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Music Therapy in the PICU: 0- to 6-Month-Old Babies

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Abstract

This article describes a live-music therapy intervention on the heart rate, oxygen saturation, and respiratory rate of infants in a pediatric intensive care unit. The infants in this study were hospitalized in a large teaching hospital in Madrid, Spain, where they were born in high-risk circumstances. This study highlights the importance of considering musical elements in the infant-adult interaction, using live music as a semiotic mediator in this interaction. In a random sample of 100 interventions with 0- to 6-month-old infants, data for heart rate and oxygen saturation were collected during six different periods: before, during, and after an interaction with live music and before, during, and after an interaction without live music. The music sessions included a keyboard and guitar as the main sources of harmonic support.

Keywords

arousal, emotion, music, stress, valence

Studies of the early development of children in high-risk situations indicate that the vulnerability of children during hospitalization is often dependant upon developmental level and circumstance of hospitalization . The length of the average ICU stay varies according to the type of unit: Oncology, transplant, pediatrics, and dialysis tend to require longer stays than other ICU settings. There are studies showing that children with chronic illnesses or many hospitalizations are able to better overcome these developmentally high-risk situations if they are provided adequate supports inside and outside of the hospital (Aldridge, 2003; Kallay, 1997).

To counteract the effects of hospitalization, musical experiences can be incorporated into the newborns' lives, providing an aesthetic component that normalizes and gives coherence to their new situation (Nöcker-Ribaupierre, 2004). Listening to music, the newborn is exposed to a coherent and organized multimodal stimulation involving both the senses and the emotions.

The current study included 0- to 6-month-old infants hospitalized in a large urban hospital in Madrid, where 29% of the hospitalized children are in the pediatric intensive care unit (PICU). These babies often have inadequate development because the circumstances of their treatment might not allow for the necessary exploration of their bodies nor adequate interaction with adults and the surrounding environment. According to Rodríguez and Moro (2008) and Rodríguez (2006), the triad interaction (baby-object-adult) that composes the construction of the human psyche may be affected in these circumstances. Although these considerations do not pose an immediate threat to the baby's survival, they could represent a risk for the baby's psychological development, becoming a risk for cognitive growth in general. Hospitalized newborns are highly sensitive to the stimuli to which they are exposed, including hospital lights, which are constantly illuminated in the neonatal intensive care unit (NICU) and PICU, as well as acoustic contamination caused by monitors and alarms. All of these factors have a negative influence on the development of hospitalized children, as they can prevent rest. Even when the unit staff understands such risks implied by these environmental exposures and seeks to mollify these risks by dimming the unit lights at night and lowering the volume of monitors and alarms, these measures seem to be insufficient.

Tomasello (1999), a developmental psychologist, describes how the frequency of children's responses to a stimulus increases when that stimulus is of a reciprocal quality to the child's behavior. The field of music therapy awards much importance to this fact, as the base of music therapy's methodology and interventions is in observing the rhythmic

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behaviors of the children and using those observations to determine the tempo and rhythm of the music used for the therapeutic session. The music is a necessary medium in the adult-infant and infant-environment interaction. The music therapist is a specialist who adapts musical elements to the newborn's circumstances through observations of the infant's first actions and/or musical interactions (rhythm, melody, intensity, tempo). Through active musical improvisation, the music therapist offers a meaningful communicative channel for the infant, before the infant's language acquisition. The newborn's communicative expressions contain musical elements that the adult receives and then often returns in an organized and coherent way. Music therapy potentiates the construction of significance previous to other semiotic interactions between child and adult (Rodríguez, 2007; Vygotsky, 1934). The therapeutic advantages of these interactions in hospitalized children come from the improved conditions for infant development due to a more organized environment. Piaget (1936/2006) has shown how the development of intelligence is connected to a person's biology and his or her actions with respect to the context (p. 21). However, what happens when the person's environment constitutes high-risk circumstances? What the baby is building in these circumstances does not follow normal or typical development, so the music therapist intervenes to prevent possible alterations in development. The therapist does not forget that the baby needs the adult physically and emotionally. Attachment is a unique and exclusive relationship with each person (Brazelton, 1993) that has implications for infant development. Environmental and ecological factors are also crucial for good development. The mechanisms that the infant constructs, in the case of hospitalization, do not conform to normal or typical infant development, requiring intervention to prevent developmental irregularities.

Newborns' responses are fundamentally rhythmic, musical, and acoustic, taking place in every stage of activation—profound sleep, somnolence, alertness, calm, and crying (Papôusek, 1996). All babies have such tools to express themselves according to the level of stimulus they receive. Senses are functional at the moment of birth. Some senses, like the sense of sight, require more time to fully develop. Other senses, like the sense of hearing, are functional even before birth (Rubel, 1984; Tomatis, 1996). Trevarthen (1997) states that music, in contrast to language, cultivates a wide range of expressive behavior. The observations of the respiratory rate during profound sleep and somnolence, the infant's corporal movements and actions, his or her rhythmic play with the adult and with objects, and the tone and intensity of the cry are all elements that are reflected in the music therapist's intervention as the therapist returns an acoustic, coherent, organized space to the infant in accordance with the infant's circumstances.

Upon entering an intensive care unit, there are many things that call one's attention. There are different smells, sounds, and textures, and above all, there is acoustic contamination, which negatively influences the well-being of hospitalized children. PICUs are a recent phenomenon in Spain. Only since the 1970s has the PICU begun to work in a generalized fashion in Spain (Ruza, 2003). Today, the PICU is an essential element in the workings of a hospital, providing specialized care to critically ill infants.

Studies analyzing infants' behaviors in the PICU denote how babies spend the majority of their time sleeping, either in a coma or under the effects of tranquilizing medications. After waking up, these infants are observed to develop a neutral and indifferent affect, highly atypical for healthy infants in any other circumstance. Most of the babies remain quiet, without any kind of adult interaction. Ruza (2003) describes the ''adaptive disruption with depression'' that affects 15% of all infants during their stay in the intensive care unit and that appears when children of any age remain in the PICU for longer than 1 week. Additionally, there is the so-called reactive attachment disorder, which affects 50% of infants younger than 8 months old who are admitted to the intensive care unit (Ruza, 2003). The fundamental symptoms are excessive sleepiness, lack of interest in the environment, hypomotility, and a poor feeding response, all of which tend to resolve completely once the infants return to their homes. Regression is more marked, however, in infants with developmental difficulties who tend to temporarily lose skills and behavioral patterns that may have been more strenuously acquired through early educational interventions.

Among the objectives of the infant's stay in the NICU or PICU are (a) creating space compatible with the infant's psychological and emotional development, (b) encouraging infant-adult interaction with the most favorable communicative conditions, and (c) promoting the family's emotional balance, allowing parents to maximally share the infant's experience of hospitalization. Music therapy provides a noninvasive way to achieve these objectives, promoting infant-adult communication and creating an aesthetic space where that which is beautiful is also useful as it transforms into a therapeutic element (Nöcker-Ribaupierre, 2004; Standley, 2002).

This study took place in the PICU of a university hospital in Madrid—a tertiary care center attending to critically ill children of all ages beyond the newborn period. A random sample of 100 hospitalized infant responses from babies 0- to 6-months-old were investigated for 15 months and involved the participation of 87 infants. The percentage of infants younger than 6 months was 29% of all those hospitalized in the PICU during the study.

The predominant pathologies of this age group were bronchiolitis (38.98%), surgical and nonsurgical cardiological pathologies (13.56%), solid organ transplant (1.69%), and other pathologies (45.76%). The study period was determined with consideration to the seasonal patterns of bronchiolitis, a pathology that tends to disappear during spring and summer.

The 0- to 6-month age group of infants admitted to the PICU was chosen because of the high-risk nature of hospitalizations during this stage of development, during which physical growth, maturity, competency acquisition, and psychological development are factors used to determine whether an infant is developing normally. During this stage of infancy, a child does not yet plan his or her behavior and requires an adult for psychological

development, justification for our inclusion of an adult presence during PICU visits during our study. The alterations of these factors have qualitative repercussions in the infant's development. All developmental systems are interconnected—gross motor, fine motor, sociocognitive, and emotional—and influence the function of the others. We have consequently considered it important to choose to study this period of childhood development, in which the human being is absolutely dependent and vulnerable to physical, environmental, psychological, and emotional circumstances.

A random sample of 100 patients was chosen and subsequent interventions carried out, consecutively selecting infants fulfilling the study requisites (admitted to the PICU during the study time period) and with parental consent. In those interventions that were repeated, the time between two sessions was always greater than 48 hours in order to exclude the phenomenon of habit formation. Del Olmo, Tarrío, Carrasco, and Rodríguez (2008) conducted a pilot study of 50 patients in which their heart rates reflected an average of ± 7 points ($SD = 14$) with and without musical intervention. With only 50 cases, these findings with respect to heart rate had statistical significance; for respiratory rate, however, no significant differences were found, suggesting that a sample size of 100 patients would permit power of 80% to detect a difference in the means of 3.2 points, assuming a standard deviation of the differences of 11.33 using a paired t test with a significance level of .05.

Descriptive statistics of the continuous variables of the six different moments studied, including number of participants, means, and standard deviations, are presented. For the categorical data, we present the frequency distribution (absolute and relative). Furthermore, if needed, the confidence intervals of 95% are calculated. We analyzed the evolution of the quantitative parameters of heart rate, respiratory rate, and oxygen saturation during the six studied moments between the two groups: With the experimental group, music was used in the intervention; with the control group, music was not used. A variance analysis of two factors of repeated intrasubject measures was used: (a) presence of music (*without* or *with*) and (b) timing (*before, during*, and *after*). Principal effects, as well as effects of interactions between both factors, were studied (a significant effect of interaction would indicate a difference in the evolution profile). The post hoc observations were done using the Bonferroni method. The analysis of collected data was done with the SPSS 9 statistical program. All the trials are considered bilateral, and the significance level has been established to be $p < .05$.

Method

This study analyzes the physiological responses of 0- to 6-month-old newborns in the PICU. The intervention is focused on three significant moments, before, during, and after the infant-adult interaction, both with music and without music. The analysis of the interaction with music comprises the experimental group, while the analysis of the interactions without music forms the control group. The control data were collected prior to the experimental data.

For the control group, data were collected and organized according to parameters corresponding to physiological responses in the control group: (a) heart rate (b) respiratory rate, and (c) oxygen saturation of the infant 5 minutes before the infant-adult interaction without music, during the infant-adult interaction without music, and 5 minutes after the infant-adult interaction without music, at which point the examiner asked the adult to leave the room and then waited 1 minute before recording the physiological data for a third time.

Once the data corresponding to the control group were collected, the examiner would proceed to measure the same physiological parameters of the same study participants again, with the presence of live music. Data were collected according to the parameters corresponding to physiological responses of the experimental group with music: (a) heart rate, (b) respiratory rate and (c) oxygen saturation of the infant 5 minutes before the infant-adult interaction with music, during the infant-adult interaction with music, and 5 minutes after the infant-adult interaction with music, at which point the examiner stopped playing music and asked the adult to exit the room before recording the physiological data for the last time.

Data collection without music and with music was done on the same day and during a cumulative time period no greater than 45 minutes between one session and the other, such that there were no important differences between the physical and environmental circumstances in which the infants were found.

Interventions

A five-octave Casio WK 3300 electrical keyboard was used as the principal musical instrument, present in all the musical interventions. A Spanish Alhambra classical guitar was also used as harmonic support. This instrument was chosen by the music therapist, the lead investigator, who noted that its characteristics (easy to use, no wires, portability) allowed its use more comfortably and efficiently.

In addition, the study took the adult caregiver's voice into account during each intervention. Although it was not required for the adult caregiver to sing, any vocal intervention on the part of the adult caregiver was musically supported during the intervention. The inclusion of the adult voice in the study is due to the importance of song and its observed beneficial effects on the infant's relaxation and the decrease of cortisol levels (Trehub, 2003). Before the musical intervention, the infant's physical and psychological responses were observed, as well as the acoustic characteristics of the unit. Once these variables were observed, the nature of the musical intervention was determined according to the following musical elements:

The tempo of the musical intervention was established to be 80 beats per minute in the binary musical interventions and 90 beats per minute in the ternary musical interventions. The musical tempo was initially adjusted at the beginning of each musical intervention according to the infant's heart rate and

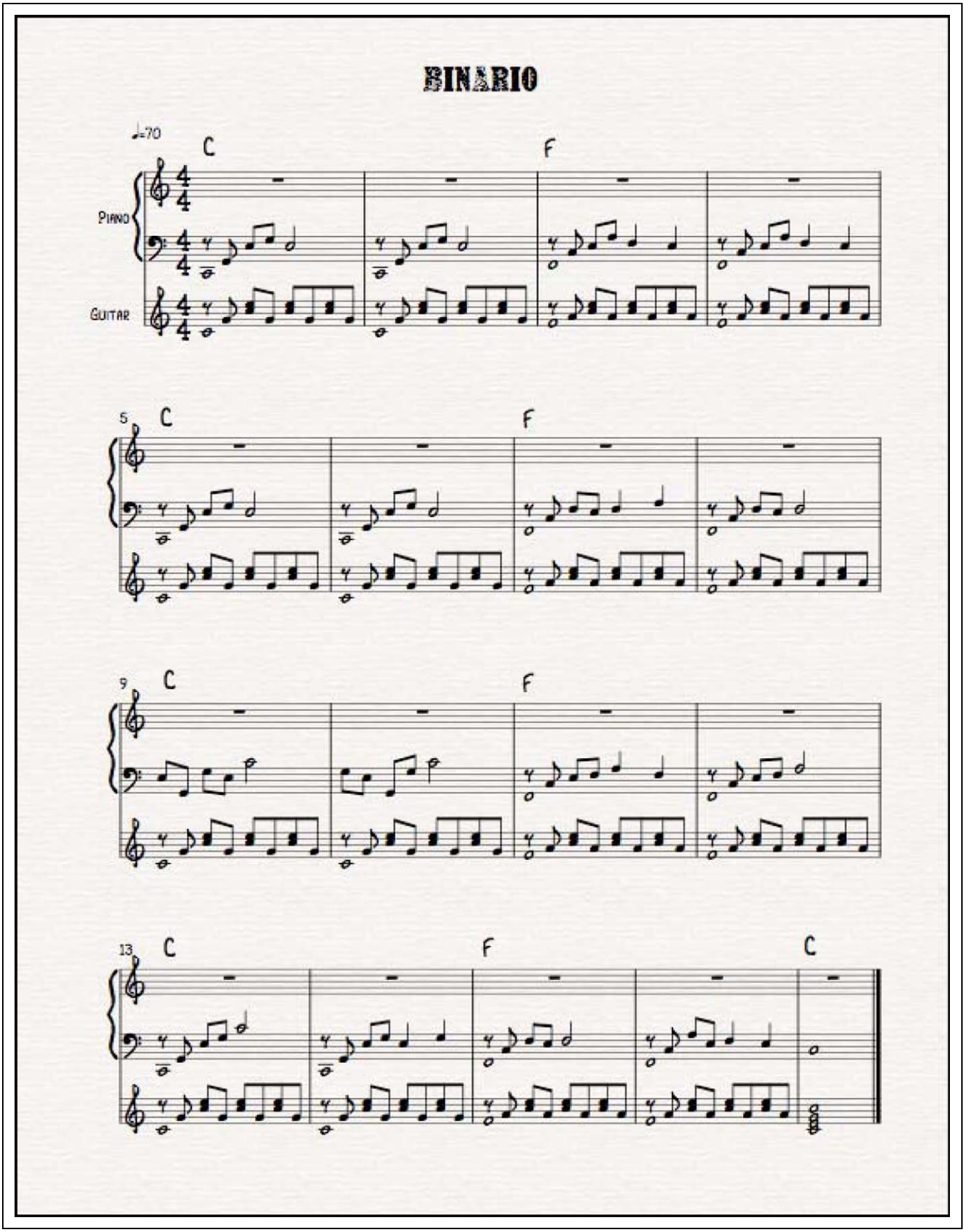

Figure 1. Score of musical intervention corresponding to the introduction with chords I and IV in the major mode

Table 1. Study Interventions

a. Tempo	80 per minute	90 per minute	
n	31	69	
%	31.00	69.00	
b. Rhythm	Binary	Ternary	
n	31	69	
%	31.00	69.00	
c. Mode	Major	Minor	
n	92	8	
%	92.0	8.0	
d. Dynamics	*mp*	*mf*	*f*
n	4	79	17
%	4.0	79.0	17.0

then was gradually slowed to a rate of 80 to 90 beats per minute, according to the previously determined study protocol.

The tone of the infant's vocalizations and cries determined the choice of either major or minor keys for each intervention. The musical intervention always began with two basic chords (I and IV), corresponding to the first and fourth grades of the musical scale, as much in the major key as in the minor key. This harmonic sequence was maintained as the introduction to every musical intervention because these harmonic functions are composed of tonic and subdominant chords and do not produce dissonant tones (Rueda, 1994; see Figure 1).

The study used the following tones: keyboard, guitar, or both instruments together. In this last case, the guitar was always used as the secondary instrument. The musical interventions took three different musical dynamics into account: low intensity (*mp*), medium intensity (*mf*), and high intensity (*f*). This parameter always considered (a) the intensity of the infants; (b) the postural-tonic adult-infant dialogue through the qualities of intensity of voice, caresses, whispers, and language; and (c) the level of environmental noise in the unit, recognizing and integrating as much as possible the sounds of alarms and monitors into the musical intervention (Abromeit, Shoemark, & Loewy, 2008; Ghetti & Hannan, 2008; Stewart & Schneider, 2000). Every musical intervention lasted 10 minutes. The melodic range used in the musical interventions was established to be between G2 and E5 corresponding to 98.0 Hz and 1,318.8 Hz, respectively, in the tempered scale.

Results

This study analyzed 100 musical interventions with 87 participants. The following data were collected about the study population: infant's age, gender, and length of stay in the PICU, and the adult caregiver's age and type of relationship (father, mother, other). With respect to the infants' ages, the greatest percentage were 2- to 3-month-old infants, with 28% being 2 month-old infants and 29% being 3-month-old infants. The average length of stay in the PICU was 1 week (48%). With respect to gender, males comprised 45% of the studied infant population, while females accounted for 55% of infant study participants. Mothers visited the PICU in 82% of interventions, fathers in 16% of interventions, and grandmothers in 2% of interventions. Of the adult caregivers in the study, 46% were between 30 and 40 years of age. The interventions varied as follows: tempo: 80 to 90 beats per minute (Table 1, row a); rhythm: binary or ternary values (Table 1, row b); mode: major or minor keys (Table 1, row c); dynamics: low intensity (*mp*), medium intensity (*mf*), or high intensity (*f*; Table 1, row d). Additional values, recorded as *yes* or *no*, were musical instruments (pitch); electrical keyboard and guitar; and voice.

Table 2. Respiratory Rate Average Differences Before, During, and After the Adult-Infant Interaction With and Without Music ($N = 100$)

	Average	Standard deviation
During-before, without music	0.95	10.80
After-before, without music	1.84	12.24
During-before, with music	–0.41	11.54
After-before, with music	–2.71	11.04

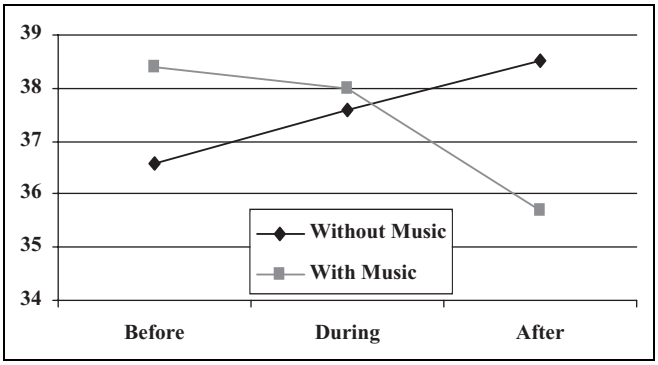

Figure 2. Respiratory rate average in breaths per minute

Results of Changes in Physiological Variables With Studied Interventions

Respiratory Rate

Figure 2 shows changes in the respiratory rate before, during, and after interventions. There are notable differences in respiratory rate before, during, and after the adult-infant interaction with music compared to interventions without music ($p = .023$). With music, the infants' respiratory rates decrease over the three measurement periods—before, during, and after the interaction. Meanwhile, their respiratory rates tend to increase over the three measurement periods without music. The respiratory rate after the interaction with music represents the lowest rate of all those measured. Table 2 shows respiratory rate average differences before, during, and after the adult-infant interaction with and without music.

The heart rate evolution shows significant differences depending on whether music is used or not ($p = .014$). The heart rate value after the adult-infant interaction with music is the lowest of all those values observed. Heart rate average differences before, during, and after the adult-infant interaction with and without music are shown in Table 3 and Figure 3. Oxygen

Table 3. Heart Rate Average Differences Before, During, and After the Adult-Infant Interaction With and Without Music ($N = 100$)

	Mean	Standard deviation
During-before, without music	0.09	15.97
After-before, without music	–0.19	17.42
During-before, with music	–3.40	13.45
After-before, with music	–6.82	14.21

Table 4. Oxygen Saturation Average Differences Before, During, and After the Adult-Infant Interaction With and Without Music

	Mean	Standard deviation
During-before, with music	0.06	3.70
After-before, without music	0.26	4.50
During-before, with music	0.45	3.60
After-before, without music	1.26	3.04

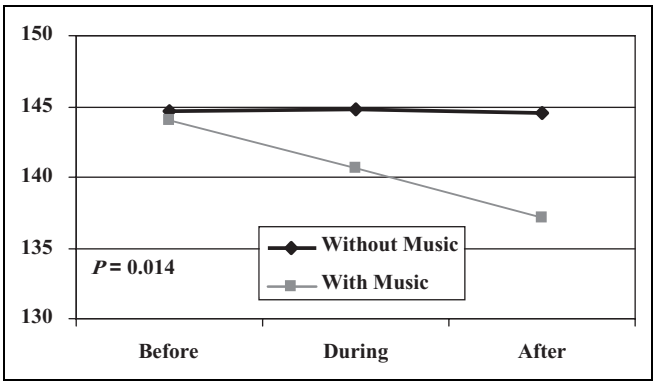

Figure 3. Heart rate average in beats per minute

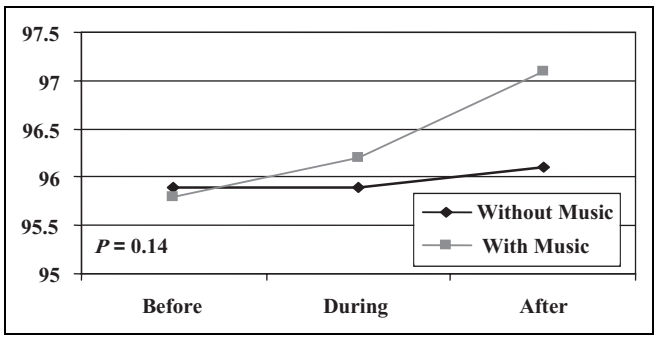

Figure 4. Mean of oxygen saturation

saturation tends to progressively increase during the three consecutive observational periods—before, during and after the adult-infant interaction with music. This finding, however, it is not statistically significant ($p = .4$). The oxygen saturation value after the interaction with music is the highest of all recorded oxygen saturation values. Table 4 and Figure 4 show the oxygen saturation average differences before, during, and after the adult-infant interaction with and without music.

Results of the evaluation of the physiological variables—heart rate, respiratory rate, and oxygen saturation—were analyzed according to the musical rhythm. Comparing the mean of the quantitative parameters of heart rate, respiratory rate, and oxygen saturation before, during, and after the interaction without music, and the three evaluations with music, the decrease in the heart rate is observed to be greater in musical interventions utilizing a binary rhythm ($p = .02$; see Table 5 and Figure 5). However, there is not significant variation in respiratory rate and oxygen saturation when comparing binary to ternary rhythms.

Discussion

The purpose of this study is founded in the need for experimental evidence of the benefits of music therapy in 0- to 6-month-old critically ill infants in high-risk situations who are admitted to the PICU. This study is intended to demonstrate the interest in having this therapeutic modality present in hospital units, where the infant must be seen as a developing subject. Although there are abundant studies (Calabro, 2005; Gibbs & Kennelly, 2005; O'Neill, 2005; Shoemark & Hanson-Abromeit, 2005) reflecting the importance of using music with newborns and hospitalized infants, none of these studies offer significant statistical data about musical parameters and their direct influence on infants' responses (Malloch, Burnham, Shoemark, Newnham, & Campbell, 2005). Music by itself is a variable containing in one moment multiple variables (rhythm, tempo, intensity, tone, pitch, harmony, and texture). The different choices made by the composer, interpreter, or music therapist with regard to each of these results is that the music will have many different meanings for different listeners. There is a clear connection between musical elements and human actions. Music is at the same time organized human sound and human action. This study supports the importance of succinct musical elements and their succinct influence on the infants' responses during their hospital stays in the PICU. The musical rhythm likely determines the respiratory synchronization of a 0- to 6-month-old newborn and his or her adaptation. This is more easily achieved in binary values.

During the first days of life, a mother clutches the child to her breasts, securing the infant's well-being through her heart rhythm. This rhythm is binary, as can be easily distinguished with a stethoscope (http://www.3m.com/product/information/Littmann-Master-Cardiology-Stethoscope.html shows different heart rhythms). Swartz (cited by Campbell, 2001., p. 76) records the mother's heart rhythm and reproduces it later in the incubators, improving infant well-being and leading to an increase in weight gain in premature babies. It is possible to find a relation between the mother's heart tempo and rhythm and the relaxation achieved by listening to it. Interestingly, most of the classical and popular lullabies present ternary rhythm in a slow tempo, achieving a circular and sleep-inducing movement akin to the binary motions of a mother's rocking.

It is clear that music provides calm and well-being and helps infants to sleep. Because it has been proved helpful,

Table 5. Comparing the Mean of the Quantitative Parameters of Heart Rate (HR), Respiratory Rate (RR), and Oxygen Saturation (O2SAT) Before, During, and After the Interaction Without Music and With Music

Parameter	Mean	Standard deviation
HR without music		
Binary ($n = 34$)	147.16	21.56
Ternary ($n = 66$)	143.43	17.27
Total ($N = 100$)	144.70	18.81
HR before music		
Binary	146.76	23.04
Ternary	142.59	20.10
Total	144.01	21.12
HR during music		
Binary	140.50	19.47
Ternary	140.67	18.57
Total	140.61	18.78
HR after music		
Binary	135.00	18.40
Ternary	138.32	20.27
Total	137.19	19.62

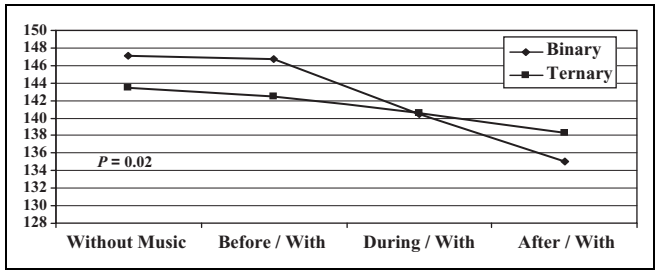

Figure 5. Mean heart rate according to the rhythm (beats per minute)

music has been used as a tool throughout the ages in almost every culture. The intensity of the music interventions in this study range from mezzo forte/medium intensity to forte/high intensity (Jensen, K., from http://www.pvv.ntnu.no/~farner/sonata/sonata.html/). The therapeutic use of music to enhance communication may provide the infant-adult interaction with emotional significance. LeDoux (1999) suggests that "emotions turn into self-motivating elements not only in the immediate reactions but also in future projections" (p. 22). It is certain that music embodies a therapeutic function because it enhances infant-adult communication in terms of shared emotion. Music therapists should thus observe the musical elements of the interaction in order to facilitate the influence of communication.

In terms of oxygen saturation, the study shows a small increase in the infant-adult interaction with music, although it does not have statistical significance ($p = .14$). However, the oxygen saturation increase at the end of the music intervention with respect to the basal heart rate demonstrates statistical significance ($p = .00$) in interventions with music as compared to interventions without music. Hypoxia reduces oxidized metabolism and energy release, especially in oxygen-dependent tissues, like in the brain. Severe hypoxia produces headache, drowsiness, lack of psychomotor coordination, and vision and hearing loss and can cause coma and even death (Bass et al., 2004). As a compensatory mechanism, one's heart rate, respiratory rate, and blood pressure increases. Neurological disturbances are more subtle and are manifested as lack of concentration, apathy, and decreased physical and mental performance. Increased heart rate and pulmonary vascular pressure can be observed. The adverse impact of chronic or intermittent hypoxia on human development, behavior, and academic performance has been documented in many studies of children and in experimental studies of adults (Bass et al., 2004). All of these adverse effects have also been observed in cases of mild decreases in oxygen saturation levels (just below the lower limit of normal for age), which must be taken into account in any situation that could leave a child vulnerable to hypoxia, among these, the clinical conditions and acquired pathologies implicit in the hospital context. This means, therefore, that whenever possible, one must minimize a child's potential risk of hypoxia. One notable example of patients found in these situations is the infant in the intensive care unit. These infants frequently have low oxygen saturation levels, due to compromised hemodynamic or respiratory status. Using music as a therapeutic tool to prevent hypoxic states favors the physical and psychological well-being of the hospitalized infant (and the repercussions that this signifies for his or her development)

One of the most important decisions when determining the method of this study was taking into account the interaction of the adult caregiver (parents or others) with the infant in visits to the unit. This consideration is necessity in order to observe which changes are produced in the infant as a consequence of the adult-infant interaction compared to when the infant is alone. Infants in the PICU are accompanied by many professionals who work there, but they also spend a lot of time alone and demand much attention. It was thought that if the study did not observe changes in the infant's responses in the presence of the adult caregiver, and if this situation was not taken into account, then the arrival of the music therapist playing musical instruments would cause changes not only due to the music as an independent study variable but also due to the very presence of an adult companion.

While this study has not collected data with respect to the physiological and psychological responses of the adult caregiver, the manner of the caregiver's interaction with the infant was observed and played an influential role at the time of carrying out the musical intervention. Infants develop communicative tools with the help of an adult, but they are born with some communicative mechanisms, such as the cry, which they immediately use as a mode of expressing and communicating their needs. The adult quickly learns to distinguish if the cry of the baby is one of tiredness, hunger, or pain, depending on the tone and intensity of the cry (Loewy, 2004). Even if the adult is in another room when hearing the baby cry, it is this significant expressive cue that reveals why the baby is crying. The infant quickly learns that his or her cry provokes a response from others and learns to utilize the cry as a means of communication and expression.

The ear is a functional organ from before birth, and an infant can recognize sounds, melodies, pitch, and key from a very young age. At 2 months of age, infants listen to music with more attention than they give to any other sound. From as early as 6 months of age, babies prefer music composed in the key and harmonies typical of the musical culture into which they were born and raised. Furthermore, babies are capable of recognizing melodies that they have heard before, even if the tempo has been changed (Standley, 2001). What occurs when an infant is found in a disorganized acoustic environment? This environment contributes to an increase in anxiety, which compounds whatever high-risk situation the infant may already be experiencing. The key is to introduce music in a way such that the sound is beautiful and organized, which changes the acoustic environment and the physical, physiological, and psychological responses of the infant.

Conclusion

The rhythm of the music exercises influenced the infant's physiological parameters: The heart rate showed a greater decrease with musical interventions with a binary rhythm ($p = .02$). This phenomenon could not be demonstrated with respect to respiratory rate or oxygen saturation. Active music therapy applied in a situation of parental interaction with the infant produced, in some measure, regulating effects in the infant, manifest in the improvement of the infant's heart rate, respiratory rate, and oxygen saturation. Parental interaction with the infant combined with an active therapeutic musical intervention resulted in the provision of a coherent and integrated system of stimulation for the hospitalized infant.

Declaration of Conflicting Interests

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