THE EFFECTS OF MUSIC THERAPY IN THE NICU ON BEHAVIOR, WEIGHT, AND

LENGTH OF STAY: A SYSTEMATIC REVIEW

A Systematic Review

Presented to the faculty of the School of Nursing

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Submitted in partial satisfaction of the requirements for the degree of

MASTER OF SCIENCE

in

Nursing

Family Nurse Practitioner

by

Stefanie Erin Rabold

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Abstract

of

THE EFFECTS OF MUSIC THERAPY IN THE NICU ON BEHAVIOR, WEIGHT, AND LENGTH OF STAY: A SYSTEMATIC REVIEW

by

Stefanie Erin Rabold

Statement of Problem.

Infants in the neonatal intensive care unit (NICU) are either ill or premature and in need of extrauterine support in order to reach physiologic maturity. The stressors accompanying a medical condition or the condition of prematurity are significant for an infant. In the NICU, the environmental noises and stimuli are known to cause increase stress in infants. The additional stressors associated can lead to a prolonged stay in the NICU, impacting their ability to grow and develop, and can be a difficult and challenging experience for the infants and their families. *Sources of Data.*

Three databases were searched to evaluate research studies fitting the inclusion criteria of behavior, weight, and length of stay. Thirteen articles met the inclusion criteria for the systematic review. Studies included randomized controlled trials, controlled trials, meta-analyses, and systematic reviews.

Conclusions Reached

Evidence demonstrates music therapy has a positive effect on behavior, weight, and length of stay. Some conflicting evidence was found in behavior studies and weight studies. The overall recommendation for both variables was to consider application. Length of stay had strong evidence on the positive effect of music therapy and is recommended as an intervention for infants in the NICU.

auer Celfin Committee Chair

4-22-13

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INTRODUCTION

The patients found in the neonatal intensive care unit (NICU) are high risk infants including those born premature (preterm) or full term and may have a serious medical or surgical condition. A premature infant is classified as an infant born at 37 weeks or less in gestational age. This requires admission to the NICU as the premature birth does not allow for all body systems to fully develop, leading to requirement of additional physiologic support to maintain life. Blackburn (1998) found, "Preterm infants are dependent on intensive care for survival, but are also vulnerable to the effects of the NICU environment, to maintain vital functions, promote growth and development, and provide opportunities for development and organization" (p. 279). Until the infant reaches maturity leading to self support, hospitalization is required in a NICU. According to the Centers for Disease Control and Prevention (CDC), in the United States 1 in every 8 babies are born prematurely and prematurity is the leading cause of death among newborn babies (2010).

Full term infants, those born at 38 weeks or greater gestational age, may require care in the NICU as well. Although the conditions requiring NICU care are not related to prematurity, congenital anomalies or acquired illnesses may require hospitalization and admission to the NICU. Preterm infants are often admitted for conditions of prematurity, which include apnea of prematurity, respiratory distress syndrome, poor feeding, intraventricular hemorrhage, jaundice, and poor thermoregulation (March of Dimes, 2012). Ill infants are classified as including medical or surgical conditions that require hospitalization, these can be either preterm or full term infants. Some conditions that may be seen in the NICU other than the previous listed include severe medical conditions requiring mechanical ventilation or supplemental oxygen, such as bronchopulmonary dysplasia, pulmonary hypertension, pneumonia, and respiratory syncytial virus. Surgical conditions require admission to the NICU, such as omphalocele repair,

esophageal atresia repair, bowel resection, and repair of congenital heart anomalies (American Academy of Pediatrics, 2004; March of Dimes, 2012). These conditions imply additional stressors on the infant and can cause adverse outcomes, such as the inability to process nutrients for growth or use calories to maintain a healthy system (Blackburn, 1998). Adverse outcomes acquired from hospitalization in the NICU include immaturity, developmental delays, learning disabilities and behavior problems (Als, 1986).

The NICU Environment

Infants born prematurely or ill are in need of physiologic support to achieve adequate growth and development leading to sufficient calorie intake, weight gain, self regulation, thermocontrol, and independent respiratory impulse. The problem lies in the environment of the NICU, as it is filled with loud, unpleasant, and startling sounds that interfere with the development of the remaining body systems (White - TrautWhite - Traut, Nelson, Burns, & Cunningham,1994). A negative effect from the noise has been noted by increased stress responses (Als, 1982). The neonatal stress response can lead to energy expenditure, which can alter the recovery and normal growth and development in the infant (Blackburn, 1998). In her 1998 article regarding the effect of the NICU environment, Blackburn describes a "Energy Conservation Model" to explain how stress is an important factor that can impede development. Blackburn (1998) explains:

The calories and nutrients infants consume are first used to meet physiologic demands and the consequences of both immature function and pathophysiologic events and then to respond to stressors in the environment. Whatever calories or nutrients are left over can then be used for growth and development. (p. 281).

It is important for all infants to grow and develop and to minimize the effects of the negative environment on medical problems seen in the NICU. Interventions are needed to minimize the

impact and to also improve the environment to optimize growth and development leading to shorter hospital stays.

Intervention

An intervention suggested to improve growth and development is music therapy (Neal & Lindeke, 2008, and Gooding, 2010). Music therapy is defined as a deliberate, often structured, and systematic intervention intended to achieve a desirable therapeutic outcome. The music is specific, determined by musical therapists and placed into practice guidelines as appropriate for soothing, calming, and developmentally stimulating for infants (Stouffer, Shirk & Polomano, 2007). Practice guidelines have been developed to assist nurses and other healthcare professionals on implementing music appropriately and therapeutically as part of routine clinical care (Stouffer et al., 2007).

Music therapy is not a new idea, it has been documented as early as 1914 in the Journal of the American Medical Association for being used with patients undergoing anesthesia. The discipline of medical music therapy began after World War II when musicians went to the veterans hospitals to play for wounded soldiers. Notable patient responses were made and this led the doctors and nurses to hire musicians. Most of the music therapy studies were with surgical patients and focused on physiologic changes (Hodges & Wilson, 2010b). Music played for hospitalized patients has been in existence for about a century and many different uses have been found since. Today, there are music therapists and clinicians specializing specifically in the components of music and its effects. Music therapists are trained to select the type of music appropriate for the patient, how its delivered, and the optimal timing and sequencing of music interventions (Stouffer et al., 2007). In the 1970s, researchers began to study the effects music had on physiologic outcomes in infants. Different types of music and modes of delivery are of

interest at this time (Hodges & Wilson, 2010b). This systematic review will examine all music therapy studies published investigating the effectiveness of music therapy on daily weights, behavioral responses, and length of stay in infants admitted to the NICU.

THE PROBLEM

Background

In the NICU, the environment and its affects on the developing infants has become a concern. Research has found that several body systems develop in the period between 25 and 40 weeks post-conceptional age including the nervous system. For babies born prematurely, this time is usually spent in the NICU, which is characterized by loud, sharp, unpredictable sounds (Lotas, 1992). Full-term infants are equipped to deal with these stressors, but the burden of being ill or premature may hinder this capacity. White - Traut et al. (1994) states, "The types, intensities, and proportions of all NICU stimuli appear to be inappropriate for the optimal sensory development of premature infants...the NICU environment may contribute to delayed cognitive, emotional, physical, neurologic, and sensory development" (p. 396). Ill full-term infants also undergo stress from the pathophysiologic process of the medical or surgical condition and the environment of the NICU. "Both medical and surgical interventions and pathologic processes can result in pain and place additional burdens on the infant's fragile resources." (Blackburn, 1998, p. 281). Ill full-term infants may have a developed nervous system but still need to grow and develop appropriately. The NICU environment is not conducive for this process, whether the infant has a fully developed nervous system or not (Als, 1982; Bremmer et al., 2003; White - Traut et al., 1994). Humans require interaction between the auditory system and the environment for normal development (Bremmer, Byers, & Kiehl, 2003). Proper social, behavioral, and neurological functioning is developed and learned with appropriate interactions between the nervous system and the environment in everyday life. This

is thought to be a key factor in influencing "appropriate ontogenetic integration patterns or deleterious adaptation patterns leading to malfunction" (Als, 1986, p.4). An example of a potential longterm sequelae of inappropriate interaction during development is attention deficit hyperactivity disorder (Bremmer et al., 2003).

Factors affecting growth include stress behaviors and the inability to use energy for the developmental process. Als (1982), created a table that describes behavior activity and categorizes it as a "stress reaction" or "self-regulatory behavior." This table helps to identify what is considered to be stress based on the behavior response or what is considered a normal, non-stressful behavior in the preterm and term infant. Some examples of stress are respiratory pauses, color changes, spitting up, tremors, flaccidity, hypertonicity, crying, or irritability. Selfregulatory behaviors are smooth respirations, good color, hand clasping, grasping, sucking, cooing, rhythmical robust crying, or attentional smiling. Stress behaviors can be created from the environment in the NICU and the pathophysiologic process of a medical or surgical condition. According to Blackburn (1998), "Environmental conditions affect the infant's physiological status. The infant often responds to changes in the environment and to caregiving interventions with behavioral and physiologic changes" (p. 281). The NICU environment differs greatly from the environment inside the womb. The last system to develop in an infant is the neurological, specifically the visual and auditory pathways, and these senses are the most stimulated in the NICU. The inappropriate environment of the NICU for premature infants creates stress, agitation, crying, and sleeplessness (White-Trout et al., 1994). These behaviors use energy and calories which should be used for growth and development (Als. 1986: Blackburn, 1998: Gooding, 2010).

The Energy Conservation Model (Figure 1) described by Blackburn (1998), explains the use of energy and its hierarchal chain of events, and how stress can affect growth and

development. The model starts with the "energy in," which would be all available energy created by food calories. Then the "energy out" is first used for physiologic processes such as thermal control, respiration, cardiovascular system, ecetera. Next the "energy out" is used for behavioral responses such as stress. After the body uses the energy for these processes first, what is left over is the "growth energy retained," which can be used for weight gain, growth, formation of new tissues, etc. If the energy put in is only enough to cover the physiologic and behavioral processes, then there is nothing left to use for growth (Blackburn, 1998). This would result in poor weight gain and hindered development of the infant.

ENERGY IN +	PHYSIOLOGIC ENERGY OUT +	BEHAVIORAL ENERGY OUT =	GROWTH ENERGY RETAINED
food	thermal control	recycling	weight gain
calones	respiration	stress	growth
	cardio-vascular system	overload	formation of new
	digestion		dendrites
	other processes		development/ and organization of subsystems

Figure 1. Energy Conservation Model

As described by Blackburn's (1998) model, stress can have an affect on the physiologic measurements of infants. This leads to variables that can be measured for a tangible outcome effected by music therapy.

Research Variables

Music therapy as an intervention will be evaluated for its effectiveness on provoking weight gain, self regulatory behaviors and shortening hospital stays in this systematic review. Music as an intervention is determined from practice guidelines developed by music therapists (Gooding, 2010; Stouffer et al., 2007). The type of music used for the desirable therapeutic outcomes in a NICU population is a sedative type; described as a slower tempo, softer volume, a regular and steady rhythm, and minimal jumps between notes of the melody line, and is played on instruments such as strings, acoustic guitar, or piano (Stouffer et al., 2007). The music can be played either in a free field fashion or through headphones with sound levels deemed appropriate by the American Pediatric Academy and musical therapists which is determined at 45 decibels for patients in the NICU.

Scientific evidence and research conducted by music therapists suggest music has benefits to positively influence the appropriate development and create a less stressful environment for infants (Gooding, 2010).

According to Gooding (2010), medical music therapy, which has developed rapidly in the past 15 years, has been shown to be effective in reducing stress, reducing the perception of pain, reducing stimulus deprivation and promoting psychological adjustment to trauma. Just as importantly, music has few, if any, unwanted side effects. (p. 212).

This type of intervention can be the key to solving many issues seen within a NICU. Music has unique acoustic properties that can serve as a masking agent for much of the routine ambient noise in both the NICU and other general hospital environments. Music is acoustically different from all other sounds because it is both sound and silence expressively organized in time. These properties allow music to mask ambient sounds and promote appropriate neurological simulation through therapeutic exposure (Gooding, 2010).

A theory on development involves the ecological perspective that an individual's behavior is inseparable from the environment. The environment influences the behavioral, social and neurological outcome of an individual. Normally, individuals and their environment are constantly changing in a process of mutual adaptation. In the case of infants in the NICU, the environment does not change much and consistently supplies inappropriate interaction for the

developing infant. The environment should be manipulated to support optimal developmental outcomes. By adding music to the routine noise of the NICU plus quiet time, variety to the environment will be apparent and thus facilitate development (White-Trout et al., 1994). According to Blackburn (1998), the ideal environment for a NICU would meet the infant's physiologic or neurobehavioral needs, since the infant is transitioning from intrauterine life to extrauterine life, the environment should be more conducive for development of the nervous system. This can be accomplished through modification of both the physical environment (light, noise) and caregiving interventions (handling, positioning, organization of care). Music has the potential to assist with this modification. Music applied therapeutically can soothe and provide exposure to complex auditory stimuli that promote appropriate neurological simulation (Gooding, 2010).

Dependent Variables

The dependent variables used in this review are behavioral responses, daily weights, and length of hospital stay.

Behavioral responses. Behavioral responses are defined as agitation seen by crying, muscle tension, facial expressions, restlessness, sleep state, and irritability to stimuli. This definition comes from Als (1982) as described earlier. The objective is to determine how an infant responds to music. Does the music cause the infant to calm and relax or does it create stress? Observing behavioral responses will help to determine what the infant feels about the music. There is not a standard scale or method to measure these behaviors, but a trend in the majority of articles reviewed shows an affinity towards one behavioral scale. Developed by Als (1984), the same author who has determined infant responses as "stress reactions" or "selfregulatory behavior," gives a seven point behavior scale describing the infants deep sleep state to highly aroused state which measures the infants stress level.

Daily weight change. Another variable tested is daily weight change. Weight is indirectly effected by music. According to Blackburn (1998) Energy Conservation Model, the less stress behaviors the infant is undergoing, the more energy or calories the infant has available for growth, development, and healing. This would imply that if music creates a calming effect, which decreases stress behaviors typically seen in the NICU, the weight should increase. The best observation of weight gain or loss is through a daily weight measurement. Daily weight is usually measured in grams and used as a trend. Typically NICUs do not have a weight requirement to be discharged home, rather the infant must be able to self maintain normal body functions. Body temperature regulation is not usually seen until about 2000 grams of weight (Trachtenbarg & Golemon, 1998). The average weight at the time of discharge can vary and therefore it is not as important as the infant's ability to self support. The more weight the infant gains, the more likely the infant will be able to self support (Trachtenbarg & Golemon, 1998).

Length of stay. The final dependent variable is length of stay in the NICU. This variable is also indirectly affected by music. If music is able to decrease stress behaviors, energy will be able to be used for growth and healing, which in turn should decrease the time the infant needs to be in the NICU. The faster the infant is able to gain weight and heal from their condition, admission to the NICU will be shorter than without music therapy. Length of stay is the number of days the patient is in the hospital from time of admission to discharge. According to the National Perinatal Information Center (2011), the average length of stay for all gestational ages admitted to a NICU is 13.2 days and for very early premies, infants born under 32 weeks gestational age, the average is 46.2 days. Infants born between 32 and 33 weeks gestational age have an average length of stay at 20.3 day and 34 to 36 weeks have an average length of stay at 9.8 days in the NICU.

Problem Statement

The problem for this systematic review is described as infants in the NICU face many difficulties that other infants who are not admitted to the NICU encounter. These difficulties range from an inappropriate environment which causes stress and hinders growth and development, to dealing with medical and surgical conditions that may affect the ability to handle difficult situations. Time spent in this environment can be very long and stressful causing agitation or behavioral changes (White - Traut et al., 1994). Following Blackburn (1998) Energy Conservation model, stress behaviors use the available energy first and whatever is left over goes to growth and development. It is speculated that this stress is hindering the infants ability to gain weight and heal, thus granting a longer stay in the NICU. The longer an infant is hospitalized the risk of infection is higher and financial issues also occur for the parents and hospitals (National Healthcare Safety Network, 2010). Blackburn (1998) found, "Preterm infants often require long hospitalization and are at risk for developing iatrogenic complications from interventions to ensure their survival as well as from the intensive care nursery environment" (p. 281). If an infant can be discharged sooner, multiple problems can be avoided. According to previous research, the environment affects the developmental process of neonates and music has been found to help mask the startling noises from alarms and other routine noises found in the NICU (Gooding, 2010). The purpose of this systematic review is to identify research studies or evidence regarding music therapy as an intervention that can create a less stressful environment. decrease stress behaviors, which in turn will increase weight and decrease the length of stay. The goal for finding such an intervention is to apply it to clinical practice by nursing on a daily basis.

Research Question

For this systematic review, the following research question will guide the investigation in the literature search of research to date. Does music therapy in the NICU create a less stressful

environment as evidence by behavioral scores, improve weight gain, or decrease the length of stay for infants?

Significance to Nursing

The significance of this review can change clinical practice and create further research for music therapy. If proven beneficial, the intervention of music can be applied to all infants in the NICU to decrease stress behaviors, improve growth and healing, which will decrease the length of stay. Currently, most NICUs do not use music therapy as a standard practice because the body of literature is limited and it is a newer intervention still under investigation. Music therapy can change clinical practice by being used as a daily intervention. This intervention can be set up to be delivered in a couple different methods such as, speakers in the infants crib or with an overhead sound system regulated to the appropriate sound level. The preselected music can be easily played for a determined time. Most NICUs have a regular "quiet time" used as a daily intervention; music therapy could also have a scheduled time throughout the day. Nurses will find this intervention to not interfere in their daily routine and be implemented with relative ease at the bedside by the nurse pressing a "play" button.

The infants and their families will benefit the most from music therapy. Decreased stress allows for the infant to be more comfortable and less irritable, retain energy to apply towards growth and healing, and have a shorter stay than what might be anticipated without music. Shorter stays in the hospital has been proposed as a way to reduce the risk for infection and hospital acquired infections. Anecdotal reports by families attest to how music is calming and pleasant, and the use of music makes the stay for everyone more agreeable. This intervention will also benefit nursing by creating a calming effect for the infant, leading to an infant at ease requiring less one on one attention. If the nurse does not have to always be at the bedside, time is freed up to allow for other important tasks of the infant's care. Assessment and judgement by the

bedside nurse will determine if it is appropriate for usage of music at that time. The advance practice nurses can identify patients who may benefit the most from the intervention and use the music guidelines to select appropriate music. Further research is needed in evaluating the effectiveness of music therapy in the NICU.

SEARCH STRATEGY

The aim of this review is to identify, appraise, and map the available evidence on music therapy in a NICU and its effects on behavior, weight, and length of stay in infants. A search of the literature using CINAHL, PubMed, and PsychInfo databases, without limiting the year of publication was conducted. The search started with a basic search of "music therapy in the NICU," from there the search was modified to include other articles using "neonatal intensive care unit" and "newborn intensive care." The results were limited using the variables tested in the study such as "weight," "length of stay," and "behavior," although many articles were retrieved most did not fit the basic inclusion criteria. Additional studies were identified by reviewing reference lists of matching articles. Many articles were screened for eligibility, but quickly excluded due to the type of "music," which most often was not really music rather sounds or some other intervention such as "multimodal stimulation." A total of 37 full text articles were read and carefully analyzed for the inclusion and exclusion criteria. The final number of articles included in the review were 13.





THE SAMPLE

Selection Criteria

From the articles retrieved through the search of databases and reference lists, a preliminary selection was conducted. The number of articles were filtered down by adding search terms specific to the systematic review such as "behavior," "weight", or "length of stay." This was conducted in three separate searches, one for each variable. In each search, any duplicate articles were removed. In the end, there were three sets of preliminary articles to screen for inclusion and exclusion criteria. Some of the articles tested for more than one variable and thus were included in multiple sets.

Inclusion criteria. The articles fitting the inclusion criteria to be part of the systematic review must meet minimum requirements to be screened for all inclusion criteria first. The article was either a research study, meta-analysis, or systematic review. The required written language was English and published in a peer reviewed journal. A review of the title and abstract was used to identify a majority of the inclusion criteria and as long as no exclusion criteria applied, the article was placed into the screening of the full text. Other inclusion criteria consisted of the setting in which the study took place. The required setting was in a neonatal intensive care, level did not matter, or another term for the same setting was a newborn intensive care unit. The age group of the subjects was under one year of age, which is classified as an infant, and could have been born at any gestational age. Any race, ethnicity, group, or gender was included. The music was played live or through a recording. The music was instrumental, some contained minimal vocals, and was determined by a musical therapist. If the music was not determined by a musical therapist, the music was of soothing tempo and repeated melodies, such as lullabies, and played at a comfortable level, no louder than 85 decibels. These characteristics were determined by music therapy guidelines set by a musical therapist (Gooding, 2010). Each study contained at

least one testable dependent variable. It tested the effects from music on weight, either daily weights or admission weight and discharge weight. The effect music had on length of stay in the NICU was measured in number of days starting from admission to discharge. The final variable was behavioral changes. The behavior of the infant was observed and noted for changes throughout the music study as a dependent variable. A behavior or agitation scale was included to quantify the behavior, and was compared to the other variables. The study tested at least one dependent variable for its effects from music but some studies contained all three dependent variables.

Exclusion criteria. The studies that met the inclusion criteria also did not have any of the exclusion criteria. Other than not fitting the inclusion criteria, only few specifics were part of the exclusion. The setting was not in a newborn nursery, pediatric intensive care, or other pediatric floor that contained infants. The age range for the subjects was not more than one year of age. The music was not of vocals only, or ambient sounds such as "womb" noises. These sounds do not fit the music therapy guidelines (Blackburn, 1998).

Strengths

The strength of this systematic review was based on a variety of studies with different populations, environment, and how music therapy was implemented. Even though the studies fit the criteria, and therefore are similar, there were a variety of differences. This is a strength since the objective of a systematic review is to encompass as many studies as possible and determine the overall effect of the intervention, a true answer to the research question is determined. An individual study can have limitations that may affect the results, but when numerous studies are analyzed together, the validity of the results can be better determined.

Limitations

The search for articles created a limitation due to the term of "neonatal intensive care" not being a standard search term for that specific unit, additional searches using "NICU" or "newborn intensive care" had to be used to find all articles. The unit is named differently at many hospitals and therefore made the search more extensive. Another limitation was the search retrieved many articles due to the large number of search terms needed to find specific articles. Numerous irrelevant articles had to be filtered out to find matching articles for the review.

QUALITY APPRAISAL

Using the Level of Evidence (Melnyk & Fineout-Overholt, 2011), each article was appraised for its level of evidence based on the likelihood of reliable evidence to lacking of direct evidence. A level I evidence is considered the highest quality of evidence and a level VII is the lowest quality. The goal was to have high quality evidence to include in the review so that the power of the results from the review could be determined as strong evidence. The level of evidence was determined from a scale created by Melnyk & Fineout-Overholt (2011), all results were placed into a table for viewing (Table 1a,b,c,d).

Results for Level of Evidence

After reviewing each study to determine its level of evidence, the article was placed into a table for viewing. The level of evidence was based off the research design and the proper methods used in the study. Some articles had a valid research design but did not account for the tests or interventions clearly and this made the evidence unreliable. Other articles took a realistic approach in their research design, such as a controlled trial versus a truly randomized control trial. This type of design was not considered as valid, but the methods and consistency for obtaining data were reliable. The level of evidence took into account the validity of the research design and the reliability of the data collected to obtain its overall level.

Level of evidence for each article. A total of 13 articles met the inclusion criteria for the review. Of the 13, behavior was measured in 12. A total of 5 articles measured weight and 3 measured length of stay. Some articles measured multiple variables, but each article was given a level of evidence only one time. *Table 1* displays all 13 articles and the rationale for determining its level.

Dependent variables.

Behavior. Most studies chose to measure behavior and therefore more evidence was available for that dependent variable. Within the studies that measured behavior, 3 studies met criteria for a level I, 3 met criteria for a level II, 5 met criteria for a level III, and 1 met criteria for a level IV. A majority of the studies met criteria for a level III, which is in the midrange level, signifying the quality of the research design. 6 of the studies met criteria for either a level I or II, implying the evidence found for behavior is lacking on its likelihood of reliable evidence.

Weight. There were 2 studies which met criteria for a level I, 1 study met criteria for a level II, and 2 studies met criteria for a level III of the articles that measured weight. The dispersement of levels indicate an inconsistency of research design when weight was measured. Testing for weight was not conducted consistently and should have been accounted for more carefully. The methods used to gather data for weight were not consistent within the study nor were the methods consistent among all studies. The evidence is unreliable.

Length of stay. Of the 3 studies that measured for length of stay, 2 studies met criteria for a level I and 1 study met criteria for a level III. The number of studies that measured for length of stay was 3 which is a fewer number of studies compared to the previous variables. Although, 2 of these studies were meta-analyses, which contain a large body of evidence. The evidence generated from the studies was considered reliable.

Methods for Intervention Delivery

The intervention used in all studies was music therapy. The delivery method of music therapy and the length of time differed between studies. For example, in the study by Arnon et al. (2006), live harp music was played to the infants for thirty minutes and a recorded version of the same music was also played for comparison. Other studies, such as Butt & Kisilevsky (2000), Shoemark (2003), and Caine (1991), used recorded lullabies which followed music therapy guidelines as appropriate and finally live or recorded music was combined with another form of care such as kangaroo care in the studies by Schlez et al. (2011), Lai et al. (2006), Teckenberg -Jansson, Huotilainen, Pölkki, Lipsanen, & Järvenpää (2011), and Keith, Russell, & Weaver (2009).

Instruments for Dependent Variables

The instruments used within the studies to determine each dependent variable varied among the studies. The inconsistency of instruments for measurement made the overall recommendation from the review open to interpretation. The instruments used are described below.

Behavior scales. There was no standard method to test for behavior changes in infants, therefore a few scales were used. The most common tool used for behavior was a scale by Als (1984), it is a seven point scale identifying whether the infant is in a deep sleep (1) to quiet awake or alert (4) to prolonged respiratory pauses greater than eight-seconds (7). This scale was utilized in 2 studies; Arnon et al. (2006) and Schlez et al. (2011), others used a modified version of the scale consisting of a five point or six point scale. In a study by Malloch et al. (2012), the Neurobehavioral Assessment of the Preterm Infant scale was used and it was difficult to understand the overall behavior state of the infant in comparison to the scale by Als (1984).

Weight and length of stay. The other measurements of weight and length of stay are tangible numbers and do not require interpretation to understand. The studies in this review were inconsistent about the method used to gather the data and the reliability of the data needed to be considered. In a study by Teckenberg - Jansson et al. (2011), the study design did not measure weight as a dependent variable, rather data was pulled from the subject's chart and this weight measurement was not at the same time as all subjects. All subjects received each intervention that was used in the study and weight was not measured after each intervention. The average daily weight gain was calculated at discharge from the recorded weights in the chart. It cannot be determined if music affected weight or not with this design. Length of stay is the only measurement with consistency. The number of hospitalized days for the subject was calculated and compared within the study.

Resulted Effects From the Studies

Each study in this review adds to the body of knowledge for music therapy and its use in different settings with multiple effects.

Behavior. The measurement of behavioral responses is measured the most often in this review; with a total of 12 studies measuring behavior. The highest level of evidence for behavior was from 3 level I studies, a systematic review and meta-analysis by Hartling et al. (2009), Standley (2002), and Standley (2012). These studies concluded that music has a positive and significant effect on behavior, but further research is warranted. Lai et al. (2006), found music resulted in more occurrences of the quiet sleep state and fewer of the crying state, and concluded the more exposure to music leads to better behavior states. Similar to that result, behavior scores showed a gradual decline of arousal, from agitated to calm, during live music therapy in a study by Arnon et al. (2006). The reduction in frequency and duration of inconsolable crying episodes in infants given music therapy was found by Keith et al. (2009). No significant effect on

behavior from music therapy was found by Hodges & Wilson (2010a), Schlez et al. (2011), and Shoemark (2003).

Weight. The dependent variable of weight was not measured in 8 of the 13 studies and the evidence available is minimal. Two studies, Malloch et al. (2012), Standley (2012), and Teckenberg - Jansson et al. (2011), found no significance in weight changes effected by music therapy. Contradicting this result was music had a positive and significant effect on weight which was found by Standley (2002), and Caine (1991).

Length of stay. The final dependent variable length of stay was measured in 3 studies included in this systematic review. Two of the three studies, Standley (2002), and Standley (2012), were of level I evidence. These studies and a study by Caine (1991) found music significantly decreased the length of stay in a NICU.

Grading of Recommendations

After each individual article was graded for their level of evidence, the articles were grouped by the dependent variable and study findings. There were three variables displaying effects from music therapy, the variables were weight, length of stay, and behavior. Some articles were found in multiple grading tables because there was more than one variable. Evidence was graded using the Grading of Recommendations by the Joanna Briggs Institute (2008) to determine the overall recommendation for use of music and its effects on weight, length of stay, and behavior in a hospitalized neonatal population. Each group was graded for its feasibility, appropriateness, meaningfulness, and effectiveness. (Table 2a,b,c).

The evidence for behavior consisted of research which varied from level I to level IV studies, with the majority of studies a level III. The evidence for weight consisted of some evidence generated from level I research, but other evidence came from less valid research designs. There is no reliable evidence for weight affected by music therapy. Length of stay

evidence came from 2 level I and 1 level III research designs, but 3 of the 13 studies tested for this variable, indicating further research is necessary.

Feasibility. Feasibility is defined as the "practicality and utility of an intervention or activity and to factors that affect decision making among policy makers, clinicians, and patients" (Joanna Briggs Institute, 2008, p.2). This intervention does require equipment and minimal training once preselected music is determined from practice guidelines. Each study used music therapy differently and some methods where more practical than others, but nonetheless there is a variety of options that may be economical for each situation. The feasibility for all three variables was graded as a "B." Considering all available evidence it is determined that music therapy in the NICU had moderate support that warrants consideration of application and it is practicable with limited training and modest additional resources.

Appropriateness. The appropriateness was considered from all studies. Appropriateness is defined as "evidence about the extent to which an activity or intervention is ethical or culturally apt" (Joanna Briggs Institute, 2008, p.4). A collection of studies took place outside of the United States and involved different types of music that was more culturally accepted in that area. Therefore, the intervention was tested in multiple environments under different cultural expectations demonstrating how it can be manipulated to be appropriate for everyone. Behavior was graded with an "A." There are many high quality studies which took place in different parts of the world with different types of music applied to fit the culture or norm of that area. The lower quality studies also were in different parts of the world and reflected appropriateness. Music therapy in the NICU for its effects on behavior is ethically acceptable and justifiable with strong support that merits application. A grade of "B" was given to weight and length of stay for the appropriateness. Even though there are high quality studies in both of these variables, the variation on music in different parts of the world was minimal, partially due to the total number

of studies which tested these variables. The cultural and ethical acceptance is unclear but there is moderate support that warrants consideration for application.

Meaningfulness. Meaningfulness is defined as "evidence about the personal opinions, experiences, values, thoughts, beliefs or interpretations of clients and their families or significant others" (Joanna Briggs Institute, 2008, p.5). In the studies which tested for behavior, the authors presented their experiences or thoughts about how the music positively affected the subjects and their families. Some studies conducted parent or staff opinion questionnaires about the music, such as the studies by Arnon et al. (2006) and Keith, Russell, & Weaver (2009). A grade "A" was given to behavior for meaningfulness. The evidence for music therapy and its effects on behavior for its meaningfulness provides a strong rationale for practice change and has strong support that merits application. Weight and length of stay again have minimal studies which express any thoughts towards the meaningfulness of music therapy in the NICU, therefore a "B" grade was given. The studies do provide a moderate rationale for practice change and there is moderate support that merits consideration for application.

Effectiveness. The effectiveness is defined as "evidence about the effects of a specific intervention on specific outcomes" (Joanna Briggs Institute, 2008, p.5). For the effectiveness of behavior, 8 studies showed a positive effect from music and three studies demonstrated no effect from music. Of the 8 studies, four studies were a level I research and three of the four had statistically significant positive effects on behavior. Two studies were a level II research and had positive statistical significance, three level III research studies also demonstrated a positive significant effect. A grade "B" was given because the effectiveness is established to a degree that suggests application for music therapy in the NICU on behavior. The variable weight was given a grade "B" on effectiveness. Two studies tested for weight, which were not apart of the meta analysis, both found no significance but research design flaws exist which effect the reliability of

the results. Two level I studies and one level III study did conclude music had a positive benefit on weight gain. The effectiveness is established to a degree that suggests application. Length of stay however earned a grade "A" for effectiveness. Three studies tested for length of stay, and two studies were level I research with a large amount of data. All studies in this systematic review that measured length of stay found positive significance on a decreased length of stay from music therapy in the NICU. The effectiveness is established to a degree and there is strong support that merits application.

CONCLUSION

This systematic review adds to the body of literature and will hopefully be found useful by clinicians. The problem infants encounter in the NICU can be significant now and later in life, since it has been found that the environment causes stress which theoretically affects the development of infants. Music therapy has been identified as an intervention which may counterbalance the effects currently seen in the NICU. The effects seen from music therapy on infants has not been studied extensively and this review summarizes the effects on behavior, weight, and length of stay. Clinicians researching music therapy as an intervention in the NICU population can refer to this systematic review for current evidence.

Evidence related to research question

The research question asked for this review was: Does music therapy in the NICU create a less stressful environment as evidence by behavioral scores, improve weight gain, or decrease the length of stay for infants? The evidence found by the multiple studies included in this review can be viewed in table 1 and are briefly discussed in the quality appraisal. Behavioral scores were found to be lower, or less heightened of behavior, during and after music therapy. Some studies concluded music would be more beneficial if more encounters occurred. Other studies found no effect. Evidence for weight gain was divided, 3 studies found no effect and 2 studies found there to be an increase in weight. The recommendation is to consider application of music therapy for weight gain, although further research needs to be conducted to find a conclusive answer. The evidence for length of stay reveals a shorter time spent in the NICU and it is recommended to apply music therapy in the NICU to decrease the length of stay.

Limitations of systematic review

A limitation to this systematic review was contributed to the number of articles found. This specific type of research has not been conducted for very long or regularly, therefore the number of published articles was minimal. A smaller number of studies in this systematic review may not give an accurate picture of the effects from the intervention.

Another limitation found when grading the evidence was the amount of evidence available determined the effectiveness of the intervention as either strongly supported or not at all supported. If there was more evidence available the outcomes of grading may be different. Also, when analyzing the evidence, the inconsistency of behavior measurement left the results to interpretation and thus making it hard to concluded the reliability of the evidence. A standard form of measurement will allow for consistency in future research.

Implications for clinical nursing practice and future research

Nursing practice can use music therapy as a daily intervention, either play during the nurses discretion or have its own scheduled time throughout the day. A decrease in stress allows for the infant to be more comfortable. This will benefit nursing by the infant being at ease and requiring less one on one attention to please. If the nurse does not have to always be at the bedside, time is freed up to allow for other important tasks of the infant's care. Also, a shorter stay will help the infection rates decrease since the infant has less time to be exposed.

The profound evidence from this review merits further research of music therapy in the NICU and its effects on behavior, weight, and length of stay. The latter two variables have

minimal evidence available compared to behavior and future research should be focused on these variable since some evidence suggests a closer look. The research should take care into designing a protocol that will elicit the best possible evidence. This evidence can be the determinant whether music therapy should become a standard care in the NICU.

In conclusion, the potential for music therapy to be beneficial and used as standard practice in the NICU is possible. Evidence that infants experience a less stressful time when exposed to music is evident in the research. Other benefits seen are an increase in weight and decreased length of stay in the NICU. This systematic review is a collective research study available for healthcare personnel to review and learn about the benefits of music therapy and its effects on behavior, weight, and length of stay in the NICU.

Level	I	П	Π	Π
Critique: Strengths, Limitations	Strength: Analyzes each study individually Suggestions for future research Weakness: Number of included studies limited Results not clearly identified	Strength: Repeated measures Power analysis of sample size determined medium effect size Weakness: No control for music or KC, difficult to determine effects contributed from.	Strength: Power analysis of sample size, 20 subjects for significance Weakness: Potentially skewed sample Insufficient exposure to music Lack of proper measurement for behavior.	Strengths: Tested 2 different modalities of music and no music. Each subject received all 3 therapies, internal control. Weaknesses: Sample, no power analysis No true randomization, each subject was a control and experiment
Results	Music may be beneficial in terms of behavioral states. Further research is warranted.	Treatment group had more occurrence of quiet sleep states and less crying. Significance found on day 2. Control group had significantly more active awake and crying states on day 3 than the music group.	No significant differences between groups on behavior state.	Behavior scores showed gradual decline during live music therapy. Statistically significant after live music therapy. No behavioral effects from recorded music or no therapy.
Sample/ Characteristics	N= 9 studies Randomized control trials.	N=30 Preterm infant/ mother dyads in the NICU	N=22 Premature infants with a respiratory disorder	N=31 Stable preterm infants admitted to the NICU
Method, Variables, Type Music	Systematic Review. Behavior state.	RCT, repeated measure. Lullaby music with KC X3 days. Behavioral State Instrument	RCT. Recorded music. Organized versus disorganized behaviors, unknown tool.	Controlled trial, within subjects design. Behavioral state (Als, 1984). Live harp lullaby, recorded same music, and no music
Author, Title, Journal, Issue	Hartling, L. Et al. Music for medical indications <i>Fetal</i> and Neonatal, 94(5), F349-F354	Lai, HL. Et al. Randomized controlled trial of music during kangaroo care International Journal of Nursing Studies, 43,	Shoemark, H. The effects of recorded sedative music <i>Australian Journal</i> of Music Therapy, 14, 3-19.	Arnon, S. et al. Live music is beneficial <i>Birth</i> 33 (2)
Year	2009	2006	2003	2006
No.	-	2	3	4

Table 1. Level of Evidence Table: Scale I- VII (Melnyk & Fineout-Overholt, 2011)

	Level	Π	Ш	∃
	Critique: Strengths, Limitations	Strengths: Internal control, each infant received both therapies: kangaroo care (KC) with harp music and KC alone Power analysis of sample size determined medium effect size to be at N=48 Weaknesses: Treatments were only delivered once, behavior only measured twice No true randomization, each subject was a control and experiment	Strength: Sample size determined from previous studies conducted in their lab, indicating six subjects are sufficient. Weakness: Limited exposure to music, needed repeated measures. Did not disclose type of music effective for behavior Too many numbers without explanation, hard to read	Strength: Repeated measures Sample size determined from previous studies and meta-analysis Music therapy based on guidelines Weakness: Parents withdrew their babies from the study because they did not want their child to experience the no music intervention. No control for the standard care provided in addition to the intervention
erholt, 2011)	Results	No significance in behavior, scores remained unchanged.	significance between types of music in behavior states, but type not disclosed. Music returned behavior state to baseline or below after heel lance.	Significant reduction of the frequency and duration of episodes of inconsolable crying.
yk & Fineout-Ov	Sample/ Characteristics	N=52 Stable preterm infant/ mother dyad in the NICU	N=14 Preterm infants in the NICU	N=24 Premature infants in the NICU
ole: Scale I- VII (Meln	Method, Variables, Type Music	Controlled trial, within subjects design. Live harp music, Neonatal Behavior State (7 point scale)	Controlled trial, within subjects design. 2 phases to study, music condition and no music. Lullabies, 2 kinds: vocals and instrumental. Brazelton's state of arousal.	Controlled trial, within subjects, repeated measures design. Music during an episode of inconsolable crying, alternated with no music intervention. Crying frequency and duration, form of behavior.
el of Evidence Tab	Author, Title, Journal, Issue	Schlez, A. Et al. Combining kangaroo care and live harp music therapy <i>Israel</i> <i>Medical</i> <i>Association</i> <i>Journal 13</i>	Butt, M. L. & Kisilevsky, B. S. Music modulates behaviour <i>Canadi</i> <i>an Journal of</i> <i>Nursing Research</i> , <i>31</i> (4), 17-39.	Keith, D. R., Russell, K., & Weaver, B. S. The effects of music listening Journal of Music Therapy, 46(3), 191-203.
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Level	IV	Π	Ш	Т
Critique: Strengths, Limitations	Strength: Repeated measures Weaknesses: Poorly developed research design No power analysis or tool identified. No control group	Strength: Outside control group not exposed to any NICU stimuli Randomization Weaknesses: sample size, no power analysis Behavioral scale was not common, harder to analyze. Not consistant weights, mean weight gain	Strength: Repeated measures Weakness: Mal study infants received both treatments but were considered one group when weight was determined. Weight was averaged per day at discharge. Unable to assess whether music was a contributing factor to the results Poor design	Strength: Calculated effect size for each study Weakness: Number of included studies Year of publication, more recent research studies available
Results	No significant effects of behavioral distress was seen. During music an increased percentage of active sleep and decreased percentage of drowsy was seen.	NICU-MT group scored better on irritability and crying extent compared to NICU-noMT. NICU-MT compared to control showed a close behavior score at end of treatment. No significant weight gain.	No significant differences between groups on weight.	Music generally has a positive and significant effect in the NICU. Significant benefits for behavior state, weight gain, and days in hospital.
Sample/ Characteristics	N=20 Preterm infants in the NICU, who receive at least one session of music therapy prior to study	N=39 Full term infants in NICU, and control group healthy non- hospitalized infants.	N=61 Premature infants in the NICU Comparison group of 52. Infants in NICU, standard care only	N= 10 studies Premature infants in a NICU
Method, Variables, Type Music	One group, repeated measures design, case- control. Live music lullabies sung with guitar. Behavior (no tool identified)	RCT. Live music and control of no music in the NICU and non- hospitalized infants. Neurobehavioral assessment of Preterm Infants and Weight	Controlled trial, within subjects, repeated measures design. KC combined with music one day, KC alone on next day. Music from stringed instruments. Growth/Weight	Meta-analysis. Music as an independent variable. Behavior state, weight gain, and days in hospital.
Author, Title, Journal, Issue	Hodges & Wilson. Effects of music therapy Alternative Therapies, 16(5)	Malloch, S. Et al. Music therapy with hospitalized infants <i>Infant</i> <i>Mental Health</i> <i>Journal 33</i> (4)	Teckenberg- Jansson, P. Et al. Rapid effects Nordic Journal of Music Therapy, 20(1), 22-42.	Standley, J. M. A meta-analysis of the efficacy Journal of Pediatric Nursing, 17(2)
Year	2010	2012	2011	2002
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Level	Ι	Ш
Critique: Strengths, Limitations	Strength: Calculated effect size for each study Number of included studies tripled in size compared to last study Weakness: None seen	Strengths: Exposed to music multiple times until discharge Weaknesses: Small Sample, no power analysis No randomization, assignment of subjects No behavior scale, observation only
Results	Music consistently has positive and significant impact. significant for behavior and length of stay. not significant for weight gain.	Significantly increased daily average weight, reduce length of stay, and reduce stress behaviors in the music group.
Sample/ Characteristics	N=30 Preterm and low birth weight infants in the NICU	N= 52 Stable preterm and low birth weight newborns in the NBICU
Method, Variables, Type Music	Meta-analysis. Music as an independent variable. Behavior state, weight gain, and length of stay.	Quasi-experimental. Recorded lullabies, 60 minutes of music alternated with routine auditory stimulation three times daily until discharge. Weight, Behavior, and LOS
Author, Title, Journal, Issue	Standley, J. M. Music therapy research <i>Neonatal Network:</i> <i>The Journal of</i> <i>Neonatal Nursing</i> , <i>31</i> (5)	Caine, J. The effects of music Journal of Music Therapy, 28(4)
Year	2012	1661
No.	12	13

Table 1. Level of Evidence Table: Scale I- VII (Melnyk & Fineout-Overholt, 2011)

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Table 2c. Grading of Recommendations Table: For overall recommendation of Length of Stay

	Grade	X		
	Effectiveness	Strong support that merits application	Moderate support that merits consideration for application	Not supported
	Grade		X	
	Meaningfulness	Strong support that merits application	Moderate support that merits consideration for application	Not supported
	Grade		X	
	Appropriateness	Strong support that merits application	Moderate support that merits consideration for application	Not supported
)	Grade		X	
	Feasibility	Strong support that merits application	Moderate support that merits consideration for application	Not supported
	Grade of Recommendation	¥	B	С

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