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# Analysis of the Effects of Music Therapy on Pain and Anxiety Levels in Pediatric Burn Patients

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Analysis of the Effects of Music Therapy on Pain and Anxiety Levels in Pediatric Burn Patients

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Paper Submitted in Partial Fulfillment

Of the Requirements for the Degree

Of Masters of Science

Physician Assistant Studies

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## **Introduction**

The management of pain and anxiety in burn patients remains a complicated and challenging field in medicine. Burn injuries resulting in tissue damage are considered one of the most severe traumas that can be experienced. Pain and anxiety continue to be major problems for patients with burn injuries during all stages of the treatment. Adequate treatment for burn injuries often include escharectomy, skin grafting, debridement, regular dressing changes, and physical therapy.<sup>1</sup> Range-of-motion exercises are essential in preventing complications such as contractures and promoting functional use of the burned tissue.<sup>2</sup> Acute pain from burns can cause physical and psychological consequences that have the potential to lead to chronic pain. Anxiety is closely associated with pain in burn patients and creates added stress that consequently can exacerbate the pain.<sup>3</sup> Repetitive painful procedures generate anticipatory anxiety for patients, which can directly influence a patient's perception of pain.<sup>1,2</sup> This negative interaction with pain leads to a decrease in the therapeutic effects of medications.<sup>4</sup>

Proper pain management is essential during recovery because it reduces the chance of developing malnutrition and promotes a stronger immune system.<sup>1,5</sup> High levels of stress and anxiety are associated with increased levels of the hormone cortisol.<sup>5</sup> Elevated levels of cortisol are linked with a reduction in the production of immunoglobulin A (IgA), leading to suppression of the immune system.<sup>1,5</sup> IgA is an antibody responsible for creating a strong mucosal environment to fight off infections of the upper respiratory tract, gastrointestinal tract, and genitourinary tract.<sup>5</sup> Impairment in the IgA production can result in an increased risk of infection. It is essential to find ways to reduce pain and anxiety to prevent stress and stop the development of further debilitating conditions.

The most common method to control the pain and anxiety experienced by burn patients is the use of opioid analgesics and anti-anxiety medications.<sup>1, 2, 6, 7</sup> Currently there is a push to utilize more non-pharmacological therapies in the treatment of burn patients to reduce the need for analgesics and limit drug side effects. The pediatric population can especially benefit from the use of non-pharmacological therapies because dosing and side effects vary greatly for children.<sup>6</sup> With the incorporation of a holistic approach to pain management, analgesic use can be reduced and treatment therapies can be more accurately designed to fit the patients' unique therapeutic needs.

Music has been an integral component of social life and a universal language shared across cultures throughout history.<sup>8</sup> Music has been utilized in numerous medical settings for years such as hospital waiting rooms and medical offices to promote relaxation.<sup>2</sup> It has the power to adapt and evoke physical, cognitive, and emotional changes. In 1914, the first case of music therapy was recorded by Dr. Kane.<sup>7</sup> He observed and documented the effect music had on his patients before, during, and after surgery. He concluded that patients who received the music therapy had reduced anxiety before the start of the surgery and better tolerated the induction of anesthesia.<sup>7</sup>

Today the American Music Therapy Association defines music therapy as “an established health profession that uses music and the therapeutic relationship to address physical, psychological, cognitive, and/or social functioning of patients of all ages and disabilities.”<sup>8</sup> Music therapists offer opportunities for active and passive patient participation in a non-pharmacological treatment to help reduce pain and anxiety.<sup>8</sup> Therefore, the aim of this review is to assess the effectiveness of music therapy on pain and anxiety levels in pediatric burn patients

through the evaluation of randomized control trials and experimental studies of music interventions for burn patients during treatment procedures.

## **Background**

### **Music Therapy and Gate Control Theory of Pain**

The pain experienced by pediatric burn patients on a daily basis can range from moderate to severe depending on the treatment procedure. During the treatment process, patients experience background pain at rest, procedural pain during debridement or dressing changes, and breakthrough pain during rehabilitation.<sup>2,4</sup> One of the main accepted theories for the control of perceived pain is the gate control theory of pain.<sup>2-4,9-11</sup> This theory states that pain has three main components: sensory-discriminative, motivational-affective, and cognitive-evaluative.<sup>9</sup> Receivers in the central nervous system act as gatekeepers by allowing nerve impulses to transmit to the spinal cord dorsal horn.<sup>4,9</sup> These signals then synapse and transmit the perception of pain to the brain. Through cognitive-evaluative factors such as imagery, self-statements, and attention-diversion devices, pain impulses to the brain are reduced.<sup>9</sup> Music targets the central nervous system and provides a competitive sensory stimulus to pain.<sup>11</sup> Distracting the patient from the pain closes the gate and leads to the diversion of the painful stimulus resulting in a state of relaxation.<sup>9-11</sup> Music therapy incorporates cognitive strategies to effectively lower pain and anxiety levels in burn patients.

Prensner et al. gave several case examples of music therapy effectively treating pediatric burn patients at the MetroHealth Medical Center in Northeast Ohio.<sup>9</sup> In one case a six-year-old male with burns covering 30% TBSA refused to participate in therapeutic range of motion exercises with his fingers and arms. However, when the music therapist played a familiar children's song with interactive hand movements, the patient completed all the exercises

independently.<sup>9</sup> That same patient also had edema in his extremities and was unable to relax to allow the medical team to place an IV so a music therapist played music for the patient. Ten minutes later the medical team returned and was able to place the IV and the child remained calm during the entire procedure.<sup>9</sup> In another case a seven-year-old male with burns covering 24% TBSA participated in a combination of Music Based Imagery (MBI) and music listening before, during, and after routine dressing changes. The child experienced a marked decrease in heart rate and a steady trend in pain and anxiety levels with few peaks in intensity<sup>9</sup>. Through the distractive and interactive methods of Music Therapy, these pediatric burn patients had reduced perceptions of pain allowing the medical care team to provide necessary treatment procedures.<sup>9</sup> This created a more favorable experience for the patients and enhanced their ability to progress in their rehabilitation.

### **Music Therapy Used in The Management of Pain**

A number of studies have explored the effects of music on pain levels before, during, and after medical procedures for burn patients. Few studies have examined the effects of music therapy in the population of pediatric burn patients. To complete a thorough analysis of this topic, studies involving adults were also reviewed in addition to studies in the pediatric population.

In one study, pain was defined as “an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage.”<sup>10</sup> Children respond to pain in a variety of ways. Pain is demonstrated through observable behaviors including crying, kicking, yelling, or retracting. Pain can also be expressed through covert behaviors such as thoughts, attitudes, and mental images that are a result of the painful stimulus.<sup>10</sup> Lastly pain can be conveyed through physiological responses such as neuroendocrine

responses, thermoregulation change, increased metabolism, impaired healing, and possible immunosuppression.<sup>10, 11</sup>

Whitehead-Pleaux et al. completed a study, solely with pediatric patients regarding the effects of Music therapy on pain during donor site dressing changes. Most severe burn patients require skin grafts harvested from a site that was not burned (donor site) to treat their burn.<sup>10</sup> The majority of pain receptors are intact at the donor site, which increases the level of pain and anxiety experienced by the pediatric patients. These patients must undergo regular donor site dressing changes throughout their treatment. In this study, the control group received verbal support and the experimental group had a music therapist play music and prompt participation.<sup>10</sup> The Wong Baker FACES Scale (see Figure 1) and the Nursing Assessment of Pain Intensity or NAPI (see Figure 2) were used to assess the pain experienced by the patients.<sup>10</sup> The NAPI results showed that the experimental group displayed significantly more distress than the control group ( $p=0.02$ ). The Wong Baker FACES Scale revealed no difference between the groups.<sup>10</sup> The small sample size did not accurately represent variance and limits the generalization that can be made based on the results.

A larger randomized control trial on the effects of music intervention in adult burn patients used a numeric rating scale (NRS) 0-10 to measure pain intensity for 5 days in a hospital. 0 represented no pain and 10 represented unbearable pain.<sup>4</sup> The NRS pain scores showed the experimental group who received music intervention had a statistically significant decrease in pain before, during, and after the dressing changes (see Figure 3, 4, and 5).<sup>4</sup> The control group had no significant changes in their level of pain before, during, or after treatment.<sup>4</sup> The results of this study indicate that music intervention decreased the level of pain experienced by the patient during all stages of the treatment process.



### **Music Therapy Used in The Management of Anxiety**

Anxiety is closely associated with pain during repetitive procedures such as wound care and range-of-motion exercises for burn patients.<sup>1,2,6</sup> Pediatric patients, often establish anticipatory anxiety that further exacerbates the pain and hinders the body's ability to heal properly. Anxiety in one study was described as "a vague, unpleasant emotional state with qualities of apprehension, dread, distress, and uneasiness."<sup>10</sup> One study found that patients who listened to music during range-of-motion exercises experienced significantly less anxiety before and after the routine physical therapy (see figure 6).<sup>2</sup> Additionally, the results of a randomized control trial further supported the use of music therapy in burn patients.<sup>6</sup> Patients who listened to their favorite songs for 20 minutes a day in a relaxing environment experienced significantly less daily anxiety during the treatment of their burns.<sup>6</sup>

A pilot study used music based imagery (MBI) and Relaxation Response Elicitation (RRE) to reduce stress and prevent anxiety in 28 burn patients.<sup>9</sup> MBI is designed specifically for the patient by having them focus and concentrate on a positive image while music is playing. Then the patient is asked to identify how the image can be described by the music.<sup>9</sup> This active participation aids in the distraction of pain and lowers the potential for anxiety. RRE regulates and restores the body's natural vital rhythms, which are interrupted when an injury occurs. A music therapist selects a vital rhythm to address such as a heart rate to match the tempo of the music. The tempo of the vital rhythms reduces stress while providing interactive music stimulation in patients to promote relaxation.<sup>9</sup> The study recorded a success rate of 98%. 22 patients recorded a successful outcome, 5 fell asleep during the protocol, 1 had a neutral outcome, and 0 had an unsuccessful outcome.<sup>9</sup>

With anxiety being the most common emotional issue facing burn patients, a recent meta-analysis of 17 studies and 804 burn patients was conducted to assess anxiety in addition to pain management in burn patients.<sup>1</sup> The analysis found a statistically significant difference in pain management with music intervention, indicating a positive effect on pain relief.<sup>1</sup> Also, in 11 of the studies, music interventions noticeably reduced anxiety in patients compared to non-music interventions.<sup>1</sup> This resulted in increased patient satisfaction during treatment.

### **Music Therapy effects on Heart Rate, Respiration Rate, and Blood Pressure**

The research findings surrounding physiological measures of pain and anxiety in burn patients are more variable. In a meta-analysis, four studies showed significantly decreased heart rates in the music intervention group.<sup>1</sup> In this analysis, four studies found blood pressure did not change significantly between the intervention group and the control group.<sup>1</sup> In regards to respiration rate, two studies showed a significant difference between pre and post treatment measurements in both the music intervention and control groups.<sup>1</sup> Two other studies showed no difference in respiration rates across the groups during dressing changes.

This evidence was further supported by a randomized controlled trial monitoring heart rate, respirations, and blood pressure before and after daily dressing changes for the burn patients.<sup>2</sup> In this trial no change in heart rate, respiration rate, or blood pressure was noted between pretreatment and post-treatment values in both the music intervention group and control group.<sup>2</sup> There was also no statistical difference between the groups for the physiological measurements.<sup>2</sup> These findings imply that physiological measurements of pain may not be reliable and accurate in assessing pain and anxiety management in burn patients.

## **Methods**

A thorough search of all literature regarding the clinical application of music therapy for pediatric burn patients was completed between the dates of May fifth through July second. PubMed and Google Scholar were the databases used to gather research for this paper. Keywords that were applied as search criteria are as follows: ‘Burn Trauma’, ‘Music Therapy’, ‘Music Therapy and Pediatric Burn Patients’, ‘Pain and Anxiety Treatment with Music Therapy’, and ‘Music Therapy Effects on Pain and Anxiety in Pediatric Patients.’

Articles were included if they met the following criteria: (1) Articles were published within the past 20 years, (2) Articles that were Peer Review, Randomized controlled trials, or meta-analyses, (3) Articles that included background information on what music therapy is, (4) Articles that included studies of music therapy and its benefits in the treatment of severe burns. Abstracts were read from the articles that met the initial inclusion criteria. The remaining articles were then examined and analyzed in their entirety for selection. Finally, articles were chosen for inclusion in this research paper.

## **Discussion**

Pain management in burn patients continues to be a challenging issue and is often associated with high levels of anxiety. Pediatric burn patients are a difficult population to treat and require careful dosing along with close monitoring of drugs. Currently, there are limited studies identifying the therapeutic outcomes of music therapy in the pediatric burn population. Music has a long history of therapeutic and healing practices. It has the power to stimulate the brain and elicit an emotional response to relax and reduce anxiety in patients.<sup>8</sup> One of the benefits of music therapy is its ability to adapt to a variety of situations. Not only is it more affordable for patients, but it also can be easily transported to various settings making it highly

portable and versatile. However this versatility creates challenges with identifying conclusive evidence about therapeutic outcomes. There are numerous types of musical interventions that can be utilized within music therapy and there is no one governing protocol. The studies analyzed for this research all used different interventions and protocols to determine the impact of music therapy on the burn patients. A variety of scales were used to assess pain and anxiety along with physiological markers such as blood pressure, heart rate, and respiration rate.

One of the main intervention differences within the research studies was the use of passive versus active music therapy. In the study by Kuo-Chang Hsu et al. the passive music approach was demonstrated and evaluated for effectiveness with pain and anxiety.<sup>4</sup> Listening to the crystal music on the CD did provide external stimuli for the participants, however a more active music intervention approach could create an even greater impact on pain and anxiety levels for patients.<sup>4</sup> Music therapists have the ability to lead guided meditations, song writing activities, and singing to help tailor the music intervention to each patient.<sup>4</sup> This optimizes the therapeutic experience and enhances patient outcomes.

The Prensner et al. pilot study demonstrated the positive impact music therapy can have on burn patients.<sup>9</sup> However, the sample size for this study was small and presented limited numerical information, which restricts the weight that this study can hold within the medical community. Despite the small sample size, the clinical case examples suggest that music therapy can be beneficial in the treatment of burned patients regardless of age and severity of their burns.<sup>9</sup> Music is one of the few sources that can adapt to a patient's needs and can be made available in any setting. Music therapists have the trained skills to alter music therapy protocols to account for a patient's limitations while capitalizing on their strengths. This boosts a patient's progress with physical and emotional rehabilitation. Burn patients experience chronic intense

pain that can often lead to problems with compliance in treatment. When pain becomes too intense providers run the risk of overmedicating their patients, which can cause sedation.<sup>1,2,6</sup> Patients then are unable to participate in physical and occupational therapy, which are essential to their recovery.<sup>2,6</sup> This study shows that engagement in music therapy can promote compliance with procedures, decrease pain intensity, and manage anxiety in burn patients of all ages.<sup>9</sup> Further research is needed with randomized controlled trials to support this study and provide information about the level of assistance music therapy can offer burn patients.

A recent study published in January of 2017 evaluated the effects of music and massage intervention on pain, anxiety, and the level of relaxation in burn patients.<sup>6</sup> The results of this study were consistent with other resources indicating that music and massage decreased pain plus anxiety while increasing relaxation in patients.<sup>6</sup> With increased relaxation, burn patients can experience improvement in symptoms and better manage the pain and anxiety associated with burn treatments. Implementing these interventions could potentially decrease the need for opioid pain medications thus providing a safer approach to overall care of the patient. One limitation with this study was the lack of records regarding the dosage of pain medication administered to each patient during the study.<sup>6</sup> If the dosages were changed during the course of the study, the level of pain experienced by the participants could have been altered consequently.

Children who are hospitalized with severe burns experience high levels of pain and anxiety on a daily basis. Pediatric patients can often feel overwhelmed by the level of care they require which restricts their ability to simply function as a young child.<sup>12</sup> According to Edwards et al. "Music therapy in pediatric hospitals is used to help children regain a sense of mastery and control through the use of music to facilitate expression of feelings about hospitalization and treatment."<sup>12</sup> Music therapy is a vital resource for children who are learning to cope after a

stressful and traumatic experience. Children learn to relax through the use of music therapy prior to, during, and after regular treatments in the hospital.<sup>12</sup> A variety of music therapy options such as improvisational, song writing, song singing, and music listening provide opportunities for self-expression, freedom of choice, and fun interactive play.<sup>12</sup> Allowing the child to have a choice and a voice in their treatment help them regain control of their own life and feel less victimized.<sup>8,12</sup>

### **Clinical Applications**

Music therapy is not only a treatment option for burns patients who are undergoing medical procedures. The emotional and psychological recovery for these patients can be long and challenging. The Southwest Hospital in Chongqing China recognized the daily struggles the pediatric burn patients face not only during hospital treatments, but also once they have been discharged. As a result, in 2011 the hospital created the Chunmiao Burn Children Summer Camp. This camp is for children who have sustained severe burns following a traumatic event and it is completely funded by the hospital.

This camp heavily relies on the incorporation of music therapy as a way for the children to open up and move beyond their physical limitations. Music therapists have the ability to transform and adapt every session to meet the needs of the patients.<sup>8</sup> At the burn camp, the music selected for each session depended on the current state of the children. If the children were energetic, stressed out, or emotional the music therapists would play music with a tempo to match their energy level and slowly decrease the rhythm to bring their heart rate down and ease their emotional states. The music adjusts and transforms to fit the needs of the patients.<sup>8</sup>

Music lyrics can become meaningful and powerful mediums for children to express their journey to recovery. Song writing provides a unique opportunity for children to communicate

their feelings, experiences, frustrations, and fears.<sup>8,12</sup> At the burn camp a music therapist led a song writing session with seven pediatric burn patients. The children were given the opportunity to speak freely with peers who understood their struggles. They composed a song describing how they do not want to be seen as different by others even though they have physical scars from their burn injuries. This music therapy session allowed the children to identify their insecurities and vocalize their emotions in a healthy and therapeutic way. For many trauma victims, especially pediatric burn patients, the treatment required moves beyond the physical management and care. Music therapy provides patients with nonpharmacologic management of pain and anxiety, while creating positive changes in mood and emotional states throughout the course of their recovery.<sup>8</sup>

### **Conclusion**

Music therapy may decrease pain and anxiety during treatment procedures in children who have experienced severe burns. The current research shows many positive outcomes with the use of music therapy as an intervention. However, we cannot say for certain that music therapy is causing the reduction in pain and anxiety, but it does demonstrate great promise. Many studies have shown that pediatric burn patients have a positive reaction to music as a form of treatment intervention and no negative impacts have been associated with any of the studies. With no negative side effects, music therapy continues to be a beneficial nonpharmacologic treatment option for patients and creates an opportunity for providers to reduce drugs and sedation in children.

Nevertheless, more research is needed to conclude that music therapy in fact does provide pain relief and reduces anxiety levels in burn patients. Future research should be focused on the pediatric population with larger sample sizes in randomized controlled trials using consistent

methods for the measurements of pain and anxiety levels. Studies should also assess the long-term outcomes of music therapy as a form of treatment for pediatric burn patients even after the medical procedures are completed. Burn patients often experience emotional and psychological struggles surrounding their scars and outward appearances. Further high-quality studies are needed to carefully assess both the short-term and long-term effectiveness of music therapy interventions in the recovery of pediatric burn patients.



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**Appendix A**



Figure 1: Wong Baker FACES Scale

**Nursing Assessment of Pain Intensity (NAPI)**

Circle score in each column that best describes the patient's behavior

Verbal	Body Movement	Facial	Response to touch
0 = positive	0 = moves easily	0 = smiling	0 = neutral
1 = other complaint/whimper	1 = neutral shifting	1 = neutral	1 = winces when touched/moved
2 = pain crying	2 = tense/flailing arms and legs	2 = frowning/grimace	2 = cries out when touched/moved
3 = screaming		3 = clenched teeth	3 = screams when touched/moved

Total NAPI Score \_\_\_\_\_

Figure 2: Nursing Assessment of Pain Intensity

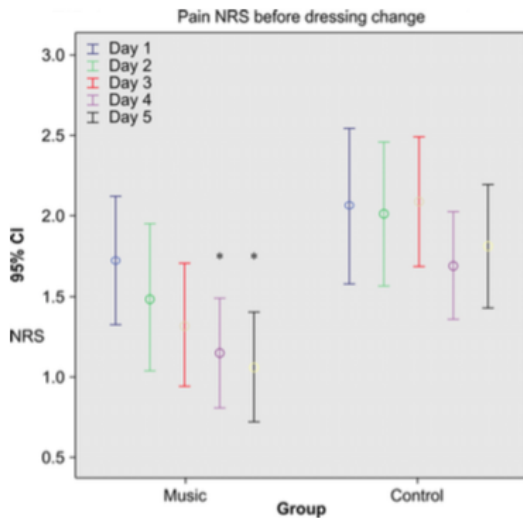


Figure 3: Pain rating before dressing change

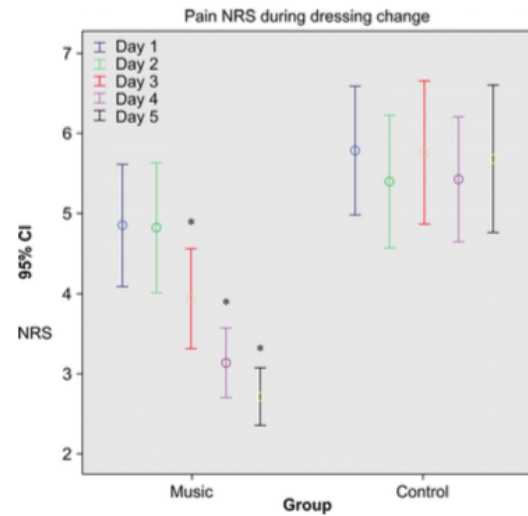


Figure 4: Pain rating during dressing change

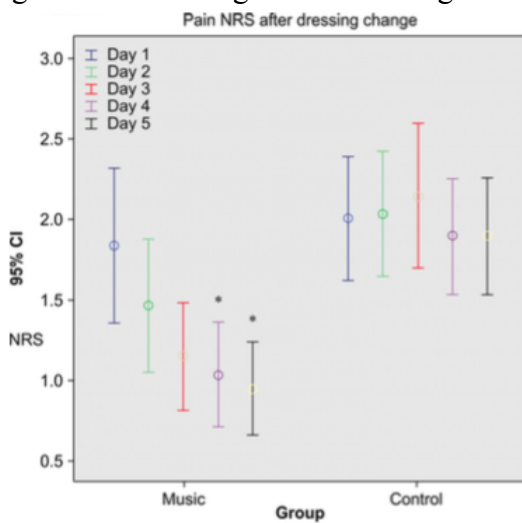


Figure 5: Pain rating after dressing change

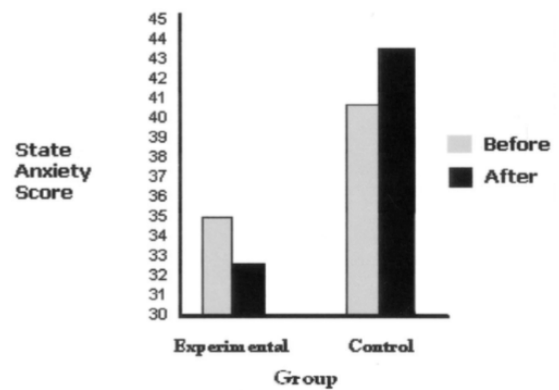


Figure 6: State anxiety score across groups



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