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# The effects of giving pacifiers to premature infants and making them listen to lullabies on their transition period for total oral feeding and sucking success

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**Aim and objective.** This research aimed to assess the effect of giving pacifiers to premature infants and making them listen to lullabies on the transition period to total oral feeding, their sucking success and their vital signs (peak heart rate, respiration rate and oxygen saturation).

**Background.** It is very important that preterm infants start oral feeding as soon as possible to survive and get healthy quickly. Previous studies have shown that by using some external stimuli, premature babies can move to oral feeding at an earlier period than 34th gestational week, have increased daily weight gain and be discharged from hospital earlier.

**Design.** In this quasi-experimental and prospective study, 90 premature infants were studied with 30 premature infants allocated to each of pacifier, lullaby and control groups.

**Method.** The research was conducted at a neonatal intensive care clinic and premature unit of a university hospital in the east of Turkey between December 2007–January 2009. The data were collected through demographic information form for premature infants, the LATCH Breastfeeding Charting System and patient monitoring.

**Results.** We found that the group who proceeded to the oral feeding in the shortest period was the pacifier group ($p < 0{\cdot}05$), followed by the lullaby group and the control group, respectively ($p > 0{\cdot}05$). We also found that the highest sucking success was achieved by infants in the pacifier group ($p < 0{\cdot}05$) followed by the lullaby group ($p > 0{\cdot}05$).

**Conclusion.** These results demonstrate that giving pacifiers to premature infants and making them listen to lullabies has a positive effect on their transition period to oral feeding, their sucking success and vital signs (peak heart rate and oxygen saturation).

**Relevance to clinical practice.** Neonatal intensive care nurses can accelerate premature infants' transition to oral feeding and develop their sucking success by using the methods of giving them pacifiers and making them listen to lullabies during gavage feeding.

**Key words:** lullaby, nursing, oral feeding, pacifier, premature infants, sucking success

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## Introduction

Thanks to developments in health technology, the premature infants' chance of survival is gradually increasing. Premature infants who leave their intrauterine environment early encounter a very different environment to that in a neonatal intensive care unit (NICU) and experience an adaptation process. In this process of long-term care, problems caused by

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developmental and neurological disorders are commonly seen (Alls 1982, Lee 1991, Standley 2001). One of the common problems of the premature infants who receive treatment and care in NICU relates to the premature infants' feeding. Before the premature infant starts to feed, it is necessary to decide which nutrients and which feeding type will be used. According to the premature infant's condition, one of the alternatives of breast milk, fortified breast milk (protein, energy, macrominerals, trace elements and vitamin reinforced breast milk), term infant formulas or special premature infant formulas can be preferred (Savaşer 2002). The feeding type (enteral–oral, gastric, transpyloric or parenteral delivery) is determined according to the degree of maturity of the premature infant's gastrointestinal system, their gestation age, birth weight, sucking ability, muscular tonus, heart rate, pulse and respiration rates, level of wakefulness, state of illness and level of tolerance (Lebenthal 1995, Aydın 1996).

For a premature infant to feed orally in an effective and safe manner, it is necessary for them to be able to combine the actions of sucking, swallowing and breathing (Koenig *et al.* 1990, Mizuno & Ueda 2003). Although sucking movements exist from the 28th gestational week, feeding must be started through gavage methods (nasogastric/orogastric) for premature infants who are born earlier than 34 weeks (Can 2002, Savaşer 2002, Alpay 2005, Çavuşoğlu 2008) because the coordination between sucking and swallowing cannot be assured in premature infants younger than 34 weeks. Gavage feeding is a safe feeding method for those infants whose coordination of sucking, swallowing and breathing has not yet developed. Although the method has advantages for feeding of the premature infant, its use is contradictory because gavage feeding prevents sensorimotor experiences that are thought to develop feeding skills and it also creates a route of entry for infectious agents (Savaşer 2002, Bingham *et al.* 2003, Pinelli & Symington 2009). For the premature infants to survive and get healthy quickly, once the coordination of sucking, swallowing and breathing is assured, then gavage feeding must be ceased as soon as possible and oral feeding must be started (Lebenthal 1995, Aydın 1996, Can 2002, Savaşer 2002, Alpay 2005, Çavuşoğlu 2008).

Sucking is defined as nutritive and non-nutritive. Compared with non-nutritive sucking, nutritive sucking behaviour is a sucking type that consists of a food intake and it occurs at a slower speed (Dağoğlu 2002). By using various stimulating attempts in neonates, nutritive sucking success can be developed by reinforcing the non-nutritive sucking behaviour and increasing sucking experiences (Cooper *et al.* 1989, Palmer 1993). One approach involves the use of pacifiers, which reveals non-nutritive sucking in response to an oral stimulus. Pacifiers can thus be used during gavage feeding and at feeding intervals to ensure sucking organisation (Dağoğlu 2002). There are studies emphasising that pacifiers help premature infants ensure the coordination of breathing and sucking–swallowing (Koenig *et al.* 1990, DiPietro *et al.* 1994, Pickler *et al.* 1996, Efe & Savaşer 2005, Pinelli & Symington 2009).

Another attempt used as a stimulus for a premature infant is music, the auditory stimulus. Purposeful sounds like music can be preferred at any stage of care in neonatal units because they have potential of teaching, comforting and fostering neurological development. The most useful styles of music in the ICU are those vocalised by female vocalists (lullabies with a mother's voice or female voice) or accompanied by a single instrument, that have a light rhythmic tonic – such as steady rhythmic classical music (Chaze & Ludington-Hoe 1984, Lott 1989, Standley 2001). Lullabies are the music styles transferred from one generation to another over time, reflecting the culture of the society where they are sung, affecting the infants with their melodies and forming a spiritual bond between mother and infant (Artun 2000, Şimşek 2006).

Review of the related literature indicates that by using various external stimuli (pacifier, lullaby, music, breast milk smell, kangaroo care etc.), premature infants can proceed to oral feeding earlier than the 34th gestational week, can gain more daily weight and can be discharged from hospital in a shorter period. Therefore, using various stimuli is recommended for transiting to oral feeding (Lee 1991, Hernandez-Reif & Field 2000, Field *et al.* 2004, Efe & Savaşer 2005, Boiron *et al.* 2007, Bragelien *et al.* 2007).

There are few studies relevant to this subject in Turkey. In their descriptive study, Conk and Bolışık (1986) demonstrated that preterm neonates who take pacifiers develop more sucking reflexes than those who do not and their transition period to total oral feeding accelerates. Similarly, in their experimental study, Efe and Savaşer (2005) examined the effect of pacifiers on the premature infants' transition period for oral feeding. The authors stated that the infants who were given pacifiers proceeded to complete oral feeding earlier, had more weight gain and were discharged from hospital earlier than the control group. Unlike the studies conducted in our country (Conk & Bolışık 1986, Efe & Savaşer 2005), this study was planned using a wider sample group and premature infants' sucking success was also evaluated. In addition to giving pacifiers to premature infants, as the method of making them listen to lullabies as an auditory stimulus can make premature infants' transition to oral feeding easier and supports their sucking success, this strategy was also included in the study. There are no other studies planned on the use of lullaby application as an

auditory stimulus in Turkey. The results obtained from such research are thought to be a guide for nurses who are responsible for the care of premature infants hospitalised in NICUs. The aim of this research was to assess (1) the effect of methods of giving pacifiers to premature infants and making them listen to lullabies on the transition period to total oral feeding, (2) their sucking success and (3) their vital signs (peak heart rate, respiration rate and oxygen saturation).

## Methods

### Sample

The research was conducted at a neonatal intensive care clinic and premature unit of a university hospital in the east of Turkey between December 2007–January 2009. The research population comprised premature infants at the 30–34th gestational week who were hospitalised for treatment and care between the dates on which the research was conducted. The research was conducted with 90 premature infants allocated to three groups of 30 infants. In power analysis, the power was determined as 0·93 for 30 infants in each group at a 0·05 significance level and at 0·95 confidence interval – thus, the sample size was determined to be adequate.

In this study, the first group was composed of 30 premature infants who were the control group for the research and who received no intervention. The second group comprised 30 premature infants whose intervention involved the giving of pacifiers. The third group comprised 30 premature infants who were exposed to the singing of a lullaby.

For premature infants to be fed orally, they must combine the activities of sucking, swallowing and breathing at the same time (Koenig *et al.* 1990, Mizuno & Ueda 2003). In premature infants, the coordination of these skills is formed completely in the 34th gestational week (Can 2002, Savaşer 2002, Alpay 2005, Çavuşoğlu 2008). When the gestational age averages of the control and experimental groups were compared in the study, no statistically significant difference between them was noted. The groups were compared in terms of their gender, gestational age, birth weight, height, head circumference measurements and Apgar scores at 1–5 minutes, and it was determined that there was no statistically significant difference between these items in both groups. This demonstrates that the research groups were similar in terms of above-mentioned variables.

Inclusion criteria for this study were that the premature infants:

- were at 32 (±2) gestation weeks and who did not have sucking reflex
- weighed approximately 1000 gm or more
- had Apgar scores >6
- had stable health conditions during the first 24 hours after birth
- did not have any congenital malformation that may cause asphyxia and affect respiration and who had spontaneous respiration
- did not have cranial bleeding and hyperbilirubinemia that may lead to blood abnormalities
- did not have a congenital or acquired malformation related to hearing
- had no family members with a hearing loss starting in childhood
- were enterally fed via gavage and who could tolerate it
- were breastfed
- had a mother who was literate in Turkish and who was willing to feed her baby.

### Data collection

Data collection involved an information form to define premature infants prepared by the researcher after a literature review (Standley 2002, Bingham *et al.* 2003, Standley 2003, Efe & Savaşer 2005, Aydın 2006) to reveal the demographic characteristics of premature infants who met the inclusion criteria for the research group; the LATCH Breastfeeding Charting System to evaluate their sucking success; and the use of patient monitors to measure life signs.

The data were obtained during three feeding meals at 09·00, 12·00 and 15·00 every day. Peak heart rate, respiration rate and oxygen saturation values were recorded before, during and after feeding. In addition to recording daily body weight, the researcher weighed the infant every day before the first feeding meal (feeding at 09·00). The vital signs were monitored until the premature infant proceeded to oral feeding, whereas body weight measurement was continued until the infant was discharged from the hospital.

Data were collected by the researcher. However, because the LATCH Breastfeeding Charting System is a form based on observation, it was completed following examination by the researcher and an observer. Before starting the research, the observer was trained by the researcher on using the LATCH Breastfeeding Charting System form. The researcher and the observer evaluated each infant by scoring the LATCH Breastfeeding Charting System form at the same time and separately at two other breastfeeding periods.

In addition, other equipment used in the research included a digital infant scale, a measuring tape for the height and head circumference, pacifiers, baby bottles, baby bottle sterilisers, a bottle heating device, a lullaby CD (the first

lullaby named 'Uyusun da Büyüsün' in tune hejaz in Mircan Kaya's 'Bizim Ninniler' album, which was released by the Çan Music Production Company was used), a CD player, speakers, sound decibel meter, patient monitors and a clock.

### LATCH Breastfeeding Charting System

The LATCH Breastfeeding Charting System was developed by Jensen and Wallace in 1993 in Oregon. The LATCH is an assessment tool that was generated by an analogy with Apgar score system in terms of scoring method. Its evaluation is as fast and easy as the Apgar score (Koyun 2001, Yenal & Okumuş 2003). The Turkish validity of the LATCH Breastfeeding Charting System was performed by Demirhan in 1997 and Koyun in 2001. The LATCH Breastfeeding Charting System form is composed of five evaluation criteria. The LATCH acronym is a combination of the English equivalent of the initial letters of these five criteria and is listed as shown in the following:

L (Latch on breast) how well the infant latches onto the breast
A (Audible swallowing) the amount of audible swallowing noted
T (Type of nipple) the mother's nipple type
C (Comfort breast/nipple) the mother's level of comfort in relation to nipple
H (Hold/Help) the amount of help the mother needs to hold her infant to the breast.

Each item is evaluated between 0–2. The lowest (0) and the highest (10) scores can be obtained from the charting system (Adams & Hewell 1997, Demirhan 1997, Koyun 2001, Yenal & Okumuş 2003). The highest score shows the infant's sucking success. For LATCH Breastfeeding Charting System in this research, Cronbach's alpha coefficient was determined as 0·78 and correlation coefficient between independent observers was determined as 0·91.

### Intervention

Implementation of the research was carried out in four stages.

*Stage 1: Pacifier, lullaby and control group*

The premature infants admitted to neonatal intensive care clinics were evaluated in terms of the research inclusion criteria, and the parents of suitable cases were interviewed for approximately 10–15 minutes. The 'Premature Baby Demographic Information Form' was completed by the parents during face-to-face interviews taking approximately five minutes and informed consents were taken. The information that could not be obtained from infants' parents (gestational age, birth weight, Apgar score, height and head circumference) was obtained from patient files. The first 30 infants admitted within the dates of the research and meeting the research criteria formed the control group, the second 30 infants formed the pacifier group and the last 30 infants formed the lullaby group.

*Stage 2*

The premature infants admitted to neonatal intensive care clinics for treatment and care and complying with the patient inclusion criteria were started on gavage feeding in accordance with normal procedures. During infant gavage feeding, the flow rate of milk should be left to gravity by using the suspension technique without applying the pressure to the injector. The infant's own mother's milk was used as the nutrient at an amount determined by the neonatologist according to the premature infant's body weight and the total liquid amount she or he had to receive. The breast milk was heated to body temperature in the baby bottle heating device before feeding. The infants in each group were followed during three feeding meals (at 09·00, 12·00 and 15·00) and a 'Patient Follow up Schedule' was filled in.

*Control group (*n = *30).* No intervention was applied to the premature infants in the control group except the routine application of gavage feeding.

*Pacifier group (Experiment I) (*n = *30).* Premature infants were gavage fed without being taken out of incubators. When the feeding process started, the pacifier implementation was initiated by giving the infant a pacifier. When the feeding was completed, the implementation was also terminated. This implementation was continued every day in three feeding meals until the premature infant proceeded to oral feeding.

*Lullaby group (Experiment II) (*n = *30).* A speaker system was placed at the foot of the infant in the incubator, and it was connected to the CD player. The lullaby CD chosen for the implementation was inserted in the CD player. As soon as the premature infant commenced gavage feeding, the sound level of the CD player was modulated and the lullaby was played in such a way the sound level could be 65 dB (Standley & Moore 1995, American Academy of Pediatrics 1997, Coleman *et al.* 1997, Standley 2000, 2002, 2003, Committee to Establish Recommended Standarts for Newborn ICU Design 2007) in the incubator. When the gavage feeding was completed, the implementation of lullaby was also terminated. This implementation was carried on every day in three

feeding meals until the premature infant proceeded to oral feeding.

*Stage 3: Pacifier, lullaby and control group*
To evaluate the infant's sucking behaviour, the LATCH Breastfeeding Charting System form was filled in twice, by the researcher and an observer at the same time and independently of each other: The first form completion was just after the premature infants in the three groups taken into the research study proceeded to oral feeding and were given to their mothers and the second one was after 24 hours.

*Stage 4: Pacifier, lullaby and control group*
The premature infants in the study were followed until they were discharged from hospital. The infants were weighed just before they were discharged from hospital, and their body weights and discharge dates were recorded.

### Ethical considerations

Written informed consent was obtained from parents before they participated in this study. Parents were told that they could withdraw from the study at any time and that all information would be kept strictly confidential. To perform the research, ethical consents and an official approval were obtained from the relevant hospital. In addition, by interviewing the vocalist who sang the lullaby to be used in the study and her music production company, their consent was also obtained.

### Statistical analysis

Statistic analysis was carried out using the statistical software program, SPSS version 11.5 for Windows (SPSS Inc., Chicago, IL, USA). While evaluating the data, percentage distributions, mean, standard deviation, chi-square test, one-way analysis of variance between-group and within-group comparisons, Cronbach's alpha coefficient of consistency calculation, correlation in compatibility analysis between independent observers and *post hoc* Bonferroni correction analysis in advanced analysis were used. For all analyses, a $p < 0{\cdot}05$ was considered statistically significant.

## Results

The comparison of control and experimental groups in terms of premature infants' demographic characteristics is given in Table 1. When the premature infants in control and experimental groups in the research were compared according to their gender, gestational age, birth weight, height, head circumference measurement and Apgar scores at 1–5 minutes, it was observed that there was no statistically significant difference between groups ($p > 0{\cdot}05$).

The infants in the pacifier group were observed to proceed to total oral feeding in the shortest time, followed by the lullaby group. The longest time was in the control group, and the difference between groups was determined to be statistically significant ($p < 0{\cdot}05$). The pacifier group was determined to those who were hospitalised in the

**Table 1** Characteristics of premature infants in control and experimental groups

| Characteristics | Groups<br>Control ($n$ = 30)<br>Mean ± SD | <br>Pacifier ($n$ = 30)<br>Mean ± SD | <br>Lullaby ($n$ = 30)<br>Mean ± SD | Significance |
|---|---|---|---|---|
| Gender* | | | | |
| Male | 18 | 19 | 19 | $\chi^2 = 0{\cdot}095$ |
| Female | 12 | 11 | 11 | $p > 0{\cdot}05$ |
| Gestational age | 31·60 ± 1·57 | 31·90 ± 1·29 | 31·23 ± 1·33 | $F = 1{\cdot}699$<br>$p > 0{\cdot}05$ |
| Birth weight (g) | 1495·33 ± 350·54 | 1468·83 ± 266·23 | 1508·33 ± 338·06 | $F = 0{\cdot}118$<br>$p > 0{\cdot}05$ |
| Height at birth (cm) | 41·83 ± 2·87 | 41·55 ± 3·11 | 41·12 ± 2·87 | $F = 0{\cdot}446$<br>$p > 0{\cdot}05$ |
| Head circumferences | 28·60 ± 2·58 | 28·91 ± 1·72 | 29·05 ± 1·89 | $F = 0{\cdot}365$<br>$p > 0{\cdot}05$ |
| 1 minute Apgar | 6·23 ± 1·28 | 6·37 ± 1·22 | 6·47 ± 1·17 | $F = 0{\cdot}276$<br>$p > 0{\cdot}05$ |
| 5 minutes Apgar | 8·50 ± 1·01 | 8·90 ± 1·06 | 8·63 ± 0·96 | $F = 1{\cdot}214$<br>$p > 0{\cdot}05$ |

X, mean; SD, standard deviation.
*$n$, %.

hospital for the shortest time and they were followed by the lullaby group. The group spending the longest time in the hospital was determined to be the control group, and the difference between the groups was determined to be statistically significant ($p < 0{\cdot}05$, Table 2). The statistically significant difference noted in terms of the transition period to total oral feeding and mean time of hospital stay between control and experimental groups were determined to be because of the pacifier group, according to the result of *post hoc* advanced analysis. In addition, although it was not statistically significant, the infants in the lullaby group were noted to proceed to total oral feeding an average 37·27 hours earlier and they were discharged from the hospital an average 25·73 hours earlier than the infants in the control group. The difference between averages of discharge weights in control and experimental groups was determined to be statistically insignificant ($p > 0{\cdot}05$, Table 2). The highest sucking success was among the premature infants in the pacifier group, and they were followed by the lullaby group. By contrast, the infants in the control group had the lowest sucking success. The difference between the control and the experimental groups was determined to be statistically significant in terms of sucking success ($p < 0{\cdot}05$). According to the result of *post hoc* advanced analysis, this statistical difference between groups was determined to be because of the pacifier group (Table 3).

When the averages of peak heart rate before, during and after the first gavage feeding of the control and the experimental groups were compared, it was determined that there was no statistically significant difference between groups and within groups ($p > 0{\cdot}05$). Conversely, in the last feeding meal through gavage of the control and the experimental groups, no statistically significant difference between groups was noted in terms of peak heart rate averages before and after feeding ($F = 0{\cdot}244$, $F = 2{\cdot}386$; $p > 0{\cdot}05$), but there was a significant difference during feeding ($F = 5{\cdot}247$; $p < 0{\cdot}05$). According to *post hoc* advanced analysis results, it was determined that the significant difference between groups resulted from the pacifier and lullaby groups (Table 4).

When within-group comparisons of the averages of peak heart rate before, during and after the last gavage feeding meals of the control and the experimental groups were analysed, it was determined that there was no statistically significant difference in the control group ($F = 1{\cdot}526$; $p > 0{\cdot}05$), but there was a statistically significant difference in the pacifier and lullaby groups and within groups ($F = 6{\cdot}007$, $F = 5{\cdot}808$; $p < 0{\cdot}05$). According to *post hoc* advanced analysis results, it was determined that the difference between the peak heart rate averages appearing in the pacifier and lullaby groups resulted from the measurements during feeding (Table 4). When the averages of respiration rates before, during and after the first and last gavage feeding meals of the control and the experimental groups were compared, it was determined that there was no statistically significant difference between groups and within groups ($p > 0{\cdot}05$, Table 5).

**Table 2** Comparisons of control and experimental groups in terms of transition period to total oral feeding, duration of hospital stay and weight on discharge

| | Groups | | | |
|---|---|---|---|---|
| | Control ($n = 30$) Mean ± SD | Pacifier ($n = 30$) Mean ± SD | Lullaby ($n = 30$) Mean ± SD | *F*; *p* |
| Transition period to total oral feeding (hours) | 280·30 ± 174·89 | 184·27 ± 78·17* | 243·03 ± 123·34 | 4·064; **< 0·05** |
| Duration of hospital stay (hours) | 522·03 ± 269·83 | 368·90 ± 118·65* | 496·30 ± 223·66 | 4·420; **< 0·05** |
| Weight of discharge (g) | 1863·67 ± 184·10 | 1803·00 ± 146·62 | 1864·33 ± 180·11 | 1·271; > 0·05 |

**Post hoc* advanced analysis result.
Significant values are in bold.

**Table 3** Comparison of control and experimental groups in terms of score averages of LATCH Breastfeeding Charting System

| | Groups | | | |
|---|---|---|---|---|
| Scale | Control ($n = 30$) Mean ± SD | Pacifier ($n = 30$) Mean ± SD | Lullaby ($n = 30$) Mean ± SD | *F*; *p* |
| LATCH Breastfeeding Charting System | 7·27 ± 1·74 | 8·57 ± 1·23* | 7·95 ± 1·45 | 5·736; **< 0·05** |

**Post hoc* advanced analysis result.
Significant values are in bold.

**Table 4** Comparison of groups within groups and between groups in terms of the first and the last measurement of peak heart rate averages

| | Groups | | | |
|---|---|---|---|---|
| PHR | Control ($n$ = 30) Mean ± SD | Pacifier ($n$ = 30) Mean ± SD | Lullaby ($n$ = 30) Mean ± SD | $F$; $p$ |
| First measurement PHR | | | | |
| Before feeding | 137·77 ± 18·02 | 143·53 ± 13·91 | 144·57 ± 14·76 | 1·641; >0·05 |
| During feeding | 142·57 ± 16·66 | 145·00 ± 11·90 | 146·37 ± 15·51 | 0·506; >0·05 |
| After feeding | 138·67 ± 12·23 | 140·63 ± 11·56 | 143·47 ± 12·70 | 1·175; >0·05 |
| $F$; $p$ | 0·779; >0·05 | 0·948; >0·05 | 0·310; >0·05 | |
| Last measurement PHR | | | | |
| Before feeding | 138·62 ± 6·37 | 137·50 ± 10·25 | 136·81 ± 9·19 | 0·244; >0·05 |
| During feeding | 135·67 ± 6·49 | 129·42 ± 7·69* | 130·08 ± 6·86* | 5·247; **<0·05** |
| After feeding | 138·38 ± 5·32 | 135·17 ± 6·57 | 134·96 ± 5·55 | 2·386; >0·05 |
| $F$; $p$ | 1·526; >0·05 | 6·007; **<0·05** | 5·808; **<0·05** | |

First measurement, measurements of first gavage feeding; Last measurement, measurements of last gavage feeding before transition to oral feeding; PHR, peak heart rate.
**Post hoc* advanced analysis result.
Significant values are in bold.

When the averages of oxygen saturation before, during and after the first gavage feeding meals of the control and the experimental groups were compared, it was determined that there was no statistically significant difference between groups and within groups ($p > 0·05$). When the averages of oxygen saturation before, during and after the last gavage feeding meals of the control and the experimental groups were compared, no statistically significant difference between groups was recorded ($F = 0·016$, $F = 2·215$, $F = 1·965$; $p > 0·05$, Table 6).

When the within-group comparisons of the averages of oxygen saturation before the last gavage feeding meals of the control and the experimental groups were compared, once again no statistically significant difference between the oxygen saturation averages of the control group ($F = 2·068$; $p > 0·05$) was found, but there was a statistically significant difference between the averages of the pacifier and lullaby groups ($F = 14·407$, $F = 10·797$; $p < 0·05$, Table 6). According to *post hoc* advanced analysis results, it was determined that the difference between the oxygen saturation averages resulted from the averages during feeding and after feeding in both groups (Table 6).

## Discussion

### Findings related to transition period to the total oral feeding, hospital stay and discharge weight of the premature infants

In premature infants, it is rather difficult to proceed from gavage feeding to oral feeding. During this transition period, these infants may develop conditions such as unwillingness for sucking and oral feeding (Palmer 1993, Pinelli & Symington 2009). Using various stimulating techniques to reinforce premature infants' sucking experiences during gavage feeding ensures the development of oral feeding skills

**Table 5** Comparison of groups within groups and between groups in terms of the first and the last measurement of respiration rate averages

| | Groups | | | |
|---|---|---|---|---|
| Respiration rate | Control ($n$ = 30) Mean ± SD | Pacifier ($n$ = 30) Mean ± SD | Lullaby ($n$ = 30) Mean ± SD | $F$; $p$ |
| First measurement respiration | | | | |
| Before feeding | 49·27 ± 7·32 | 52·40 ± 6·24 | 53·20 ± 7·73 | 2·552; >0·05 |
| During feeding | 50·93 ± 6·29 | 51·20 ± 3·99 | 51·46 ± 3·44 | 0·095; >0·05 |
| After feeding | 51·60 ± 7·30 | 51·73 ± 4·81 | 52·13 ± 5·40 | 0·066; >0·05 |
| $F$; $p$ | 0·886; >0·05 | 0·417; >0·05 | 0·682; >0·05 | |
| Last measurement respiration | | | | |
| Before feeding | 52·19 ± 3·22 | 51·50 ± 4·76 | 50·77 ± 4·90 | 0·604; >0·05 |
| During feeding | 52·38 ± 2·80 | 50·67 ± 6·20 | 51·08 ± 5·58 | 0·662; >0·05 |
| After feeding | 53·71 ± 3·71 | 50·83 ± 4·49 | 51·85 ± 4·30 | 2·683; >0·05 |
| $F$; $p$ | 1·738; >0·05 | 0·172; >0·05 | 0·326; >0·05 | |

**Table 6** Comparison of groups within groups and between groups in terms of the first and the last measurement of oxygen saturation averages

| | Groups | | | |
|---|---|---|---|---|
| $SPO_2$* | Control ($n$ = 30) X ± SD | Pacifier ($n$ = 30) X ± SD | Lullaby ($n$ = 30) X ± SD | $F$; $p$ |
| First measurement $SPO_2$ | | | | |
| Before feeding | 94·13 ± 1·74 | 94·93 ± 1·20 | 94·56 ± 1·17 | 2·481; > 0·05 |
| During feeding | 95·10 ± 2·49 | 95·30 ± 2·29 | 94·97 ± 2·01 | 0·163; > 0·05 |
| After feeding | 95·20 ± 1·75 | 95·17 ± 2·67 | 94·83 ± 2·49 | 0·226; > 0·05 |
| $F$; $p$ | 2·537; > 0·05 | 0·225; > 0·05 | 0·322; > 0·05 | |
| Last measurement $SPO_2$ | | | | |
| Before feeding | 94·38 ± 2·58 | 94·29 ± 2·05 | 94·27 ± 1·97 | 0·016; > 0·05 |
| During feeding† | 95·76 ± 1·67 | 97·04 ± 2·19 | 96·61 ± 2·21 | 2·215; > 0·05 |
| After feeding† | 95·52 ± 2·25 | 96·50 ± 1·25 | 96·00 ± 1·38 | 1·965; > 0·05 |
| $F$; $p$ | 2·068; > 0·05 | 14·407; **< 0·05** | 10·797; **< 0·05** | |

*Oxygen saturation.
†*Post hoc* advanced analysis result.
Significant values are in bold.

(Palmer 1993, McCain 1995, Standley 2003, Bragelien *et al.* 2007).

In this study, it was determined that the premature infants in the pacifier group were the earliest to proceed to total oral feeding, followed by the lullaby group. The longest transition period to oral feeding was in the control group ($p < 0·05$, Table 2). We found that using pacifiers, one of the oral stimulation attempts, during the premature infants' gavage feeding developed the sucking reflex, increased the nutrient suction, reduced the energy consumption, ensured the transition to total oral feeding in an earlier time (Conk & Bolışık 1986, Bingham *et al.* 2003, Efe & Savaşer 2005) and the oral–tactile stimuli generated by pacifiers developed the transition skills from gavage feeding to oral feeding (McCain 1995, Pickler *et al.* 1996, Pinelli & Symington 2009).

In their studies, Pickler *et al.* (1996) and McCain (1992) determined that using pacifiers during gastric feeding of premature neonates made the infants more alert and active; they consumed less energy and they proceeded to total oral feeding earlier. Other studies (Koenig *et al.* 1990, Sehgal *et al.* 1990, DiPietro *et al.* 1994, Gaebler & Hanzlik 1996, Mattes *et al.* 1996, Pickler *et al.* 1996, Fucile *et al.* 2002, Yue *et al.* 2003, Efe & Savaşer 2005, Boiron *et al.* 2007, Bragelien *et al.* 2007, Pinelli & Symington 2009) have shown where pacifiers were used during feeding infants proceeded to total oral feeding in a shorter time than where they were not used.

In their meta-analysis study related to the implementations used in premature infants' feeding, Daley and Kennedy (2000) revealed the conclusion that the oral stimulating methods performed before and during feeding supported the infants' transition to oral feeding. Standley (2003) reported that, as a result of giving pacifiers to neonates along with music, the amount of nutrients that the preterm infants took orally increased and the transition in preterm infants from non-nutritive sucking to nutritive sucking accelerated.

Similar to the findings of the various previous studies on this subject (Conk & Bolışık 1986, Sehgal *et al.* 1990, McCain 1992, Gaebler & Hanzlik 1996, Mattes *et al.* 1996, Pickler *et al.* 1996, Yue *et al.* 2003, Alice 2005, Efe & Savaşer 2005), the use of pacifiers also appeared to reduce the premature infants' transition time to oral feeding in this study. Despite the intensity of the studies supporting the positive effects of using pacifiers on neonatal infants' feeding, there are also studies supporting the idea that using pacifiers in infants who are breastfed can cause some disadvantages, such as sucking unwillingness (Righard & Alade 1997, Schubiger *et al.* 1997, Aarts *et al.* 1999, Dağoğlu 2002, Pinelli & Symington 2009).

In this study, we found that the infants in the lullaby group, who were second fastest to proceed to total oral feeding, achieved this 37·27 hours earlier than those in the control group. Although this period is not statistically significant between groups, it is said to be clinically significant. DesCasper and Carstens (1981) revealed in their study with two-day-old neonates that there is a relationship between music and sucking behaviour and, because of this relationship, sucking behaviour is reinforced and the transition to oral feeding is facilitated.

In the studies analysing the effects of music on premature infants' oral feeding (DesCasper & Carstens 1981, Schunk 1993, Standley 1998a,b, Standley 2002, 2003, Yue *et al.* 2003), use of music was found to reduce the infants' transition periods to oral feeding and to develop their feeding

behaviours. The findings of our research are in accordance with the findings of these previous studies.

The pacifier group in the study stayed in hospital for the shortest time, followed by the lullaby group. The group that stayed in hospital for the longest time was determined to be the control group ($p < 0{\cdot}05$, Table 2). The duration of hospital stay decreased to 153·13 hours in the pacifier group and 25·73 hours in the lullaby group when compared with the control group.

In studies that analysed the effects of pacifier use on the duration of hospital stay of gavage-fed premature infants (Efe & Savaşer 2005, Bragelien *et al.* 2007, Pinelli & Symington 2009), it was reported that the duration of hospital stay of these infants given pacifiers was shorter than that of the infants in the control group. Gaebler and Hanzlik (1996) described in their study where premature infants were given oral stimulus for five minutes before feeding that the duration of hospital stay of these infants also decreased in comparison with the infants in the control group. In studies conducted by Caine (1991), Standley (2002), Coleman *et al.* (1997) and Standley (1998a,b) in which they made the experimental group infants listen to lullabies, it was determined that the experimental group stayed in hospital less time than the infants in the control group. The findings of this research are in accordance with those of previous studies (Caine 1991, Gaebler & Hanzlik 1996, Coleman *et al.* 1997, Standley 1998a,b, 2002, Efe & Savaşer 2005, Bragelien *et al.* 2007, Pinelli & Symington 2009). The body weights of the premature infants in both the control group and the experimental group were measured when they were discharged from the hospital and the body weights of all groups were similar ($p > 0{\cdot}05$, Table 2).

### Findings related to premature infants' sucking success

Sucking success of premature infants in a NICU is one of the criteria commonly used for discharge as it provides infants with regular weight gains (Nyqvist *et al.* 1999). Various external stimuli are used for premature infants during gavage feeding as methods to influence nutritive and non-nutritive sucking success (Palmer 1993, McCain 1995, Pickler *et al.* 1996, Standley 2003, Bragelien *et al.* 2007). We found that the infants in the pacifier group had the highest sucking success in the study ($p < 0{\cdot}05$) and this group was followed by the lullaby group. The sucking success of the infants in the control group was determined to be lower than the infants in both experimental groups.

Use of pacifiers as a stimulating attempt during gastric tube feeding of premature infants was stated to develop the sucking reflex in studies (Conk & Bolışık 1986, Bazyk 1990, Sehgal *et al.* 1990, Gaebler & Hanzlik 1996, Bingham *et al.* 2003).

Boiron *et al.* (2007), Gaebler and Hanzlik (1996) and Bazyk (1990) reported in their studies that non-nutritive sucking attempts (oral stimuli) used for premature infants who were gavage-fed had positive effects on the infants' sucking success. Pinelli and Symington (2009), McCain (1995), Sehgal *et al.* (1990) and Yu and Chen (1999) found that giving pacifiers to premature infants before oral feeding increased their sucking success. In her meta-analysis study on the effects of music therapy on premature infants in 2002, Standley evaluated various research conducted using lullaby and stated that lullabies increased sucking success in premature infants.

In her 2000 study, Standley explored the effect of lullabies sung by a female singer on non-nutritive sucking in premature infants and determined that the amount of nutrient orally taken by the infants increased and the sucking activity was reinforced. In Schunk's (1993) study examining the effect of music on premature infants' feeding behaviours, he found that music developed infants' sucking performance. In a later study by Standley (2003), she gave both lullaby and pacifier stimuli together to premature infants who were gavage-fed but who had baby bottle feeding meal implementation to support their nutritive feeding 15 minutes before their bottle feeding meals. She showed that sucking success of the infants in the experimental group increased more and the nutrient was taken in a shorter time compared to the infants in the control group.

That the use of pacifier was more effective on premature infants' sucking success than listening to lullabies in the study can be thought to result from the fact that sensory receptors are intensive around the mouth, that oral stimuli are more effective than auditory stimuli and that the infants are more sensitive to oral stimuli because they are in their oral period, which is one of the psychosexual development stages.

### Findings related to premature infants' vital signs

There are studies in the literature with different results on the effects of use of pacifiers and different music on premature infants' vital signs in a NICU (Collins & Kuck 1991, Cassidy & Standley 1995, Pickler *et al.* 1996, Coleman *et al.* 1997). It was reported that after birth, a neonatal has a heart beat rate above 170/minute and, once it is stable, it varies between 120–160/minute (Sabancı 2000, Dağoğlu 2002). These values can change during premature infant's sleep and wakefulness. When the premature infants' peak heart rate averages were analysed in the study, they were determined to be between 129–146/minute in experimental and control groups and

averages were found to be within normal limits. Although peak heart rate averages were within normal values in each group, they were observed to marginally increase in the measurements taken at the first feeding meal during feeding, but they did not create a significant difference; by contrast, there was a statistically significant decrease in peak heart rate averages during feeding in both experimental groups in the last measurements.

In their study examining the effect of non-nutritive sucking on premature infants' feeding behaviours and performance, Pickler *et al.* (1996) stated that the infants' heart beat rates increased during feeding. Because feeding organisation is not developed in premature infants, the increase in peak heart rates during feeding is a normal condition (Hill 1992, Standley 2003). In addition, because the premature infants met the stimulus perceived as foreign in their peripheral environment for the first time, both of the methods applied in the first gavage feeding meal (pacifier and lullaby) can be thought not to have created a statistically significant difference in peak heart rate averages.

In addition to the infants' development of feeding organisation by the time of their last gavage feeding, the methods of giving pacifiers and listening to lullabies, which are more familiar to them by this time, can cause a significant decrease within the normal limits in the peak heart rate averages during premature infants' feeding because of their various calming/soothing, stimulating and instructive effects.

Pickler *et al.* (1996) and McCain (1992) determined in their studies that using pacifiers during gastric feeding of premature neonates decreased the heartbeat rate. Efe and Savaşer (2005) found that the heartbeat rate average values in their study group where pacifiers were used were much lower than the ones in the group where pacifiers were not given. In studies conducted by Cassidy and Standley (1995) and Coleman *et al.* (1997), a decrease in the preterm infants' peak heart rate values was observed after the premature infants were made to listen to classical music, lullabies, songs or conversations consisting of male/female voices in NICU. The findings of this study are in accordance with the findings of these previous studies.

Normal respiration rates of the neonates are generally 40–60/minute in the general population. Premature infants' respiration rates are variable depending on the state of sleep and wakefulness, and there can be a tendency to apnoea (Sabancı 2000, Dağoğlu 2002). In this study, there was no statistically significant difference between the respiration rate averages recorded before, during and after feeding in the premature infants' first and last gavage feeding meals, within groups and between groups ($p > 0{\cdot}05$, Table 5). The respiration rate averages of the premature infants in this study were between 49–54/minute in the experimental and control groups and they stayed within normal limits (Table 5).

In studies in the literature examining the effectiveness of the use of pacifiers and implementation of any music therapy in premature infants, parameters such as peak heart rate and oxygen saturation were generally evaluated, but those related to respiration rate remained insufficient. Efe and Savaşer's study (2005) determined that respiration rate average values in the group where pacifiers were used were lower than those of the group where pacifiers were not used.

In this study, distribution of oxygen saturation averages of the experimental and control groups varied between 94–97%. A difference between oxygen saturation averages in the first and last gavage feeding meals of the control and experimental groups could not be specified (Table 6). As in the peak heart rate, because the infant met with pacifiers and lullabies for the first time and these were foreign for his or her peripheral environment during his or her first gavage feeding meal, these interventions can be thought not to have created a variation in the premature infant's oxygen saturation averages. In contrast, the premature infants' oxygen saturation averages during and after feeding of the last gavage feeding meal were observed to significantly increase in both experimental groups ($p < 0{\cdot}05$, Table 6). The pacifier and lullaby stimuli, with their characteristics of soothing/calming, stimulating and instructing the infant, can be thought to have had positive effects on oxygenation.

Pinelli and Symington (2009) and Pickler *et al.* (1996) stated that the use of pacifiers in premature infants was effective in regulating oxygen saturation values. In their study where premature infants listened to lullabies as an auditory stimulus, Moore *et al.* (1994) determined that the infants who listened to lullabies had higher oxygen saturation level than those in the control group. Cassidy and Standley (1995), and Standley (2002) stated in their studies that using music therapy in premature infants increased oxygen saturation level. The findings of this study are in accordance with the findings of previous studies.

## Conclusion

In this study, we determined that the methods of giving pacifiers to premature infants and making them listen to lullabies during gavage feeding reduced the infants' transition period to oral feeding and duration of hospital stay, as well as developing their sucking success.

In the last gavage feeding meal, peak heart rate averages of the pacifier and lullaby groups during feeding were

determined to be statistically lower than those of the control group ($p < 0{\cdot}05$). While there was no difference between groups in terms of oxygen saturation averages ($p > 0{\cdot}05$) in the last gavage feeding meal, oxygen saturation averages of the premature infants of the pacifier and lullaby groups during and after feeding were determined to increase ($p < 0{\cdot}05$). The results show that pacifiers and lullabies have positive effects on the premature infant's vital signs (peak heart rate, oxygen saturation).

## Relevance to clinical practice

Neonatal intensive care nurses can accelerate the premature infants' transition to oral feeding by using the methods of giving pacifiers to the infants and making them listen to lullabies during gavage feeding to develop their sucking success.

## Contributions

Study design: AY, DA; data analysis: AY, DA and manuscript preparation: AY, DA.

## Conflict of interest

None.

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