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Research Article

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The Benefits of Music Therapy on Preterm Infants in the Intensive Care Unit

Kayene A. Leivas[1]*, Laís Z. Ramos[1], Giulia C. Piperno[1], Ana F. J. Alves[1], Cíntia Kawata[1], Henrique A. C. Sabino[2], and Beatriz C. Molinari[3]

[1]Medical student, UNISALESIANO - Centro Universitário Católico Salesiano Auxilium, Araçatuba, SP, Brazil

[2,3]Centro Universitário Católico Salesiano Auxilium, Araçatuba, Brazil

***Corresponding Author:**
Kayene A. Leivas, Medical student, UNISALESIANO - Centro Universitário Católico Salesiano Auxilium, Araçatuba, SP, Brazil. kaaleivas@outlook.com

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Abstract

This clinical study seeks to demonstrate the benefits that music therapy can provide, by the analysis of heart rate, respiratory rate, peripheral oxygen saturation and the Neonatal Facial Coding System pain scale on preterm neonates hospitalized in the neonatal intensive care unit, where they are exposed to factors which are stressful and harmful to their health. During the period between March and September 2022, each hospitalized PT neonate was submitted to a single 20 minutes music therapy session with non-classical instrumental music without voice. A total of 17 preterm neonates were included in the analysis of this study. The data collected demonstrated that music therapy was beneficial in stabilizing vital signs with an average reduction in heart rate of 12 beats per minute during the therapy (p = 0.012). Conclusion: Music therapy is capable of stabilizing vital signs such as heart rate in a single session and reducing the stress of the neonate.

Keywords: Complementary Therapies, Music Therapy, Infant, Premature, Intensive Care Units, Pediatric.

Introduction

Birth is a unique process, although it is also challenging and traumatic for the neonate and the family that welcomes the baby [1]. From this event, the physiological development requires a linear process and can be influenced by various factors, such as prematurity, inadequate nutrition and others [2]. Preterm neonate (PTN) is defined as a baby that is born with a GA lower than 37 weeks [3]. Beyond the traumatic birth experience, there are also stress factors during the period of hospitalization in the Neonatal Intensive Care Unit (NICU), such as noise pollution caused by life support equipment, alarms and circulation of people. For this reason, this environment with excessive noise stimulation is taken as prejudicial to PTN recovery [3- 4].

We can define Music Therapy (MT) as the study of sound with the aim of the therapeutic effects of relaxation and significant changes in the metabolism of the individual [5]. MT shows noteworthy efficacy on the neurological and physiological development of the neonate, helping, for example, to decrease stress factors, in addition to reducing feelings of fear and anxiety [6-9].

Furthermore, music is an extensive neuropsychological representation since it unifies several areas of the brain in order to process the sound more quickly, distinguishing brain regions stimulated by the sound heard [10]. In this way, it is capable of stimulating brain regions that control vital signs, that are sources of relevant information about the physical and mental state of the patient, such as the sympathetic and parasympathetic autonomic nervous systems, as shown in figure 1 [7- 11].

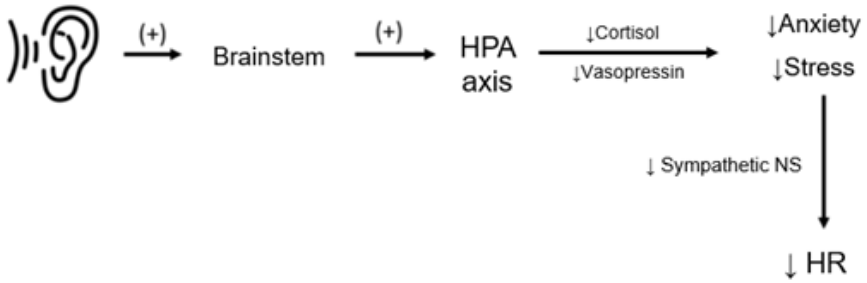

Figure 1: Diagram of the physiology of hearing and its integration with other systems, emphasizing the cardiovascular system. (+): stimulation, HPA axis: hypothalamic-pituitary-adrenal axis, HR: heart rate

This article aimed to follow neonates hospitalized in a neonatal intensive therapy unit, exposing them to music therapy and analysing the effects on heart rate, respiratory rate, oxygen saturation and the Neonatal Facial Coding System (NFCS) pain scale.

Method

Design

An analytical, unmasked, prospective unicentric quantitative experimental study using a controlled and self-pairing approach was carried out in the field. This research was carried out with the approval of the Ethics Committee of the Catholic Salesiano Auxilium University Center – Uni SALESIANO, registered under the number 5.233.822.

The research was conducted at the Unimed Hospital of Araçatuba, SP, Brazil, a private institution, with the authorisation of the institution.

Research Participants

Research participants were new-born with GA (Gestational Age) between 27 weeks and 36 weeks and 6 days of both sexes, hospitalized in the NICU and with the consent of parents via a previously signed IC (Informed Consent). Additionally, these participants needed to have been free of interventions such as hearing tests, medication, and collection of samples, feeding or physiotherapy, for at least 20 minutes before the introduction of music therapy.

New-born's in the NICU with GA less than 27 weeks and greater or equal to 37 weeks were excluded from the research, along with infant who presented with a history of epilepsy, or who had previous exposure to music therapy, those without parental consent for the research and those preterm neonates who had experienced any of the interventions named above within 20 minutes of the music therapy.

Process

The data collection process was with visits to the NICU, once for each research participant, with an average time of 20 minutes, performed in the afternoon. The same loudspeaker was used with the same non-classical instrumental music without voice (the music used was "Instrumental Worship God´s Glory" – William Augusto) with a pre-established volume not exceeding 70 dB on the decibel meter [1-8]. In addition, data of physiological measurements (being: heart rise (HR), respiratory rate (RR) and peripheral oxygen saturation (SpO2) from new-borns were collected from external participants´ monitors, and the validated scale for the evaluation of pain in the neonate, the NFCS [12].

During the MT, the loudspeaker was positioned above the incubator and data was collected before the beginning of the session and immediately before the end of the session by photographs of the external monitors of participants. To control false negatives and to exclude the possibility of participants who presented with auditory changes, an interview was conducted with their parents, by telephone contact, when the hearing tests had been done, so that only new-born's without auditory changes were included.

Statistical analysis

All data analysis was performed using the Jamovi application, version 4.3 for Windows, and the Shapiro-Wilk Test was used to test for the normal distribution of the data and was followed by a Student T-test. P values of $p \leq 0.05$ were accepted as being statistically significant.

Results

A total of 17 MT sessions were performed, between the months of March and September 2022.

Table 1 describes the demographic characteristics of the research. Of the research participants, 58.8% were male. The PTN were classified by GA groups, with the more frequent ones being: very preterm (33.3%) and late preterm (33.3%).

Table 1: Characteristics of neonates who participated in music therapy sessions carried out during the period from March to September 2022 in the neonatal intensive care unit of the Unimed hospital of Araçatuba, SP, Brazil

Characteristic		Número	Total	%
Sex	Female	7	17	41.2%
	Male	10	17	58.8%
Baby hearing screen test	No change	15	17	88.2%
	Deaths	2	17	11.8%
GA classification	Extreme preterm	1	15	6.7%
	Very preterm	5	15	33.3%
	Moderate	4	15	26.7%
	Late	5	15	33.3%

Gap gestational age, extreme pre-term, gap < 28 weeks, very preterm: gap between 28 and 32, moderate, gap between 32 and 34, late, gap between 34 and 37 weeks. [3].

In table 2 the vital sign parameters before and after the intervention with MT were compared. It was observed that the alteration in HR presented a significative decrease (p=0.012), while the other parameters (RR, Sp02 and NFCS) did not show statistical significance (p>0.05).

Table 2: Variation and standard deviation between the vital signs of the neonates hospitalised before and after music therapy sessions carried out during the period from March to September 2022 in the neonatal intensive care unit of the Unimed hospital of Araçatuba, SP, Brazil.

Paired Samples T-Test			
		SD	p
Initial – HR	Final - HR	16.0	0.012
Initial – RR	Final - RR	16.0	0.257
Inítial - SaO_2	Final - SaO_2	15.0	0.110
Inítial - NFCS	Final - NFCS	16.0	0.188

SD: standard deviation, HR: heart rate, RR: respiratory rate, SaO_2: peripheral oxygen saturation, NFCS: neonatal facial coding system

Figure 2 shows vital parameters studied before and after MT. It was noted in part a, referring to HR, that the variation at the lower whisker was from 111 to 93 bpm, the variation at the upper whisker was from 175 to 170 bpm, and the median variation was from 147 to 135 bpm (p=0.012). Part b, which refers to RR, shows that variation at the lower whisker was from 23 to 26 ipm, the variation at the upper whisker was from 84 to 63 imp with a median variation from 44 to 40 ipm. Furthermore, it is shown in part c, which depicts the NFCS scores, that the maximum variation was from 2 to 1 point and there was no variation on the lower whisker, and the median variation was maintained at 0 points before and after MT. Finally, in part d, depicting Sp02, the lower whisker variation obtained was from 93% to 92%, with a median variation from 96.5% to 98.5%, with no alteration in the upper whisker value (maintained at 100%).

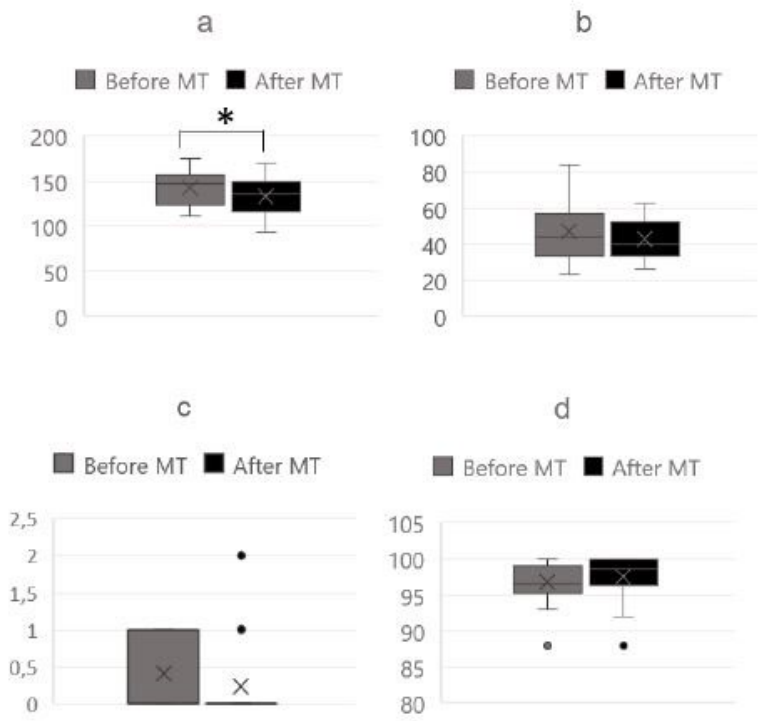

Figure 2: Comparison of the heart rate in bpm (a), respiratory rate in ipm (b) NFCS (c) and peripheral oxygen saturation as a % (d) shown before and after music therapy in preterm neonates in the neonatal intensive care unit in Araçatuba-SP, 2022 ($p < 0.05$).

Discussion

This study investigated the effects of MT on physiological stability in preterm neonates hospitalized in the NICU. It was demonstrated that MT was beneficial in stabilizing vital signs, with an average reduction in HR of 12 bpm during the therapy. This alteration was expected due to the effect that music produces in the brain of an individual, lowering the levels of cortisol and modulating brain structures such as the amygdala and the mesolimbic system, responsible for emotions and motivational processes, changing HR and Blood Pressure (BP) as a consequence [7-13].

Several studies confirm that MT, in addition to inducing changes in affective responses, causes inhibition of the sympathetic nervous system and stimulation of the parasympathetic nervous system, triggering reductions in BP, HR and RR [14]. These physiological effects are directly linked to the activity of the hypothalamic-pituitary-adrenal axis. The activation of this axis causes the hormonal release of vasopressin and cortisol, hormones which are directly related to HR, respiratory rhythm and to the effects of stress and anxiety [7, 10, 15, - 16].

Given that pain is a vital sign, it can also be influenced by the stress factors present in a NICU such as screening tests, medications, collection of samples, feeding and physiotherapy. The process of nociception starts from the 6th week of gestation and is complemented by the process of myelinisation of nerve fibres from the 2nd trimester. Therefore, it is understood that pain is felt by the foetus during this period independently of the myelinisation of its nerve fibres. Furthermore, the descending inhibitory systems which function as an endogenous analgesic system are still immature at birth [13-17].

Although this perception can be demonstrated by NFCS, with an expectation of a significant change in the scores, in this study no statistically significant changes were found. There is a lack of articles in the literature for comparison between MT and NFCS.The music in this study was used to reduce external noises, and in this way reduce the factors of stress and anxiety, leading to a greater stability of the vital signs. The sound used in this study had a rhythm that was slow and regular: a characteristic which shows the best indication for reducing vital signs, such as HR, given that the MT session had the objective of stabilising vital signs. Additionally, the volume of the noise was indicated to influence autonomic cardiac regulation [7, 11-14].

It is worth noting that music therapy without the voice has the same impact on the patient´s vital signs as other methods of MT, such as lullabies, conversations between parents and children, live music and the combination of other methods that stimulate the connection between parents and neonates. Among the methods of MT explored in other studies, it has been demonstrated that principally the HR shows changes under this adjuvant therapy [6, 15, 18–20]. It is therefore understood that MT is an alternative therapy with significant results and that has the ability to benefit patients in the NICU.in conclusion, this study demonstrated that music therapy showed a beneficial effect on vital signs. In the light of emerging new proposals that help the well-being of hospitalised patients, music therapy has an important benefit for this change and demon-

strates that its implementation can be conducted and encouraged.

Statements and Declarations

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Competing Interests

The authors have no relevant financial or non-financial interests to disclose.

Author Contributions

All authors contributed to the study concept and design. Material preparation, data collection and analysis were performed by Ana Flávia Alves de Jesus, Cíntia Kawata, Giulia Caroline Piperno, Kayene Alcântara Leivas e Laís Zanchetta Ramos. The first draft of the manuscript was written by Laís Zanchetta Ramos and Kayene Alcântara Leivas and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript. The authors Beatriz Carmona Molinari and Henrique Sabino were responsible for supervision this article.

Ethics Approval

This study was performed in line with the principles of Concelho Nacional de Saúde (CNS) 466/2012 e 510/2016. Approval was granted by the Ethics Committee of the Centro Universitário Católico Salesiano Auxilium – Uni SALESIANO, by the number 5.233.822 (02/09/2022), CAAE 53742921.3.0000.5379.

Consent to Participate

Written informed consent was obtained from the parents.

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