

Does a Mother Singing to her Premature Baby Affect Feeding in the Neonatal Intensive Care Unit?

Hugh Blumenfeld and Leonard Eisenfeld

CLIN PEDIATR 2006 45: 65

DOI: 10.1177/000992280604500110

The online version of this article can be found at:

<http://cpj.sagepub.com/content/45/1/65>

Published by:



<http://www.sagepublications.com>

Additional services and information for *Clinical Pediatrics* can be found at:

Email Alerts: <http://cpj.sagepub.com/cgi/alerts>

Subscriptions: <http://cpj.sagepub.com/subscriptions>

Reprints: <http://www.sagepub.com/journalsReprints.nav>

Permissions: <http://www.sagepub.com/journalsPermissions.nav>

Citations: <http://cpj.sagepub.com/content/45/1/65.refs.html>

>> [Version of Record](#) - Jan 1, 2006

[What is This?](#)

Does a Mother Singing to her Premature Baby Affect Feeding in the Neonatal Intensive Care Unit?

Hugh Blumenfeld, PhD¹

Leonard Eisenfeld, MD²

Summary: Recent studies suggest that premature neonates exposed to music have reduced symptoms of stress, faster weight gain, and shorter neonatal intensive care unit (NICU) stays. This pilot study attempted to measure contingent effects of mothers' singing during feedings. Mothers sang to their babies during 2 of 4 feedings on 2 consecutive days, logging songs they sang, and subjectively evaluating each feeding. Infants' heart and respiration rates were recorded as well as duration of feeding and volume of fluid taken orally; feeding velocity and percent of feeding goal were calculated. In paired *t* tests, no significant benefits or deterrents assignable to the singing were observed. *Clin Pediatr.* 2006;45:65-70

Introduction

Music has long held a privileged place among complementary therapies and attempts to understand its physiologic effects and future possibilities are creating a robust literature.^{1,2} The effects of music on neonates—especially premature infants—has been a special focus of attention.⁷⁻⁹ Recent studies indicate that neonates and even fetuses in utero are capable

of responding to music in measurable ways and that music can help stimulate developmental progress.^{10,11} Other researchers, notably Jayne M. Standley, have used controlled trials and meta-analysis to establish that music can have a positive therapeutic value with significant clinical results in the neonatal intensive care unit (NICU).⁷ While data for coupled physiologic indicators such as respiration, heart rate, and blood pressure have been

mixed,^{8,9} several researchers have measured music's salutary effects on symptoms of pain¹¹⁻¹³ and stress.¹⁴⁻¹⁶ Long-term effects reported in the literature include faster weight gain^{14,16} and shortened average length of stay,^{14,16} although 1 study noted the latter result only for girls.¹⁶ Increases in non-nutritive sucking have also been reported,¹⁷ suggesting that music may have contingent effects during the act of feeding itself. NICU research is especially intriguing because the possibility of improved clinical outcomes for medically at-risk infants is compounded by potential economic benefits; even a shortening of NICU stays by an average of 1 day results in savings of thousands of dollars per patient.

While a few studies have used live singing, the vast majority of music studies have used recorded

¹Medical Student, Class of 2007, University of Connecticut School of Medicine;

²Attending Neonatologist, Connecticut Children's Medical Center, Hartford, Connecticut.

Connecticut Children's Medical Center Neonatal Fund, private donation from Lauren Keibel.

Reprint requests and correspondence to: Leonard Eisenfeld, MD, Connecticut Children's Medical Center, 282 Washington Street, Hartford, CT 06106.

© 2006 Westminster Publications, Inc., 708 Glen Cove Avenue, Glen Head, NY 11545, U.S.A.

music, played at regular intervals and at specified volumes in order to obtain measurable and presumably reproducible results. Still, there are no accepted standards for the delivery of music to neonates in terms of sound level, distance from source, duration of stimulus, or type/tempo of music used,¹⁸ and at least 1 review of neonate responses to sound has warned against the use of recorded music.¹⁹ Few of the studies address the mechanism whereby musical "treatments" actually affect babies nor has music exposure been administered to coincide with babies' wake/sleep cycles or with the schedule of caregiving activities. The majority of studies on long term effects hypothesize that music, played at proper levels, lowers stress by masking the random, often loud and disturbing aural stimuli of the NICU and substituting pleasant, patterned sounds; positive results are attributed to lower overall stress. None of the reports of improved weight gain or shorter length of stay used music during feedings.

The goal of this study was to probe the effects of mothers' singing both on the infants and on the culture of the NICU. The experimental design is an attempt to measure any direct, contingent effect of live singing by mothers on caloric intake in babies of approximately 34 to 36 weeks' gestational age; these infants are developing the suck-swallow-breathe reflex necessary for oral feeding, but do not yet have the endurance/experience to drink their entire nutritional quota. These babies typically begin by taking a only a portion of their meals orally, the balance being fed to them via nasogastric tube. Because it is current policy not to discharge these "feeders and

growers" until they are capable of taking in sufficient calories for growth on their own, a significant amount of NICU resources are devoted to babies who do not otherwise require medical intervention. It is therefore in the interest of the unit—and the parents—to discover efficient ways to help newborns reach the point of self-sufficiency sooner, decreasing the average time until discharge.

Music, especially live, sung music, has several potential advantages as a candidate treatment for promoting infant development. First, singing causes no harm, and while premature babies are prone to overstimulation, music seems to be tolerated well at this age and has no known negative effects. Unlike recorded music, live music can be modulated to a baby's responses. Second, singing potentially strengthens the bond between parent and child; it also offers parents a significant way to participate in the care of their children, which generally correlates with positive patient outcomes. Third, singing costs nothing.

We hypothesized that singing to an infant during feeding might affect caloric intake. On the positive side, music might lower stress, increase concentration/alertness, and promote babies' sense of well-being by improving the bond between mother and child. Physiologically, the structure and temporal structuring of music might help babies create and sustain a sucking/swallowing/breathing rhythm. Singing might also increase eye contact in babies capable of it, or substitute for eye contact if visual perception is not developed enough to enable it. All of these would, in theory, increase the volume of fluid an infant can consume before tiring. Alternatively, music

might serve as a distraction from the task at hand, lull a tiring baby to sleep, or come between the well-documented visual bonding between mother and child which is established via eye contact. Physiologically, song rhythms might interfere with the natural rhythms of eating in such a way that eating is disrupted; in addition, singing might cause overstimulation, thereby increasing stress. Singing may also affect the mothers, either increasing or reducing stress²⁰ and the amount of time they spend with their babies.²¹

Methods

Eleven infants just beginning to feed on their own were the subjects of this study, 6 boys and 5 girls; their mothers were recruited between October 2002 and March 2003 to participate in a protocol approved by the Connecticut Children's Medical Center IRB. All but 2 were between 31 and 34 weeks gestational age at birth, and were between 34.1 and 36.4 weeks gestational age at the time of the study; of the 2 outliers, 1 was a 31-week-old infant born at 23 weeks and the other was a 40-week-old infant born at 34 weeks with medical complications that caused postponement of oral feedings. None had any unresolved medical issues at the time of the study. Eight mothers breastfed, 3 bottle-fed. Participating mothers were asked to administer 2 consecutive feedings on 2 consecutive days, 1 feeding during which they sang to their babies and the other feeding without singing. Each infant thus served as its own control. To correct for a possible confounding effect due to the order of feedings, mothers were asked to reverse the order of

singing and non-singing feedings between day 1 and day 2. To avoid confounding based on strong infant recognition of and preference for mothers' voices noted in one study, we asked only mothers to sing and not fathers or nursing staff.^{22,23}

Mothers self-reported the time feedings began and ended; this allowed heart rate and respiration rate data to be read off the computer monitors up to 24 hours later. Data points for these vital signs were taken at 5-minute intervals and then averaged together. The nursing staff continued their normal procedure of entering data for volume prescribed (Rx), volume taken orally (PO), and remainder administered via nasogastric feeding tube (NG). Mothers were necessarily aware that we were collecting vital signs data, but were not aware that oral intake was also being monitored and was, in fact, the focus of

the study. It was hoped that this would reduce the effect of not being able to create a blind experimental design. In addition to the numerical data, mothers were asked to list the songs they sang during the feedings along with any comments. They were also asked to rate the overall quality of their babies' feeding behavior (alertness, focus, suck/swallow reflexes, rhythmicity, spitting up) and their own degree of comfort/satisfaction on a subjective scale from 1 (highest) to 3 (lowest).

For reference, the sound level of singing by 8 mothers was measured at a distance roughly equal to that between the baby's exposed ear and the mother's mouth over a 30-second interval with a DAS 1350-A sound pressure level meter (www.dasdistribution.com), using the directional setting. Instantaneous digital readings for all eight samples taken together varied between 60 and 79 dB; while it

was not possible to calculate a precise average, readings were concentrated between 65 and 70 dB.

Results

A total of 25 pairs of feedings were recorded for the 11 babies, with 3 of the mothers doing an extra pair. Five of these paired feedings involved twin boys who were sucking but were not yet getting any oral milk. Due to administrative or technical problems, vital signs were recorded for both feedings in 13 of the pairs. Of the 11 babies, 10 were born at 31 to 34 weeks gestational age and the other at 23 weeks. Oral feeding began at 34.1 to 36.4 weeks for 9; at 31 weeks for the 23 weeker and at 40 weeks corrected for a medically complicated infant once his condition resolved.

The data (Table 1) show no significant difference in oral in-

Table 1

RESULTS OF PAIRED SINGING VS. CONTROL FEEDINGS

Parameter	Singing	Non-Singing	p Value*
Volume (n = 20)	30 mL ± 18 mL	29 mL ± 19mL	0.97
Duration (n = 20)	23 min ± 9 min	23 min ± 8 min	0.58
Velocity mL/min (n = 15)	1.3 ± 0.9 mL/min	1.5 ± 1.2 mL/min	0.45
Efficiency (PO/Rx * 100) (n = 20)	67% ± 31	63% ± 37	0.65
HR (n = 13)	156 ± 7 bpm	158 ± 11 bpm	0.40
Resp (n = 13)	48 ± 6	48 ± 5	0.89
Infant's feeding behavior (n = 20) [†]	1.7 ± 0.8	1.5 ± 0.7	0.48
Mother's experience (n = 20) [‡]	1.45 ± 0.7	1.6 ± 0.8	0.45

*p value based a paired *t* test using differences between individual feeding pairs.

[†]Infant's feeding behavior: 1 = good, 2 = fair, 3 = poor (n = 20).

[‡]Mother's experience: 1 = comfortable, 2 = slightly anxious, 3 = very anxious.

take during singing vs. nonsinging feedings. Similarly, no differences were detected for duration or velocity of feedings, nor were there differences in heart rate and respiration. Results did not vary by infants' gender or gestational age, breast vs. bottle feedings, or first vs. second feedings (data not shown). Mothers' subjective ratings of the overall quality of the feedings were also not significantly different. Furthermore, in the case of fraternal twin boys whose mother conducted the experiment once the 34 week-old boys could suck but before they could drink, singing did not affect either the nutritive success of suckling or the total time the infants spent at breast in 5 pairs of feedings.

Participating mothers were given a handout explaining the experiment and offering suggestions for singing that included a list of 30 familiar song titles, 10 musical genres and instructions

on how to improvise. The songs mothers chose to sing to their infants can be grouped into 5 broad categories (Table 2).

There was no observable correlation between tempo (when noted by mother) or song type and the measured parameters of the feedings.

Discussion

There is much speculation as to the possible mechanisms for music's purported effects on infant behavior and health. With respect to long-term effects on weight gain and length of stay, the negative results of the current study argue for a nonspecific role in overall stress reduction rather than a contingent effect on feeding directly.

Recruiting subjects for this pilot study proved more difficult than expected. Fewer than 20% of the mothers who initially and en-

thusiastically agreed to participate in the study followed through and completed it. As feedings are normally 3 hours apart, the study required a stay of approximately 4.5 hours each day; many mothers were not able to be in the NICU for 2 consecutive feedings, whether because they had to return to work or because they had other children at home. Another group of mothers opted out due to excessive anxiousness, often brought on by minor medical problems, even after these issues resolved. These issues included weight loss, jaundice, slight temperature elevation, reflux, and occasional episodes of apnea/bradycardia, all of which are normal aspects of NICU life. The rest, perhaps half, gave no reason for their decision not to participate. For many of them, the problem seemed to be inherent shyness/inhibition concerning singing or the NICU environment, which lacks privacy and can

Table 2

SONGS

Nursery rhymes	*Twinkle, Twinkle Little Star (7), ABCs (3), *Old MacDonald (3), This Old Man (3), *Itsy Bitsy Spider (2), Baa Baa Black Sheep, *Row Row Row Your Boat, Humpty Dumpty, *Hush Li'l Baby, *London Bridge
Children's songs	*Wheels on the Bus (4), *Barney Theme Song, Where is Thumbkin, If You're Happy and You Know It, Green Speckled Frogs, Flintstones Theme, Brady Bunch Theme, BINGO, Take Me Out to the Ballgame, *Hokey Pokey, Scooby Doo
Classic/popular songs	*You Are My Sunshine (3), *Over the Rainbow (2), Do Re Mi, Rudolph, *Frosty the Snowman, Twelve Days of Christmas, *Jingle Bells, Sunrise Sunset, *My Girl, Up On A Roof, New York, New York, Battle Hymn of the Republic
Contemporary pop	Heartache (Dixie Chicks), Alan Jackson (no title given), Copa Cabana, Friends in Low Places (Garth Brooks), Summer Lovin'
Other	Humming (3), improvisation (2), "sang a book," "sang with the radio"

*Indicates the song was listed on the handout; numbers in parentheses indicate the number of trials in which a song was used.

be intimidating. Furthermore, the list of songs sung by those who did participate (Table 2) shows a limited musical repertoire that is likely both a result and cause of feelings of inadequacy/inhibition regarding singing. Finally, the window of opportunity for conducting the study—after oral feedings began and before babies were able to reach their goal—proved to be extremely short, in some cases as little as 2 days. Although mothers were approached as early as possible about participating in the study, if they were not reminded and cajoled immediately beforehand, the majority did not follow through. Given the relatively short time most mothers spend in the NICU each day, it proved difficult to catch them at the right moment.

Introducing music to the NICU had unanticipated positive results. One especially anxious mother began to sing to her baby every day, reporting that it comforted her, although she remained too anxious to carry out the study. Another mother participated with some trepidation, many people having derided her singing in the past; she reported that the singing gave her great pleasure and indicated that she would continue after going home. The nursing staff in general greatly approved the mothers' singing and their positive attitude toward music in the NICU, specifically their belief in its palliative effects, reflected those reported in a recent survey of NICU staff.²⁴ As a result of observing the study, the nurse generally considered to be the most experienced feeder on the floor reported that she has begun singing to the babies she feeds, especially the hard cases, and gave anecdotal support for the positive effects of singing during feedings. In these ways, the study suggests that whatever mu-

sic's direct effects on babies, there remain many potential benefits for parents and caregivers who overcome their reluctance to sing.

There were many variables that could not be controlled during the feedings, as well as before and after, and these doubtless contributed to the variability in the data. These include what mothers chose to sing and how (volume, tempo, register, timbre); positioning of the baby; mental/physical state of baby and mother; timing of baths, diaper changes, heelsticks, and other minor procedures; amount of milk/formula taken during previous feedings; and time of day. These variables, by contributing to the relative variability in the data, might mask a real effect, but this study indicates that any effect is too small to be measured with the current protocol. In addition, because decibel levels of mothers' singing were measured at a different time, they did not necessarily reflect the experimental conditions. However, they may offer a guide to other researchers trying to determine appropriate sound levels for recorded music.

Difficulty in retaining subjects for the study points to some underlying issues in NICU life that are rarely addressed. The amount of time parents are willing and/or able to spend in the NICU may be more limited than is generally assumed. While singing may offer parents a way to interact with their babies and participate in caregiving, the problems of sub-optimal parental involvement clearly have much deeper socioeconomic origins. The discomfort and resistance that almost all the mothers exhibited when it came to singing also reflects larger cultural issues that have an impact on parental participation in NICU care. Passivity in the face of

a highly technologized and professionalized medium affects both music and medicine.

In conclusion, this is the first study to our knowledge probing the effect of a mother's singing to her own premature neonatal patient under natural feeding conditions. Our preliminary results do not indicate any harmful effects and encourage further investigation of live, interactive music.

Acknowledgments

Thanks to Dr. Victor Herson, Medical Director, and Sally Leeds, Developmental Specialist, for their input on the study concept and design; to Stephanie Markow, RN, Ginny Dodd, RN, Nancy Walker, RN, and Pat Hanrahan, MSW, for their assistance with patient contacts and data collection; and to Kate Murphy for administrative support. We wish to acknowledge monetary support from the CCMC Neonatal Fund and Lauren Keibel, who made a contribution in memory of Matthew Eisenfeld. Finally the authors wish to thank all the mothers who participated in this study and sang to their babies.

REFERENCES

1. Campbell D, ed. *Music, Physician for Times to Come: An Anthology*. Wheaton, IL: Theosophical Publishing House, 1991.
2. Avanzini G, Faienza C, Minciacchi D, ed. The neurosciences and music. *Ann NY Acad Sci*. 2003;999.
3. Jones JE, Kassity N. Varieties of alternative experience: complementary care in the neonatal intensive care unit. *Clin Obstet Gynecol*. 2001;44(4):750-768.
4. Olson SL. Bedside musical care: applications in pregnancy, childbirth, and neonatal care. *J Obstet Gynecol Neonatal Nurs*. 1998;27(5):569-575.

5. Als H, Lawhon G, Duffy FH. Individualized developmental care for the very low birth weight preterm infant: medical and neurofunctional effects. *JAMA*. 1994;272(11):853-858.
6. Aucott S, Donohue PK, Atkins E, Allen MC. Neurodevelopmental care in the NICU. *Ment Retard Dev Disabil Res Rev*. 2002;8(4):298-308.
7. Standley JM. A meta-analysis of the efficacy of music therapy for premature infants. *J Pediatr Nurs*. 2002;17(2):107-113.
8. Standley JM. The role of music in pacification/stimulation of premature infants with low birth weights. *Music Ther Perspectives*. 1991;9(1):19-25.
9. Cassidy JW, Standley JM. The effect of music listening on physiological responses of premature infants in the NICU. *J Music Ther*. 1985;32(4):208-227.
10. Lorch C, Lorch V, Diefendorf AO, Earl PW. Effect of stimulative and sedative music on systolic blood pressure, heart rate, and respiratory rate in premature infants. *J Music Ther*. 1994;31(2):105-118.
11. Bo LK, Callaghan P. Soothing pain-elicited distress in Chinese neonates. *Pediatrics*. 2000;105(4):E49.
12. Butt ML, Kisilevsky BS. Music modulates behaviour of premature infants following heel lance. *Can J Nurs Res*. 2000;31(4):17-39.
13. Joyce BA, Keck JF, Gerkensmeyer J. Evaluation of pain management interventions for neonatal circumcision pain. *J Pediatr Health Care*. 2001;15(3):105-114.
14. Caine J. The effects of music on the selected stress behaviours, weight, caloric and formula intake, and length of hospital stay of premature and low birth weight neonates in a newborn intensive care unit. *J Music Ther*. 1991;28(4):180-192.
15. Kaminski J, Hall W. The effect of soothing music on neonatal behavioral states in the hospital newborn nursery. *Neonatal Network*. 1996;15(1):45-54.
16. Standley JM. The effect of music and multimodal stimulation on responses of premature infants in neonatal intensive care. *J Pediatr Nurs*. 1998;24(6):532-538.
17. Standley JM. The effect of contingent music to increase non-nutritive sucking of premature infants. *Pediatr Nurs*. 2000;26(5):493-495, 498-499.
18. Cassidy JW, Ditty KM. Presentation of aural stimuli to newborns and premature infants: an audiological perspective. *J Music Ther*. 1998;35(2):70-87.
19. Graven SN. Sound and the developing infant in the NICU: conclusions and recommendations for care. *J Perinatol*. 2000;20(8 Pt 2):S88-93.
20. Field T. Maternal depression effects on infants and early interventions. *Prev Med*. 1998;27(2):200-203.
21. Whipple J. The effect of parent training in music and multimodal stimulation on parent-neonate interactions in the neonatal intensive care unit. *J Music Ther*. 2000;37(4):250-268.
22. Standley JM, Moore RS. Therapeutic effects of music and mother's voice on premature infants. *Pediatr Nurs*. 1995;21(6):509-512, 574.
23. Standley JM, Madsen CK. Comparison of infant preferences and responses to auditory stimuli: music, mother, and other female voice. *J Music Ther*. 1990;27(2):54.
24. Kemper K, Martin K, Block SM, et al. Attitudes and expectations about music therapy for premature infants among staff in a neonatal intensive care unit. *Altern Ther Health Med*. 2004;10(2):50-54.