

**MUSIC THERAPY FOR PAIN AND ANXIETY IN HOSPITALIZED CHILDREN: A
SYSTEMATIC REVIEW OF RANDOMIZED CONTROLLED TRIAL**

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Review article

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ABSTRACT

Introduction. Music has been widely recognized for its effectiveness in controlling anxiety and pain. However, in particular groups such as children, the implementation may be challenging, especially regarding the type of music selection. The aim of the study is to evaluate the music therapy efficacy on pain and anxiety management in pediatric care to improve the management of pain and anxiety in the pediatric population.

Methods. This review was written according to the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) statement. In assessing the impact of music therapy as a method of pain and anxiety management in pediatric care, a database tracking was conducted for articles publicized between 2000 and 2022. The databases used including Sciencedirect, Cochrane library, PubMed, and Wiley online library. Articles were deemed if the study subjects ranged in age from 0 to 21 years old, the intervention was live or recorded music, and the study took place in an inpatient background.

Results. 1,129 publications were discovered. In final search of literature, there are 12 articles included in this review. There is consistent and consequential evidence that music may relieve pain and anxiety in hospitalized children before and during procedures. The type of music that is widely used is classical and traditional instrumental music. In addition, there were only two studies using nursery rhymes.

Conclusion. The patient's preference in choosing music for children enables them to determine the appropriateness of therapy. Classical music can be the main choice in applying music therapy in reducing anxiety and pain in children.

Keywords: Pediatric, music; pain; anxiety; inpatient; nurse

INTRODUCTION

Extreme anxiety may harm a child's physical and psychological health, cause adverse postoperative outcomes that hinder recuperation, rehabilitation and reduce a child's alliance in self-care [1–3]. Hospitalized children may experience anxiety due to daily activities, recurring convulsions, loss of control, or loneliness [4–6]. According to the current study, compelling pain and anxiety management are critical to healing [7,8]. Untreated pain and anxiety may cause diverted recovery, extended hospitalization, impaired physical growth and development, faked personality, and a lifelong nervousness of medical providers and treatments to be inducted [6,9–12].

There are multiple hindrances to implementing sufficient management of child care. Many parents and healthcare providers fear the side effects of pain and anxiety remedies [13–16]. Since 1999, the U.S. pediatric mortality rate, ages 0 to 19, has nearly tripled due to illicit prescription opioids [18]. Due to the risks and harmful effects of sole reliance on pharmacological treatments, Governments and healthcare providers are striving for alternative non-pharmacological modalities for manipulating pain and anxiety, particularly in children [19].

Music, touch, and nurse-led distraction techniques are non-pharmacological therapies currently widely used in pediatric care [20]. This therapy is effective in helping reduce the dose and duration of pain and anxiety medications and improve pain and anxiety scores; thus, nurses can continue to maintain their autonomy [21,22]. Focusing on music therapy turns out that this therapy has the potential to reduce or even eliminate the need for pharmacological therapy (18). Music also impacts human emotional and physiological responses by diverting attention from the symptoms of pain and anxiety that arise (19). The theory best known as the mechanism of pain, Gate Control, posits that pain receptors collaborate to transmit pain signals to the brain [23]; thus, distractions such as music can block specific pain pathways and reduce the amount of pain felt. Music therapy sessions allow individuals to express their pain and anxiety in healthy ways, such as through improvised songs and playing instruments [24,25]. Music has been used in clinical settings such as general practice

(medical and dental) and more specialized settings such as surgery and related medical professions (such as physiotherapy and speech therapy). It is essential to recognize differences between the clinical practice of music therapists, who are certified, and the use of music by lay practitioners, who are not explicitly trained or have some background in music psychology or clinical psychology [26,27].

Previous systematic reviews of randomized controlled trial studies concluded the excellent efficacy of music therapy for children in controlling pain and anxiety when facing medical procedures. However, these studies could have clearly shown the type of music and therapy delivery method, which is still a big question [28]. Another review study found that the evidence for the effectiveness of using music to reduce dental anxiety in children is inconclusive and of limited quality [27]. The present review study aims to assess the effect of music therapy on pain and anxiety management in pediatric care to improve pain and anxiety management in the pediatric population from existing literature published from 2000 to 2022. The time-lapse chosen to updating studies in previous review. Review question including what types of music most used? What method used to deliver the music?

METHODS

Review Protocol

Following the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) 2020 guidelines, we conducted a systematic review of the literature consisting of Randomized Controlled Trials (RCTs) that appraised the effectiveness of music therapy in alleviating pain and anxiety in pediatric care [29].

Eligibility Criteria

We removed duplicates and uploaded articles to the web-based bibliography and database manager.

It was then distributed to the team members, and a single reviewer initially reviewed the title and abstract. The following step was a full-text review by two reviewers. Additional reviewers were organized to deal with contentions to reach a consensus. The inclusion criteria include subjects ranged in age from 0 to 21, using live or recorded music in a hospital setting, effective or ineffective in alleviating pain and anxiety, and the full text was available in English. Articles are excluded if located in an outpatient setting, such as an emergency department or venipuncture clinic; music therapy by a music therapist; in labour or involving pregnant adolescents; during surgery or under general anaesthesia, or occurs in the neonatal intensive care unit (NICU) or pediatric intensive care unit (PICU). Babies treated in the NICU must be excluded because premature babies' nervous systems are immature, so they respond to pain differently from full-term babies. Although not all babies treated in the NICU are premature, several articles do not always distinguish between premature and full-term babies born in the NICU. Theses or dissertations, conference articles, comments, editorial reports, and poster presentations are exempt.

| Elements | Statement |
|--------------|---|
| Population | Children in Pediatric care |
| Intervention | Music or audio provided using any equipment |
| Comparison | With or without any treatment or therapy |
| Outcomes | Reduction in pain or/and anxiety scale |
| Study design | Experimental study |

Table 1. *PICOS statement*

Information source

A medical librarian searched a database for articles published in the previous ten years, from 2000 to 2022, in May 2022. Scencedirect, Cochrane library, PubMed, and Wiley online library were all searched.

Search Strategy

PubMed, Scencedirect, Wiley Online Library, and the Cochrane Library were among the databases searched. Furthermore, we also search on the list of references in the article that meet the criteria to broaden the search results further. In creating a comprehensive search strategy for each database, the following search terms were used: (1) pediatric, child, adolescent, infant, toddler, adolescent, adolescent, male, female, (2) pain, tone, voice (3) anxiety (4) hospitalization, hospitalization, procedure, postoperative, surgery. A review of all included study references was also conducted. We also add filters to each database, including publication type and research design.

| Databases | Keywords |
|----------------------|--|
| Scencedirect | Child OR Children OR Toddler AND Music OR Music therapy OR Voice AND Pain OR Aching OR Anxiety |
| Cochrane library | Child OR Children OR Toddler AND Music OR Music therapy OR Voice AND Pain OR Aching OR Anxiety |
| PubMed | (((((("child"[MeSH Terms]) OR ("pediatric nursing"[MeSH Terms])) OR ("toddler"[Title/Abstract])) OR ("children"[Title/Abstract])) AND (((("music"[MeSH Terms]) OR ("music therapy"[MeSH Terms])) OR ("voice/therapy"[MeSH Terms])) OR ("tone therapy"[Title/Abstract]))) AND (("pain"[MeSH Terms]) OR ("anxiety"[MeSH Terms])) |
| Wiley online library | Child OR Children OR Toddler AND Music OR Music therapy OR Voice AND Pain OR Aching OR Anxiety |

Table 2. Search String

Data Collection

Two authors independently screened the title and abstract to suit the inclusion criteria, if it was not clear, then they continued by reading the main text. No automation tools were used in selection

literatures.

Data Extraction

To extract the required data, we followed the McMaster Critical Review Form-Quantitative Studies v. 2.0 and added some information that we think is important. The data we extracted included authors, countries, outcomes, study designs, participants, interventions, evaluation methods, and main findings. Two authors performed data extraction independently. The finalization of the extraction process was read and endorsed by the first author.

Quality of the Study

Study quality was assessed by two authors independently using the Critical Appraisal Skills Program (CASP) for the Randomized Controlled Trial [30]. This tool consists of 11 questions which are divided into four sections with the choices of Yes, No, and Can't Tell checklist columns. We categorize the quality of studies into High, Medium, and Low. High quality studies if you have answers YES 10 – 11/11, medium quality if you have answers YES 7 – 9/11, and Low quality if answers YES \leq 6/11.

Study Risk of Bias Assessment

The risk of bias or validity in the process and results of a systematic review is reflected in its methodological quality. The Cochrane Handbook 5.2.0 was used to reckon methodological quality. Two authors independently assessed the risk of bias in the included studies. In the circumstance of a disagreement, refer it to the corresponding author for arbitration. The Cochrane bias risk assessment tool was used to evaluate the risk of RCTs, which possessed random sequence generation, allocation concealment, blinding of subjects and researchers, blinding of outcome assessment, insufficient outcome data, and selective reporting.

RESULTS

Study Selection

A systematic electronic search identified that 1,129 publications were discovered through backward searching of relevant papers. The full-text screening was conducted on 783 articles. A total of 692 articles failed to meet eligibility criteria at the full-text screening stage, and only 12 articles were finally eligible for further analysis. The search results follow the PRISMA 2020 flow diagram (Fig. 1).

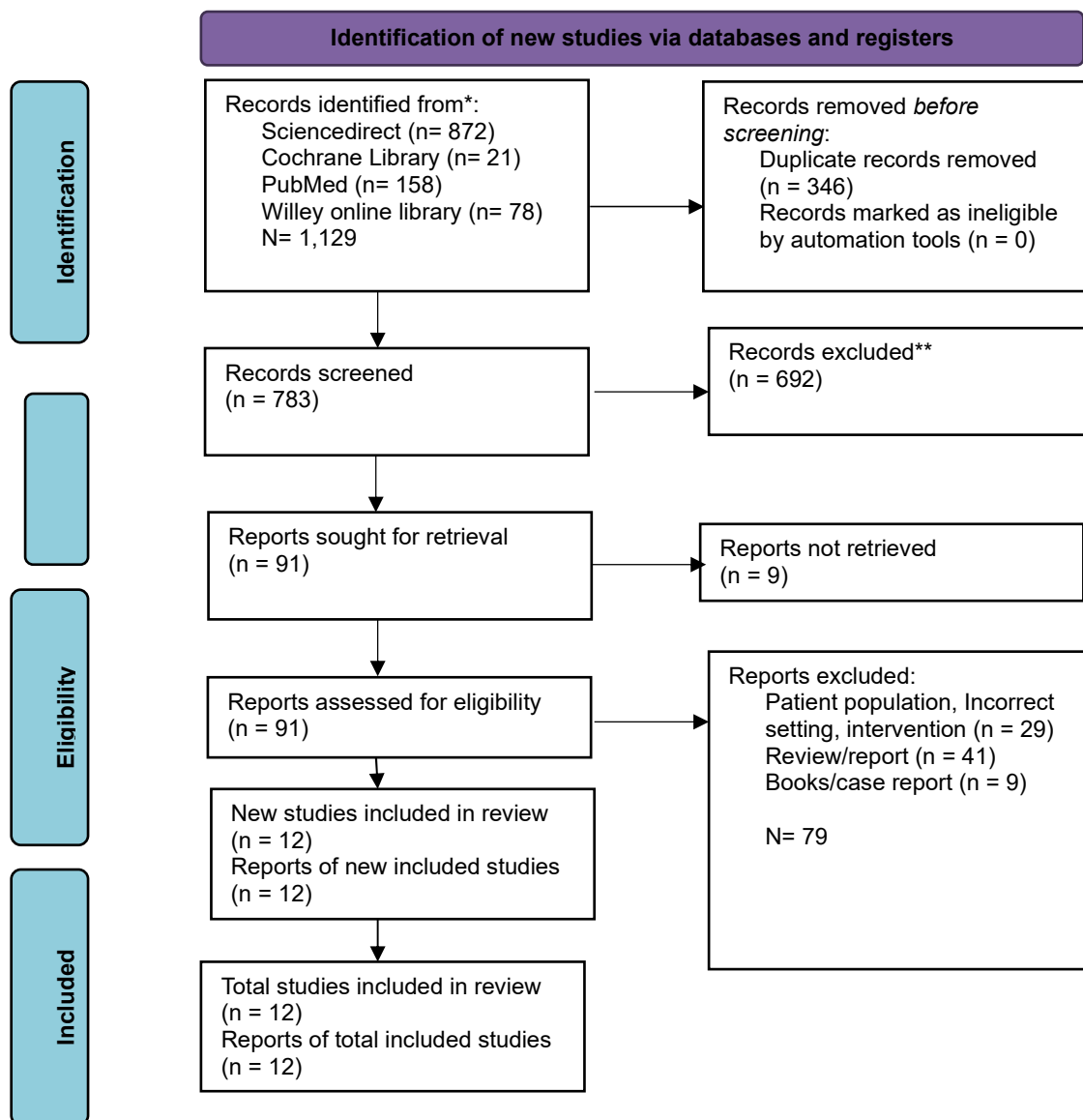


Figure 1. PRISMA flow diagram for literature search

| Author, Year, country | Study Design | Participants | Intervention | Evaluation tools | Effect on anxiety | Effect on pain |
|-------------------------------|--------------------|-------------------------|---|--|--|--|
| Noguchi, 2006, US | RCT | n= 62 Ages 4 – 6yo | 'Little squirrel' song using headphones for 1 minute and 56 seconds before, during, and after injection | OSBD, The faces pain scale | OSBD score 4.64 (p>.05) | Pain score 3.39 (p<.01) |
| Kim et al., 2010, South Korea | RCT | n = 23 Age 22mo–14yo | Mothers voice using headphones ≥30 min pre-post operative | mYPAS | Significantly attenuated (P=0.001) | - |
| Balan et al., 2009, India | RCT | n =50 Ages 5-20yo | Indian instrumental classical music using earphone before, during, and after venipuncture ≥20 min | Using VAS 5 min after the insertion | - | Reduction in VAS pain scores during procedure |
| Liu & Petrini, 2015, China | RCT | n=112 Age >18yo | Soft music with 60–80 beats per minute using earphone for 30 min post operative for 3 days | Faces pain scale, STAI immediately after the therapy | Significant reduction in STAI score (P=0.020) | Significant reduction in faces pain score (p=0.019) |
| Yu et al., 2009, China | RCT | n = 30 Ages 2–12yo | Children's songs using headphones for 30 min during acupuncture | mYPAS, CHEOPS, WB-FACES at 1 min, and at 30 min after intervention | Significant reduction in m-YPAS anxiety scores after acupuncture (p < .05) | No significant reduction in CHEOPS and FACES pain scores during or after acupuncture |
| Nguyen et al., 2010, Vietnam | RCT | n = 20 Ages 7–12yo | Traditional Vietnamese using headphones 10 min prior to and throughout LP (18–27 min) | STAI, The NRS | Significant reduction in STAI anxiety scores before LP (p < .001) | Significant reduction in NRS pain scores during (p < .001) and after (p < .003) LP |
| Franzoi et al., 2016, Brazil | RCT | n = 26 Age 3–12yo | Instrumental using headphones for 15 min pre-operative | mYPAS | Significant reduction in m-YPAS anxiety scores (p = .0441) pre-operatively | - |
| Sabzevari et al., 2017, Iran | RCT | n= 100 7 – 14yo | Classical Music using speakers (pair) after endoscopy | Baker - Wong pain scale | - | Significant reduction in Wong-Baker face score (P<0.000) |
| Longhi et al., 2015, UK | Quasi-experimental | n=37 Ages 7days–4yo | Lullabies through ambient for 10 min during | CHEOPS | - | Significant reduction in CHEOPS pain |

| | | | hospitalization | | | scores (p = .003) |
|----------------------------|-----|---------------------|---|---|--|--|
| Kazemi et al., 2012, Iran | RCT | n=30 Age 9–12yo | Instrumental using headphones for 20 min during hospitalization | STAIC | Significant reduction in STAIC anxiety scores (p < .05) during hospitalization | - |
| Bulut et al., 2020, Turkey | RCT | n=35 Age 7-11 yo | Classical music using the Creatone music pillow for 20 minutes, 1 hour after being taken to the unit from the children's PACU | WB-FACES, mYPAS | Significant reduction in m-YPAS anxiety scores (p < .05) | Significant reduction in WB FACES score (P<.05) |
| Suresh et al., 2015, USA | RCT | n=18 Ages 6–18yo | Music listed in iPod using headphones for 30 min | FPS-R before and 30 min after treatment within 48 h after surgery | - | Reduction in FACES pain scores and pain burden post-operatively, but not statistically significant |

*mo=month; yo=years old; OSBD= Observational Scale of Behavioral Distress; VAS= visual analogue scale; mYPAS= modified Yale pre-operative anxiety scale; CHEOPS= Children's Hospital of Eastern Ontario Pain Scale; STAI= state-trait anxiety inventory; STAIC= Spielberger State-Trait Anxiety Inventory; WB-FACES= Wong-Baker FACES; FPS-R= Faces Pain Scale-Revised; NRS= Numeric Rating Scale; PACU= Post anesthesia care unit

Table 3. Characteristics of studies included.

Study Characteristics

Eleven randomized controlled trials (RCTs) and one quasi-experimental study met the inclusion criteria and was analyzed. The studies included 543 participants ranging in age from seven days to 18 years. The research was conducted in eight countries: India (8.33%, n=1) [31], Brazil (8.33%, n=1) [32], Iran (16.67%, n=2) [33,34], South Korea (8.33%, n=1) [35], the United Kingdom (UK) (8.33%, n=1) [36], Vietnam (8.33%, n=1) [37], the United States (US) (16.67%, n=2) [38,39], Turkey (8.33%, n=1) [25], and China (16.67%, n=2) [40,41].

Studies reported the implementation of music therapy before a procedure (n =5, 41.67%), during a procedure (n =4, 33.33%), after a procedure (n =6, 50%), or at any time during a hospitalization (n

=2 16.67%), music-based interventions were used. The time spent listening to music ranged from 1 minute to at least 30 minutes. Most of the studies (n=7, 58.3%) used recorded music with headphones (n=7, 58.3%); one used speakers and ambient music.

The studies in the analysis scrutinized the effects of music-based interventions on pain (n=5, 41.67%) and anxiety (n=5, 41.67%). Some studies found a consequential lowering in pain scores in the music group (n=3), while others found no significant reduction (n=2). Before and during procedures, all studies conveyed a significant reduction in anxiety scores in the music group (n=5). Only one study discovered no significant lessening in anxiety scores in the music group following surgery.

Study quality

Based on the results of the study quality assessment which consisted of thirteen questions, only four studies were in the High Quality category, and eight other studies were in the Medium Quality category.

| Authors | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 | Q9 | Q10 | Q11 | Q12 | Q13 |
|------------------------|----|----|----|----|----|----|----|----|----|-----|-----|-----|-----|
| Noguchi, 2006 | Y | N | Y | N | Y | N | Y | Y | Y | Y | Y | Y | Y |
| Kim et al., 2010 | Y | N | Y | N | N | N | Y | Y | Y | Y | Y | Y | Y |
| Balan et al., 2009 | Y | Y | Y | N | N | N | Y | Y | N | N | Y | Y | Y |
| Liu & Petrini, 2015 | Y | N | Y | N | N | N | N | Y | Y | Y | Y | Y | Y |
| Yu et al., 2009 | Y | N | Y | N | N | N | Y | Y | Y | Y | Y | Y | Y |
| Nguyen et al., 2010 | Y | Y | Y | N | N | N | Y | Y | N | Y | Y | Y | Y |
| Franzoi et al., 2016 | Y | N | Y | N | N | N | N | Y | Y | Y | Y | Y | Y |
| Sabzevari et al., 2017 | Y | Y | Y | N | Y | N | Y | Y | N | N | Y | Y | Y |
| Longhi et al., 2015 | Y | Y | Y | N | N | N | Y | Y | Y | Y | Y | Y | Y |
| Kazemi et al., 2012 | Y | N | Y | N | N | N | Y | Y | Y | Y | Y | Y | Y |
| Bulut et al., 2020 | Y | Y | Y | N | Y | N | N | Y | Y | Y | Y | Y | Y |
| Suresh et al., 2015 | Y | Y | Y | N | N | N | Y | Y | Y | Y | Y | Y | Y |

Table 4. Summary of quality assessment

Risk of Bias in Studies

Based on the bias assessment, all studies are in the low category in the Bias in measurement of the outcome domain. For overall bias, there are four studies that are in the Some Concerns category, and eight studies that are in the Low risk of bias category.

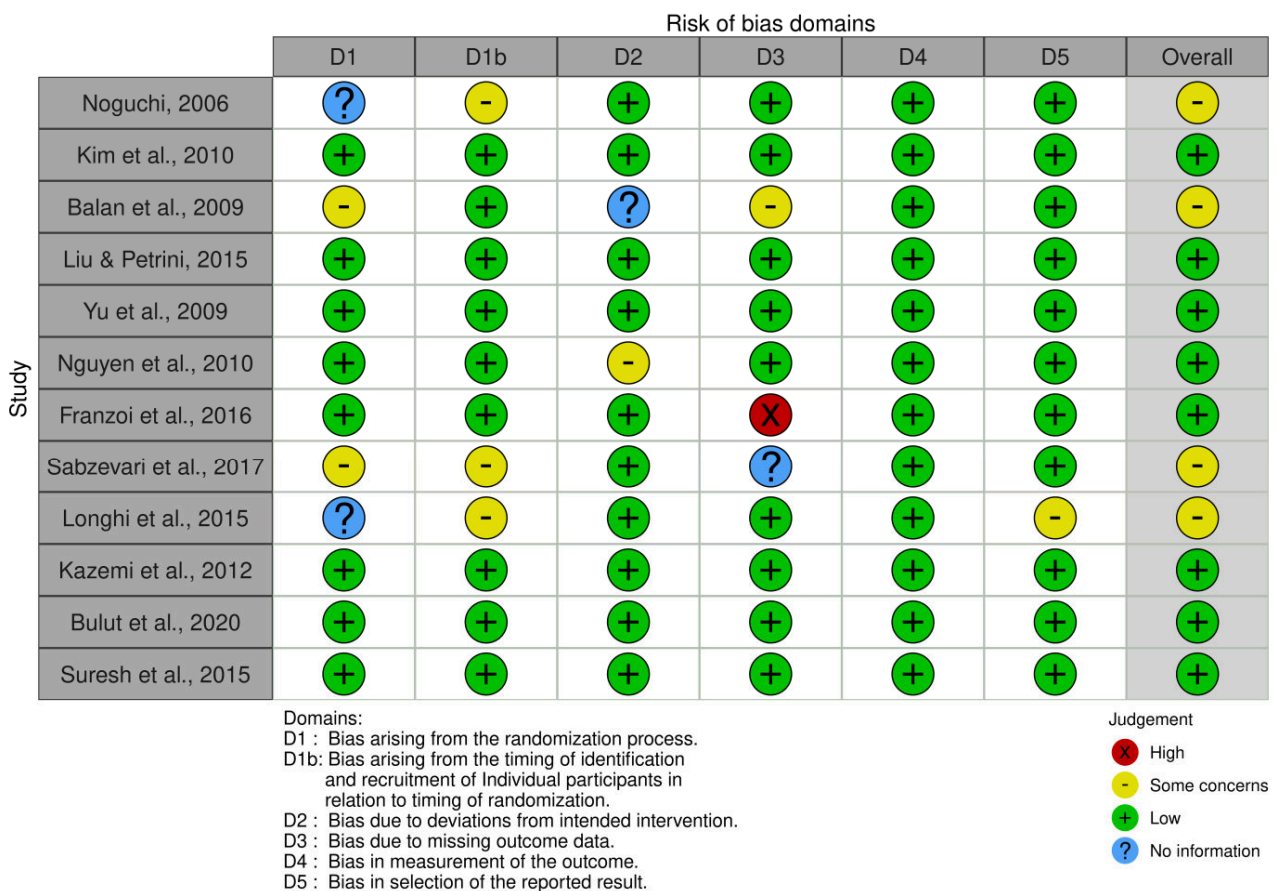


Figure 2. Traffic-light plot for RoB in individual study

Effect on Anxiety

There are eight studies [25,32,34,35,37,38,40] who analyzed the effect of music on pediatric anxiety in dealing with hospital care situations. The measurements of participants' anxiety levels used a variety of instruments, including The Observational Scale of Behavioral Distress (OSBD), the modified Yale Preoperative Anxiety Scale (mYPAS), and The Spielberger State-Trait Anxiety

Inventory (STAIC). Overall there was a significant decrease in anxiety in the studies that analyzed the effects of this music intervention.

Effect on Pain

There are nine studies [25,31,33,36–41] who analyzed the effect of music on the level of pain experienced by pediatricians. However, two studies showed insignificant results in reducing experienced pain [31,41]. The instruments used to measure pain include Wong-Baker Faces (WB-FACES), Visual Analog Scale (VAS), Numeric rating scale (NRS), and The Children's Hospital of Eastern Ontario Pain Scale (CHEOPS).

DISCUSSION

Non-pharmacologic methods are widely used as forms of pain, fear, and vomiting control for children in the hospital setting. There are several medical procedures in the hospital that can provide an unpleasant experience, especially in Pediatric care. This review evaluated the impact of music therapy as a corroborative strategy for pain and anxiety control in hospitalized children. The publications' central theme was statistically meaningful evidence that music can decline anxiety before and during procedures [32,34,35,37,38,40,41]. However, results concerning pain, often viewed as physiologic analogs to pain, were mixed [31,32,36–39,41]. Music-based interventions are also secure for hospitalized children, according to the evidence. Only one RCT reported any negative effects, deemed minor and mostly related to headphone affliction or no refinement in pain or anxiety scores [37].

It is crucial to explore patient factors that contributed to music interventions' success in employing this review's findings. Several studies have emphasized the importance of patient discretion in deciding on music for children [32,37,39,41]. Researchers have allowed two-year-olds to choose the type of music they want to listen to in several research studies [37,39,41]. According to one study,

this sovereignty contributed to lower pain and anxiety levels in music groups [37]. In another study, subjects were reluctant to listen to researcher-selected music, resulting in significant sample loss [32]. It reflects a broader healthcare shift towards patient-centered care over the past decades, recognizing the importance of patient preferences in achieving positive health outcomes[24]. Music-based interventions deliver tangible ways for children to partake directly in care giving and manage challenging situations.

It is also important to regard the kit for implementing musical interventions. There is a high reliance on pre-recorded audio delivered through headphones. It exemplifies the viability and cost-effectiveness of music interventions in the hospital. The costs associated with the equipment needed to play music are relatively affordable, and several previous studies suggest that nurses may execute interventions without formal internship [32,35,37,39,41].

Music treatment is unassailable, affordable, and uncomplicated to learn, and hospital nurses can use it efficiently [42]. Music in nursing practice can be used unattended or in concurrence with other methods, such as jaw relaxation [43] and therapist guidance [44]; it can be used in a variety of sets, circumstances, and people for a miscellany of pursuits [43–47]. According to studies, 20-90 minutes of music therapy is an adequate remedy time. The following types of music were played: Sedative music [48], researcher-supplied music and subject-preferred music, soothing music, and easy-listening music are all examples of sedative [46].

Music therapy may activate the natural analgesia in the human body that leads to alleviating pain, known as Endorphine [49]. Endorphine is a neuro hormone provoking pleasant sensations. The pain will be relieved along with parasympathetic system activation, which leads to the relaxation of the body. Aside from feel-good chemicals, nor-adrenaline and serotonin contribute enormously to pain relief via attenuated transmission of the brain's descending impulse. The descending control system is a sensory neuron fiber that runs from the midbrain (precisely the peri-aqueductal gray matter) to the inter-neuronal inhibitory system [50–52]. The system will remain active in response to the

stimulus of soft music, which inhibits the transmission of the pain stimulus. Music therapy has been shown to stimulate the axons or nerve fibers on the ascending tracts of RAS neurons (Reticular Activating System). The stimulus is transmitted to the cerebral cortex, limbic system, and corpus callosum through the autonomous nervous and neuro-endocrine systems. When one is immersed in soft music, the limbic system is aroused, causing it to secrete phenylethylamine (neuroamin), which controls impulse and mood emotion. Music stimulates the parasympathetic nervous system to work on the sympathetic nerves, causing the switch to alpha-type brain waves to yield soothing outcomes on the autonomic nervous system [53–55].

The physiological justification backs up the study's finding that music therapy has a positive effect on reducing or relieving anxiety and pain in children. Nurses ought to employ a combination of pharmacologic and non-pharmacologic interventions to relieve pain and avoid the medication's unwanted side effects [56]. It lays the hypothetical underpinnings for skillful or qualified nurses to gain new knowledge of other methods effective in relieving pain and anxiety, such as the use of music therapy, in health-care facilities. It echoes the assertion made by Huang, Good, and Zauszniewski [48] that music therapy is one of the interventional techniques that has concrete proof nursing theories to proficiently alleviate anxiety and pain.

Indeed although all considerations included in this integrator writing survey are of tall or great quality, it is conceivable that the comes about might have been impacted by pondering confinements. For case, a few ponder utilized a little test measure or did not incorporate a test estimate calculation. Test estimate was famous when evaluating the quality of each article. In expansion, most things did not dazzle the analysts, spectators, or members. Even though blinding in the investigation is critical to play down any conceivable inclination, it is troublesome to do so with music-based mediations, especially live music.

Two studies used an invalidated pain or anxiety scale in the study population, which was highlighted when appraising the precision of each article [37,41]. Because pain and anxiety are

subjective, they are challenging to assess. Standardized pain and anxiety scales are used by providers to assess pain and anxiety, especially in nonverbal or nonresponsive patients. CHEOPS, FACES, FPS-R, NRS, and VAS pain scales were used in the studies. The m-YPAS and STAIC anxiety scales were used in the studies. While there are numerous pain and anxiety scales available, a validated and user-friendly pain or anxiety scale may not always be obtainable or ubiquitously used for the workforce being ascertained.

A wide age range of participants was used in multiple studies. From infancy to adolescence, children's emotions, personalities, behavior, and speech will grow and develop. The way children react to stimuli like pain and anxiety will vary based on their developmental stage and age. Despite the fact that the studies only looked at children aged 0 to 18, the use of such a wide age range of individuals makes the reliability analysis of the findings questionable.

LIMITATION

In our search for full-text articles, we only collected 12 articles due to the limited access we faced, which prevented us from further exploring the magnitude of the effect of music therapy on pain and anxiety in children in the form of a meta-analysis. Some of the studies we include are also in the Some Concern category, so using the results of this study requires caution. However, we believe that nurses can apply music therapy autonomously in managing pain and anxiety in children as a form of nursing implementation and improving the quality of care.

CONCLUSION

For children in the hospital, pain, and anxiety often come to them in various incredibly invasive medical procedures. Music therapy can be the first choice for nurses to offer children with minimal side effects and is friendly to children's conditions. Physiologically, music therapy can trigger natural analgesics in the body through neurohormones that have a calming effect. Based on studies

that apply music therapy, the type of music generally used in classical music is delivered through headphones. Future studies can further examine how music therapy influences chronic pain conditions in children.

Conflict of Interests

There is no conflict of interest.

Ethical Approval

Ethics approval Ethical approval will not be required because this study will retrieve and synthesize data from already published studies.

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Author's Contribution

All authors equally contributed to preparing this article.

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