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Effects of music therapy on the physiological responses of preterm newborns on non-invasive ventilation: a quasi-experimental study

Efeitos da musicoterapia nas respostas fisiológicas dos recém-nascidos pré-termos em ventilação não invasiva: estudo quase-experimental

Efectos de la musicoterapia sobre las respuestas fisiológicas de los recién nacidos prematuros con ventilación no invasiva: estudio cuasiexperimental

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ABSTRACT
Objective: To evaluate the effects of music therapy on the physiological responses of preterm newborns (PTNBs) on non-invasive ventilation. **Method:** A quasi-experimental study, with a single group and of the before-and-after type, conducted with thirty premature infants in a Neonatal Intensive Care Unit. **Results:** As for respiratory frequency (RF), a reduction of up to six breaths per minute was observed (p=<0.001) and, in relation to heart rate (HR), the reduction was up to seven beats per minute (p=<0.002). In oxygen saturation, a 2% (p=0.003) mean increase was identified. Axillary temperature presented a 0.1ºC increase after the intervention (p=0.05). In the pain scale, a one-point reduction (p=0.001) was identified. **Discussion:** Music therapy presents beneficial effects in relation to reductions in RF, HR and pain level, as well as an increase in oxygen saturation and axillary temperature. **Conclusion:** Music therapy interferes positively with the physiological responses of PTNBs on non-invasive ventilation.
DESCRIPTORS: Music Therapy; Preterm Newborn; Vital Signs; Neonatal Nursing; Neonatal Intensive Care Unit.

RESUMO
Objetivo: Avaliar os efeitos da musicoterapia nas respostas fisiológicas do recém-nascido pré-termo (RNPT) em ventilação não invasiva. **Método:** Estudo quase-experimental, de grupo único, do tipo antes e depois, com trinta prematuros, hospitalizados em uma Unidade de Terapia Intensiva Neonatal. **Resultados:** Em relação à frequência respiratória (FR), observou-se redução de até seis incursões por minuto (p=<0,001) e em relação à frequência cardíaca (FC), de até sete batimentos por minuto (p=<0,002). Na saturação de oxigênio, identificou-se o aumento em média de 2% (p=0,003). A temperatura axilar apresentou aumento de 0,1ºC após a intervenção (p=0,05). Na escala de dor, identificou-se uma redução de um ponto (p=0,001). **Discussão:** A musicoterapia apresenta efeitos benéficos em relação a redução da FR, da FC e do nível de dor, bem como, aumento da saturação de oxigênio e da temperatura axilar. **Conclusão:** A musicoterapia interfere positivamente nas respostas fisiológicas do RNPT em ventilação não invasiva.
DESCRITORES: Musicoterapia; Recém-nascido Pré-termo; Sinais Vitais; Enfermagem Neonatal; Unidade de Terapia Intensiva Neonatal.

RESUMEN
Objetivo: Evaluar los efectos de la musicoterapia sobre las respuestas fisiológicas de los recién nacidos prematuros (RNP) con ventilación no invasiva. **Método:** Estudio cuasiexperimental, de un solo grupo, del tipo antes y después, con treinta prematuros, hospitalizados en una Unidad de Terapia Intensiva Neonatal. **Resultados:** Se observó una reducción de la frecuencia respiratoria (FR) de hasta seis respiraciones por minuto (p=<0,001) y de la frecuencia cardíaca (FC) de hasta siete latidos por minuto (p=<0,002). Se detectó un aumento del 2% (p=0,003) en la saturación de oxígeno. La temperatura axilar aumentó 0,1ºC tras la intervención (p=0,05). Se identificó la reducción de un punto (p=0,001) en la escala de dolor. **Discusión:** La musicoterapia tiene efectos beneficiosos en cuanto a la reducción de la FR, FC y el nivel de dolor, así como también, un aumento de la saturación de oxígeno y temperatura axilar. **Conclusión:** La musicoterapia interfiere positivamente en las respuestas fisiológicas del RNP con ventilación no invasiva.
DESCRIPTORES: Musicoterapia; Recién Nacido Prematuro; Signos Vitales; Enfermería Neonatal; Unidad de Terapia Intensiva Neonatal.

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INTRODUCTION

Music therapy is a tool developed by the use of music and its elements, with the objective of promoting therapeutic benefits and purposes. In the hospital setting, it works as a complementary therapy, helping to reduce the impact caused by hospitalization[1].

Using music therapy as an integrative and complementary practice is a care strategy that accumulates scientific evidence of its effectiveness in managing pain, anxiety and emotional stress[2,3]. By considering the beneficial effects of music therapy aiming to improve the care provided to the patient, the Ministry of Health, by issuance of Ministerial Ordinance GM No. 849 of March 27th, 2017, defines music therapy as the new institutionalized practice for the National Policy of Complementary and Integrative practices in the Unified Health System (*Sistema Único de Saúde*, SUS)[4].

Currently, the use of complementary methods of care provided in Neonatal Units is discussed, given that prematurity is a public health problem that requires high-risk and quality perinatal care, with capable professionals, thus generating high economic and social costs[4].

During the hospital stay, preterm newborns (PTNBs) are frequently exposed to situations that can provoke moments of stress, increase in pain levels, and physiological changes[6].

The brain of the newborn, and even that of the fetus, has basic capabilities for music processing. The auditory system begins its function from the twenty-fourth gestational week, and still intrauterine infants experience and react to a variety of external sounds, including the mother's voice and environment music. Therefore, regardless of the gestational age at birth, music can help to improve some unwanted effects generated from the hospitalization of PTNBs[7].

That said, music therapy minimizes the adverse consequences of hospitalization and prematurity in the short- and long-term, presenting itself as a safe and adverse effect-free intervention proposal that can become routine in Neonatal Units, increasing the quality of care provided to newborns and their families[2,8,9,10,11].

Given the benefits presented and considering that the articles only cover the use of music therapy on clinically stable infants or on those subjected to painful procedures, the following question arises: What are the physiological effects of music therapy on PTNBs on non-invasive ventilation (NIV)? Thus, the objective of this study was to evaluate the effects of music therapy on the physiological responses of PTNBs on NIV.

METHOD

A quasi-experimental study, of the before-and-after type and with a single group. A total of 30 premature infants participated in the study, recruited by means of convenience sampling, and admitted to a Neonatal Unit of a university hospital located in the Brazilian South region.

This Neonatal Unit has 24 beds, distributed as follows: 10 for the Neonatal Intensive Care Unit (NICU), 10 for the Intermediate Care Unit (InCU), and 4 for the Kangaroo Unit. This is high-risk pregnancy hospital that is a

reference for newborn care, and which does not have in its routine any protocol for applying music therapy in its units.

Recruitment of the participants was conducted by the lead researcher by establishing criteria. The inclusion criteria adopted were newborns (NBs) with a gestational age from less than 37 weeks, who were in a heated incubator, with non-invasive ventilation (NIV), on the CPAP (Continuous Positive Airway Pressure) mode, and with FiO2 below 60%. The following NBs were excluded: malformed NBs, those with a chest tube, those subjected to surgical procedures, those who had received sedation in the last six hours and those on CPAP for less than 24 hours, as well NBs who, at the time of the intervention, had an axillary temperature (AT) below 36.5ºC or over 37.5ºC, and a respiratory frequency (RF) below 50 breaths per minute.

Data collection took place between November 2018 and April 2019. The period chosen for collection was the night shift, which, after observation in the aforementioned unit, presents lower flux of professionals in the setting and, consequently, less interference.

The variables identified in this study were the following: heart rate (HR), RF, AT, oxygen saturation (Sat O2), and the Neonatal Infant Pain Scale (NIPS).

The Neonatal Infant Pain Scale has six pain indicators, assessed from zero to two points. This is a fast assessment scale that can be used in full-term and preterm newborns, with a score above 3 points being considered as pain[12].

The analysis of the HR, RF, and Sat O2 variables occurred at five different moments. It was decided to measure AT and to apply the pain scale only at two moments to avoid handling the NB during the intervention.

To this end, before the music intervention was initiated, verifications of HR, RF, Sat O2, AT, and of the NIPS pain scale were conducted, mentioned as "BEFORE"; subsequently, the NB was maintained for a period of 30 minutes without being handled.

After this moment, the following variables were again verified: HR, RF, and Sat O2 (TIME 0). Immediately after that, the music therapy session was initiated, lasting 20 minutes. During the session, the variables were verified at two different moments, namely: 1) ten minutes after the music began (TIME 1) and 2) when the music ended (TIME 2). After 30 minutes have elapsed from the end of the session, the HR, RF, AT, Sat O2 variables and NIPS pain scale were verified, mentioned as "AFTER".

The HR and Sat 02 variables were measured by means of an oximetry sensor, viewed on the multi-parametric monitor. The AT variable was verified by means of a digital thermometer. RF verification occurred by observation and counting of the breaths, during a minute, by the nurse practitioner responsible for the infant's care, unaware of the study objective and under supervision of the researcher. Annotation of the values of the observed variables and the pain scale score was in charge of the researcher.

For the musical intervention, a DVD without image transmission was used, connected to an earphone and with instrumental music

developed by a musician for using it specifically with hospitalized newborns, which was repeatedly played. The music was validated by a music therapist who approved its sonority for use in this study. The music was played for 20 minutes, using earphones that were within the incubator, but with no contact with the auricular region of the NBs, in order not to provoke any tactile stimulus. The music was tested regarding the decibel (dB) level before the intervention began, by means of an app for such purpose, so that the sound would not exceed 60 dB during the entire application.

Application of the music therapy was in charge of the same researcher according to the control standards, in order to ensure data reliability. During the music therapy session, the PTNBs did not receive any type of stimulus or intervention other than the music.

The data were described and analyzed by means of the *Statistical Package for the Social Sciences* (SPSS) program. The variables were subjected to Shapiro-Wilk's normality test and, after the results, they were separated into two groups for analysis. The paired t test was used for the AT variable, as this is a parametric variable; and Friedman's test was employed for the non-parametric variables (NIPS pain scale, RF, HR, and Sat 02). The Wilcoxon test compared the mean of the values obtained at each verified time, relating them to the first verification of the variables, which was determined as control.

This study was approved by the Ethics Committee for Research involving Human Beings of the UEL, under opinion No.: 1,912,197 and CAAE: 64203816.4.0000.5231, emphasizing that only the newborns whose parents authorized their participation by signing the Free and Informed Consent Form (FICF) participated in the study.

RESULTS

The descriptive variables of the characteristics of the 30 PTNBs who composed the sample were described in Table 1**.**

Table 1 – Characteristics of the preterm newborns on NIV subjected to the musical intervention.

Variables	**N (30)**
Male gender**	17 (56.6%)
Gestational age at birth (weeks)*	29.10±2.987
Chronological age (days)*	17.63±18.810
Corrected age (weeks)*	31.6±1.886
Birth weight (grams)*	1,366.0±686.893
Current weight (grams)*	1,471.3±582.602
First minute Apgar*	5.57±2.763
Fifth minute Apgar*	7.77±2.029

*Variable described in mean±standard deviation; **Variable described in frequency.

All the participants were on CPAP with a nasal cannula, maintaining oxygen inspiratory fraction (Fi02) between 21% and 40% and positive end-expiratory pressure (PEEP) between five and seven, before the intervention.

Regarding the effects of music therapy in

relation to the HR, RF and oxygen saturation variables, benefits were observed (Table 2). When considering the first variable as control, it can be seen that the mean reduction in RF was four breaths per minute (brpm) in the first ten minutes of music playback (p=0.001), and six brpm at the end of the 20-minute intervention (p=<0.001). As for HR, the mean reductions verified were as follows: four beats per minute (bpm) in the first 10 minutes of music therapy (p=0.017), five bpm at the end of the intervention (p=<0.001), and seven bpm after the intervention (p=0.002). Considering Sat 02, a mean increase of 2% was identified after the ten minutes of intervention (p=0.003) and it remained stable until the final verification.

Table 2 – Mean of the variations in respiratory frequency, heart rate and oxygen saturation in relation to the time of the music therapy intervention. Londrina – PR, 2018-2019.

	Before	**Time 0***		**Time 1****		**Time 2*****		**After******	
Variables	**SD**	**SD**	**p-value**	**SD**	**p-value**	**SD**	**p-value**	**SD**	**p-value**
Respiratory frequency	58±8.1	58±8.5	0.773	54±8.8	0.001	52±8.2	0.001	53±8.0	0.003
Heart rate	156±15	156±14.5	0.354	152±12.5	0.017	151±12.8	0.001	149±14.3	0.002
Oxigen saturation	95±3.0	96±3.0	0.566	97±2.0	0.003	97±1.9	0.002	97±2.2	0.004

Values expressed in mean±standard deviation; SD: Standard Deviation; *Start of music playback; **Ten minutes of intervention; ***Twenty minutes of intervention; ****Thirty minutes after the intervention.

Regarding the AT and NIPS pain scale variables (Table 3), considering a 95% Confidence Interval (CI), an increase of 0.1ºC was observed, from 36.7ºC before the intervention to 36.8ºC after its implementation (p=0.05; standard deviation=0.13). In relation to the verification of the pain scale, before and after the intervention, there was a one-point reduction, going from the mild pain classification to no pain (p=0.001; standard deviation=0.8).

Table 3 – Comparison of the mean variation of the NIPS pain scale and axillary temperature before and after the intervention. Londrina – PR, 2018-2019.

Variables	**Before**	**After**	**p-value**
Axillary temperature	36.72±0.13	36.80±0.280	0.05
NIPS pain scale	1.00±0.8	0.60±0.855	0.001

Values expressed in mean±standard deviation

DISCUSSION

This study had the objective of assessing the effects of music therapy on the physiological responses of PTNBs on non-invasive mechanical ventilation in the CPAP modality. No similar article was found in the literature that evidenced the interaction of music with non-invasive ventilation, indicating the need for further studies on the theme.

Music therapy is observed to present beneficial effects on the vital signs of PTNBs. Results that are similar to those presented in several studies, but that do not address patients on NIV. The main results evidenced are reductions in respiratory frequency[8,13] and in heart rate[14].

When considering oxygen saturation, however, the results differ from those presented in other articles that did not reach statistical significance in the increase of this variable[8,13,14].

In relation to body temperature, in this study, it can be observed that there was statistical significance associated with the musical intervention, which differs from another study that also assessed the effects of music therapy on the physiological responses of preterm newborns hospitalized with spontaneous breathing, not finding statistical significance in this variable[15].

In this study, the use of music therapy presented a reduction in the pain scale, a result that differs from a clinical trial that used music therapy as an intervention at the moment of arterial puncture for exam collection, aiming at relieving pain. The aforementioned trial, observed by means of the Neonatal Facial Coding System (NFCS), evidenced that the use of music and of glucose at 25%, at the moments after exam collection, did not present statistical difference in pain reduction[16].

Another point to be considered is that the means of the variables presented remained better after thirty minutes of music application in relation to the verification considered as control, which suggests an effect after the end of the intervention; in dissonance with the conclusion of another article which indicates that the effects of music in relation to the reduction of bradycardia, apneas and oxygen desaturations on stable NBs were not clinically relevant after the end of the music[17].

In this study, instrumental music was chosen, recorded for the neonatal unit, and resembling classical music. A bibliographical review evidenced that, whether by means of lullabies, or recorded or passive compositions, the application of music therapy has beneficial effects on the physiological and psychological parameters of the PTNBs, proving that most of the infants respond positively during and after the musical intervention, regulating the physiological levels that were altered, aiming to reach normal values, by reducing HR and RF and increasing Sat 02. In addition to this, an improvement in well-being was verified, through the observation of the psychological responses, such as reduced crying and increased sleep[18].

CONCLUSION

This study evaluated the effects of music therapy on the physiological responses of preterm newborns on non-invasive ventilation. There was a positive effect in relation to the

reduction in respiratory frequency, heart rate, and pain level, as well as improved oxygen saturation at the first moment, remaining stable, and an increase in axillary temperature during and after the musical intervention.

Although this study did not use a control group and, despite not being a randomized clinical trial, the results point to the beneficial effects of music therapy in Neonatal Units and contributes to fill the gap on the theme associated with preterm newborns. Considering the fact that this is a relevant and important theme for the care of PTNBs, it has a small sample size, further studies being necessary that evaluate the use of music therapy and the physiological changes related to the vital signs in PTNBs in various mechanic ventilation modalities.

Music therapy is recommended because it is a low-cost method and of feasible implementation in the routine of Neonatal Units. To this end, the need for a team capable of including music as a therapy tool arises, aiming to improve the quality of the care offered to PTNBs.

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