The effectiveness of music therapy on feeding and weight gain in premature infants in the NICU: a systematic review

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Abstract

Infants born prematurely are underdeveloped in certain physiological aspects, including the gastrointestinal system. Oral feeding and sufficient weight gain are encouraged in the NICU environment and interventions are put in place to assist the infant in this regard. However, not all preterm infants can tolerate oral feeding due to their immature organs. Research in music therapy has developed interventions to assist the infant in obtaining full oral feeds and optimal weight gain. Conversely, these techniques have shown varied outcomes. A systematic literature search was carried out across multiple databases and ten studies met the eligibility criteria for inclusion in the review. Findings from the ten studies suggest that music therapy, both as a live and receptive modality, proved beneficial to the feeding and weight gain aspects of a developing premature infant. The analysis included i) types of interventions used; ii) music therapist vs parental application; iii) factors for consideration for application of music therapy intervention; iv) transition to oral feeding; v) self-regulation; vi) physiological development of the sucking-swallowing-breath skill; and vii) the impact of music therapy on weight gain. Recommendations for further research of music therapy interventions for feeding and weight gain with premature infants are suggested. Specifically pertaining to the extension of qualitative research in the NICU and the application of music interventions by healthcare professionals other than music therapists to assist premature infants in oral feeding and weight gain.

Keywords

Music Therapy, NICU, premature infants, feeding, weight gain, integrative literature review.

List of abbreviations

NICU- Neonatal Intensive Care Unit

PAL- Pacifier Activated Lullaby

PAM- Pacifier Activated Music

EMT- Environmental Music Therapy

AAP- American Association of Pediatrics

Declaration of Plagiarism

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Chapter 1: Introduction

1.1 Background and context

The Neonatal Intensive Care Unit (NICU) is a specialised unit within hospitals that cater for paediatric patients, specifically infants born prematurely or born with biological deficits that result in them needing assistance in the extrauterine environment (Kenner & Lott, 2016). This environment is characteristically stressful on patients and family members taking into consideration factors such as unwanted noises from the machines, and overstimulating stimuli (Nöcker-Ribaupierre, 2013). The World Health Organisation (2012) defines a premature infant as an infant who is born before 37 weeks and is still alive. These premature infants are still developing and require assistance in their development. An important aspect that is typically focused on in the NICU is the feeding schedule and methods of feeding. During gestational development, the foetus starts developing the gastrointestinal system at around ten weeks. However, infants born prematurely struggle with enteral (oral) feedings and have to go through a process of various feeding methods before they are capable of tolerating full enteral feedings (Kenner & Lott, 2016). Premature infants that are unable to feed orally are placed on a feeding tube and are slowly transitioned over to oral feeding, in the form of bottle-feeding or breastfeeding. This transition from tube feeding to oral feeding can be a slow process as the infant's gastrointestinal system may not yet be fully developed, causing the infant to aspirate their oral liquid intake, and slowing growth and development (Kenner & Lott, 2016).

Therapeutic interventions have been designed to assist premature infants in their transition from parenteral to enteral feeding (Chorna et al., 2013; Loewy et al., 2013; Standley et al., 2010). These interventions target sucking and swallowing skills as well as incorporate interventions to assist the infant in obtaining homeostasis, a state of balance in all physiological parameters, making the oral feeding experience for the infant more tolerable.

Research in music therapy has been conducted to investigate the development of sucking and swallowing skills in premature infants through the intervention of lullaby pacifiers, whereby the music therapy is administered prior to oral feedings (Chorna et al., 2013; Loewy et al., 2013). These interventions have shown results in easier transitions from tube feeding to oral feeding. While the development of sucking and swallowing skills is crucial to the premature infants' feeding schedule and their transition from tube feeding to oral feeding, another

important aspect is optimal daily nutritional intake and tolerance to nutritional intake. Nutritional intake is determined by the weight of the infant and at which week of gestational age the infant is born. Premature infants are typically required to consume 110-135 kcal per day in the form of enteral feeding (Kenner & Lott, 2016). The present study investigated existing literature on music therapy with premature infants. It focuses on the effectiveness of music therapy as an intervention to promote the feeding and nutritional intake of premature infants in the hopes of achieving optimal weight gain and earlier discharge from the NICU.

1.2 Research aim

The aim of the study is to review published literature that focuses on the effectiveness of the use of music therapy with premature infants to promote oral feeding or assist with a smoother transition from parenteral feeding to enteral feeding, and how these music therapy interventions may also impact weight gain.

1.3 Research questions

Main research question:

What is the effect of music therapy on feeding and weight gain with premature infants in the NICU?

Sub-questions:

- What are the different music therapy interventions used to target feeding with premature infants in the NICU?
- What does the literature suggest, regarding when music therapy should be implemented with the premature infant?
- What does the literature say about how music therapy assists infants in the transition to oral feeding?
- What impact on weight gain do the targeted music therapy interventions have?

1.4 Chapter overview

In the second chapter, a brief overview of the literature on the current topic will be explored. Important aspects of the development of an infant and the effect that premature birth may have on the development of an infant, specifically within the context of the gastrointestinal system and auditory system, will be discussed. As stated previously, premature infants are

placed in a specialised unit called the NICU and remain in the hospital until they have reached sufficient developmental goals. Chapter two will give a brief description of the NICU environment and the treatment and care for fragile premature infants specifically in the context of feeding. The chapter will conclude with the current literature on music therapy being utilised in the NICU, and the developmental effects music therapy interventions have on the premature infant.

Chapter three explains the methodologies used within this study and posits the benefits and processes of an integrative review. A detailed explanation of the search strategy for existing appropriate literature and the process of extracting relevant articles for the study will be addressed. Chapter four comprises the results and findings of the articles extracted, as well as details regarding the relevant literature which will be placed in a table format. Chapter five will discuss the findings in relation to the research questions and will provide the reader with further implications for the music therapy profession. The final chapter of the study will conclude the study and discuss limitations that occurred throughout the process of the study. Suggestions for further research will be stated in the conclusion.

Chapter 2: Literature Review

2.1 Introduction

Bright lights, loud sounds, unnatural social environments, and uncomfortable procedures are some of the stressful characteristics imposed on premature infants found within the Neonatal Intensive Care Unit (NICU). These stimuli can be overstimulating and damaging to the developing infant born prematurely and have been shown to cause challenges within the infant, such as infection, loss of weight, feeding problems, excessive energy expenditure, and later discharge dates (Goldson, 1999). However, when the stimulation is reduced, infant development has been shown to improve markedly (Kenner & Lott, 2016).

Martin (2018) describes a premature infant as an infant who is born before 37 gestational weeks. These infants are acutely sensitive to all external stimuli, and interventions are needed to compensate for these stimuli, assisting in the growth and development of the premature infant. As stated previously, one of the challenges faced with premature infants in the NICU, is feeing. Due to the underdeveloped gastrointestinal system and sucking-swallowing skills, premature infants struggle to engage in enteral (oral) feeds after birth and as a result acquire their nutrients via parenteral methods (Embleton & Simmer, 2014; Kaya & Aytekin, 2016).

Emery et al. (2018) focus on the developmental needs of premature infants with emphasis on the infants who are hospitalised for long periods of time. Extended hospital stays for the premature infant have been found to impact the clinical stability of the infant and the velocity of weight gain directly (Auto et al., 2013). NICU staff aim to improve the infant's overall well-being and work towards a healthy discharge date. While a decreased length of stay is ideally aimed towards, and benefits, the developing infant, an earlier discharge date can also be beneficial to the hospital. Martin (2018) states in her study that NICU facilities are one of the most expensive departments to run within a hospital and a decreased length of stay for infants can also reduce the costs for the hospital.

Studies have shown that music has proved beneficial in the physiological and behavioural development of a premature infant during their stay in the NICU. Results have shown: stabilised heart rate, weight gain, sucking skill improvement, oxygen saturation increase, deeper sleep, and in turn, earlier discharge from the NICU (Amini et al., 2013; Standley, 2012; Standley & Swedberg, 2011). In the context of feeding and weight gain, studies in music therapy regarding the Pacifier Activated Lullaby (PAL) have shown positive results,

specifically in the transition from parenteral to enteral feedings (Standley, 2012; Standley & Swedberg, 2011).

2.2 NICU environment

Infants treated in the NICU range from premature infants to infants born with health problems or those who have gone through a stressful birth process. The NICU staff aim to assist the infant in their developmental needs and establish attachment bonds between the infant and their parents. NICU staff work towards the healthy discharge of the infant as no discharge will be allowed if the infant is not healthy (Harer & Moreno, 2019).

The premature birth of an infant can be stressful for both the parents and the infant. However, considering that the infant is now being forced into an unnatural sensorial environment, the natural intrauterine development can be compromised due to environmental stressors found within the NICU environment (Martin, 2018). Due to auditory sensitivity, premature infants can easily become overstimulated which has been shown to be detrimental to their long-term neurodevelopmental outcomes, as well as experience an increase in heart rate, blood pressure, respiratory rates, and a decrease in oxygen saturation (Martin, 2018; Yue et al., 2020). Studies have shown that light, sound, social and procedural aspects within the NICU can either overstimulate or understimulate, in comparison to the stimulation a full-term infant would receive in their home environment (Goldson, 1999).

Procedures, interventions and guidelines have been put in place within the NICU to compensate for these stimuli. Goldson (1999) has recommended that light should be reduced, or patches worn over the eyes to block out the harsh clinical lights. Noise intensity should be decreased throughout the entire NICU environment and within the incubator. Procedures that need to be performed on the infant should be timed and kept to a minimum, so as not to stress the infant, and more skin-to-skin contact and cradling should be administered, to socially stimulate the infant. Some of these recommendations can prove challenging and time-consuming for the staff within the NICU and, therefore, interventions have been put in place to help compensate and assist nursing staff with the overstimulating environment.

2.3 Premature Infants in the NICU

In some cases, premature infants can be born as early as 26 weeks. Prematurity, as defined by Rubin (2014 p. 113), is “the term used when a newborn infant is delivered before term and is often associated with low birth weight, of less than 2500 grams.” Length of stay within the

NICU can be directly correlated to the gestational age of the premature infant. Infants born closer to term, typically leave the NICU earlier than those born more prematurely. The earlier the infants are born, the more intrauterine developmental milestones are not met. Due to the decrease in the infants' self-protective and self-regulatory abilities, it is the responsibility of the healthcare workers to understand how the infant should develop and how the healthcare workers can assist in helping the infant to develop and achieve these milestones (Nöcker-Ribaupierre, 2013; Rubin, 2014).

The development of the auditory system is very sensitive in full-term infants but is even more so in premature infants. When looking at the development of the auditory system, Nöcker-Ribaupierre (2013) explains that the initial structure of the ear is established within the third week of gestation. At 18 weeks the cochlea begins functioning, allowing the foetus to hear auditory stimuli from the extrauterine world. At 26 weeks of gestational age, the foetus can react to auditory stimuli (Amini et al., 2013; Auto et al., 2013). Even though the foetus is capable of reacting to external auditory stimuli, the auditory system is still developing. Therefore, when infants are prematurely born at this age, or up until 37 gestational weeks, they are highly sensitive to auditory stimuli. With regard to auditory stimulation, the main concern with premature infants is the development of the vestibular system which can be impacted because of damage to the cochlea or hair cells found within the ear. According to Allen (2013), damage to these parts of the auditory system can occur from noxious stimuli in the environment such as unwanted noise. The NICU tries to compensate for the sensitivity to auditory stimuli by trying to avoid noise levels above 45dB.

The gastrointestinal system is one of the key systems that develops in an infant during their intrauterine life. As stated previously, underdeveloped gastrointestinal system, commonly found in premature infants, have been shown to cause challenges for the premature infant and the nursing staff, specifically in the context of feeding and nutritional intake (Kenner & Lott, 2016). The gastrointestinal system serves the function of absorption, ingestion, digestion of nutrients and elimination of waste products. According to Kenner and Lott (2016), this system begins developing within the third to fourth foetal week and is fully developed by the 20th foetal week. There are certain factors, in the extrauterine world, that can influence gastrointestinal development such as genetic factors, types of feeding, the diet composition, intrinsic timing mechanisms, when feeds are initiated, regulation of hormones and the types of nutrients, hormones and peptides that the infant is receiving through trophic feeds. Due to these factors, Kenner & Lott advise that enteral nutrition feeds are only administered at 33 to

34 weeks of gestational age. As the premature infant's gastrointestinal system develops and the sucking-swallowing and breathing skills are enhanced, the infant is capable of more oral feeds and absorbing more nutrients.

2.4 Feeding and Weight Gain in Premature Infants

One of the main criteria for premature infants to be discharged from the NICU is the tolerance of full oral feeds consisting of eight feeds in a day and a natural rate of weight gain. Adamkin (2009) identifies the importance of establishing different feeding strategies, through the understanding of foetal nutrition as soon after birth as possible, and that it varies from infant to infant but that each strategy provides the best foundation to improve the growth and development of the infant. These strategies reduce the complications and morbidities that the premature infant is challenged with, and vary from parenteral nutrition to enteral feeding consisting of bottle feeding, trophic gavage feeding and breastfeeding.

2.4.1 Feeding Programme for Premature Infants

Premature infants need to fulfill certain requirements in order for them to be discharged from the hospital. NICU staff aim for the earliest possible discharge date. Each individual infant is unique and develops at its own rate (Standley, 2012). Studies have shown that one of the key requirements for discharge is weight gain and the ability to tolerate full oral feeds. Optimal nutrition intake has been shown to improve growth and neurological outcomes within premature infants (Dutta et al., 2015). Kaya and Aytekin (2016) state that feeding problems in premature infants cause the infant to stop gaining weight, and as a result, the infant has to resort back to either gavage feedings or parenteral feedings. This delays the discharge date. It is due to these challenges that guidelines and feeding programmes are established and are uniquely developed for each individual infant (Dutta et al., 2015).

The feeding programme is established moments after the birth of the infant. Criteria that are considered in the establishment of the feeding programme are: gestational age, weight, sucking ability, muscular tonus, heart rate, pulse and respiration, and gastrointestinal maturity (Yildiz & Arikan, 2010). All premature infants are placed on parenteral nutrition within hours of their birth and remain on this form of feeding until they meet the requirements of the criteria for enteral feeds. Infants' tolerance to enteral feeding is determined by the maturity of the gastrointestinal system and the development of the sucking-swallowing and breathing skills (Yildiz & Arikan, 2010).

Premature infants transition slowly from parenteral nutrition to enteral nutrition and this process can take anything from one to two weeks, depending on the prematurity of the infant (Embleton & Simmer, 2014). During parenteral feeds, the composition of the feed predominantly consists of the nutrients the infant requires to gain weight and assist in maturing the gastrointestinal system (Kenner & Lott, 2014).

As stated previously, premature infants are transitioned from parenteral feeds to enteral feeds slowly, through trophic feeds, which consist of small volumes of milk administered through gavage (tube) feedings directly into the stomach (Dutta et al., 2015). Trophic feeds for infants weighing over one kilogram, initially consist of 30ml/kg/day of formula or milk and increase by 15-20 ml/kg/day, every two to three days, depending on whether the infant tolerated the previous day's feeds. These enteral feeds are administered every two or three hours, eight times a day, or as many times as the infant can tolerate until they are capable of orally feeding for the full day (Senterre, 2014). The end goal for the premature infant is to have a nutritional intake of 150-180 ml/kg/day in the form of enteral oral feeding, and for the infant to be gaining 10-20mg/kg/day in weight.

2.4.2 Forms of Feeding

There are various feeding interventions that are used with premature infants in the NICU. Premature infants are typically placed on parenteral feeds within hours of their birth (Nhlabatsi et al., 2018). Thereafter, the slow transition from parenteral feeding to enteral feeds which can be in the form of gavage feeding, through a tube, or oral feeds, in the form of a bottle or breastfeeding.

Parenteral feeding is the initial method of nutritional intake a premature infant undergoes. This method of nutritional intake is administered through a catheter inserted in a vein and consists predominantly of required nutrients (Embleton & Simmer, 2014; Kenner & Lott, 2016). Total parenteral nutrition has been found to improve the growth of the infant by reducing the weight loss the infant experiences post-birth, and assisting the infant to return to their birth weight at a faster rate (Malcom, 2015).

According to studies conducted by Standley (2012), when the premature infant is moved from parenteral feeds to enteral feeds, they remain on a feeding tube (gavage feeds) until approximately 34 gestational weeks. During this time interventions are put in place to enhance the infant's sucking skills through non-nutritive sucking (Standley, 2012). The importance of the non-nutritive sucking skill is to assist in gastrointestinal activity, growth,

and production of insulin. All these components help the premature infant to transition to full oral feeds and progress to a discharge date.

Enteral feeding, also known as oral feeding, or feeding where nutrients are administered into the gastrointestinal system, consists of different forms and is altered in accordance with the infant's tolerance (Nhlabatsi et al., 2018; Yildiz & Arikan, 2010). This form of feeding is preferred to that of parenteral feedings, as it has been shown to eliminate the risks of vascular catheterization, sepsis and fasting, which are risks found with total parenteral nutrition (Dutta et al., 2015; Embleton & Simmer, 2014).

Breastfeeding is highly recommended within the NICU environment with premature infants. Breast milk has been shown to help infants build immunity to disease and has overall better long-term health outcomes (Kenner & Lott, 2016). Premature infants are vulnerable to illness, which can be compensated for through the administration of the mother's breast milk. It is for this reason that mothers of premature infants are encouraged to breastfeed. Infants who have not developed the sucking-swallowing and breathing skills fully will likely struggle with breastfeeding. This may result in them aspirating and, therefore, not reaching their required nutrient intake (Goldson, 1999). Other enteral feeding interventions are employed when the premature infant is unable to tolerate breastfeeding such as gavage (tube) feeding. However, in the end, the premature infant is only discharged when they are capable of tolerating full oral feeds in the form of breastfeeding or bottle feeding.

2.5 Music Interventions Employed in the NICU

Vitale et al. (2021) describe the use of music, within the NICU for premature infants, as both a sensorial and cognitive experience and that it assists the infant in adjusting to the new multisensorial environment it is exposed to post-birth, as it stimulates and contributes to the development of the infant's sensory system. With the consideration of the NICU being such a specialised environment and its patients being so sensitive to sensorial stimulation, music interventions have had to adjust and compensate for the guidelines of the NICU environment and the sensitivity of the infant (Gooding, 2010). Music interventions aim at assisting in the physiological and neurological development of the infant and have shown positive results.

2.5.1 Sound

Infants' intrauterine world is exposed to auditory stimulus, however, it is very different to the extrauterine world. Goldson (1999) emphasises that sounds from the extrauterine world are

muted by the abdominal wall, the uterus, the amniotic fluid, and the biological sounds naturally produced by the mother (heartbeat and blood flow), reducing the external frequencies by up to 50dB (Nöcker-Ribaupierre, 2013).

As stated in section 2.3, when an infant is born prematurely it is suddenly exposed to loud, random, and noncontingent sounds, which the infant cannot control. This can be damaging to the sensitive auditory system. Studies have found that the auditory overstimulation that occurs within the NICU, can affect an infant's sleep, which can cause a negative chain reaction in physiological aspects such as inhibiting weight gain, tolerance to feeds, increased heart rate, excessive crying, increase in energy expenditure, all resulting in longer hospitalisation for the infant (Goldson, 1999; Kenner & Lott 2016). Over the years, measures have been developed and implemented within the NICU to reduce sound, for the developmental benefit of the premature infant. Kenner & Lott (2016) write about these interventions as creating a healing environment. The goal and establishment of the healing environment are defined by Kenner & Lott as "An environment will be maintained to promote healing by minimising the impact of the artificial, oftentimes harsh, extrauterine NICU environment on the developing infant's brain." (Kenner & Lott, 2016 p. 418).

The American Association for Paediatrics (AAP) has established a guideline that all NICUs should have an environmental sound frequency of 45dB and not exceed 75dB. This guideline has been put in place so as not to cause hearing damage or loss to the premature infant (Allen, 2013). However, this guideline is challenging to maintain when considering the environment and natural sounds that occur. Martin (2018) stated that premature infants can sustain damage to the cochlea if they are exposed to sound frequencies over 45dB for extended periods of time. The tested ambient frequency of a NICU environment can reach up to 90dB. Allen (2013) emphasises that certain NICU equipment emit natural sounds, such as cardiorespiratory alarms which can increase the environmental sound level to 73dB. Sounds of endotracheal suctioning increase the sound level to 68dB. Incubators have helped to combat auditory overstimulation, however, the sound within the incubator with the equipment off and the hood down still ranges at 53dB, and if a cardiorespiratory alarm is needed it increases the sound within the incubator to 59dB. All of these sound frequencies fall within the guideline that has been put in place by the AAP, however, they can still be considered overstimulating for the premature infant (Allen, 2013).

2.5.2 Sound versus Music

With the consideration that premature infants are highly sensitive to auditory stimuli, studies have shown scepticism towards the implementation of music into this environment. However, research that has been conducted on the implementation of music therapy in the NICU environment has proved beneficial. The debate within the literature has been about the difference between unwanted and uncontrollable sounds, and music, which is uniquely created for the individual infant. Work and studies conducted by Rossetti (2012) describe the implementation of music therapy into the medical environment as Environmental Music Therapy (EMT) (The Louis Armstrong Center for Music and Medicine, 2012). Rossetti defines EMT as "The intentional use of live music and sound to modulate the soundscape of an area or space." (The Louis Armstrong Center for Music and Medicine, 2012, 2:43). Rossetti (2012) explains this form of music therapy as not trying to mask the sounds of the environment but trying to create a soundtrack to everything that is going on, with the intention of altering the patient's and staff's perception of the acoustic environment (The Louis Armstrong Center for Music and Medicine, 2012).

Studies into music implementation within the NICU have established guidelines and measures that need to be taken into consideration, so as not to overstimulate the premature infant with auditory stimuli. When considering the AAP guidelines of not exceeding 75dB within the NICU environment, Allen (2013) suggested that lullabies should be played at 70dB and this study showed a significant decrease in crying episodes within the premature infant, which led to a lowering in energy expenditure. Live music is a preferred intervention within the NICU, as the therapists can adapt the music to the physiological cues that the premature infant displays which lowers the risk of auditory overstimulation (Nöcker-Ribaupierre, 2013; Yildiz & Arikan, 2010). An important factor to consider in the implementation of music within the NICU, is whether the intervention is considered to be music therapy or music medicine. The distinction between these two concepts is determinant of the goals the healthcare professional is wishing to achieve. Bradt et al. (2014) describes music medicine as a predominantly pre-recorded application of music and is usually offered by medical personnel and does not necessarily involve any systematic therapeutic process as it is predominantly utilised for symptom management. Bradt et al. describes music therapy as the psychotherapeutic use of music, whereby, a therapeutic process is developed between a client and a trained and registered music therapist. Music therapy is personally tailored for

the client and may include receptive and active interventions, that are conducted between the client and therapist in the moment.

2.5.3 Music Therapy and Premature Infants

Studies have shown positive results regarding the administration of music with premature infants, both physically and neurodevelopmentally, and have shown a long-term effect. Some of the most common interventions of music therapy that have been implemented into the NICU consist of music combined with kangaroo care, music and multimodal stimulation, music listening that is developmentally appropriate, creative music therapy, and the PAL (Loewy et al., 2013; Standley, 2003). Some of the pioneer researchers in music therapy within the NICU are: Standley and Swedberg (2011) who designed the PAL intervention; Loewy, Stewart, Dassler, Telsey and Hemel (2013) who did extensive research into the intervention constructed by Loewy, consisting of the Rhythm, Breath, Lullaby intervention; Keith, Russell and Weaver (2009) who researched music therapy and consolable crying and Nocker-Ribaupierre (2010) who did extensive research into auditive stimulation (Martin, 2018). These interventions have shown positive results in the length of stay, stabilizing oxygen saturation, increased tolerance to stimulation, enhanced bonding between infant and parents, and improved social interactions between infant and parents (Gooding, 2010).

Music therapy interventions within the NICU have focused on the growth and development of the premature infant and aim towards achieving the earliest possible discharge (Standley, 2012). Standley (2003) stated that one of the earliest discriminative abilities of a foetus while still in the womb is perceiving auditory stimuli. It is for this reason that Standley emphasises that auditory exposure after birth is critical for the further development of these capabilities and neurological development (Standley, 2000). Literature by Amini et al. (2013), has shown that the use of lullabies within the NICU environment has assisted in lowering the heart rate of the premature infant and increasing oxygen saturation. These findings resulted in infants sleeping better and gaining weight faster. These findings also showed positive outcomes on feeding rates, volume intake and faster transitions to full oral feeds in studies conducted by van der Heijden et al. (2016).

The use of live music in comparison to recorded music is considered more beneficial and has shown significant results in the decrease of heart rates amongst premature infants (Arnon et al., 2006). Most studies make use of a lullaby singing style both in the form of recorded and live music. Live music was often paired with multimodal stimulation in which the music

therapist softly hums or sings a lullaby while slowly administering tactile, visual and vestibular stimulation (Nöcker-Ribaupierre, 2013). Multimodal stimulation paired with live music showed an increase in the premature infant's weight gain and earlier discharge (Arnon et al., 2006). Medical interventions and research into the extrauterine development of premature infants has slowly developed over the years, including the development of the Babybe system, which consists of a gel mattress that is placed in the infant's incubator and mimics the mother's heartbeat and breathing sounds, simulating the experience of kangaroo care and skin-to-skin contact. The Babybe system can also transmit a recording of the mother's voice through the mattress and this device has been shown to increase infant sleep, lower heart rate and increase oxygen saturation (Vitale et al., 2021).

With guidelines and protocols that have been put in place by the AAP, to make sure that the infant is not overstimulated or exposed to a noxious stimulus, Music Therapy, predominantly in America, has implemented its protocol to help music therapists stay within the AAP guidelines. Gooding (2010) lists these protocols as the following: music therapy for infants under 1500 grams should be kept as non-contact music listening, and the use of lullabies can be used to promote language development. This protocol was supported by Haslbeck & Stegemann (2018) when they stated that music functioned as a surrogate for supportive social signals when physical contact may be limited in the infant. Nöcker-Ribaupierre (2013) states in her study, that music administered to a premature infant of 25-28 gestational weeks should consist primarily of "soft, tone singing" and that no instruments should be used. Nöcker-Ribaupierre then goes on to explain that instruments can be implemented with premature infants once they reach 32 gestational weeks, however, the singing should remain soft and in a lullaby style (Nöcker-Ribaupierre, 2013). van der Heijden et al. (2016), explain that music interventions used within the NICU should be soothing and very basic in structure, not incorporating too many different musical elements When the infant reaches the age of 30 gestational weeks music therapy can consist of multimodal stimulation paired with kangaroo care. Multimodal stimulation is not used on infants prior to 30 gestational weeks due to hypersensitivity which can lead to overstimulation and delays in neurological development. Dokkum et al. (2020) suggest the use of a maximum of one instrument paired with the voice to prevent overstimulating the infant. The commencement of oral feeding can be paired with contingent music therapy as it has been shown to reinforce nonnutritive sucking and a faster transition from parenteral to enteral feeding (Gooding, 2010). Contingent music therapy as defined by Robertson and Detmer (2019) incorporates behaviourism techniques, in which

music is initiated or ceased in accordance with the infants behaviours that they are exhibiting. This technique is described and employed in many music therapy interventions within the NICU. Music is provided to the infant while they are in a calm state, however, the music is stopped when the infant displays signs of agitation, discomfort or crying, and is only returned once the infant returns to a calmed state. Auto et al. (2013) state in their research that infants who have music therapy while being fed orally experience improved appetite and a better sucking/swallowing mechanism, causing the infant to tolerate more liquid feeding.

2.5.4 Pacifier Activated Lullaby (PAL) and Development of the Sucking Skill

Due to weakness in sucking and swallowing in premature infants, Standley (2003) has developed interventions to assist in the development of nonnutritive sucking (sucking without administering nutrients). The nonnutritive sucking skill is one of the first rhythmic behaviours that an infant engages in after birth and studies by Standley (2003), Standley (2000), Standley et al. (2010) theorise that this skill assists in neurological development. The PAL is a pacifier that is linked up to an audio system with pre-recorded lullabies. The system detects when the infant is sucking and at what strength the suck is. If it reaches the developmental standards of a suck the infant is rewarded with 10 seconds of a lullaby (Standley, 2012). The utilisation of a lullaby typically combines language information in the infant's home language, and what is heard in the intrauterine environment, with calming and rhythmic stimuli. Standley (2003) stated that this is the best choice of music to be paired with pacification for premature infants. This intervention was administered an hour prior to the infant's oral feed and lasted 15 minutes. In the studies conducted by Standley (2012), positive results were discovered with the PAL on premature infants. Standley discovered that premature infants gained weight faster, they transitioned to oral feeds at a faster rate and levels of stress were significantly reduced.

Later studies by Chorna et al. (2013) discovered that the implementation of recordings of the mother's (maternal) voice, had an even more significant impact on the premature infant (Chorna et al., 2013). The mother's voice is one of the first voices the infant hears in the intrauterine environment and it is one of the most prominent voices the infant hears while developing in the womb. Gooding (2010), therefore, emphasised the use of the mother's maternal voice as a therapeutic medium, as the voice is capable of soothing the infant and providing exposure to auditory stimulus in a non-overstimulating manner, which in turn will

promote neurological stimulation and development. The study conducted by Chorna et al. (2013) discovered that the average hospital stays for premature infants decreased by 20%.

2.6 Conclusion

Premature infants face varied challenges within their first weeks of life. Underdeveloped gastrointestinal systems have resulted in the challenges of feeding and gaining weight. The clinical environment of the NICU can be overstimulating with its uncontrollable sounds and unwanted stimulation having an effect upon the premature infant. These factors, paired with the fragile immaturity of the premature infant, cause challenges in the physiological and neurodevelopmental growth of the infant. Music Therapy has been an intervention employed in the NICU that has shown positive results in the growth of the premature infant. Certain music interventions such as the PAL and multimodal stimulation have shown positive results in feeding and weight gain of premature infants. It is important to mention that these interventions were administered prior to oral feeds and not during oral feeds. Oral feeding can be considered a stressful experience for the infant (Standley, 2012).

Chapter 3: Methodology

3.1 Introduction

This chapter outlines the study design as an integrative literature review and will explain the steps taken in conducting the review, including search strategies and the databases that were utilised, and the process by which articles were extracted and evaluated for quality.

3.2 Systematic Literature Review

A systematic literature review as defined by Jesson et al. (2011 p. 104) "provides a systematic, transparent means for gathering, synthesising and appraising the findings of studies on a particular topic or question." A systematic literature review allows readers an integrated overview of various interventions used and their efficacy with specific client groups. Harden and Thomas (2005) describe how a systematic literature review is often based on common themes and has similar conclusions from the articles that are included in the review.

Music Therapy is an intervention and non-pharmacological treatment that is being studied within the context of the NICU and has shown results in the physiological development of premature infants. However, literature has shown the utilisation of multiple music therapy interventions and techniques, with some interventions showing similar results where other interventions differ in results. A systematic literature review of the different music therapy interventions can answer the specific questions regarding the various interventions' efficacies with this specific client group.

3.2.1 Integrative Reviews

An integrative literature review incorporates a broad inclusion of studies and can include studies based on qualitative, quantitative and mixed-method methodological design as well as experimental and non-experimental research. Whittemore and Knalf (2005) describe that an integrative review method allows for a broader range of methodologies, which affords the reader a broader understanding of a certain research topic. Harden and Thomas (2005) creatively explain that research and studies are hard to restrict and describe into any one category of methodological design and that there may be an overlap of methodology between quantitative and qualitative research. The following review is based on an integrative review

as it incorporates research and studies that utilise a wide range of methodologies and strategies.

3.2.1.1 Characteristics of Different Designs and Benefits of an Integrated Review

As stated above, this study is an integrative review that utilises literature based on both quantitative and qualitative research and, therefore, it is important to discuss these different research designs in more detail. As stated by Bryman (2012 p. 16), "many writer's methodological issues find it helpful to distinguish between quantitative research and qualitative research." While describing these different research designs, it is important to remember Creswell's (2014) statement of how qualitative and quantitative research should not be viewed as opposing or opposite designs but, instead, should be viewed as opposite sides of a spectrum. Bryman emphasises this point by stating that it is important to distinguish differences between designs and that these designs carry striking differences, however, the distinction is not definitive, "studies that have broad characteristics of one research strategy may have characteristics of the other" (Bryman, 2012, p. 37).

Quantitative research is explained by Muijs as exploring a phenomenon and explaining it by collecting numerical data and analysing that data using a mathematically based method (Muijs, 2013, p. 2). Leavy (2023) emphasises that quantitative research is centred around achieving objectivity, and precise measurements. When analysing and collecting data, a method of quantification is predominantly used and, therefore, it can be stated that quantitative research makes use of a deductive approach when analysing the relationship between theory and research, and that importance is placed on the testing of these theories (Bryman, 2012). In the following study, literature involving the effect of music therapy on feeding and weight gain is included, and, due to feeding and weight gain being measurable variables, quantitative literature will be included and analysed.

Unlike quantitative research, qualitative research emphasises words rather than quantification when it comes to collecting and analysing data. Leavy (2023) describes qualitative research as an inductive design that aims at constructing meaning and producing descriptive data rather than statistical data. Qualitative research collects data in the field and typically at the site where the participants experience the issues or challenges that the study is focusing on. The research process is emergent in qualitative designs. Creswell (2014) elaborates on this aspect by stating that the initial plan for research often cannot be tightly prescribed and that

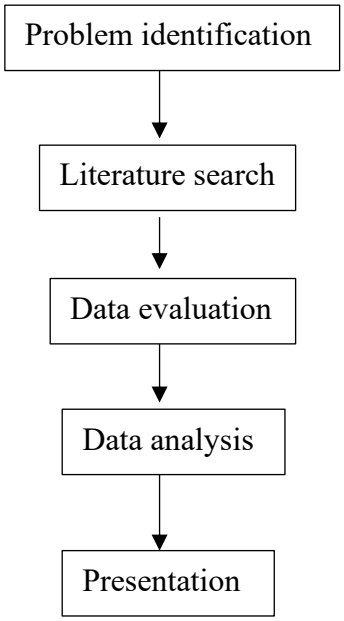
some or all of the phases of the research process may change or shift once the researcher enters the field and begins collecting data. In the conclusion of qualitative research, researchers aim to develop a complex picture of the issue or challenge that is being studied. In this study, multiple interventions to target feeding and weight gain are being explored. The effectiveness of interventions can be expressed through the personalised experiences of medical staff or parents of premature infants. These experiences may give more in-depth insight into these interventions and their broader impact. Therefore, studies of parents' or medical staff's experiences of the music therapy interventions are described, were included and analysed.

3.3 Stages of an Integrative Review

The following study followed the framework adapted and constructed by Whittemore and Knalf (2005) who adapted Cooper's (1998) framework for a systematic review. Cooper's framework was constructed for the purposes of all types of reviews, however, with the following study being constructed as an integrative review, Cooper's (1998) framework does not address the specific issues or challenges of integrating diverse methodologies as found in integrative reviews. Therefore, Whittemore and Knalf (2005) adapted the framework to include these challenges and issues found within this unique type of review. In Whittemore and Knalf's framework, there are five stages in conducting a rigorous integrative review: problem identification, literature search, data evaluation, data analysis and presentation. These stages are displayed in figure 1 and will be discussed below in more detail.

Figure 1

Flow chart of the stages of conducting an integrative review



3.3.1 Problem Identification

The first stage of the integrated review process is establishing the problem that the review is attempting to address. Whittemore and Knalf (2005) express that it is also important to state the variables of interest and a clear, specified review purpose is an important aspect for this phase of the review process, as it will assist in the stages that follow in the process.

An initial scan of titles and abstracts assisted in revealing that music therapy is a recognised therapeutic intervention utilised in the NICU. This initial scan helped to develop an aim for the current review and clarify any variables of interest. The initial hypothesis that was established in the review was that music therapy could have a beneficial impact on premature infants' feeding and weight gain while in the NICU. This led to the primary research question of the review being established as to how effective music therapy has been on these two variables through past studies that have been conducted. Within the medical field and the NICU environment, there are pre-established goals for the discharge date of premature infants, which medical staff and therapists aim to achieve. Feeding and weight gain are just two of the developmental criteria needed for an infant to be discharged from the NICU.

Oral feeding is a developmental concept that is highly encouraged in the NICU environment, however, premature infants with underdeveloped gastrointestinal systems have shown difficulties with this developmental outcome and, as a result, they are slowly transitioned from tube feeding onto oral feeding, through the utilisation of different medical and therapeutic interventions. The inability to oral feed may lead to insufficient weight gain and result in a longer hospital stay as the premature infant is required to remain on the feeding tube which can be rather uncomfortable and painful for the infant (Coughlin, 2014).

The field of music therapy has investigated and researched interventions to assist in the above-mentioned aspects of under-development, with specific targeting on feeding and weight gain, in premature infants. However, research has documented the utilisation of multiple music therapy interventions that have shown positive outcomes. The research has shown that these diverse music therapy interventions have produced positive yet varying outcomes. This could be due to the fact that even though feeding was an outcome the approach to feeding varied as it either focused on regulating the infant or focused on developmental milestones. These different approaches also seemed to have an impact on the weight gain variable, with some studies showing outcomes not significant to weight gain, while others showed a discernible difference between the intervention and control groups. This concept led to a sub-question of whether music therapy interventions targeting feeding influence or impacted the weight gain of premature infants. These discoveries, stated above, guided the search for literature which will be discussed in the section below. The literature aims to answer the research question about the effect of music therapy on feeding and weight gain in premature infants, which music therapy interventions have been implemented within the NICU, and how these interventions have assisted in the growth and development of the premature infant.

3.3.2 Literature Search

The next stage in the review process is to identify and collect all relevant literature. Bethany-Saltikov (2012) states the importance of searching for all relevant articles, or as many as possible, as it ensures that the review is as unbiased as possible. In order to carry out an accurate search, Whittemore and Knalf (2005) suggest that the process of the search should be clearly documented and that it should include the initial search terms used, the databases that were searched, additional search terms, as well as clear inclusion and exclusion criteria.

In order for the following review to be thorough and precise in answering the above-mentioned research questions, a comprehensive search strategy was developed and carried out in retrieving relevant articles. The search criteria were applied in the same manner across all databases. There was no reference management software used in the process. Databases included in the search:

- Healthcare Administration Database
- Nursing & Allied Health database
- Dissertation & Thesis Global
- PubMed Central
- ScienceDirect
- Scopus
- Health & Medical collection
- CINAHL
- Google Scholar

In the initial search, the terms ‘music therapy’, ‘premature infant’, ‘feeding’ and ‘weight’ were utilised. The results for the use of the term ‘premature infants’ yielded extensive results and a brief scan of the literature led to the conclusion that articles consisting of premature infants outside of the NICU, or in other contexts, were being included. The term ‘premature infant’ was then reassessed and changed to NICU. After the adapted search terms, all the relevant literature relating to the search terms ‘music therapy’, ‘NICU’, ‘feeding’, and ‘weight’ (Table 1) was assessed and reviewed in accordance with the inclusion and exclusion criteria stated below.

Table 1

Keywords used in first inclusive study.

Intervention	And	Participants/ Environment	And	Outcomes
“Music therapy**”**		“NICU”		“feeding” AND “weight”

Inclusion Criteria:

The inclusion criteria stated below, assisted in finding relevant literature to answer the above-mentioned research questions (Bethany-Saltikov, 2012). Literature that met the criteria stated below was included in this review. Due to the limited amount of literature found within this field of music therapy, research targeted towards feeding and weight gain with premature infants, a broader inclusion of study types was utilised, however, as stated by Purssell and McCrae (2020), studies that are considered for inclusion must produce results specific to that of the intended review aim, therefore, the other inclusion categories were more stringent, to focus the literature search.

Types of Studies:

Due to the study being an integrative literature review, literature based on quantitative, qualitative, and mixed-method research was extracted for the study. This allowed for a broader search of studies and, therefore, broadened the outcome possibilities. The study included published articles, peer-reviewed journal articles, dissertations and theses that met the following criteria:

a. Published between 2000-2022
b. Works published in English or translated and re-published in English.
c. Qualitative, Quantitative, and mixed-method designs.

Types of Participants:

Literature that was included in the study consisted of research incorporating premature infants between 27-38 weeks of gestational age. For studies to be included in the review the studies had to be conducted with premature infants who were placed within a NICU and had access to music therapy as a therapeutic intervention. Studies that included parents and their infants in the NICU were included. This allowed for a more qualitative search to the study as these studies focused on the parent's experiences of music therapy with their infants.

Types of Interventions:

The integrative review includes studies that comprise music therapy as the primary intervention. Music Therapy interventions consist of both receptive recorded music as well as live music making from either music therapists, staff, parents or guardians. In all the music therapy interventions, literature including the presence of a music therapist who carried out the intervention was preferred. However, observational research, where the medical staff or parents implemented the intervention and the intervention was designed or approved by a music therapist was not excluded, as long as the primary therapeutic intervention consisted predominantly of music therapy.

Types of Outcomes:

Bethany-Saltikov (2012) explains that outcomes usually refer to measurable outcomes or clinical changes in health. For the purpose of the following review, the literature that was included comprised outcomes that address the following:

a. Rate of transition from parenteral to enteral feeding
b. Increase in volume/nutritional intake.
c. Weight gain at a faster rate
d. Experiences of the infants displayed during feeding as a result of the music therapy intervention.

Exclusion Criteria:

For the purpose of the review, literature that meets the following criteria will be excluded from the study review:

a. Literature published in a language other than English
b. Literature published before 2000
c. Literature focusing on outcomes other than feeding and weight gain.

d. Literature consisting of interventions across multiple therapeutic professions.
e. Literature indicating no music therapist present.

3.3.3 Data Evaluation and Quality Assessment

Due to the fact that the following study is an integrative review that includes both quantitative and qualitative literature, the evaluation and quality assessment process is rather complex. Although there is no golden rule on how to assess quality, in order to achieve a review of a good standard, the studies included need to be appraised and assessed. The appraisal of the studies will assist in the establishment of outcomes for this review.

Xiao and Watson (2019) describe quality assessment as the "fine sieve to refine the full-text articles" this is typically the final stage, before data extraction and synthesis, in gathering the articles required for the study. However, according to Whittemore and Knalf (2005), the standard of quality assessment varies in accordance with the type of review that is being conducted. The process of quality assessment within a review helps to inform the researcher of possible interpretations and findings that can lead to discussions, however, Xiao and Watson also point out that this process helps to reveal potential weaknesses and inconsistencies.

Due to the fact that this study is an integrative review comprising qualitative and quantitative literature, it was deemed important to utilise an appropriate tool. Xiao and Watson (2019) state that due to an integrative review utilising multiple methodologies, in turn, multiple checklists are required for the study. The Specialist Unit for Review Evidence (SURE) critical appraisal tool was used for the study (Special Unit for Review Evidence, 2018). The SURE is a tool used to appraise systematic literature reviews that include diverse methodologies within the field of health and social care. The SURE critical appraisal checklists (Appendix 1 and 2) pertain to quantitative and qualitative studies respectively are discussed below.

- **SURE Experimental Studies Critical Appraisal Checklist**

The following checklist contains 14 questions with further descriptions and subheadings. This checklist is used to assess literature based on experimental, randomised and nonrandomised literature, and focuses on research hypotheses, the population of participants, intervention and

control group randomisation, whether participants or investigators were blinded to the study or outcomes, appropriate sample size, ethical considerations and limitations of the study.

- **SURE Qualitative Studies Critical Appraisal Checklist**

The following checklist is similar in layout to the experimental studies checklist described above, however, this checklist consists of ten questions. These questions relate to qualitative research with a focus on more in-depth analysis and questions focused around the appropriateness of methodologies employed, sampling strategies, data collection methods, ethical considerations, the process of data analysis, and conflicts of interest.

3.3.4 Data Analysis and Presentation

Data extraction involved the process of critically reading through the articles that met the inclusion criteria and highlighting and 'extracting' the relevant information in order to answer the research questions. Whittemore and Knalf (2005) suggest that this stage be executed thoroughly by ordering, coding, categorising, and summarising data, extracted from the primary literature, into integrated conclusions centred around the research problem. Due to this study being an integrative review, Whittemore and Knalf suggest that a constant comparison method be incorporated at this stage in the process. This constant comparison method consists of data reduction: data display, data comparison, drawing conclusions and verifications. Data reduction involves subdividing all the included literature sources into subgroups and categorising. In the following review, studies were sub-grouped into qualitative and quantitative methodologies. The next step in data reduction involves extracting and coding data in order to simplify, focus and organise the data into a workable framework that is suitable for answering the research questions. This data is typically organised into a spreadsheet or matrix. The next stage in Whittemore and Knalf's (2005) framework consists of data display, which involves the process of converting the extracted data into a display that assembles data around specified variables. These displays assist in the interpretation of the findings as they enhance the visualisation of patterns or relationships within and across the extracted data. During the data comparison process patterns, themes, or relationships are identified from the primary data. Upon the discovery of these patterns and themes, a conceptual map can be established including identified themes.

The final step of data analysis consists of developing conclusions or conceptual models which are continually revised in order to include as much of the data as possible (Whittemore

& Knalf, 2005). An important aspect of the conclusion process is the synthesis of important elements, discoveries or conclusions of each of the subgroups into an integrated summation of the current studies topic. Webster and Watson (2002) describe the synthesis stage as the transition from an author-centric focus to a concept-centric focus (Okoli, 2015). This process was followed, and all the relevant information will be presented in chapter four. The final stage of an integrative literature review, as stated by Whittemore and Knalf (2005), needs to include methodological limitations of the review. Therefore, a discussion of the findings and recommendations for future research will be incorporated into chapter five and the conclusion will state the limitations of the study.

3.4 Conclusion

This chapter provided an outline of the rationale for this integrative systematic literature review as well as descriptions of the different methodologies employed, such as qualitative and quantitative data. The stages of the integrative review as outlined by Whittemore and Knalf (2005) were discussed in detail and included the inclusion and exclusion criteria for the study. The process of developing a search strategy, and the implementation of the search strategy, was outlined. Finally, data extraction and quality assessment were described and will be continued in the following chapters of the study.

Chapter 4: Analysis and Findings

4.1 Introduction

This chapter provides an overview of the analysis of the studies included in the integrative literature review. It discusses the search process in detail and presents an overview of the articles identified for inclusion in the review. All relevant information extracted from the articles is presented in a table form and is discussed in terms of their parameters and outcomes.

4.2 Data Collection

The following literature search process was conducted using the PRISMA process and a diagram (figure 2) of the process is displayed below. The initial phase of the data collection involved searching for articles and studies that met the inclusion criteria as stated in chapter three. The keywords ‘music therapy’; ‘NICU’; ‘feeding’; ‘weight’ were used in the initial search as the use of ‘premature’, or any term synonymous, resulted in extensive results consisting of literature that did not fit the inclusion criteria or they were duplicates. This initial search warranted 7 179 articles.

The next step in the process involved scanning all the titles and abstracts that the searches produced. For the databases, CINAHL (Cumulated Index to Nursing and Allied Health Literature) and Google Scholar, results of the search were extensive and repetitive and, therefore, all of the results were not scanned. For the database CINAHL, the first 800 results were scanned and for Google Scholar, the first 500 results were scanned. Through the scanning process, specific articles were extracted due to the fact that the title or abstract used synonymous terminology, or the abstract did not specify all the inclusion criteria, however, upon scanning the full text, it was evident that the articles met the inclusion criteria.

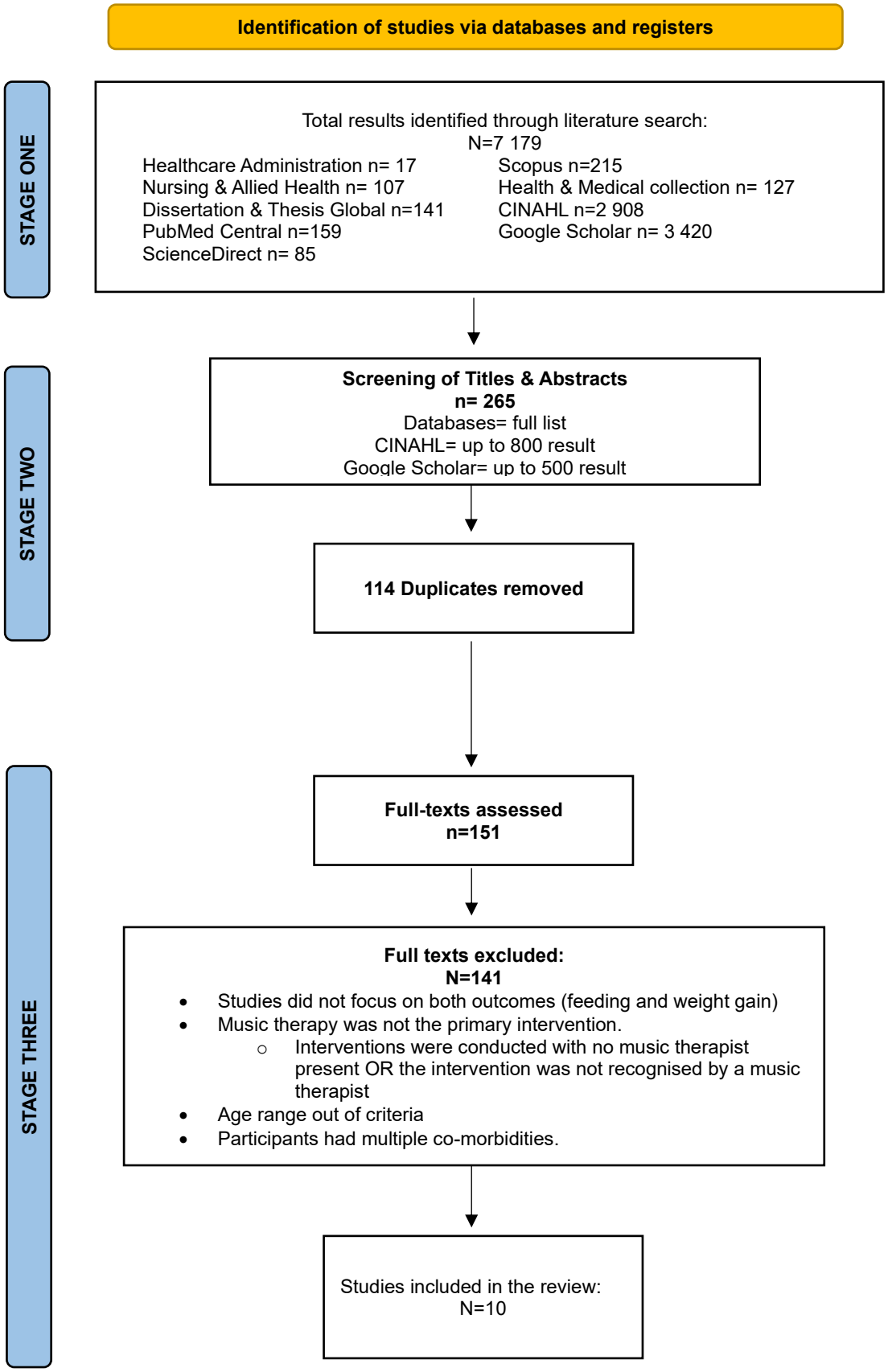
After the process of scanning titles and abstracts, the search yielded 265 studies of which 114 duplicates were removed. Upon removing the duplicates, all 151 articles' full texts were scanned. In this process, methodologies and result sections were of importance towards inclusion into the review, however, full tests were scanned and extracted. 10 articles met the full inclusion criteria for this study.

It is important to mention that specific articles that met the inclusion criteria were, however, excluded from the study. Some of the articles referred to the music intervention as music therapy, however, upon closer inspection it was evident that the intervention was employed by someone other than a music therapist or the intervention was targeted more at music

medicine than music therapy. Music medicine is more receptive and is usually administered by a medical staff member; it does not always require a music therapist's presence. Shultis (2012) describes music medicine as a non-pharmacological intervention that typically addressed stress, anxiety and/or pain through a receptive medium and is usually used in combination with a medical treatment. The process of music medicine involves the patient listening to music that has been preselected by medical staff. However, Shultis (2012) contrasts music therapy as a therapeutic process that includes a music therapist and that a therapeutic relationship is established through music. Music therapy may include both receptive and live-improvised recreational music. The music serves as a healing component toward the entirety of the patient and does not just focus on the medical condition or procedure (Shultis, 2012). In one of the articles considered for inclusion, the researcher obtained a certificate of validity from a music therapist for their intervention. However, the intervention also included massage therapy, and was, therefore, excluded as it was not evident which intervention had an impact on the study outcomes. The researcher administering the intervention with the premature infants was not a music therapist. Some studies were conducted by other therapy professions and utilised a music therapy technique. However, these studies were excluded as there was no music therapist present or the therapists did not indicate whether they received appropriate music therapy training in the application of the intervention.

Figure 2

Flowchart of data collection process



4.3 Data Extraction

The following section will describe and present an overview of the articles included in the review, and will provide the reader with a brief overview of the information that was extracted from the selected articles. General information pertaining to the included studies will be presented in Table 2. This will be followed by Table 3 which will present the methodological aspects and details regarding music therapy interventions employed within the different studies.

4.3.1 General Overview of Studies Selected for the Review

Table 2 provides general information about the articles that met the inclusion criteria and were incorporated into the review. The ten included studies consist of nine quantitative studies and one qualitative study. The studies are arranged in accordance with their methodological design, beginning with the nine quantitative articles included in the review and finishing with the one qualitative study. Within the methodological design, the articles are arranged in chronological order with the most recent articles appearing first. The majority of the studies were published in the United States of America, with the exception of 2 studies which were published in Germany.

4.3.2 Relevant Information Extracted from the Studies

The following section will give an overview of all the information extracted from all the studies that were included in the review and will be presented in Table 3. In the table, each study was summarised under relevant headings including the methodology and designs, the number of participants, the types of participants of the study (as some of the studies included the parents as participants), the method of data collection, research objectives with measured outcomes, intervention design, recruitment method of participants, intervention procedure, and results and conclusions.

Table 2

Studies selected for the review

Study No.	Title	Author(s) & Date	Country
1	Family-centered music therapy - empowering premature infants and their primary caregivers through music: results of a pilot study	Menke et al., 2021	Germany
2	NICU music therapy: song of kin as critical lullaby in research and practice	Loewy, 2015	USA
3	A Pacifier Activated music player (PAL) with mother's voice improves feeding in preterm infants	Chorna et al., 2014	USA
4	The effects of music therapy on vital signs, feeding, and sleep in premature infants	Loewy et al., 2013	USA
5	Effects of neurodevelopmental stimulation on premature infants in neonatal intensive care: randomised controlled trial	Walworth et al., 2012	USA
6	The effect of music reinforcement for non-nutritive sucking on nipple feeding of premature infants	Standley et al., 2010	USA
7	Effects of the Pacifier Activated Lullaby (PAL) on weight gain of premature infants	Cevasco & Grant, 2005	USA
8	The effect of music-reinforced nonnutritive sucking on feeding rate of premature infants	Standley, 2003	USA
9	The effect of parent training in music and multimodal stimulation in the Neonatal Intensive Care Unit	Whipple, 2000	USA
10	The interactive potential of creative music therapy with premature infants and their parents: a qualitative analysis	Haslbeck, 2013	Germany

Table 3

Study No.	Methodology & Design	Participants	Data Collection Method	Research Objectives & Outcomes Measured	Intervention Design	Intervention Procedure	Results & Conclusions
1	Quantitative Randomised controlled longitudinal study design. Data was collected in a pre-post design.	N=50 parent-infant pairs	Data regarding the infants was collected from their patient files. Only complete data sets were included and rendered for data analysis. Measures and data collected were compared with the control group through the use of Hotelling's t^2 test. Parent stress levels were recorded using the Parental Stress Questionnaire (PSQ), Stait-Trait-Anxiety-Inventory (STAI), and Edinburgh Postnatal Depression Scale (EPDS).	The aim of the following study was to test the feasibility of live-improvised interactive music therapy with premature infants and their parents on infant development and parental stress. Primary outcomes of the study included: the physiological development of the infant at discharge with regard to body weight, length and head circumference, duration of caffeine therapy, duration of nasogastric/ orogastric tube feeding and length of hospitalisation. Secondary outcomes consisted of parental stress and anxiety.	Parent-infant pairs were allocated into groups through the use of random sequences. Premature infants and their families that were allocated to the intervention group received interactive live-improvised music therapy twice a week from a certified neonatal music therapist. A treatment plan was determined in accordance with a parent-infant assessment	Interventions varied in accordance with the goals of the individual infant. Music therapy commenced on the 21st day of the infant's life and consisted of a 30-minute session after one of the infant's scheduled feeding times. The sessions began with an initial touch which progressed into a therapeutic touch. The therapist would begin entraining rhythmically to the infant's vital signs which were then transferred into infant-directed humming. Music was kept simple and gentle. Throughout the session, if parents were involved, they engaged in skin-to-skin contact with their infant. After the session infants were observed by the therapist and data was collected	The study results indicated that infants exposed to the music therapy intervention had significant results within the primary outcomes of the study. Results showed that infants spent 11.1 days less on caffeine therapy, 12 days less on nasogastric/orogastric tube feeds and 15.5 days less in the hospital. The researchers hypothesised that live music therapy may facilitate stable and regular breathing in premature infants which may have a direct influence on the duration of the NGO tube feed due to the regulating effect on the respiratory rate. Variables related to direct infant development such as weight gain did not have significant differences between groups. The researchers elaborated on this finding stating that these findings could be the result of hospitals' decision to discharge infants when they have stabilised. There did not seem to be a correlation between the parental variables measured and the infant variables measured.

Study No.	Methodology & Design	Participants	Data Collection Method	Research Objectives & Outcomes Measured	Intervention Design	Intervention Procedure	Results & Conclusions
2	Quantitative Randomised controlled trial	N=272 premature infants	Interventions were provided in the morning or afternoon, vital signs were collected by an uninformed assistant every one minute during the 10 minutes prior to the administering of the intervention, 10 minutes during the intervention and for 10 minutes after the intervention. Patient files.	The main focus and aim of the following study were to compare the effect of live entrained pre-composed music versus live entrained parent-selected music on physiological parameters and developmental parameters of premature infants in the NICU Measured outcomes included: weight gain, sucking patterns, heart rate, oxygen saturation, sleep and parental stress levels.	Music therapists met with the parents of the infants before the intervention application to identify their levels of stress and assist them in using their song of kin. Randomisation of the sequence of when the infant would receive the intervention (morning or afternoon) was implemented. This was to ensure that the infants did not receive the intervention at the same time of the day over the course.	The following study made use of the song of kin intervention. The infants received live music sessions three times a week over a two-week period, consisting of six sessions in total. The live music consisted of either a song of kin or a familial lullaby, "twinkle, twinkle" which was entrained into the breathing of the infant	The study showed significant differences between the lullaby intervention group and the control group. The study results showed the song of kin intervention to display higher levels of sucking rate and calorie intake. It was also discovered in the study that sucking rates were most profoundly influenced by the use of the song of kin when compared to that of the familial lullaby ("twinkle, twinkle"). The researcher hypothesised that this outcome could be a result of the infant displaying an increased incentive to feed when they hear their parents utilising melodies that are original and unique to their culture or preference.

Study No.	Methodology & Design	Participants	Data Collection Method	Research Objectives & Outcomes Measured	Intervention Design	Intervention Procedure	Results & Conclusions
3	Quantitative Randomised parallel group trial	N= 94	Mother's presence was recorded by the NICU nursing staff. All the data was collected from the nursing staff and the medical records of the infants. For each outcome a sensitivity analysis was conducted using a multi-variable linear regression All statistical data was analysed using the R statistical program, version 3.0.1	The aim of the study was to test whether playing a recording of the mother's voice through a PAL during nonnutritive sucking would improve and develop the sucking skill and promote more effective feeding in premature infants. Primary outcomes: change in feeding rate between the start and end of the intervention. Secondary outcomes change in oral feeding volume and frequency after the intervention and the number of days it took the infant to achieve full oral feeds. Balancing measures included discharge weight and growth rate.	The following study recruited premature infants at a gestational age of 34 to 35 weeks at the start of the study. Infants were eligible for the study if they were receiving their nutrition through 50% enteral feed and 50% oral feeds three days prior to intervention implementation. The songs were recorded and uploaded onto a streamlined digital audio software programme so that the researcher could edit out all unnecessary background noise and loop the music for 15 minutes prior to the commencement of the intervention. At the beginning of the study, mothers were presented with four children's books and two songbooks. Mothers were encouraged to read and sing to their infants. The songs chosen for the study were highly repetitive in rhythm and melody and were in a major key with a one-octave pitch range and a 4/4 meter.	On the first day of the intervention baseline data of the premature infant was recorded from the previous 72 hours. The intervention took place over five days whereby the music therapist would enter the room with the PAM for 15 minutes and close the door to allow for the staff of the hospital to remain blinded to the trial. The experimental group received PAM for 15 minutes daily, 30-45 minutes prior to a scheduled feeding time. Infants remained in their incubators or crib for the duration of the intervention. The speaker was placed six inches from the infant's head.	The results from the five-day intervention implementation showed significant differences between the control and intervention groups. Oral feeding rate, oral volume intake and the number of oral feeds in a day improved significantly in the intervention group. Sucking pressure in the intervention group increased between the first and fifth days of the intervention. The researchers also discovered that the infants exposed to the PAM-with-mother's-voice achieved oral feeds on average seven days before the control group. However, there was no significant difference in weight gain between the two groups. The researchers concluded that their results support the use of operant conditioning with positive reinforcement in the development and improvement of premature infant oral feeding skills.

Study No.	Methodology & Design	Participants	Data Collection Method	Research Objectives & Outcomes Measured	Intervention Design	Intervention Procedure	Results & Conclusions
4	Quantitative	N=272 premature infants	Data was collected for multiple physiological parameters by a blind data collector. Parental stress perception was assessed using a Likert rating scale and questionnaire administered at the beginning and end of the intervention period.	The aim of the following study was to determine the effect of live music therapy interventions on physiological functions and development in premature infants. Secondary outcomes included: feeding, sleeping and caloric intake throughout the two-week intervention period	The study took place over 11 hospitals and compared the reactions from infants when subjected to 3 live music interventions. The intervention application would be randomised and applied in either the morning or afternoon over a two-week period and was administered by a mix of music therapists and parents. The study consisted of 3 separate interventions of which the infants would be exposed to all of the interventions, totalling 6 sessions. However, randomisation of the sequence of which intervention the infant would experience was generated by a computer	The infants were subjected to 3 different interventions with all 3 interventions consisting of live music making: • Live singing of the song of kin as a familial lullaby or "twinkle, twinkle" in the case where parents could not identify a lullaby. • Entrained breathing sounds which were incorporated through the application of an ocean disc. • Entrained live heartbeat sounds through the use of the Gato box. Each treatment was provided twice a week over a two-week period. If the infant received an intervention in the morning, experimental data was collected and control data was then collected in the afternoon and vice versa.	The study found varying results across the 3 interventions employed. In the Gato box intervention, it was observed that the infants' sucking behaviours increased. The song of kin intervention showed a higher level of caloric intake and improved feeding behaviour compared to the use of "twinkle, twinkle." In conclusion, the study demonstrated that the use of live, entrained sounds and lullabies that are provided by a trained music therapist who is able to constantly observe the infant's vital signs and alertness levels, is capable of helping the infant to self-regulate.

Study No.	Methodology & Design	Participants	Data Collection Method	Research Objectives & Outcomes Measured	Intervention Design	Intervention Procedure	Results & Conclusions
5	Quantitative Randomised controlled trial	N=168 premature infants	All the data were collected from the infant's medical charts	The aim of the following study was to assess the effect of neurodevelopmental stimulation (music therapy) on premature infants. The variables measured in the study consisted of length of stay, weight gain and number of days to full feeds.	Infants who were admitted to the four different NICUs included in the study were randomly assigned to either the control or experimental groups. The experimental groups consisted of two different interventions. Two of the hospitals offered Developmental multimodal stimulation (DMS) with unaccompanied live lullaby singing and the other two hospitals added chordal guitar accompaniment to the live lullaby singing.	Infants who were included in the experimental group received DMS sessions for 20 minutes once a week, for the full duration of their hospitalisation. The intervention consisted of administering different modes of stimulation in a layered format, beginning with auditory, tactile, vestibular, and lastly visual stimulation. The auditory stimulation encompassed the music aspect of the intervention. The music was characteristically simple in rhythm and slow in tempo.	The results of the study showed no significant difference in weight gain at discharge between the groups. However, a positive trend was discovered in the variable of oral feedings where infants who received the DMS took less time to achieve oral feeds than control infants. The study concluded that DMS with music as the auditory stimulation proved to be beneficial in accordance with neurodevelopmental gains as seen with reduced length of stay.

Study No.	Methodology & Design	Participants	Data Collection Method	Research Objectives & Outcomes Measured	Intervention Design	Intervention Procedure	Results & Conclusions
6	Quantitative Randomised controlled study	N=68	Observation Data collected from patient files (nurses' notes)	The aim of the study was to determine the effect that the PAL system had on the cessation of gavage feeding and achievement of oral feeding in premature infants. dependant variables of the study included: 1) the total number of days prior to nipple feeding, 2) days of nipple feeding, 3) discharge weight, and 4) overall weight gain	The researchers allocated premature infants who were born 32 weeks gestational age and referred by the NICU medical staff into 1 of the 3 intervention groups The three groups would consist of a control group, 1 PAL trial and 3 PAL trials. For infants in the PAL groups, the intervention would take place 30 minutes before a scheduled feeding. Infants were not held throughout the intervention process and would remain in their cribs or incubators	Once the infant was presented with the PAL device the infant's pressure would initiate the recording device with the contingent music which consisted of traditional lullabies chosen by the music therapist. The music would play for 10 seconds and continue as long as the infant retained a predetermined suck pressure. Infants in the PAL groups received the intervention for 15 minutes over a five-day period between 4:00 and 5:00 pm.	The results of the study showed differences between gender and intervention with regard to nipple feeding. Female infants were found to nipple feed for longer than male infants which also meant that they achieved full oral feeds sooner than male infants. This result also seemed to display in the weight gain variable of the study with male infants showing significantly less weight gain than female infants while in the hospital. Due to the study also working with age range, it was discovered that infants at 36 weeks took considerably longer than infants at 32 or 34 weeks to achieve oral feeding and that infants in the 3 PAL interventions group, had the most beneficial outcomes. The variable of weight gain was significant, in accordance with the age of the infant, with infants of 36 weeks having considerably more weight gain than infants at 32 or 34 weeks. The study concluded that the PAL intervention was most beneficial to infants of 36 weeks with regard to weight gain but it also showed potential for facilitating nipple feeding across all age ranges.

Study No.	Methodology & Design	Participants	Data Collection Method	Research Objectives & Outcomes Measured	Intervention Design	Intervention Procedure	Results & Conclusions
7	Quantitative Post-hoc analysis	N= 62 premature infants	Data collection methods for all 3 analyses consisted of the running-time schedule for the 15-minute intervention period. The data was displayed as the amount of time the infant received music as a result of sucking and the amount of time the infant was not sucking which was measured by no music.	The objective of the analysis was to determine the effect of the PAL on the weight gain of premature infants when the same intervention is analysed through three different perspectives. Analysis 1: effect of a number of PAL trials on weight gain Analysis 2: compare the effect of the PAL on weight gain pre-during-post intervention Analysis 3: determine the effect of the feeding schedule on the time of PAL intervention application with the premature infant.	Analysis 1: Infants were randomly assigned into 4 different groups each receiving a different amount of PAL trial. Analysis 2: Infants who were selected for this analysis included infants with complete weight recordings. The analysis involved weight gain, three days prior to PAL use, the days the infant received the PAL and three days after PAL intervention. Analysis 3: PAL was administered in five different slots during the three-hour feeding schedule to determine the most efficient time to administer the intervention.	Through all the different analyses the same music therapy intervention was employed consisting of the PAL. The intervention entailed placing speakers in the corners of the infant's incubator near the head. The intervention would be 15 minutes in duration consisting of only 1 session a day. The session began the moment the nipple of the pacifier was placed on the infant's lips.	Results across all 3 analyses did not show any significant difference in weight gain of the infants, however, upon closer inspection, there were trends established in the different analyses. Analysis 1: upon closer analysis, it was discovered that infants who participated in 2 or 3 PAL trials gained additional weight with each trial. The analysis of this data suggested that 3 PAL trials seemed to be the most beneficial for weight gain, however, infants may vary and may need additional PAL sessions or in some cases fewer to obtain optimal weight gain Analysis 2: closer analysis of this intervention showed that infants who received only 1 PAL session nearly tripled their weight from the pre-intervention weight to the post-intervention weight. Analysis 3: this analysis warranted some significant trends on the time at which PAL is the most beneficial to be applied. The analysis discovered that infants who received the PAL 30 minutes before their scheduled feed scored the highest with the amount of non-nutritive sucking which was also transferred to nutritive sucking. It was also discovered that infants who participated in nonnutritive sucking interventions during their tube feedings had fewer parenteral feeds and were ready for oral feeding three days earlier.

Study No.	Methodology & Design	Participants	Data Collection Method	Research Objectives & Outcomes Measured	Intervention Design	Intervention Procedure	Results & Conclusions
8	Quantitative	N=32 (16 boys and 16 girls)	Data was collected and recorded from the nurses' notes and infants' medical files. Data included: the amount of nutrition ingested, the length of oral feeding in the morning and again in the afternoon.	The objective of the study was to determine the effect of the PAL on the feeding rate of premature infants. Variables measured consisted of the amount of nutrition ingested, and the length of oral feeding.	The study incorporated infants who had been referred by nursing staff or physical therapists as a result of them presenting as poor feeders. Infants were randomly assigned to either a control group or an experimental group.	The intervention consisted of infants receiving 15 to 20 minutes of the PAL approximately 30 to 60 minutes before the late afternoon scheduled feeding. Music selected for intervention consisted of commercially recorded lullabies. The tape-recorder was placed at the feet of the infant and was monitored to maintain a volume of approximately 65 dB	The initial t-test comparison showed no significant difference between the infants with regard to feeding rates in the morning. However, there was a significant difference in feeding rates between the experimental and control group with regard to the afternoon feeding. Experimental group infants had an increased feeding rate for afternoon feedings when compared to the morning feeding rate while the control group had a decrease in feeding rate when compared to the morning feeding. The researcher concluded the study by stating that reinforcement of nonnutritive sucking with lullaby music improves oral feeding rates in premature infants.

Study No.	Methodology & Design	Participants	Data Collection Method	Research Objectives & Outcomes Measured	Intervention Design	Intervention Procedure	Results & Conclusions
9	Quantitative Experimental/control group design	N= 40 (10 mother-infant dyads per group)	Experimental subject Observations Parent-Neonate Interaction Survey	The following study's aim was to determine the effect that training parents in music and multimodal stimulation might have on the quantity and quality of the interactions between parent and a premature infant along with the weight gain of the infant.	Variables consisted of 1) observed infant stress; 2) observed parent actions and responses; 3) interaction between parent and premature infant; 4) infants' weight gain during hospitalisation; 5) Infants' weight gain at a one-month follow-up; and 6) parent follow-up surveys	Parents in both the control and experimental groups received the standard hospital care training. Mothers in the experimental group received two to three music therapy training sessions with their infants in which they were guided through applying multimodal stimulation with their infants at different times of the day at the parents' convenience	The study found no significant differences pertaining to the average daily weight gain between the experimental and control groups. However, it was discovered that infants in the experimental group gained an average of 7.89 g more per day and left the hospital 16.10 days sooner than the infants in the control group. Parents who received training displayed decreased stress levels and the parents also showed increased interaction with their infants in comparison to the control group. The study also discovered that the length of hospitalisation was shorter and daily weight gain was greater for the infants whose parents had received the music and multimodal stimulation training, although these results were not great enough to be of significance.

Study No.	Methodology & Design	Participants	Data Collection Method	Research Objectives & Outcomes Measured	Intervention Design	Intervention Procedure	Results & Conclusions
10	Qualitative Multi-perspective, longitudinal study Based in grounded theory and therapeutic narrative analysis	N= 18 premature infants	Analysis of video footage Narrative interviews with parents. Memos, protocols and physiological data of the infants, and interview data were applied to data triangulation.	The objective of this study was to further investigate the interactive potential of creative music therapy with premature infants and their parents.	The design of the study consists of a fusion of narrative interviews and micro-video analysis to explore the potential benefits and limitations of Creative Music Therapy with premature infants and their parents from different perspectives. Sessions, in which the parents participated, were videotaped and to expand the focus of the study narrative, interviews were obtained and transcribed-verbatim.	The music therapy intervention consisting of Creative Music Therapy (designed by Nordoff-Robbins). Video analysis was divided into 4 steps, with steps 2 and 3 pertaining to the current review. Step 2 focused on episodes of minimal dialogue of which two examples were extracted for analysis Step 3 scanned the video footage for contrasting episodes of parental involvement of which two sessions were extracted as they displayed interaction and therapeutic change. Once video footage had been extracted, interview data was assessed in accordance with the videos.	The study discovered that Creative Music Therapy can facilitate empowerment through communicative musicality and this results in responsiveness between the parent and premature infant. The responsiveness from the therapist through improvised humming entrained and attuned to the infant's breathing showed beneficial results in regulating the infant. It was discovered that promoting the parent's sensitivity during their interactions with their infants may empower the parent to respond sensibly and attune to their infant's needs which will transpire in the infant's growth

4.4 Quality

As stated in chapter three, all studies required a quality appraisal so as to assure the studies are of high quality. The SURE appraisal quality checklist was utilised as described in section 3.3.3. The following two sections will provide graphic representations of the process of assessing the quality of the included studies and give an overview of the resulting quality of the accumulated studies. All of the studies included in the review displayed high methodological quality.

4.4.1 Quantitative Studies

The review included nine quantitative studies of which seven were randomised, controlled trials (studies 1, 2, 3, 4, 5, 6, and 8), one study was a post-hoc analysis (study 7), and one experimental control group design (study 9). Upon closer inspection of the randomised controlled trials, four studies were standard randomised, controlled trials (studies 2, 5, 6, and 8). Study 3 was a randomised, parallel-group trial, study 4 was a randomised, clinical multisite trial, and study 1 was a randomised controlled longitudinal study. All of the studies had clear and focused research hypotheses and the use of the music therapy interventions was well described. The studies expressed randomisation, and that medical staff and parents of the infants, when only infants were receiving the intervention, were blinded to the allocation of groups. Most studies expressed that the group allocations were completely randomised, except for study 2 which attempted randomisation but expressed that if the participants consisted of a twin pair of premature infants both infants would be assigned to the same group so as not to inhibit unclear results. Methodology and data analysis for all of the quantitative studies were appropriate. Three of the studies (studies 1, 2 and 5) express limitations in the study. All the studies substantiated the appropriateness of their sample size and stated when participants had to be withdrawn from the study, or data was excluded due to missing data. Table 4 gives an overview of the SURE critical appraisal tool questions and how the studies were assessed.

Table 4

Quality appraisal of quantitative studies

	Does the study address a clearly focused question/ hypothesis?	Was the population randomised?	Was allocation to intervention or comparator groups concealed?	Were participants/ investigators blinded to group allocation?	Were interventions well described and appropriate?	Was ethical approval sought and received?	Was a trial protocol published?	Were the groups similar at the start of the trial?	Was the sample size sufficient?	Were participants properly accounted for?	Are the statistical methods well described?	Results	Is any sponsorship/ conflict of interest reported?
Menke et al.													
Loewy													
Chorna et al.													
Loewy et al.													
Walworth et al.													
Standley et al.													
Cevasco & Grant													
Standley													
Whipple													

Colour code: Green= yes yellow= unclear red= no/ not stated

4.4.2 Qualitative Studies

There was only one qualitative study that met the inclusion criteria for this review. This study stated clear and well-defined aims and objectives, and the data collection methods and intervention strategies were well-defined and described. The study made use of multiple data

sources consisting of video analysis and narrative interviews and made use of triangulation. Clear limitations were described in the study including ethical considerations, and the results and findings of the study were credible and contributed to the overall structure and knowledge stated in this review. Table 5 outlines the SURE critical appraisal questions for qualitative research and how the included study was assessed in accordance with these questions.

Table 5

Quality appraisal of qualitative studies

	Does the study address a clearly focused question/ hypothesis?	Is the choice of qualitative method appropriate?	Is the sampling strategy clearly described and justified?	Is the method of data collection well described?	Is the relationship between the researcher(s) and participants explored?	Are ethical issues explicitly discussed?	Is the data analysis/ interpretation process described and justified?	Are the findings credible?	Is any sponsorship/ conflicts of interest reported?
Haslbeck									

4.5 Methodology, Design and Participant Characteristics

Due to this study being an integrative review, it was discovered that multiple methodology designs were utilised. The majority of the quantitative articles employed an experimental design. Study 1 originally employed a pre-post-follow-up design, however, challenges were found in data collection from the follow-up aspect of the design and, therefore, the study was adapted to a pre-post design. Study 7 employs a post hoc analysis in which the researchers

analysed their collected data from three different aspects to see which data set proved the most beneficial towards the weight gain of the premature infants.

The qualitative study (study 10) employed grounded theory and narrative analysis. Micro-video analysis and narrative interview data were fused together to explore the potential benefits and limitations of creative music therapy for premature infants and their parents from different perspectives. Data triangulation was applied throughout the process through the use of memos, protocols, physiological data from the infants, and interview data collected from the parents.

The total number of participants across all ten studies was 1 076. This number included studies 1 and 9 which included parent-infant dyad as their participants. Music therapy interventions were administered to different age ranges of premature infants. Due to the varied age ranges, consideration was taken of how much stimulation the infant could tolerate and, therefore, the length of their sessions varied. Table (6) provides a breakdown of the ages of the infants included across the studies, the length of the music interventions and the time at which the intervention was administered.

Table 6

Age of Participants, Length of Intervention, Time of Intervention

Study No.	Participant's Age Range	Length of Sessions	Time of Intervention
1	30 weeks	30 minutes	30 minutes after a feed
2	32 weeks	10-15 minutes	AM/PM
3	34-35 weeks	15 minutes	30-45 minutes prior to feeding
4	32 weeks	10-15 minutes	AM/PM
5	Before 37 weeks	20 minutes	-
6	32 weeks; 34 weeks; and 36 weeks	15 minutes	4-5 PM (before a feeding)
7	32-36 weeks	15 minutes	Analysis 3: 5 block intervals
8	34 weeks	15-20 minutes	30-60 minutes prior to a feeding
9	Before 37 weeks	15-30 minutes	Availability
10	26-41 weeks	Does not specify	During a feeding

4.6. Data Collection Methods

In most of the quantitative studies the researchers obtained their data regarding the premature infants through observation or through collecting data from the infants' medical files. Studies 1 and 9, where parents were involved in the study and were part of the research protocol, assessed the parents' stress levels. Study 1 made use of the Parental Stress Questionnaire (PSQ), Stait-Trait-Anxiety-Inventory (STAI) and the Edinburgh Postnatal Depression Scale (EPDS) to assess the parents' stress levels both in regard to the application of the music therapy intervention with their premature infant as well as the overall feelings of stress they experienced having an infant born prematurely. Study 9 utilised a parent-infant interaction survey, as well as follow-up surveys, a month after the infant's discharge. These surveys were used to assess how much time the parents interacted with their infants, how much music is used and how it affected the parents.

The qualitative study (study 10) made use of video analysis and narrative interviews as their method of data collection. A total of 122 sessions with premature infants were videoed, these videos were assessed and relevant video footage was extracted for analysis for the given topic of the study. Parents were interviewed and in total two verbatim-transcribed interviews were available for data triangulation.

4.7 Research Objectives

The research objectives of the studies included in this review can be classified into two main categories: the effect of live music therapy on feeding and/or weight gain in premature infants (studies 1, 2, 4, 5, 9, and 10) and the effect of receptive music therapy, in the form of the PAL on feeding and/or weight gain in premature infants (studies 3, 6, 7, and 8). Two of the studies (studies 1 and 9) had a primary outcome focused on parental stress and it is important to note that these two studies are the only two that requested parent interaction and involvement in the music therapy intervention. One of the studies involved parents' experiences of the music intervention with their premature infants which gives the review a more in-depth knowledge of the applications of the interventions.

In the quantitative studies, four of the studies (studies 1, 2, 5, and 6) have measured variables of both feeding and weight gain with premature infants. Three of the studies (studies 3, 4 and 8) have a focused, measured outcome of feeding in which the measures consist of the volume or amount of nutrients consumed during an oral feed and the duration of time to achieve full oral feeds. Two studies (studies 7 and 9) focus on weight gain, however, it is important to note that the interventions utilised in these two studies are interventions utilised in targeting feeding in premature infants. Studies 3, 6, 7, and 8 make use of the PAL device, which has a measured outcome of feeding and/or weight gain. Study 9 makes use of multimodal stimulation, with music therapy being used as the auditory stimulation. This intervention is also used in study 5 which targets both feeding and weight gain. It is important to note that each of these broken-down categories has a somewhat equal distribution of both live music therapy and receptive music therapy, which allows for a broader overview of the effectiveness of music therapy on these specified outcomes.

Study 10 is the only study included in the review that is based on a qualitative design. The main objective of this study was to study the interactive potential that creative music therapy may have with premature infants and their parents. The study analysed video footage of sessions and interview data of the parents to explore, describe and examine the parents'

experiences of receiving creative music therapy with their premature infants. Two of the infants were referred for the process as they were struggling to feed and the music therapy interventions and therapy goals were established around these aspects. Video footage was critically analysed to describe the infant's sucking pattern in accordance with the music as well as the perceived stress levels of the infant. The mother's experience of the intervention is described and analysed in narrative interview data. These experiences of the mothers add depth to this review.

4.8 Intervention Procedures

All the included studies made use of a music therapy intervention with premature infants. In order to answer the research questions of *what* the different music therapy interventions used to target feeding are, and whether these interventions have an impact on weight gain, a closer inspection of these varied interventions is warranted.

4.8.1 Parent and Music Therapist Application

In some of the included studies, parents were encouraged to participate in the intervention. In study 1 the infants and their parents received a live-improvised interactive music therapy session. In the cases where parents were available, the parent was encouraged to hold their infant on their chest and engage in skin-to-skin contact. Parents were invited to relax and were encouraged to participate in the vocal improvisation. They were empowered to hum or sing to their infant within their level of comfort. Studies 2 and 4 consisted of song of kin lullabies or parent-preferred lullabies in which the music therapists encouraged the parents to sing their chosen song to the infant. Parents were instructed on how to entrain to their infant's breathing rate and/or activity level. Parent participation was the first option for the intervention for these two studies. However, music therapists had notated versions of the lullabies within the vocal range of the parents so that they could replicate the lullaby should parents be unavailable for the application of the intervention. Study 3 required the recording of the mother singing preselected children’s songs. Mothers met with a music therapist prior to the implementation of the intervention. They were guided and assisted in recording the songs that would be played through the recording device upon the infant's sucking strength. In study 10, for sessions where parents were available, they were encouraged to participate in the creative music therapy process and sing to their infants.

Studies 5, 6, 7, and 8 were conducted by music therapists who either used pre-recorded music or implemented live music therapy interventions without the presence of the parents.

Table 7 provides an overview of who was involved in the music therapy intervention.

Table 7

Overview of Intervention Application Personnel

Study no.	Music Therapist	Music Therapist and Parent
1		X
2		X
3		X
4		X
5	X	
6	X	
7	X	
8	X	
9		X
10		X

4.8.2 Intervention Approaches and Techniques

In the following section we will take a closer look at the different interventions that were employed in the included studies. The music therapy interventions across the studies included both live and receptive music therapy interventions. Table 8 gives an overview of whether the study incorporated live (active) music therapy or whether the intervention employed was receptive.

Studies 3, 6, 7, and 8 make use of the same receptive interventions in the form of the PAL. The PAL consists of a pacifier that is attached to a pressure transducer, which registers the strength of the infant's suck. If the suck matches the required suck pressure, a tape recorder is activated and it rewards the infant with music. The studies that utilised this intervention applied different applications of the device and measured different variables. Study 3 made use of recording the mother singing two preselected children's songs. Study 6 consisted of a continuous selection of lullabies sung but a young female with minimal accompaniment. Study 7 consisted of music sung by an 8-year-old with keyboard accompaniment, lullabies from around the world and music that had been performed and recorded by the University's music therapy students. Study 8 selected their music from commercially recorded lullabies

sung by a female vocalist. In the PAL intervention, all of the infants remained in their incubators or cribs and minimal physical contact was employed so as not to overstimulate the infants.

Studies that utilised active music-making could be split into two main categories: live music-making and multimodal stimulation. Studies 1, 2, 4 and 10 made use of different forms of live music-making. Study 1 made use of multiple interventions dependant on the goals that had been set for the infant and parent dyad. The session typically begins with tactile stimulation through the initial touch, the therapist then utilises rhythmic entertainment which is translated into infant-directed humming which is fully improvised. At this point, the parents are also encouraged to participate and sing along with the therapist. Study 2 makes use of live lullabies consisting of either the song of kin lullaby or a familial lullaby "Twinkle, Twinkle, Little Star." The application of the lullabies usually consisted of entraining to the rhythm of the infant's breathing. Study 4 incorporated three different live-music therapy interventions in which the infants were exposed to all three. The first intervention entailed live singing of either a song of kin or a familial lullaby. The second intervention involved entrained breathing sounds which were then incorporated into the intervention through the use of an ocean disc. The third intervention used the entrained live heartbeat sounds through the use of the Gato box. Study 10 incorporated live creative music therapy sessions with the premature infants and their parents. Interventions differed in accordance with the goals established for the infant-parent dyad. For the purpose of this review, the interventions that were analysed to target feeding and weight gain consisted of entrainment of sucking patterns through the use of live singing by either the parent or the music therapist, and an intervention of song creating with the parent, to target the suck-swallow-breath rhythm within the premature infant.

Studies 5 and 9 made use of multimodal stimulation as their music therapy intervention. Study 5 used Developmental Multimodal Stimulation (DMS) across four sites. Music therapists applied multimodal stimulation in a layered fashion beginning with auditory, tactile, vestibular, and ending with visual stimulation. Music was administered as the music aspect of the intervention. Two of the sites in the study made use of unaccompanied lullabies paired with DMS while the other two studies used chordal guitar accompaniment with the lullabies. Study 9 entailed music therapists training parents in the multimodal stimulation intervention. The first session entailed the music therapist guiding the parents in multimodal stimulation with their infants. Music therapists were present for the entire duration of the

session and observed both the parents and the infants in their interactions. In the second session, parents were instructed on the benefits of nonnutritive sucking and facilitating calmer states in the infants so as to enhance the sucking endurance necessary for feeding.

Table 8

Type of Interventions

Study No.	Live-music Therapy	Receptive Music Therapy	Intervention
1	X		Live-improvised music therapy
2	X		Song of kin
3		X	PAL
4	X		Live singing (Song of kin); Gato box (rhythmic entrainment to heart beat); Ocean disc (entrainment to breathing)
5	X		Developmental Multimodal Stimulation (DMS)
6		X	PAL
7		X	PAL
8		X	PAL
9	X		Multimodal Stimulation
10	X		Creative Music Therapy (CMT)

4.9 Results of the Studies

Studies 1, 2, 5, and 6 measured both feeding and weight gain as variables in their studies. Study 6 seemed to be the only study that showed significant differences in both outcomes. Study 6 analysed their data in terms of age and gender. Their results revealed that female premature infants typically nipple fed for longer which resulted in them achieving oral feedings sooner than male premature infants. This discovery also pertained to weight gain with female premature infants gaining weight at a faster rate than male premature infants. When analysing the data in accordance with age, study 6 discovered that infants at the age of 36 gestational weeks took longer to achieve oral feedings than infants at 32 or 34 gestational weeks. However, in the weight gain variable, it was discovered that infants at 36 weeks gained weight faster than infants at 32 or 34 weeks. Studies 1, 2, and 5 showed no significant

difference in weight gain, however, they showed significant differences in the feeding variable with all three of them showing a faster transition to oral feeding and increased volume intake.

In studies 3, 4, 8, and 10 the music therapy interventions were used to target the feeding variable. All four of the studies showed positive results with regard to oral feeding, displaying increased nutrient intake, higher sucking rates and faster transition to oral feedings. Study 8 stated in the results that no significant differences were found in feeding rates when the intervention was employed in the morning. However, there was an evident increase in feeding rates when the intervention was employed in the afternoon, whereas the control group's feeding rate interestingly decreased in the afternoon but not by a significant amount.

Studies 7 and 9 addressed the variable of weight gain through the application of a music therapy intervention used for feeding. Neither study showed significant differences in weight gain, however, on closer inspection of both studies, positive trends were discovered. Study 7 discovered that infants who received two to three PAL trials gained additional weight with each trial. In the second analysis, it was discovered that infants who received one PAL trial had their weight triple in accordance with pre-intervention weight. The third analysis showed trends in accordance with the time of the intervention and infant physical displays and vital signs. It was discovered that infants who received the PAL 30 minutes prior to feeding, scored higher in non-nutritive sucking which was then transferred into nutritive sucking. It was also discovered that the infants that had PAL during tube feedings had fewer parenteral feedings and were ready for oral feeding three days earlier.

Table 9 provides an overview of the outcomes that were measured in the included studies and the overall results that were discovered through each study.

Table 9

Outcomes Measured and Results

Study No.	Feeding & Weight Gain	Feeding	Weight Gain	Results
1	X			12 days less on nasogastric/orogastric tube feeds. No significant difference in weight gain.
2	X			Song of kin displayed higher levels of sucking rate and calorie intake. No significant difference in weight gain
3		X		Oral feeding rate, oral volume intake and the number of oral feeds in a day improved. Infants receiving PAM with mothers' voices achieved oral feeds on average seven days earlier.
4		X		Gato box: infants sucking behaviour increased Song of kin: higher levels of caloric intake and improved feeding behaviour
5	X			No significant difference in weight gain. Infants receiving DMS transitioned to oral feedings at a faster rate
6	X			Gender difference with regard to nipple feeding and weight gain, with females achieving nipple feeding sooner than males and gaining weight at a faster rate. Infants of 32-34 weeks achieved oral feeding faster than infants at 36 weeks of age. 3 PAL trials had the most beneficial outcomes Infants at 36 weeks gestational age gained weight faster than infants of 32-34 weeks.
7			X	No significant difference in overall weight gain. Analysis 1: infants who received two to three PAL trials gained additional weight Analysis 2: infants who received one PAL trial doubled their weight in comparison to pre- and post-intervention weight Analysis 3: Infants receiving PAL 30 minutes before their feed scored highest nonnutritive sucking and this was also transferred to nutritive sucking. Infants who received PAL after a feed fell asleep.
8		X		No significant difference in feeding rate when intervention was administered in the morning. However, infants had increased feeding rates in the afternoon.
9			X	No significant differences in weight gain, however, infants in the experimental group gained 7.89g more per day and were discharged 16.10 days sooner.
10		X		Creative music therapy can facilitate empowerment through communicative musicality. Promoting the parents' sensitivity to their infants' transpired into their infant's growth.

4.10 Author's Conclusions

The following section will synthesise the 10 articles' conclusions and suggestions for future research. Methodological issues will be addressed should the study have stated these issues.

4.10.1 Limitations

It is important to mention that some of the studies highlighted limitations in their research. Study 1 stated that the complexity of family-centred interventions encompasses many different procedures, and as a result, it was difficult for the researcher to draw conclusions. Study 1 also highlighted the fact that the participation of both parents was not always feasible and, therefore, it limited the significance of their results. Study 2 highlights the limitation of the possibility of including a third group in the study in which the group receive PAM with a female voice, however, they felt that this group was not necessary as similar studies by Standley had been done. Study 2 also mentions how the suck threshold was kept the same across all participants which meant consideration of the infant's specific developmental rate was excluded. Study 5 highlights the limitation that not all of the sites included in the study made use of both musical stimuli, therefore, the issue of site bias came into play. Infants who did not receive DMS with chordal guitar accompaniment may have responded differently to the timbre of the instrument if they had received the opportunity of being exposed to this intervention.

4.10.2 Suggestions for Further Research

In terms of suggestions for future research, all but one of the studies provide recommendations for further research. Three of the studies (studies 1, 5, and 9) suggest longitudinal studies in order to test the intervention's efficacy over a longer period of time. Study 1 suggests assessing the short-term and long-term effects these interventions have on the infant as well as the maternal and paternal health outcomes. A suggestion for a further study like this will provide the field with knowledge as to whether family-centred care should be employed as a standard of practice within NICUs. Premature infants face developmental challenges while in the NICU and these challenges transfer into their development over their first few years of life. Study 5, therefore, suggests a longitudinal analysis to investigate the first years of a premature infant's life to see whether the intervention has any longitudinal developmental benefits. This study also suggests furthering research to determine gender differences within the application of the intervention. This may assist in the choice of musical stimuli and may refine the clinical protocol of utilising music therapy within the NICU. The remaining studies (studies 2, 3, 4, 6, and 7) suggest further research into the effect of their

interventions. They also suggest adapting the interventions to establish protocols and guidelines for their use and for the benefits the interventions have on the premature infants. Study 10, as it is a qualitative study, suggests further research into conducting mixed-methods designed to assess the quantitative benefits of creative music therapy on premature infants. It also suggests testing the study from different methodological perspectives to affirm the trustworthiness of the results discovered in the current study.

4.10.3 Feeding and Weight Gain in Premature Infants

The studies included in this review emphasise the importance and benefit of music therapy on the developing premature infant. Study 1 concludes by stating that music therapy may facilitate stable and regular breathing, and as a result, may support the premature infant in developing the suck-swallow-breath rhythm. The development of this skill and the regulation of the respiratory rate may have a direct influence on the duration of time the infant spends on parenteral feeding. Study 2, which incorporated the participation of the parents, emphasised that comfort is induced through singing. When an infant is learning to feed, their level of comfort has a direct influence on their willingness to suck as both work in a continuum of trust and awareness.

Study 4 demonstrated that live, entrained and organised lullabies, provided by a trained music therapist, assist the infant in self-regulating which is optimal for infant development. Study 5 supports the concept of self-regulation. The study concluded that the improved outcomes in infants receiving DMS may have been a result of the brain integrating new information while maintaining a regulated state and responding positively to stimuli. As a result, these infants developed at a faster rate.

Parent involvement within the music therapy interventions proved to be beneficial both to the development of the premature infant as well as the stress levels of the parents. Study 9 emphasised that parents' stress levels impact their interaction with their premature infants and visa versa. It was discovered that the lack of opportunities to interact with their premature infants while in the NICU proved to be a stressor for parents. However, when parents were given the opportunity to engage with their infants and were provided with training on how to provide appropriate stimulation to their premature infants, both the parents and the infants benefitted. Parents in the experimental group were more aware of the importance of

providing a calm and constant environment for their infants, and of providing an environment for optimal growth as the infants displayed fewer stress behaviours

4.11 Conclusion

This chapter presented the analysis of the ten identified articles that met the inclusion criteria for the study. The following chapter will discuss the findings in relation to the research questions guiding the study. Chapter five will offer a further discussion of the synthesis of the findings stated in this chapter.

Chapter 5: Discussion

5.1 Introduction

This study aimed to investigate the effect of music therapy on feeding and weight gain with premature infants in the NICU, through the analysis of existing literature. The aim was to determine the different music therapy interventions that are currently being used within NICUs that target feeding and weight gain and how these interventions are administered. The review brings into focus how music therapy interventions may assist the infants in their transition onto full oral feeds and how these interventions may impact the weight gain of the premature infants. This chapter addresses the research questions by discussing the following findings: i) types of interventions used; ii) music therapist vs parental application; iii) factors for consideration for application of music therapy intervention; iv) transition to oral feeding; v) self-regulation; vi) physiological development of the sucking-swallowing-breath skill; vii) the impact of music therapy on weight gain.

5.2 Music Therapy interventions targeted at feeding with premature infants in the NICU

Music therapy in the NICU has been widely researched and various interventions have been designed to assist the premature infant in its development and support the parents who experience high levels of stress. Discharge goals of full tolerance to oral feeding and sufficient weight gain have been the focus of many music therapy studies, with studies adapting and designing different interventions. This review identified ten studies that focused on music therapy interventions targeted at feeding and weight gain in the premature infant. The interventions discovered in the integrative review have been shown to assist the infant in achieving full oral feeds. The music therapy interventions can broadly be categorised into two types, live (active) music therapy consisting of live and creative forms of therapy and receptive music therapy which entails listening to pre-composed music that has been designed and approved by a qualified music therapist. The primary receptive form used with premature infants is the Pacifier Activated Lullaby. Studies 1, 2, 4, 5, 9 and 10 utilised live music therapy interventions while studies 3, 6, 7, and 8 made use of receptive recorded music therapy interventions. Across the ten studies, it was discovered that a ‘Lullaby’ was the most common style of music that was utilised within the interventions, whether it was the live implementation (singing) of the lullaby or whether the intervention entailed precomposed and

recorded lullabies. Lullabies, as stated by Loewy (2015), are typically familiar to the families. Polverini-Rey (1992) extends the notion of lullaby applications due to their calming effect and that, if it is applied by the parents of the premature infants, it can assist in creating positive parent-infant interactions. The use of lullabies will be discussed in detail in section 5.2.1.

As stated in chapter two there are varied music therapy interventions that have been used to target different developmental goals in premature infants, such as music and kangaroo care, developmentally appropriate music listening and the ocean disc, to mention a few (Loewy et al., 2013; Standley, 2003). These interventions have broadly focused on stabilising heart rate, increasing oxygen saturation, improving sleep, increasing nutrient intake and stabilising weight gain. The broad selection of interventions could be attributed to Haslbeck (2013) who speaks about the development of music therapy within the NICU over the years. Haslbeck explains that technological and medical improvements have brought generated neonatal advances. As a result, music therapy and clinical practice within the NICU have advanced in parallel, moving from a predominantly receptive approach, towards more active approaches that incorporate live singing (Hanson-Abromeit et al., 2008; Haslbeck & Costes, 2011; Malloch et al., 2012; Teckenberg-Jansson et al., 2011).

5.2.1 Active music therapy

Live music therapy with premature infants consists typically of music therapy interventions such as creative music therapy (study 10), rhythmic entrainment through the use of the Gato Box (study 4), song of kin (Studies 2 and 4), live improvisation (study 1), and multimodal stimulation (studies 5 and 9). Live music has become a preferred form of music therapy in the NICU as it entails a music therapist's presence, and Walworth et al. (2012), encourage this notion as a music therapist is able to behaviourally assess the infant’s responses in the moment and can adapt the intervention accordingly.

Study 1 incorporated live-improvised music therapy and described the intervention as a music therapist or parent placing a light touch on the infant and monitoring the infant for any signs of overstimulation before beginning to sing. Monitoring of overstimulation is assessed through increases or decreases in the infant's muscle tension and the rate at which the infant is breathing (Menke et al., 2021). Study 10, which incorporated a similar intervention, states that Creative Music Therapy is based upon providing the infant with an experience that neither overwhelms nor overstimulates them (Haslbeck, 2013). Study 10 emphasises the

continuous, careful assessment of the infant through their breathing patterns, facial expressions and gesticulations. The intervention in study 1 continues with the therapist slowly beginning to entrain to the rhythm of the infant's breathing and vital signs. Once the therapist is entrained, infant-directed humming is initiated and adapted in accordance with the infant's physical displays as well as the vital signs displayed on the monitor. Due to this intervention consisting of varied forms of stimulation (auditory and tactile), there is always the fear of overstimulating the infant. As a result, the music is kept simple and gentle with consideration of the parent's heritage and culture implemented into the humming. Incorporation of culture and heritage is also commonly seen throughout study 10, whereby one of the mothers in the study begins singing a Turkish-lullaby-like song for her daughter. Study 10 describes how the infant's sucking rhythm matches that of the mother's singing and how they both enter into a moment of interactional synchrony. This intervention was implemented throughout the infant's stay in the NICU and results showed an improved coordination within the infant's suck-swallow-breath rhythms. This concept is supported by the literature discovered in chapter two from Nöcker-Ribaupierre (2013) and Yildiz and Arikan (2010) who stated that the implementation of a live music therapy intervention by a music therapist allowed for the music to be adapted in accordance with physiological cues which lowered the risk of overstimulating the infant.

Another live music therapy intervention that was identified incorporated multimodal stimulation. There were two studies (studies 5 and 9) that implemented multimodal stimulation, each in very unique ways. The result of these studies indicated no significant difference in weight gain, however, when referring to an intervention targeted at improving feeding, study 5 found a decrease in the time spent achieving full oral feeds. The process of multimodal stimulation involves the layering of different stimuli in accordance with the infant's tolerance and usually follows the order of auditory, tactile, vestibular and lastly visual. Due to the multiplicity of stimuli, careful observation is required throughout the process. It was discovered in study 9, where parents were trained to administer the intervention, that the results may show some inaccuracies towards the outcomes. The author states that parents did not perform the intervention as frequently as a music therapist who works in the NICU would have. Study 5 highlights a limitation towards site bias as they state that one of the sites included in the study administered the intervention with chordal guitar accompaniment while the other site consisted of only singing which led to the possibility of inaccurate data, as was theorised by the authors. Multimodal stimulation has been broadly

administered with premature infants in the NICU and seems to be one of the most recognised active music therapy interventions to target feeding and weight gain. Arnon et al. (2006) states that multimodal stimulation that was paired with live music as the auditory stimulation aspect of the intervention showed promising results of premature infant weight gain which transferred to an earlier discharge.

Another active music therapy method, the song of kin, designed and implemented by Loewy (2015), was utilised in studies 2 and 4. This intervention incorporates the combined work of a music therapist and the parents. It involves the parents either singing their chosen lullaby, as demonstrated in study 10, with the mother singing a Turkish lullaby, or it involves the parents providing the therapist with a lullaby that the parents identify as belonging to their family history. Loewy (2015 p. 178-179) states in the work that "live music that imbues the cultural practices of the patient's life-world may have the greatest efficacy in fostering a sense of containment and resilience, as it represents what is safe and familiar." Study 2 highlights the importance of establishing the song of kin as it was to be used by the parents and therapists as the "go to" melody within sessions. It provides the parents with a tool to assist in relationship development between themselves and their premature infant as well as provide continuous care for the infant upon discharge. However, study 2 states that should a song of kin not be identified, a simple familiar melody such as "Twinkle, Twinkle Little Star" can be utilised so as not to pressurise and stress the parents into providing a lullaby. Holditch-Davis et al. (2003) state the importance of providing a stress-free environment for both the parents and premature infants as they state that when a parent is distressed the traumatic response of the parent risks being transferred physiologically, and unknowingly, onto their infants.

The final live music therapy intervention, identified in study 4, has not been broadly researched with regard to the use of the specific instrument on its effect on feeding with premature infants, and may warrant further research. The intervention involves the use of the Gato Box for rhythmic entrainment. The concept of rhythmic entrainment is well-researched with regard to the establishment of tempo in live singing with premature infants as seen in the previously discussed interventions. The Gato box is described by Loewy et al. (2013) as a small rectangular, tuned wooden box with 2-4 tones. The instrument is played with the fingers so as not to produce a loud, harsh and overstimulating sound, and is typically used to entrain to the rhythm of the infant's heartbeat. Loewy (2019) supports the use of this intervention as one that is used in helping infants to synchronise and regulate the rhythm of

their breathing. This is due to the rhythmic patterns that the music therapist plays on the instrument which are characterised as predictable and mimicking the heartbeat of a human. Loewy (2019) believed that when the music therapist entrains to the infant and provides a suggestive elongated rhythm which is sustained, it eases the breath and meter at which the infant is breathing. Nöcker-Ribaupierre (2013) emphasises the importance of breathing entrainment through the use of the Gato box but suggests that it only be implemented with infants older than 32 weeks, with the goals of the intervention primarily based on improvement in physical behaviour due to the ability to regulate the respiratory rate.

5.2.2 Receptive (recorded) music therapy

Studies 3, 6, 7, and 8 made use of receptive interventions, with all of them making use of the PAL device within their studies. Studies 6, 7, and 8 refer to the intervention as PAL (Pacifier-Activated Lullaby) whereas study 3 refers to their intervention as PAM (Pacifier-Activated Music). The most noticeable difference between the two is that the PAL utilised pre-recorded lullabies sung by female vocalists, music therapy students or 8-year-old children, whereas the PAM made use of a recording of the mothers singing children's songs or well-known lullabies. All of the studies' interventions entailed a similar process whereby a pacifier was fitted with a pressure transducer which would determine the infant's suck pressure. The pacifier was connected to a recorder that when the infant sucked at a determined pressure it would activate the recorder and the infant was rewarded with ten seconds of music. The recorder was typically placed in the incubator, either six inches above the infant's head or at the feet of the infant, and the volume (dB) was continuously monitored by the music therapists so as not to exceed the recommended decibel level stipulated in the AAP guidelines discussed in chapter two. Gerhardt & Abrams (2019) also stipulate that when music is being used within the NICU, small speakers are located at the head of the premature infant instead of the music being played throughout the NICU. It is also advised that the music has the bass emphasised and the treble diminished. Standley (2000), who is considered the pioneer of the PAL, has been doing extensive research on the device and the implementation of the intervention as seen in studies 6 and 8. Standley (2000) describes the PAL as the use of lullabies that act as contingent reinforcement for sucking by the premature infant. Standley's studies have shown the intervention as effective in assisting the infant in their rate and endurance during nonnutritive sucking (Standley, 2000; Standley, 2003; Standley et al., 2010). This finding is supported in the literature by DiPietro et al. (1994), Gill et al. (1988) and McCain (1992), who all discovered that infants who were exposed to a pacifier

experience prior to and after their gavage feeding displayed less behavioural stress and were perceived as more awake and active than infants who did not receive a pacifier during these times.

5.2.3 Music Therapist versus Parental Application

Another aspect of the interventions that was highlighted in studies 1, 2, 4, 9 and 10 is the participation of the parents within the application of the music therapy intervention. The importance of parental presence throughout the intervention process was described in study 4. The study states that an infant responds positively to the mother's voice as a result of vocal familiarity, and this showed the infant's potential for recognition. This vocal familiarity that the infant experiences throughout the interventions provide the infant with an environment for consistency, comfort, and security that modern-day NICUs have struggled to replicate (Loewy et al, 2013).

Studies 1 and 10 included the parents by means of them initiating physical touch through skin-to-skin contact and when the improvised infant-directed humming was initiated by the therapist, parents were encouraged to participate through humming along, or in the case of study 10, parents were encouraged to join in the improvisations or sing lullabies. In study 1, Menke et al. (2021) highlight the importance of parent inclusion as they state that mothers who are anxious while engaging with their infant are less sensitive to their child's communication and interaction signals and that the mother's stress may transfer to the infant. Menke et al. (2021) emphasise the importance of family-based interventions and developmental care for both the infants and the parents as these interventions and programmes bring attention to the importance of accompanying and providing a healing environment for both the parents and the infant. Study 10 supports this concept by stating that when the parents sing for their infant they provide the infant with opportunities to experience intimate, emotional inter-subjectivity, even in an environment that lacks privacy (Haslbeck, 2013). Shields (2010) defines Family-Centered Care as "an approach to the planning, delivery, and evaluation of health care that is governed by a mutually beneficial partnership between health care providers, patient and families" (Shields, 2010 p. 2629). The use of live-improvised and interactive music therapy reduces stress which helps to foster development in infants and enhance the experience of physical and emotional closeness within the interactions experienced between the parents and the infants (Haslbeck, 2017; Nöcker-Ribaupierre, 2013).

Studies 2 and 4 incorporated the parents through the song of kin. It was preferred that the parents sing the lullaby to their infants, however, music therapists were present in case parents were too anxious to sing. Loewy (2015) expressed the importance of parental training in entrainment, so that they could continue with the intervention after the discharge of the infant. It was found that the song of kin had the biggest influence on the sucking rate when it was administered by the parents. Loewy (2015) supports this statement with the work of Lawhon (2002) and Olischar et al. (2011) who state that the role of music therapy assists parents in developing psychotherapeutic ways of providing their premature infants with appropriate stimulation that is nurturing, and an appropriately timed interaction, which affects the infant's neurobiological development.

Maiello (2019) reminds us that the foetus is capable of perceiving and listening to sounds within the intrauterine environment. Research has also shown that rhythmical sounds produced by the mother, such as her heartbeat and the mother's voice, leave traces within the infant's memory. It is for these reasons that Nöcker-Ribaupierre (2019) emphasises the potential for the mother's voice in bridging the levels between the infant's experiences from the intrauterine environment to the extrauterine environment. The mother and infant need assistance in their bonding process because of the sudden shift for the pregnant mother unexpectedly delivering her infant early, the exposure of the infant to a new high-tech over-stimulating environment and the shift into the home environment (Nöcker-Ribaupierre, 2019).

5.3 Factors for consideration for the application of music therapy interventions

Protocols and guidelines established in the NICU are stringent and are adhered to with the utmost effort. Studies have had to adapt their interventions around these protocols and guidelines, and this was discovered throughout the studies included in this integrative review. Studies 6, 7 and 8 based their interventions around the appropriateness of the time at which the intervention was implemented as well as the appropriateness of the age of the infant at the time of the intervention. Even though these studies are the only studies to address these concepts, trends were discovered across all of the studies with regard to the age of the infant at the time of the intervention, as well as the timing of the interventions. These will be discussed in detail in the following two sections. Kenner and Lott (2016) state that certain factors in the extrauterine world have an impact on the development of the gastrointestinal system and these factors include genetics, types of feeding, the diet and its composition, the

timing of the feeding, hormone regulation and types of nutrients administered in the feed. It is for these reasons that Kenner and Lott (2016) emphasise that the infant's tolerance to feeding is not determined by the age of the infant but is determined by the maturity of their gastrointestinal development and the development of the suck-swallow-breath skill.

5.3.1 Pre-feeding, During, Post-feeding

As stated in chapter two the transition from parenteral to enteral (oral) feedings is a slow and lengthy process as the process needs to be dictated by the premature infant's pace and the rate of their development. It was discovered, in the studies included in the review, that there were optimal times when the intervention should be implemented. Standley (2003) reminds us that the foetus is capable of perceiving auditory stimuli within the intrauterine environment and for these reasons suggests that auditory stimulation and exposure are crucial, after birth, for assisting in the development of the infant.

In the majority of the studies in the review, interventions were conducted prior to the scheduled feeding (studies 1, 2, 3, 4, 6, 7, 8). Trends were established in accordance with the intervention that was being implemented such as studies 2 and 4 which both utilised the song of kin and were administered in the morning or afternoon. Studies involving the PAL device (studies, 3, 6, 7, 8) all discovered that the optimum time for the implementation of the intervention was prior to a scheduled feeding. Study 10 was the only study that mentioned implementing their intervention during the feeding time, and the study showed considerable improvement in the infants' sucking abilities over multiple sessions (Haslbeck, 2013). These findings in study 10 are supported by Auto et al. (2013) who discovered that infants who had music during their scheduled feeding displayed an increased appetite, and they were able to tolerate more liquid feeding as a result of their developing suck-swallow-breath skill.

One of the analyses in study 7, by Cevasco & Grant (2005), focused on optimal PAL intervention time in accordance with the standard feeding schedule implemented across NICUs. Senterre (2014) describes the feeding schedule in the NICU as taking place every two to three hours, and eight times a day. Study 7 constructed their intervention application times around these intervals and split the times into five blocks: 30 minutes after feeding, 31-60 minutes after feeding, one to two hours after feeding, one hour to 30 minutes prior to feeding, and 30 minutes prior to feeding (Cevasco & Grant, 2005). This analysis discovered that the optimum time for the intervention to take place was either prior to or during feeding.

The study discovered that infants who received the PAL prior to their scheduled feeding displayed an increased sucking rate of 77.25% which was transferred into the actual oral feeding in which infants were found to suck for 71% of the oral feed. This finding is supported by literature from McCain (1995) who states that successful feedings result from the infant's state prior to feeding.

Study 8 implemented the intervention in the morning and again in the afternoon at least one hour prior to the scheduled feeding time. This study discovered that feeding rates for infants in the experimental group increased in the afternoon intervention in comparison to the morning feeding rate. It is of interest to note that while the infants in the experimental group had an increase in feeding rate with the afternoon feedings, the control group infants' feeding rate decreased with the afternoon feeding, however, the results were not significant (Standley, 2003).

5.3.2 Age of the Premature Infant

Premature infants have not yet met certain developmental goals and, as a result, certain forms of stimulation are advised against as the younger the infant is the more easily they can be overstimulated. The studies worked within the age range of 26-41 weeks, with the majority of the studies focusing on the ages 32-36 weeks gestational age. As with the timing of the interventions discussed above, trends were found in accordance with the age of the infant and the type of intervention that was being utilised. Studies 1 and 10, which utilised active forms of music therapy, incorporated infants with the youngest age range; study 1 working with infants at 30 weeks gestational age and study 10 working with infants as young as 26 gestational weeks. Studies 2 and 4, which both made use of the song of kin intervention, worked with premature infants with a gestational age of 32 weeks. The studies that used the PAL device (studies 3, 6, 7, and 8) implemented their interventions with infants at a gestational age range of 32-34 weeks. Studies 5 and 9 implemented multimodal stimulation and worked with infants who were less than 37 weeks gestational age. The implementation of these interventions with specific age ranges could be attributed to the relationship between the age of the infant and appropriate levels of stimulation. A detailed breakdown of the types of interventions that are deemed appropriate for premature infants of a specific age is provided by Nöcker-Ribaupierre (2013). This breakdown indicates that infants between 23-24 gestational weeks should not be receiving any form of musical stimulation, infants between 25-28 gestational weeks may receive music that is characteristically soothing and

minimal with no instruments. This age range is also encouraged with parent participation using the mother's voice, and is seen in both studies 1 and 10 which used infants of a similar age range. For infants of 28-31 gestational weeks, interventions implementing pre-recorded music as their primary stimulation, can be administered with careful observation. Infants at 32 gestational weeks are capable of tolerating more stimulation and, therefore, interventions such as multimodal stimulation and lullaby singing paired with kangaroo care or skin-to-skin contact are recommended. Infants at the age of 34 gestational weeks begin to display social awareness towards parents and caregivers, therefore, encouragement for parents to participate in music therapy is important as the therapist is capable of supporting social interactions between parents and infants and encouraging attachment bonds. Lastly, infants at the age of 36 gestational weeks are able to respond and predict auditory stimuli and are, therefore, able to tolerate more stimulating interventions (Nöcker-Ribaupierre, 2013).

Study 6 by Standley et al. (2010) was one of the only studies that focused on the effect of the intervention in accordance with the age range. The study discovered that infants of 34 gestational weeks benefitted the most from the PAL intervention as they spent less time on gavage feeding. Standley et al. (2010) emphasised that this age range benefitted the most as it is the age at which the infant is deemed neurologically ready to nipple feed. This is supported by Kenner and Lott (2016) who suggest that enteral (oral) feedings begin between weeks 33 and 34 gestation as it is the age at which the gastrointestinal system has developed and the infant shows enhancements and development in the suck-swallow-breath skill, therefore, allowing the infant to tolerate more oral feeds and to consume more nutrients.

5.4 Transition to oral feeding

Although the primary goal was to progress the infant towards tolerating full oral feeds, the studies within the review approached their interventions through either assisting the infant in self-regulation tactics, or through assisting the infant in obtaining developmental skills such as the suck-swallow-breath skill. These two concepts are intertwined in that an infant who is capable of self-regulating may also tolerate more stimuli, which translates to assisting the infant in developing skills for feeding. The converse applies to physiological development and the acquisition of feeding skills. These skills allow the infant to tolerate longer feeds without becoming over-stimulated and may result in the infant maintaining homeostasis, resulting in deeper sleep which decreases energy consumption. Study 10 emphasises the importance of these two concepts when they refer to the work of Als (1983) and Tooten et al.

(2013) who found that premature infants require individualised, nurturing interactions with their parents, in order to support healthy development as there is a sense of familiarity and safety in the parent's presence which in turn assists the infant's ability to self-regulate. These interactions support healthy development in the premature infant. Literature from chapter two highlighted the importance of developmental milestones and how infants born at a younger gestational age require more assistance in achieving these developmental milestones. This is due to the infant displaying a decrease in their self-protective and self-regulatory abilities (Nöcker-Ribaupierre, 2013; Rubin, 2014). The following section will discuss self-regulation of premature infants in greater detail.

5.4.1 Self-regulation

Regulation of the infants was achieved through different methods with some studies utilising entrainment (studies 1 and 4) while others aimed at utilising the infant's ability to recognise their mother's voice (studies 2 and 10).

Study 1, which utilised the live-improvised music therapy interventions, found that the intervention assisted in reducing the stress of both the parents and the premature infant and that this helped to foster an environment conducive for development. The study emphasised that by entraining to the infant's breathing patterns through the improvisation, the music supported and encouraged the regulation of the infant's respiratory rate. When the respiratory rate was regulated this transferred to a stable heart rate which is an optimal state for an infant to tolerate feeding (Menke et al., 2021). Study 4 also focused their intervention on entrainment as they chose music that was characteristic of inducing relaxation and comfort. They found that live, organised, entrained sounds, and the use of lullabies by a music therapist, could help the infant to self-regulate. Thoman et al. (1991) and Boukydis et al. (2004) believe that such attuned music application as that being applied in Study 4, provides a therapeutic alternative to an infant's tendency to habituate and respond to the NICU environment which is characteristically overstimulating and chaotic. Entraining to the infant's vital signs is rhythmic in nature and literature by Maiello (2019) reminds us that infants are able to retain and recall rhythmical elements from their intrauterine life. Study 10 (Haslbeck, 2013) focused around the concept of empowerment in order to assist the premature infant in self-regulation. Empowerment is described by Funnel (2004) as "the sense of letting the power out, to help the premature infant discover and use his/her innate ability to regulate, orientate and engage." Study 10 showed that empowerment of both the parents and their

infants is a crucial component of the process, as the intervention assisted in orientating and encouraging the participation of the parents to engage with their infants through communicative musicality. Communicative musicality is described by Monaci et al. (2021) as a theory that states that when an infant is within close contact with a caring adult, they are capable of grasping emotions and expressions of the adult and that they are able to express their own state of being through means of regulating and moving their body which may contain musical elements. Trevarthen and Malloch (2000) highlight this point in their work by stating that infants tend to intuitively respond musically to their parents' vocal play through imitating and replicating their parent's expressions. This response from the infant led Trevarthen and Malloch to suggest that human beings are born like this and that an infants displays of sympathy are established through rhythmic coherence of body movement and varied expressions. This is necessary in a person's life as it assists in establishing healthy emotional and cognitive development throughout their life and that "humans, of all ages, not just infants, need to have the impulses of sympathy attuned. They need to share experiences in order to help make sense of them" (Trevarthen & Malloch, 2000, p. 7). This discovery of the deeper understanding of empowerment led Haslbeck to theorise that Creative Music Therapy may promote the infant's sucking ability. Als and Gilkerson (1997) support this discovery by stating that communicative musicality is recognised as multifaceted, creative and adaptable in accordance with the situation that is presented; the relationship-based decision-making process that occurs during communicative musicality facilitates empowerment. Edwards (2011) emphasises the point that infants are not necessarily able to discriminate between music and speech and therefore, they are drawn to the types of vocal interplay that they experience as more meaningful and recognisable.

Study 2 emphasises the impact of singing on the infant's ability to feed by stating that the infant's comfort level determines the motivation to suck. The study found that singing induces comfort, specifically through the use of the lullaby, which has a prolonged effect on the sucking activity (Loewy, 2015). Standley (2003) states that lullabies comprise of language information in the home language that the infants were exposed to within the intrauterine environment and that this may further promote nurture and comfort. These lullabies are also typically paired with calming and rhythmic stimuli that encourage sucking during pacification, incorporating the above-mentioned technique of entrainment. Research conducted by Allen (2013) highlights the importance of the use of lullabies to assist in regulating the infant. It was found that lullabies decreased the amount of crying episodes in

premature infants which led to a decrease in energy expenditure, thus allowing the infant to gain weight at a faster rate. This discovery by Allen (2013) is supported in study 6 (Standley et al, 2010) which indicates that nonnutritive sucking results in a calmer infant, further resulting in lower activity levels, energy conservation and weight gain. The use of lullabies for promoting communication between the infant and parent, therapist or caregiver, and regulating premature infants, can also be found in studies by Conrad et al. (2011); Nakata & Trehub (2004); Trainor (1996) and Trainor et al. (1997).

5.4.2 Physiological development of the suck-swallow-breath skill

Discharge of a premature infant from the NICU, is in accordance with the achievement of developmental goals such as the suck-swallow-breath skill, tolerance of full enteral feeds and stabilised weight gain. The studies address the importance of growth and development within the premature infant specifically with regard to the development of the said suck-swallow-breath skill. Lau et al. (2003) describe the suck-swallow-breath as a skill whereby an infant displays an ability to suck efficiently and swallow rapidly so as not to minimise the duration of airflow interruption.

It was discovered, through the review, that physiological development in the premature infant is as a result of either entrainment or due to the regulating of the infant which has been discussed in the previous section. Studies 1 and 10 (Haslbeck, 2013; Menke et al., 2021) emphasise the importance of entrainment in encouraging physiological development within the premature infant. Menke et al. (2021) describe how the use of the chosen music therapy intervention assisted in facilitating a stable and regular breathing pattern within the premature infant which, in turn, assisted in the premature infant's development of the suck-swallow-breath skill at a faster rate. Study 10 (Haslbeck, 2013) states that the use of creative music therapy assists with the physiological development of the infants and promotes growth in the suck-swallow-breath skill through the fine attunement and entrained rhythms found within the music.

Studies that included the use of the PAL (studies 3, 6, 7, and 8) discovered that the development of the sucking skill was a result of operant conditioning with positive reinforcement as the infants received the reward of a lullaby when they maintained a determined sucking pressure. The lullaby is characteristically chosen to assist in regulating and calming the infant to a level at which feeding is tolerable. Study 3 (Chorna et al. 2013)

made use of the mother's voice and found that this aspect of the intervention was considered developmentally appropriate. The mother's voice provides a positive auditory stimulation to the infant while the infant is engaging in developmental procedures such as nonnutritive sucking and feeding during their hospitalisation. The literature discussed in Chapter two by Vitale et al. (2018), highlights that music in the NICU is experienced as both sensorial and cognitive by the premature infant, thus assisting the infant in tolerating a multisensorial environment. Gooding (2010) states that when oral feeding is paired with contingent music therapy like that of the PAL and PAM interventions, nonnutritive sucking occurs at a higher rate, promoting a faster transition to oral feeding.

As stated in previous sections, premature infants are susceptible to being overstimulated due to environmental and procedural factors. It was discovered that overstimulation played a key role in multiple factors throughout the review process, including the aspect of the infant's development. Study 2 (Loewy, 2015) utilises lullabies to assist in the development of the infant as it was discovered that, due to the soothing quality of the voice, this form of music did not overstimulate the infant. Characteristically, simple lullabies seem to assist the infants in orientating themselves within the environment and, therefore, provide transitional support, assisting the development of the infant through infancy into childhood. This finding was also seen in study 5 with infants receiving developmental multimodal stimulation as these infants displayed positive neurodevelopmental gains and the length of stay in the hospital decreased (Walworth et al., 2012). Decreasing the length of stay, found in study 5, correlates with the literature by Emery et al. (2018) who expressed the need for music therapy interventions to focus on the developmental needs of premature infants and to focus on decreasing the length of stay for infants who are prone to spend longer periods of times in hospitals.

5.5 Impact of music therapy feeding intervention on weight gain

As stated in previous sections in the studies where the music therapy interventions were targeted towards feeding, there were no significant differences in weight gain in the premature infants. There were, however, findings and trends of importance that should be noted, and the concept of weight gain should not be ignored and may require further research. It was discovered that feeding and weight gain act in correlation with each other as described by Kaya and Aytekin (2016) who state that infant feeding problems result in the cessation of weight gain. Therefore, it can be said that through the development of the feeding skill, infants may gain weight at a faster rate. The opposite of this concept can be seen in study 3

which highlights infants with immature and poor oral feeding skills who experience greater energy expenditure during oral feedings which delays the development of the feeding skill. This, in turn, results in the infant not being able to consume enough calories in order to achieve sufficient growth (Chorna et al., 2013). The PAL intervention seemed to have the most findings with regard to the weight gain variable as studies 6, 7 and 8 focused their intervention around this variable. It is important to remember that the PAL provides an infant with a nonnutritive sucking experience and study 8, by Standley (2003), emphasises that nonnutritive sucking facilitates a lower activity level in premature infants, which in turn, results in energy conservation and further results in the infant gaining weight. Standley (2003) discovered that when premature infants gained weight, they transitioned onto full enteral feeds quicker, and it was also discovered that the infants displayed reduced stress. In the majority of the studies (studies 1, 2, 5, 6, 7 and 9) pertaining to feeding and weight gain as measured outcomes, the authors concluded that the lack of sufficient results was as a result of infants being discharged earlier due to them obtaining the feeding skills and meeting the requirements stated in chapter two pertaining to eight oral feeds in a day.

5.6 Implications for Practitioners

Music therapy has proved to be a beneficial, nonpharmacological intervention for premature infants within the NICU. This review process has discovered benefits with regard to music therapy's effect on feeding and weight gain with premature infants, two developmentally important requirements that an infant needs to meet before their intended discharge.

5.6.1 Implications for active interventions and receptive interventions

The most prominent theme that was discovered throughout the review process was the clear distinction between live (active) music therapy interventions (studies 1, 2, 4, 5, 9, and 10) and receptive (recorded) music therapy interventions (Studies 3, 6, 7, and 8). The findings imply that both active and receptive music therapy interventions are beneficial to the premature infant with regard to growth and development. However, there seems to be a large shift towards the preference for live-active music therapy as there is a music therapist present who can continuously monitor the premature infant and can adapt the music accordingly in the moment (Walworth et al., 2012).

In regard to the implementation of active music therapy, Shoemark et al. (2015) remind us that infants are sensitive to potentially overstimulating auditory environments and that these

environments have the potential to alter developmental pathways. Therefore, it is advised that auditory stimuli be developmentally adequate and meaningful, in accordance with the intended goals for the premature infant. Study 4 (Loewy et al., 2015) highlights the preference of live music therapy as they state that the utilisation of entrainment is best applied in the moment, as the musical elements of the music can be shifted in accordance with the displays of the infant. The music elements are typically kept characteristically simple, consisting of simple melody lines, a simple 4/4 or 3/4 meter, and tempo is established through entrainment. Loewy et al. (2013) also go on to explain that the application of the interventions by a trained music therapist provide a pathway to addressing overwhelming stimuli and overstimulating environments for both the premature infants and their parents.

Another preference that is considered within the application of live-active music therapy is the fact that parents are able to participate in the intervention. It was discovered that the majority of the live music therapy interventions utilised the participation of the parents (studies 1, 2, 4, 9 and 10) while the receptive recorded music interventions that utilised the parents consisted of study 3. Live interventions, such as that of the Song of kin (studies 2 and 4) and creative music therapy, incorporate the participation of the parents which has been shown to be beneficial in the attachment and the stress levels of both the parents and the premature infant. The inclusion of parents and cultural songs within the therapeutic space highlights the theory of attachment. Prior and Glaser (2006) emphasise the importance of attachment with infants as they state that infants are able to instinctively attach to their carer(s) or parents. This attachment is vital as it serves a specific biological function between the infant and the parents. The attachment assists in promoting protection, survival and genetic replication. As stated previously, the NICU is a characteristically stressful environment on both the premature infants and their parents. Prior and Glaser state that attachment behaviour is proximity-seeking and in the context of the NICU the infant may attach to a figure by whom safety is provided in the face of threat, urging the importance of parental-participation within the NICU. Parent-selected songs, as discussed in study 2, provide enhancement in bonding between parent and premature infants. This music can provide continuous, optimum quality of care within the NICU as these songs that are derived from the parents and their cultural heritage are applied effortlessly by the parents, to the developing premature infant, in their transitional moments.

Receptive music interventions such as the PAL, have shown considerable benefits with regard to the development of the premature infant's suck-swallow-breath skill which refers that procedures, paired with rewarding stimuli, help to regulate the infant. It could be argued that all of the above-mentioned live music therapy interventions in section 5.2.1, also constitute receptive interventions as the patient (premature infant) is receptively receiving the music, and is not actively engaging in the creation of the music. However, they were categorised under live music therapy as music was created in the moment and in accordance with the infant's displays. The heartbeat or breathing pattern determined the tempo of the music being created as seen in studies 1, 2, 4, 5, 9 and 10. Therefore, the infant's vital signs and displays were considered as their contribution to the musical material. Thomann et al. (1991) emphasise the discrepancy between live versus artificial nurturance by stating that entrainment to breathing and/or heartbeats occurs spontaneously, and due to the unpredictability of the infant's displays, being able to respond in the moment is valuable to the infant's growth.

5.6.2 Implications for age and time of the intervention

The development of the premature infant is very sensitive and consideration needs to be taken with regard to when the intervention is implemented with the infants. The results of the review discovered that the optimum time to implement the intervention was prior to the scheduled feeding, typically 30-60 minutes before a scheduled feeding, as this time period seemed to prepare the infant for the feeding stimuli as well as regulate the infant enough so that the feeding experience was not overstimulating. Due to the underdeveloped gastrointestinal and auditory systems, as discussed in chapter two, the age of the infant is also taken into consideration to avoid causing aspiration. The results discovered that infants between the ages of 32 and 36 gestational weeks were most receptive to the music and responded best to the music therapy intervention. Study 6 by Standley et al. (2010) emphasised that infants at 34 gestational weeks were the best age to begin musical interventions. This is also seen in the general literature, found in chapter two, which states that infants typically remain on tube feedings up until 34 gestational weeks and this is the optimal age to begin introducing interventions to help in the development of the sucking skill.

5.6.3 Implications for self-regulation and development

The interventions across the review focused on both the regulating of the premature infant as well as the physiological development of the infant with regard to the suck-swallow-breath skill. The results of the review discovered that self-regulation by the premature infant assists in physiological development and visa versa. Through this, it may be said that music therapy interventions employed within the NICU should target both regulation of the infant as well as focus on physiological developmental goals, as both these states assist and create an optimum condition for the infant to tolerate oral feeding. This is theorised in Study 5 by Walworth et al. (2012) who state that progress and improved outcomes that are displayed in premature infants could be attributed to the brain showing the ability to integrate new information and maintaining a state of homeostasis while being subjected to musical stimuli.

5.6.4 Implications for weight gain

Many of the articles included in the review discovered no significant differences in weight gain between the control and experimental groups of the intended studies. It could be said that this is due to the infants being discharged when they obtained sufficient stability and the ability to oral feed. Therefore, they are discharged at different weights and potentially different ages. However, study 7 (Cevasco & Grant, 2005) states that it is important for the premature infant to acquire the feeding skill in order to gain weight and, therefore, the variable of weight gain should not be disregarded.

Chapter 6: Conclusion

6.1 Introduction

The aim of this study was to conduct a systematic literature review on the effect of music therapy on feeding and weight gain in premature infants in the NICU. In order to be inclusive of all study designs, Whittemore and Knalf's (2005) framework for conducting an integrative review was followed. During the search it was discovered that a distinction between music medicine and music therapy was necessary and the search term of "premature infant" needed to be adapted so as to further refine the search. The use of the term "NICU" limited the search to include studies conducted within an environment rather than with a specific participant. Therefore, the scanning process of the articles consisted of an additional step of screening for articles that specifically pertained to premature infants. There were ten studies (nine quantitative studies and one qualitative study) that met the criteria for the review and that were included in this study. All ten studies support the hypothesis that music therapy has an effect on feeding and the development of the feeding skill in premature infants during their stay in the NICU. However, there seemed to be no significant effect on the variables of weight gain in the included studies.

6.2 Summary of findings.

The present integrative review aimed to investigate the effect music therapy has on feeding and weight gain in premature infants while in the NICU. An extensive search of literature was carried out, which led to the identification of ten studies that met the inclusion criteria for the review. The findings suggest that music therapy as both a live or receptive form of intervention is beneficial in the development of feeding in premature infants. These findings are not only beneficial to the family and premature infants who develop at a faster rate, meeting discharge requirements sooner, but also to the hospital as an infant's early discharge date results in a decrease of NICU costs. The review also concluded that there is an appropriateness of timing in regard to the implementation of the intervention, with the best time being prior to feedings and at an optimum age of between 32-36 gestational weeks. Obtaining self-regulation, in order for the premature infant to develop, was also discovered throughout the review process. The use of music therapy in this regard is considered beneficial as music has a regulatory effect on premature infants and their parents. The use of the mothers' voices seemed to display the biggest calming effects on the infants.

6.3 Limitations of this Study

While care was taken with the synthesis of the findings for this review, in order to answer the research questions stipulated in chapter one, there is still the consideration of the complexities involved through combining and comparing different methodologies as stated by Whittemore and Knalf (2005). It should be noted that the findings of the included studies did not contradict one another, but rather, the results were similar in nature and assisted in broadening the scope of research and literature of the specific topic.

A small number of articles met the inclusion criteria for this review. This review only included studies that were conducted by a music therapist or involved the recruitment of a music therapist for the purpose of implementing the interventions. It was discovered, during the screening process, that in some studies the intervention was conducted by other healthcare professionals (for example physiotherapists, doctors, nurses, speech and language therapists). These studies warranted beneficial results or non-significant results with the implementation of music to target feeding and weight gain. However, by excluding these studies, important research may have been missed. The review included studies that were published in English; however, it was discovered that there were articles that met the inclusion criteria but were published in another language and, therefore, important research data may have been missed throughout this process. While an extensive search of databases was carried out, the inclusion of more databases may have yielded more results.

6.4 Recommendations for Future Research

Research into music therapy for feeding and weight gain in premature infants is not particularly extensive and caution needs to be taken as to whether the intervention is music therapy or is identified as music medicine (being administered by medical staff and nurses or other healthcare professionals). The studies that do exist on this topic have shown positive results in both the feeding and weight gain aspects, however, it is unclear as to which intervention may be most beneficial as the approaches with each intervention varied. Further research could prove beneficial as to the efficacies of both music therapy interventions and interventions that are considered music medicine.

The time spent in the NICU has been shown to be a stressful period for both the premature infant and their parents. Procedures and therapeutic interventions are put in place to assist the

infant in their extrauterine growth and development towards discharge from the NICU. However, these procedures can be stressful and may cause unwarranted stress to the parents. It was stated, in the discussion chapter, that parental displays of stress could transfer to the premature infants and may hinder their growth and development. Music therapy has shown quantitative results in the decrease of stress symptoms in both the premature infant and their parents (Menke et al. 2021). However, there is limited research with regard to the experiences of the specific music therapy feeding interventions from the parents and even the staff of the NICU. Research, consisting of more qualitative methodologies, may prove beneficial in the growth of music therapy interventions within the NICU.

Growth and development of the premature infants while in the NICU was rather unpredictable and interventions were administered at different gestational weeks. Some of the literature in chapter two and chapter five discussed the appropriateness of implementing stimuli with premature infants in accordance with their gestational age. Some of the studies (studies 7 and 8) in the review expressed positive outcomes with specific age ranges. They expressed a preference for working with infants of a certain age or at a certain time of the day when the premature infant appeared to be in the most calm, alert state and thus able to tolerate the music intervention. However, there is limited research with regard to the most appropriate age range at which to implement the music therapy intervention.

6.5 Conclusion

Premature infants require delicate care during their stay in the NICU, and discharge of the infant is only achieved when they reach the developmental requirements as stated throughout this review. Feeding and weight gain are vital aspects in the growth and development of premature infants during their stay within a NICU. Interventions across different healthcare professions have been put in place to assist the infant to gain sufficient weight and develop the suck-swallow-breath skill necessary for the transition from parenteral to enteral feeding.

Music therapy is a therapeutic intervention that has been widely researched and implemented within the NICU to target the growth and development of premature infants as well as to assist parents in developing attachment bonds and caring for their premature infants. This review concludes that music therapy is a beneficial non-pharmacological therapeutic intervention that can be administered with premature infants in the NICU to achieve the above-mentioned developmental goals of feeding and weight gain. Music therapy is a

modality that has shown to not overstimulate the infant but rather have a regulating effect, which in turn assists in infant development.

In order to further enhance music therapy interventions, with particular reference to feeding and weight gain and the lived experiences of parents and staff members, the review concluded that more studies into the field of music therapy within the NICU for premature infants, would be beneficial.

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Appendices

Appendix A: Qualitative study appraisal form

Specialist Unit for Review Evidence (SURE)

Questions to assist with the critical appraisal of qualitative studies[1]

Citation:
Study Design:

1. Does the study address a clearly focused question/hypothesis	Yes	Can't tell	No
Setting?			
Perspective?			
Intervention or Phenomena			
Comparator/control (if any)?			
Evaluation/Exploration?			
2. Is the choice of qualitative method appropriate? Is it an exploration of eg behaviour/reasoning/ beliefs)? Do the authors discuss how they decided which method to use?			

3. Is the sampling strategy clearly described and justified? Is it clear how participants were selected? Do the authors explain why they selected these particular participants? Is detailed information provided about participant characteristics and about those who chose not to participate?	

4. Is the method of data collection well described? Was the setting appropriate for data collection? Is it clear what methods were used to collect data? Type of method (eg, focus groups, interviews, open questionnaire etc) and tools (eg notes, audio, audio visual recording). Is there sufficient detail of the methods used (eg how any topics/questions were generated and whether they were piloted; if observation was used, whether the context described and were observations made in a variety of circumstances? Were the methods modified during the study? If YES, is this explained? Is there triangulation of data (ie more than one source of data collection)? Do the authors report achieving data saturation?	
5. Is the relationship between the researcher(s) and participants explored? Did the researcher report critically examining/reflecting on their role and any relationship with participants particularly in relation to formulating research questions and collecting data). Were any potential power relationships involved (ie relationships that could influence in the way in which participants respond)?	
6. Are ethical issues explicitly discussed? Is there sufficient information on how the research was explained to participants? Was ethical approval sought? Are there any potential confidentiality issues in relation to data collection?	

7. Is the data analysis/interpretation process described and justified? Is it clear how the themes and concepts were identified in the data? Was the analysis performed by more than one researcher? are negative/discrepant results taken into account?	

8. Are the findings credible? Are there sufficient data to support the findings? Are sequences from the original data presented (eg quotations) and were these fairly selected? Are the data rich (ie are the participants' voices foregrounded)? Are the explanations for the results plausible and coherent? Are the results of the study compared with those from other studies?	
9. Is any sponsorship/conflict of interest reported?	
10. Finally…consider: Did the authors identify any limitations? Are the conclusions the same in the abstract and the full text?	
Summary *Add comments relating to areas of concern that were avoidable and a statement indicating if the results are reliable and/or useful.*	

This checklist should be cited as:

Specialist Unit for Review Evidence (SURE) 2018. Questions to assist with the critical appraisal of qualitative studies available at: http://www.cardiff.ac.uk/specialist-unit-for-review-evidence/resources/critical-appraisalchecklists

[1] Adapted and updated from the former Health Evidence Bulletins Wales (HEBW) checklist with reference to the NICE Public Health Methods Manual (2012) and previous versions of the Critical Appraisal Skills Programme (CASP) checklists.

Appendix B: Quantitative Study appraisal form

Specialist Unit for Review Evidence (SURE)

Questions to assist with the critical appraisal of randomised controlled trials

and other experimental studies[1]

Citation:
Study Design:

1. Does the study address a clearly focused question/hypothesis	Yes/Can't tell/No
Population/Problem? Can you identify the setting & eligibility criteria? Intervention? Comparator/control? Outcomes? Can you identify the primary outcome?	
2. Was the population randomised? If YES, were appropriate methods used? Eg: random number tables, opaque envelopes Note: The following methods are not appropriate: alternating participants coin toss, birth dates, record numbers, days of the week	
3. Was allocation to intervention or comparator groups concealed? Is it possible for those allocating to know which group they are allocating people to? As above, methods such as alternating participants coin toss, birth dates, record numbers, days of the week will not allow appropriate allocation concealment.	
4. Were participants/investigators blinded to group allocation? If NO, was assessment of outcomes blinded?	

5. Were interventions (and comparisons) well described and appropriate? Aside from the intervention, were the groups treated equally? Was exposure to intervention and comparison adequate? Was contamination acceptably low?	
6. Was ethical approval sought and received? Do the authors report this?	
7. Was a trial protocol published?	
Was a protocol published in a journal or clinical trial registry before participants were recruited? If a protocol is available, are the outcomes reported in the paper listed in the protocol?	
8. Were the groups similar at the start of the trial? Are baseline characteristics provided and discussed (eg age, sex, social class, life style etc.)? Are there any significant differences that may influence study outcomes?	
9. Was the sample size sufficient? Were there enough participants? Was there a power calculation? If YES, for which outcome? Were there sufficient participants?	
10. Were participants properly accounted for? Was follow-up ≥ 80%? Were patients analysed in the groups to which they were randomised? Was an Intention to Treat analysis conducted? Was the follow-up period long enough?	
11[1]. Data analysis Are the statistical methods well described? Consider: How missing data was handled; were potential sources of bias (confounding factors) controlled for; How loss to follow-up was addressed.	

[1] Adapted and updated from the former Health Evidence Bulletins Wales (HEBW) checklist (http://www.cardiff.ac.uk/insrv/libraries/sure/doc/Project%20Methodology%205.pdf) with reference to the NICE Public Health Methods Manual (2012) and previous versions of the Critical Appraisal Skills Programme (CASP) checklists, with reference to the CONSORT statement.