



A Structured Review on the Effect of Music Therapy on the Development of Preterm Infants

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INTRODUCTION

A birth is considered pre-term when an infant is born prior to 37 weeks of gestation. This situation usually results in complications which have adverse effects on the health outcomes of the newborn. Due to innovations in medical technology, the likelihood of survival of preterm infants has significantly increased. In fact, preterm infants born prior to 23 weeks have a 17% survival rate where as premature infants born between 35 to 38 weeks have a 98% survival rate.¹

Preterm babies spend a significant amount of time in the Neonatal Intensive Care Unit (NICU). The NICU is a very different environment in comparison to the uterus ² and as a result, it can be disruptive to the development of preterm infants.³ Continuous exposure to a variety of painful procedures such as the heel lance procedure, and sensory stimuli such as light and sound in the NICU, contribute predominantly to this disruption in development.³ In addition, stress induced by these conditions often lead to short term complications for preterm infants, such as sleep disturbance, decreased oxygen levels and increased heart rate.⁴

Improving the developmental outcomes of preterm babies has prompted an extensive research interest in the use of alternative methods during neonatal care. An example of such alternative interventions is music therapy. Although, there is evidence suggesting a beneficial effect of music therapy in masking NICU noise², soothing preterm babies after painful procedures and stress reduction,⁵ its effect on the development of preterm babies remains unclear.

RESEARCH QUESTION

The objective of this structured review is to determine the effects of the different types of music interventions on developmental outcomes of preterm infants.

METHODS

Search Strategy
A preliminary search was carried out across 5 different databases : MEDLINE Ovid, PubMed, EMBASE, SCOPUS and the Cochrane Database of Systematic reviews. This preliminary search yielded a total of 454 studies. After screening of titles and abstracts, and elimination of duplicates, 75 studies were selected for retrieval of full texts and 379 were excluded. These were excluded if : they were irrelevant to the research question (n= 340) ; could not be accessed via the uOttawa library (n =36) or were in a foreign language (n =3).

Study Selection and Review
The 75 articles selected for retrieval of full texts were subjected to inclusion and exclusion criteria, and reviewed by two independent reviewers. After review and consensus, 49 studies were excluded, and 26 studies were included for this review. (19 single studies and 7 aggregated studies) (See Figure 1)
Inclusion criteria :
Population - preterm babies
Intervention - Music therapy only (as broad as singing, live music, classical music, harp music, Mozart, recorded music, lullaby) .
Studies looking at music therapy in combination with other interventions were excluded.
Outcome Development as measured in behavioral and physiological responses, weight gain, neurodevelopment and pain reduction
Study Type - RCTs, Systematic reviews, Integrative reviews, Meta-analysis, Quasi-experimental studies.
Year range: 2000-2016

Data Extraction and Synthesis
A table of characteristics was created for included studies and a summary of findings synthesized

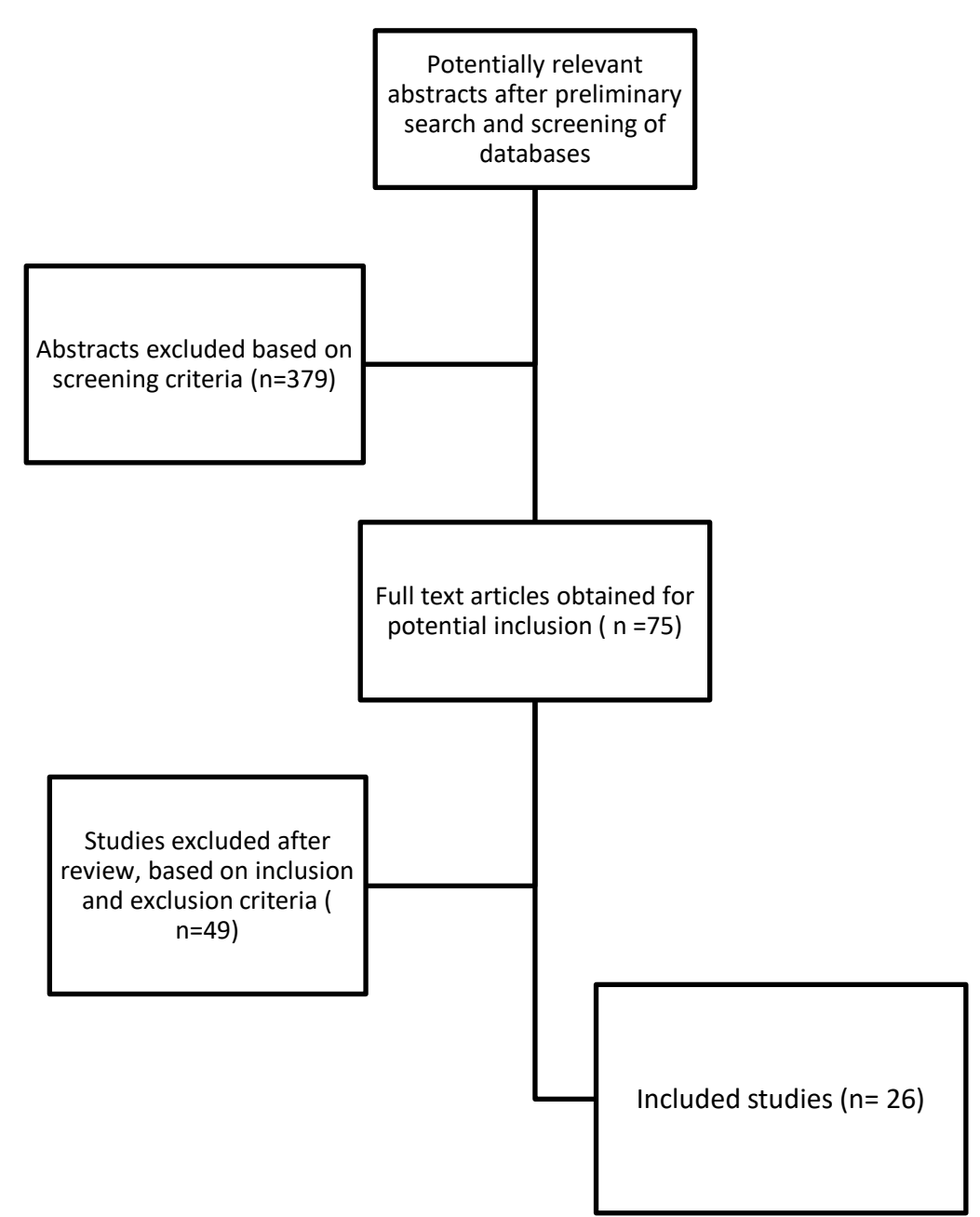


Figure 1 : Flow chart for identification of studies After application of inclusion/exclusion criteria

RESULTS

Table 1. Number of Studies that found a given outcome, as reported in aggregate studies (meta analyses, integrative and systematic reviews, n=7).

Physiological & Behavioral Outcomes		Effect found			Summary of Findings
		Significant	Not significant	No effect /Inconclusive	
Short- Term	O ₂ Saturation	4	0	1	Recorded music was associated with better mean O ₂ saturation and faster return to baseline following a medical procedure; ⁶ Music therapy may have beneficial effects among stable preterm infants on O ₂ saturation; ⁷ Music therapy improved O ₂ Saturation in preterm infants; ³ Recorded music was associated with an improvement in O ₂ saturation among preterm infants > 28 weeks. ⁵
	Heart Rate (HR)	3	1	1	Recorded music was associated with both stability in HR and decrease following intervention; ⁶ Music therapy may have beneficial effects among stable preterm infants on HR; ⁷ Music therapy decreased HR during and following heel lance, but only in older infants (>31 weeks); ³ Four studies showed an association between music therapy and lower HR, while seven studies found no association. ⁸
	Respiratory Rate (RR)	3	0	0	Recorded music was associated with decrease in RR following intervention; ⁶ Music therapy had a significant effect on lowering RR; ⁹ Music therapy may have beneficial effects among stable preterm infants on RR. ⁷
	Behavioural state*	2	1	0	Music therapy associated with decreased number of crying episodes; ⁶ Music therapy may have beneficial effects among stable preterm infants on behavioral state. ⁷
	Pain response	2	0	0	While music therapy decreased pain response on a standard index following treatment , there was no difference between music alone, and music combined with non-nutritive sucking. An effect was found only in older preterm infants (>31 weeks). ³
	Arterial Pressure	0	0	1	Music therapy had no effect on mean arterial blood pressure. ⁶
	Sleep Quality	2	1	0	Music therapy may have beneficial effects among stable preterm infants on sleep quality; ⁷ Live music was associated with improved sleep quality. ⁹
	Resting Energy Expenditure	1	0	0	Music therapy may have beneficial effects among stable preterm infants on resting energy. ⁷ expenditure.
	Medium-Term	Weight Gain	2	1	0
Feeding**		4	1	0	Music therapy may have beneficial effects among stable preterm infants on feeding behaviours; ⁷ Music therapy is associated with an improvement in feeding behaviour; ¹¹ Use of pacifier-activated lullaby was associated with improved feeding rate; ¹⁰ Music therapy was associated with improved feeding behaviours. ⁹
Length of hospitalization		2	0	1	Music therapy may have beneficial effects among stable preterm infants in the length of hospitalization; ⁷ Music therapy was associated with a decrease in the length of hospitalization among preterm infants >28 weeks. ¹⁰
Long- term	General Development	2	0	0	Music therapy may have beneficial effects among stable preterm infants on long-term infant development; ⁷ Maternal voice is associated with better long-term development (3-6 months). ¹¹

*Includes exhibiting calm behavior, scores on standardized indices, and decrease in crying behavior
**Includes caloric intake, volume of oral feeding, oral feeds per day, and time to full feeds

Table 2. Number of Studies that found a given outcome, as reported in un-aggregate studies (experimental studies, n= 19).

Physiological and Behavioral Outcomes		Effect found			Summary of findings
		Significant	Not significant	No effect /Inconclusive	
Short-Term	O ₂ Saturation	5	4	4	Music therapy was associated with higher O ₂ saturation during, and a faster return to baseline following a medical procedure; ¹² Music therapy was associated with an increase in O ₂ saturation in preterm infants; ^{13,14} Certain types of music therapy (entrained breath sounds) were associated with an increase in O ₂ saturation in preterm infants; ¹⁵ Music therapy was associated with decreases in O ₂ desaturation and the number of sleep apnea events in preterm infants. ¹⁶ Music therapy was not associated with a significant difference in O ₂ saturation. ^{4,17-20} Music therapy had no effect on O ₂ saturation; ^{2,21} Music therapy had no effect on the return to baseline O ₂ saturation following a medical procedure in preterm infants. ²²
	Heart Rate (HR)	7	6	0	Music therapy was associated with a reduction in HR in preterm infants; ^{2,21,23} Live music therapy was associated with reduced HR in preterm infants 30-minutes following treatment; ¹⁸ Music therapy was associated with a faster return to baseline HR following a medical procedure in preterm infants > 31 weeks; ²² Certain types of music therapy (lullabies and rhythm sound interventions) were associated with decreased HR during the treatment, while ocean discs were associated with decreased HR following the treatment; ¹⁵ Music therapy was associated with decreased HR in preterm infants during and following a medical procedure; ¹⁹ Music therapy was not associated with a significant difference in HR. ^{4,13,16,17,20} ; Live singing was not associated with changes in HR in preterm infants. ²⁴
	Respiratory Rate (RR)	2	5	1	Music therapy involving lullabies only was associated with a reduction in RR in preterm infants; ² Music therapy was associated with a decrease in RR in preterm infants. ²³ Music therapy was not associated with a change in RR in preterm infants. ^{13,17,18,20} Live singing was not associated with changes in respiratory rates in preterm infants. ²⁴
	Behavioural state*	1	2	1	Live music therapy was associated with better behavioral states in preterm infants 30-minutes following treatment. ¹⁸ Music therapy was not associated with a significant difference in behavioral state; Music therapy was not associated with changes in behavioral states in preterm infants. ^{4,17} Music therapy had no effect on behavioral state following a medical procedure in preterm infants. ²²
	Pain response	3	0	0	Music therapy was associated with decreased pain response following a medical procedure in preterm infants ¹⁵ ; at > 31 weeks after the procedure ²² ; and on a standard index following a treatment ¹⁶
	Blood Pressure	0	1	0	Music therapy was not associated with changes in blood pressure in preterm infants. ¹³
	Non-nutritive Sucking	1	0	0	Certain types of music therapy (lullabies and rhythm sound interventions) were associated with increased sucking behavior in preterm infants. ¹⁵
	Sleep Quality	2	1	0	Live music therapy was associated with deeper sleep in preterm infants; ²¹ Music therapy was not associated with an increase in quiet sleep in preterm infants. However, the authors reported a trend in disassembly of sleep-wake cycles in preterm infants; ²⁵ Music therapy was associated with a significant difference in the sleep-wake state of preterm infants following a medical procedure. ¹⁹
	Resting Energy Expenditure (REE)	1	0	2	Certain types of music therapy (entrained breath sounds) was associated with a decrease in REE in preterm infants. ²⁶ One type of music therapy (Mozart) was associated with a decrease in REE in preterm infants, while another type of music therapy (Bach) was not associated with a decrease in REE in preterm infants. ²⁷
	Body Temperature	0	1	0	Music therapy was not associated with changes in body temperature in preterm infants. ¹³
	Motor Activity	2	1	0	Certain types of music therapy (lullabies and rhythm sound interventions) were associated with increased activity levels in preterm infants; ¹⁵ Music therapy was associated with a reduction in motor activity in preterm infants. ²³ Music therapy was not associated with changes in motor activity in preterm infants. ⁴
	Salivary cortisol	1	0	0	Music therapy was associated with a decrease in the number of bradycardia events in preterm infants. ¹⁶
	Medium-Term	Feeding**	2	1	1
Bradycardia		1	0	0	Music therapy was associated with a decrease in the number of bradycardia events in preterm infants. ¹⁶

DISCUSSION

Within the extensive body of research focusing on the use of music therapy as an alternative intervention in the NICU, hardly any studies focus specifically on overall development of preterm infants. Instead the existing evidence is centered around specific outcomes which altogether affect development. Consequently, for the purpose of this review, development was defined in terms of physiological, behavioral responses and feeding outcomes.

Most studies reported a significant short term effect of music on physiological outcomes such as oxygen saturation, heart rate and respiratory rate. The general effect of stabilization after music therapy might reflect the potential benefits on physiological development. In addition, beneficial short term effects in behavioral outcomes like pain response and stress relief were particularly important after medical interventions such as heel pricking for blood sampling. The significant decrease in pain response reported by most studies points to the fact that music therapy might also benefit the neurodevelopment of preterm babies.

Only a few of the studies selected for this review reported significant medium and long term effects of music therapy. Meanwhile some studies reported no significant effect of music therapy and the absence of any effect. Hence reflecting the necessity for follow up studies and further research.

The limitations of this review include : the absence of a quality assessment during selection of studies (except the type of study), the majority of results included in this review reflect immediate or short term changes, hence failing to provide adequate information on the long term development outcomes of pre-term babies, the exclusion of studies in foreign language and the relatively short year range.

CONCLUSION

The use of music therapy as an alternative intervention in the NICU might have beneficial effects on the development of preterm babies as measured by physiological and behavioral responses. However current evidence predominantly indicates short term effects. In other words, evidence is still lacking with regards to the long term effects of music therapy. Therefore, longer interventions and evaluation of long term effects is necessary to determine the effects of music therapy on the development of preterm infants.

REFERENCES

- Gooding, L. F. Using music therapy protocols in the treatment of premature infants: An introduction to current practices. *Arts Psychother.* **37**, 211–214 (2010).
- Amini, E., Rafiei, P., Zarei, K., Gohari, M. & Hamidi, M. Effect of lullaby and classical music on physiologic stability of hospitalized preterm infants. *J. Neonatal. Perinatal. Med.* **6**, 295–301 (2013).
- Pölkki, T. & Korhonen, A. The effectiveness of music on pain among preterm infants in the NICU: A systematic review. *JBI Database Syst. Rev. Implement. Reports* **12**, 354–373 (2014).
- Hodges, A. L. et al. Effects of Music Therapy on Preterm Infants in the Neonatal Intensive Care Unit. *Altern. Ther.* **16**, 72–74 (2010).
- Standley, J. Music Therapy Research in the NICU: An Updated Meta-Analysis. *Neonatal Nerv.* **31**, 311–317 (2012).
- Allen, K. A. Music Therapy in the NICU. *Adv. Neonatal Care* **13**, 349–352 (2013).
- Hasbeck, F. B. Music therapy for premature infants and their parents: an integrative review. *Nord. J. Music Ther.* **21**, 203–226 (2012).
- van der Heijden, M. J. E. et al. Do Hospitalized Premature Infants Benefit from Music Interventions? A Systematic Review of Randomized Controlled Trials. *PLoS One* **11**, e0161848 (2016).
- Bieleninik, L., Ghetti, C. & Gold, C. Music Therapy for Preterm Infants and Their Parents: A Meta-analysis. *Pediatrics* **138**, e20160971 (2016).
- Standley, J. M. Music therapy for the neonate. *Newborn Infant Nurs. Rev.* **1**, 211–216 (2001).
- Pineda, R. et al. Enhancing sensory experiences for very preterm infants in the NICU: an integrative review. *J. Perinatol.* **16**, 1–10 (2016).
- Chou, L.-L., Wang, R.-H., Chen, S.-J. & Pai, L. Effects of music therapy on oxygen saturation in premature infants receiving endotracheal suctioning. *J. Nurs. Res.* **11**, 209–216 (2003).
- da Silva, C. M., Caçõo, J. M. R., Silva, K. C. D. S., Marques, C. F. & Mery, L. S. F. Physiological responses of preterm newborn infants submitted to classical music therapy. *Rev. Paul. Pediatr.* **31**, 30–6 (2013).
- Jabraeili, M., Sabet, T., M. M. & Asghari, M. The Effect of Recorded M um 's Lullaby and Brahm's Lullaby on Oxygen Saturation in Preterm I nfants : a Randomized Double-Blind Clinical Trial. *Tabriz Univ. Med. Sci.* **5**, 85–94 (2016).
- Loewy, J., Stewart, K., Dassler, a.-M., Telsey, a. & Homel, P. The Effects of Music Therapy on Vital Signs, Feeding, and Sleep in Premature Infants. *Pediatrics* **131**, 902–918 (2013).
- Schwilling, D. et al. Live music reduces stress levels in very low-birthweight infants. *Acta Paediatr.* **104**, 360–367 (2015).
- Alipour, Z., Eskandari, N., Ahmari Tehran, H., Eshagh Hossaini, S. K. & Sangi, S. Effects of music on physiological and behavioral responses of premature infants: A randomized controlled trial. *Complement. Ther. Clin. Pract.* **19**, 128–132 (2013).
- Arnon, S. et al. Live music is beneficial to preterm infants in the neonatal intensive care unit environment. *Birth-Issues Perinat. Care* **33**, 131–136 (2006).
- Shahani, F., Nayeri, N., Karimi, R., Zarei, K. & Chehrizi, M. Effects of music therapy on pain responses induced by blood sampling in premature infants: A randomized cross-over trial. *Iran. J. Nurs. Midwifery Res.* **21**, 391 (2016).
- Yildiz, A. & Arkan, D. The effects of giving pacifiers to premature infants and making them listen to lullabies on their transition period for total oral feeding and sucking success. *J. Clin. Nurs.* **21**, 644–656 (2012).
- Garunkšiene, R., Buinauskienė, J., Ulotziene, I. & Markunienė, E. Controlled trial of live versus recorded lullabies in preterm infants. *Nord. J. Music Ther.* **23**, 71–88 (2014).
- Butt, M. L. & Kisilevsky, B. S. Music Modulates Behaviour of Premature Infants Following Heel Lance. *Canadian Journal of Nursing Research* **31**, 17–39 (2000).
- Wirth, L. et al. Effects of standardized acoustic stimulation in premature infants: A randomized controlled trial. *J. Perinatol.* **36**, 486–492 (2016).
- Blumenfeld, H. Does a Mother Singing to her Premature Baby Affect Feeding in the Neonatal Intensive Care Unit? *Clin. Pediatr. (Phila)*. **45**, 65–70 (2006).
- Olišchar, M., Shoemark, H., Holton, T., Weninger, M. & Hunt, R. W. The influence of music on aEEG activity in neurologically healthy newborns ???32 weeks' gestational age. *Acta Paediatr. Int. J. Paediatr.* **100**, 670–675 (2011).
- Lubetzky, R. et al. Effect of Music by Mozart on Energy Expenditure in Growing Preterm Infants. *Pediatrics* **125**, e24–e28 (2010).
- Rosenfeld Keidar, H., Mandel, D., Mimouni, F. B. & Lubetzky, R. Bach music in preterm infants: no 'Mozart effect' on resting energy expenditure. *J. Perinatol.* **34**, 153–155 (2013).
- Standley, J. M. The effect of music-reinforced nonnutritive sucking on feeding rate of premature infants. *J. Pediatr. Nurs.* **18**, 169–173 (2003).