

## R E V I E W

# Music therapy in pediatric and neonatal intensive care units: A systematic review and meta-analysis

LUIZA LORENZ CAVALCANTE<sup>1</sup>, RICARDO CÉSAR BARBOSA<sup>1</sup>, ADÍLIA MARIA PIRES SCIARRA<sup>2</sup>, MOACIR FERNANDES DE GODOY<sup>3</sup>

<sup>1</sup>Faculty of Medicine of São José do Rio Preto - FAMERP, São José do Rio Preto, Brazil; <sup>2</sup>Department of Neurological Sciences, Psychiatry and Medical Psychology of the Faculty of Medicine of São José do Rio Preto - FAMERP, São José do Rio Preto, Brazil; <sup>3</sup>Department of Cardiology and Cardiovascular Surgery of the Faculty of Medicine of São José do Rio Preto - FAMERP, São José do Rio Preto, Brazil

## ABSTRACT

**Background and aim:** Music Therapy is a form of therapy that involves the musical sphere to promote the well-being and improvement of patients' vital conditions. Conversely, intensive care units are normally recognized as stressful and threatening environments. Therefore, it can be used to contribute to maintaining the mental health of these patients.

**Methods:** A systematic review with meta-analysis of Music Therapy in pediatric and neonatal intensive care units was performed. The methodology followed the PRISMA 2020 guidelines, with 12 articles analyzed, and a total of approximately 825 patients. The vital signs assessed were perceived pain intensity, oxygen saturation, blood pressure, respiratory and heart rate. Additionally, a comparison was made between different types of music for each population studied.

**Results:** It was observed a reduction of respiratory rate and pain sensitivity index in the pediatric ICU by 1.92 bpm ( $p: 0.004$ ) and 2.09 Wong-Baker FACES units ( $p: <0.0001$ ). It was shown that the favorite kind of music elected by the children had given better results than the others evaluated.

**Conclusions:** There is a scarcity of articles that would allow a comprehensive analysis of this theme, specifically studying different types of this therapy with these populations. Additionally, based on the results presented in the study, the results suggest that music therapy may be a promising adjunct intervention in hospital settings, although further studies are required. ([www.actabiomedica.it](http://www.actabiomedica.it))

**Key words:** music therapy, intensive care units, children, neonates, meta-analysis



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**Correspondence:** Luiza Cavalcante, MD / Faculty of Medicine of São José do Rio Preto - FAMERP Street: Prof. Enjolras Vampré, 99, 15091 - 290, São José do Rio Preto, Brazil / E-mail: [luiza.cavalcante@edu.famerp.br](mailto:luiza.cavalcante@edu.famerp.br)  
ORCID: 0009-0003-5880-2962

## Introduction

Music Therapy is a therapeutic approach that utilizes the power of music to enhance the well-being and overall health of patients. It aims to reduce respiratory rate and improve mental health through individual or group sessions that incorporate musical instruments, singing, melodies, and recordings. This type of treatment is widely recognized in various countries across Oceania, Europe, Asia, and the Americas. Consequently, organizations have been established to supervise, train, and assist other health institutions to enhance their effectiveness in patient care. Other organizations, such as the American Music Therapy Association and the European Music Therapy Confederation, provide a list of active groups in several countries, including the United States, Australia, Finland, Germany, and New Zealand (1,2). The UBAM, a renowned organization in Brazil, exemplifies the significance of music therapy in the Brazilian healthcare system. Furthermore, the government recognized this type of treatment as an integrative and complementary practice within the Unified Health System (SUS) on March 27, 2017 (3). It is important to emphasize that music therapy focuses on maintaining the mental health integrity of patients during stressful activities and improving some physical aspects. It can be regarded as a treatment for Post-Intensive Care Syndrome (PICS), a mental illness that affects numerous patients in Intensive Care Units. They usually develop emotional disorders, which can lead to severe depression and a poor quality of life (4-6). Data analysis reveals that numerous current studies demonstrate the efficacy of music therapy, especially for children in the intensive care unit (7-12). It also indicates that there are various types of approaches

and modalities that professionals can use in this therapy. From this perspective, there is a clear need to analyze the applicability of music therapy in the Intensive Care Units (ICU). Furthermore, it is imperative to assess the most efficacious intervention among the numerous options available in Music Therapy.

## Objectives

The general objective of this systematic review was developed using the PICOS method, as represented below (Table 1).

Using this method, it was concluded that the central objective was to analyze the influence on vital parameters (heart rate, respiratory rate, blood pressure, oxygen saturation, and pain sensation level) most highlighted among the articles. To characterize the specific objective, the authors considered evaluating the different outcomes according to the type of management of this treatment, given that music therapy is present in the medical field with diverse instruments and musical styles.

## Method

Several scientific articles published in different databases were investigated. It is worth mentioning that since this is a systematic literature review, the researched documents were analyzed objectively and impartially, during the period from July of 2024 to February 2025. Several revisions of the values and articles used throughout the research were carried out, although they were done manually by the authors. The analysis was based on understanding the methodology

**Table 1.** PICOS method applied to this systematic review.

Description	Abbreviation	Question componente
Population	P	pediatric and neonatal ICU patients.
Intervention	I	Music Therapy.
Control	C	children and neonates without music therapy.
Outcome	O	change in values with Music Therapy, such as, heart rate, respiratory rate, blood pressure, oxygen saturation, and pain sensation level.
Study	S	Quasi-experimental study. Randomized controlled clinical trial. Experimental study.

employed, the outcomes obtained, and the conclusions drawn by the authors. Furthermore, the data from the period of 2013 to 2024 was considered as the publication date. The access to the chosen scientific literature database for the survey was provided through an institutional subscription: “Faculdade de Medicina de São José do Rio Preto”, SP, Brazil; “Portal de Periódicos Capes” (CAPES MEC); remote access. It was provided free access to search publications, which meant that they were available to the researchers. It is worth noting that databases available on internationally recognized platforms for scientific research, such as Medline, LILACS, and PubMed, were also used. The researchers were able to access all of them due to their availability in the public domain. However, not all studies found in these databases were used because some did not allow their reading to be entirely free. Following Article VI of Resolution No. 510/16, Subjects (CEP/FAMERP) were not necessary. Finally, the submission of this study to the Research Ethics Committee with Human (2016) of the Ministry of Health of Brazil, National Health Council, establishes that research using publicly available information, such as this study, should not be evaluated or registered by the CEP/CONEP system. PRISMA (2020) methodology (13) was used to analyze and filter the database used for the systematic review and meta-analysis. Therefore, the search for articles was based on criteria and flowcharts pre-established by this methodological system. In this manner, combinations of keywords were developed to filter the works in different research databases. They are listed below.

#### Medline:

- (ti: music therapy") AND (ti: intensive care")) AND (children) AND NOT (neurodevelopment) AND NOT (newborn) AND NOT (neonatal)
- (ti:("music therapy")) AND (ti:("intensive care")) AND (neonatal) AND NOT (neurodevelopment) AND NOT (children)
- (ti:("music therapy")) AND (ti:("intensive care")) AND (newborn) AND NOT (neurodevelopment) AND NOT (children)
- (ti:("music therapy")) AND (ti:("intensive care")) AND (infant) AND NOT (neurodevelopment) AND NOT (children)
- (ti:("music therapy")) AND (ti:("intensive care")) AND (infant) AND NOT (neurodevelopment) AND NOT (children)
- (ti:("music therapy")) AND (ti:("intensive care")) AND (newborn) AND NOT (neurodevelopment) AND NOT (children)
- (ti:("music therapy")) AND (ti:("intensive care")) AND (children) AND NOT (neurodevelopment) AND NOT (newborn) AND NOT (neonatal)

#### LILACS:

- "music therapy" "intensive care" children
- "music therapy" "intensive care" infant newborn neonatal
- music "intensive care" infant newborn neonatal

#### PubMed:

- "music therapy" AND "intensive care" AND children NOT neurodevelopment NOT newborn NOT neonatal
- "music therapy" AND "intensive care" AND newborn NOT neurodevelopment NOT children
- "music therapy" AND "intensive care" AND neonatal NOT neurodevelopment NOT children
- "music therapy" AND "intensive care" AND infant NOT neurodevelopment NOT children
- music "intensive care" infant NOT neurodevelopment NOT children
- music "intensive care" newborn NOT neurodevelopment NOT children
- music "intensive care" neonatal NOT neurodevelopment NOT children
- music "intensive care" children NOT neurodevelopment NOT newborn NOT neonatal

Web of science:

- "music therapy" "intensive care" children NOT neurodevelopment NOT newborn NOT neonatal
- "music therapy""intensive care" neonatal NOT neurodevelopment NOT children
- "music therapy""intensive care" newborn NOT neurodevelopment NOT children
- "music therapy""intensive care" infant NOT neurodevelopment NOT children
- music "intensive care" infant NOT neurodevelopment NOT children
- music "intensive care" neonatal NOT neurodevelopment NOT children
- music "intensive care" newborn NOT neurodevelopment NOT children
- music "intensive care" children NOT neurodevelopment NOT newborn NOT neonatal

Furthermore, articles that were beyond the predetermined analysis period (2013-2024) were disregarded. As a result, it was possible to determine an absolute quantity of articles; 907 studies (258 for children and 649, for neonatal) that would later be analyzed and filtered. The initial filtering procedure consisted of eliminating duplicate studies, specifically 543 studies (63 for children and 480 for neonate) that had appeared on multiple occasions in other research databases or with a different keyword sequence. Furthermore, 232 articles (148 for children and 84 for newborns) were excluded because their titles contained information that was outside the analyzed repertoire. For example, if the study was different from a quasi-experimental study or a randomized controlled clinical trial, or if they emphasized professionals' perceptions regarding Music Therapy, among other reasons. The subsequent filtering process comprised an analysis of the title and abstract of the works, with only those that were closest to the inclusion criteria being considered for inclusion in the subsequent review process. At the end of the process, 46 studies (19 for children 27 for neonates) were excluded, and 68 articles were passed (28 for children 40 for neonates).

The inclusion and exclusion criteria are the following:

**Included:** Articles with significant keywords in the title that align with the research theme,

such as "music therapy," "intensive care," CICU, NICU, SICU, among others; publications published during the predetermined period (2013-2024); obtaining the essential data from both the experimental and control groups, including at least one of the following parameters: heart rate, respiratory rate, blood pressure (systolic and diastolic), oxygen saturation, and patient pain sensitivity level.

**Excluded:** Articles with titles containing keywords outside the research theme, such as "autism" and "neurodevelopment"; documents of a different type than quasi-experimental study, randomized controlled clinical trial, and controlled clinical trial; those without permitted access; texts addressing a different age group than the one evaluated; when the analyzed group had a wide range of vital signs due to differing ages. With variation in the type of intervention (music therapy), such as time and with or without a relative during the therapy. If the article showed discrepancies in its information, and when the studies exhibit discreteness. During the third filtering stage, articles that could not be accessed in full text were disregarded because they were not in the public domain or saved in the research database at the time of this study's development. Under these conditions, nineteen articles were excluded (six of children and thirteen of infants). The final step comprised a thorough reading of the remaining texts, with only those that met the inclusion criteria included in the study. In the end, 13 articles were used, six for children and seven for neonates. To represent this process, the PRISMA 2020 methodology was used, and a flowchart was created, which was also provided by the developers of this research method (Figures 1-2).

After analyzing the articles, new studies were conducted to compare the improvement rates of patients based on vital sign categories, using parameters such as blood pressure, oxygen saturation, pain sensation level, respiratory rate, and heart rate. Data extracted from each study were organized into two separate Tables. The first group (Tables 2-3) included the publication

year, type of music therapy used, methodology analysis, and routinely used. Figures 3-4 comprised data extracted from the articles, including systolic blood pressure, pain sensation level, respiratory rate, and heart rate. It is important to observe that the analysis of pain sensation level was only performed if multiple studies with the same analysis methodology were found. Therefore, by filtering the articles from the databases it was possible to analyze five articles focused on pediatric intensive care units. One study was excluded because it used a different methodology for quantifying pain sensation level, than

Wong-Baker FACES, which makes it unsuitable for comparison with the others. In addition, the spreadsheet with the most common and discussed vital parameters (respiratory rate, heart rate, blood pressure, oxygen saturation, and pain sensation level) among pediatric and neonatal articles were chosen for creating Forest Plot graphs, containing all these type of data before (control) and after music therapy (experimental). Furthermore, specialized software, RevMan, which is available in the public domain, was employed for meta-analysis. Through RevMan, it was possible to analyze the heterogeneity index between

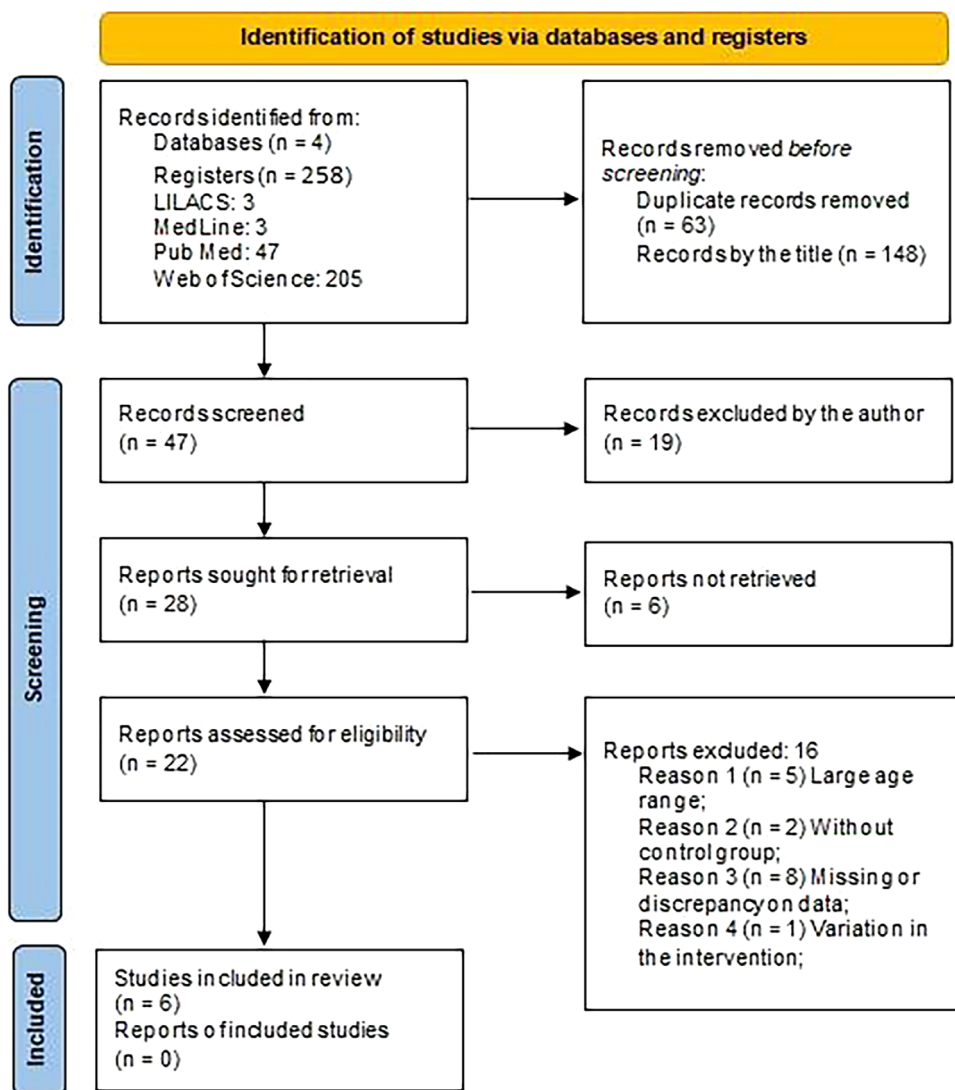


Figure 1. Prisma 2020 Flowchart's. Music therapy in pediatric ICU.

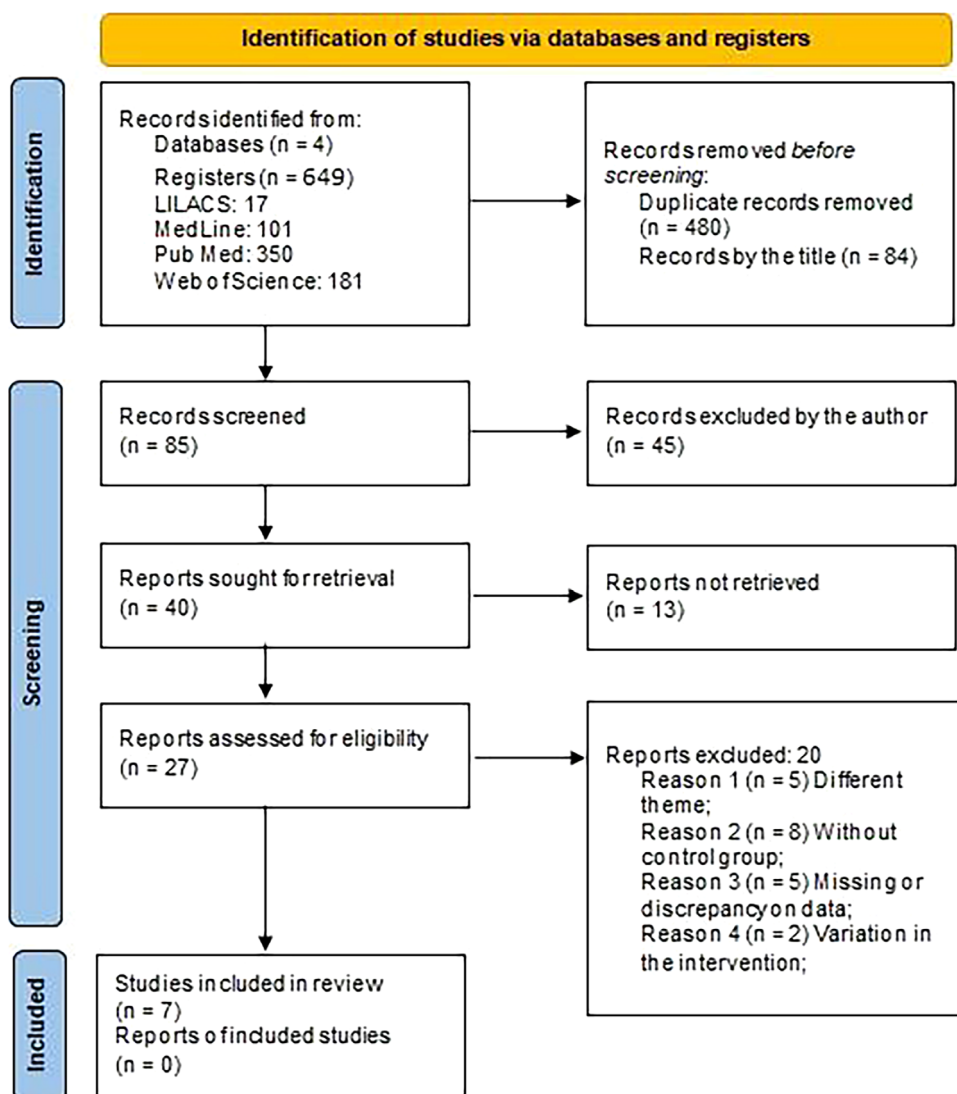


Figure 2. Prisma 2020 Flowchart's. Music therapy in neonatal ICU.

the articles, confidence intervals, and p-values of each graph produced. The values extracted from the chosen articles were characterized as continuous data since they were derived from the same population. Furthermore, it was assumed that changes in vital parameters could not be solely attributed to the use of music therapy, but could be influenced by other factors, such as the environment, the patient's condition (routine ICU or before cardiac surgery), type of therapy, duration, and timing of vital sign measurement collection. For the creation of these signal vitals that were used to perform the meta-analysis, it was collected and organized the mean and standard

deviation values before and after the intervention. The same was also considered for the control group, because with both (data from experimental and control groups), it was possible to evaluate the best type of music in the Music Therapy. So, it is important to mention that the Forest Plot graphs were based on vital parameters, mean and standard deviation values before and after the intervention. For the evaluation of the best type of music, only the mean of the vital signs from the group with and without the intervention was used. Furthermore, those signal vitals collected were compared with the parameters considered normal for each age group to heart and respiratory

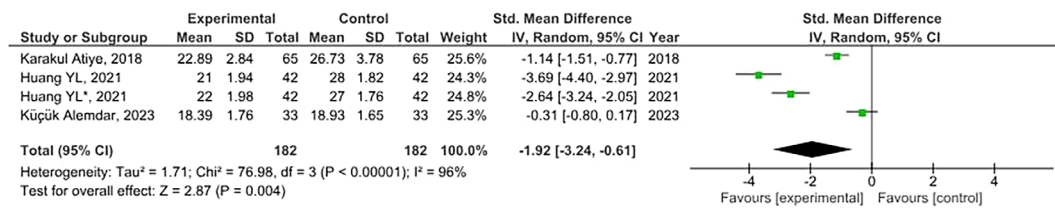
**Table 2.** Spreadsheet with the main general information of the analyzed articles. Music therapy in pediatric ICU.

Article, year	Age range, number of participants	Method used for assessment	Exam Routine	Music Therapy	Extracted Data
<b>Huang YL, 2021, (20)</b>	3 - 7 years old, Music group: 84 Control group: 42 Total: 126 participants.	Wong-Baker FACES; scale of FLACC and Analgesia Protocol and Intervention; Routine analyses of vital conditions;	In the morning of the day of cardiac surgery and then 3 days after the music therapy session. Since the sessions occurred 3 times a day, the data were collected from the last intervention of the day.	One group with favorite music accompanied by video ("music video")(Huang YL, 2021) and another group with recorded favorite music (Huang YL*, 2021) Each session lasted 30 minutes and included the patient's favorite songs. It was administered three times a day for 3 days after cardiac surgery.	Respiratory rate; Heart rate; Blood pressure; Oxygen saturation; pain sensation level (Wong-Baker FACES scale)
<b>Küçük Alemdar, 2023, (21)</b>	12 - 18 years old, Music group: 33 Massage group: 33 Control group: 33 Total: 99 participants.	Wong-Baker -FACES; Children's Fear Scale (CFS) and blood cortisol levels; Routine analyses of vital conditions;	The patient was assessed 10 minutes before the blood test, during the test, and 10 minutes after.	Classical music, referred to as "music pillow" by the music therapist. The benefits of massage therapy were also analyzed but were not considered for this study. For 20 minutes, it started 10 minutes before the blood collection	Respirator y rate; Heart rate; pain sensation level (Wong-Baker FACES scale)
<b>Abd-Elc hafy SK, 2015 (22)</b>	4 - 12 years old, Music group: 25 Control group: 25 Total: 50 participants.	RASS Assessment, Post-Hospital Behavior Questionnaire ; Richmond Agitation-Sedation Scale; Objective Pain Scale; glucose and blood cortisol levels; Routine analyses of vital conditions;	Before cardiac surgery; at the time of anesthesia; Median sternotomy; rewarming; admission to the ICU; extubation	Recording of the patient's favorite music. It started with the induction of anesthesia until the moment of extubation.	Respirator y rate; Oxygen saturation;
<b>Karakul Atiye, 2018 (23)</b>	9 - 17 years old, Music group: 65 Control group: 65 Total: 130 participants.	Satate - Trait Anxiety Inventory for Children; Routine analyses of vital conditions;	Before surgical operation and after therapy	Recording of classical music: "The Art of The Fugue" by Johann Bach, contrapunto, episode 3. Chosen by a university professor in the field of Music Therapy. Post-operative intervention for 20 minutes.	Respiratory rate; Heart rate;
<b>Calcaterra V, 2014 (24)</b>	3 - 14 years old, Music group: 21 Control group: 21 Total: 42 participants.	faces pain scale (FPS); FLACC-s; glucose and blood cortisol level; Routine analyses of vital conditions;	Beginning of the surgery; end of the surgery; upon awakening in the postoperative period; discharge from the ICU.	Recording administered by a music therapist of fast/slow classical music. 20 minutes, with a break (2 minutes) between the fast classical music and the slow one. It was administered in the outpatient postoperative period upon awakening.	Blood pressure; Oxygen saturation;

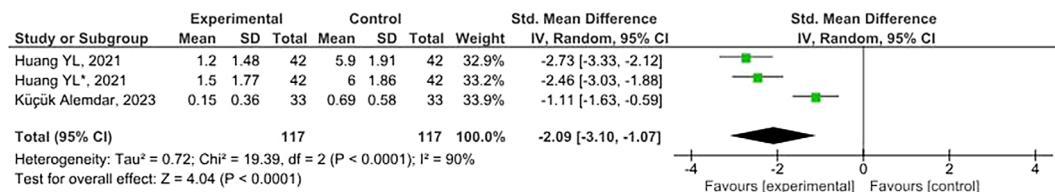
Table 3. Spreadsheet with the main general information of the analyzed articles. Music therapy in neonatal ICU.

Article, year	Age range, number of participants	Method used for assessment	Exam Routine	Music Therapy	Extracted Data
Caparros-Gonzalez, RA, 2018 (25)	between 32-36 weeks of gestation. Control group: 8 Music group: 9 Total: 17 participants.	Routine analyses of vital conditions	10 minutes before the therapy and 2 minutes after.	Calm music created by a computer system, "Melomics", approved by 10 music therapists For 20 minutes, three times a day for 3 days.	Respiratory rate; Heart rate; Blood pressure; Oxygen saturation;
Namjoo R, 2021 (9)	Less than 37 weeks of gestation. Two groups of Music Therapy: 60 Control group: 30 Total: 90 participants.	Routine analyses of vital conditions	10 minutes before music therapy, during, and 20 minutes after therapy.	2 types of music therapy: recorded lullabies (Namjoo R, 2021) and sung by the mother (Namjoo R*, 2021). The songs were approved by pediatric psychologists. For 20 minutes, for 14 days. The control group stayed in the mother's lap for 20 minutes.	Heart rate; Oxygen saturation;
Kurdahi Badr L, 2017 (17)	31.8 ± 2.79 weeks of gestation. 42 participants, including control group data. All patients participated as the control group and received both types of music therapy, with an 8-hour interval between tests.	Routine analyses of vital conditions; Neonatal Pain, Agitation and Sedation Scale (N-PASS);	5 minutes before the test and 5 minutes after the biological neonatal screening	2 types of music therapy: recordings of lullabies (Kurdahi Badr L, 2017) and music listened to by the mother in the last trimester of gestation (calm music) (Kurdahi Badr L, 2017). The recordings were played during the biological neonatal screening, lasting for 10 minutes, starting 5 minutes before the examination.	Respiratory rate; Heart rate; Oxygen saturation;

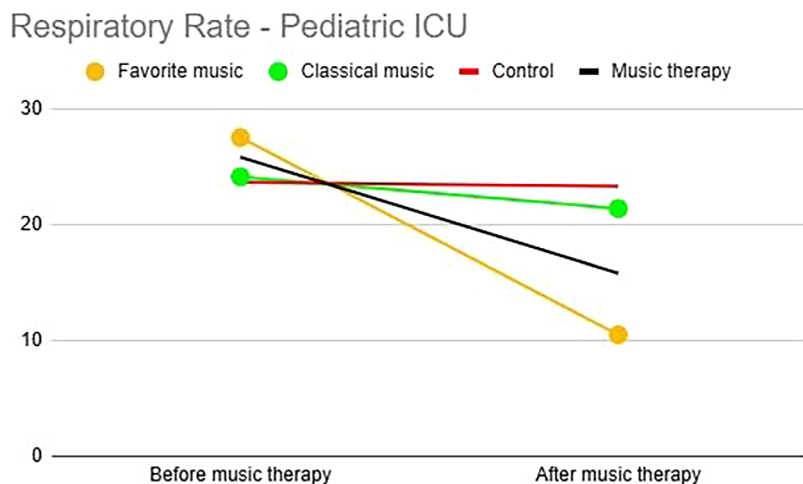
<p><b>Jabaraceli M, 2016 (26)</b></p>	<p>Between 29-34 weeks of gestation. Music group: 46 Control group: 20 Total: 66 participants.</p>	<p>Routine analyses of vital conditions; Automated Auditory Brainstem Response (AABR);</p>	<p>10 minutes before, 15 minutes of music therapy, and 20 minutes after</p>	<p>2 types of music therapy: recording of maternal voice singing "Lullaby" (<b>Jabaraceli M*, 2016</b>), with 21 newborns, and another recording of "Brahm's Lullaby" (<b>Jabaraceli M, 2016</b>) with 25 babies. 15 minutes, for three consecutive days</p>	<p>Oxygen saturation; Respiratory rate and Heart rate no data provided, stated not to alter values before and after therapy;</p>
<p><b>Taheri L, 2017 (27)</b></p>	<p>Less than 38 weeks of gestation. Music group: 26 Control group: 26 Total: 52 participants.</p>	<p>Routine analyses of vital conditions</p>	<p>Before; 10 minutes after the start of therapy; at the end of the intervention; 20 minutes later.</p>	<p>Recording of a lullaby sung by a female voice 20 minutes, for three days.</p>	<p>Heart rate; Oxygen saturation;</p>
<p><b>Vieira A, 2024 (18)</b></p>	<p>Over 28 weeks of gestation. Music group: 10 Control group: 9 Total: 19 participants</p>	<p>Routine analyses of vital conditions; Neonatal Infant Pain Scale (NIPS); Behavioral Indicators of Infant Pain (BIIP);</p>	<p>After, during (10 minutes) and before the music therapy.</p>	<p>20 minutes of music therapy, using classical music, "Mozart for Babies". The music was played inside the incubator.</p>	<p>Respiratory rate; Heart rate; Oxygen saturation;</p>
<p><b>Bagli E, 2024 (19)</b></p>	<p>Gestational age of 28-34 weeks. Classical Music Group: 17 Lullaby Music Group: 17 Control Group: 17 Total: 53 participants</p>	<p>Routine analyses of vital conditions and Comfort-Neo.</p>	<p>After and before music therapy (during the period of OG tube feeding)</p>	<p>The lullaby music group was performed by the mother. She sang a lullaby song to the baby for 10-15 minutes, during OG tube feeding. <b>(Bagli E*, 2024)</b> The classical music group used "Mozart-Baby Smart" recorded for 10-15 minutes, during OG tube feeding. <b>(Bagli E, 2024)</b></p>	<p>Oxygen saturation; Heart rate; Respiratory rate;</p>



**Figure 3.** Forest Plot graphs, processed by the RevMan Software. Music Therapy in Pediatric ICU: RESPIRATORY RATE.



**Figure 4.** Forest Plot graphs, processed by the RevMan Software. Music Therapy in Pediatric ICU: PAIN SENSITIVITY LEVEL (WONG-BAKER FACES).



**Figure 5.** Average before and after graphs, conducted by the authors. Respiratory rate - pediatric ICU.

rates by the literature (14,15), just to know if they could be used in this study. For the comparison of the different types of Music Therapy among the studied by age groups (pediatric and neonatal) (Figure 5), was created a series of graphs that were created by using Microsoft Excel. It used the means of vital values found in the articles before and after music therapy, if it was the experimental group, but also, for comparison, the data from the control group was extracted. It was not possible to conduct a meta-analysis

for this purpose due to a lack of appropriate articles to analyze different types of music therapy, as filtered by the PRISMA 2020 method. The different studied groups were groups that used classical music; music chosen by the patient; recorded or sung lullabies by the music therapist or mother; popular regional music with a calming effect; and electronic music created by a music therapist using a computer. In addition, there was a control group that did not receive the auditory stimulation of music therapy.

## Assessing the risk of bias

All selected studies underwent manual analysis conducted by their authors to assess the risk of bias using the Rob.2 system developed by the company Concraine (16). Most of them were analyzed under the “randomized parallel trial” systematic; however, three of the studies [Kurdahi Badr L, 2017 (17)], [Vieira, A 2024 (18)] and [Bağlı E, 2024 (19)] were of the “randomized crossover trial” type. For studies analyzed under “randomized parallel trial”, aspects such as the randomization process; intended interventions; missing outcome data; measurement of the outcome; and selection of the reported result were evaluated. While for the study with a “randomized crossover trial,” aspects such as the randomization process; intended interventions; missing outcome data; selection of the reported result; period, and carryover effects were considered. The articles were manually classified according to the evaluated criteria using the flowcharts provided in the Rob.2 program. Among the analyzed studies, ten were considered to be low risk and two with some risk. The studies considered to have some risk were one from the pediatric intensive care unit and the other from the neonatal sphere.

All studies were used to compose this work.

## Results

It was observed that all the articles used a passive methodology for music therapy, wherein the patient is the listener to the songs performed by music therapists, with the vast majority of the songs being recorded. In the active methodology, in which the patient is the musical agent, they can play music with professional health accompaniment, such as singing, playing, and doing improvised songs. However, this type of music therapy was excluded from this study due to the lack of published articles analyzing this type of music therapy and the initially established exclusion criteria (such as coherent information, and control group data). In addition, with these tables created with the vital signs, it was possible to notice that in the comparison between the information found in the studies and the bibliography (14, 15), that some of the articles were in the normal range for the patient’s age. However,

others were not in the normal parameters, because the majority of those patients had some cardiac problems and were analyzed and exposed to Music Therapy during cardiac surgery. So, it can be considered that this variation found was due to the vital conditions of the population analyzed, which was not absolutely stable in these conditions.

It is observed that Music Therapy reduced the respiratory rate and pain sensitivity index in the pediatric ICU by 1.92 bpm ( $p: 0.004$ ) and 2.09 Wong-Baker FACES units ( $p: not\ significant$ ). Most of the Graphs assessed that the data among the articles showed high or moderate values of heterogeneity (greater than 75%), with 5 being high and 3 moderate. It is important to highlight that it was not possible to process data for the meta-analysis on blood pressure parameters in the neonatal ICU due to the lack of articles found. While in the pain sensitivity criterion, it was only possible to compare the articles with the same type of scale.

A significant portion of the Graphs showed a positive change in vital parameters with Music Therapy compared to control groups (patients who did not receive the same intervention), although not statistically proven using a meta-analysis. It is evident that among the analyzed subgroups, children and adolescents who listened to their favorite music performed better, as there was a greater positive variation between the values before and after, as well as in the neonatal ICU, with electronic music standing out (music created by a computer with the assistance of a music therapist), when comparing to the others types.

## Discussion

Most of the articles found used passive Music Therapy as the analysis method, in which the patient listens to melodies, sung or played by recording. Few articles explore other types of therapy, such as active therapy, in which the patient has access to musical instruments, performing, for example, improvisations. One hypothesis for the greater presence of passive methodology among articles studying vital parameters is that it is more economical and practical to perform, as it can be administered by any healthcare professional, requiring only a sound resource. Additionally,

not every patient may be able to perform the movements needed to use musical instruments, especially in pediatric intensive care units, where many children are in critical health conditions. As shown in one study (8) that compared the efficacy of active Music Therapy with passive, varying according to space, availability, and patient health, active therapy was not used in the meta-analysis due to eligibility criteria. There are certain controversies among the analyzed articles from UTI pediatric; some claim to reduce heart rate and not vary oxygen saturation (20, 23, 28, 29). However, the meta-analysis found that the reduction found in these individual works was more likely to have been caused by other factors than Music Therapy, considering heart rate, because the p-value was greater than 0.05. While oxygen saturation is statistically significant, as the p-value is less than 0.05 and the variation is statistically moderate (30%). Nevertheless, clinically, as the increase in saturation was less than 0.5, numerous articles asserted that there was no distinction between the control and intervention groups clinically. Moreover, in graphs where the p-value was less than 0.05, there was a high or moderate heterogeneity value. Although there were variations among the articles in the values found, due to the conditions the patients were in; the meta-analysis showed a statistically relevant value. Even with a variation in values among the articles used, possibly due to situational factors of each patient, there was still an improvement in the pain sensation index, heart rate, and oxygen saturation in the pediatric ICU. Therefore, demonstrating the impact of the intervention employed. As for the other articles, when the vital signs were different among them, the meta-analysis showed a high heterogeneity index and high p-value. Thus, there are strong indications that Music Therapy did not directly interfere with these values, possibly, the variation found was caused by other biological and situational factors. It is worth highlighting that many of these patients were in different hospital situations, which may be a reason for presenting high heterogeneity values. Regarding the technique, it is not possible to consider that it caused this variation among the articles, as the equipment used, and the healthcare team involved was similar among the articles. However, the exposure time of the patients to music therapy in each study was different, as well as the type of music

presented, which may also confer differences between the values presented, causing heterogeneity. Analyzing the moment of vital signs data collection among patients, it is noticed through the articles used that due to having different exposure times among them, this moment was also varied. On the other hand, for this study, only the values immediately before and after the use of the intervention were used to minimize the variation in vital signs of the studied individuals and cause any risk to the accuracy of the presented data. Compared to other systematic review studies published during the period from 2013 to 2024; it is noticed that Music Therapy stands out for reducing pain and anxiety levels in its patients (28-31). There are still some studies highlighting the reduction in respiratory rate and increase in oxygen saturation (19, 27, 32). On the other hand, during the research, articles were found (33) denying the usefulness of music therapy, precisely because they have different models of using this type of therapy, which for these authors contributed to their conclusion that it is not possible to make a comparison of the applicability of music therapy compared to the control group. However, through the statistical analysis performed, grouping all types of Music Therapy subgroups, it is possible to affirm that there is indeed a statistically significant difference between the values before and after the use of this type of intervention in the pediatric and neonatal population. Additionally, other factors can be evaluated, such as blood cortisol levels and duration of breastfeeding, which have good results in some articles and systematic reviews (28), as well as a reduction in postpartum depression rates (34, 35) but were not analyzed throughout this work, as it was not possible to compare these rates with the pediatric population. Few systematic reviews reported which subgroup of Music Therapy could be better. Among those found, only two articles highlighted classical and popular music (30, 36), which aligns with the results found, as there was an emphasis on recording the patient's favorite music in Pediatric Treatment Units, which can be classified as popular music. Moreover, there are other studies (37, 38) that examined the sphere of healthcare professionals and patients' parents. They claim to notice a significant reduction in anxiety levels. Many of them also noticed a more harmonious atmosphere between healthcare professionals

and families. In one study (37), approximately 100% of respondents reported noticing an improvement in reducing stress levels. Thus, by lessening the stressful environment and fostering a more joyful, serene, and pain-free atmosphere; music therapy may help to lower the incidence of Post-Intensive Care Syndrome (PICS) in patients.

### Limitations

It is evident that due to the manual extraction and organization of data, some articles may have been missed, despite the use of various keywords for the search. Additionally, some analyzed articles had a wider age range than others, which could lead to variation in the overall means among vital parameters within the same article. The studies presented variations in the length of patient exposure to music therapy, which may have influenced the vital parameters of individuals exposed during the intervention.

### Conclusions

The requirement for additional articles in this field is evident, particularly in the sphere of active music therapy, to facilitate a more comprehensive and mathematical examination of diverse subgroups of music therapy. This type of therapy deserves recognition for its role in reducing patients' pain sensitivity levels and significantly improving their quality of life, as they require fewer analgesics. It also promotes well-being in the pediatric and neonatal population. Despite periods of elevated stress, such as hospitalization in Intensive Care Units (ICUs) Furthermore, it was observed that the respiratory rate in the pediatric population experienced a decrease of approximately two breaths per minute and a slight increase in oxygen saturation levels. However, less results were obtained for the neonatal population, which received a p-value more than 0.05 at all aspects.

**Ethic Approval:** Due to our research being a Systematic Review, the submission of this study to the Research Ethics Committee with Human Subjects (CEP/FAMERP), was not necessary. In accordance with Article VI; Resolution no. 510/16

(2016) of the Ministry of Health of Brazil, National Health Council, which establishes that research using publicly available information, such as this study, should not be evaluated or registered by the CEP/CONEP system.

**Conflict of Interest:** All authors declare that they do not have commercial associations (e.g. consultancies, stock ownership, equity, interest, patent/ licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article.

**Author's Contribution:** LC: Writing (introduction, methods, results, discussion, conclusion), statistical analysis, drafting; RB: Writing (results, discussion, conclusion), statistical analysis, drafting; AS: Concept and design, writing (introduction, methods), critical revision for important intellectual content; MG: Concept and design, critical revision for important intellectual content. All authors approved the final version to be published and agreed to be accountable for all aspects of the work.

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### References

1. American Music Therapy Association. About music therapy & AMTA [Internet]. Silver Spring (MD): AMTA; [cited 2023 Aug 8]. Available from: <https://www.musictherapy.org/about/>.
2. European Music Therapy Confederation. Country representatives [Internet]. Brussels: EMTC; [cited 2023 Aug 8]. Available from: <https://emtc-eu.com/emtc-countryrepresentatives/>.
3. Brazil. Ordinance No. 849, of March 27, 2017. Inclui a arteterapia, Ayurveda, biodança, dança circular, meditação, musicoterapia, naturopatia, osteopatia, quiropraxia, reflexoterapia, reiki, shantala, terapia comunitária integrativa e yoga à Política Nacional de Práticas Integrativas

- e Complementares. Brasília: Diário Oficial da União; 2017 [Internet]. [cited 2023 Aug 8]. Available from: [https://bvsm.s.saude.gov.br/bvs/saudelegis/gm/2017/prt0849\\_28\\_03\\_2017.html](https://bvsm.s.saude.gov.br/bvs/saudelegis/gm/2017/prt0849_28_03_2017.html). [Portuguese].
- Robinson CC, Rosa RG, Kochhann R, et al. Quality of life after intensive care unit admission: multicenter cohort study protocol to assess long-term outcomes in survivors of intensive care unit admission in Brazil. *Rev Bras Ter Intensiva*. 2018 Oct-Dec;30(4):405413. doi: 10.5935/0103-507X.20180063.
  - Docherty C, McPeake J, Quasim T, et al. The relationship between pain, anxiety and depression in patients with post-intensive care syndrome. *J Crit Care*. 2023 Dec;78:154359. doi: 10.1016/j.jcrc.2023.154359.
  - Ho MH, Li PWC. What happens after discharge from the intensive care unit? Common challenges to intensive care unit survivors with post-intensive care syndrome. *Intensive Crit Care Nurs*. 2023 Oct;78:103484. doi: 10.1016/j.iccn.2023.103484.
  - Liu MH, Zhu LH, Peng JX, et al. Effect of Personalized Music Intervention in Mechanically Ventilated Children in the PICU: A Pilot Study. *Pediatr Crit Care Med*. 2020 Jan;21(1):e8e14. Doi: 10.1097/PCC.0000000000002159.
  - Kobus S, Buehne AM, Kathemann S, Buescher AK, Lainka E. Effects of Music Therapy on Vital Signs in Children with Chronic Disease. *Int J Environ Res Public Health*. 2022 May 27;19(11):6544. doi: 10.3390/ijerph19116544.
  - Nanjoo R, Mehdipour-Rabori R, Bagherian B, Nematollahi M. Comparing the effectiveness of mother's live lullaby and recorded lullaby on physiological responses and sleep of preterm infants: a clinical trial study. *J Complement Integr Med*. 2021 May 24;19(1):121129. doi: 10.1515/jcim-2020-0507.
  - Yurkovich J, Burns DS, Harrison T. The Effect of Music Therapy Entrainment on Physiologic Measures of Infants in the Cardiac Intensive Care Unit: Single Case Withdrawal Pilot Study. *J Music Ther*. 2018 Mar 9;55(1):62-82. doi: 10.1093/jmt/thx017.
  - Millett CR, Gooding LF. Comparing Active and Passive Distraction-Based Music Therapy Interventions on Preoperative Anxiety in Pediatric Patients and Their Caregivers. *J Music Ther*. 2018 Jan 13;54(4):460-478. doi: 10.1093/jmt/thx014.
  - Fleming S, Thompson M, Stevens R, et al. Normal ranges of heart rate and respiratory rate in children from birth to 18 years of age: a systematic review of observational studies. *Lancet*. 2011 Mar 19;377(9770):1011-8. doi: 10.1016/S0140-6736(10)62226-X.
  - Page MJ, McKenzie JE, Bossuyt PM, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*. 2021 Mar 29;372:n71. doi: 10.1136/bmj.n71.
  - Storni JG, Capabianco HS, Pereira E, Fernandes M. Monitorização Respiratória. In: Torre FPF, Cesar RG, Storni JG, Chicuto LAD, Pecchin R, editors. *UTI Pediátrica*. Barueri: Manole; 2015. pp. 257-268. [Portuguese].
  - Fioretto JR, Martin JG. Peculiaridades da semiologia na unidade de cuidados intensivos e classificações habitualmente utilizadas. In: Silva LR, Solé D, editors. *Diagnóstico em pediatria*. Barueri: Manole; 2022. pp.11-21. [Portuguese].
  - Sterne JAC, Savović J, Page MJ, et al. RoB 2: a revised tool for assessing risk of bias in randomised trials. *BMJ* 2019; 366:14898. doi: 10.1136/bmj.l4898.
  - Kurdahi Badr L, Demerjian T, Daaboul T, Abbas H, Hasan Zeineddine M, Charafeddine L. Preterm infants exhibited less pain during a heel stick when they were played the same music their mothers listened to during pregnancy. *Acta Paediatr*. 2017 Mar;106(3):438-445. doi:10.1111/apa.13666.
  - Vieira AKA, Coutinho GF, Farias KS. The acute effects of music therapy on neonates in a Neonatal Intensive Care Unit. *RSD*. 2024 Feb 2;13(2):e0613244926-6. [Portuguese]. doi: 10.33448/rsd-v13i2.44926.
  - Bağlı E, Küçükoğlu S, Soylu H. The Effect of Lullabies and Classical Music on Preterm Neonates' Cerebral Oxygenation, Vital Signs, and Comfort During Orogastric Tube Feeding: A Randomized Controlled Trial. *Biol Res Nurs*. 2024 Apr;26(2):181-191. doi:10.1177/10998004231202404.
  - Huang YL, Lei YQ, Liu JF, Cao H, Yu XR, Chen Q. Comparison of the Effectiveness of Music Video Therapy and Music Therapy on Pain after Cardiothoracic Surgery in Preschool Children. *Heart Surg Forum*. 2021 Mar 26;24(2):E299-E304. doi: 10.1532/hsf.3509.
  - Küçük Alemdar D, Bulut A, Yilmaz G. Impact of music therapy and hand massage in the pediatric intensive care unit on pain, fear and stress: Randomized controlled trial. *J Pediatr Nurs*. 2023 Jul-Aug;71:95-103. doi: 10.1016/j.pedn.2023.05.007.
  - Abd-Elshafy SK, Khalaf GS, Abo-Kerisha MZ, Ahmed NT, Abd El-Aziz MA, Mohamed MA. Not All Sounds Have Negative Effects on Children Undergoing Cardiac Surgery. *J Cardiothorac Vasc Anesth*. 2015 Oct;29(5):1277-84. doi: 10.1053/j.jvca.2015.01.005.
  - Karakul A, Bolşık ZB. The Effect of Music Listened to During the Recovery Period After Day Surgery on the Anxiety State and Vital Signs of Children and Adolescents. *J Pediatr Res*. 2018 Jun 27;5(2):82-87. doi: 10.4274/jpr.24892.
  - Calcaterra V, Ostuni S, Bonomelli I, et al. Music benefits on postoperative distress and pain in pediatric day care surgery. *Pediatr Rep*. 2014 Sep 29;6(3). doi:10.4081/pr.2014.5534.
  - Caparros-Gonzalez RA, de la Torre-Luque A, Diaz-Piedra C, Vico FJ, Buella-Casal G. Listening to Relaxing Music Improves Physiological Responses in Premature Infants: A Randomized Controlled Trial. *Adv Neonatal Care*. 2018 Feb;18(1):58-69. doi:10.1097/anc.0000000000000448.
  - Jabraeili M, Sabet T, MustafaGharebaghi M, Asghari Jafarabadi M, Arshadi M. The Effect of Recorded Mum's Lullaby and Brahm's Lullaby on Oxygen Saturation in Preterm Infants: a Randomized Double-Blind Clinical Trial. *J Caring Sci*. 2016 Mar 1;5(1):85-93. doi: 10.15171/jcs.2016.009.
  - Taheri L, Jahromi M, Abbasi M, Hojat M. Effect of recorded male lullaby on physiologic response of neonates in

- NICU. *Appl Nurs Res*. 2017 Feb;33:127-130. doi:10.1016/j.apnr.2016.11.003.
28. Yue W, Han X, Luo J, Zeng Z, Yang M. Effect of music therapy on preterm infants in neonatal intensive care unit: Systematic review and meta-analysis of randomized controlled trials. *J Adv Nurs*. 2021 Feb;77(2):635-652. doi: 10.1111/jan.14630.
29. Golino AJ, Leone R, Gollenberg A, et al. Impact of an Active Music Therapy Intervention on Intensive Care Patients. *Am J Crit Care*. 2019 Jan;28(1):48-55. doi: 10.4037/ajcc.2019792.
30. Bar A, Monalisa J, Damayantie N, Halimah H. Music Therapy for Pain and Anxiety in Hospitalized Children: a Systematic review of Randomized Controlled Trial. *NSC Nursing*; 2023, Volume 3, Nr.2, pp. 30-52. doi: 10.32549/OPI-NSC-92.
31. Bieleninik Ł, Ghetti C, Gold C. Music Therapy for Preterm Infants and Their Parents: A Meta-analysis. *Pediatrics*. 2016 Sep;138(3):e20160971. doi: 10.1542/peds.2016-0971.
32. Kobus S, Diezel M, Dewan MV, et al. Music Therapy Is Effective during Sleep in Preterm Infants. *Int J Environ Res Public Health*, 2021 Aug 4;18(16):8245. doi: 10.3390/ijerph18168245.
33. Mohan A, Gokulakrishnan G, El-Saie A, Brickley A, Hagan J, Pammi M. Music therapy for preterm neonates in the neonatal intensive care unit: An overview of systematic reviews. *Acta Paediatr*. 2021 Dec;110(12):3180-3200. doi: 10.1111/apa.16055.
34. Palazzi A, Meschini R, Piccinini CA. NICU music therapy effects on maternal mental health and preterm infant's emotional arousal. *Infant Ment Health J*. 2021 Sep;42(5):672689. doi: 10.1002/imhj.21938.
35. Kobus S, Diezel M, Dewan MV, et al. Music Therapy in Preterm Infants Reduces Maternal Distress. *Int J Environ Res Public Health*. 2022 Dec 30;20(1):731. doi: 10.3390/ijerph20010731.
36. Ting B, Tsai CL, Hsu WT, et al. Music Intervention for Pain Control in the Pediatric Population: A Systematic Review and Meta-Analysis. *J. Clin. Med*. 2022 Feb 14;11(4):991. doi: 10.3390/jcm11040991.
37. Thorn AC, Brown K, Tolland M, Read J. Pediatric staff and their perceptions of music therapy services. *J Pediatr Nurs*. 2023 Nov-Dec;73:e138-e145. doi: 10.1016/j.pedn.2023.08.001.
38. Cousin VL, Colau H, Barcos-Munoz F, Rimensberger PC, Polito A. Parents' Views with Music Therapy in the Pediatric Intensive Care Unit: A Retrospective Cohort Study. *Children (Basel)*. 2022 Jun 26; 9(7):958. doi: 10.3390/children9070958.

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