Effect of classical music on stress among preterm infants in a neonatal intensive care unit

Diler Aydin[1], *Suzan Yildiz*[2]

[1] Harran University School of Nursing – Pediatrics Nursing Department, Turkey,
[2] Istanbul University Florence Nightingale Nursing Faculty, Pediatrics Nursing Department, Turkey.

Abstract

Objective: The aim of this study was to observe the effects of music played in the neonatal intensive care unit (NICU) on stress symptoms, oxygen saturation, peak heart rate, and respiratory parameters among preterm infants.

Methods: The study was conducted from November 2004 to February 2006, and 26 preterm babies in the NICU at the Pediatrics Department of the Medical Faculty of Istanbul University were assessed. Written permission was obtained from their families. A music system was set up in the incubators of infants in the experimental group, and classical music was played for 1 h each day. Peak heart rate, oxygen saturation, stress symptoms, and respiratory parameters were observed before the music was played as well as 5 and 55 minutes afterward.

Results: A significant decline in stress levels was observed among the neonatal infants in the experimental group compared with those in the control group, but no meaningful difference in hospitalisation time or oxygen saturation was observed. The peak heart rate and respiratory parameters were below normal levels. Listening to classical music decreased stress among newborns in the NICU.

Conclusion: Listening to classical music decreased stress among newborns in the NICU. The results showed that neonatal intensive care nurses can use classic music in NICUs as it masks the ambient noise, decreases stressful behaviours and bradycardia, has soothing and stimulating effects, and facilitates sleeping.

Key words: music, preterm, intensive care, stress, growth.

Introduction

Music can be defined as the art of narrating feelings and thoughts with sounds or as the art of arranging sounds to express a sense of aesthetics (1). Music has been a means of expression throughout human history (2). Music has also been used for many years in the treatment of various diseases to increase well-being/happiness and decrease aches/pains as it has both sedative/calming and stimulant effects (1, 3, 4). Its use in health applications and in social life has gradually increased. Music therapy is currently being trialled for patients in all age groups, including babies, children, adolescents, and the elderly.

In hospitals, music is used in palliative care (5), intensive care (6), surgery (7), psychiatry, oncology (1), gynaecology, paediatrics, coronary care, radiation, chemotherapy, mechanical ventilation (8), in situations where medical procedures are performed (9, 10), in the treatment of symptoms such as pain and (11) anxiety (12, 13), to improve quality of life, and in spiritual healing (14, 15, 16, 17, 18).

The longevity of preterm infants has increased because of developments in medical technology. However, when preterm infants leave the intrauterine environment prematurely, they encounter the NICU, a very different environment, and undergo an adaptation process. Developmental deficiencies and neurological disorders may occur during this process, and the infants require long-term care for such problems (3, 17).

Services/care provided to infants in the NICU in line with progress in individual supportive developmental care over the past few years have decreased stress symptoms among neonatal/preterm infants. 'Individual Supportive Developmental Care' has been used to organise the behaviour of premature infants on the basis of the Synactive Theory developed by Heidelise Als, who has been researching the topic since 1980 (15, 19). Studies on the use of music/sound (classical music, lullabies, traditional music, mother/female voice, etc.) in individualised developmental care have shown that music has sedative and stimulant effects on preterm infants by masking undesired noise (20).

Preterm infants in the NICU are exposed to stress due to environmental adaptation to the ambient conditions of the NICU. Purposeful sounds, such as music, affect learning, are soothing, and have neurological development potential; they have begun to be used as therapy in NICUs to decrease stress, improve heart rate and respiration, speed up growth, and shorten the hospitalisation period (7, 21, 22). Today, music therapy is used as a means of reducing stress (13), accelerating growth (9, 23), facilitating transition to feeding, reducing pain, facilitating transition to sleep, ensuring positive changes in oxygen saturation level (SO_2) and peak heart rate values (6, 24, 25), and reducing the length of stay in hospital (12, 20, 26, 27, 28, 29).

The aim of the current study was to determine the effects of music on growth (assessed by weight, height, and head circumference), stress symptoms, oxygen saturation, peak heart rate, respiratory parameters, and hospitalisation period among preterm infants in an NICU.

Materials and method

The study was conducted among 26 preterm infants, 13 of whom constituted the trial group and the remaining 13 the control group (power: 0.80; β: 0.20; n: 13). The experiment was performed in the Neonatal Intensive Care Unit and Neonatal Special Care Unit at the Pediatrics Department in the Medical Faculty of Istanbul University between January 2005 and February 2006. The study was conducted in accordance with the Helsinki Declaration and was granted ethics committee approval. In addition, a study permit was received prior to the study being performed.

The inclusion criteria for infants were: weight, 1000–1500 g; stable within the initial 24 h after birth; no congenital anomaly, cranial bleeding or hyperbilirubinaemia; no intubation; and no family history of hearing loss beginning in infancy.

Hypotheses of the study

The following hypotheses were tested in relation to music therapy among preterm infants hospitalised in the NICU:

Hypothesis 1: Music decreases stress symptoms.

Hypothesis 2: Music increases anthropometric measurements (weight, height, head circumference).

Hypothesis 3: Music increases oxygen saturation levels.

Hypothesis 4: Music balances peak heart rate values.

Hypothesis 5: Music balances respiratory parameters.

Hypothesis 6: Music decreases the hospitalisation period.

Data collection tools

A Patient Consent Form, Infant Information Form, and Patient Follow-up Form, all of which were developed by the investigators in line with the literature, were used for data collection.

Points were allocated on the basis of the stress symptoms shown by preterm infants participating in the study, and average stress scores were calculated. Infants with no stress symptoms scored 0 points, those with mild stress symptoms scored 1 point, those with mid-level stress scored 2 points, and those with severe stress scored 3 points.

Stages of the study

The families of the infants who met the case selection criteria were interviewed, and the consent of the families who wished to participate in the study was obtained using the Informed Consent Form. The Infant Information Form was also completed for the infants. These forms were numbered starting from 1. Infants with odd number forms were included in the trial group and those with even number forms in the control group.

A music system was set up in the incubators of the trial group infants; 2 loudspeakers were placed at the feet of the infants within the incubator. A decibel measurement device was placed outside the incubator on a nearby counter, and it was connected to a power source after the maximum sound level was set at 45–60 dB. The microphone of the decibel measurement device was placed between the loudspeakers within the incubator to measure the sound level within the incubator.

The nurses were informed of the study and of the music system and its operation prior to the study. Routine checks of the preterm infants in the NICU are carried out at 3 h intervals. One of the nursing care sessions in the NICU was selected (the longest care session in the afternoon) and classical music was played to the preterm infants by

the nurses for 1 h during these sessions until the infants were discharged. The preterm infants were monitored while they were listening to the classical music and data were recorded twice weekly by the investigators.

Before the nursing session, the preterm infants were assessed and stress symptoms, oxygen saturation peak heart rate, and respiratory parameters were observed over 1 min before therapy and recorded in the Patient Follow-up Form. The music therapy session was then started and routine monitoring (temperature, respiration, pulse, blood pressure) and daily care (mouth, eye, skin care, etc.) of the infants was performed; they were also fed. After 5 min, the stress symptoms of the infants were observed, and their oxygen saturation and respiratory parameters were measured and recorded. The music was played for 1 h; 5 min before the end of the session and at the 55th min, the stress symptoms of the infants were again observed, and oxygen saturation, peak heart rate, and respiratory parameters recorded.

In order to follow-up the growth of the infants, their weight, height, and head circumference measurements at admission and on discharge were also recorded.

Dependent and independent variables

The independent variable of the study was classical music, and the dependent variables were growth parameters, oxygen saturation, peak heart rate, respiratory parameters, hospitalisation period, and stress symptoms.

Analysis of the data

Statistical Package for Social Sciences (SPSS) for Windows 10.0 was used for the statistical analysis. Besides descriptive statistical methods (percentage, average, standard deviation), a One-way Anova and Student's t-test was used for intergroup comparisons of parameters with a normal distribution, and a paired sample t-test was used for intragroup comparisons. For intergroup comparisons of stress parameters that were not normally distributed, a Kruskal Wallis test was used; the Mann Whitney U test was used to identify the group responsible for any differences, and a Friedman and Wilcoxon Sign test was used for intragroup assessments. Chi-Square and Fisher's Exact Chi-Square tests were also used. The results were within the 95% reliability range, and the significance level was set at $p < 0.05$.

Findings

When the sex and gestation week distributions of the infants were compared, there was no statistically significant difference, indicating that the groups were homogeneously distributed. Most of the infants were deemed Appropriate for Gestational Age. There was no statistical difference between the groups in terms of this diagnosis ($p > 0.05$).

When the infants constituting the study group were evaluated in terms of their physical measurements, the average weight of both groups was about 1 510 g, the average height was 41 cm, and the average head circumference was 29 cm at discharge. There was no statistically significant difference between the average weight, height, and head circumference measurements of the groups at admission and discharge ($p > 0.05$). The hospitalisation period for both groups was about 22–23 days on average. There was no statistically significant difference in hospitalisation period between the trial and control groups ($p > 0.05$).

According to Table 1, the oxygen saturation results of the trial and control groups were distributed between 95–98%. There was no statistically significant difference between the initial and final oxygen saturation values of the groups, but they were maintained within normal limits.

When the initial and final average peak heart rate values of the groups were compared, it was found that there was no statistically significant difference in heart rate prior to the music therapy session and that 5 and 55 minutes after the session was initiated ($p > 0.05$). Peak heart rate values were between 135–157 beats/min and were within normal limits in both groups. However, an observed decrease in heart rate from the first to final measurement was statistically significant for the control group. There was also a significant decrease in the peak heart rate of infants in the trial group at the 5th and 55th minutes of the 1-h music therapy sessions (Table 2, p: 0.039).

When the respiration parameters of the trial and control groups prior to the care session and at 5 and 55 minutes during the session were com-

Table 1. Comparison of the Initial and Final Average Oxygen Saturation (SO_2) Values of the Groups (S = 26)

SO_2 values		Trial (s = 13) Mean ± SS	Control (s = 13) Mean ± SS	t; p
Initial SO_2	Prior	97.8 ± 2.1	97.2 ± 3.1	0.512; 0.613
	5th min	98.3 ± 1.5	96.9 ± 2.9	1.530; 0.143
	55th min	98.7 ± 1.5	97.1 ± 4.7	1.177; 0.258
F; p		1.374; 0.196	0.017; 0.819	
	Prior-5th min	0.905; p: 0.383	0.315; p: 0.758	
	Prior-55th min	1.369; p: 0.196	0.129; p: 0.899	
	5th min – 55th min	0.768; p: 0.457	0.145; p: 0.887	
Final SO_2	Prior	95.5 ± 3.7	97.3 ± 1.8	1.614; 0.120
	5th min	96.7 ± 3.4	96.6 ± 2.4	0.066; 0.948
	55th min	97.3 ± 2.9	97.4 ± 3.5	0.061; 0.952
F; p		3.505; 0.086	0.005; 0.947	
	Prior-5th min	**1.185; p: 0.259**	**0.939; p: 0.366**	
	Prior-55th min	1.872; p: 0.086	0.068; p: 0.947	
	5th min – 55th min	0.743; p: 0.472	0.572; p: 0.578	

Table 2. Comparison of the Initial and Final Average Peak Heart RateValues of the Groups (S=26)

HPB values		Trial (s = 13) Mean ± SS	Control (s = 13) Mean ± SS	t; p
	Prior	150.5 ± 19.4	135.2±24.5	1.768; 0.090
Initial HPB (…/min)	5th min	152.8 ± 16.0	145.6 ± 17.0	1.102; 0.281
	55th min	143.8 ± 13.8	138.0 ± 16.6	0.965; 0.344
F; p		3.542; 0.039	0.253; 0.624	
	Prior-5th min	0.769; 0.457	2.087; 0.059	
	Prior-55th min	1.429; 0.179	0.503; 0.624	
	5th min – 55th min	2.251;0.044	1.889; 0.083	
	Prior	156.9 ± 18.6	149.5 ± 13.3	1.165; 0.255
Final HPB (…/min)	5th min	152.7 ± 14.1	153.6 ± 9.9	0.243; 0.810
	55th min	151.6 ± 15.3	143.2 ± 15.8	1.376; 0.182
F; p		3.505; 0.086	6.061; 0.030	
	Prior-5th min	0.549; 0.593	0.964; 0.354	
	Prior-55th min	1.804; 0.096	1.176; 0.262	
	5th min – 55th min	1.375; 0.194	2.803; 0.016	

pared, no statistically significant difference was identified (Table 3). When the study findings were assessed, it was found that the respiration parameters were within normal limits (27, 30).

The initial and final stress values were not statistically significant between the trial and control groups in general. However, when the trial group was examined, there was a significant difference in between prior stress values and stress values at the 5th and 55th minutes of the therapy session. The significant difference was due to a statistically significant decrease in the average stress scores between the prior and the 55th minute and between 5th minute and 55th minute (Table 4).

Discussion

Calabro et al. studied the effects of music on weight gain and physiological and behavioural conditions of infants, and reported that there was no difference between trial and control groups (31). Similarly, the current study revealed no significant difference in growth values and hospitalisation period between the control and trial grou-

Table 3. Comparison of Initial and Final Average Respiratory Values of the Groups (S = 26)

Respiratory values		Trial (s = 13) Mean ± SS	Control (s = 13) Mean ± SS	t; p
	Prior	58.5 ± 8.8	58.3 ± 10.3	0.041; 0.968
Initial respiration (…/min)	**5th min**	59.9 ± 8.9	59.8 ± 9.7	0.021; 0.983
	55th min	55.7 ± 6.8	54.5 ± 8.1	0.419; 0.679
F; p		1.518; 0.242	2.978; 0.048	
	Prior-5th min	0.744; 0.471	0.452; 0.660	
	Prior-55th min	1.232; 0.242	1.237; 0.240	
	5th min – 55th min	1.611; 0.133	2.327; 0.038	
	Prior	61.2 ± 11.2	59.2 ± 5.8	0.694; 0.494
Final respiration (../min)	**5th min**	63.8 ± 10.3	62.5 ± 8.4	0.251; 0.804
	55th min	59.4 ± 8.2	55.0 ± 7.0	1.462; 0.157
F; p		1.123; 0.310	4.230; 0.050	
	Prior-5th min	0.603; 0.557	0.540; 0.599	
	Prior-55th min	0.706; 0.494	1.575; 0.141	
	5th min – 55th min	1.457; 0.171	2.408; 0.033	

Table 4. Distribution and Comparison of Initial and Final Average Stress Scores of the Groups (S = 26)

Stress score		Trial (N = 13) Mean ± SS	Control (N = 13) Mean ± SS	U; p
	Prior	0.76 ± 0.83	1.00 ± 1.15	78.00; 0.722
Initial	**5th min**	0.92 ± 0.95	1.15 ± 0.89	73.00;0.525
	55th min	0.23 ± 0.59	0.76 ± 1.16	63.50; 0.167
		KW: 3.882; p: 0.038	KW: 0.765; p: 0.682	
	Prior-5th min	Z:-0.520; p: 0.603	Z:-0.416; p: 0.677	
	Prior-55th min	Z:-7.32; p: 0.083	Z:-0.680; p: 0.496	
	5th min – 55th min	Z:-2.021; p: 0.043	Z:-1.299; p: 0.194	
Final	**Prior**	1.07 ± 0.95	1.23 ± 1.23	82.50; 0.913
	5th min	1.00 ± 0.70	1.23 ± 0.72	69.50; 0.401
	55th min	0.46 ± 0.87	0.61 ± 1.04	78.00; 0.668
		KW: 5.450; p: 0.046	KW: 0.765; p: 0.682	
	Prior-5th min	Z:-0.302; p: 0.763	Z:-0.187; p: 0.852	
	Prior-55th min	Z:-2.705; p: 0.048	Z:-1.552; p: 0.121	
	5th min – 55th min	Z:-2.811; p: 0.040	Z:-1.814; p: 0.070	

U: Mann-Whitney U test KW: Kruskal-Wallis test

ps. When studies where the findings demonstrated faster physical growth and decreased hospitalisation period were examined, the music applied was usually classical music, traditional lullabies, ambient sound, or the mother's voice, and was in the mother tongue of the infants (18, 23, 32, 33). Taking into consideration the study environment, it is possible that listening to Mozart instead of classical Turkish music and traditional lullabies had no positive effect on growth values and hospitalisation period among the preterm infants. Our argument can be confirmed by the knowledge that hearing begins at the 20–22nd week of pregnancy, perception of speech begins after the 27th week, and the infants learn some of the basic characteristics of their mother tongue during foetal life. Furthermore, the environment will be perceived as more familiar by the foetus if the music played during the last trimester of pregnancy is also played during delivery (15, 18, 23, 34). In conclusion, hypotheses 2 and 6 could not be verified.

The lack of any difference in oxygen saturation values between the groups is similar to findings from other studies (6, 7, 16, 31). Our study results were, to some extent, in line with the findings of Standley's study (2001) where the oxygen satu-

ration values increased during the first day in the trial group but decreased subsequently (18, 23). In light of these results, it may be that the values initially increased to a certain extent due to the stimulating effect of the music, but then remained within the normal values due to the soothing effect of the music as it continued over the 22–23 days of hospitalisation. In conclusion, hypothesis 3 was not verified.

There was a significant decrease in the peak heart rate of infants in the trial group at the 5th and 55th minute of the 1-h music therapy session (Table 2, p: 0.039). This result relating to the initial measurements was also observed during the final measurements, but was not statistically significant. One reason for this might be the fact that the infants became used to the Mozart played to them for 22–23 days, and that the instrumental and rhythmic music only acted as a stimulant and kept the peak heart rate within the normal limits. These study results were similar to those of other studies (9, 16, 31).

When the within-group respiration parameters of the trial group were evaluated, no significant difference was observed, whereas there was a significant difference in the values of the control group. As with the peak heart rate measurements, this may be due to the continuing stimulating effect of the music on the trial group, which balanced out the respiratory parameters. In conclusion, hypotheses 4 and 5 were verified.

A decrease in agitation and crying was observed in the literature as well as in the current study (35, 36). In conclusion, hypothesis 1 was verified.

Conclusion and suggestions

Classical music therapy has been used in NICUs as it masks the ambient noise, decreases stressful behaviours and bradycardia, has soothing and stimulating effects, and facilitates sleeping. Considering that mothers listen to music in their own language, it is recommended that studies assess the effectiveness of Turkish classical music in the NICU, and measure the effects of music therapy in the NICU during different procedures (e.g., taking blood samples).

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Corresponding Author
Diler Aydin,
Harran University School of Nursing,
Paediatrics Nursing Department,
Sanliurfa,
Turkey,
E-mail: dileraydin@gmail.com