2021

Playing Music as a Nursing Intervention to Reduce Distress in Neonatal and Pediatric Acute Care Patients: A Literature Review

Seren E. Özoğlu
University of Central Florida

PLAYING MUSIC AS A NURSING INTERVENTION TO REDUCE DISTRESS IN NEONATAL AND PEDIATRIC ACUTE CARE PATIENTS: A LITERATURE REVIEW

by

SEREN E. ÖZOĞLU

A thesis submitted in partial fulfillment of the requirements
for the Honors in the Major Program in Nursing
in the College of Nursing
and in the Burnett Honors College
at the University of Central Florida
Orlando, Florida

Spring Term 2021

Thesis Chair: Joyce Burr, PhD, RN, AHN-BC

Abstract

Pediatric and neonatal patients are especially vulnerable to suffering from distress. This literature review identifies research which applies passive music listening to distressed neonatal and pediatric acute care patients. Databases searched to find relevant studies include CINAHL plus with full text, MEDLINE, Alt HealthWatch, APA PsycArticles, and APA PsycInfo from EBSCOhost. Six studies were identified to meet search criteria. The studies that supported music listening with the neonatal and pediatric populations had a positive effect in reducing distress levels. Additional research is warranted to further validate these findings. Music listening with neonatal and pediatric patients is a simple, cost-effective intervention that nurses can implement at the bedside.

Keywords: music, therapy, neonatal, pediatric, adolescent, acute care, preoperative, intraoperative, postoperative, perioperative, anxiety, pain, distress

Dedication

To my best friend, Alex Carpenter. Thank you for patiently listening to me read through my drafts and for offering your perspectives. Your unwavering support, confidence, and consistent encouragement through this project have helped shape who I am today. Thank you for reminding me of my strength, that I am loved, and never alone. Most importantly, thank you for always having my back. You are one of life's greatest gifts to me, and I respect, appreciate, and love you immeasurably. Let those who read this value the significant impact you have made in my life, and know that it will always be remembered in my work, through all of time.

Acknowledgements

I would like to give thanks to Dr. Burr, my thesis chair, for making this project possible. I have learned so much and have grown immensely from this experience. Thank you for taking the time to work with me and help me become a better student and researcher.

Thank you to Mrs. Neubauer, who was always a source of wisdom, positivity, and knowledge during this process. Thank you for always being there for me, and for offering your academic and emotional support when times were difficult.

I would like to thank the Burnett Honors College and the College of Nursing for giving me this opportunity.

Finally, I would like to thank Jayne Willis from Orlando Health for her scholarship. Without it, I would not have had the same opportunities to be successful with this research.

Table of Contents

Introduction

While there are various purposes for using music interventions, an objective of applying music interventions is to lower levels of distress in patients as a complement to drug therapy. Research suggests that using music interventions can be beneficial, demonstrating that these interventions can induce physiologic responses, such as lowering heart rate (Uggla et al., 2016). Music interventions can be utilized by nurses as a complementary therapy. Music listening is an "inexpensive, easily applicable intervention" (Kulhmann et al., 2020, p. 1) that can be used in acute care settings. While the adult population has been widely studied, neonates, infants, and children have received less attention. This literature review focuses on music, neonatal, and pediatric research.

Music listening is supported as an intervention among adult surgical patients. Adults have shown willingness to use music during their surgical care. According to one study, 88% of surgical adult patients that were surveyed agreed that they would welcome music into their treatment regimen (Lane et al., 2018, p. 35). Since this intervention is widely accepted among adults, it provided a reason to study neonates and pediatric patients as well.

Young children can become easily stressed when undergoing treatment in an acute care setting. Surgical pediatric patients can exhibit distress behaviors in response to their preoperative anxiety. This distress can exacerbate postoperative complications. Listening to music can reduce distress such as anxiety for these patients (Millett & Gooding, 2017, p. 460). Similarly, in neonates, the Neonatal Intensive Care Unit (NICU) environment is stressful with loud noises from technology. Research suggests that noise levels above 70 decibels can have a negative impact on NICU babies. When introducing relaxing and slow music to these patients, the

parasympathetic nervous system becomes active, relaxing neonates evidenced by lowered heart and respiratory rates (Caparros-Gonzalez et al., 2018, p. 58-59).

Background

Neonatal and Pediatric Populations

The populations that were reviewed included neonates and pediatrics. A neonate is a child from birth to 28 days old (World Health Organization, n.d.). The American Academy of Pediatrics defines boundaries for the pediatric age range between birth and age 21 (Hardin & Hackell, 2017). The pediatric age range can be broken down into smaller developmental categories. Infants are between twenty-eight days to a year old. Toddlers are between 1-3 years old. Preschoolers are between the ages of 3-6, school-age are children between 6-12 years old, and adolescents are ages 13-18. In addition, the age range of 18-21 is categorized as late adolescence (Hardin & Hackell, 2017). It is important to understand these developmental breakdowns within the pediatric age range because it is unknown if neonates and pediatric patients across all developmental stages will respond similarly to music listening. Though there is slight overlap in these age categories such as with neonates and infants, the intention of using "neonates" as a category and search term was to find more studies relating to NICU babies.

Music Listening

Music listening is the primary intervention and is defined as the act of listening to pre-recorded or live music. Music listening can also be described as passive listening (Prakash, n.d.). Though nurses could perform live music for patients, it is unlikely they will do so. In this thesis, only studies with participants listening to pre-recorded music will be utilized.

Music Therapy

Music therapy "is the clinical and evidence-based use of music interventions to accomplish individualized goals within a therapeutic relationship by a credentialed professional who has completed an approved music therapy program" (American Music Therapy Association,

2017a, para. 2). This is an important distinction to understand because nursing and music therapy are separate disciplines.

Interventions provided by music therapists are more hands on. Therapeutic interventions can include "song writing, lyric discussion, music and imagery, music performance, learning through music, and movement to music" (American Music Therapy Association, 2017b, para. 1). For example, music therapists may hold group sessions such as drum circles or perform music in front of patients with live instruments. Nurses at the bedside are unlikely to perform these interventions. It is more likely that nurses would provide patients with music to listen to through mediums such as a CD or iPod, and headphones for the patient. Providing music listening for patients can be done so without formal education in music therapy.

Distress in Acute Care

Distress is the dependent variable that will be investigated for the literature review. Pain and anxiety are aspects of distress. Pain is an uncomfortable feeling that can bring about other physical symptoms, such as nausea or weakness. Pain sensations can be described as burning, throbbing, stabbing, or aching (Muhammad, 2017). Anxiety is a negative emotion concerned with possible future events. This can cause physical manifestations such as muscular tension and avoidance behavior (American Psychiatric Association, n.d.). These aspects of distress are represented conceptually through self-reported pain level, self-reported anxiety level, respiration rate, heart rate, blood pressure, and cortisol levels. Use of ranking scales were analyzed to understand these behavioral patterns in infants, who cannot self-report pain or anxiety levels.

The Acute Care Inpatient Setting

Acute care environments tend to cause distress in children, which can cause stress responses and further delay medical treatment (Lerwick, 2016). Neonatal infants can also

become stressed in the NICU environment (Caparros-Gonzalez et al., 2018, p. 58). Inpatient settings provide acute care. As the World Health Organization explains, acute care services include “all promotive, preventive, curative, rehabilitative or palliative actions, whether oriented towards individuals or populations, whose primary purpose is to improve health and whose effectiveness largely depends on time-sensitive and, frequently, rapid intervention” (Hirshon et al., 2013, para. 2). Additionally, the domains of acute care include “emergency medicine, trauma care, pre-hospital emergency care, acute care surgery, critical care, urgent care and short-term inpatient stabilization” (Hirshon et al., 2013, para. 3). Inpatient settings for this literature review include the neonatal intensive care unit (NICU), emergency care, pre-op, intra-op, and post-op surgical care.

Significance

Experiencing distress can bring negative side effects. In children, painful invasive experiences can cause "extreme anxiety during future procedures" and can trigger an extreme reaction during a procedure. Additionally, these fears can manifest into adulthood and discourage adult patients from seeking out medical attention (Çelikol et al., 2019, p. 226). Fear of anxiety and pain during the inpatient experience can inhibit patients from wanting to collaborate with healthcare professionals during their stay (Price, 2017). It is crucial to control these fears in children in order to promote positive healthcare results. Controlling these stressors may not only benefit the pediatric patient but dispel the stress of parents as well (Kahsay, 2017). NICU infants can also be negatively affected by stress from the critical care environment. Research suggests that exposure to stressors can be linked to alterations in the frontal, parietal, and temporal lobes, and alterations with motor skills (Smith et al., 2011).

Applying a passive distraction method, such as music listening, can help distract distressed patients. This can reduce problems occurring with children, their families, and the healthcare workers. In 2019, Çelikol's research supported that music listening could reduce levels of pain sensitivity and anxiety among distressed patients. Distraction from procedures that caused distress could lower pain sensitivity and anxiety because these methods encouraged a sense of control for these patients. It was noted that nurses could easily implement this intervention because of its simplicity and effectiveness (Çelikol et al., 2019, p. 226). Providing more options to control distress in children can provide more opportunity for those patients to be soothed.

Problem

Drug therapy is utilized to reduce patient distress in acute care. Pharmaceutical agents such as Morphine and Fentanyl are available to combat some of these stressors. However, these medications can bring unwanted side effects. Along with experiencing physical side effects, patients can experience more severe problems with pharmacological therapy including drug tolerance, overdosing, and even death.

Narcotic Usage

Two common drugs used in the acute care environment to reduce patient distress are Morphine and Fentanyl (Karcioglu, 2013, p. 9-10). These drugs are narcotics, which come with black boxed warnings. In the attempt to reduce pain and anxiety levels, Morphine can cause additional problems that may possibly require more drug therapy to correct. According to the Mayo Clinic, common side effects of morphine can include symptoms such as "cramping, difficulty having bowel movements, drowsiness, false or unusual sense of well-being, sleeplessness, unusual drowsiness, [and] weight loss" (Mayo Clinic, n.d., para. 4). Fentanyl is an extremely potent drug. It is 50-100 times stronger than Morphine (National Institute of Drug Abuse, 2020, p. 1). Because of this, it is much easier to overdose and kill a patient with Fentanyl. Patients can also become quickly tolerant to these drugs if not prescribed with caution. Sometimes it may only take a few hours to develop tolerance (Hayhurst & Durieux, 2016, p. 483).

Overdosing

These powerful drugs can affect children differently than adults. Because babies and children are smaller in size, the dosage for these drugs differ in different age groups (Boyer, 2013, p. 6). Unlike Morphine, which is measured in milligrams, Fentanyl is measured in

micrograms because of its dangerously high potency. The lethal dose of Fentanyl is 250 mcg, or 2.5 milligrams (National Center for Biotechnology Information, n.d., a). A reported lethal dose of Morphine in children and babies was at 30 milligrams (National Center for Biotechnology Information, n.d., b). The lethal dosage of Fentanyl has a much narrower range than Morphine. Still, Morphine can be overdosed if not administered with caution. If overdosed, these narcotics can cause respiratory depression because they are central nervous system (CNS) depressants. If this occurs, the patient must be given the reversal agent, naloxone (Boom, 2012, p.1). Narcotic use in acute care is risky and possibly fatal and it is recommended that patients and families explore other options with the healthcare team before resorting to narcotic opioid drugs (Matson, 2019, p. 73).

Purpose

This purpose of this literature review was to examine current research from 2015-2020 studying music listening. The focus of this literature review was to examine music listening in acute care with neonatal and pediatric patients. It explores the potential benefits of this intervention. Additionally, this literature review analyzes music listening as a viable nursing intervention in the acute care environment.

Method

Databases that were searched included CINAHL plus with full text, MEDLINE, Alt HealthWatch, APA PsycArticles, and APA PsycInfo from EBSCOhost. Search terms included music* or music listening or music therap* and intervention*, or preop*, or preprocedur*, or surg*, or intensive care unit, or ICU, or PICU, or NICU, or critical care, and neonat*, or bab*, or infant*, or ped*, or adolesc*, or child*, and anxiet*, or worr*, or fear*, or sedat* or pain* or distress* or stress*. Limiters included abstract available, peer reviewed, academic journals, and English language.

Seventy-eight articles were found with these search terms. All articles that were not duplicates were reviewed under the inclusion criteria that 1.) the study used music listening as an intervention, whether it was the only intervention group or a single arm of the study, 2.) neonatal and pediatric age range were exclusively studied 3.) participants and caregivers provided informed consent and assent, and 4.) music listening interventions were applied with pre-recorded tracks and not live music. After review, six articles were chosen which fit the inclusion criteria and are included in the literature review.

Findings

Human subject protections in the studies reviewed included approval by an ethics committee and informed caregiver consent and assent of patients older than 7 years old before starting. Behavioral assessments used in these studies were assessed by trained researchers. All studies expressed clear inclusion and/or exclusion criteria in their protocols and identified that participants were free to opt out of the intervention at any given point. No study specifically expressed that participants dropped out due to distress. Data was collected and analyzed from participants who completed the study from beginning to end.

Researchers used vital signs as parameters of distress and pain, along with behavioral scales of distress, anxiety, and pain. Most used were The Modified Yale Preoperative Anxiety Scale (m-YPAS) and The State-Trait Anxiety Inventory for Children (STAIC). Both the m-YPAS scale and the STAIC scale were each used for two different studies. Many of these studies used additional behavioral scales, and multiple scales for data collection.

Common Behavioral Measures of Distress

The Modified Yale Preoperative Anxiety Scale (m-YPAS) was utilized by the Kuhlmann et al. (2020) study and the Franzoi et al. (2019) study to measure pediatric preoperative anxiety. This scale includes 5 domains that observe the patient's activity level, emotional expressivity, state of apparent arousal, vocalization, and use of parent. The patient is rated on these conditions, with 23.33 being a minimal score and 100 being a maximum score. Score calculation is done by dividing the given score by the maximum score in each domain, adding all the given values, dividing by 5, and then multiplying by 100. The higher the score, the higher level of indicated anxiety (Franzoi et al., 2016). According to Jenkins et al. (2014), the Cronbach alpha value is 0.92 in testing its reliability and validity.

The State-Trait Anxiety Inventory for Children (STAIC) was used for two different studies. This scale is one of the many versions of the original State-Trait Anxiety Inventory, used to measure state anxiety in adults (American Psychological Association, 2011). For each STAIC item, there are three response options, with each option equating to a different numeric score. The sum of all 20 items reflect the participant's score, with a higher score indicating a higher level of state anxiety. The participants self-rated when using this scale. This scale's Cronbach alpha value is 0.66 (Çelikol et al., 2019). In Addition, according to Schisler (1998), the STAIC scale should be used for elementary-aged children and the STAI-Y form should be used for high school-aged adolescents and adults (Schisler, 1998, pg. 81).

Music Listening during NICU Infant Care

Caparros-Gonzalez et al. (2018) aimed to understand if applying a relaxing music listening intervention composed by artificial intelligence could have an effect on respiratory rate, systolic and diastolic blood pressure, and heart rate. Seventeen premature infants (between the ages of 32-36 weeks of gestation) who had passed hearing exams were randomly split into the control or intervention group.

The intervention group experienced music listening for 20 minutes/day, 3 times/day, for 3 consecutive days. The control group used the same protocol, but with a "20-minute track of silence," which was defined as absence of sound and noise. Parameters measured for this study include heart rate, respiratory rate, oxygen saturation, and blood pressure, which were recorded during a ten minute pre-session baseline period, and two minutes post-intervention.

Relaxing music was played via a Melomics computer system. Tempo ranged from 52-54 bpm, instruments included winds and strings, and the music was predicable with consonance, played at a volume of under 50 decibels. Music sessions occurred between 0900-1000, 1400-

1500, and 2100-2200 to avoid interference with NICU care. The first session was not included in analysis because it was considered an adaption session.

Baseline information was obtained 10 minutes prior to the intervention. Music was played through a speaker within an incubator for 20 minutes, and then posttest measurements were taken two minutes following the intervention. The speakers were removed and the incubator was cleaned following the procedure. During the procedure, a NICU nurse observed the participant for signs of distress. The study would have been discontinued had there been any signs of distress in the infant, such as startles, tremor, irregular respiration, flushing of skin, flayed fingers or hand in stop position, gagging, spitting up, grunting, or hiccupping. The infants did not display any of these behaviors during the study, and were fully alert and awake during the intervention

Decreased respiratory rates ($p = <.001$) and heart rates ($p = .045$) in the intervention group were statistically significant in this study. It was expressed that the changes in heart rate and respiratory rates could be due to a "potential protective effect of music against NICU noise, as well as a summative effect on heart rate variability" (Caparros-Gonzalez et al., 2018, p.64). These outcomes suggest that listening to relaxing music has a positive effect on the physiological parameters in premature infants. There were no observed negative effects. This study suggests that more research is needed but recommends that NICU nurses can utilize this in practice with healthy premature infants because it is a simple and feasible intervention to use. (Caparros-Gonzalez et al., 2018).

Music Listening during Pediatric Trauma and Emergency Care

The van der Heijden et al. (2019) study examined the usefulness of music listening or watching cartoons in lowering patient distress during hospitalization. This three-armed study of

children ages 3-13 took place on the surgical trauma unit and medical emergency room (ER). The arms of the study included a control group, a music listening group, and a cartoon watching group. The children included in this study were receiving a venipuncture, an IV, were being injected with local anesthetics, receiving a wound dressing, suturing of open wounds, or were having a temporary split or plaster cast applied.

Pre-recorded relaxing music was played for participants in the music group as they were receiving treatment. Music therapists composed original songs for the participants. The music was played via ambient speakers from an iPod. In the cartoon intervention group, the patients watched Disney cartoons via a laptop connected to speakers during treatment. The control group did not receive either of these interventions during treatment.

Pain and distress were measured using the Alder Hey Triage Pain (AHTP) scale for patients under four years old, the Faces Pain Scale (FPS) for patients four and older, and the Observational Scale of Behavioral Distress-revised (OSBD-r) tool. Using the AHTP scale, the assessors were instructed to score these patients once, as well as distinguish the most distressed displayed behavior of the patient. Heart rate was also measured as a physiologic response to distress and pain.

The Alder Hey Triage Pain was used to measure pain levels in the ER. The AHTP scale examines five behavioral responses to pain. These include crying, facial expressions, posture, movement, and pallor. These domains are scored from zero to two, with a total score minimum score of zero indicating less pain, and a maximum score of 10 indicating more pain. Distress was measured via the Observational Scale of Behavioral Distress-revised (OSBD-r) tool. This scale includes eight behavioral responses to distress. These include information seeking, crying, screaming, use of restraints, verbal resistance, seeking emotional support, verbal pain, and flail.

A total score of 0 suggests ‘no distress behavior’ and a maximum score of 23.5 can indicate much distress. These scores were determined from the video feed 2 minutes before the procedure, during the whole procedure, and two minutes after the procedure ended. In addition, heart rate was measured via a transcutaneous oximeter. It was also noted whether or not the caregiver was present, whether the patient was restrained, (35% of patients) or if there were any adverse effects experienced from the study. The OSBD-r and AHTP scales were assessed later from the video footage. Van der Heijden et al. (2019) explained that while the OSBD-r and AHTP scales are useful in determining pain and distress, they are not as reliable indicators of these parameters in children under the age of seven.

The van der Heijden et al. (2019) study argued that music intervention participants experienced less pain during their procedures, as measured by the AHTP scale. HR measurements did not vary much between the three groups ($p = .830$) Van der Heijden notes that a significant number of children did not express signs of pain or distress before the procedures. The OSBD-r scale was not statistically significant across the three study groups ($p = .550$). The AHTP scale was the only scale that was able to determine any significant difference in pain levels ($p = .003$), whereas the OSBD-r and FPS scales were unable to provide statistically significant information ($p = .077$). This could be due to the frequency in which the scores are calculated with the OSBD-r scale (every 15 seconds), which may not show as much of a difference compared to the AHTP scale, which was calculated only three times during the study. In addition, it is not known how reliable younger children are with self-reporting scales. It was concluded that there is potential for both the music listening and cartoon-watching interventions to work. There is emphasis to investigate if self-selected music or parent-selected music would

be more beneficial. Ultimately, this study suggests that this intervention is cost-effective, noninvasive, and able to be applied by nurses (van der Heijden, et al., 2019).

Music Listening during Blood Draws in Pediatric Acute Care

The Çelikol et al. (2019) study aimed to understand the effects of watching videos and listening to music on anxiety reduction in children during blood draws. The population consisted of 200 inpatient children who needed a blood draw. Participants were between the ages of 8-12 years old.

In this study's control group, the participants did not receive any extra interventions. In the intervention groups, the participants could request listening to music or watching a 3D video. Music and video group participants each had three selections of their media to choose from. They were instructed to make a single selection. The video participants were given 3D glasses to watch their video, and music participants were given headphones to listen with. In both intervention groups, the patients watched/listened to their media for 5 minutes prior to the blood draw and during the blood draw. The participants were video recorded and no pharmacological agents were used to reduce pain or anxiety.

Scales utilized include the STAIC scale and the Fear of Medical Procedures Scale (FMPS). The FMPS scale is measured with 29 questions. With a minimum score of 29 and maximum score of 87. Participants scoring under 30 are identified as having little fear, those who score 29-58 are identified as having some fear, and those who score 58-87 are identified as having too much fear. Çelikol et al. (2019) determined that these scales were reliable with a Cronbach alpha value of 0.66 for the STAIC scale and 0.92 for the FMPS. Data for these scales was collected before the introduction of the intervention and following the conclusion of the intervention.

During the procedure, it was noted that 25% of the participants cried from the control group, while only 16% cried in the music group and 8% in the video group. Crying is significant because it can signify distress and pain in children. Both the intervention groups showed a reduction in STAIC scores post-intervention. This reduction in scores was statistically significant ($p < .001$) in comparison to the control group, post-blood draw ($p = .536$). However, the scores between music listening and video watching did not have statistically significant differences. Similarly, post-intervention FMPS video and music groups ($p <.001$) were statistically significant. The control group also showed statistically significant reduction in the FMPS data, post-blood draw ($p = .014$). While this study was able to determine that these interventions were useful in reducing patient anxiety, it was unable to determine which method was more effective. This could be due to the child's sociocultural context and pain experience or even type of procedure performed (Çelikol et al. 2019).

Music Listening during Perioperative Care with Infants

The purpose of the Kuhlmann et al. (2020) study was to understand how music listening could affect levels of distress, anxiety, and postoperative pain in infants undergoing surgery. Participants were infants 0-3 years old admitted for inguinal hernia repair, undescended testis surgery, or hypospadias correction. This was a three-armed study. One intervention group listened to music preoperatively only, and the other listened to music preoperative and intraoperatively, along with a control group which did not receive any music interventions.

The COMFORT-Behavior scale and modified Yale Preoperative Anxiety Scale-Short Form, and Numeric Rating Scale for pain were utilized to measure pain, anxiety, and distress behaviors in the participants. In addition, incidents of emesis and use of anesthetics and analgesics was counted to further evaluate distress levels. Trained researchers evaluated the

participants. The Parental Postoperative Pain Measure-Short Form was used to measure pain levels 24 hours postoperatively. Saliva samples were gathered before, during, and after the procedures to measure cortisol levels, however, researchers stopped collecting saliva after 30 samples because data was not sufficient. Heart rate, blood pressure, and MAP were all measured as well.

There were six different data collection points. These points were at the preoperative ward (T1), the holding area before surgery (T2), during surgery (T3), 30 minutes after PACU admission (T4), 4 hours postoperative in PACU (T5), and 24 hours postoperative in PACU (T6). At T1, COMFORT-Behavior, physiological variables, baseline values were measured. T2 measured COMFORT-Behavior, physiological variables, and the modified Yale Preoperative Anxiety Scale-Short Form. T3 measured physiological variables and the modified Yale Preoperative Anxiety Scale-Short Form. At T4, T5, and T6, COMFORT-Behavior scores were measured along with, physiological variables. During the surgery, SBP, DBP, HR, and MAP were measured every 5 minutes. Measurements were taken by trained researchers.

Preoperative participants listened to music until they arrived at the operating room. Pre- and intraoperative participants listened to music throughout the procedure, and up to the moments before awaking from anesthesia. After induction of anesthesia, participants in the intervention groups were given headphones to listen to the music.

COMFORT scores were reduced from the baseline in both intervention groups as compared to the control group. However, there was no significant difference in these scores from all the groups 4 hours postoperatively ($p = .219$). Evidence indicates that heart rate was reduced preoperatively during the intervention ($p = .003$), but insignificant overall between the three study groups, across all time points ($p = .690$). However, changes in SBP ($p = .270$), DBP ($p =$

.264), and MAP (p = .452) were insignificant across all time points and study groups. Music listening did not lower distress in all participants, but this study suggests that the higher the baseline anxiety level in a participant, the more beneficial music listening may be, evidenced by heart rate reductions in participants preoperatively. Kuhlmann et al. (2020) discussed that music listening could be more beneficial to older children and adults as opposed to infants because it infants may become overstimulated by music, and that this should be investigated further.

Music Listening during Perioperative Care with Preschool and School-Aged Children

The aim of the study by Franzoi et al. (2016) was to understand how music listening for 15 minutes preoperatively could affect anxiety levels of the participants from 3-12 years old undergoing surgery. The data, including heart rate, respiratory rate, blood pressure, and oxygen saturation were collected upon entrance to the waiting room, and fifteen minutes later. The Yale Preoperative Anxiety Scale (m-YPAS) was utilized to measure the behavior effects of anxiety. Participants were separated into two categories, preschool-aged and school-aged children, because these age groups present different physiological variables.

The intervention group listened to music for 15 minutes in the waiting room while the control group did not. The children in the control group did not listen to music during the intervention period, but were offered music after their measurements were taken, which was listened to via headphones. The music provided to all participants was classified as instrumental, non-lyrical and slow (a tempo of 60-80 beats per minute). The pieces were performed with string instruments, minimal percussion, using lower tones, and sound output at a level of 60 dB.

The Yale Preoperative Anxiety Scale (m-YPAS) showed a reduction of 31% in the intervention group, after the participants listened to music. This reduction was determined to be statistically significant (p = .0132). Domains such as activity (p <.0001), vocalization (p =

.0055), emotional expression (p = .005), and apparent awakening state (p <.0001) showed the most changes in the experimental group, post-intervention. Respiration rate also significantly decreased in preschool-aged children (p = .0453). This study expressed that musical preferences should be considered because they are different between the two age groups. Studying a narrower age range was also suggested, due to different physiological baselines and differences in cultural context for music. Franzoi et al. (2016) suggested that music listening could be used as a potential non-pharmacological nursing intervention to lower distress in children. However, it still needs to be studied.

Music Listening during Perioperative Care with School-Aged Children and Adolescents

The Karakul and Bolisik (2018) study aimed to understand how music listening could affect anxiety state and vital signs of older pediatric patients. The participants were pediatric patients between 9-17 years old, who were receiving surgery from an ambulatory pediatric surgery clinic. Music listening interventions were applied postoperatively to participants in the intervention group.

The State-Trait Anxiety Inventory (STAI) for Children was used to measure behavioral outcomes. Pre and postoperative pulse, respirations, blood pressure, oxygen saturation, and temperature were measured. The STAI was filled out by a researcher and vital signs were measures fifteen minutes before entering surgery. After measurement of baseline data preoperatively, both groups of patients underwent surgery. Vital signs were measured again after awakening from the procedure. In the intervention group, data from the STAI form was collected 20 minutes post-intervention, when the participants were fully awake. In the control group, the STAI data was collected twenty minutes after the physician noted the patient was waking up.

Postoperatively, the intervention group listened to music with headphones and a music player for 20 minutes. The music selected included “The Art of The Fugue” by Bach, Contrapunctus Episode 3. This selection was chosen for being slow and smooth. The control group did not listen to any music, however, their data was recorded at the same time points as the intervention group.

Following the intervention, a decrease in vital signs, most significantly the blood pressure ($p < .001$), pulse ($p < .001$), and respiratory rates ($p = .001$) in the intervention group were found to be statistically significant in comparison to the control group. Body temperature and oxygen saturation values were not significantly different ($p > .05$). The postoperative STAI scale average scores were decreased in the intervention group (35.01) compared to the control group (41.23). Karakul and Bolisik (2018) explain that intervention group anxiety score was lower than the control group anxiety score. This study supports the use of music listening in the pediatric population postoperatively. It also supports the feasibility as a nursing intervention during the post-operative recovery period (Karakul and Bolisik, 2018).

Discussion

Across these studies, both physiologic and scale-based data were used to make the determination if music listening was effective in lowering neonatal and pediatric distress levels. Overall, there was a positive effect between lowering physiologic parameters and scale scores. However, the parameters did vary in statistical significance.

Trends in Physiologic Parameters and Scale Responses

Physiologic parameters that were examined include heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, respiration rate, oxygen saturation, and body temperature. Activation of the sympathetic nervous system in response to stress will increase heart rate, blood pressure, and respirations, while activation of the parasympathetic nervous system to return the body back to its normal. Using vital signs as a measure of distress reductions is significant because vital signs represent the body's biologic response to stress. Music has the ability to stimulate the parasympathetic nervous system (Lee et al., 2016). A decrease in stress will commonly lead to a decrease in vital signs as the body returns to its normal rates.

Music listening has the ability to reduce heart and respiratory rates. The studies done by Caparros-Gonzales et al. (2018), Kuhlmann et al. (2020), and Karakul and Bolisik (2018) indicated that heart rate reductions were statistically significant. Van der Heijden et al. (2019) did observe heart rate reductions, but did not find them statistically significant between the pre and post intervention groups. Franzoi et al. (2016) and Karakul and Bolisik (2018) both found a decrease in respirations that were statistically significant. Finally, music listening can lower blood pressure. Karakul and Bolisik (2018) indicated that blood pressure reductions were statistically significant. In addition, Kuhlmann et al. (2020) noted decreases in systolic blood

pressure (SBP), diastolic blood pressure (DBP), and mean arterial pressure (MAP), though they were considered statistically insignificant.

Music listening can reduce pain, distress, fear, and anxiety in the acute care setting indicated by statistically significant post-intervention score reductions. The AHTP scale scores were reduced, indicating post-intervention pain reductions (van der Heijden et al., 2019). The FMPS and STAI-C scale scores both decreased in the Çelikol et al. (2019) study. Kuhlmann et al. (2020) observed an initial decrease in COMFORT scores post-operatively. The Franzoi et al. (2016) study found that 31% of participants had a decrease in m-YPAS scores, post-intervention. Finally, the Karakul and Bolisik (2018) study found a 16.7% reduction in STAI scores, post-intervention and post-operatively.

Low Risk for Adverse Effects

Music listening can be used as a complement to treatment. None of the studies identified any significant adverse physiological effects to music, however, it was noted in the Kuhlmann et al. (2020) study that infants may become psychologically overstimulated in response to music. Because music is not a pharmacological intervention, there is no risk for toxicity or overdosing.

Limitations

Varying Perceptions of Music

It is difficult to understand how children perceive music at different developmental levels, and there is a possibility that some children may perceive certain types of music differently than their peers. The mechanisms in which music can lower distress levels is not fully understood (Caparros-Gonzalez et al., 2018). These considerations were not discussed in the studies.

Because listening music is both an emotional and psychological experience, children may have varying levels of understanding with music. Newborns have a much more limited understanding of emotions than older children, and therefore, may respond differently (Kuhlmann et al. 2020). Additionally, it is possible that a child may have negative associations with the music which could negate any positive effects. Musical preferences of children who were old enough to express choices were not taken into consideration during the studies, which could have an impact on their responses (Kuhlmann et al. 2020) and musical preference might change as children age (Franzoi et al., 2016). Finally, not all studies identified the specific type of music or exact piece they played for their participants, so it is impossible to know if all studies used the same type of music.

Varying Responses to Distress

Children perceive and react to distress differently. Cultural norms and family dynamics can have an influence on how children respond to pain (Çelikol et al., 2019). A child or infant's response to pain or anxiety may not look identical to that of their peers, especially at the different developmental stages. This can make it difficult to record observable behavioral changes with psychologic scales after implementation of music listening. Kuhlmann et al. (2020) concludes

that music listening is not always effective, but that it was more beneficial for children who were more distressed at baseline than children who did not experience higher levels of baseline distress.

Parental Presence

Parents can play a role in reducing distress levels in their children. The decision across all studies to include parents during the application of music listening was not the same. Some studies included parents during the intervention period, while others did not. Parental presence could have contributed to distress reductions in participants along with music listening, and lack of parental presence could have contributed to higher baseline distress in some children.

Nursing Implications

Nurses could provide a music-listening device and headphones to children, or speakers in a newborn bassinet as part of daily nursing care. Seattle Children's Hospital (n.d.) is providing devices such as iPads to pediatric patients during their stay, with the intention of promoting stress reductions in these patients. Recommendations to provide music listening tools for patients as a part of regular nursing care have been identified Caparros-Gonzales et al., 2018; van der Heijden et al., 2019; Franzoi et al., 2016; Karakul and Bolisik, 2018; Çelikol et al., 2019. If hospitals are unable to provide devices in rooms for music listening, patients and their families can use alternative sources. Playing music from a device requires little training and little preparation for a nurse, and can be feasibly incorporated into bedside patient care.

Recommendations

Passive music listening should be used for children and infants who are receptive to it. Musical preferences of children should be taken into consideration, because not every child has the same context behind a single piece of music. Future studies to determine how different genres of music impact a child or infant physiologically and psychologically are recommended. Future studies should also be used to determine the effect of parental presence on calming neonatal and pediatric patients with music. Additionally, music listening should not be the only intervention to reduce distress levels in patients with highly acute circumstances and should be complementary to drug therapy or other therapies. Nurses should be trained to recognize cases where playing music will overstimulate, or negatively impact the patient.

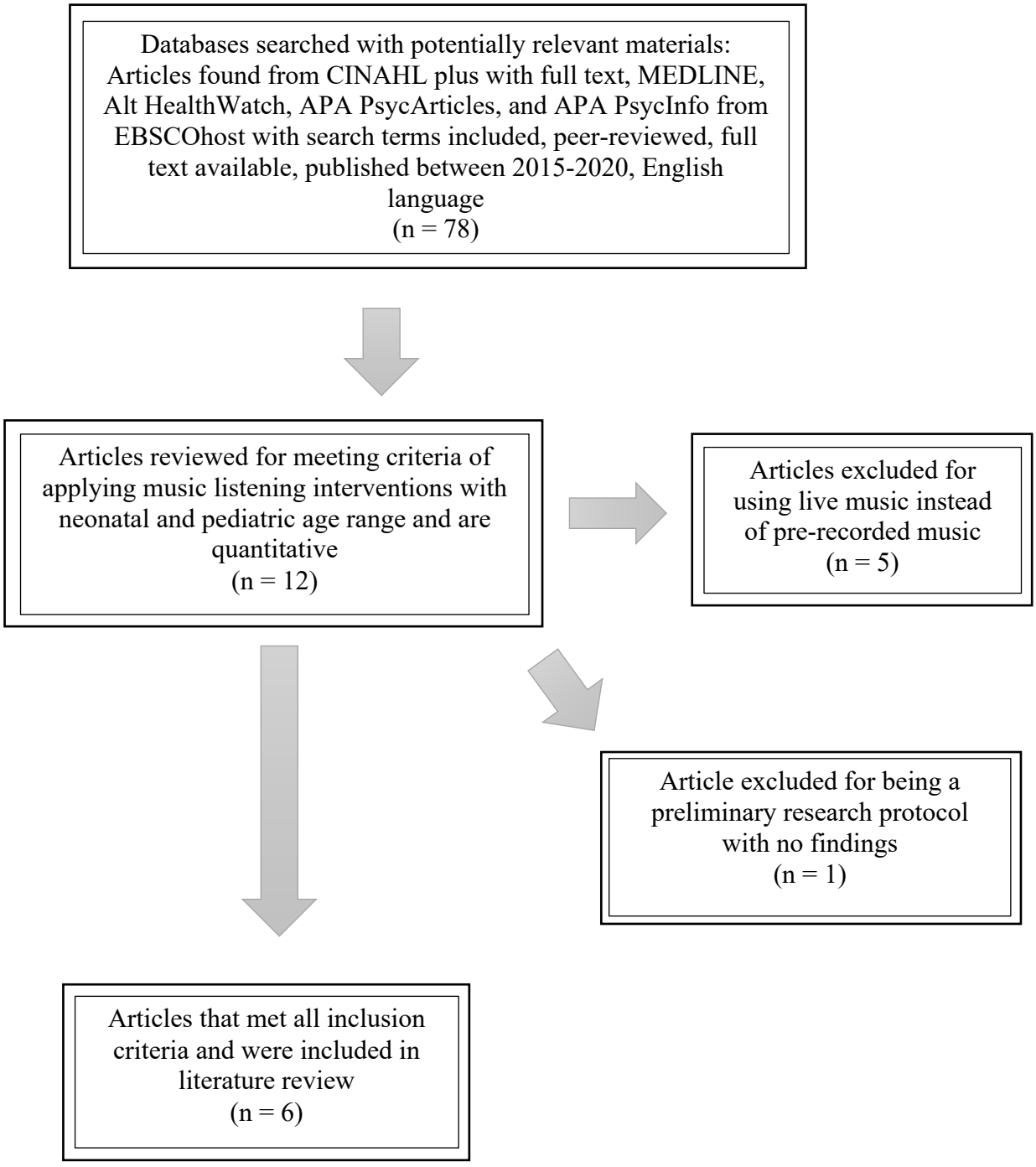
Conclusion

Music is known as the universal language and understanding its therapeutic benefits may be helpful in managing distress in pediatric and neonatal patients. Passive music listening with infants and children is supported by research to lower distress levels in neonatal and pediatric patients by lowering heart rates, respiratory rates, blood pressures, pain and anxiety scale scores. More research is recommended. Passive music listening interventions initiated by nurses have the potential to be psychologically and physically beneficial to this unique population and possibly limit the distress experienced by babies and children.

Appendix A: Selection Method of Literature

Figure 1: Selection Method of Literature

Search Terms: music* or music listening or music therap* and intervention*, or preop*, or preprocedur*, or surg*, or intensive care unit, or ICU, or PICU, or NICU, or critical care, and neonat*, or bab*, or infant*, or ped*, or adolesc*, or child*, and anxiet*, or worr*, or fear*, or sedat* or pain* or distress* or stress*



Appendix B: Table of Evidence

Figure 1: Table of Evidence

Title	In-Text Citation	Exclusion Criteria	Assessed by	Consent	Scales used	Phyiologic Parameters Investigated	Results
Listening to Relaxing Music Improves Physiological Responses in Premature Infants: A Randomized Controlled Trial	Caparros-Gonzalez et al., 2018	Premature infants were excluded if they were being treated with sedative, analgesia medications, caffeine, or steroids; if they were supported by ventilation, continuous positive airway pressure, or nasal cannula; if they had any auditory impairment, malformation, or disease; if they were exposed to any potentially central nervous system depressor prenatally; or if they were diagnosed with a heart, lung, or congenital disease. ALSO: 5 participants were discharged from the incubator before finishing the intervention.	n/a	Caregiver consent	no use of scales, just physiologic parameters	heart rate, respiratory rate, oxygen saturation, and blood pressure	Decreased respiratory rates (p = <.001) and heart rates (p = .045)
Children Listening to Music or Watching Cartoons During ER Procedures: A RCT.	van der Heijden et al., 2019	hearing impairment, developmental disability, or no responsiveness to stimuli from the environment due to altered level of consciousness	Research assistant	Parental consent and assent of child 7yr and >	Alder Hey Triage Pain Score (AHTPS), Faces Pain Scale-Revised (FPS-R), Observational Scale of Behavioral Distress-revised (OSBD-r),	HR	HR measurements did not vary much between the three groups (p = .830). The OSBD-r scale was not statistically significant across the three study groups (p = .550). AHTP scale was the only scale that was able to determine any significant difference in pain levels (p = .003). OSBD-r and FPS scales unable to provide statistically significant information (p = .077)
Music Interventions in Pediatric Surgery (The Music Under Surgery In Children Study): A Randomized Clinical Trial	Kuhlmann et al., 2020	Hearing impairment, emergency surgery, premedication with midazolam, impaired communication with parents, or missing informed consent	Research assistant	Caregiver consent	The COMFORT-Behavior scale and modified Yale Preoperative Anxiety Scale-Short Form, and Numeric Rating Scale, Parental Postoperative Pain Measure-Short Form was used to measure pain levels 24 hours postoperatively	SBP, DBP, MAP, HR, incidence of emesis	COMFORT scores reduced from the baseline in both intervention groups compared to the control group. Insignificant difference in these scores from all the groups 4 hours postoperatively (p = .219). Heart rate was reduced preoperatively during the intervention (p = .003), but insignificant between three study groups and across all time points (p = .690). Changes in SBP (p = .270), DBP (p = .264), and MAP (p = .452) were insignificant across all time points and study groups.
Music listening for anxiety relief in children in the preoperative period: a randomized clinical trial.	Franzoi et al., 2016	Children undergoing emergency surgery; who received pre-anesthetic medications before or during music listening; and/or those with hearing or cognitive problems reported by the parents/guardians of the child	The research team	Caregiver consent and school-aged children consent	Yale Preoperative Anxiety Scale (m-YPAS)	RR	m-YPAS reduction statistically significant (p = .0132). Activity (p <.0001), vocalization (p = .0055), emotional expression (p = .005), and apparent awakening state (p <.0001) had greatest changes in the experimental group, post-intervention. Respiration rate significantly decreased in preschool-aged children (p = .0453)
The Effect of Music Listened to During the Recovery Period After Day Surgery on the Anxiety State and Vital Signs of Children and Adolescents	Karakul and Bolisik, 2018	INCLUSION criteria: 1) those who understood the purpose of the study and who voluntarily agreed to participate; 2) between the ages of 9-17, 3) no mental retardation in the child, 4) patient's daily surgical intervention, 5) the patient is operated on with general anesthesia.	Research assistant	A consent form was filled out by all participants.	State-Trait Anxiety Inventory (STAI) for Children	HR, RR, BP, SpO2, Temperature	Post intervention decrease in vital signs: blood pressure (p < .001), pulse (p < .001), and respiratory rates (p = .001) in the intervention group were statistically significant in compared to control group. Body temperature and oxygen saturation values not significantly different (p > .05). The postoperative STAI scale average scores decreased in intervention group (35.01) compared to the control group (41.23).
Children's Pain, Fear, and Anxiety During Invasive Procedures.	Çelikol et al., 2019	INCLUSION critera: between 8 and 12 years of age, literate, no mental problems, able to communicate easily, and willing to participate in the study	N/a	Oral and written consent	The State-Trait Anxiety Inventory for Children State Form, Fear of Medical Procedures Scale (FMPS)	n/a	STAIC score reduction was statistically significant (p < .001) compared to post-blood draw (p = .536). Differing scores between music listening and video watching not statistically significant. Post-intervention FMPS video and music groups (p <.001) statistically significant. The control group statistically significant reduction in the FMPS data, post-blood draw (p = .014).

References

American Music Therapy Association. (2017). *Definition and quotes about music therapy*. Retrieved from https://www.musictherapy.org/about/quotes/

American Music Therapy Association. (2017). *Therapeutic music services at-a-glance.* Retrieved from https://www.musictherapy.org/assets/1/7/TxMusicServicesAtAGlance_17.pdf.pdf

American Psychiatric Association. (n.d.) *What are anxiety disorders?* Retrieved from https://www.psychiatry.org/patients-families/anxiety-disorders/what-are-anxiety-disorders

American Psychological Association. (2011). *The State-Trait Anxiety Inventory (STAI).* Retrieved from https://www.apa.org/pi/about/publications/caregivers/practice-settings/assessment/tools/trait-state

Boom M, Niesters M, Sarton E, Aarts L, Smith TW, Dahan A. (2012). Non-analgesic effects of opioids: Opioid-induced respiratory depression. *Curr Pharm Des*, *18*(37), 5994-6004. https://doi.org/10.2174/138161212803582469

Boyer, E. W. (2012). Management of opioid analgesic overdose. *The New England Journal of Medicine*, *367*(2), 146–155. https://doi.org/10.1056/NEJMra1202561

Çelikol, Ş., Büyük, E. T., & Yıldızlar, O. (2019). Children's pain, fear, and anxiety during invasive procedures. *Nursing Science Quarterly*, *32*(3), 226–232. https://doi.org/10.1177/0894318419845391

Caparros-Gonzalez, R. A., de la Torre-Luque, A., Diaz-Piedra, C., Vico, F. J., & Buela-Casal, G. (2018). Listening to relaxing music improves physiological responses in premature infants: A randomized controlled trial. *Advances in Neonatal Care*

(Lippincott Williams & Wilkins), *18*(1), 58–69. https://doi.org/10.1097/ANC.0000000000000448

Franzoi, M. A. H., Goulart, C. B., Lara, E. O., & Martins, G. (2016). Music listening for anxiety relief in children in the preoperative period: A randomized clinical trial. *Revista Latino-Americana De Enfermagem*, 24, (2841). https://doi.org/10.1590/1518-8345.1121.2841

Hardin, A. P., & Hackell, J. M. (2017). Age limit of pediatrics. *Pediatrics*, *140*(3). https://doi.org/10.1542/peds.2017-2151

Hayhurst, C.J., Durieux, M. E., Differential opioid tolerance and opioid-induced hyperalgesia: A clinical reality. *Anesthesiology*. *124*(2), 483-488. https://doi.org/10.1097/ALN.0000000000000963

Hirshon, M. J., Risko, N., Calvello, J. E., Stewart de Ramirez, S., Narayan M., Theodosis, C., O'Neill, J., (2013). Health system services: The role of acute care. *Bulletin of the World Health Organization. 91*(5), 313-388. http://dx.doi.org/10.2471/BLT.12.112664

Jenkins, B. Fortier, M., Kaplan, S., Mayes, L., Kain, Z., (2014). Development of a short version of the modified yale preoperative anxiety scale. *Anesthesia & Analgesia.* 119(3), 643-650. https://doi.org/10.1213/ANE.0000000000000350

Karakul, A., & Bolisik, Z. B. (2018). The effect of music listened to during the recovery period after day surgery on the anxiety state and vital signs of children and adolescents. *The Journal of Pediatric Research*, 5(2), 82. https://doi.org/10.4274/ipr.24892

Karcioglu, O., Pitetti, R., Lewis, L. M., Thomas, Stephen H. (2013). Management of pain in the emergency department. *ISRN Emergency Medicine. 2013*(1), 1-19. https://doi.org/10.1155/2013/583132

Kahsay, H. (2017). Assessment and treatment of pain in pediatric patients. *Current Pediatric Research*. 21. 148-157. Retrieved from https://www.alliedacademies.org/current-pediatrics/

Kuhlmann, A. Y. R., van Rosmalen, J., Staals, L. M., Keyzer-Dekker, C. M. G., Dogger, J., de Leeuw, T. G., van der Toorn, F., Jeekel, J., Wijnen, R. M. H., & van Dijk, M. (2020). Music interventions in pediatric surgery (The music under surgery in children study): A randomized controlled trial. *Anesthesia & Analgesia, 130*(4), 991-1001. https://doi.org/10.1213/ANE.0000000000003983

Lane, D., Palmer, J.B., & Chen, Y. (2018). A survey of surgeon, nurse, patient, and family perceptions of music and music therapy in surgical contexts. *Music Therapy Perspectives, 37*(1), 28-36. https://doi.org/10.1093/mtp/miy008

Lee, K. S., Jeong, H. C., Yim, J. E., & Jeon, M. Y. (2016). *The Journal of Alternative and Complementary Medicine*, *22*(1). https://doi.org/https://doi.org/10.1089/acm.2015.0079

Lerwick, J. L. (2016). Minimizing pediatric healthcare-induced anxiety and trauma. *World Journal of Clinical Pediatrics*, *5*(2), 143–150. https://doi.org/10.5409/wjcp.v5.i2.143

Matson, K. L., Johnson, P. N., Tran, V., Horton, E. R., Sterner-Allison, J., (2019). Opioid use in children. *The Journal of Pediatric Pharmacology and Therapeutics. 24*(1), 72–75. https://doi.org/10.5863/1551-6776-24.1.72

Mayo Clinic, (n.d.). *Morphine (oral route).* Retrieved from https://www.mayoclinic.org/drugs-supplements/morphine-oral-route/side-effects/drg-20074216

Muhammad, S. (2017). *What is pain/types of pain treated?* Retrieved from https://www.hopkinsmedicine.org/pain/blaustein_pain_center/patient_care/what_is_pain.html

Millett, C. R., & Gooding, L. F. (2017). Comparing active and passive distraction-based music therapy interventions on preoperative anxiety in pediatric patients and their caregivers. *Journal of Music Therapy, 54*(4), 460-478. https://doi.org/10.1093/jmt/thx014

National Center for Biotechnology Information. (n.d.). *Fentanyl.* Retrieved from https://pubchem.ncbi.nlm.nih.gov/compound/3345

National Center for Biotechnology Information. (n.d.). *Morphine*. Retrieved from https://pubchem.ncbi.nlm.nih.gov/compound/Morphine

National Institute of Drug Abuse. (2020). *Fentanyl Drug Facts*. Retrieved from https://www.drugabuse.gov/publications/drugfacts/fentanyl

Prakash, R. (n.d). *Passive and active music therapy.* Retrieved from https://sites.duke.edu/voicestogether/who-we-are/

Price, B. (2017). Managing patients' anxiety about planned medical interventions. *Nursing Standard*, *31*(47), 53–63. https://doi.org/10.7748/ns.2017.e10544

Seattle Children's Hospital. (n.d.). *iPads for kids program gives patients a dose of distraction during hospital stays.* Retrieved from https://www.seattlechildrens.org/information-technology/articles/ipads-for-kids/

Smith, G. C., Gutovich, J., Smyser, C., Pineda, R., Newnham, C., Tjoeng, T. H., … Inder, T. (2011). Neonatal intensive care unit stress is associated with brain development in preterm infants. *Annals of Neurology*, *70*(4), 541–549. https://doi.org/10.1002/ana.22545

Uggla, L., Bonde, L., Svahn, B., Remberger, M., Wrangsjö, B., & Gustafsson, B. (2016). Music therapy can lower the heart rates of severely sick children. *Acta Paediatrica*, *105*(10), 1225–1230. https://doi.org/10.1111/apa.13452

World Health Organization. (n.d.). *Infant, newborn.* Retrieved from https://www.who.int/infant-newborn/en/

Van der Heijden, M., Mevius, H., van der Heijden, N., van Rosmalen, J., van As, S., & van Dijk, M. (2019). Children listening to music or watching cartoons during ER procedures: A RCT. *Journal of Pediatric Psychology, 44*(10), 1151-1162. https://doi.org/10.1093/jpepsy/jsz066

Varni, J.W., Limbers, C.A. & Burwinkle, T.M. (2007) How young can children reliably and validly self-report their health-related quality of life?: An analysis of 8,591 children across age subgroups with the PedsQL™ 4.0 Generic Core Scales. *Health Qual Life Outcomes* 5(1). https://doi.org/10.1186/1477-7525-5-1