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The Effects of Harp Music on Heart Rate, Blood Pressure, Ventilation and Anxiety

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ABSTRACT

The aim of this study was to investigate the therapeutic effects of harp music on vital signs and anxiety. After approval was received from the Institution Review Board, forty-two students between the ages of 18 and 22 from a small division II University in rural Pennsylvania were recruited and had their heart rate, blood pressure, and ventilation rate assessed before and after exposure to harp music. Ventilation was measured visually while heart rate and blood pressure were measured using digital apparatus. Additionally, their levels of anxiety were measured using the State-Trait Anxiety Inventory questionnaire. Half of the participants experienced live harp music while the other half were exposed to recorded harp music. When compared to baseline measurements, a significant decrease in both blood pressure ($p < 0.000$) and anxiety levels ($p = 0.0370$) were found when participants were exposed to the harp music. No significant relationship was found in heart rate or ventilation nor between the live and recorded trials. The results indicate that music exposure can produce some desired therapeutic effects in healthy individuals.

Keywords: ALTERNATIVE MEDICINE; HEALTH BENEFITS; MUSIC THERAPY; RELAXATION TECHNIQUES; THERAPEUTIC EFFECTS; VITAL SIGNS

INTRODUCTION

The use of music for entertainment and enjoyment has been around since the early stages of our society, yet the possible health benefits were not identified until more recently (EBSCO CAM Review Board 2016, McFerran 2012, Smith 2009). Music therapy is now a frequently discussed topic in the recent advancements of alternative medicine. Multiple studies have shown a significant decrease in stress, anxiety, and other psychological discomforts upon exposure to music (EBSCO CAM Review Board 2016, Quentzel 2009). These observations have been integrated into the medical field and patient care techniques by offering alternative ways to decrease anxiety beyond drugs and medication. A 2012 meta-analysis conducted by Dr. Jun-Mei Zhang and colleagues reviewed more than 300 studies that incorporated musical intervention. Of those studies, positive effects on anxiety, depression, and overall quality of life were determined to be significant upon exposure to music. (Zhang, 2012). This meta-analysis was one of many that evaluated the research on the positive effects that music can have on the mind.

So what about the physiological aspects of health that music may have? Are they equally affected by musical intervention? These questions are the focus of more recent research in music therapy. In one study, it was noted that positive effects on

various vital signs, such as blood pressure and heart rate, still require further research and observation to be determined significant. Although psychological aspects like anxiety and depression have shown positive decreases with musical intervention, (Zhang, 2012), they are still considered subjective measurements and therefore, maybe less reliable. If objective measurements, such as blood pressure and heart rate also coincide with the changes in the psychological response, then music therapy can be viewed not only as a mental aid, but also as a physical one. A study conducted by Ni and colleagues tested these hypotheses by measuring the levels of preoperative anxiety and vital signs in 172 patients. The patients exposed to musical intervention not only scored lower on their State-Trait Anxiety Inventory, but they also demonstrated significant decreases in their vital signs compared to baseline. Still, Ni noted that the mean change in anxiety was much greater than the change in the vital signs (Ni, 2012).

Furthermore, another study examining 168 post-operative abdominal surgery patients produced similar results as Ni's study (Vaajoki, 2011). In that study, positive effects on blood pressure, heart rate, and respiratory rate were found upon music exposure in the post-operative patients (Vaajoki, 2011). Music therapy is not limited to a particular patient population or medical intervention. Researchers have reported effective results across all specialties and situations (Ko 2011, Moris 2013, Ni 2012, Vaajoki 2011). According to a meta-analysis completed by Moris (2013), music intervention can even be beneficial intra-operatively. In fact, all 28 articles reviewed indicated that patients exposed to classical music in the operating room had lower reported analgesia and anxiety before sedation. This study also revealed that the surgeons were found to have lower heart rates and blood pressures during surgery and that the surgeons performed tasks quicker and more accurately when exposed to music in the operating room (Moris, 2013).

Music intervention is a non-invasive, drug independent form of therapy. If researchers can demonstrate positive results through their data then the information can be used within the medical field to treat patients. For instance, instead of providing a patient with an anti-anxiety medication to lower their blood pressure and heart rate, perhaps music therapy could produce the same effects with minimal to no adverse effects. Unfortunately, this particular topic has not been thoroughly supported with research and evaluation as of yet. Another question that remains to be answered is whether or not live music or record music would be more effective in lowering a patient's vital signs. Most studies of significance utilize only one form of musical intervention. In this study, heart rate, blood pressure, ventilation rate, and anxiety levels were measured before, during and after exposure to harp music. Additionally, all of these variables were tested using both live and recorded harp music. The purpose of this study was to illustrate the positive therapeutic effects of musical intervention on subjective and objective measures in order to provide additional support for music therapy as an alternative form of medicine.

METHODS

After approval was received from the Institution Review Board, forty-two students from a small division two University in rural Pennsylvania were recruited to participate in this study. Participants were between the ages of 18 and 22 and self-reported a state of good physical and mental health. Twenty-two of the participants were randomly assigned to the live music trial (Group A) while the other 20 participants were assigned to the recorded music trial (Group B). Each participant was then assigned to two 15-minute sessions on two separate days; a

control trial and an experimental trial. The order of these trials was randomly assigned to each participant.

Upon arrival on the experimental day for group A, participants were asked to lay supine on a massage table and to relax and make themselves comfortable. From there, their initial blood pressure and heart rate were assessed and recorded using a digital Omron device and Timex recorder respectively. All participants were then exposed to the same three harp songs, approximately 3 minutes in length each, performed live by the primary investigator. Ventilation rate was also measured and recorded after one minute into each of the three songs by an assistant, and heart rate was recorded at the end of each song. Upon the completion of the last song, the final blood pressure and heart rate measurements were recorded. The participant was then immediately asked to complete the State-Trait Anxiety Inventory questionnaire (STAI) based on their current emotional state.

The procedure for group B followed the same protocol. The only difference between the groups was the type of music the participants were exposed to. Group B participants listened to the same three songs as group A, but by means of a recording instead of a live performance. All vital sign measurements were completed at the same time intervals and in the same fashion. Group B participants were also immediately asked to complete the STAI questionnaire upon the completion of the last song.

Each participant was also exposed to a control trial, approximately 5-7 days after their experimental trial. On this day, the participants' normal resting blood pressure, heart rate, and ventilation rate were measured and recorded once. They also completed the same STAI questionnaire upon completion of the vital sign measurements.

Instruments

Blood pressure was recorded using the *Brylanehome Omron Automatic Blood Pressure Monitor while heart rate was recorded using a Timex digital exercise watch. Ventilation rate was based on observation of the number of times the chest rises per minute and was assessed throughout the study by the research assistant.* The purpose of the original STAI is to assess an individual's conscious awareness of their levels of anxiety using 40 self-reporting questions involving feelings of unease, worry, tension, and stress. *I*nternal consistency coefficients for the scale have ranged from .86 to .95 whereas test-retest reliability coefficients have ranged from .65 to .75 over a 2-month interval. Considerable evidence attests to the construct and concurrent validity of the scale (Spielberg, 1989). *The State-Trait Inventory questionnaire selected was constructed for Cognitive and Somatic Anxiety (STICSA). The version used in this study is a modification by* M. J. Ree, C. MacLeod, D. French, and V. Locke (University of Buffalo 2000) *of* Spielberger's original STAI questionnaire that is frequently used and acclaimed for adult anxiety (C. D. Spielberger 1983). Participants answered the shortened, 21 question modified version on a scale of 1 to 4 with higher scores indicating higher levels of anxiety. The same measuring tools were used throughout the study.

Statistical analysis was conducted using repeated measure t-tests in consultation with a local universities

RESULTS

Upon statistical evaluation, the decrease in systolic blood pressure from initial to final was determined to be significantly lower for both groups A (live music) and B (recorded music) ($p < 0.000$, Figure 1). There was no significant change indicated in diastolic blood pressure from initial to final recording for both groups. The change in heart rate was determined by

a repeated measures t-test between the first heart rate recording, before any music exposure, and the final heart rate recording, when music exposure was complete. The change in ventilation rate was determined in the same manor. No significant change was found between the initial and final recordings of heart rate or ventilation in either musical group (live or recorded). The anxiety questionnaire was evaluated using a t-test comparing the average scores on the experimental day and the consecutive scores on the control day. A significant decrease was found between the STAI scores for group A, ($p = 0.0370$), but not for group B. On the control day, STAI scores were significantly higher than their initial scores that were measured on the experimental day (Figure 2).

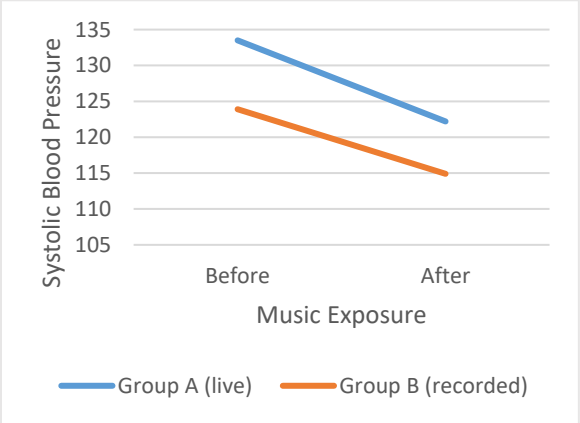

Figure 1. The Change in Blood Pressure of Groups A and B When Exposed to the Music.

When comparing groups A and B, no significant difference was found between these two groups in any of the assessed physiological variables. The difference in systolic blood pressure between group A and group B was minimal and therefore determined insignificant ($p = 0.242$, Figure 1).

DISCUSSION

The results indicate that after being exposed to the harp music, participants had a significant decrease in their self-reported anxiety scores compared to baseline STAI levels. This subjective response decreased with their physiological drop in systolic blood pressure. No other physiological variables measured demonstrated a significant decrease in responses.

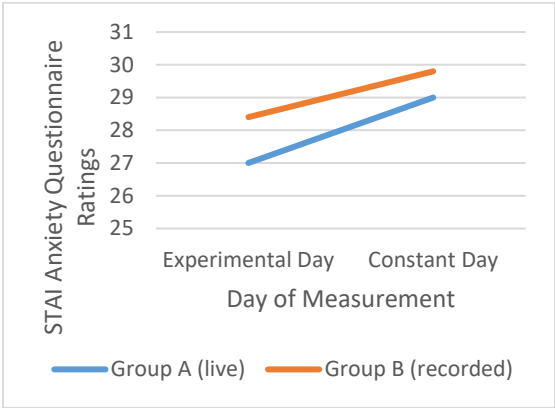

Figure 2. The Change in Anxiety Levels of Groups A and B When Exposed to the Music.

The results of this study are comparable in systolic blood pressure to the results of Ko and Lin (2011) and Pal (2014), where they reported significant decreases in blood pressure due to music exposure. In addition, these studies found a significant decrease in heart rate and ventilation rate. The difference in the results between this study and Ko and Pal's studies could be due to the differences in methodology. The study done by Ko involved surgical patients instead of healthy individuals, like the college students used in this study. A certain predisposed level of anxiety could have been present in the surgical patients due to the stress that often accompanies an upcoming surgery. This predisposition could have led to a more noticeable decrease in the physiological stress responses in Ko's study. Another factor that could have led to the decreases found in heart rate and ventilation in other studies compared to ours can be seen in Gopal's study (2014). Gopal involved healthy college age individuals as did our study, but incorporated more than one exposure to

musical therapy. This repeated exposure could have led to the more significant decreases in heart rate and ventilation in their study. Although the current harp study did not show the physiological changes that can occur when exposed to music therapy, it did indicate an overall decrease in an individual's anxiety.

A topic not commonly addressed by other researchers is whether live versus recorded music would have a significantly different effect on heart rate, blood pressure, and ventilation. Both live and recorded music was included in our study in order to identify if the physical presence of another human being affects the participant's levels of anxiety in a more noticeable way than if they were without that personable touch. There was no significant difference found between the mean scores of the two groups ($p > 0.05$) indicating that in this study the physical presence when being exposed to music therapy did not affect the results in a way that is significant.

This study is limited due to certain aspects of the methodology. Because ventilation was recorded without the participant knowing, initial ventilation was not measured before music exposure resulting in the first measurement of ventilation at 1 minute into the music. Experimental ventilation rate was compared to the constant recording of ventilation but that was measured with the participant laying down and in a relaxed state. In order to see if the change in ventilation and heart rate was significant, it may be beneficial to predispose the participants to a stressful state before exposing them to the music. By elevating their anxiety slightly and creating conditions more closely related to a surgical situation, it may be easier to identify a change in their physical responses once they are exposed to the music.

A variable that should be addressed in future studies is the tempo of the musical intervention. The three foreign lullabies were chosen due to their unreligious and unfamiliar nature, preventing any possible emotional connections with the musical pieces. The rhythm and speed of the pieces were slightly fast which could have elevated the resting heart and ventilation rate. It could be hypothesized that if the musical pieces played to the participants were slightly slower, the ventilation and heart rate may have decreased to a baseline equivalent to the songs rhythm. Previous studies have shown musical synchronicity to play a large role in the effectiveness of musical intervention. One study found a significant increase in attention and performance in participants performing aerobic exercise when exposed to fast paced music videos. (Hutchinson 2016). Similar findings have been found in other activities such as a 1000 meter rowing race. Musical intervention elicited better performance at the task when external attention was placed on music (Gabana 2015). If fast paced music has been found to prompt quicker exercise, than slow paced music is likely to prompt relaxation. Future studies should take into consideration the relative speed and rhythm of the music rather than the genre and attempt to identify if the tempo of the music impacts the physiological and psychological responses. Additionally, an outside harpist or musician unrelated to the study could be recruited in order to decrease any possible effects on the results of the study.

Due to the lack of access to a patient population, only healthy individuals were recruited for this study. This limitation did not allow the researcher to determine if effects of music therapy are enhanced in a patient compared to a healthy individual. Specific patient populations may greatly benefit from the use of music therapy such as pre-operative patients struggling with the anxiety often present when faced with surgery. Another beneficial field of study could be oncology to help minimize the

stress accompanied with cancer treatments without the use of drugs. Although music therapy has not demonstrated equivalent effectiveness as some other forms of treatment, its noninvasive and simple methodology makes it a possibility and a powerful tool in the medical field. It is recommended that future studies look at the physiological changes that are occurring in the patient who have been diagnosed with either anxiety or those who are undergoing specific surgical procedures.

Additionally, consideration needs to be given to the instrumentation of the study. Researchers should consider addressing the reliability of the digital blood pressure cuff as well as the appropriate cuff size for arm circumference in future studies.

CONCLUSION

In conclusion, this study provides further research in support of music therapy as an alternative form of medicine, specifically in treating anxiety. Although significant results were not found for some of the variables tested, such as heart rate and ventilation, these findings are not in agreement with previous literature pertaining to music therapy. The insignificance of the decrease found in heart rate and ventilation is most likely due to the methodology and sampling herein rather than the basic principle behind the study itself. Regardless, the overall drop in anxiety and systolic blood pressure indicates that music can be used to lower an individual's anxiety both physically and psychologically when measured by the STAI. Further research is still needed to advance music therapy to a more frequented and acclaimed practice and to determine the specific methods that lead to the most effective use of music in the medical field.

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