

The Effect of Music Therapy as an Adjunctive Treatment in Pediatric Cancer Patients Receiving Traditional Therapies: A Systematic Review

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Abstract

Aim: This study aimed to analyze articles that discussed the effect of music as adjunctive therapy to traditional treatments of pediatric cancer patients compared to a control of no music therapy. **Background:** Cancer is a leading cause of death in children, with over 400,000 children diagnosed annually. During standard oncologic treatments, children often experience psychological and physical adverse effects. The use of music therapy can provide numerous supportive benefits to pediatric patients as adjunctive treatment in reducing psychological and physical burdens. **Design:** This was a systematic review of English-language articles from PubMed. **Methods:** Nine outcome articles were utilized in this systematic review, including quantitative and qualitative reviews of case studies, interviews, historical accounts, randomized control trials, and other systematic reviews. **Results:** The study found increased quality of life (QOL) involving dimensions of mood, cognition, relaxation, self-esteem, vitality, and a sense of community involving interpersonal relationships. The implementation of music therapy in pediatric oncology patients decreased stress/distress and pain. Qualitative data suggests QOL dimensions of localization and control of feelings, sense of community involving social roles and ecological health, stress, distress, and pain, improved in pediatric oncology patients receiving music therapy. **Conclusion:** The literature supports music therapy as a complementary treatment during traditional therapies to help decrease stress and pain in children and improve quality of life and sense of community. Therefore, music therapy as an adjunctive therapy should be implemented into standard practice.

Cancer is a leading cause of death in the pediatric population, with 400,000 children diagnosed yearly (Tsai et al., 2014; Wong et al., 2021). Due to innovative advances, the overall survival rate for pediatric cancers in the United States is estimated to be approximately 83% (Raybin & Krajicek, 2020). Pediatric cancer diagnoses and conventional treatments have substantial physical and emotional adverse effects. The pediatric cancer population is subject to invasive interventions such as surgery and chemotherapy during standard evidence-based therapy. An investigational analysis of the effect of complementary and alternative medicine on the physical and psychological burden of pediatric cancer patients is necessary to improve standard oncology therapy in this population (Jong et al., 2020).

The treatment of pediatric cancers involves various invasive procedures and protocols that often involve extended hospital stays. These standard treatment options include surgery, chemotherapy, radiation, and targeted biologic therapies (Raybin & Krajicek, 2020). Survival rates of pediatric oncology patients are improving due to advances in standard therapies and earlier diagnoses. However, pediatric patients are still left with neurocognitive, psychological, and physical side effects from the disease and treatment. Among various studies, the most common side effects during and after treatment included fatigue (62%), worrying (30%–54%), feeling nervous (45%), dry mouth (42%), insomnia (41%), and feeling sad/depressed mood (39%), with 40% of patients experiencing at least one symptom (Lopez et al., 2019; Tsai et al., 2014). Additionally, the United Kingdom reports that approximately one quarter of patients will go on to eventually develop mental health disorders such as major depressive disorder (MDD), generalized anxiety disorder (GAD), and post-traumatic stress disorder (PTSD; Coughtrey et al., 2018). Psychological adverse effects have decreased outcomes, reduced quality of life, significant distress, and extended hospitalizations. Current treatments for psychological symptoms fall under complementary and alternative medicine (CAM; Coughtrey et al., 2018).

The use of CAM has gradually gained support in oncology patient treatment regimens over the past few decades. Reports indicate that there was an increase in the use of CAM by parents for

their children from 9% to 46% over the past 20 years. Patients with cancer have reported physical (more energy, reduced feelings of nausea) and psychological (feeling calmer, emotionally more substantial, and more optimistic about the future) benefits from using CAM (Molassiotis & Cubbin, 2004). Complementary and alternative therapies include meditation and relaxation, herbal medicines, faith-based, hypnosis, exercise, and creative art techniques as alternative and adjunctive options. It is recognized by the National Institutes of Health and has gained acceptance as an integrative form of therapy. Complementary and alternative medicine has gained popularity over the years despite the earliest documented approaches beginning in the 1980s. Creative art therapy (CAT) is classified under CAM as a mind and body intervention; it includes modalities such as music, art, dance, yoga, drama, and poetry as therapeutic approaches. Music therapy includes participating in songwriting, lyric analysis, learning a musical instrument, listening to a live performance, or listening to music through headphones. Creative art therapy is effective for reducing symptoms of pain and anxiety in children with cancer. It has the potential to be integrated into standard therapies during extended hospital stays due to the natural creativity of children and the potential for children to communicate complex emotions through creative outlets (Raybin & Krajicek, 2020).

The use of music therapy in pediatric oncology treatment demonstrates promise due to evidence of its value in the adult population. Fewer data are focusing solely on pediatric patients than on adults. Therefore, a systematic review of existing studies is necessary to summarize current evidence and provide a framework for prospective work. From studying adult patients, music therapy has demonstrated effectiveness as adjunctive therapy to improve evidence-based practice. Similar to desired effects in children, music therapy in adults has been attempted to ameliorate anxiety, depression, pain, and fatigue, and improve mood, relaxation, and overall well-being during treatment in both inpatient and outpatient populations (Lopez et al., 2019; Tsai et al., 2014). The effect of music therapy has been studied in conjunction with traditional therapy, including chemotherapy, radiotherapy, and surgery (Toccafondi et al., 2018). The effects

of music therapy on adult cancer populations in different research methods demonstrate similar positive correlations (Samadi et al., 2021; Thrane, 2013; Tsai et al., 2014). Initial pediatric research has demonstrated a similar positive correlation effect; however, there are comparatively fewer data focusing solely on this population (Thrane, 2013; Xie et al., 2022). An analysis of different methods and enumeration of effects in these samples should be conducted to summarize current data. A systematic review of such studies will assess current research to create standard-based practices and highlight prospective areas of research.

Contemporary research continues to investigate the improvement in conventional cancer treatments, emphasizing epigenetics. Epigenetics has become the research focus of many conventional oncologic treatments, investigating environmental effects on gene expression.

These alterations in gene expression are hypothesized to be related to lifestyle changes and thus are of particular interest to researchers. Current adult outcomes support using nonconventional holistic care in evidence-based practice. Fewer studies support the same benefits in children; thus, improvement is needed in the research and integration of holistic care in the pediatric population. Creative art therapy may be a good option for children due to prior success with adult populations. Future research should aim to apply findings concerning CAT, specifically music therapy, to evidence-based therapies. The objective should explore how treating a patient's psychosocial health with music therapy will affect quality of life and coping mechanisms. The research question investigates the effectiveness of music therapy compared with the absence of music therapy in pediatric patients. The outcome measures included quality of life, sense of community, stress, distress, and pain. The systematic review concluded that music therapy decreases stress and improves the quality of life during conventional oncology treatment and should be considered in standard-based care.

OBJECTIVE

The objective of this study was to assess the effectiveness of music therapy, compared with a control of no music therapy, in pediatric patients receiving traditional cancer treatment.

METHODS

This systematic review included qualitative and quantitative data to assess the research question. Case studies, interviews, historical accounts, other systematic reviews, and randomized control trials with pre-test/post-test were the design methods included in the analysis. All were primary sources and had to meet the following inclusion and exclusion criteria before being considered for full-text review. Exclusion criteria were that the mean age of participants was greater than 18 years old or unstated, other modes of alternative therapies (art, pet, gaming, etc.), sole investigation of parents or sibling outcomes, and pharmacological or traditional medical interventions only. Inclusion criteria were that patients must have a cancer diagnosis or be a survivor of cancer who had previous treatments, must have participated in some form of music therapy, and data sources could have been from anywhere in the world.

The analyzed intervention was music therapy in conjunction with standard oncology treatment in pediatric patients (ages 3–17). The following forms of music were included in the systematic review: playing music through an MP3 player, the radio, live music, acoustic, or full band, as well as songwriting or learning how to play a musical instrument. The parameter of the systematic review was broad and only required that music was an intervention. The type of music intervention or type of music played was not assessed or recorded and thus not reported in the analysis.

Four different reviewers performed data extraction (Figure 1). Through the Covidence program, two group members were randomly selected to review each full-text article to assess its applicability to addressing the research question. Articles with missing data were excluded, such as articles that made participant assumptions about dropouts. All articles were primary sources derived from the PubMed database. From the full-text eligibility inclusion and exclusion criteria listed previously, 47 articles were gathered for review. Nine of the 47 articles were selected for analysis in the systematic review, and the other articles were utilized as background information.

Several different outcomes were identified from the data collected; however, the analysis was delimited to reflect variables that were addressed

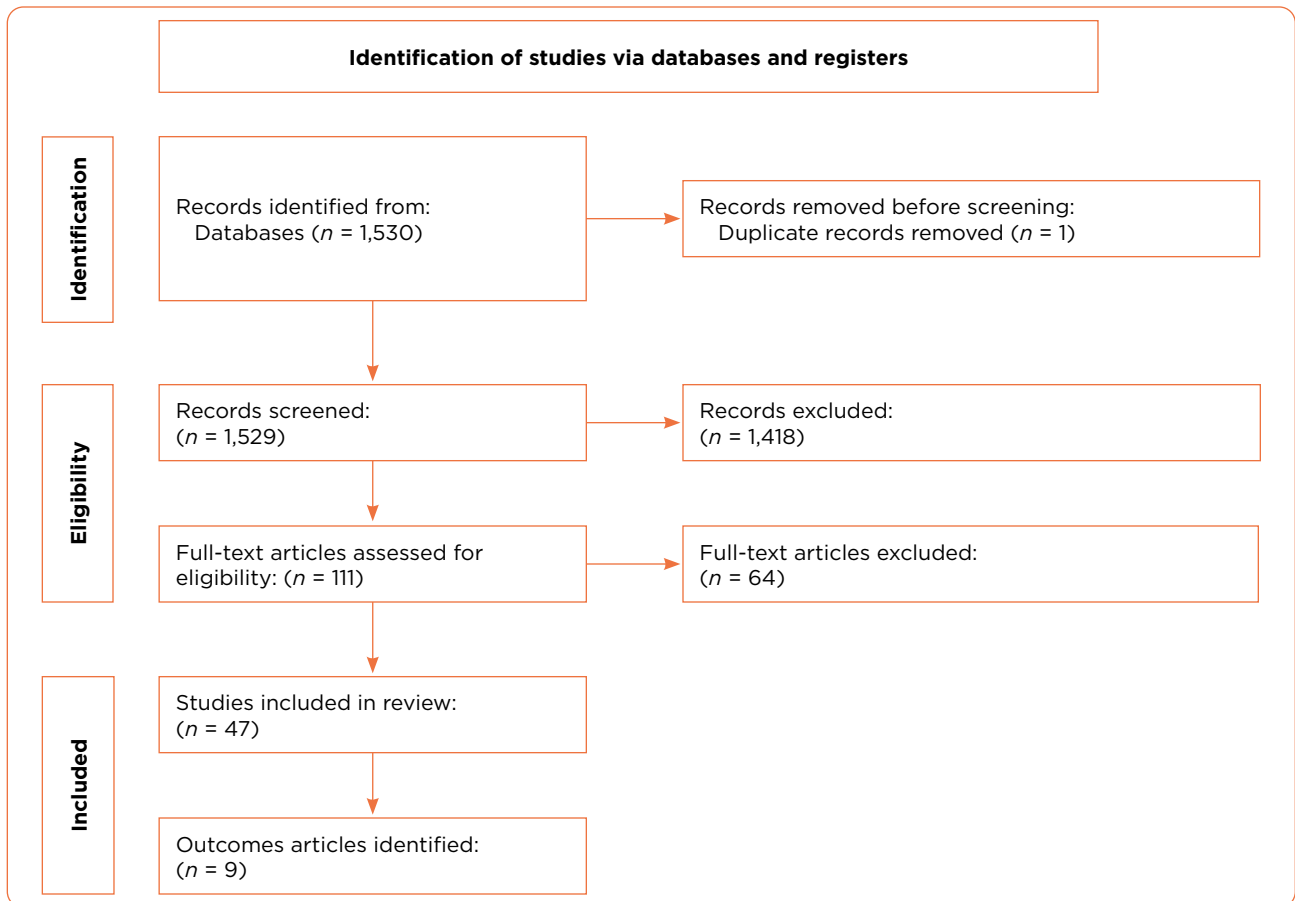


Figure 1. PRISMA flow diagram.

both quantitatively and qualitatively. This crossover provides more substantial support that the outcomes analyzed in this systematic review are essential for further research. The intervention was measured throughout the articles for improvement as determined by a significant p -value ($< .05$) for quantitative data and an overall individual reported improvement for qualitative data.

The assessment of risk of bias was evaluated by two reviewers (Table 1). The design was based on the Cochrane risk-of-bias tool (Higgins et al., 2011). It was modified to reflect common limitations listed throughout the articles analyzed in this systematic review and the desired important points assessed within the data.

Grade was assessed based on two reviewers chosen randomly to grade each article for the strength of evidence, and the average of the two grades was recorded (Table 2). The criteria were based on the Grading of Recommendations, Assessment, Development, and Evaluations

(GRADE) guidelines and modified to reflect more specific domains that contributed explicitly to the research topic (Andrews et al., 2013). The final grade was determined by the criteria for low, moderate, or high risk identified in the given resource.

Pre- and post-test evaluation revealed the overall quality of life and its dimensions increased with music therapy treatment implementation throughout chemotherapy (84%), palliative care (18%), and other (64%; Table 3). The overall quality of life and its dimensions also improved relaxation in music therapy vs. control of no music therapy during and post treatment and treatment goals during therapy. In addition to increasing overall quality of life, music therapy increased self-esteem and decreased depression rates compared with the control post treatment. Additionally, goals addressing interpersonal relationships were achieved (84.2%) with the implementation of music therapy. Stress and distress decreased with music therapy showing an increase in parasympathetic activity in music vs.

Table 1. Assessment of Risk of Bias

	Not randomized	Other (family/friend) accounts of experiences for patient	Smaller sample size (< 50)	Generalizability	Selective reporting methods	Other bias
Barrera	-	-	+	+	+	-
Wong	-	-	+	-	+	+
Facchini (qualitative)	N/A	-	+	-	-	+
Kemper	-	-	-	+	+	?
Cheung	+	+	+	+	+	+
Ferrari (qualitative)	N/A	+	-	+	+	?
Thrane	+	+	-	+	+	+
Knoerl	-	+	-	+	+	+
Aasgaard (qualitative)	N/A	+	-	?	+	+

Note. + = low risk; - = high risk; ? = unclear

non-music therapy groups and pre- to post-music therapy on stress evaluations. Finally, overall pain decreased with music therapy.

Qualitative data (Table 4) suggests quality-of-life dimensions of localization and control of feelings, sense of community involving social roles, and

ecological health, stress, distress, and pain significantly improved in pediatric oncology patients receiving music therapy. Multiple studies support that music therapy helped patients feel like more than their given identifier of the patient and deemed music therapy intervention meaningful.

Table 2. Strength of Evidence Grading

	Balance of desirable and undesirable outcome	Confidence in estimates of effect (quality of evidence)	Values and preferences	Resource implications	Overall strength of recommendation
Barrera	+	+	+	+	High quality
Wong	+	+	+	+	High quality
Facchini (qualitative)	+	-	+	+	Moderate quality
Kemper	+	-	+	+	Moderate quality
Cheung	+	+	+	+	High quality
Ferrari (qualitative)	+	-	+	+	Moderate quality
Thrane	+	+	+	+	High quality
Knoerl	+	-	+	+	Moderate quality
Aasgaard (qualitative)	+	-	+	+	Moderate quality

Note. High quality: Further research is improbable to change our confidence in the effect estimate. Moderate quality: Further research is likely to impact our confidence in the effect estimate and may change the estimate. Low quality: Further research is very likely to impact our confidence in the estimate of effect and is likely to change the estimate.

Table 3. Outcomes Quantitative Table

Outcomes	Dimensions of outcome	Number of participants	Number of articles	Quality of evidence ^a	Comments
Quality of life	Mood, cognition, relaxation, self-esteem, vitality	250	4	Strong	Barrera <i>p</i> -value (< .01): improvement in mood pre and post Wong, <i>p</i> -value (.004): achieving goals of treatment (1–4 goals) to number of sessions (180 average) Kemper, <i>p</i> -value (< .01): relaxation in music therapy vs. non-music therapy Cheung, <i>p</i> -value (< .001): better QOL, self-esteem, and less depression than the control group
Sense of community	Interpersonal relationships	91	1	Strong	Wong, <i>p</i> -value (.004)
Stress and distress		152	3	Moderate	Wong, <i>p</i> -value (.004), Kemper, <i>p</i> -value (< .05): parasympathetic activity increase in music vs. non-music therapy Knoerl, <i>p</i> -value (< .013): pre/post music therapy on stress
Pain		74	2	Strong	Kemper, <i>p</i> -value (< .05), Thrane <i>p</i> -value (phase I randomized: < .03/ phase II nonrandomized: < .006)

Note. ^aGRADE average from each article involved. QOL = quality of life.

Further findings suggest a meaningful effect of receptive interventions on pain perception and physiologic parameters of pain, stress, and distress based on heart rate variability, blood pressure, and saturation. Implementing music therapy in individual vs. group interventions with these parameters is worth further exploration.

This crossover between qualitative and quantitative (Table 5) supports the evidence that music therapy has a positive effect on stress, distress, and pain in pediatric cancer patients receiving treatment. The crossover also demonstrates that music therapy helps patients improve their quality of life and sense of community.

DISCUSSION

This systematic review evaluated evidence concerning the application of various music therapy interventions in treating pediatric oncology patients during and following invasive oncological treatments. This review aimed to assess the evidence and potential benefits of implementing music therapy as an adjunct when applied to standard treatment plans in pediatric populations. This review specifically examined and assessed psychological and physical variables. A total of nine outcome articles were included in this review after screening with specific inclusion and exclusion criteria. The outcome articles shared common themes such as

Table 4. Outcomes Qualitative Table

Outcomes	Dimensions of outcome	No. of participants	No. of articles	Quality of evidence	Comments
Quality of life	Localization and control of feelings	20	1	Moderate	Being seen as human beings instead of just patients
Sense of community	Social roles, ecological health	24	2	Moderate	Better working role in care with a doctor Better awareness of the world around us and small acts of kindness—combining illness and treatment with typical aspects of life
Stress and distress		596	1	Moderate	Significant
Pain		596	1	Moderate	Purposed from passive evaluation—direct testing needs further research

Table 5. Total Outcomes for All Outcome Articles

Outcome articles	Total outcomes
Barrera	Play performance/engagement Overall mood (satisfaction) ^a Parental impressions of child
Wong	Cognitive function (energy/attention/memory) ^a Body functions (pain/sensory/voice/speech) Engagement General tasks Communication Stress ^a Interpersonal relationships ^a Community
Facchini (Qualitative)	Distress ^a Pain ^a Well-being
Kemper	Pain ^a Relaxation ^a Vitality ^a Well-being Stress ^a Anxiety Depression Heart rate
Cheung	Depression Self-esteem ^a Quality of life ^a
Ferrari (Qualitative)	Localization and control of feelings Communications Sense of community Being more than a just a patient
Thrane	Pain ^a Anxiety Heart rate Respiratory rate
Knoerl	Anxiety Stress ^a
Aasgaard (Qualitative)	Palliative care Active social role ^a Ecological changes in health ^a

Note. ^aIncluded within the four themes analyzed.

improved quality of life, stress, anxiety, and pain. The conclusions of the systematic review demonstrated overall positive psychological and physical benefits associated with the application of music therapy intervention during and following oncologic treatments in pediatric patient populations despite the heterogeneity of the data collected.

Mood and Depressive Symptoms

Pediatric cancer patients often have psychological and emotional burdens that may be overlooked

during and following invasive treatments (Facchini & Ruini, 2021). Music therapy interventions may be beneficial as they are shown to have positive emotional and mood regulatory effects. Based on this review, children who underwent high-dose chemotherapy who received music therapy during their procedures experienced significantly fewer disturbances in mood and experienced an overall positive effect on reducing treatment-related depression (Wong et al., 2021). Different musical interventions effectively reduce negative mood and depressive symptoms in pediatric oncology patients. Oncology treatment using musical training of different instruments provided both therapeutic and leisurely effects in Chinese pediatric populations. The patients were randomly assigned to different musical instruments and assessed for weekly improvement in self-esteem, depressive symptoms, and overall quality of life for 1 year after undergoing musical training. Results found that musical training is effective in reducing depressive symptoms and enhancing self-esteem in pediatric oncology patients (Cheung et al., 2021). Despite various forms of musical interventions such as receptive music therapy, active music therapy, and combined methods of receptive and active interventions, there are psychological benefits that can enhance the quality of life in pediatric patients undergoing painful treatment procedures (Facchini & Ruini, 2021).

Children undergoing different oncologic treatments may have specific goals and needs. Social engagement and play therapy have been associated with mood and emotional regulation in children. Children with negative mood states are shown to be disassociated in social settings and during play (Barrera et al., 2002). One study examined children's ratings of their feelings and mood using the FACES Pain Scale and examined children's play engagement before and after musical interventions during treatment. Parental ratings using the Play-Performance Scale demonstrated a trend among ages in the children, despite overall positive feedback. Findings indicated that children had improvement in mood, and younger children and adolescents showed a greater improvement and an increase in play performance and engagement, while school-aged children did not improve as much following music therapy interventions. One cited reason for

the age discrepancy may be that younger children have been reported to be at a greater risk of developing emotional and behavioral problems during and following hospitalization or chronic illnesses. This is likely due to their limited understanding and lack of full emotional maturity.

This suggests that early intervention in standard oncology treatments is essential, and music therapy may be more beneficial in supporting younger children than older children. Additionally, parents' ratings of their children suggested a general improvement in the child's play activity after implementing music therapy (Barrera et al., 2002).

Stress

Stress is a common manifestation affecting patients during and following oncological treatments. Patients may have stress from physically demanding treatments and the emotional strain that the diagnosis brings. Musical therapy interventions can be tailored to address a patient's individualized needs specifically. One study examined various specific, measurable, achievable, relevant, and time-bound (SMART) goals set by the World Health Organization that were evaluated by a certified music therapist before, during, and following oncologic treatments for each study participant. Some specific treatment goals focused on reducing stress and distress. Overall, 89.2% of treatment goals were achieved during the course of treatment, demonstrating that the application of music interventions to standard treatments can be therapeutically beneficial and provide additional needed support. Despite the musical preferences of different patients, standard music selections unfamiliar to patients provide additional benefits that reduce stress and add relaxation benefits. Patients participated in 40-minute sessions during two separate visits. Visit 1 served as the control, and visit 2 consisted of the child resting in a quiet room while listening to music for 20 minutes after undergoing treatments. The child's parent then completed the Visual Analogue Scale (VAS) along with the child that analyzed three positive and three negative states: relaxation, well-being, and vitality or energy, and anxiety, stress, and depression. Results demonstrated improvement in reported relaxation and an overall reduction in stress with music, despite the music being objective and unfamiliar to all patients (Kemper & McLean, 2008).

Pain and Physiologic Symptoms

Music therapy also offers strong potential physical benefits, such as reducing pain symptoms. Pain is a common symptom and may be an adverse effect of both the disease process and the intense oncological treatments. Pain can be psychological or physical in origin. One randomized control trial examined the effects of musical interventions on the reduction of pain in pediatric leukemia patients following lumbar punctures. This study evaluated patients for reduced vital signs and self-reported pain as indicators of physical or psychological pain following lumbar punctures in leukemic patients. Patients were grouped; one wore identical headphones but had no music, while the other group had headphones on with music playing during the lumbar puncture. Reports indicated that patients reported a decreased rating in self-reported pain with the addition of music and a reduction in both resting heart rate and respiratory rate during chemotherapy (Thrane, 2013). Additional studies noted improvements in heart rate, respiratory rate, blood pressure, and oxygen saturation following the implementation of music therapy (Facchini & Ruini, 2021). One study reported a reduced value in the high frequency parameter used to establish physiological relaxation measurement (Kemper & McLean, 2008). Alleviating pain and physiologic effects during treatments through the implementation of musical-based interventions may allow for more efficacious protocols that provide additional comfort and support to pediatric patients.

Despite different modalities of music therapy, positive benefits illustrated numerous beneficial outcomes that provided needed therapeutic support to patients aiding in providing efficacy to standard treatments. Through this systematic review, Table 3 demonstrated effectiveness in providing beneficial musical intervention that is therapeutic in reducing psychological and physical adverse effects due to oncological treatments. Specifically, significant advantages in applying musical therapy interventions as adjuncts were demonstrated in psychological (stress reduction, quality of life, self-esteem, overall mood) and physical (pain, relaxation, reduction of vital signs) outcomes. Regardless of the type of musical intervention applied, pediatric patients illustrated a reduction in associated adverse effects.

CLINICAL IMPLICATIONS FOR PRACTICE

The following systematic review provides supportive evidence for using music therapy in oncological treatments as an adjunct in providing additional needed benefits to patients. Music therapy has the potential to be universally implemented in oncology settings by children, parents, medical staff, and physicians. However, more education is needed to provide these populations with the tools to allow patients and parents to consider this form of intervention and understand the potential benefits. One study performed on the medical staff members at a teaching hospital in the southeastern United States reported that 70% of respondents from a pediatric oncology unit had strong, positive attitudes regarding benefits in clinical outcomes and reduction of pain (Bouhairie et al., 2006). Staff and physician attitudes regarding music therapy may impact future applications to oncology settings, availability of treatment, and patient access as an option of treatment consideration. This calls for future research regarding the education on the benefits of music therapy and various interventions for medical staff in oncology units. There is importance in providing supportive and emotional treatments in future oncological settings that may be more efficacious in reducing adverse effects on patient outcomes. Music therapy can be short and cost-effective, thus worthwhile to consider implementation in clinical practice (Facchini & Ruini, 2021).

Role of Advanced Practitioners

Advanced practitioners are integral members of a patient's care team and may often serve as a primary advocate during a patient's treatment in various oncology settings. Advanced practitioners serve in high-capacity roles that come with high levels of responsibility. This may involve determining proper treatment protocols, adjusting care plans to provide added comfort to the patient, and ultimately communicating with other health professionals. These other professionals include music therapists who work in conjunction with advanced practitioners regarding the care decisions in the best interest of the patient. As established in this review, music therapy has numerous psychological and physical benefits that may alleviate some of the intense adverse effects associated with oncology treatments. Addi-

tionally, this mode of therapy is both cost effective and easy to implement in both receptive and active forms. Advanced practitioners have the ability to adjust treatment plans as necessary and in the best interest of the patient. Providers have the opportunity to provide this form of adjunctive therapy as an option of consideration to the patient and the family and allow the patient to benefit from possible treatment with the music therapist. The provider may also play a role in establishing psychological and social goals specific to the individual patient that may improve from added music therapy. The therapeutic role of music may assist in improvement of socialization, allow for verbalization of complex emotions, allow for healthy coping mechanisms, and provide a needed outlet for stress and anxiety. Pediatric patients may lack maturity in communicating complex negative emotions associated with the burden of a cancer diagnosis and extended hospitalization and may not know ways to understand or verbalize these feelings with the provider or family. Music offers an outlet to communicate these emotions and may provide for more effective treatments by creating a calm and supportive environment for the patient. Participating in music therapy facilitates an increased sense of community and allows for psychosocial support. Additionally, music offers possibilities for collaboration and interaction between the patient's family and medical staff. The added benefits of music therapy offer not only psychological, social, and emotional support but also benefit the provider by allowing the patient and their family to be more interpersonally supported and may lead to more efficacious treatments (Stanczyk, 2011).

Bias

The articles were systematically screened with well-defined exclusion and inclusion criteria. Articles excluded from this systematic study were those in which the mean average age of participants was over 18 years. Additional modes of therapy such as art, virtual reality, and pet therapy were excluded. Articles that researched pharmacologic and medical interventions as opposed to music therapy treatments were also excluded. Finally, articles in which the effect of music therapy was measured in siblings and parents instead of the patient were excluded. The inclusion criteria required a cancer diagnosis or survivor of cancer and a mean age of

18 years or younger. The inclusion criteria were broadened to research published articles worldwide that focused on music therapy as an adjunctive treatment to conventional oncology treatment. The enumeration of these inclusion and exclusion criteria allows for increased strength of the systematic review.

Including a bias table allows for the assessment of the limitations of the completed systematic review. The bias table was constructed from the limitations of note in the articles and parameters investigated that may skew the information analyzed (Table 1). The Cochrane Collaboration tool was used to assess the risk of bias in randomized trials (Higgins et al., 2011). The biases included in the table provide realistic parameters that may influence the data collected without undermining the findings of the benefit of music therapy on pediatric oncology patients. The nonrandomized criterion stipulates that the patients did not choose the music therapy given or the length of time exposed to the music. The randomized criterion encompassed placement in control vs. music therapy group. Randomized and nonrandomized data allow for control of specific data analysis criteria. Another bias included family accounts of the experiences of the patient as opposed to gathering data only from the patient. This bias does not discredit the study but instead allows for a higher level of communication between the subject and examiner by providing another language route. A small compared to a large sample size provides a more controlled study but may prove more difficult to generalize the data. Nonselective reporting methods entail the inclusion of all criteria despite poor results, while selective reporting methods may only include the relevant information. While performing this systematic review, biases were assessed and considered. These biases do not discredit the overall conclusion of the positive effect of music therapy on pediatric cancer patients but rather are criteria to consider for future studies. The GRADE guidelines were utilized with multiple domains to assess the overall strength of the systematic review (Andrews et al., 2013). The domains included were a balance of desirable and undesirable outcomes, the confidence of estimates of effect (quality of evidence), values and preferences, and resource implications. Prospective studies should take into consideration

further exploration of these biases as well as other criteria. Different age groups and communication between the patients and examiners should be assessed, for example, if the use of a parent was effective in explaining the patient mood. The type of music, the volume of music, the length of music, and the method in which music is played are also variables that may warrant further study.

The poor generalizability of the data gathered for this systematic review is the study's primary limitation. The systematic review analyzes a particular patient population, making the data difficult to generalize to universal populations. Pediatric patients in different age ranges were selected, requiring a cancer diagnosis. One study utilized an age range from 15 to 25 years, and one included the descriptive range of school-aged children (Ferrari et al., 2015; Xie et al., 2022). The heterogeneity of the cancers was another factor preventing the generalizability of the data collected and biased examination. Children with leukemia, osteosarcoma, lymphoma, and neuroblastoma were included in the sample (Barrera et al., 2002). In addition, the studies analyzed had different measurement instruments and methodology. One measurement instrument included mood ratings using schematic faces and parental ratings of play (Barrera et al., 2002). Another measurement instrument assessed heart rate variability and visual analog scales of relaxation (Kemper & McLean, 2008). The time the intervention was administered to the patients was also variable. One study provided four sessions of music therapy over 12 weeks (Knoerl et al., 2022). Another study gave 3 to 4 hours of the intervention for 14 days over 8 months (Ferrari et al., 2015). Yet another study only provided the intervention once (Barbeito et al., 2022). This variability in measurement instruments provides another component that prevents the easy generalizability of the data collected. It also prevents ascertaining a clear or best method to gather data in future studies. Another limitation to this systematic review was the inclusion of PubMed articles exclusively. Overall, the significant limitations of the systematic review were poor generalizability from a specific patient population and nonrandom samples. Despite these limitations, the results were statistically significant in demonstrating a positive correlation in reducing adverse effects.

There were many threats to the validity of the generalizability of the studies. The different methodologies and samples utilized provided sources for any inconsistencies in the findings. However, the results delineated the overall consistent statistical significance of music therapy on pediatric oncology patients. Despite the heterogeneity in the methods of our studies (qualitative vs. quantitative; how they tested for music effect), the consistency of the results reached across these studies demonstrates the generalizability of music therapy across different populations.

CONCLUSION

Implications for future research include determining the effects of differing creative art therapies vs. music therapy as adjunctive therapies for the pediatric oncology population. Additional creative art therapies worth investigating include pet, visual arts, dance, and writing modalities. Moreover, differing types and methods of music therapy are worth exploring. Fundamental music therapy methods involve receptive listening-based and active methods involving interactive music instrument playing. Studies suggest two potential receptive methods. Of these, the first addresses relaxation music therapy, which can be integrated to ameliorate anxiety, depression, and cognitive disorders. Secondly, receptive analytical music therapy is thought to play an integral role in analytic psychotherapy (Bradt & Dileo, 2010). Future research comparing the effects of receptive, interactive, and guided imagery music therapy as adjunctive therapies for the pediatric oncology population is warranted. Therefore, the literature supports music therapy as a complementary treatment to traditional therapies to help decrease stress and pain in children and improve quality of life and sense of community. Music therapy as an adjunctive treatment to standard pediatric oncology treatment regimens should be implemented into standard practice. Advanced practitioners in oncology can help increase patient awareness of the benefits of music therapy in coping with oncologic stressors by implementing music therapy as standard practice. ●

Disclosure

The authors have no conflicts of interest to disclose.

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