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The Effects of Music on Vital Signs, Weight, and Wellbeing of Premature Infants

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Abstract

Background and Objectives: To compare the effects of selected recorded music with the effects of ambient noise on the physiological and behavioural state responses and weight of preterm infants in NICU. *Methods*: 50 non-ventilated, preterm infants, 28-36 weeks of gestation aged 1-10 days of life were exposed to music on alternate days at morning and evening for 14 days. The effect of the music was measured before, during , and after by observing the oxygen saturation, heart rate, respiratory rate and wellbeing as measured by behavioural state, and feeding as measured by weight changes; and compared to a control group of 50 infants in whom no music (only standard NICU care with ambient noise) was provided. *Results*: Oxygen saturations and heart rate did not change significantly in the 10 min before, during or after the music in the intervention (p=0.95 and 0.19) or control group (p=0.23 and 0.20). Respiratory rate decreased in both the groups (p <0.0001 and <0.0002). In the music group Behavioural pattern changed from 3 to 4 of the Thomas score; from before the music therapy *sleep-wake transition*, to *active sleep,* showing increased mouthing, sucking and twitching movements of the limbs (p<0.0001) vs no change in control group. *Increase in the weight from the mean of* 1.5 (0.28) to 1.6 (0.30) after 14 days was seen in infants who received music therapy (p<0.0001). *Conclusion*: Behavioral state changed significantly from sleep-awake transition to active sleep and significant weight gain occurred after 14 days in music therapy group. There were no significant differences in the heart rate and oxygen saturation over the three measurement points over a period of 40 minute session for both the groups over 14 days. Respiratory rate significantly decreased in both the groups. There was no adverse effect of music therapy.

Keywords: Music; Premature Infants; Physiological and Behavioral Response.

Introduction

Preterm infants are those born after the beginning of the 20th week of gestation and before the end of the 37th week. Despite significant advancements in the care of preterm infants during the past 40 years, these infants still have high rates of subnormal growth, illness, and neuro-developmental deficits [1]. Music is a form of sound stimulation that has been found to enhance physiological and behavioral health patterning in many populations including preterm infants.

Investigators have demonstrated that providing appropriate stimulation to preterm infants is necessary for their growth and development and that lack of appropriate infant stimulation negatively affects physiological and neurobehavioral functioning. Music is a form of sound stimulation that has been found to enhance physiological and behavioral health patterning in many populations including preterm infants [2].

This increasing incidence of prematurity,

prevalence of significant morbidity, and burden to society, both personal and cost-related, make it imperative to identify developmental care strategies and health patterning modalities such as music that might reduce this burden.

Key Messages

Music therapy infants of 28-36 weeks gestational age during first 10 days of life,go into 'active sleep' and had weight gain over a period of 14 days compared to ambient noise group. These effects were significant. There was no effect of music on heart rate, respiration and oxygen saturation.

Aims and Objective

The specific aim of the proposed study and associated null hypotheses include: Compare the effects of selected recorded music with the effects of ambient noise on the physiological and behavioral state responses of preterm infants in the NICU.

H_{01}: There will be no significant differences in oxygen saturations between the music intervention group and ambient noise control group.

H_{02}: There will be no significant differences in heart rates between the music intervention group and ambient noise control group.

H_{03}: There will be no significant differences in respiratory rates between the music intervention group and ambient noise control group.

H_{04}: There will be no significant differences in behavioral states between the music intervention group and ambient noise control group.

Methodology

Research Design

A prospective open label non-probability measure was used to explore the physiological and neurobehavioral health patterning responses of preterm infants from 28 to 36 weeks gestation to a selection of recorded music in a NICU.

A 20-minute session of lullaby, classical music, devotional song with a relatively constant rhythm, volume, and pitch provided at a volume level in the 60 db was given to 50 infants in the intervention (music) group. This will be given for 2 weeks on alternate days (total 6 days) at morning 10 am and evening 8 pm.

A control group (ambient group) of 50 infants were selected in which no music was given and kept on ambient noise of NICU.

The parameters measured were oxygen saturation, heart rate, respiratory rate and behavioural state and weight of preterm infants.

In the intervention group (music) first measurement was done at 0 min before), second at 20 minute (during) and third measurement at 40 min (after) of the session. Similarly in the control (ambient) group readings were taken at 0 min (before), 20 min (during) and at 40 min (after).

Design Rationale

Sound conditions were administered after a feeding during a time that is usually a resting period for the infant.

Once the headphones or the speakers and pulse oximeter were placed, the baby was undisturbed in the incubator or trolley and the incubator remained closed unless it was necessary to disrupt the study for the infant's medical care or comfort (e.g., apnoea spell requiring stimulation, de-saturation, fussiness, emesis, etc.). Headphones presented the stimulus at the same carefully controlled decibel level (60-70db) which was measured with the help of a soft-ware installed in the android cell.

Oxygen saturation, heart rate and respiratory rate were chosen as physiological health patterning measures because they are responsive to auditory stimuli. Behavioural state was chosen because it characterizes the underlying functioning of the brain and reflects infants' ongoing responses to acoustic stimulation.

An infant's behaviour (e.g., respiratory pattern, eye opening, movements, muscle tone, eye movement, crying, alertness, etc.) is affected by the state he is in: (a) alert, (b) non-alert waking, (c) fussing or crying, (d) sleep-wake transition, (e) active sleep, or (f) quiet sleep. An infant's respiratory pattern will be slow, regular, and abdominal during quiet sleep whereas it will be irregular and primarily costal during active sleep. Also, behavioural state is a sensitive measure of infant response to sound and changes in behavioural state provide information about the neurobehavioral status of infants including the impact of interventions.

Thomas derived behavioural classification scheme is as follows:

0. Alert- the infant's eyes are open, bright, and attentive or scanning. Motor activity is low and respirations fairly even, but the infant may be active.

1. Non-alert Waking- the infant's eyes are usually open, but dull and unfocused. Motor activity may vary, but is usually high and respirations are even. The eyes may be closed during high-activity and fuss vocalizations may occur.
2. Fussing or Crying- fuss sounds are continuous or intermittent at low levels of intensity. Intense vocalizations occur either singly or in succession.
3. Sleep-Wake Transition (including drowse and gaze)- the infant shows behaviours of costal.
4. Active Sleep- the infant's eyes are closed. Respiration is uneven and primarily sporadic movements may occur, but muscle tone is low between movements. Rapid eye movements (REMs) occur intermittently accompanied by occasional eye opening. Other behaviours may include smiles, frowns,grimaces, sighs, mouthing, sucking, and twitching movements of the extremities. High-pitched cries may be emitted as well as straining or grunting vocalizations during large stretching movements.
5. Quiet Sleep (including active-quiet transition) - the infant's eyes are closed. Respiration is relatively slow, regular, and abdominal. Tonic motor tone is maintained and motor activity is limited to occasional startles, sighs, or rhythmic mouthing. Limb or body movements or isolated REMs may occur. Infants behavioural state was observed during the before during and after the session.

Sample

The total sample recruited consisted of 100 non-ventilated, preterm infants from 28 to 35 weeks gestation. Infants were within 1 to 10 days of birth and APGAR scores were from 8 to 10 at five minutes after birth.

Sampling and Recruitment Procedures

Participants were selected for the study based upon predetermined theoretical and practice-based inclusion and exclusion criteria.

All infants had signed parental consent and were screened for normal hearing by a audiologist to ensure their ability to hear the sound stimuli.

Inclusion Criteria

- 28 to 35 weeks of gestation
- 1 to 10 days of life
- 5 min APGAR score 8 to 10
- Small Gestational age
- Respiratory Distress
- Passed hearing test

Exclusion Criteria

- Diagnosis of congenital defects, IVH, NEC, Patent Ductus Arteriosus, acute lung disease, or neonatal anaemia (Haemoglobin <12 gm/dL)
- Current ventilator use
- Known maternal drug, alcohol, or illegal substance abuse.

Eligible infants were identified, parents were informed about the study and informed consent will be taken before starting the therapy.

Study Protocol

Supply and Equipment Set-Up: Prior to data collection, study equipment was setup in the hospital research laboratory. Pulse oximeter was connected to the infant. Headphones will be connected to the ipod or the mobile phone .Instead of headphones speakers can be used. The decibel level transmitted from the iPod or the mobile phone should not exceed 60 decibel. IPod was locked to prevent any changes in settings.

The music was started after 10 minutes and stopped after 20 minutes. The pulse oximeter recordings continued until 10 minutes after sound recording was stopped. Investigator hands were again washed and equipment was cleaned using the disinfectant wipes. Oxygen saturation and heart rate data were then downloaded from the pulse oximeter and recorded.

Statistical Analysis

For Inter-group analysis unpaired t test were used and the intra-group analysis were done by repeated measures of Annova. For demographic analysis chi square test was used.

Results

Demographic Data

Total 1105 patients were admitted during January 2014 – July 2014 in NICU of Sir T Hospital Bhavnagar. Out of which 621 patients were admitted during my posting in NICU from Jan-March and in July. 196 patients fall in gestational age of 28-36 weeks. A total of 105 clinically stable, non-ventilated,

appropriate-for-gestational-age (AGA) preterm infants from 28 to 36 weeks gestation were recruited for this study by non-randomized non-probability quota method.The final sample size included 100 preterm infants (50 infants in the intervention group and 50 in the control group) 5 were withdrawn from the studies as 2 did not passed hearing test and 1 patient was kept on ventilator and 1 had neonatal anaemia and 1 developed NEC (Flow chart 1).

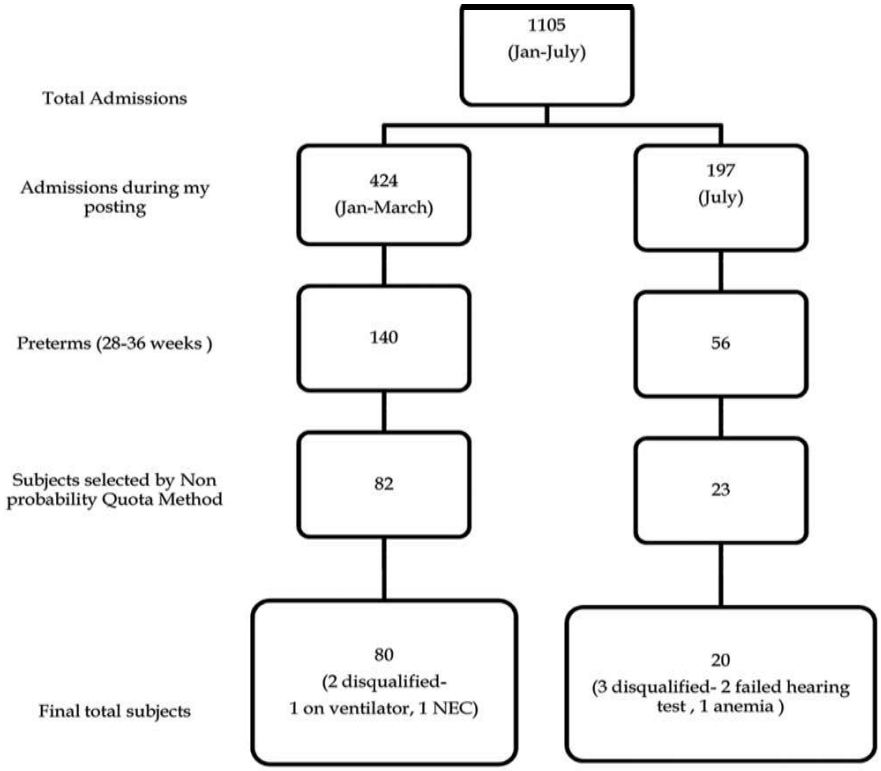

Fig. 1: Flow Chart showing selection of subjects

Table 1: Demographic data of subjects (N= 100)

Demographic	Total N	Music n=50 n(%)	Ambient Noise n=50 n (%)	Test Statistics	p- value
Gender					
Male	50(50)	28(56)	22(44)	χ2=1.44	0.23
Female	50(50)	22(44)	28(56)		
Birth Weight (kg)		1.59(0.28)*	1.52(0.29)*		
<1	1	1(2)	0(0)	U=1126.5	0.31
1-1.49	37	18(36)	19(38)		
1.5-1.99	51	24(48)	27(54)		
>2	11	7(14)	4(8)		
Gestational age (weeks)				χ2=7.10	0.06
28-29.9	12	4(8)	8(16)		
30-31.9	18	11(22)	7(14)		
32-33.9	43	17(34)	26(52)		
34-35.9	27	18(36)	9(18)		
APGAR Score at 5 min		8.34(0.519)*	8.34(0.530)*		
8	66	34(68)	32(64)	t=0.3	0.75
9	32	15(30)	17(34)		
10	2	1(2)	1(2)		
Age at Study (days)		1.36(0.80)*	1.37(0.52)*		
1-5	94	49	45	U=1345.5	0.46
5-10	03	01	01		

*Mean SD; ÷2= Chi Square test ; U= Man Whitney's test ; t= Unpaired t test

Table 2: The comparative parameters before starting the study

Parameters	Music Mean(SD)	Ambient Mean(SD)	Test	p-Value
Heart rate	133(0.93)	134(1.13)	t=2.26	0.03
Respiratory rate	38.2(0.73)	38.0(0.34)	t=0.46	0.94
Oxygen Saturation	97.6(0.31)	97.62(0.31)	t=0.50	0.62
Activity Level	3.1(0.08)	3.0(0.09)	U=97.5	0.148
Weight	1.5(0.28)	1.5(0.28)	t=1.1	0.2

Table 3: Variables measured between two groups and intra-group p value

Measurements	Timing	Music Mean (SD)	Ambient Noise Mean (SD)
Oxygen Saturation SpO_2%	Before	97.60(0.31)	97.62(0.31)
	During	97.66(0.33)	97.46(0.50)
	After	97.82(0.27)	97.69(0.32)
	Intra-group p value	*0.95*	*0.23*
Heart rate per min.	Before	133.11(0.93)	134.00(1.13)
	During	132.70(0.70)	132.46(0.85)
	After	133.06(0.72)	134.26(0.82)
	Intra-group p value	*0.19*	*0.20*
Respiratory Rate per min.	Before	38.2(0.73)	38.09(0.34)
	During	37.26(0.38)	37.93(0.29)
	After	35.87(0.38)	37.57(0.31)
	Intra-group p value	*<0.0001*	*<0.0002*
Behavioral State	Before	3.1(0.08)	3.0(0.09)
	After	4.8(0.06)	3.1(0.16)
	Intra-group p value	*<0.0001*	*0.08*
Weight	Before	1.5 (0.28)	1.5(0.28)
	After 2 weeks	1.6 (0.30)	1.5(0.29)
	Intra-group p value	*<0.0001*	*0.09*

Demographic data is shown in Table 1.Birth weight for study infants ranges from 900 grams to 2220 grams. Most of the study infants were in birth weight groups from 1500 to 1999 grams followed by1000-1499 grams. This is applicable to both the music group and the ambient noise group.

Infant's gestational ages ranged from 28 weeks to 36 weeks. There were more infants in the range of 32-34 weeks in ambient groupcompared to the music therapy. Infants were approximately equally divided among 32-34 and 34-36 weeks. There were a few more ambient group infants than music noise group infants in the lowest gestational age category.

Infant ages at the time of the study ranged from 1 to 10 days of life (*M=1.3*). Most of the infant included in both the group belongs to first two days of life. Very few infants were included after the 5th day of life.

APGAR scores were from 8 to 10 (*M* = 8.78; *SD* = 0.53). Five minute APGAR scores met the study inclusion criteria of 8 to 10 and had a mean of 8.78. Most of the infants received an APGAR score of 8. There were an equal number of infants in the music and ambient noise groups who had received an APGAR score of 10 (1 in each group) and approximately equal who had APGAR score of 9.

As there was no significant difference in the birth weight, ages (gestational age and age at study date), and APGAR scores in music and ambient noise groups of infants so that these characteristics most likely did not influence study results.

There were no significant differences in the heart rate and oxygen saturation in both the group responses over the three time periods, but there were significant changes in individual infant's respiratory rate, behavioural pattern and weight (Table 3).

Oxygen Saturation

No significant differences were noted within the intervention and control groups i.e. music and ambient groups before, during and after the music therapy (p=0.95) and (p=0.23) respectively. (Elicited by using repeated measures of Annova).

Heart Rate

Infant heart rate did not change significantly in the 10 min before, during or after the sound condition (p=0.19). Similar was seen in ambient noise group (p=0.20).

Respiratory Rate

Infants respiratory rate decreased after music therapy in both intervenetion and the ambient noise group (p <0.0001) and (p <0.0002) respectively.

Behavioural State

Infant's behavioural pattern before the music therapy was in sleep-wake transition and later after music therapy there was a significant difference (p<0.0001), most of them went into active sleep, this increased the mouthing and sucking and twitching movements of the limbs.

Weight

Increase in the weight after 14 days was seen in infant's who received music therapy (p<0.0001). In the ambient noise group no such change was seen (p=0.09)

Discussion

Oxygen saturation improved in the music therapy group infants during and after the music, though this change was not significant. An infant's respiratory pattern will be slow, regular and abdominal during quiet sleep whereas it will be irregular and primarily costal during active sleep. Therefore, infants will most likely have lower oxygen saturation during the state of quiet sleep then active sleep [3,4]. While in the control group (ambient) no such observation was found. Study findings were similar to thosewho found no significant differences in preterm infant oxygen saturations before, during, or after recorded music [5,6]. These results did not corroborate other investigator's findings of significantly higher preterm infant oxygen saturations in response to a music intervention [7,8] nor significantly lower preterm infant oxygen saturations in response to noise [9].

While infants in the music group had mean heart rates that were lower than infants in the ambient noise group after the sound conditions, this difference was very small and not statistically or clinically significant. Study findings were similar to those of who found no significant differences in preterm infant heart rates before, during, or after recorded musicalso found no significant differences in these preterm infant heart rates before or during live music, but found significant differences thirty minutes after live music [5,6]. The results of this study are not consistent with other investigator's findings of significantly lower preterm infant heart rates in response to a music intervention [7].

In music therapy group the respiratory rate decreased during and after the therapy as the neonate goes into active sleep after the therapy, the respiration becomes smooth, similar change was seen in ambient noise group this was attributed to the physiological change in the respiratory rate which becomes smooth over the period of time. Results were similar to the study done by Arnon which states that there is improvement in the respiratory rate [5].

Significant change in the infants' behaviour was noticed after the music therapy. Most of the infants were in the sleep-wake transition before the music therapy; it was noticed that during and after the sound they went into active sleep, and smile, grimacing, mouthing, sucking and twitching movements were seen after the therapy. Study findings were similar tothose who found no significant differences in these preterm infant's behavioural state before or during live music, but found significant differences thirty minutes after live music when infants were in their deepest sleep states. They also found that infants in the music group had a significantly greater occurrence of quiet sleep states and less crying when integrated with kangaroo care [5,6].

Weight gain was observed amongst those babies who received music this is because the sucking pattern improved as most of the infant went into active sleep after the therapy which increased the feeding. The results were similar to the study which states that there is daily weight gain and increase calorie intake by music therapy [10].

Limitations

- As the study was conducted in a single centre and on limited number of subjects, to generalise this result there is a need to conduct the study at multi-centric level on more number of subjects.
- Random fluctuations such as variations in room sound levels or unplanned environmental sounds were observed which at times were unavoidable.
- Time allotted for the presentation of the music

was brief and studies with longer duration should be conducted.

Conclusions

- Music therapy had no significant effect on the infant's oxygen saturation and heart rate. Respiratory rate decreased significantly in both the groups.
- In music therapy group infant's behavioural state improved significantly from sleep-awake transition to active sleep. Smiles, mouthing, sucking and twitching movements of the extremities were seen.
- Significant weight gain is seen in music therapy group infants after 2 weeks.
- Preterm infants in a NICU did not have adverse reactions to a carefully designed music intervention.

What is Already Known

Music has no significant effect on oxygen saturation and heart rate of preterm infants.

It significantly improves the behavioural state in form of sleep awake transition to active sleep.

Smiles, mouthing, sucking and twitching movements of the extremities were seen.

What this Study Adds

There was significant weight gain in test group infants after 2 weeks.

Preterm infants in a NICU did not have adverse reactions to a carefully designed music interventation.

References

1. Colvin M., McGuire W, Fowli PW. ABC of preterm birth: Neurodevelopmental outcomes after preterm birth. British Medical Journal. 2004; 329(7479): 1390-1393.
2. Gardner S.L, Goldson E. The neonate and the environment: Impact on development. Handbook of neonatal intensive care (6th ed., p 273–349). St. y Louis: Mosby; 2006.
3. Lorch CA, Lorch V, Diefendorf AO, Earl PW. Effect of stimulative and sedative music on systolic blood pressure, heart rate, and respiratory rate in premature infants. Journal of Music Therapy. 1994; 31(2): 105-118.
4. Thoman EB, Ingersoll EW, Acebo C. Premature infants seek rhythmic stimulation, and the experience facilitates neurobehavioral development. Behavioral Pediatrics. 1991; 12(1): 11-18.
5. Arnon S, Shapsa A, Forman L, Regev R., Bauer S, Litmanovitz, L., et al. Live music is beneficial to preterm infants in the neonatal intensive care unit environment. Birth. 2006; 33(2): 131-6.
6. Lai H, Chen C, Peng , Chang F, Hsieh M., Huang H., Chang S. Randomized controlled trial of music during kangaroo care on maternal state anxiety and preterm infants' responses. International Journal of Nursing Studies. 2006; 43(2): 139–146.
7. Burke M,Walsh ,Oehler J, Gingras, J. Music therapy following suctioning: Four case studies. Neonatal Network. 1995; 14(7): 41-49.
8. Cassidy JW, Standley JM. The effect of music listening on physiological responses of premature infants in the NICU. J Music Therapy. 1995; 32(4): 208-227.
9. Elander G, Hellstrom G. Reduction of noise levels in intensive care units for infants: Evaluation of an intervention program. Heart & Lung: Journal of Critical Care. 1995; 24(5): 376-9.
10. Caine J. The effects of music on the selected stress behaviors, 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 Therapy. 1991; 28(4): 180-192.