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The Effect of Recorded Mum's Lullaby and Brahm's Lullaby on Oxygen Saturation in Preterm Infants: a Randomized Double-Blind Clinical Trial

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ABSTRACT

Introduction: Music stimulation has been shown to provide significant benefits to preterm infants. Thus the aim of this study was determine the effect of recorded mum's lullaby and Brahm's lullaby on oxygen saturation in preterm infants.

Methods: This double-blind randomized controlled trial was carried out on 66 premature newborns with the postnatal age of ≥3 days and weight ≤ 2800 grams at Taleghani Hospital. Infants were randomly divided into three groups: control, Brahm's lullaby and Mum's lullaby groups. Infants were continuously monitored for primary outcome of percutaneous oxygen saturation, for three consecutive sessions.

Results: There were significant difference in neonate oxygen saturation between the Brahm's lullaby and Mum's lullaby as compared with control groups in the 15 minutes after intervention.

Conclusion: This study showed beneficial effects of Brahm's lullaby and Mum's lullaby sound. Therefore; it may be used for improving short term outcomes in premature infants.

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Introduction

Preterm birth, defined as childbirth occurring at less than 37 completed weeks or 259 days of gestation, is a major determinant of neonatal mortality and morbidity and has long-term adverse consequences for health of newborn.[1] A recent publication estimates about 13 million preterm babies are born each year worldwide.[2]

Dramatic advances in neonatal medicine in the last 20 years are assuring the survival of preterm infants.[3,4] Therefore, the goal of neonatal care has recently shifted from merely survival and avoidance of major disability to the preservation of normal brain development.[5]

Long-term studies show that prematurely born infants have a significantly higher risk of later neurodevelopment problems than their full-term counterparts, even when they are spared medical complications of prematurity during their stay in neonatal intensive care unit (NICU).[3,4,6]

Brain growth and neurologic development are rapid from 20 weeks gestation to two years of age.[7] Development of the auditory system begins at around three to six weeks of gestation and all major structures of the ear are in place for sound to produce physiological effects in the fetus by 25 weeks gestation.[8]

Auditory functioning, demonstrated by cortical auditory evoked responses in the cerebral cortex and brainstem, is apparent by 26 to 28 weeks of gestation indicating that preterm infants beyond that point can respond to and process auditory stimulation.[4] At 30 to 35 weeks gestation, the fetus hears maternal sounds, responds to those sounds, and begin to discriminate among speech sounds, especially in relation to pitch and rhythm.[9]

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The primary auditory stimulation which infants receive in the NICU is ambient noise.[10] Noise level in NICU usually vary between 50 and 80 dB peak over 100 dB (from motors, fans, ventilators, personnel, telephones, pagers, alarms, trash lids and door)and frequently range between 70 and 80 db.[11] The American Academy of Pediatrics recommended that ambient environmental noise levels in the NICU should not be exceed 45 db.[12,13] Adverse effect of excessive noise on preterm infants causes increased stress responses, masking of speech input, disturbances in sleep, and increases the risk of cochlear damage.[14] Ambient noise that is considered too loud may be irritating and noise levels that are too soft may be disconcerting.[15]

Auditory intervention in the NICU includes efforts to both reduce ambient noise and induce patterned auditory input like that in the intrauterine environment.[13] Ambient noise is a stressor to infants in the NICU and should be minimized as it may cause sensory-neural damage to developing auditory structures, contributing to later language or auditory processing disorders.[2] Researches suggests that prolonged exposure to ambient noise levels in the NICU could contribute to impaired language development.[15] Moreover, noise interferes with sleep and causes physiologic stress and may also result in detrimental infant responses including low oxygen saturation levels.[16]

Oppose to ambient noise is structured sound. The use of structured sound has been encouraged as a means of reducing environmental stress. Most structured sounds in the form of music are rhythmic and formatted containing consistencies of tension (buildup of volume and tempo in a musical phrase), more organized, contained fewer dynamic changes in sound amplitude.[17]

Soothing music can facilitate the relaxation response through stimulating the release of endorphins from the brain and consequently decreasing sympathetic nervous system activity as evidenced by a lowering oxygen consumption.[4] Some reports have suggested that music serves a distracter, a more predictable and stable source of stimulation that ameliorates chaos of the NICU environment; thereby, this distraction may decrease the amount of stress experienced by infants.[5]

In a recent research, recorded maternal voice was proposed as another form of patterned sound which could be used for preterm neonates.[9] The maternal voice is a predominant source of multimodal stimulation for the developing fetus that is largely lost for the preterm infant surrounded by the unfiltered levels of auditory stimuli in the NICU. In the normal womb environment, the fetus not only hears own mother's voice, but feels her vertebral column and diaphragm which gently vibrates and moves in sync with her voice.[18] There is general theoretical support for the view that interactions with one's mother may play a significant role in a child's normal growth and development.[9] When mum is not at reach or her physical or emotional condition doesn't permit direct interaction, the recorded mum's lullaby samples are desired choice as alternatives. This kind of music samples should be chosen for simplicity, gentle rhythms, simple harmonies, and a soft tone sound.[18,19]

The studies in Iran have shown that the noise level in the NICU is higher than standard level.[20,21,22] According to long-term hospitalization of premature infants in a neonatal intensive care unit, need for intervention to reduce the effects of such noise on preterm infants is seems necessary.

In a meta-analysis, only one study from ten study compared the baby's physiological response to mum's lullaby with lullaby woman.[6] No research has investigated the effect of patterned sound in the form of recorded mum's sound and Brahms' Lullaby and so, in this study a CD recording of the mother based on dominant mum's language was used for experimental groups.

We hypothesized that auditory stimulation in the form of recorded patterned sounds might

improve physiological parameters SPO2 of stable preterm infants in the neonatal intensive care unit. Therefore, the aim of this study was to test this hypothesis.

Materials and methods

In the present randomized, double-blind controlled trial, premature infants were followed up for three consecutive sessions (from3 to 14 days after birth). This period was selected due to the fact that neonatal stabilization mostly occurs in these days.[23,24]

The study was performed from October 2012 to January 2013 at the NICU of Taleghani Hospital, Tabriz.

The inclusion criteria were: being born between 29-34 weeks of gestation, postnatal age of 3 days, weight under 2800 grams. The premature infants suffering from congenital heart diseases and acute infections need for ventilators, receiving oxygen through continuous positive airway pressure, or received hypnotics as well as sedative drugs and traditional treatments during the intervention were excluded from the study.

Reviewing a meta-analysis and previously published studies which evaluated the effects of patterned sound in the NICU on preterm infants and utilizing "Gpower" software, the sample size was determined considering quantitative variable based on (effect size: 0.42, α=0.05, Power: 0.8). It refers to 20 neonates for each group.[6] Considering attrition rate of 10-15% and also the Automated Auditory Brainstem Response (AABR) results, a total of 25 subjects were included in each three group. Overall, 78 premature newborns were assessed for eligibility. Of the 78 preterm infants, 75 were enrolled and 3 infants were excluded because their parents refused taking part in the study.

After ethics committee approval and parental consent, infants were randomly divided into three groups (25 in each group) including Brahms' lullaby, Mum's lullaby, and control groups. Randomized block design by R.A.S (random assignment software) was used for producing random numbers. Five infants in mum's lullaby group, and 4 infants in control group were excluded. Therefore, the study completed with 66 premature infants. (Brahms' lullaby group=25, Mum's lullaby= 21 and Control=20) (Figure1).

Maternal voice in this study refers to a taped recording of 15-minute session maternal voice modified in low 65-70 dB, 1000 hertz. The correctness of intensity and frequency was checked and determined by researcher by means of S.L.M (SAADAT, Malesia). A CD recording of the mother reciting a folkloric (Turkish or Persian lullaby) based on dominant mum's language was used in the experimental component of this study. Researcher recorded mums sound in a quiet place by means of a digital recorder (ICD- UX 300F, SONY 4GB).

The recording material copied on a CD and then transferred to IPod touch and saved as a Mp3 file. The verbalized lullaby took approximately five minutes to recite and repeated three times, and was not a common verse. Brahms' lullaby in this study refers to a taped recording of 15-minute session Brahms' lullaby in low 65 dB, 1000 Hertz that as sound file kept and saved on iPod, the infants in the control group received routine auditory stimulation.

Physiological data including oxygen saturation in three groups were obtained through a SAADAT monitoring system (SAADAT, Malaysia) which was calibrated before the study was used by the manager. The sensor connected to newborns right foot and recorded by research assistant. Physiologic parameter was recorded continuously (in five minutes increments) for 45 minutes (10 minutes before, 15 minutes during, and 20 minutes after the sound condition). In this study, research assistant who was responsible for data collection was not aware of the group assignment of the subjects.

Timing of patterned sound exposure was 3 consecutive days and the intervention implemented between 10 A.M. and 7:00

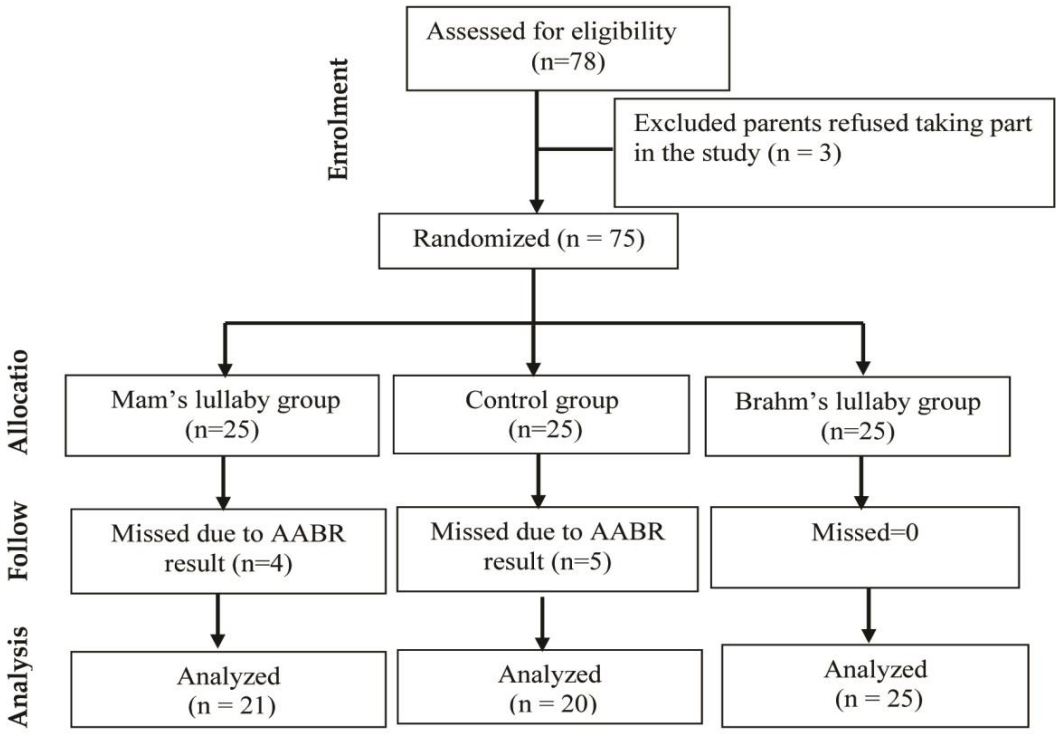

Figure1. Consort flowchart of the study

P.M. exception of the time between two Shifts.

The software SPSS ver. 13 was used for data analysis.Descriptive statistics were carried out on all demographic variables, Chi-square was used to assess nominal data for any significant associations between the groups (Table 1). One- way ANOVA followed by Tukey post hoc test was used to compare the means between groups. A repeated measures ANOVA was also referred to as a within-subjects ANOVA or ANOVA for correlated samples and detect any overall differences between related means which followed by Sidak post hoc test.[25]

Results

The findings of the study showed no significant difference between the three groups in baseline data including infant gender, birth weight, weight in intervention days, gestational age, postnatal age, 1-minute and 5-minute Apgar scores, mother's age, and neonate's race (Table 1).

There were significant difference in neonate oxygen saturation between the music and ambient noise groups; also there were significant oxygen saturation changes for preterm neonates over the time period after the sound. Neonate oxygen saturation did not change significantly in 10 minutes before the sound (P=0.63) or during the 15 minutes of sound (P=0.08); however, neonate oxygen saturation increased significantly in the 15 minutes after providing the sound conditions (P=0.02). At 45 minutes point, there was a significant difference in oxygen Saturation levels as a function of Brahms' lullaby (P=0.02, 95% CI (0.32, to 4.84)) (Table 2).

Mauchly's test showed a statistically significant effect of Brahms' period (P=0) and mum's period (P=0); these findings indicate that the sphericity assumption was rejected (Table 3) and Table 4 shows the comparison of groups during study period.

Discussion

Infants have been shown to benefit from the initiation of stimulation programs during hospitalization.[26] In considering the sequential developmental importance of the preterm infants senses, as noted in past NICU studies, the current study has taken into account the fact that the premature infants' immature sensory modalities such as hearing are at risk for being over-stimulated.[4] Studies that have investigated the impact of music and music therapy in premature infants typically use recorded music.

Current study was conducted to compare the effects of patterned sound (in the form of Brahms' and mum's lullaby) on oxygen saturation in premature infants. The result of other studies have showed that recorded patterned music was associated with significant increase in infant's oxygen saturation. In addition during the study no signs of negative reaction and sensitivity to music were found, like other studies.[27,28]

In a clinical-trial 44 low birth weight infants with 34 weeks of gestational age, lullaby music was played through earphones for the music group. This continued for 8 days at 20 minutes per day.

Table 1. Demographic characteristics of the participants

Characteristics	Brahm's lullaby (N=25)	Mam's lullaby (N=21)	Control (N=20)	Statistical indicators
Sex[a]				[b]x =4.29, df=2, P=0.11
Female	9 (36)	10 (50)	14 (66.7)	
Male	16 (64.0)	10 (50)	7 (33.3)	
Race[a]				[b]x =2.68, df=4, P=0.61
Torki	19 (95.0)	23 (92.0)	21(100.0)	
Farsi	1 (5.0)	1 (4.0)	0 (0.0)	
Kordi	1 (4.0)	0 (0.0)	0 (0.0)	
Birth weight (gr)	762.40 (390.01)	792.50 (464.21)	690.47 (436.88)	[c]F=0.31, df=63, P=0.73
Intervention day's weight	1709.60 (346.86)	1665.00 (415.91)	1615.71(404.07)	[c]F=0.33, df=63, P=0.71
Gestational age	32.16 (1.31)	31.45 (1.63)	31.80 (1.83)	[c]F=1.10, df=63, P=0.33
Apgar score, 1 minute	7.64 (1.22)	7.75 (.91)	7.47 (1.53)	[c]F=0.25, df=63, P=0.07
Apgar score, 5 minutes	9.00 (0.91)	9.05 (0.75)	8.90 (0.94)	[c] F=0.14, df=63, P=0.86
Mother's age (y)	25.71 (8.03)	23.95 (4.24)	25.29 (5.13)	[c] F=0.45, df=63, P=0.63

SD: Standard Deviation, [a]N (%), [b] Chi-square test; [c] ANOVA test

Table 2. Effect of Mam's lullaby and Brahm's lullaby on oxygen saturation in preterm infants

O2 saturation (%) Min-max (minutes)	Brahms lullaby (N=25)	Mams lullaby (N=20)	Control (N=21)	Statistical indicators (between-group)
10*	94.48 (2.34) -89, 98	93.65 (2.85) - 84, 96	93.95 (3.65)- 85, 98	(F=.45, df=2 , P =0.63)
25*	94.52 (2.56)-90, 98	94.60 (1.87)-91, 97	92.76 (4.18)-78, 97	(F= 2.52, df=2 , P=0.08)
45*	94.92 (2.15)-90, 98	93.70 (2.71)-88, 98	92.33 (4.23)-83, 98	(F=3.94 , df=2 , P=0.02)
10**	-1.62, 2.68	-2.57, 1.96	2.68, 1.62	
25**	-.43, 3.95	-.47, 4.15	-3.95, 0.43	
45**	0.32, 4.84	-1.01, 3.75	14.84, -0.32	

*Mean (SD), ** Mean differences 95% CI

Table 3. Physiological response of preterm infant to structured sound

Session	Brahm lullaby (N=25)	Mum's lullaby (N=20)	Control (N=21)
[1] Session	Mauchly's W=0, df= 44, P= 0	Mauchly's W=0, df= 44, P= 0	Mauchly's W=0.002, df=44, P= 0
[2] Session	Mauchly's W=0, df= 44, P= 0	Mauchly's W=0, df= 44, P= 0	Mauchly's W=0, df= 44 , P= 0
[3] Session	Mauchly's W=0, df= 44, P=0	Mauchly's W=0, df= 44, P = 0	Mauchly's W=0, df = 44, P= 0

Table 4. Comparison groups during study period

Session	Group	Test result
1st Session		
	Control	
	Brahm's	*MD=-0.52, P=0.90
	Mam	MD=0.30, P=0.98
	Brahm's	
	Control	MD=0.52, P=0.90
	Mam	MD=0.83, P=0.73
	Mam	
	Control	MD=0.83, P=0.73
	Brahm's	MD=-0.83, P=0.73
2nd Session		
	Control	
	Brahm's	MD=-1.75, P=0.15
	Mam	MD=-1.83, P=0.15
	Brahm's	
	Control	MD=1.75, P=0.15
	Mam	MD=-0.08, P=1.00
	Mam	
	Control	MD=1.83, P=0.15
	Brahm's	MD=0.08, P=1.00
3rd Session		
	Control	
	Brahm's	MD=-2.58, P=0.02
	Mam	MD=-1.36, P=0.41
	Brahm's	
	Control	MD=2.58, P=0.02
	Mam	MD=1.22, P=0.48
	Mam	
	Control	MD=1.36, P=0.41
	Brahm's	MD=-1.22, P=0.48

*Comparisons (sidak)

Infants were monitoring for 40 minutes; 10 minutes baseline, 20 minutes into the intervention and 10 minutes post intervention. Results showed that oxygen saturation level in music group significantly increased.[21] In current study results for oxygen saturation was significant at third phase (at 45 minute) between three groups, this significance was between Brahms and control group in third session.

In Amiri study, no information about variety of races and nationalities of subjects was reported and using local version by a female in a cosmopolitan city is a matter needed to be clarified.[24] the intensity of sound in that study is much higher than

present study and this difference may affect the results.

Based on the studies, stress increases the need for oxygen. The use of music in the NICU has been shown to reduce stress and increase oxygen levels.[28] Caine showed that when lullaby music was played in the NICU, less episodes of oxygen saturation occurred. In present study, the amount of percutaneous oxygen saturation in the experimental groups at 25, 45 minutes never reached to less than 88% in mum's lullaby and 90% in Brahms' lullaby.[10]

In another study, twelve preterm infants (post-conceptual age 31 weeks) were tested in the absence of a stressful stimulus. They were observed for 15 min prior to 10 minutes during and 10 min after music was played. During music, oxygen saturation increased. Music stabilized the infants' oxygen saturation level more than the mother's voice, and no negative effects concerning apnea or bradycardia episodes occurred when infants listened to music.[29] In premature infants, music decreases heart rate, salivary cortisol and distress behaviors and increases oxygen saturation and weight gain.[30]

Chou et al., found that mean oxygen saturation levels during 30 min after suctioning were higher in the experimental group compared with control group and the mean time in minutes to recovery of oxygen level to baseline was shorter in the experimental group (music therapy) than in the control group.[31]

Coleman et al., reported a statistically significant increase in oxygen saturation during a 20-min lullaby intervention provided for 4 consecutive days among infants who were 25 to 35 weeks' gestation at birth. The levels of oxygen saturation were presented in graphic format.[32] In a study by Wood et al., the effect of the music was measured every 30-second before, during, and after the sound condition of music or ambient noise by observing the oxygen saturation, heart rate, and behavioral state. Although there were no significant differences between groups responses over the three time periods, Infants oxygen saturations decreased significantly in the 10 minutes after intervention.[33] This result is similar with current study result of oxygen saturation in 45 minute interval. The advantage of present study is a new design arrangement based on guidelines for music therapy in NICU.[34]

Conclusion

The findings of this study indicate that standard patterned sound can help to improve oxygen saturation in preterm infants during their hospitalization period. This kind of auditory stimulation method, which includes in itself the components of developmental care, offers an appropriate, low-stress and safe method for preterm and ill infants and can be used as a routine standard method in NICU. It seems that the results of this research will help to improve the short-term and long-term developmental outcomes caused by the hospitalization of preterm infants in NICU and increase the quality of nursing care.

Further studies are suggested to be conducted on the effect of patterned sound on other physiological responses, stress, sleep pattern, feeding and weight gain in premature infants. However, this research may direct the potential powers toward managing a safe environment followed by presenting patterned sound as a standard of care. No adverse effects of the music therapy were identified. However, more research can be recommended for use with preterm infants in the NICU. Music and recorded sounds is a noninvasive, none-pharmaceutical and relatively low cost intervention that can be implemented at the infant's bedside. Further research is needed to determine whether effects noted in previous studies can be consistently replicated in diverse settings and with diverse groups of preterm infants.

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Ethical issues

None to be declared.

Conflict of interest

The authors declare no conflict of interest in this study.

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