The Effects of Music on Pain and Anxiety During Screening Mammography

Kathleen Evanovich Zavotsky, RN, MS, CCRN, CEN, ACNS-BC, Adrienne Banavage, MSN, RN, OCN®, Patricia James, RN, MS, CCRN, Kathy Easter, MSN, RN, CCRN, Vicky Pontieri-Lewis, MSN, RN, ACNS-BC, CWOCN, and Lynn Lutwin, MSN, RN, OCN®

Since the 1970s, music has been used to enhance patients’ experiences. Practitioners, patients, and family members have used music to improve physiologic, psychological, and spiritual well-being at various points throughout the delivery of health care (Gallagher, 2011). Music also has been used to help decrease pain and anxiety. Trait anxiety and state anxiety have been found to affect pain levels, with state anxiety leading to higher pain self-reports, lower pain tolerance, and reduced thresholds for pain (Tang & Gibson, 2005). Such a relationship provides incentive for nurses and other healthcare providers to seek methods to reduce both pain and anxiety prior to procedures likely to produce nociceptive pain (Sanikop, Agrawal, & Patil, 2011; Strahl et al., 2000; Tang & Gibson, 2005).

Nurses have opportunities to teach patients and share information about screening mammograms. When patients express concerns about anxiety and pain during a mammogram, nurses should take the time to confirm that they may experience a certain amount of pain during the procedure. By validating these fears, nurses may help to improve the overall experience during a patient’s mammogram. However, nurses should consider teaching patients how to use pain management alternatives, such as relaxation, deep breathing, and music therapy, during procedures that are known to cause pain and anxiety.

Either in person or through patient literature, the relationship between pain and anxiety should be discussed, and patients should be encouraged to ask for assistance before, during, and after the procedure. Limited scientific investigation has focused on the use of music to decrease pain and anxiety in women undergoing screening mammography. The purpose of this article is to describe a study that investigated the impact of music therapy on pain and anxiety during routine screening mammography.
Background

In a systematic quantitative review of the literature, Schueler, Chu, and Smith-Bindman (2007) reported on some of the factors associated with mammography use. They found that physician access was the greatest predictor of compliance with mammography. Some other concerns varied between different racial and ethnic backgrounds. African American and Latina women were more concerned with safety, pain, and financial issues, whereas the financial implications were most important to Caucasian and Chinese women. Social activists have extended great effort to decrease the financial barriers associated with screening mammography; however, other barriers continue to exist.

Mammography involves compression that inflicts pain, discomfort, and anxiety, which may influence a woman’s decision to not return for repeat screenings (Poulos & Llewellyn, 2005). A blinded randomized, controlled trial by Lambertz, Johnson, Montgomery, and Maxwell (2008) studied women who received topical 4% lidocaine or oral medication and underwent screening mammography. Lambertz et al. (2008) reported that the 4% lidocaine gel demonstrated a 20% reduction in reported pain when compared to the oral medication and placebo. In addition, Markle, Roux, and Sayre (2004) demonstrated that careful explanation of the procedure and the use of special radiolucent cushions, which gave participants control over compression, showed some efficacy for reducing pain in 74% of their study sample.

Haun, Mainous, and Looney (2001) investigated the effect of music on the state of anxiety in a sample of 20 patients awaiting breast biopsy. After receiving 20 minutes of music therapy prior to the biopsy, patients reported significantly lower anxiety than those who did not receive music therapy.

Domar et al. (2005) studied the effects of relaxation techniques for reducing pain and anxiety during screening mammography. They used a controlled, randomized approach with three groups. The first group was offered relaxation techniques. The second group was offered a choice of classical music, jazz, or soft rock. The third was the control group. Although no significant differences were identified between the three groups based on interventions, it was discovered in a comparison of ethnicity that Caucasian women reported higher levels of overall anxiety after mammography than women of other ethnic backgrounds.

Music therapy has proven an effective tool to help reduce pain and anxiety for many. In Sidlnecki and Good’s (2006) randomized, controlled clinical trial, 60 people with chronic non-malignant pain were played music versus a control group with no music. The patients who were played music reported less pain and disability than the control group.

In 2010, Wakim, Smith, and Guinn performed a review of the literature related to the use of music in the perioperative setting. Their review revealed that patients generally feel that music is helpful. Wakim et al.’s (2010) review of multiple studies showed that patients who listened to music before, during, or after general anesthesia had decreases in blood pressure and heart rate, as well as lower anxiety scores. Patients undergoing invasive procedures without general anesthesia also were evaluated. In addition, patients undergoing cerebral angiography had similar findings with decreased levels of anxiety, as well as decreased heart rate and blood pressure, when listening to music. Of note, the authors recognized the importance of self-selected music over randomly selected music for maximum benefit.

The use of music therapy during bone marrow aspiration was evaluated by Shabanloei et al. (2010) who randomized 100 patients undergoing bone marrow aspiration into two groups. One group selected music from a small list to listen to during the procedure; the other group was the control group and was not offered music. The researchers measured anxiety before and after the procedure with postprocedure scores indicating lower levels of anxiety in the study group compared to the control group.

Allred, Byers, Ire, and Sole (2010) studied the impact of music and quiet rest time on patients who had recently undergone total knee arthroplasty. The researchers randomized patients into two groups, one listened to music and the other had a period of quiet, undisturbed rest prior to and just after the first ambulation. Allred et al. (2010) found that the patients who listened to music had a significant decrease in reported pain levels along with a non-significant decrease in anxiety. Although this study was small (N = 36), the authors recommended that music therapy be considered as an effective and safe intervention.

Binnis, Turner, Wilson, Pryor, Boyd, and Prickett (2011) studied the effect of music as a perioperative intervention to investigate changes in mean arterial pressure, heart rate, anxiety, and pain in women undergoing mastectomy. Thirty women were assigned to either a music intervention or the control group. The findings revealed that the intervention group had less pain and anxiety in the perioperative period.

Please complete this information immediately prior to your mammogram. Please do not include your name on this sheet. Please place check marks in the spaces provided.

Age: 

Check all that applies to your own medical history:

Asthma Cancer Diabetes High blood pressure

High cholesterol Kidney disease Osteoporosis

Check all medication that you have taken in the past 24 hours:

Pain medication Antidepressants Antianxiety

Check your race or ethnicity:

American Indian African American Pacific Islander

Hispanic White

Check the highest level of education completed:

Grade school High school Undergraduate

Post-graduate

Check how many mammograms you have had prior to today:

1–3 4–6 7–9 10–12 More than 13

FIGURE 1. Demographic Collection Sheet
Zhang et al. (2012) completed a systematic review and meta-analysis to examine the effect of music interventions on psychological and physical outcomes in patients with cancer. They examined studies from 1996 to 2011 and concluded that, based on individual, randomized trials, music intervention is accepted by patients and may help to improve psychological outcomes, but more trials are needed to further determine the effects of music.

The studies in this review lend indirect support to the theory that using music therapy during mammography is feasible and, with additional research, may help decrease pain and anxiety associated with mammography. Using this review of the literature, the current researchers developed a nursing research study that examined the relationship between screening mammography and a music intervention. Patients experience pain and anxiety during procedures, and nurses have a responsibility to research alternative and complementary treatments. This intervention was selected because it was within the control of the nursing practice.

The researchers from this study used an MP3 player with multiple genres of music and a docking station to explore the relationship among pain, anxiety, and music during screening mammography. This type of technology was chosen for this study (as opposed to personalized ear phones) after discussion with the mammography suite team. The team expressed that if ear phones were used, the participants might not be able to follow the directions from the technologist, which may have interfered with the mammography results.

The current researchers hypothesized that women who listened to music during screening mammography will report lower levels of anxiety and pain compared to women who did not listen to music.

**Methods**

**Setting and Sample**

This study was approved by the University of Medicine and Dentistry of New Jersey Institutional Review Board. The data for this quasi-experimental prospective study were collected from October 2011 to December 2012. The study included a total of 100 participants from a convenience sample, 50 in the experimental group who received music of their choice, and 50 in the control group who did not receive any music. On Mondays, Wednesdays, and Fridays, participants listened to music. On Tuesdays and Thursdays, the participants did not listen to music.

For the sample, inclusion criteria consisted of women who presented to the mammography suite for a screening mammogram; were able to speak, read, and write English; and were not hearing impaired. Informed consent was obtained from all participants.

**Procedures**

A member of the study team worked with the staff of the mammography suite to determine the workflow and how participants would be presented to the department. Each mammography suite was equipped with a small, high-quality speaker and docking station that would accommodate an MP3 player. The MP3 player was preloaded with various genres of music: pop, classical, country, pop-Latino, R&B, and show tunes. Signs were developed in the radiology waiting room to invite participation. When each participant registered for their mammogram, they received a clipboard with a short questionnaire to indicate if they would like to learn more about the study. If the patient checked “yes,” one of the researchers brought the patient to a private area where the informed consent was reviewed and obtained and demographics were collected (see Figure 1). If the participant was part of the experimental group, they were asked to select their music of choice from an MP3 player.

Immediately following the screening mammogram, the researcher turned off the music. All participants were asked to rate their pain and anxiety experienced during the screening mammogram using a Likert-type scale from 0 (no pain or anxiety) to 10 (extreme pain or anxiety) immediately after completing the mammogram.

**Data Analysis**

Data analysis was performed with SPSS®, version 21. Descriptive statistics, means, medians, frequencies, and percentages were calculated with a Student’s t test, chi-square test, and Mann–Whitney U test, and the p values were interpreted statistically. Means were compared using an independent t test, and proportions were compared using a chi-square test. The p value was set at 0.05 for statistical significance.

**Table 1. Sample Characteristics by Group (N = 100)**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Treatment (n = 50)</th>
<th>Control (n = 50)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>53.3 9.63</td>
<td>55 10.79</td>
<td>0.425</td>
</tr>
<tr>
<td>Race or ethnicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Caucasian</td>
<td>30 32</td>
<td></td>
<td>0.148</td>
</tr>
<tr>
<td>African American</td>
<td>9 10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>7 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pacific Islander</td>
<td>4 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade school</td>
<td>1 1</td>
<td></td>
<td>0.908</td>
</tr>
<tr>
<td>High school</td>
<td>12 14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Undergraduate</td>
<td>20 21</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Post-graduate</td>
<td>17 14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of mammograms</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1–3</td>
<td>12 13</td>
<td></td>
<td>0.236</td>
</tr>
<tr>
<td>4–6</td>
<td>2 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7–9</td>
<td>5 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10–12</td>
<td>9 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13 or more</td>
<td>22 22</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical history</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>24 15</td>
<td></td>
<td>0.036*</td>
</tr>
<tr>
<td>One condition</td>
<td>20 19</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combination conditions</td>
<td>6 16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medication</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>46 41</td>
<td></td>
<td>0.326</td>
</tr>
<tr>
<td>Pain</td>
<td>1 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antidepressant</td>
<td>2 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antianxiety</td>
<td>1 1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Statistically significant

Note. T test was used to measure age (df = 98); Fisher’s exact test was used to measure race or ethnicity (df = 3), number of mammograms (df = 4), and medication (df = 3); and chi-square test was used to measure medical history (df = 2) and education (df = 3).

**Clinical Journal of Oncology Nursing • Volume 18, Number 3 • Effects of Music on Pain and Anxiety**
were used to show the distribution of patient demographics. An analysis of covariance (ANCOVA) procedure was used to evaluate the effectiveness of the music therapy intervention on pain and anxiety. Pearson product-moment correlation coefficient was used to determine the relationship between pain and anxiety. Chi-square and t tests were run for categorical variables. An alpha level of 0.05 was set and a one-tailed test was used for all statistical analysis to test the hypothesis.

Results

The group equivalence was evaluated using demographics, patient history, and medication used in the 24 hours prior (see Table 1). The only significant difference reported between the control and treatment groups was medical history, ($\chi^2[2, N = 100] = 6.65, p = 0.04$). Therefore, medical history was included in the model to adjust for non-equivalence between the groups. No other significant differences were found on any patient history or demographic variables.

### Group differences

**Anxiety:** A factorial ANCOVA was conducted to compare the effectiveness of a music therapy intervention designed to reduce participants’ pain and anxiety during a screening mammography. The first set of analyses investigated the effectiveness of the music therapy intervention on participants’ anxiety levels (measured on a scale ranging from 0–10) during screening mammography.

After controlling for participant age, no significant difference was found between the treatment and control groups on anxiety scores ($F[1, 85] = 1.597, p = 0.21$), age ($F[1, 85] = 0.57, p = 0.45$), or medical history ($F[2, 85] = 0.025, p = 0.98$). In addition, no significant effect was found for number of previous mammograms ($F[4, 85] = 1.144, p = 0.34$), race or ethnicity ($F[3, 85] = 0.998, p = 0.4$), or education ($F[3, 85] = 0.445, p = 0.72$). However, although not statistically significant, the difference in adjusted means was in the expected direction, with the adjusted mean anxiety scores for the music therapy group lower than that of the control group (see Table 2).

**Pain:** An ANCOVA procedure also was used in the second set of analyses, which investigated the effectiveness of the music therapy intervention on participants’ pain levels during screening mammography. The covariate was a participant’s use of pain medication in the 24 hours prior. Unadjusted mean pain scores were lower for the music therapy group ($\bar{X} = 4.38, SD = 2.58$) compared to the control group ($\bar{X} = 4.44, SD = 2.93$). Preliminary tests were conducted to test for violation of the assumptions of normality, linearity, homogeneity of variances ($F[1, 98] = 1.129, p = 0.29$) and homogeneity of regression slopes ($F[1, 96] = 0.084, p = 0.77$).

After controlling for participants’ use of pain medication and medical history, no significant difference was found between the treatment and control groups on pain scores ($F[1, 95] = 0.051, p = 0.82$). In addition, no significant effect was found for use of pain medication ($F[1, 95] = 0.022, p = 0.88$) or medical history ($F[2, 95] = 1.013, p = 0.37$). Based on these results, no differences between the treatment and control groups were retained.

Although not the primary focus of this study, a Pearson product-moment correlation was computed to assess the relationship between the anxiety score and pain score. A significant, moderate, positive relationship was found between participant ratings of anxiety and pain ($r = 0.54, p < 0.01$). These results support an association between anxiety and pain in this population.

Discussion

Although receiving a screening mammography may save lives, barriers still remain for women. This study addressed anxiety and pain through the use of music therapy. Although no statistically significant difference was demonstrated between the experimental and the control group, this study showed that anxiety scores were lower for the music therapy group. This finding suggests the need for future research.

The relationship found in this study between pain and anxiety is well-supported in the literature. A variety of neurobiologic and cognitive variables, such as gender, age, and anxiety, play a role in the modulation and perception of pain (Strahl, Kleinknecht, & Dinnel, 2000; Tang & Gibson, 2005). Of the various cognitive, sensory, and affective-motivational components of pain, anxiety has played the greatest role in pain modulation (Tang & Gibson, 2005). In addition, anxiety affects pain levels, with state anxiety leading to self-reports of higher pain, lower pain tolerance, and reduced thresholds for pain (Tang & Gibson, 2005). Such a relationship provides incentive for nurses and other healthcare providers to seek methods to reduce both pain and anxiety prior to procedures that are likely to produce noxious pain, like mammography (Sanikop et al., 2011; Strahl et al., 2000; Tang & Gibson, 2005).

### Implications for Practice

- Use music therapy to help relax patients who report anxiety prior to a mammogram.
- Continue to study barriers to mammograms and develop and study creative interventions.
- Study relaxation techniques in patients undergoing procedures who are affected by anxiety.
The results of this study also are supported by earlier work done by Hafslund (2000) who examined the relationship between mammography and pain and anxiety. Hafslund (2000) concluded that anxiety and pain in connection with mammography were real enough, but were not perceived as a great problem by some of the women in that study.

Limitations

For the current study, one of the limitations was the potential for sampling bias, which may have been related to the randomization process. In addition, the participants were randomized based on what day of the week it was, which may or may not have had an effect. Closer analysis revealed that a convenience sample was used to accommodate scheduling fluctuations in the mammography department and the variability of patients’ schedules. In future studies, a more formal randomization process may help provide more robust findings. Another limitation was that the research team did not measure the participants’ overall satisfaction with the music therapy provided. Many of the participants in the intervention group expressed satisfaction with this simple intervention and that it helped to make their mammography experience more pleasant. In future studies, the patient’s overall experience should be explored.

Conclusions

Despite the fact that this study did not show that music therapy during screening mammograms decreased the amount of pain that the participants experienced, it did suggest that music therapy has the potential to decrease the amount of anxiety. Assisting patients in decreasing anxiety may help reduce barriers for screening mammography in some patients.

Although it was not one of the main purposes of the study, many participants were grateful for the opportunity to listen to the music. In addition, participants who listened to music expressed that they were more satisfied with their experience and found the visit to be more enjoyable.

Although literature suggests that music is a distraction for many populations of patients, music as a method of distraction during diagnostic procedures is far less investigated. When patients are faced with the possible diagnosis of breast cancer, it may be difficult to find an intervention to serve as a distraction. Simple nursing interventions, such as music therapy during screening mammography, may help save lives and is, therefore, worthy of more research.

References


