

Music Therapy in Preterm Infants: Which One is Better Active or Passive?

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Abstract

Preterm newborns present multiple complications due to their immaturity, for several years multiple methods have been used that help conventional therapy, among the most used is music therapy, this can be done in different modalities and has multiple benefits, for what is intended to review the scientific literature to evaluate them and see if they present any differences and which one has more advantages.

Keywords: Music Therapy; Premature Infant; Neonatal Intensive Care; Neurodevelopment

Abbreviations

Music Therapy; Active Music Therapy (AMT); Passive Music Therapy (PMT)

Introduction

Prematurity it's known as one of the main causes of infant mortality, it also causes different forms of long-term problems, among which are visual and hearing disabilities, and learning disorders [1,2]. It is estimated that between 10-12% of preterm infants will require hospitalization in the neonatal intensive care unit (NICU), many of them for many days [2,3].

Premature infants have a higher incidence of structural and functional alterations of the brain. These are related to difficulties in the subsequent acquisition of language, decreased academic performance, and psychiatric disorders, as well as deficits in executive functions and a greater need for special education. These alterations can manifest throughout the infant's life, even in adulthood [1,4-6].

For music processing the human brain involves cortical and sub-cortical areas, those areas form an extensive and complex neural network [5]. Sound intensity in the NICU usually exceeds recommendations reaching 50 to 80 dB (and occasionally 100 dB), while its recommendation is 45 dB during the day and 35 dB at night. Negative physiological acute responses such as changes in heart rate, respiratory rate, blood pressure, and oxygen saturation can occur after auditory overstimulation. Some chronic complications such as hearing disorders, alterations in the development of language or speech, interference with sleep, and sleep deprivation can happen from excessive noise [1,2,7]. High-intensity music has been shown to cause increases in heart rate and fetal movements, and low-intensity music has the opposite effect. It has also been shown that children who are exposed to music from the period during the last trimester of pregnancy match their movements to music (suction, tongue movements, mouth protrusions, breathing, and vocalizations) [5].

Auditory experiences begin during intrauterine development, as well as musical learning. When the human brain perceives music

limbic and paralimbic structures are activated, enhancing the connectivity of neural networks in children and adults. Music modulates and promotes learning, neurobiological processes, and neuronal plasticity [1,8,9].

Premature infants are exposed to a lesser extent to the beneficial intrauterine environment, where they are exposed to the sounds of the maternal heart, her breathing, and even her voice [1,9]. Contrary to this preemies are exposed to a lot of negative stimuli during their experience in the NICU, they can be biological (such as infections, hypoxia, hyperoxia, ischemia) and/or environmental (noise from machines, telephones, conversations, bright lights, and pain). Being more sensitive to noise due to this period of rapid synaptic development, as well as interrupting their sleep periods and causing a state of overstimulation [1-4,6-10].

Prolonged hospital stays and extreme physical fragility make physical contact with their parents difficult. Such a situation means that an affective bond cannot be created, therefore the mother-baby dyad interaction is not allowed. Separation from mothers can increase the stress response, also the incidence of postpartum depression is augmented, which can adversely affect neurodevelopment [1,11].

Music therapy (MT) promotes attachment with caregivers and can be combined with kangaroo care facilitating the self-regulation of the infant and promoting its neurodevelopment [1,10-12]. With these alternative methods, we can deliver an ambiance of familiarity, giving him familiar sounds so he can feel safe, secure, comfortable, and less stressed [7,8,10]. MT is a well-known technique, safe, inexpensive, and easy to implement, and complements other treatments. It also represents early stimulation as it favors neurodevelopment, language, and social interaction [1,11,13]. Music should not exceed 65-70 dB, so it can be matched to the vital signs of the infants. Overstimulation can disturb autoregulation and impair neurodevelopment [8]. Ideally, there should be one (or several)

music therapists, and a multidisciplinary therapeutic approach to identify the best time for the session and respect the individuality of the infant [1].

Different ways of applying MT have been described. Active Music Therapy (AMT), is through live music, instruments, or the human voice. Passive music therapy (PMT) uses recordings of classical music, children’s lullabies, sounds of nature, or the voice of the parents. We speak of combined MT by combining both methods [8,10,12]. The effects found in several studies evaluating different forms of MT can be seen in table 1.

AMT can be done with the voice (sung, hummed), sometimes accompanied by instruments such as the guitar, harp, kalimba, flute, viola, cello, keyboard, drum, xylophones, maracas, among others. Ideally, it should be done for at least ten minutes, and you should try to coincide with the parents to improve the experience [10,14]. The type of music can be adapted to the culture of each family [4,8]. No adverse effects have been reported when listening to live lullabies. This effect is enhanced by placing the patient in the kangaroo position [7,12]. There is no evidence that a specific type of music is more beneficial than others, (eg Mozart), the music used must be adjusted to the culture, maternal personal tastes, and infants’ response [5].

The music reproduced by recordings differs from live music since the latter can be adapted to the moment of application, the movements. Sometimes the music played can overstimulate the infants, due to changes in the rhythms, timbres, and melodies that are not accompany those of the newborn [8]. The passive MT does not usually exceed 55-65 dB [9,15].

Methods: Search scientific evidence on the use of MT in preterm infants, to assess its inclusion within the care plans of these patients, and find out which method has more benefits.

Study	GA	Type of Study	AMT/PMT	Benefits
Morales-Bethancourt (2020)	23-34	Brief report	AMT	Without statistically significant changes in comfort, slightly better results in patients with the kangaroo method vs infants in incubators. Measured by NIPE scale.
Schlez (2011)	26-36	Crossover subject-within	AMT	Maternal anxiety improved with music played on the harp compared to using the kangaroo method by itself. The infants’ physiological responses did not differ.

Yakobson (2020)	27-34	Cluster-RCT Protocol	AMT	There is a greater increase in heart frequency during AMT compared to kangaroo care alone
Cassidy (2009)	28-33	Observational	PMT	Infants in all groups had greater head growth during the time of treatment than during baseline conditions. This group also found a decrease in heart rate over the course of data collection.
Keidar (2014)	27-33	Prospective RCT	PMT	A 7.7% reduction of resting energy expenditure from baseline with Mozart music PMT was not found with other types of MT.
Zimmerman (2013)	26-30	Exploratory study	PMT	Infants receiving PMT significantly improved their weight gain velocity compared to matched controls ($p < 0.001$) during the neonatal period. No other differences were found.
Anderson & Patel (2018)	27-36	Systematic review	AMT/PMT	The selected literature seems to indicate that effects are present on the cardio-pulmonary system and behaviour of neonates, although the relative effect size remains unclear.
Arnon (2006)	25-34	Randomized study	AMT/PMT	AMT had no significant effect on physiological and behavioural parameters during the session; however, at the 30-minute interval after the therapy, it significantly reduced heart rate and improved the behavioural score. PMT and no music therapies had no significant effect on any of the tested parameters.
Bieleninik (2016)	23-32	Meta-analysis and systematic review	AMT/PMT	Infants Improved their respiratory rate and maternal anxiety.
Lowry (2013)	29-32	RCT	AMT/PMT	Lower heart rates occurred during AMT with lullaby and rhythm intervention. AMT helps to improve sucking behaviour. Music decreased parental stress perception.
Namjoo (2020)	32-36	RCT	AMT/PMT	The mean scores of physiological parameters (oxygen saturation and heart rate) were not significantly different in the three groups before, during, and after the intervention. However, there was an improvement in oxygen saturation and a decrease in the heart rate in the two intervention groups. The mean duration of infants' overnight sleep improved with MT and it was a long time in the recorded-lullaby group than the other two groups.
Torres-Ake (2020)	32-37	Systematic review	AMT/PMT	The articles are shown to have better results with MT vs massage therapy on oxygen saturation, and vital signs, and decrease the use of an artificial respirator.

Table 1: Comparison of the different modalities of music therapy and the benefits found in premature infants.

Source: self-made.

Discussion

This article aims to investigate new therapies to stimulate preterm infants, in an integrative way, including the family, to increase the benefits and allow parents to learn these non-invasive techniques.

In a randomized prospective study, Haslbeck, *et al.* evaluate the neurocognitive results in the short and medium term in 40 preterm infants with music therapy, and assess the structural and functional changes by non-invasive brain imaging studies. The structural analysis demonstrates increased integration in the cingulate cortex, less delay in thalamocortical processing, and greater integration of neural networks. The increase in connectivity was observed between the thalamus, prefrontal, and orbitofrontal regions, which are associated with affective and emotional processing, as well as in the supplementary motor area; which is associated with movement planning, movement initiation, and word production. Stimulation of the prefrontal cortex is associated with functions that are usually affected in children with a history of prematurity, including inhibition, working memory, cognitive flexibility, and planning. This could translate into medium and long-term effects on neurodevelopment. MT also has a family integration approach, empowering parents to perform therapies and thus increase vocal interaction with the infant. This reduces parental stress and self-esteem [1].

In a meta-analysis, MT was found to improve heart rate, respiratory rate, and increase oral feeding volume but did not find a significant impact in improving oxygen saturation or behaviour in preterm infants. This may be because the kangaroo mother care method presents sensory improvements that may mask the benefits of this intervention. PMT or combined MT was the main method in the articles reviewed in this paper, only two used harp live music as the only method, and these studies found the most benefits. A decrease in maternal stress was found, as well as a decrease in cases of postpartum depression. Although it is considered that more studies are needed to determine the effectiveness in reducing maternal stress [2].

Namjoo, *et al.* carried out a randomized study evaluating 90 premature infants where they evaluated the effectiveness of lullabies with the mother's voice and compared it with recordings. The music was played for 14 days, 20 minutes each day, and the control group received no intervention. And the responses of the

physiological constants were analyzed before, during, and after the intervention, however, no statistically significant benefits were found, despite presenting an improvement in heart rate and oxygen saturation in the two groups. There was also an improvement in the amount of sleep, the average is higher in premature infants with recordings (43 more minutes) versus premature infants with live music (24 minutes), or premature infants in the control group, which was statistically significant [7].

A study carried out in Madrid, Spain carried out 72 sessions with 29 premature infants, and evaluated the level of comfort, without finding statistically significant differences before or after receiving the music. No negative effects were reported in the evaluated infants [14].

A systematic review and meta-analysis examined the effect on preterm infants during hospitalization, and after hospital discharge. Lower respiratory frequency was found in infants (around 4 breaths less) and less maternal anxiety. An improvement in heart rate was also found (although it was not statistically significant), it is considered within the context of the relaxation response and greater stability. A lower incidence of maternal depression was observed, which is considered supportive for the development of the infant during the first two years of life. Among the limitations found are the heterogeneity of the studies, lack of long-term studies, and follow-up in children [12].

Arnon conducted a randomized study with 31 infants, placing the patients into 3 groups AMT, PMT, and the control group. There was evidence of improvement in the physiological constants after AMT, and there was no improvement in the other two groups. Parents and hospital staff also reported clear improvement from AMT. A preference by staff and parents for AMT has been evidenced after the completion of this study [15].

Music influences the neurovegetative system which can be evidenced by changes in heart rate, respiratory rate, and oxygen saturation [1,2,10]. The presence of familiar sounds gives the infant security, stability, and comfort, reducing stress [7,8,10]. An important benefit is to reduce stress, which can be assessed by identifying the number of crying episodes [2,10]. It has also been described that premature infants can be distracted from pain, improving homeostatic regulation in a space that is coherent with the environment in which they find themselves [4,10].

Conclusion

The prevalence of preterm birth is constantly rising, and long-term effects are many as we have seen. The use of non-invasive interventions such as kangaroo care and MT can bring many benefits as we reviewed in this article.

The different articles reviewed included 3 AMT cohorts, 3 PMT cohorts, and 6 articles that included both AMT and PMT. The mean gestational age was 30 weeks. Music demonstrated some benefits in physiological responses of vital signs, weight gain, oral tolerance, decreased pain, behavioural changes, less parental stress, and improved attachment. These advantages were found a little better in the AMT group, also the parents report in several studies they have a better experience and prefer this method. Although the results differed in the different studies, it is believed that these results are due to the different methodologies in the studies and the differences in the application of MT, so it is suggested to carry out a systematic review of the literature exploring this topic.

PMT and AMT have both been shown to be effective, and have multiple benefits, although the second has the advantage of being able to adapt to the needs of the moment. MT can help to decrease the neurological deficits caused by prematurity due to its multiple benefits.

Conflict of Interest

The work has not been financed by any public or private entity. The author declares no conflict of interest.

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