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# Music Therapy as an Intervention to Reduce Anxiety in Mechanically-Ventilated Patients

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# MUSIC THERAPY AS AN INTERVENTION TO REDUCE ANXIETY IN MECHANICALLY-VENTILATED PATIENTS

by

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# ABSTRACT

Patients receiving mechanical ventilation endure high levels of stress and anxiety due to the invasiveness of the procedure. These critically ill patients are often uncomfortable as a result of their serious conditions and the high-intensity environments in which they are placed. Health care workers heavily sedate these patients to minimize pain and induce a state of relaxation. However, sedatives are known for their wide-ranging, and often deleterious, side effects. Music therapy is an intervention that has been studied in a variety of hospital settings to determine any potential beneficial effects on patients. Many studies have demonstrated a relationship between music therapy and decreased anxiety levels. This thesis reviewed studies on outcomes of music therapy on anxiety in mechanically-ventilated patients. A total of 10 studies that addressed the use of music to decrease anxiety in ventilated patients were analyzed and incorporated into the literature review. The articles were selected from a variety of databases on EBSCOhost, including MEDLINE, PsycINFO, ScienceDirect, and CINAHL. The literature review provides positive evidence for the support of music therapy to help alleviate anxiety in mechanically-ventilated patients.

# DEDICATIONS

I would like to thank my family for supporting me, my friends for entertaining me, and my teachers for educating me.

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You are the best!

# TABLE OF CONTENTS

# TABLE OF FIGURES

# INTRODUCTION

The intensive care unit (ICU) is a place where acutely ill patients are managed by a team of experts to receive life-sustaining therapy; consequently, the environment may create high levels of anxiety and stress for the patient. Contributors that may exacerbate patient anxiety levels include frequent repositioning and assessments, inadequate medication, bright lighting, constant alarms and noises, and minimal or no patient communication (Rahu, 2013). Mechanical ventilation is a common intervention in the ICU to support respiratory function in patients, and because of its invasive nature, patients are more likely to experience increased anxiety levels (Lee, Chung, Chan, & Chan, 2005). Patients require a breathing tube, usually an endotracheal tube, to deliver the mechanical ventilation. The procedure hinders a patient's ability to verbally communicate with others, which often causes one to feel stressed or apprehensive. Patients typically receive mechanical ventilation for respiratory compromise, usually resulting from an underlying condition, an illness, or trauma (Hunter et al., 2010). The length of time that a patient is ventilator-dependent can vary, but an increased duration of mechanical ventilation can lead to a variety of complications. Patients regularly wean off mechanical ventilation by decreasing the amount of pharmacologic sedatives, although anxiety and stress can prolong a patient's ventilator-dependency and, therefore, delay the ability to breathe on his or her own (Hunter et al., 2010).

Patients receiving mechanical ventilation, in addition to the endotracheal tube, are more prone to anxiety because they are likely suffering from more critical illnesses. Anxiety is exhibited in many ways for patients, ranging from internal changes in the body, to outward, physical appearances. When experiencing stress, one's sympathetic nervous system is

stimulated, and deleterious effects often manifest in long-term complications. If anxiety is not relieved, it may result in greater morbidity and mortality rates; furthermore, posttraumatic stress disorder may be demonstrated in these patients once they are discharged from the ICU (Rahu, 2013). A 2015 metasynthesis study looked at interviews of patients who had endured mechanical ventilation in the past (Baumgarten & Poulsen, 2015). The researchers found that patients often felt frustrated and worthless because they were not able to communicate effectively; they also suffered from anxiety and loneliness, predominantly when they were the only ones in the room. Many subjects experienced sleep disruptions due to their surroundings and loud noises, which often led to exhaustion. The subjects valued quiet or relaxing atmospheres, and they appreciated any time their nurses allowed for a calming environment. Additionally, they believed that they had no control over their bodies, which caused them greater anxiety (Baumgarten & Poulsen, 2015).

Despite the benefits that can result from using prescribed pharmacologic measures, there are situations when non-pharmacological methods can be used as helpful adjuncts in a health care environment. Music therapy/intervention has been used in a variety of hospital settings, and studies have demonstrated a positive effect on reducing anxiety and improving comfort in certain patients (Lee et al., 2005). Music interventions can vary from music therapists who come to the room and play songs for the patients, to music played via headphones based on the patient's preferences. Music has been known to evoke a range of emotions and physiologic reactions from the listeners, and there have been a plethora of studies demonstrating the soothing effect of this intervention. Research findings have demonstrated the potential that music therapy has for a variety of different patients. One subgroup of patients, those who suffer from dementia, may

benefit from music therapy by experiencing an improved quality of interactions between them and those who are caring for them (Blackburn & Bradshaw, 2014). Another research study focused on the effects of music therapy in breast cancer patients following a radical mastectomy (Li, Zhou, Yan, Wang, & Zhang, 2012). The experimental group received music therapy in addition to the routine nursing care, while the control group received only regular nursing care. The results demonstrated a significant reduction of anxiety levels for those receiving the music intervention (Li et al., 2012).

Pain and anxiety have a cyclical relationship, where untreated pain often leads to increased anxiety, and untreated anxiety tends to exacerbate pain levels (Rahu, 2013). Music therapy has been demonstrated to decrease perceptions of pain, as seen in a randomized controlled trial that focused on women in labor. The women in the intervention group were able to pick soothing music to listen to during their labor, while the control group was not allowed any music. Pain measurements were collected every hour through the use of the Visual Analogue Scale, and the results showed women who listened to music experienced less distress and pain than those who did not have the opportunity to listen to music (Trout, 2004). A decrease in pain and anxiety is associated with faster recovery times for patients, which is especially important for those in critical care environments. These studies provide support for music as an intervention. Critically ill patients, especially those receiving mechanical ventilation, may benefit from this intervention.

# PURPOSE

The purpose of this study is to review research studies that describe outcomes of music interventions performed on critically ill patients who are receiving mechanical ventilation. Positive findings would support the idea that this intervention is a cost-effective and beneficial way to decrease anxiety of patients, and, ultimately, expedite recovery time in the ICU.

# BACKGROUND

Patients in the ICU commonly experience anxiety because of their critical situation and the high-stress environment. Patients receiving endotracheal intubation with mechanical ventilation are at risk for physical and psychological complications when remaining ventilator-dependent for an extended period of time (Lee et al., 2005). It is important to manage anxiety in these patients because it is associated with increased heart rate, blood pressure, respiratory rate, and airway constriction. These physiologic factors predictably make breathing even more difficult for the patient, which has the potential to cause a prolonged stay on the ventilator (Hunter et al., 2010). Patients experiencing increased respirations will feel breathless, and as their bodies instinctively try to "fight" the ventilator (ventilator dyssynchrony), alveolar damage occurs, contributing to greater anxiety levels (Rahu, 2013). Although pharmacological methods are typically used to help relieve anxiety in these patients, they are known to cause numerous adverse effects. The sedative agents used for these intensive care patients often result in hypotension and respiratory depression, along with increased risks for pressure ulcers, venous stasis, respiratory muscle weakness, and muscle atrophy (Hunter et al., 2010). Excess sedation prolongs the risks associated with mechanical ventilation, including lengthened hospital stays. Therefore, the drugs are expensive both on their own, and when considering the complications that often arise.

Music therapy encompasses an assortment of definitions that attempt to explain the therapeutic relationship between music and the listener. Many descriptions of music therapy relay the importance of listening to music in a controlled setting to influence a patient during illness or injury, and to improve a person's health and well-being (Almerud & Petersson, 2003).

Music therapy has been widely studied in hospitalized patients, as they are vulnerable populations who have the ability to benefit from a relaxing intervention. Evidence has been overwhelmingly in support of music as a comforting tool for patients because of its ability to contribute to a serene atmosphere; subsequently, the patients may have an easier time resting and sleeping, which is important for the recovery process (Almerud & Petersson, 2003). Although music therapy also includes live music being played directly to a patient, it can be effective when it involves patients listening to music through headphones. Headphones are important devices because of their ability to tune out background noises, which are often distracting to patients, particularly those in the ICU. Headphones allow for noise isolation, which has been shown to reduce sleep disruptions; this is an imperative matter for critically ill patients (Beaulieu-Boire et al., 2013).

## PHYSIOLOGIC EFFECTS OF MUSIC

Music is capable of diverting the patient's attention away from anxiety, so it can be a calming interruption from the harsh, constant noises in critical care environments. Patients receiving mechanical ventilation have the potential to benefit from music therapy because they are often easily fatigued, and this intervention does not place heavy demands on the patient. Personal preferences should be considered when selecting the variety of music, although slow rhythm selections—without lyrics—that contain 60 to 80 beats per minute, have shown to be effective in reducing anxiety levels (Han et al., 2010). The relatively slow rhythm of the music has been considered important because of its ability to synchronize with the heart rate and respiratory rate of the listener (Beaulieu-Boire et al., 2013).

Enjoyable, relaxing music has been shown to trigger pleasure and reward centers of the brain during functional magnetic resonance imaging and positron emission tomography tests (Vuilleumier & Trost, 2015). Music that is considered relaxing has been effective in releasing endorphins and enkephalins in listeners, while simultaneously reducing catecholamines that are associated with stress (Beaulieu-Boire et al., 2013). On the contrary, sad music demonstrated activation of parts of the brain (amygdala, hippocampus, etc.) that were often used in negative or anxious states (Beaulieu-Boire et al., 2013). Researchers suggested that different genres of music might elicit nine affective states, such as joy, sadness, nostalgia, peacefulness, power, wonder, tenderness, transcendence, and tension (Vuilleumier & Trost, 2015). The emotions evoked are dependent on the specific type of music played. In one related study, researchers studied the effects of classical music, rock music, self-selected relaxing music, or no music to determine the state of relaxation that they each brought upon the patient. A total of 56 subjects were randomly assigned to their respective groups for short listening periods, and researchers measured the subjects' relaxation levels, muscle tension, heart rates, and skin temperature before and after the intervention. Results showed that classical music, self-selected music, and no music groups demonstrated an increase in relaxation (Burns, Labbé, Williams, & McCall, 1999).

# METHODS

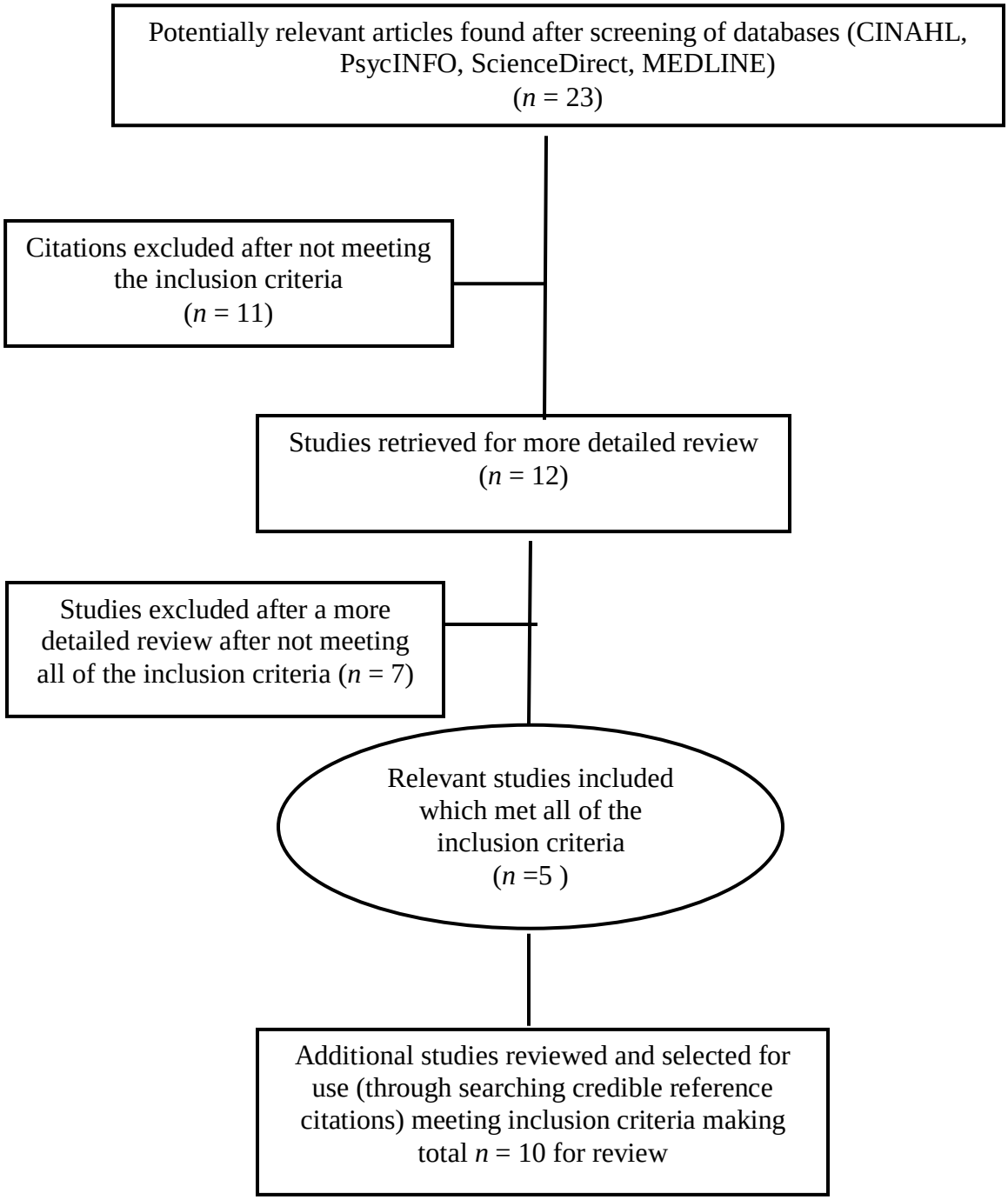
In order to conduct a pertinent and integrative review of literature, studies that focused on music therapy interventions in the ICU were examined. Data were collected from EBSCOhost databases online, including CINAHL, ScienceDirect, PsycINFO, and MEDLINE. The criteria for the searches included quantitative articles written in English and articles that were peer-reviewed. The search terms included the following terms: “music therapy,” “music,” “anxiety,” “stress,” “ICU or critical care,” and “mechanical ventilation.” Articles were excluded from the search if they did not involve mechanical ventilation.

The first search of the key word phrases yielded a total of twenty-three articles. After examining these articles to make sure that they fit the inclusion criteria, eleven of the articles were excluded from the review. Twelve of the remaining articles were further examined, and after a detailed review, seven of them were excluded. Only five articles were found to have properly fit the inclusion criteria; this low finding led to the examination of several citations from the selected articles. After a thorough search, five more studies were found to fit the inclusion criteria, making a total of ten studies for the literature review.

Figure 1: Flow Diagram of Article Selection Process

Key Search Terms = Music Therapy, Music, ICU or Critical Care, Mechanical Ventilation, and Anxiety

Limiters = English language, peer-reviewed



# FINDINGS

Ten studies pertaining to mechanical ventilation and music intervention were analyzed, and although they did not contain the same interventions and music selection, they had many similar components. While music positively impacted the patients in a majority of the studies, the music played during the intervention varied from classical music to preferences of the patient. Also, anxiety was measured in different ways, using physiologic measures and anxiety scales, because anxiety encompasses subjective and objective components.

## ANXIETY

### Biologic Markers of Anxiety

Two of the studies used biological markers to assess anxiety. A study by Beaulieu-Boire et al. (2013) examined the effects of music on sedative drug consumption and vital signs, and also on inflammation markers and sensors of hormonal stress. These values consisted of IL-6, prolactin, C-reactive protein, ACTH, and cortisol; additionally, a post-analysis focused on leptin and MET-enkephalin (Table 1). Fifty-five mechanically-ventilated subjects were randomly assigned to either a group that received two one-hour periods of classical music in the morning and evening, or a placebo-control group that received headphones with no music playing. The study was a crossover design, so both groups had exposure to both interventions during the study. Laboratory tests were drawn every morning before and after the patients listened to music. Those in the music therapy group showed a significant decrease in cortisol levels ($p$=0.02) after the intervention when compared to the control group. Reductions in prolactin ($p$=0.038) were

also seen after the patients listened to music, but not in the placebo-control group. Music intervention affected neither leptin levels nor MET-enkephalin. The inflammatory markers (CRP and IL-6) decreased over time, but were not significant; however, CRP had a long half-life, and it did not vary between the intervention and placebo-control group (Beaulieu-Boire et al., 2013).

Another study focused on the 24-hour collection of urinary cortisol samples to determine whether or not music reduced stress and anxiety levels (Chlan et al., 2012). The researchers opted to analyze urinary cortisol, rather than serum cortisol, due to the less invasive means of collection. The criteria for eligibility in this study included those who were alert, receiving acute mechanical ventilation, able to follow commands, cognitively aware, able to hear, not receiving medications that affect cortisol levels, and not suffering from renal failure or renal insufficiency (Chlan et al., 2012). A total of 70 subjects participated in this study. Subjects were randomly assigned to a group where the participants each selected music from a collection, a group where they were given headphones without music, or a group that only received the regular ICU care. There was no significant decrease in cortisol levels in the patient-directed music group. However, patterns of the urinary cortisol proved to have less extreme values over time, whereas the ones in the control group managed to increase throughout the experiment.

**Physiologic Measurements of Anxiety**

A majority of the articles that were reviewed focused on the physiologic signs of the patients. The main measures encompassed heart rate (HR), respiratory rate (RR), systolic blood pressure (SBP), diastolic blood pressure (DBP), and—for two studies—oxygen saturation ($SaO_2$). Seven of the ten articles measured physiologic signs as part of their outcome measures.

Four of these articles found definitive decreases in certain physiologic measures after the patients participated in a music intervention. The researchers set up the experiments so that the physiologic signs were measured before (baseline measurement) and after the intervention.

In one study, researchers looked at SBP, DBP, HR, RR, and $SaO_2$. The sample size consisted of 60 patients in the ICU who were receiving mechanical ventilation (Korhan et al., 2011). Subjects were enrolled if they were hemodynamically stable and able to hear, had no mental illnesses, did not receive antihypertensive drugs, and had a Glasgow Coma Scale score of at least 9. The subjects were randomly assigned to either the intervention group (classical music played through headphones) or the control group. Sedation doses were stopped 30 minutes prior to the start of data collection to allow for more accurate patient responses. The patients' vital signs were taken at 30-minute intervals throughout the intervention. The researchers found significant decreases in SBP, DBP, and RR in the patients after they listened to music, but no significant differences in $SaO_2$ and heart rate (Korhan et al., 2011). The patients in the intervention group demonstrated a trend of decreasing physiological symptoms of anxiety, even for 30 minutes after the intervention, supporting the idea that music therapy should take place for at least one hour.

Another study found mixed results pertaining to the effect of music on physiologic symptoms. This crossover study evaluated the mean blood pressure (MBP) and RR as measures of anxiety (Wong et al., 2001). Twenty patients were assigned to receive half an hour of music therapy followed by half an hour of uninterrupted rest, or the same interventions in the opposite order. The music came from a selection of relaxing Chinese music and Western music; the patients chose the type they wanted to hear. Although the findings did not support a significant

difference of HR and MBP in the conditions over time, they revealed significantly lower RR and MBP at the end of the 30 minutes ($p<0.01$), with music having a greater reduction than the rest group (Wong et al., 2001). The MBP of the experimental group was 76.15 mmHg, while the MBP of the control group was 80.90 mmHg; furthermore, the RR of the experimental group was 17.35 breaths/minute, whereas the control group was 19.25 breaths/minute (Wong et al., 2001).

Two studies found no significant decreases in physiologic measures after performing the interventions. In a crossover study, 55 ventilator-dependent subjects were randomly assigned to a placebo group (headphones without music) or a classical music intervention group, with the interventions taking place for two one-hour periods during the day. The second day, both groups received usual care, but on the third day, the groups received whichever intervention they did not receive on Day 1. While the vital signs (BP, HR, RR) did not decrease significantly after either intervention, the biologic markers—another measure of anxiety in this particular experiment—showed a reduction after the music therapy (Beaulieu-Boire et al., 2013).

The last study analyzed the effects of a music intervention or a rest group on anxiety levels, and specifically looked at SBP, DBP, MAP HR, and RR. Twenty patients were enrolled in the study, and those in the music intervention group listened to classical or easy-listening music for three 30-minute periods over two days. Those in the rest group had three 30-minute rest periods. Findings revealed no significant decrease between the groups after the 30-minute periods, although, over time, the HR, DBP, and MBP between groups differed significantly, with the experimental group having higher values (Dijkstra et al., 2009).

**Psychologic Measurements of Anxiety**

Since intubated patients experience an impaired ability to speak, it was necessary to develop scales to facilitate subjects to self-report their anxiety levels. One such item was the Visual Analogue Scale for Anxiety, or VAS-A. This scale was validated with the Spielberger State Anxiety Inventory (Chlan et al., 2013). In a Minnesota study, 373 subjects from a variety of ICUs were assigned to a music intervention group (self-initiated music tailored to individual's preferences), an active control group (self-initiated noise-canceling headphones), or regular ICU care group. Subjects in the music group listened for an average of 79.8 minutes per day, whereas those in the control group wore headphones for an average of 34 minutes per day (Chlan et al., 2013). The subjects were asked how they were feeling, and they were able to indicate their responses on the VAS-A scale, which ranged from "Not anxious at all" to "Most anxious ever" (Chlan et al., 2013). Subjects who self-initiated their music intervention had a greater reduction in anxiety ($p=0.003$) compared to the group that received only the regular ICU care; however, the noise-canceling headphone group had similar reductions in anxiety. The study has important implications for future research, as blocking out unpleasant noise might be as effective as relaxing music in reducing patient anxiety.

A study by Lee et al., (2005) that was conducted in Hong Kong, used a Chinese-State Trait Anxiety Inventory (C-STAI), which was a variation of the Spielberger-developed STAI. The STAI measured anxiety via a questionnaire that allowed people to choose one of four responses to a variety of relevant questions. The C-STAI was translated to Chinese and minimized to six items because of the high levels of fatigue associated with administering to ICU patients. The scale was used before and after subjects were exposed to the music invention or

control group. The researchers read the individual questions to the subjects, and the subjects were able to indicate their responses by holding up the number of fingers that corresponded to their response. The subjects showed decreased HR, RR, DBP, and SBP after the music intervention, but the C-STAI levels were not significantly different ($p$=0.632). However, the researchers noted that participants may have not been able to fully comprehend the meaning of the questions (Lee et al., 2005).

Conversely, a study composed of 137 subjects in China also used the C-STAI to assess anxiety levels after being assigned to a music intervention group (self-selected relaxing music from researcher's collection), a placebo group (headphones with no music), and a control group (rest with no music). Each group's intervention lasted 30 minutes, and anxiety was assessed with the C-STAI before and after the interventions. Those in the music therapy group had the greatest reduction in anxiety after the intervention ($p$<0.001), as the C-STAI score decreased from ~51 to ~40. In the headphone group, the score decreased from ~50 to ~46 ($p$<0.001), and the control group's anxiety remained at ~52, with less than a one point reduction (Han et al., 2010). Another study used the C-STAI to assess patient anxiety levels after the patients listened to music for 30 minutes followed by 30 minutes of rest (or vice versa) (Wong et al., 2001). The music group showed a significant reduction in anxiety ($p$<0.01) as compared to the rest group; the music group had a mean C-STAI score of 49.67, whereas the rest group had a mean score of 38.67 (Wong et al., 2001).

## SEDATION

### Sedative Exposure

Patients receiving mechanical ventilation often receive sedative medications to alleviate the pain and stress caused by the discomfort of the intervention. In one study, researchers monitored the amount of sedatives that were used to promote comfort, and they examined whether or not music had an effect on the amount of sedatives needed (Beaulieu-Boire et al., 2013). Music did not significantly affect the amount of certain sedative drugs, but it showed a trend of decreased narcotics consumed by subjects after the music interventions ($p$=0.06) (Beaulieu-Boire et al., 2013).

Another study randomized subjects into a music intervention group, a noise-canceling headphone group, and a control group that only received regular ICU care. Common ICU sedatives and analgesic drugs were monitored every day, and the researchers looked at sedative frequency and a drug intensity score (Chlan et al., 2013). To calculate the sedative intensity score, researchers used a weight-adjusted dose for drugs given over 4-hour time blocks, and then placed the drug amounts into quartiles that reflected a patient's drug intake throughout the experiment. There were six four-hour blocks that, after adding all the values, comprised the drug intensity score (Chlan et al., 2013). Dose frequency was calculated by looking at six four-hour blocks that consisted of the summed values of any sedative administration. Results showed a greater decrease in sedation frequency over time for the music group when compared to the others, and a greater reduction in sedation intensity when compared to the control group (Chlan et al., 2013). The subjects required less sedative medication frequency and intensity, while also reporting decreased anxiety levels after the music intervention. The average subject in the regular

ICU group received five doses of a sedative on the fifth day of the experiment; on the same day, a subject in the music intervention group only required three doses of the medication (Chlan et al., 2013).

Another study randomized ventilated subjects into a music intervention group, a positive suggestion group (MP3 player delivered an encouraging pre-recorded message about recovery), and a regular ICU care control group (Szilagyi et al., 2014). Those in the music group needed higher doses of benzodiazepines throughout the study, compared to the other two groups. The suggestion group needed the least amount of sedatives, and they had the shortest duration of mechanical ventilation. The music group also had a shorter duration of mechanical ventilation and length of stay in the ICU compared to the control (Szilagyi et al., 2014).

Finally, a study by Dijkstra et al. (2009) focused on music intervention for three 30-minute sessions per day for two days, while the control group had rest periods during the same times. The Ramsay score was used to measure sedation levels in the ventilated subjects, with higher scores signifying deeper levels of sedation (Dijkstra et al., 2009). Subjects eligible for this study needed to have a Ramsay score of 2-4, which allowed them to not be too anxious or too sluggish to listen to music. After all of the interventions took place, results demonstrated significantly higher Ramsay scores in the subjects who had listened to music. This suggested that listening to music has a correlation with greater states of sedation, which might help decrease anxiety in these subjects (Dijkstra et al., 2009).

# DISCUSSION

The findings of the ten studies revealed an overall positive outcome of music therapy on anxiety levels. Although eligibility requirements varied, all studies were conducted in critical care environments, and all subjects received mechanical ventilation. Almost all of the studies required participants to be alert, able to follow commands, have unimpaired or adequate hearing, and be hemodynamically stable.

Subjects in these studies participated in different levels of music intervention, whether listening to scheduled thirty-minute segments throughout the day, or self-initiating their music listening. They were monitored before and after the interventions, in order to compare baseline and post-intervention results. The researchers analyzed anxiety in a variety of ways, from self-rating scales to physiologic signs to sedation frequency. Most of the studies revealed lower anxiety levels in the music intervention group, whether it was due to their improved vital signs or self-report of anxiety.

The ten articles contained distinctive methods, although many crossover designs compared a music intervention group to a placebo group and/or a control group. In the case of Szilagyi (2014), one group received recorded positive messages that were played through headphones attached to an MP3 player. This proved to be the most significant for reductions in anxiety and length of ICU stay, which appeals to further research of the use of positive suggestion. None of the studies showed a detrimental impact of music on the participants, which is highly relevant for clinical practice.

## LIMITATIONS

Despite the positive effects of music therapy on different measures of anxiety, there were limitations in this review of literature. For one, there were few studies pertaining to the effects of music therapy on anxiety levels of mechanically-ventilated subjects. Only ten articles were analyzed and incorporated into the review. In order to be able to better generalize the results, it would be advantageous to integrate further studies into the analysis.

Also, the studies did not all use the same methods and measures in their experiments. Although classical music was often included in the selections of music available to the participants, the music was not uniform throughout the studies. Subjects listening to music by Bach may be affected differently than if they had listened to Beethoven. A study that allows for subjects to choose their music might have a different result than a study where the music is already selected for the subjects.

Furthermore, the researchers measured anxiety in a variety of ways. The studies were not consistent with their outcome measures, as some measured biological markers of anxiety, while others measured select physiological responses. All of the articles aimed to evaluate the anxiety of the participants, but results would be more valid if the experiments all followed used a common measure(s) of anxiety. Moreover, the self-rating scales were subjective measures of anxiety; this contains bias, as subjects may have underestimated or overestimated their levels of anxiety.

Finally, the subjects in these studies were all receiving mechanical ventilation in the ICU, but they did not have the same acuity. Subjects who are undergoing a more severe illness are likely to respond differently to music therapy than those who are less affected by their sickness.

Severely ill patients might have greater levels of pain that are reduced notably more or less through the use of nonpharmacologic interventions. There are many confounding variables involved when examining the big picture, such as sedatives, stability of the patient, age, illnesses, and so on; however, the researchers did include criteria for eligibility, and they tried to group the patients together according to the severity of their disease.

Despite the limitations stated, the research showed great promise for reducing anxiety in critically ill patients. The reductions in physiologic responses and self-reported levels of anxiety demonstrate that music therapy is capable of creating a relaxing environment for mechanically-ventilated patients.

## MUSIC PREFERENCES

The selection of music that patients listened to during the interventions differed throughout the studies. In a study by Szilagyi (2014), participants were randomized into three groups: music intervention, positive suggestion group, and control group receiving only the regular ICU care. The subjects listened to 30 minutes of music, which consisted of classical music from Vladimir Ashkenazy's album, *Favourite Mozart*. The suggestion group remained on the ventilator for an average of ~85 hours, whereas the control group was ventilator-dependent for ~256 hours. The suggestion group had the shortest length of stay on mechanical ventilation and in the ICU, but the music group also demonstrated a shorter length of stay than the control group.

In a separate crossover study, subjects were assigned to listen to one hour of music twice a day, or a placebo group (headphones and mp3 player without music) for one hour twice a day;

they were to switch interventions the following day. A musicologist advised the researcher on appropriate material, and this selection contained random works from Bach, Beethoven, Chopin, Debussy, St-Saens, and Tchaikovsky (Beaulieu-Boire, 2013).

Three studies that were based in China had similar musical choices for the ventilated subjects. A study by Han et al. (2010) looked at personal preference for the music intervention group; the subjects were allowed to select their choice from the researcher's collection, which included Western classical music/light music, Chinese traditional music, and Chinese folk songs. The songs were all considered to be relaxing and familiar to Chinese people, and they contained slow, flowing rhythms (Han et al., 2010). A different Chinese study dealt with subject preferences of Chinese and western music, and the volume was adjusted to the satisfaction of the subject (Wong et al., 2001). The last China-based study allowed for the subject's preference of music from the researcher's selection; the options varied from Chinese to Western classical to religious music to music with slow beats and natural sounds (Lee et al., 2005). The latter study demonstrated a decrease in anxiety by means of physiologic symptoms, while the former two studies revealed C-STAI scores that were significantly lower after the music intervention.

## NURSING IMPLICATIONS

The implications of this literature review are wide-ranging and highly relevant to the field of nursing. Nurses dedicate their time and attention to helping others, and they spend their shifts caring for patients in need. In hospital settings, particularly in critical care environments, patients remain stressed and uncomfortable about their conditions and complications that might arise. Nurses have a duty to minimize pain and advocate for patients who might not be cognitively aware. The ICU receives patients who are in critical condition and, most likely, under a great

deal of stress. In order to properly care for these men and women, it is essential to make them as comfortable as possible, while providing the necessary medication and medical attention. Music therapy is a beneficial tool that is inexpensive, convenient, and easy to implement. Creating a relaxing environment for the patients by allowing them to listen to their favorite songs will not only foster the healing process, but also promote a therapeutic relationship between the nurses and patients.

Furthermore, nurses work hard to care for their patients in the hopes that the patients will recover and return to their former states of health. Nurses often administer sedatives to critically ill patients and mechanically-ventilated patients, in an attempt to reduce pain and discomfort. However, the pharmacologic agents have the potential to be either inadequate or excessive. Patients who are heavily sedated have more trouble getting off a ventilator and back to their former state of health, while those who do not have enough sedatives often suffer from pain or discomfort, which can lead to further complications. Several studies have shown that music therapy may lead to decreased doses of sedative agents, which ultimately allows patients to wean off the ventilator more quickly, and allows them to get out of the ICU and back to their regular life. By simply engaging the patient in relaxing music therapy sessions, nurses have the potential to expedite recovery time for patients in the hospital.

In order to implement music therapy as an intervention in hospitals, it would be essential to properly educate nurses on how to deliver the music therapeutically. If the patients were not able to move independently, it would be necessary for the nurses to adjust the music volume to a calming level before initiating the intervention. Nurses also need to consider the length of the interventions, and contemplate planning the music therapy at times before or after a potentially

painful procedure takes place. The therapy would be most effective if the nurses considered the musical preferences of the patient, as familiar music might be less likely to irritate the individual. Additionally, the cost and availability of headphones need to be considered. Headphones are likely to be effective because of their ability to drown out background noises, and they may also benefit patients while they rest throughout the day. Although noise-canceling headphones will incur costs at hospitals, the expense of the devices may be insignificant when considering the cost of prolonged hospital stays. However, it is possible that playing music in other ways, without headphones, may reduce anxiety levels in patients as well.

## RESEARCH IMPLICATIONS

Although music demonstrated a positive relationship with reducing anxiety in many of the studies, noise-canceling headphones also proved to have favorable effects on the patients. Headphones cancel out the unpleasant sounds that patients in critical care environments are often exposed to, and many patients in this literature review experienced a decrease in anxiety levels after taking rest periods with noise-canceling headphones. Further research studies should examine a variety of headphones and earbuds to see whether they affect the patients differently. Noise-canceling headphones and earbuds are likely to considerably differ in price, so it would be necessary to determine which kind of device remains effective while costing the least amount of money.

Although music therapists were not explicitly used in many of these studies, further research should examine if a trained music professional has the ability to influence anxiety levels of the patients more so than the music from mp3 players. The use of live music was not studied

in these articles, but having a musician perform in front of a patient has the possibility of altering anxiety levels.

Additionally, music choice needs to be carefully considered in future studies. Classical music is the most widely known genre of music to create a state of relaxation for the listener, but personal preference might have more of an effect on the person. People have intimate connections and memories to certain songs or artists, and it is possible that hearing one's favorite song has the potential to improve the mood of a patient more so than listening to classical music.

# CONCLUSION

Music therapy has the potential to decrease symptoms of anxiety in patients, as it has been recognized to improve mood, reduce pain, and induce relaxation. Calm, relaxing environments are especially important for critically ill patients because any excess stress might contribute to the further decline of one's health. Patients receiving mechanical ventilation are not able to communicate effectively, which leads to feelings of isolation, anxiety, and fear. The use of slow, calming music is a noninvasive and cost-effective way to help ventilated patients, possibly making it easier for them to wean off the ventilator and improve recovery time in the ICU.

# APPENDIX: TABLES

**Table 1: Biologic Markers**

| **Biologic Marker** | **Function** |
|---|---|
| Cortisol | Released during periods of stress. Increases blood sugar, suppresses immune system, assists with metabolism, activates anti-stress properties, prevents inflammation, and reduces bone formation. |
| Adrenocorticotropic hormone (ACTH) | Released during periods of stress. Leads to increased production of cortisol. Produced in the pituitary gland. |
| Prolactin | Produced by pituitary gland. Enables milk production, is an important factor of metabolism, regulates immune system, acts as growth factor. Stimulated by stress. |
| Leptin | Regulates energy balance, maintains homeostasis, inhibits hunger, and regulates onset of puberty. |
| Interleukin-6 (IL-6) | Pro-inflammatory and anti-inflammatory properties. Stimulates immune response during infection, fights infection, and mediates fever. |
| MET-enkephalin | Opioid effects. Endogenous. Naturally-occurring. Lasts only a short duration of time. |
| C-reactive protein (CRP) | Released in response to inflammation (usually within 2 hours). Produced by the liver. Helps promote phagocytosis. Has a long half-life (approximately 18 hours). |

**Table 2: Table of Evidence**

| Articles | Participants and Study Design | Intervention Details | Outcome Measures | Results (or Key Findings) | Nursing Implications |
|---|---|---|---|---|---|
| Chlan, L.L., Engeland, W.C., & Savik, K. (2012). Does music influence stress in mechanically ventilated patients? *Intensive and Critical Care Nursing, 29*(3), 121-127. | Participants were from 12 ICUs in Minneapolis and St. Paul. They had to be receiving ventilatory support, able to follow commands, have adequate vision and hearing, and be cognitively intact.<br><br>Randomized control trial. Quantitative. | Participants were split into three groups:<br><br>1. Experimental group: Music intervention (patient-directed)<br><br>2. Control: Noise-canceling headphones<br><br>3. Control: Regular ICU care | The urinary cortisol levels were collected throughout the day (24 hours). The urine was collected and assayed so that cortisol was separated and able to be measured. | There was no significant decrease in stress (measured by urinary cortisol levels) when comparing the patient-directed music group to the others ($p$=.54). However, a variety of confounding variables need to be considered when considering the urinary cortisol to be a direct measure of stress, such as medications and comorbidities that raise cortisol levels. | Although the results did not prove to be statistically significant, the music group's cortisol levels were lower than the control. |

| Articles | Participants and Study Design | Intervention Details | Outcome Measures | Results (or Key Findings) | Nursing Implications |
|---|---|---|---|---|---|
| Chlan, L.L., Weinert, C.R., Heiderscheit, A., Tracy, M.F., Skaar, D.J., Guttormson, J.L., & Savik, K. (2013). Effects of patient-directed music intervention on anxiety and sedative exposure in critically ill patients receiving mechanical ventilatory support: a randomized clinical trial. *JAMA: Journal of the American Medical Association, 309*(22), 2335-2344. | Participants: 373 patients from 12 ICUs in Minnesota. They had to be alert, able to consent and follow commands, receiving ventilatory support, and have adequate vision and hearing.<br><br>Randomized control trial. Quantitative. | Participants were split into three groups:<br><br>1. Self-initiated music therapy<br><br>2. Self-initiated noise-canceling headphones<br><br>3. Regular ICU care | Anxiety was measured at the beginning of the study (via self-report), and daily via the VAS-A (patients could indicate their current anxiety).<br><br>Also, sedative exposure was measured via a sedation intensity score and a dose frequency score. | Those in the patient-directed music intervention group had significantly lower anxiety scores than those only receiving regular ICU care ($p$=0.003). The patient-directed music group also had reduced sedation frequency ($p$=.01). However, the noise-canceling headphone group ($p$=0.04) and the music group ($p$=0.05) both had reductions in sedation intensity. | This study has broad implications. Patients may be able to take part in their plan of care, by initiating music therapy on their own. Patients might be able to receive less sedation, which would mean less potential side effects and adverse reactions.<br><br>**Patients were able to manage anxiety by themselves<br><br>Noise-canceling headphones may also be an alternative for those who prefer quiet environments to music. |
| Hunter, B.C., | Participants | The intervention | Anxiety was | Findings showed a | Music intervention |

| Articles | Participants and Study Design | Intervention Details | Outcome Measures | Results (or Key Findings) | Nursing Implications |
|---|---|---|---|---|---|
| Oliva, R., Sahler, O.Z., Gaisser, D., Salipante, D.M., & Arezina, C.H. (2010). Music therapy as an adjunctive treatment in the management of stress for patients being weaned from mechanical ventilation. *Journal of Music Therapy, 47*(3), 198-219. | included patients (18 years of age) in a step-down unit who were ready to be weaned off mechanical ventilation. They needed to be deemed appropriate by an NP, and needed to have completed less than 8 hours on a tracheostomy collar. There were 61 patients enrolled, and 51 completed the study.<br><br>Convenience sample and historical controls. Quantitative. | consisted of music therapy sessions (45-60 minutes) three times per week during the weaning trials.<br><br>The historical controls were patients who were in the same unit within the past two years. | measured by looking at the heart rate and respiratory rate. Also, a patient survey, nurse survey, DTW (Days to Wean), and patient satisfaction evaluation were conducted. | decrease in physiologic symptoms after the sessions. The HR significantly decreased ($p$=0.027), and the RR showed significant reductions ($p$=0.0001). The nurses and patients agreed that anxiety levels were lowered. 96% of the patients were satisfied, and 100% would do the intervention again. | can be beneficial when weaning patients off of mechanical ventilation on a step-down unit. Although the patients are considered to be critically ill, they still managed to participate in their music therapy sessions. |
| Lee, O., Chung, Y., Chan, M., & | 64 patients on ventilators in the | Subjects were assigned to either a | Physiologic measures were | The experimental group showed | Familiar music appeared to have a |

| Articles | Participants and Study Design | Intervention Details | Outcome Measures | Results (or Key Findings) | Nursing Implications |
|---|---|---|---|---|---|
| Chan, W. (2005). Music and its effect on the physiological responses and anxiety levels of patients receiving mechanical ventilation: a pilot study. *Journal Of Clinical Nursing, 14*(5), 609-620. | ICU participated. The subjects had to be alert, without any psychiatric illnesses, able to follow commands, able to hear, hemodynamic-ally stable, and ventilator-dependent.<br><br>Randomized controlled trial. Quantitative. | music intervention group or a control group (rest group). Both groups wore headphones, but only the experimental group listened to music. | examined, including RR, HR, SBP, and DBP. A six-question anxiety scale (C-STAI) was used to determine the patient's anxiety levels. Furthermore, resting behavior was observed by five experts. | significant decreases in HR ($p$=0.003), RR ($p$<0.001), SBP ($p$=0.001), and DBP ($p$=0.002) after the intervention, whereas the control group did not show a significant reduction. The former also showed an increase in relaxing resting behaviors. There was no significant difference in the C-STAI after the music intervention ($p$=0.63), although many subjects were illiterate and elderly. | calming effect on the experimental group. Reducing anxiety is always advantageous in ICU patients, and playing music based on the patients' preferences is an inexpensive way to help promote relaxation. |
| Szilagyi, A., Dioszeghy, C., Frituz, G., Gal, J., | Participants needed to be at least 18 years old, | Patients were randomized into three groups: | The Simplified Acute Physiology Score (SAPS II) | The music group required higher levels of | The study shows promising results for the use of |

| Articles | Participants and Study Design | Intervention Details | Outcome Measures | Results (or Key Findings) | Nursing Implications |
|---|---|---|---|---|---|
| & Varga, K. (2014). Shortening the length of stay and mechanical ventilation time by using positive suggestions via MP3 players for ventilated patients. *Interventional Medicine And Applied Science*, *6*(1), 3-15. | have unimpaired hearing, and not have a serious psychiatric illness. A total of 39 subjects took part in the trial.<br><br>Randomized controlled trial. | suggestion, musical control, or control. The suggestion group heard a pre-recorded text for 30 minutes/day; it contained positive suggestions that encouraged efficient recovery. The music group listened to 30 minutes of classical music per day, and the control group received no intervention—just regular ICU care. | was used for assessment. The Ramsey Sedation Scale was also utilized. | benzodiazepines ($p<0.02$), whereas the suggestion group required the lowest ($p<0.01$). The music group and suggestion group ($p<0.09$) had shorter lengths of stay and shorter mechanical ventilation lengths of time than the control. | positive suggestion as an intervention to reduce anxiety and sedation levels in mechanically-ventilated patients. Nurses providing encouragement to patients may be beneficial when considering the despair and critical conditions that some of the patients might be enduring. |
| Korhan, E.A., Khorshid, L., & Uyar, M. (2011). The effect of | Participants included 60 ICU patients who were aged 18-70 and | Patients in the intervention group received 60 minutes of | Physiologic signs (RR, HR, SBP, DBP, $O_2$ Saturation) were | When compared to the control group, patients in the music therapy | Since music showed to be effective in reducing signs of |

| Articles | Participants and Study Design | Intervention Details | Outcome Measures | Results (or Key Findings) | Nursing Implications |
|---|---|---|---|---|---|
| music therapy on physiological signs of anxiety in patients receiving mechanical ventilatory support. *Journal Of Clinical Nursing, 20*(7-8), 1026-1034. | were of Turkish nationality. They had no psychiatric illness, were hemodynamic-ally stable, were not hearing impaired, had a Glasgow Coma Scale score of 9+, were on pressure support ventilation mode, and had not taken antihypertensive drugs.<br><br>Study-case-control-design. Quantitative. | classical music therapy. Propofol was stopped 30 minutes before the therapy to avoid confounding variables. | taken before the intervention, every 30 minutes throughout the therapy, and 30 minutes after it was stopped. | group showed a statistically significant decrease in physiologic signs of anxiety. The mean SBP ($p$=0.024) and mean DBP ($p$=0.016) decreased. AThe RR decreased significantly ($p$=0.043) in the music group. The intervention appeared more effective for those who had been on the ventilator for a longer period of time. | anxiety, it can potentially lower sedation doses and cause a more calming effect on those who are ventilator-dependent. |
| Han, L., Li, J.P., Sit, J.H., Chung, L., Jiao, Z.Y., & Ma, W.G. (2010). Effects of music | Participants needed to understand Mandarin, be alert and competent, be | Subjects were randomized into a single 30-minute music intervention session (based on | The C-STAI (Chinese Spielberger State-Trait Anxiety Inventory) used. | The music intervention group and headphone group showed a greater reduction | Listening to music, instead of just having rest periods throughout the day, has the |

| Articles | Participants and Study Design | Intervention Details | Outcome Measures | Results (or Key Findings) | Nursing Implications |
|---|---|---|---|---|---|
| intervention on physiological stress response and anxiety level of mechanically ventilated patients in China: a randomized controlled trial. *Journal Of Clinical Nursing, 19*(7/8), 978-987. | on mechanical ventilation, not be receiving continuous analgesia or sedative intravenously, and have no prior experience of music therapy.<br><br>137 ICU patients took part in the study, with ages ranging from 18 to 84 years old.<br><br>Randomized controlled trial.<br><br>Quantitative. | musical preference), a 30-minute placebo group (headphones without music), or a 30-minute control group (neither headphones nor music). All environments promoted rest, and baseline measures were taken before the interventions. | Anxiety was measured before and after the different sessions, and since the patients could not read the questions easily, the researcher read the questions out loud while the subjects held up fingers that corresponded with their responses. Also, HR, RR, O2 Sat., and BP were measured before, during, and after the interventions. | in state anxiety after the sessions took place ($p<0.001$). Over time, the HR and RR of subjects in the music group decreased ($p<0.01$), while they increased in the control group. The SBP in the music and headphone group had a significant reduction compared to the control group ($p<0.001$). | potential to help ventilated patients relax in a more effective way. Headphones may also be effective in blocking out harsh noises and contributing to a more relaxing state. |
| Beaulieu-Boire, G., Bourque, S., Chagnon, F., Chouinard, L., Gallo-Payet, N., & Lesur, O. (2013). | Subjects included those in an ICU who were at least 18 years old, requiring sedation medication, | Patients were divided into two groups, one with music-MP3 (classical music) and one with a | What was measured: Blood tests for inflammation markers (IL-6, C-reactive protein) | The group that listened to music did not see a consistent change in vital signs. Cortisol ($p=0.02$) | Although there didn't appear to be a reduction in vital signs in this study, there is still good evidence to |

| Articles | Participants and Study Design | Intervention Details | Outcome Measures | Results (or Key Findings) | Nursing Implications |
|---|---|---|---|---|---|
| Music and biological stress dampening in mechanically-ventilated patients at the intensive care unit ward- a prospective interventional randomized crossover trial. *Journal Of Critical Care*, *28*(4), 442-450. | needing at least 3 more days of mechanical ventilation, and in an overall stabilized condition. There were 55 eligible participants enrolled in this study.<br><br>Randomized controlled crossover study. Quantitative. | sham-MP3 (no music). It was a crossover study, so they listened to both in a random order for one hour twice a day. A staff member recorded baseline vitals and took a blood sample before the intervention. He or she then placed headphones on the patient, and then repeated the baseline vitals and blood work after the intervention. | and major stress hormones (cortisol, ACTH, and prolactin) before and after the intervention. Also, vital signs were taken before and after. | and prolactin ($p$=0.038) blood concentrations decreased in this group. The music group saw a reduction in narcotics ($p$=0.06), although other sedative drugs weren't significantly affected. | suggest that music therapy has the potential to lower biological stress levels in ventilated patients. |
| Dijkstra, B., Gamel, C., van der Bijl, J., Bots, M., & Kesecioglu, J. (n.d.) The effects of music on physiological responses and | Randomized controlled trial design. Quantitative.<br><br>There were 20 subjects included in this study. They | The patients in the music intervention group listened to music (via headphones) for three 30-minute sessions, which were spread out | Physiologic measures of anxiety (including HR, RR, systolic BP, diastolic BP, and mean arterial blood pressure) were examined. | Results showed no significant difference in physiologic measures ($p$ values for physiologic measures all greater than 0.2). | Nurses can benefit from this study by observing the higher sedation levels of patients receiving music therapy. Music has the potential to |

| Articles | Participants and Study Design | Intervention Details | Outcome Measures | Results (or Key Findings) | Nursing Implications |
|---|---|---|---|---|---|
| sedation scored in sedated, mechanically ventilated patients. *Journal Of Clinical Nursing, 19*(7-8), 1030-1039. | needed to be receiving mechanical ventilation, have no hearing impairments, having a Ramsay score of 2 to 4, and be receiving continuous sedatives. | over two days. The music selection included classical music and easy listening (songs without vocals) music.<br><br>The control group consisted of three 30-minute rest periods, and headphones were not offered. | Sedation scores, using the Ramsay scale, were also considered. | The patients in the music intervention group showed higher sedation levels after the intervention ($p$=0.015). No negative changes were shown in the music intervention group. | induce patients into states of relaxation, which means the nurse might not need to give as much sedative medications. |
| Wong, H., Lopez-Nahas, V., & Molassiotis, A. (2001). Effects of music therapy on anxiety in ventilator-dependent patients. *Heart and Lung, 30*(5), 376-387. | Randomized crossover design. Quantitative.<br><br>There were 20 patients from a Hong Kong ICU who participated in this study. They had to speak | Patients received 30 minutes of music therapy and then 30 minutes of rest, or vice versa. Baseline measurements were taken before the intervention, and they were also | Anxiety was measured by the C-STAI. Respiratory rate and mean blood pressure were monitored to determine physiologic rates of anxiety. | Scores on the C-STAI showed a significant decrease in anxiety levels in those who underwent the music intervention ($p$<0.01). Although the control group experienced a | Since the patients showed decreased levels of anxiety in the music intervention group, nurses can benefit from this study by learning that music is an effective and inexpensive way to |

| Articles | Participants and Study Design | Intervention Details | Outcome Measures | Results (or Key Findings) | Nursing Implications |
|---|---|---|---|---|---|
| | English or Cantonese, be 18-85 years old, be able to communicate, be undergoing mechanical ventilation, alert and competent, not receiving continuous sedatives, and hemodynamically stable. | taken following the intervention. | | decrease in anxiety, it was less than the music group. There were no significant differences in RR and BP between groups over time ($p$>0.05), but those in the music group experienced a greater reduction after the intervention. | reduce anxiety in their patients. Even if the physiologic indicators did not appear to be significantly reduced, nurses are able to feel better knowing that patients self-reported less anxiety levels, which has the potential to lower stress indicators inside the body. |

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