Original Article

Effect of vocal stimulation on responses of premature infants: A randomized controlled trial

Narges Eskandari[1], Zahra Alipour[2*], Hoda Ahmari Tehran[3], Seyed Kamal Eshagh Hossaini[4], Sareh Sangi[5]

[1]Department of Midwifery, Shahid Beheshti University of Medical Sciences, Tehran, Iran

[2] Department of Midwifery, Esfahan University of Medical Sciences, Esfahan, Iran

[3] Religion and Medicine Research Center, Qom University of Medical Sciences, Qom, Iran

[4] Department of Pediatrics, Qom University of Medical Sciences, Qom, Iran

[5]Department of Midwifery, Qom branch, Islamic Azaduniversity, Qom, Iran.

Abstract

Background and Objectives: There are studies that support music and singing as appropriate developmental care for premature infants, thus, we conducted this study to investigate the physiological and behavioral responses of premature infants to Quran recitation, lullaby music and silence.

Methods: In a randomized controlled trial (2011-2012),120 premature infants in the Neonatal Unit (NNU) at Izadi Hospital, were randomly assigned to experimental (holy Quran recitation, lullaby music and silence) and control groups. The four groups were surveyed for physiological responses including, oxygen saturation, respiratory rate and heart rate and behavioral states. The data were analyzed using SPSS-PC software and quantitative tests.

Results: 66females and 54 male infants with gestational age 28- 36 weeks entered into the study. The fourgroupswere not significantly different in terms of demographic variables (P>0.05). The comparisonofchangesinthe infant's responsesintheendof the intervention comparedtothebase lines, showedno statistically significant differencesbetweengroups(P>0.05). Repeated measures ANOVA and Friedman test did notindicate any significant differences in the mean ofresponseswithinanyof the four groups during the courseof study (P>0.05).

Conclusion: Although fluctuations were observed in the mean of physiological responses and behavioral states in premature infants who listened to the recitation of the holy Quran and lullaby music, but these fluctuations were not significant. Findings of this study demonstrated that the preterm infants did not display any adverse reactions to the carefully designed acoustic intervention.

Keywords: Complementary Therapy; Holly Quran recitation;Music Therapy; physiological and behavioral response; premature infants.

[*]**Correspondence** should be addressed to Ms. Zahra Alipour; **Email:**kanom_Alipour@yahoo.com

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Introduction

Preterminfants are those born after the Beginning of the20th week of gestation and before the end ofthe37th week.According to the latest statistics, 23.5% of babies are born prematurely in Iran in 2003 (1).Despite significant advancements in the care of preterm infants during the past 40 years, (2) preterm birth is on the rise causing neonatal mortality and is a major determinant of early childhood mortality and morbidity in the United States. Numerous preterm infants suffer from neurological disability including cerebral palsy; visual and hearing impairments; learning difficulties; and psychological, behavioral, and social problems (3).

Hence, besides focusing on medical procedures for survival, studies on premature infants in NICU have evaluated developmental care (4). Developmental care comprises a range of medical and nursing interventions that suggest to decrease the stress imposed on premature infants in NICUs and to facilitate their optimal neurobehavioral development (5). Light and noise management, music therapy, positioning/bundling, use of pacifiers and kangaroo care (skin contact with the mother or a caregiver) are the different approaches to developmental care (6). Studies have shown that music alone or with human voice, is considered a valuable resource to achieve developmental goals in NICU,reducing stress, covering annoying ambient noise, facilitating communication with parents and growth of the nervous system in newborns (7).

In the recent decade, several studies have investigated the effects of Quran recitation (8) andother auditory stimuli on premature infants (9). For example the effects of pop, jazz, and other types of music and lullabies on short- and long-term responses of premature infants have been evaluated .Some researchers have found positive effects of music on long-term variables including non-nutritive sucking (7), length of hospitalization (10) and weight gain (11,12).Music and Quran recitation has also been found positively effect on short-term responses such as oxygen saturation (8,13,14), heart rate (8,15), and behavioral states (8, 9,16).

Keshavarz et al (2010) played Quran recitation for premature infants and reported that the mean of respiratory rate and heart rate significantly decreased and oxygen saturation levels increased in Quran recitation group compared to the basic measurement and these changes continued to 10 min after intervention (8). According to a meta-analysis by Stanley, music has important clinical benefits for premature infants. These benefits include increased oxygen saturation, reduced stress, enhanced bonding with family members, reinforced non-nutritive sucking, increased sucking ability, and sustained homeostasis during multimodal stimulation (17). However, some studies have not confirmed the advantages of music therapy (3,18). In some studies, music on oxygen saturation and heart rate were ineffective.For example, Johnston, Filion andNuyt (2007) reported a decrease in infant's oxygen saturation, followed by music (19)and Collabra et al (2003), reported no change in infants'heart rate following music therapy (18).

Despite the existence of convincing theories, only a number of small studies have supported music and singing as appropriate developmental care for premature infants in NICU (3). Thus, we compared the effects of Quran recitation, lullaby music and silence on short-term physiological and behavioral responses of stable premature infants during their stay in the neonatal care unit of a hospital in (Qom) Iran.

Methods

To evaluate the effects of Quran recitation, recorded lullaby music and silence on physiological and behavioral responses of premature infants a double-blind randomized controlled trial was conducted. The final group size was considered as 30 infants for each group as recommended by a biostatistician. All premature infants were randomly assigned to either the intervention or control groups.

Sample and setting

This study was carried out in the Neonatal Care Unit of IzadiTeaching Hospital (Qom,

Iran). The participants were 120 premature infants with gestational ages of 28-37 weeks, Apgar scores ≥ 7 and appropriate weight for gestational age who had been hospitalized in the neonatal care unit. None of the infants received sedative drugs such as phenobarbital. They did not have disease such as intraventricular hemorrhage, necrotizing enterocolitis, sepsis, acute lung diseases, congenital defects, neonatal anemia, acute illnesses, hypersensitivity to sound, and history of maternal drug or alcohol abuse. Only the clinically and physically stable infants participatedin these studies.

Infant's responses

The dependent variables in this study were short-term physiological responses (oxygen saturation, respiratory rate, heart rate) and behavioral states of the premature infants.

Experimental intervention

Theinterventions included Quran recitation (Yusuf chapter, verse 7-23, by Shahhat Mohammad Anvar sound), lullaby music (good night kid, produced by the national radio of Iran) that played via headphones for 20 min for the premature infants. The loudness of sounds was maintained at 50-60 dB, using the A-scale of a Cirrus (cr274) sound level meter. In the silence group, the headphones were secured over the infants' ears for 20 min but no sound was played. The control group, however, did not receive any type of intervention.

Procedure

The study protocol was approved by the Ethics Committee of Qom University of Medical Sciences (Qom, Iran). During December 2011-August 2012, the purpose and procedure of the study were described to the parents of the eligible infants when they were visited in the neonatal care unit.If they desired to take part in this study, formal written consents were obtained from them.

The demographic characteristics of the infants were extractedfrom hospital records, and if they had nocontraindications to the intervention and did not require any sort of nursing care during the 40-min study, infants were included.

While the infants in Quran recitation, lullaby and silence groupswere placed in a supine position in an incubator, headphones (A4TECH model EST1987) attached to a MP3 player were placed on both of their ears.

Behavioral state instrument (BSI) was used to determine the behavioral states of premature infants via observations. In this instrument, six different behavioral states were distinguished: State1 quiet sleep, State 2 active sleep, State 3 drowsy, State 4 quiet awake, State 5 active awake and State 6 crying (3).An Oxypleth pulse oximeter (model A520, USA) was used to measure oxygen saturation level and heart rate whose sensors were attached to the infant's foot. The same device was used for all measurements. Respiratory rate (breaths per minute) was calculated based on the number of infants' chest movements in one minute.

Heart rate, respiratory rate, oxygen saturation, and behavioral states of the infants were recorded every five min before, during, and after the intervention.

For all infants, the measurement of variables started 30 min after the last feeding and other routine nursing care. The infants were placed in their incubators, the equipment was set up and baseline data was recorded five and 10 min after placing the earphones and sensors. Then, the Quran recitation or lullaby music was played for the infants in Quran or lullaby group. Data recording was repeated at the 5^{th}, 10^{th}, 15^{th} and 20^{th}min of intervention and at the 5^{th} and 10^{th}min post-intervention. After 20 min play of Quran recitation or lullaby, the player was stopped without handling the infants. No sound was played for the silence group. Physiological responses and behavioral states of the silence and control groups were recorded at defined times. All data were collected by a fellow researcher blinded to the type of interventions.

If the infants experienced any significant medical problems or handling during the intervention or within the following 10 min, they were excluded from the study. Overall, nine infants were excluded (one for crying from Quran recitation group, one from the

lullaby group for vomiting, two from the silence group for crying, and two from the control group for crying and handling, one for abnormal OAE test and two infants because their mother refuses). None of the infants experienced heart rates above 200 beats per min or oxygen saturation less than 80%. Normal hearing of all infants was ensured by otoacoustic emissions (OAE) tests when they were discharged from the hospital.

Limitations of data collection

The absence of a sound level meter to measure ambient noise and a monitor to record respiratory rate were the limitations of this study.

Data analysis

SPSS for Windows version 16.0 (SPPS Inc., Chicago, IL, USA) was used for data analysis. The characteristics of the sample were described through descriptive statistics. The normality of the data distribution was assessed by Kolmogorov-Smirnov tests. Analysis of variance (ANOVA), Chi-square, Kruskal-Wallis, Repeated Measures and Friedman tests were used to analyze the collected data.

P values less than 0.05 were considered significant for all statistical tests.

Results

In the nine-month recruiting period, 120 (66 females and 54 males) infants in four groups; Quran recitation, lullaby music, silence, and control (30 infants in each group) were included. The mean gestational and chronological age of infants were 33.49 ± 2.34 weeks (range: 28-36) and 5.29 ± 4.56 days (range: 1-25), respectively. The mean birth weight of infants was 2120.29 ± 326.68 grams (range: 1300-2700) and Apgar scores at the first and fifth min ranged from 7 to 10. While 43 babies were born by vaginal delivery, 77 were born by cesarean section. Moreover, 104 infants were breastfed but 16 received formula.

According to Kolmogorov-Smirnov test, respiratory rate, heart rate, Apgar score, and birth weight had normal distributions. Based on chi-square test, ANOVA, and Kruskal-Wallis tests, four groups were not significantly different in terms of demographic characteristics (Table 1).

Table 1: Demographic characteristics of premature infants (n=120)

Characteristics	Quran recitation group(30)	lullaby group (30)	Silence group (30)	Control group (30)	P value
Female/male(number)	16.14	14/16	22.8	14.16	0.12*
Caesarian section/normal vaginal delivery(number)	20.10	22.3	18.12	17.13	0.54*
Brest fed / formula fed(number)	25.5	27.3	24.6	28.2	0.41*
Apgar score (first minute) (Mean±SD)	8.16±0.64	8.03±0.71	8.06±0.69	8.06±0.78	0.90#
Apgar score (fifth minute) (Mean±SD)	9.26±0.58	9.23±0.67	9.2±0.61	9.4±0.62	0.59#
Gestational age (weeks) (Mean±SD)	33.03±2.42	33.50±2.47	33.80±2.29	33.63±2.23	0.58$
Age (days) (Mean±SD)	5.9±4.36	5±3.39	3.76±3.66	6.3±6.12	0.10$
Birth weight (gr) (Mean±SD)	1980±362.4	2086.03±388.92	2158.73±306.38	2116.23±298.32	0.90#

*Chi-square # ANOVA $Kruskal-Wallis

Comparison of the changes in infant responses in the end of intervention compared to the base lines, showed no statistically significant differences between groups (table 2).

Table 2: Comparison of mean changes for infant responsesin the end of the intervention compared to the base lines

dependent variable	Quran recitation group(30)	lullaby group (30)	Silence group (30)	Control group (30)	P value
Oxygen saturation	1.00±4.00	-0.63±2.18	-0.63±3.82	0.26±3.68	0.11*
Heart rate	-0.23±11.82	-2.40±11.87	-2.26±11.82	0.20±12.18	0.76#
Respiratory rate	0.46±5.87	-2.30±7.56	0.03±5.76	1.03±5.30	0.17#
Behavioral state	-0.20±1.06	-0.13±0.77	0.26±078	0.33±0.96	0.22*

* Kruskal Wallis Test # ANOVA

Table 3 Compare the changes in the infant response's mean and SD 10 min after end of intervention and the base lines.

No statistically significant differences were found between four groups (table 3).

Table 3: Comparison of mean changes for infant responses in10th min after end of intervention compared to the base lines

dependent variable	Quran recitation group (30)	lullaby group (30)	Silence group (30)	Control group (30)	P value
Oxygen saturation	0.76±3.25	-0.20±2.12	-0.26±4.05	-0.13±2.48	0.50*
Heart rate	-1.66±9.57	-1.16±11.12	2.06±11.60	1.40±11.72	0.47#
Respiratory rate	0.23±5.33	-1.83±6.63	0.86±6.40	0.30±5.57	0.32#
Behavioral state	-0.03±1.12	-0.03±0.80	0.16±0.91	0.03±0.99	0.79*

* Kruskal Wallis Test # ANOVA

Charts 1,2,3,4 show the means of oxygen saturation, respiratory rate, heart rate, and behavioral states of premature infants in different min of intervention, in four groups.

Repeated measures ANOVA and Friedman test did not indicate any significant differences in the mean of premature infant responses within any of the four groups during the study.

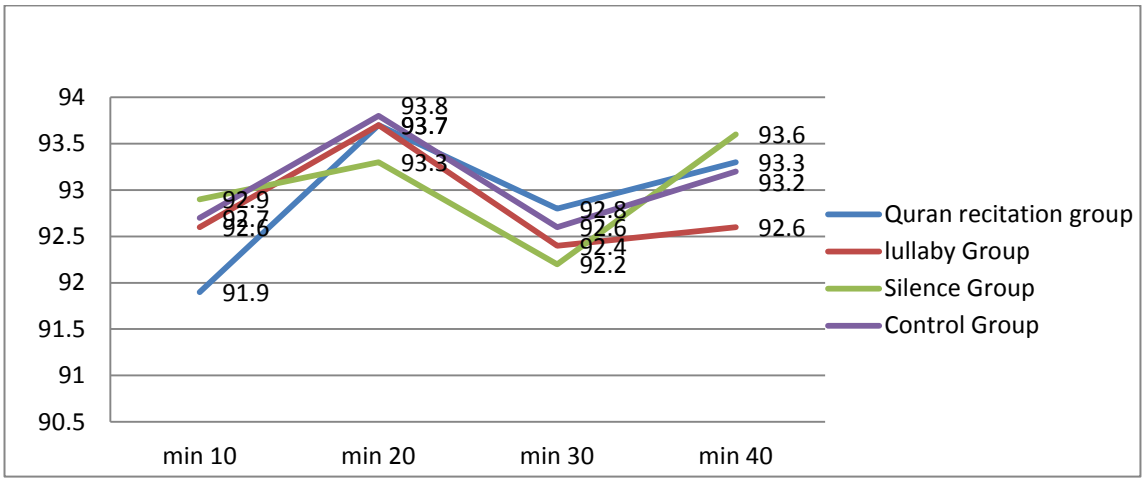

Chart 1: Comparison means of oxygen saturation of premature infants in different min of intervention, in four groups

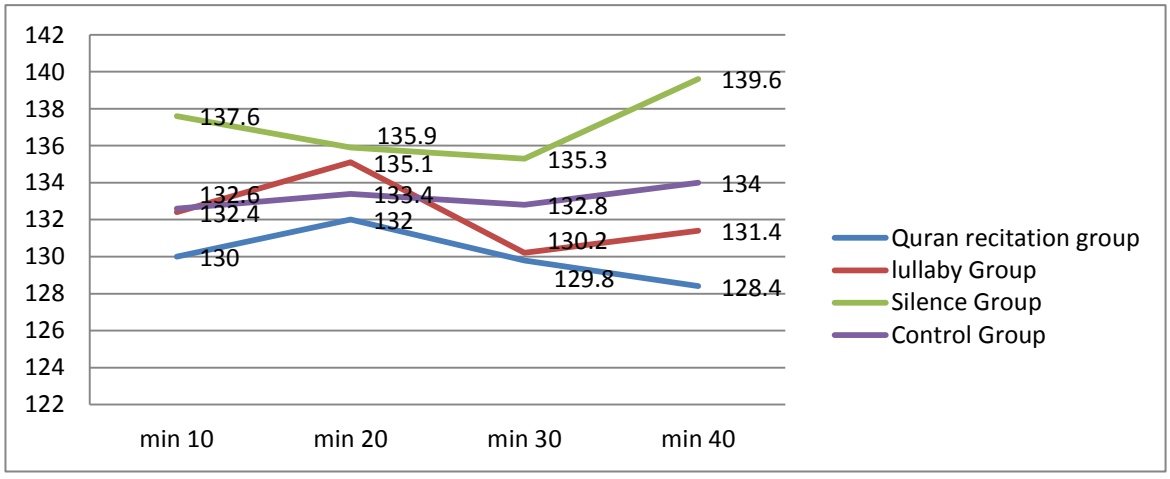

Chart 2: Comparison means of heart rate of premature infants in different min of intervention, in four groups

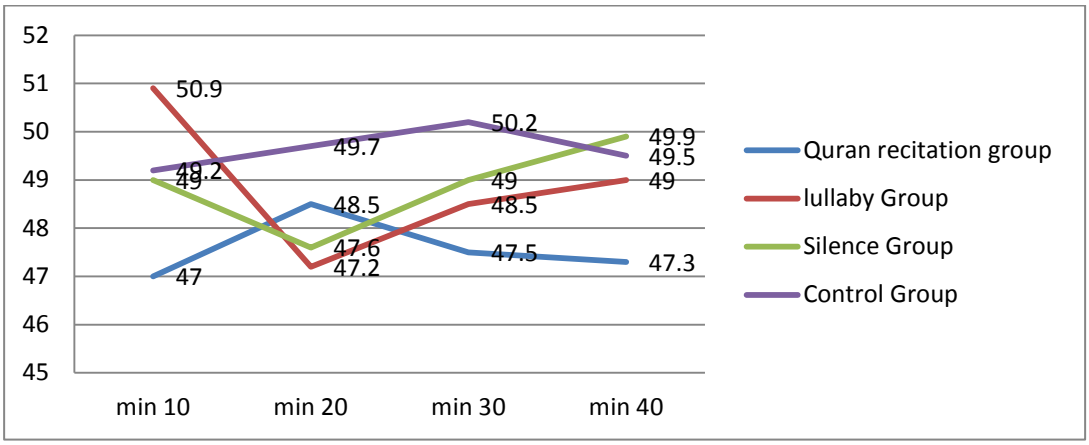

chart 3: Comparison means of respiratory rate of premature infants in different min of intervention, in four groups

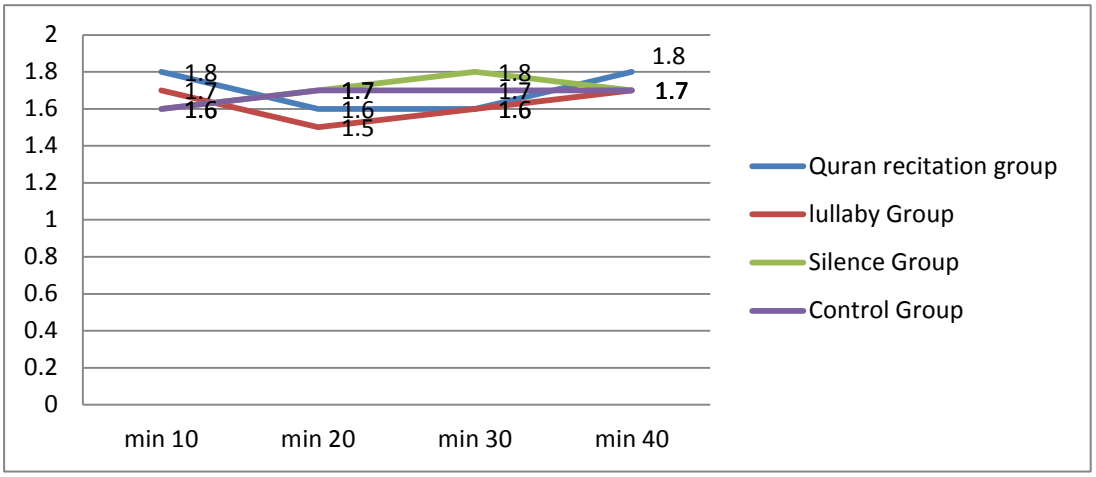

chart4: Comparison means of Behavioral stateof premature infants in different min of intervention, in four groups

Discussion

The results of the current study do not show any significant changes in short term responses of premature infants including oxygen saturation, respiratory rate, heart rate, and behavioral states, following interventions by Quran recitation, lullaby music and silence. Also, no significant differences were seen between four groups in any time of study.

Although no significant differences have been found in the changes of dependent variable between the four groups, but results of table 2 shows that most increase in oxygen saturation and most decrease in behavioral state scores occur in Quran recitation group in the end of the intervention comparing to the base line. Infants in the lullaby group experience most decrease in heart rate and respiratory rate in the end of the intervention comparing to the other groups.

The results of table3 show most increase in oxygen saturation and decrease in heart rate in 10 min afterthe end of intervention comparing to the base lines occur in Quran recitation group, decrease of respiratory rate is seen only in lullaby group and the infants in Quran recitation and lullaby group display decrease in behavioral state scores 10 min after the end of intervention.The resultsof Wood (2008)and Collabra's(2003) studies support our findings (20, 18).In a study byWood (2008), 15 min of live music (55-70 dB) did not significantly change behavioral scores, heart rate, and oxygen saturation in premature infants(20). Collabra et al.(2003) replayed Brahms lullaby music (65-76 dB, 20 min for four days) for premature infants. They found no significant differences in heart rate, respiratory rate, and oxygen saturation between music and control groups (18).

Keshavars et al. (2010) replayed Quran recitation (50-60 dB, 20 min) for the premature infants via headphones. Their results show that during and after the intervention, oxygen saturation was significantly higher and respiratory rate was significantly lower in Quran group compared to the control (8).

Keshavars et al. (2010) reported significant differences in the mean values of oxygen saturation, respiratory and heart rates in the experimental group in different times of study.But in our study, on the Repeated Measures and Friedman tests, respiratory and heart rates, oxygen saturation, and behavioral states of four groups had no significant differences at various time intervals(8).

Burke et al. (1995) reported decreased heart rate of premature infants after listening to recorded lullaby ([2]1). These results do not support our findings. Farhat (2010)and Amiri (2009) used headphones to play 20 min of lullaby music (65-75 dB) for the premature infants for eight days. They placed headphones without music on the ears of the control group ([2]2,[2]3). Farhat (2010) observed no changes in heart rate but reported significant increase in respiratory rates during intervention compared to baseline (22). On the other hand, Amiri (2009) indicated that oxygen saturation in the lullaby group significantly increased during the intervention compared to baseline. However, significant reductions in oxygen saturation were detected in the control group (23).

In contrast, Coleman (1998) reported an increased respiratory rate during 20 min of lullaby intervention(15), whereas Collabra (2003) found no effect of music (18).Decrease (Coleman 1998) (15)and increase (Elander&Hellstrom 1995) (24)in heart rate during music intervention are the two others.

The reasons of these disagreement between results of studies maybe was the difference in sample size, inclusion criteria, type and sound level of intervention, methods of response measurement, environmental ambient noise, circumstance, condition and others that can influencethe response of the premature infants.

Conclusion

Vocal interventions such as Quran recitation and music had no unwanted effects on the oxygen saturation, respiratory rate, heart rate, and behavioral states of the premature infants and did not interfere with technical aspects or routine care. More researches are strongly recommended to be done.

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Conflict of Interest

The authors declare no conflict of interest.

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