana Dental School clinic were randomly assigned to intervention and control groups. A revised modified dental anxiety scale assessed dental anxiety and collected demographic data prior to the extraction. The intervention group(62) listened to classical music for 5 minutes, but the control group(62) did not. Blood pressures, respiratory and pulses rates were taken before and after tooth extraction. We then evaluated the impact of the intervention on the physiological changes.

RESULTS: There were 46.8% males and 53.2% females. The mean age was 46.2±18.0yrs. No significant differences were observed in sex distribution and mean age between intervention and control groups. Overall dental anxiety prevalence was 52(41.9%). The music group had significantly reduced mean systolic blood pressure by 8.8mmHg (p=0.001). The respiratory rate was significantly lower for the music group (19.7±4.1) as compared to the control group (21.2±3.33), p=0.023.

CONCLUSION: Classical music was associated with reducing systolic blood pressure and the respiratory rate, which are some of the physiological indicators of dental anxiety.

KEYWORDS: Tooth extraction, blood pressure, respiratory and pulse rate, classical music intervention.

INTRODUCTION

Dental extraction has been identified as one of the dental treatments that can induce dental fear and anxiety [1]. The entire procedure may appear frightening to patients. However, the sight and sensation of injecting a local anesthetic solution using the dental syringe and needle are the most anxiety-provoking [2].

An anxious individual may exhibit physiologic and somatic sensations, including perspiration, breathlessness, and palpitations, among others [3]. Again, anxiety has been found to lead to the activation of the sympathetic nervous system which is manifested in the form of changes in respiratory rate, heart rate and blood pressure [4].

At the end of the nineteenth century, the effects of music on cardiac output, respiratory rate, pulse rate, and blood pressure had been clinically demonstrated [5]. Reports show that respiration, pulse, electroencephalogram and electromyogram are altered when the patient listens to music [6,7]. A similar conclusion about blood pressure reduction was reached by other studies [7,8]. A study showed that listening to classical music after being exposed to a stressful stimulus reduces physiological and emotional arousal [9]. Classical music from a study using Bach's music decreased heart and respiratory rates and the activity of the sympathetic nervous system [10,11].

This study investigates the effect of music on Systolic Blood Pressure, Diastolic Blood Pressure, Pulse Rate, and Respiratory Rate in a dental clinic setting. It is also intended to answer whether classical music can modulate these effects before and during dental extraction. Finally, we hope to throw more light on the clinical and physiological relevance of music.

MATERIALS AND METHODS

This was an interventional study of 124 patients attending the University of Ghana Dental School Clinic. Data was collected using a structured questionnaire. This design attempted to establish an association between listening to music and the changes in blood pressure, pulse, and respiratory rates. To detect a minimum systolic blood pressure of 8mmHg difference between intervention and control groups, at 95% confidence interval and 80 statistical power, a minimum of 62 participants were required, using a sample size.calculator from (*https://select-statistics.co.uk/calculators/sample-size-calculator-two-means*).

The participants were first-time patients undergoing tooth extraction. All patients who have once had extractions were excluded. They were randomly assigned into an intervention and a control group. Those who listened to classical music were the intervention group and those who did not listen to the music as the controls. The study was conducted between July and August. Systematic random sampling was used. With a toss of a coin the first person was chosen to be in the intervention group who listened to the classical music.

The next person was then chosen as a control. This order was maintained such that every other person who had the intervention the next became a control. There were 62 participants for the intervention group who listened to the music, while the other 62 participants were the controls.

Blood pressure, pulse and respiratory rate were taken for the two groups using a Bioline digital blood pressure monitor and a stopwatch just after the questionnaire had been administered. The intervention group then listened to the classical music, *Canon in D major* by Johann Pachelbel, for five minutes, after which the parameters were measured again. After the extraction, the blood pressure, pulse rate and respiratory rate were taken for the third time for the music group. The control group did not listen to any music after the first blood pressure, pulse rate and respiratory rate were taken. Therefore, after the extraction, the blood pressure, pulse rate, and respiratory rate were retaken for the control group immediately after the extraction.

Participant's written consent was obtained before participation in the study. Assessment of their anxiety levels was done using a revised Modified-Dental Anxiety Scale [1]. The Ethical Review Committee approved the study of the Institution. Protocol Identification Number: CPDD/012/06/2018.

Statistical Package for Social Sciences (SPSS) version 21 was used for the data analysis. Data summary was reported as means and standard deviations for the continuous variables, while frequencies and percentages for the categorical variables. Means were compared using paired T-test for the before and after comparisons but independent t-test for the two groups. Chi-Square test was used for comparing proportions and significant levels set at $p<0.05$.

RESULTS

This study involved 124 participants, which consisted of 58 males, and 66 females, representing a male to female ratio of 1: 1.14. The mean age of the respondents was 46.2±18.0 yrs. Mean ages of intervention and control groups were 46.16±18.08 and 46.13±18.03 years respectively.

The demographic characteristics of participants are summarised in Table 1.

Out of the 62 who listened to the music, 30.7% were aged 60 years and above, 22.6% were in the 20-29 years age group while below 20 years were the least (4.8%). Similarly, for the control group, 25.8% were aged 60 years and above. Those in the 40-49 years age group represented 24.2% of the total number of the control group. The controls also aged less than 20 years were the least age group (6.5%).

More than half (58.1%) of the intervention group were females, while more than half (51.6%) of the controls were males. There was no significant difference in sex distribution between males and females p=0.280.

Concerning the educational level of respondents, more of both the intervention and control groups had tertiary education; 41.9% and 40.3%, respectively. This was followed by those with secondary/vocational education 37.2% for the intervention group and 32.3% for controls. Respondents who indicated they had no formal education had the least proportions for both the intervention and the control groups; 4.8% groups.

With regards to employment status, for both the intervention and the control groups, more (33.9%) respondents stated they work in the formal sector. Students were the least based on employment distribution. They made up 14.5% of all the intervention group and 12.9% of all controls.

On religion, 88.7% of music group were Christians and 9.7% were Muslims. Also, 83.9% of controls stated they belonged to Christianity while 12.9% indicated they were Muslims.

Table 1: Demographic Characteristic

		Music intervention group n(%)	Controls group n(%)	Total n(%)	p-value
Age Group	<20 years	3(4.8)	4(6.5)	7(5.6)	0.479
	20-29 years	14(22.6)	10(16.1)	24(19.3)	
	30-39 years	8(12.9)	9(14.5)	17(13.7)	
	40-49 years	7(11.3)	15(24.2)	22(17.7)	
	50-59 years	11(17.7)	8(12.9)	19(15.3)	
	60+ years	19(30.7)	16(25.8)	35(28.2)	
	Total	**62(50.0)**	**62(50.0%)**	**124(100.0)**	
Sex	Male	26(41.9)	32(51.6)	58(46.8)	0.28
	Female	36(58.1)	30(48.4)	66(53.2)	
	Total	**62(50.0)**	**62(50.0%)**	**124(100.0)**	
Religion	Christianity	55(88.7)	52(83.9)	107(86.3)	0.713
	Islam	6(9.7)	8(12.9)	14(11.3)	
	African traditional religion	1(1.6)	1(1.6)	2(1.6)	
	Others	0(0.0)	1(1.6)	1(0.8)	
	Total	**62(50.0%)**	**62(50.0%)**	**124(100.0%)**	
Educational level	No formal education	3(4.8)	3(4.8)	6(4.8)	0.826
	Primary/JHS	10(16.1)	14(22.6)	24(19.4)	
	SHS/ Vocational	23(37.2)	20(32.3)	43(34.7)	
	Tertiary	26(41.9)	25(40.3)	51(41.1)	
	Total	**62(50.0%)**	**62(50.0%)**	**124(100.0%)**	
Occupation	Student	9(14.5)	8(12.9)	17(13.7)	0.93
	Unemployed	12(19.3)	10(16.1)	22(17.7)	
	Informal-sector employee	20(32.3)	23(37.1)	43(34.7)	
	Formal-sector employee	21(33.9)	21(33.9)	42(33.9)	
	Total	**62(50.0%)**	**62(50.0%)**	**124(100.0%)**	

The results of comparisons of blood pressure readings, pulse rate and respiratory rates before and after exposure to music among the music intervention group are shown in Table 2 below.

A paired t-test indicated that only the systolic blood pressure of respondents was significantly reduced after the music intervention compared to the baseline (131.27±14.93 vs. 127.79±14.00; **p=0.0245**). However, no statistical significance was observed in the other parameters.

Table 2: Comparison of blood pressure readings, pulse rate, and respiratory rates before and after exposure to music among the music intervention group.

Variable	n	Mean	Standard deviation.	95% CI	p-value
Baseline Systolic BP	62	131.27	14.93	127.48-135.07	
After Intervention Systolic BP	62	127.79	14.00	124.23-131.34	**0.0245**
Difference	62	3.48	11.90	0.46-6.51	
Baseline Diastolic BP	62	84.35	12.28	81.24-87.47	
After Intervention Diastolic BP	62	84.42	10.42	81.77-87.07	0.9631
Difference	62	0.06	10.94	2.84-2.71	
Baseline Pulse rate	62	84.63	14.87	80.85-88.40	
After Intervention Pulse rate	62	83.44	15.41	79.52-87.34	0.2364
Difference	62	1.19	7.86	0.80-3.19	
Baseline Respiratory rate	62	19.61	3.55	18.71-20.51	
After Intervention Respiratory rate	62	19.13	3.97	18.12-20.13	0.1845
Difference	62	0.48	2.84	0.24-1.20	

The results of comparisons of the means of the physiological parameters taken at baseline and after extraction between the intervention and the control group are shown in Table 3.

Respondents exposed to music prior to tooth extraction had significantly reduced systolic blood pressure readings by 8.74mmHg than those without music (**p=0.001**). Additionally, the respiratory rate of the music group was significantly reduced by 1.54 compared to that of the non-music group (**p=0.023**).

Table 3: Comparison of the Means of the Physiological Parameters taken at baseline and after extraction between the intervention and the control group.

Parameters	Groups	N	Mean	Std. Deviation	Sig.
Baseline BP SYS	Case	62	131.27	14.935	0.311
	Control	62	134	14.926	
	Total	124	132.64	14.933	
Baseline BP DIA	Case	62	84.35	12.278	0.178
	Control	62	87	9.259	
	Total	124	85.68	10.911	
After Extraction BP SYS	Case	62	131.74	13.227	**0.001**
	Control	62	140.48	15.102	
	Total	124	136.11	14.803	
After Extraction BP DIA	Case	62	87.5	8.92	0.295
	Control	62	89.32	10.329	
	Total	124	88.41	9.654	
Baseline PR	Case	62	84.63	14.875	0.059
	Control	62	79.76	13.602	
	Total	124	82.19	14.403	
After Extraction PR	Case	62	84.56	15.17	0.418
	Control	62	82.52	12.779	
	Total	124	83.54	14.006	
Baseline RR	Case	62	19.61	3.55	0.127
	Control	62	18.69	3.097	
	Total	124	19.15	3.35	
After Extraction RR	Case	62	19.65	4.137	0.023
	Control	62	21.19	3.328	
	Total	124	20.42	3.819	

SYS= systolic, DIA= diastolic, PR= pulse rate, RR= respiratory rate

The changes of systolic blood pressure levels at baseline, intervention, and after extraction between the music and control groups are shown in Figure 1. The systolic blood pressure dropped significantly after listening to music but, after the extraction, rose close to the baseline levels for the music intervention group. But for the control group that did not listen to any music, the blood pressure significantly increased far beyond the baseline systolic blood pressure (p<0.001).

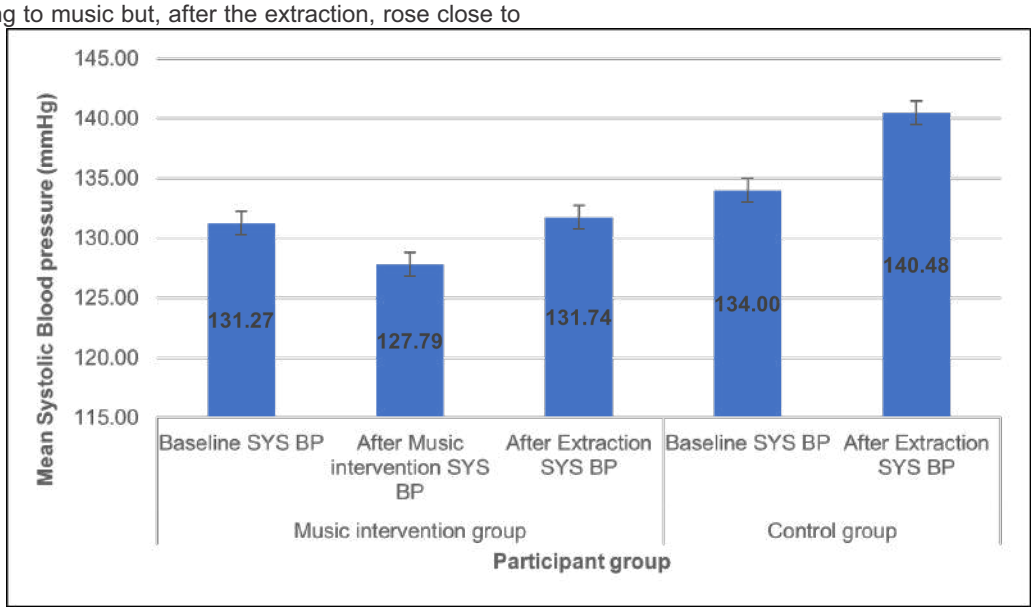

Figure 1: Error bar of systolic blood pressure changes between music intervention and control groups

The changes in the respiratory rate at baseline, intervention, and after extraction between the music and control groups are shown in Figure 2. There was a non-significant drop in the respiratory rate after listening to music, but after the extraction, the rate rose to the baseline levels in the music intervention group. But for the control group, the respiratory rate significantly increased far beyond the baseline levels after the extraction (**p<0.001**).

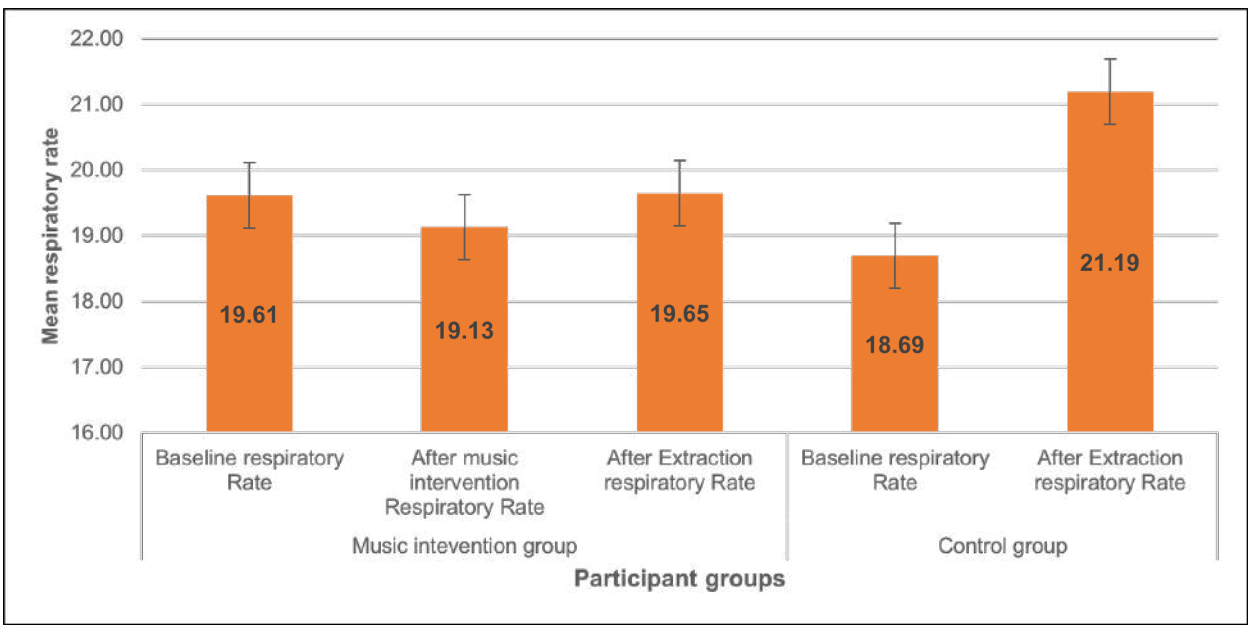

Figure 2: Error bar of respiratory rates between music intervention and control groups

DISCUSSION

Dental fear causes the autonomic nervous system activities to rise [12]. Blood pressure, contractions of muscles, and heart rates are increased due to increased sympathetic activities, which leads to an upsurge in the secretion of noradrenaline.[13, 14, and 15] The respiratory rate is also increased by the actions of the sympathetic nervous system[4]. The results of this study seem to confirm this theory.[16]

Exposure to music causes up regulation of the parasympathetic nervous system leading to a decrease in the sympathetic response. This results in a reduction of heart rate, respiratory rate, and contraction of the heart muscle.[13,17] Music, therefore, is supposed to cause a reduction in systolic and diastolic blood pressures, pulse rate, and respiratory rate, which are indicators of anxiety.[2,18]

It was observed that the music caused a significant reduction (p=0.025) in the systolic blood pressure after the music intervention compared to the other parameters. This may be because systolic blood pressure is likely the fastest in response during sympathetic activity.[13,14,15]

Participants who listened to the music had a significant reduction in the baseline systolic blood pressure (p= 0.001) and the baseline respiratory rate (p=0.023) after the extraction compared to the control group.

In Figures 1 and 2, the music intervention group's systolic blood pressure and respiratory rates decreased after the music intervention and returned to the baseline levels after the extraction. But for the control group, the systolic blood pressure and respiratory rate significantly increased far beyond the baseline levels after the extraction. This shows that the music modulated the changes in the physiological parameters, to the benefit of the intervention group in reducing the systolic blood pressure and respiratory rate.

The music used in this study was classical music. In theory, classical music has produced such effects in previous studies.[19] Therefore, this study produced results in line with the study of Un, 2016. However, there are other studies which yielded contrary results [1,20]. Chafin et al [20] in their study suggested that different effects are produced by different genres and styles of music[20]. It is important to note that this study was done among Ghanaian population who might not have been familiar with classical music. Yet, some positive effects of the music were observed in reducing the physiological parameters in this study.

CONCLUSION

Classical music intervention for the participants who were about to undergo a dental extraction procedure was proven to decrease and modulate the rise of the systolic blood pressure and respiratory rate. Because all participants were Ghanaians with homogenous demographics, further studies investigating the effect of local Ghanaian music on the blood pressure, respiratory rate, and pulse rates of patients will provide valuable scientific insight into this particular field of study.

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