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A scientometric analysis of music therapy in pediatrics settings globally: Research trends, collaboration networks, and emerging topics (2000–2024)

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Abstract

Music therapy (MT) has emerged as an effective non-pharmacological intervention for enhancing emotional regulation, social communication, and neurocognitive function in children. This study provides the first comprehensive scientometric analysis of global MT research trends in pediatric settings. Analyzing 1,383 publications from Web of Science, we employed co-citation networks, keyword clustering, and burst detection to: 1) map international collaboration networks, 2) track thematic evolution, and 3) identify emerging frontiers. Results reveal exponential growth since 2010, peaking in 2022, with the U.S., U.K., and Australia as leading contributors. Core research clusters focus on autism spectrum disorder, pediatric anxiety, and pain management, while cutting-edge domains include AI-assisted MT, computational modeling, and neuroplasticity-based interventions. The field shows a paradigm shift from generalized approaches to precision therapies, particularly in pediatric oncology, neonatal care, and neurodevelopmental rehabilitation. Key institutions like Aalborg University and University of Toronto anchor collaborative networks. This analysis not only delineates the intellectual structure of pediatric MT research but also provides empirical guidance for future studies, clinical applications, and cross-disciplinary innovation in this rapidly evolving field. The findings highlight MT's growing scientific validation and its transition toward technology-integrated, evidence-based practices in child healthcare. *(Afr J Reprod Health 2025; 29 [8s]: 105-119).*

Keywords: Music Therapy; Pediatric Healthcare; Scientometric Analysis; Neurodevelopmental Disorders

Résumé

La musicothérapie (MT) s'est imposée comme une intervention non pharmacologique efficace pour améliorer la régulation émotionnelle, la communication sociale et les fonctions neurocognitives chez l'enfant. Cette étude propose la première analyse scientométrique complète des recherches mondiales en MT pédiatrique. À partir de 1 383 publications (Web of Science), nous avons analysé les réseaux de co-citation, les clusters de mots-clés et les tendances temporelles pour: 1) cartographier les collaborations internationales, 2) suivre l'évolution thématique, et 3) identifier les frontières émergentes. Les résultats montrent une croissance exponentielle depuis 2010 (pic en 2022), avec les États-Unis, le Royaume-Uni et l'Australie comme principaux contributeurs. Les recherches portent principalement sur le trouble du spectre autistique, l'anxiété pédiatrique et la gestion de la douleur, tandis que les domaines émergents incluent la MT assistée par IA, la modélisation computationnelle et les interventions basées sur la neuroplasticité. On observe un changement paradigmatique vers des thérapies ciblées, notamment en oncologie pédiatrique, soins néonatals et réhabilitation neurodéveloppementale. Cette analyse éclaire la structure intellectuelle du domaine et offre des pistes pour futures recherches et innovations cliniques, soulignant la validation scientifique croissante de la MT et son intégration technologique dans les soins pédiatriques. *(Afr J Reprod Health 2025; 29 [8s]: 105-119).*

Mots-clés: Musicothérapie, Soins de santé pédiatriques, Analyse scientométrique, Troubles du neurodéveloppement

Introduction

Music therapy, or MT for short, is when music is used for therapy, i.e., an organized way of using music's basic elements—like rhythm, melody, and harmony—to improve mental health, physical health, and social welfare. It is used to describe the use of music, in a formal way, to promote quality of life and well-being in medical, educational, and even daily life environments[1,2]. After World War II, music therapy started being used more and more in facilities like mental clinics and rehabilitation centers, mostly in the U.S. and Europe[3]. Ever since, music therapy (MT) has been studied more, with

psychology, neuroscience, and education all credited to it and especially in supporting the emotional wellbeing of children.

In the context of this study, the term "children" refers to pediatric populations typically under the age of 18 who are the subject of MT interventions in clinical and developmental contexts. These include children with neurodevelopmental conditions (e.g., autism spectrum disorder ASD, attention-deficit hyperactivity disorder ADHD), emotional and behavioral challenges (e.g., anxiety, trauma, Post-Traumatic Stress Disorder (PTSD)), and chronic or critical illnesses (e.g., cancer, preterm birth). This classification aligns with the inclusion scope of the 1,383 publications analyzed in this scientometric study.

Neuroscience understood how MT works and affects people. It has been seen through brain imaging that listening and engaging with music activates areas of the brain that control emotions, attention, language, and motor function—like the prefrontal cortex, amygdala, and hippocampus[4]. This information is in fact important to children because their brains are continuing to develop and can be changed a lot, and therefore music can have a more significant influence on how they grow up emotionally and intellectually during the early stages of life[5]. Music also seems to activate the reward system of the brain, the system that emits dopamine, and this serves to reinforce positive behavior and motivation. This has been shown to be especially useful in the management of conditions like ASD and ADHD[6,7].MT has been shown to enhance social communication, facilitate joint attention, and improve emotional recognition[8,9]. Additionally, rhythmic training in MT has been found to improve executive functioning and impulse control in children with ADHD, aiding in focus and cognitive flexibility[10]. In pediatric hospitalization settings, MT serves as a non-pharmacological intervention to reduce pain, anxiety, and emotional distress, particularly for children undergoing surgical procedures, cancer treatments, or intensive care[11]. The integration of interactive musical experiences—such as improvisation, singing, and rhythmic entrainment—has also been effective in fostering self-regulation and emotional resilience in children exposed to trauma or PTSD[12].

Growing levels of empirical literature have underlined the clinical effectiveness of MT, with systematic reviews and meta-analyses consistently proving that it is an effective intervention across a range of pediatric disorders. Doulah *et al*., through collating an impressive range of interventions for children on the ASD, recorded statistically significant enhancements in aspects of nonverbal communication, social interaction, and sensory integration[13]. Rodwin *et al*. provided further empirical data in a randomized controlled trial by demonstrating that music-based interventions significantly decrease emotional and behavioral symptoms like heightened anxiety, aggression, and social withdrawal[14]. Parallel findings from neurophysiological research have provided insights into music-evoked neural plasticity as a means to optimize cognitive functions, particularly those related to auditory processing, speech-related memory, and affect regulation[15].

Although the therapeutic potential of MT continues to garner robust support from interdisciplinary sources, the field does have considerable method standardization gaps. Variability in treatment protocols, outcome measures, and sample demographics frequently restrict external validity of outcomes[16]. Additionally, while current research is mostly centered around outcome-oriented efficacy, not very much is understood about the intellectual composition, collaborative processes, and thematic evolution of MT scholarship in pediatric settings[17].

Scientometric analysis offers a powerful methodology to quantitatively map the landscape of research by analyzing publication trends, citation patterns, co-authorship networks, and emerging topics[18]. CiteSpace, a widely used scientometric visualization tool, enables the identification of key authors, influential institutions, and research frontiers through techniques such as co-occurrence analysis, citation burst detection, and knowledge clustering[19]. By systematically analyzing research output from 2000 to 2024, this study aims to:

(1) Analyze international collaboration networks, identifying key authors, institutions, countries, disciplines, journals, and influential publications contributing to MT research.

(2) Examine keyword co-occurrence trends to reveal the evolution of research themes and emerging topics.

(3) To detect high-impact references and research milestones.

(4) To categorize the thematic structure of MT research across different time periods.

By employing a data-driven approach, this study provides a comprehensive knowledge map of MT research, contributing to a deeper understanding of its development, interdisciplinary impact, and future directions.

Methods

Data source and search strategy

The Thomson Reuters Web of Science Core Collection (WoSCC) hosts over 12,000 internationally recognized scholarly journals and is widely used as a core database in research in academia[20]. This study takes WoSCC as the main search database. In this context, "TS" stands for "Topic Search", a standard Web of Science query parameter that searches for terms in the title, abstract, author keywords, and Keywords Plus fields. The search query used search terms such as ((TS=(child)) OR TS=(childhood)) OR TS=(children) AND ((((TS= (music therapy)) OR TS= (musical treatment)) OR TS= (musical treatment)) OR TS= (musicotherapy)) OR TS= (musical-therapeutics), across publications from 2000 to 2024. The retrieved bibliographic records were exported in plain text, with complete records and cited references, for the purpose of in-depth data analysis. Overall, 1,383 valid documents were selected for this bibliometric analysis after removing irrelevant items, such as publications focused on adult populations, music education without therapeutic intent, or non-research article types (e.g., news reports, book reviews). Irrelevant records were screened manually based on title and abstract content. Additionally, key information such as authors, institutions, journals, document types, and countries or regions of origin was extracted and analyzed in Microsoft Excel (WPS Office 2019) to identify publication trends and patterns of research distribution.

Bibliometric analysis tools

CiteSpace

CiteSpace was primarily used to visualize scientific collaboration networks, which reflect the co-occurrence of authors, institutions, or countries within the same research outputs.Co-occurrence Network Scientific collaboration is the co-occurrence of several authors, institutions, or countries/regions in a single research paper at the same time[21]. A particular text-mining algorithm can identify these temporal changes in themes and mark them as "activity bursts"[16]. CiteSpace enables the detection of citation bursts using Kleinberg's algorithm, allowing us to identify influential references and emerging research fronts across time slices[22,23].

Results

Distribution of publications

Annual rise in volume of publication is an indication of accumulations of information within a specialized field of research and provides measurable report of its study development. A total of 1,383 publications for children's MT were realized through this search, of which 1,131 were research papers and 252 reviews. The total number of authors behind the publications are 4,717 from 1,905 institutions and placed into 674 journals across 127 subject classes (Table 1). Figure 1 provides the annual count of publications. In 2000, there were 12 papers published for this topic, and in 2001 this decreased to 7. Between the period of 2000-2006, the overall count of publications was quite limited. There was a rise close to 2007, after which the increase was steady right up to the year 2019. As of 2010, the rate of increase became greater and continued to finally reach its highest in 2022.With respect to journal publications, the Journal of MT leads the pack with 100 publications, then comes the Nordic Journal of MT with 75 publications, and The Arts in Psychotherapy with 55. Figure 2 gives the top 20 journals by publication frequency, and this can be used as a reference guide by researchers when selecting the appropriate journal to submit their papers to in this area of research.

Co-citation network of children's MT

The co-citation network visualization provides valuable insights into the citation relationships and intellectual structure of research in children's MT over the past two decades. Early-stage literature from 2000 to 2010 is represented by gray-colored nodes, which exhibit high node density and rich interconnections. These foundational studies function as the root system of the research field, supplying theoretical and empirical nourishment for its continued development. During the intermediate

Table 1: Overview of publications in children's MT research (2000–2024)

Categories	Publication	Articles	Review	Authors	Institutions	Journals	Subject categories
Amount	1383	1131	252	4717	1905	674	127

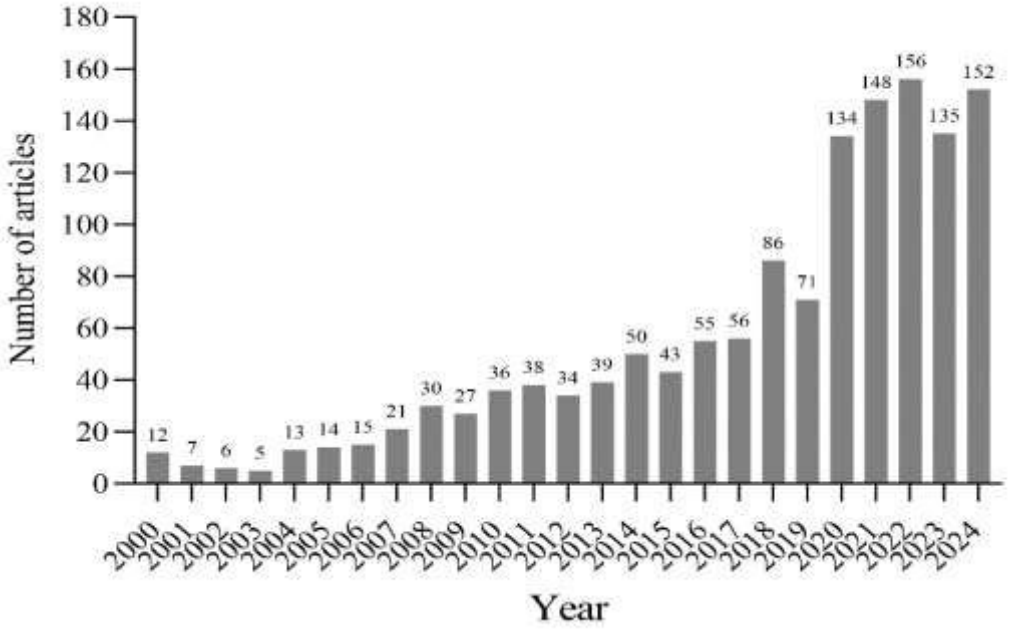

Figure 1: Annual volume (annual volume)

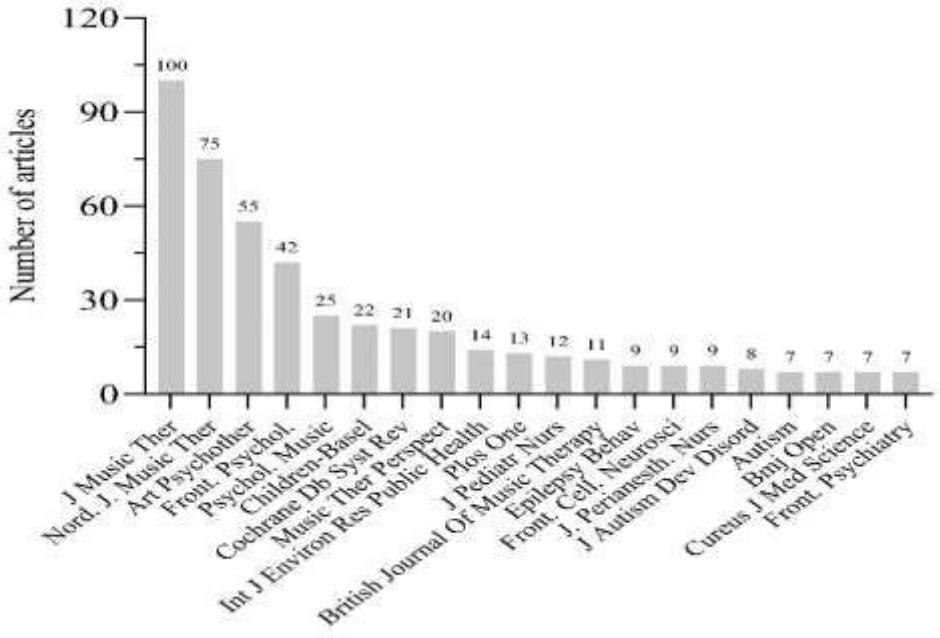

Figure 2: Journal publications (top 20 magazines)

period from 2011 to 2017, the network expands as blue-colored nodes become more dispersed, signifying the formation of major research branches that contribute to the diversification of scholarly discourse. In the later period from 2018 to 2024, the network structure becomes more refined, with nodes evolving into tightly clustered branches. This transformation indicates both the consolidation and specialization of research themes, suggesting an increasing concentration on specific aspects of children's MT.

Within this network, several highly co-cited publications have played a pivotal role in shaping the field. Among them, studies by Stegemann *et al*., Bieleninik *et al*., Sharda *et al*., Geretsegger *et al*., Page *et al*., Porter *et al*., Carter, and Mayer-Benarous *et al*. exhibit the highest co-citation frequencies, ranging from 20 to 40 citations. These publications hold a central position in the development of children's MT research, serving as intellectual cornerstones that have influenced subsequent studies. The concentration and specialization of research clusters around these key works will be further elucidated in the citation timeline visualization, which traces the evolution of thematic focus and scholarly attention over time[3, 25- 30]. The citation analysis highlights several milestone publications, among which three studies stand out for their significant impact:

(1) The Effects of Improvisational MT on Joint Attention Behavior in Children with Autism: A Randomized Controlled Trial

(2) Emotional, Motivational, and Interpersonal Responsiveness of Children with Autism in Improvisational MT

(3) Music in Intervention for Children and Adolescents with Autism: A Meta-Analysis

The co-citation network measures the size of each node as an indication of the citation importance of a specific reference, and the lines connecting it as its betweenness centrality—illustrating how much a publication acts as a conduit between various sections of the research community. By combining co-citation network analysis with historiographical inquiry, structural evolution of the field may be tracked and landmark studies discerned which have been responsible in the furtherance of children's MT research. Table 2

Scientific cooperation

The scientific collaboration network shows a densely connected structure at three levels: country, institution, and individual researcher. The density of the nodes and the numerous connecting lines reflect the rich and active collaborative relationships in the area of children's MT research. At the national level, The United States is the largest contributor, followed by the United Kingdom, Australia, China, and Canada, which are all together significant hubs of international cooperation. At an institutional level, top institutions with highest research output and co-influencing institutions are Aalborg University, the University of Melbourne, the University of Toronto, and the University of London. These institutions significantly contribute to the establishment of research progress for children's MT based on large scholarly collaborations. Among the most prolific contributors, Gold, Christian; Robb, Sheri L.; Elefant, Cochavit; Silverman, Michael J.; and Bieleninik, Lucja emerges as leading authors with a significant number of publications. The dense interconnections between nodes represent a high degree of research collaboration among these scholars, indicating the formation of academic alliances and knowledge-sharing networks.

Keywords burst

On a more granular level of investigation, keyword burst tracking provides critical insight into the changing research agenda in children's MT throughout the period of 2000-2024. Across the dataset, there were 759 keywords that exhibited burst activity at one or another point in time, representing changes in thematic concern over time. In the top 50 highest intensity burst keywords. Most notably, spectrum disorder recorded the greatest burst power at 6.92 for the period of 2022 to 2024. Keyword activities showed a significant burst between 2010 and 2015 with a power of 6.17, while autism showed a burst between 2012 and 2017 with a power of 4.62.

In addition to identifying historical keyword bursts, particular attention was given to 20 keywords that are still experiencing bursts in 2024, as they may indicate emerging research trends in the field. Notably, spectrum disorder exhibited a burst

Table 2: Highly cited publications in children's mt research (2000–2024)

No.	Article information	Journal	LCS	GCS
120	The effects of improvisational music therapy on joint attention behaviors in autistic children: A randomized controlled study	J AUTISM DEV DISORD	99	183
141	Emotional, motivational and interpersonal responsiveness of children with autism in improvisational music therapy	AUTISM	67	144
42	Music in intervention for children and adolescents with autism: A meta-analysis	J MUSIC THER	61	132
43	Effects of music therapy for children and adolescents with psychopathology: a meta-analysis	J CHILD PSYCHOL PSYC	61	145
488	Effects of Improvisational Music Therapy vs Enhanced Standard Care on Symptom Severity Among Children with Autism Spectrum Disorder The TIME-A Randomized Clinical Trial	JAMA-J AM MED ASSOC	57	95
341	Family-centred music therapy to promote social engagement in young children with severe autism spectrum disorder: a randomized controlled study	CHILD CARE HLTH DEV	55	88
101	Music for pain and anxiety in children undergoing medical procedures: A systematic review of Randomized controlled trials	AMBUL PEDIATR	53	176
170	Music Therapy to Reduce Pain and Anxiety in Children with Cancer Undergoing Lumbar Puncture: A Randomized Clinical Trial	J PEDIATR ONCOL NURS	51	152
21	Musically adapted social stories to modify behaviors in students with autism: Four case studies	J MUSIC THER	47	145
70	Music therapy in the assessment and treatment of autistic spectrum disorder: clinical application and research evidence	CHILD CARE HLTH DEV	46	95
335	Effects of a Music Therapy Group Intervention on Enhancing Social Skills in Children with Autism	J MUSIC THER	45	76
22	The effects of interactive music therapy on hospitalized children with cancer: A pilot study	PSYCHO-ONCOL	42	99
105	Impact of music therapy to promote positive parenting and child development	J HEALTH PSYCHOL	39	86
222	Music Interventions for Children with Autism: Narrative Review of the Literature	J AUTISM DEV DISORD	37	84
205	The Effects of Music Therapy Incorporated with Applied Behavior Analysis Verbal Behavior Approach for Children with Autism Spectrum Disorders	J MUSIC THER	36	56
478	Music therapy for children and adolescents with behavioral and emotional problems: a randomized controlled trial	J CHILD PSYCHOL PSYC	35	67
8	The effect of therapeutic music interventions on the behavior of hospitalized children in isolation: Developing a contextual support model of music therapy	J MUSIC THER	33	52
165	Effect of Developmental Speech and Language Training Through Music" on Speech Production in Children with Autism Spectrum Disorders"	J MUSIC THER	32	70
631	The Therapeutic Relationship as Predictor of Change in Music Therapy with Young Children with Autism Spectrum Disorder	J AUTISM DEV DISORD	30	79
319	Randomized Clinical Trial of Therapeutic Music Video Intervention for Resilience Outcomes in Adolescents/Young Adults Undergoing Hematopoietic Stem Cell Transplant	CANCER-AM CANCER SOC	30	117
378	Common Characteristics of Improvisational Approaches in Music Therapy for Children with Autism Spectrum Disorder: Developing Treatment Guidelines	J MUSIC THER	30	51

86	Use of songs to promote independence in morning greeting routines for young children with autism	J AUTISM DEV DISORD	30	49
87	Effect of long-term interactive music therapy on Behavior profile and musical skills in young adults with severe autism	J ALTERN COMPLEM MED	27	60
50	An analysis of music therapy program goals and outcomes for clients with diagnoses on the autism spectrum	J MUSIC THER	26	102
40	Interactive music therapy as a treatment for preoperative anxiety in children: A randomized controlled trial	ANESTH ANALG	26	57
115	Randomized controlled trial of the active music engagement (AME) intervention on children with cancer	PSYCHO-ONCOLOGY	26	46
577	Music therapy supported the health-related quality of life for children undergoing hematopoietic stem cell transplants	ACTA PAEDIATR	24	42
247	The Effectiveness of a Short-Term Group Music Therapy Intervention for Parents Who Have a Child with a Disability	J MUSIC THER	24	44
527	Music-based interventions to reduce internalizing symptoms in children and adolescents: A meta-analysis	J AFFECT DISORDERS	24	41
30	Relating improvisational music therapy with severely and multiply disabled children to communication development	J MUSIC THER	24	35

intensity of 6.92 from 2023 to 2024, trial had an intensity of 4.25 from 2022 to 2024, rehabilitation showed an intensity of 3.33 from 2022 to 2024, and fear had an intensity of 3.25 from 2023 to 2024.

Reference burst

917 references total contained citation bursts, indicating how influential they are in the area of children's MT. Table 3 lists the top 30 cited sources from 2000 to 2024. Of the top 30, the article MT for People with Autism Spectrum Disorder had the largest citation burst, which was highly active from 2015 to 2019. This study examines how the core challenges of autism spectrum disorder (ASD)—namely, impairments in social interaction and communication—can be addressed through the use of MT. Through engagement of individuals with ASD in structured musical activity, the therapy attempts to encourage expression and improve interpersonal communication. As an updated edition of the 2006 Cochrane Review, this systematic review comprehensively screened databases including CENTRAL, Ovid MEDLINE, EMBASE, LILACS, PsycINFO, CINAHL, ERIC, ASSIA, Sociological Abstracts, and International Dissertation Abstracts up to July 2013. By hand, also relevant studies were screened, and researchers were directly contacted to elicit more details. The review included all randomized controlled trials (RCTs) of MT alone or with standard care versus control conditions such as placebo, standard care alone, or no treatment.

Table 3 illustrates the most influential references that exhibited citation bursts over various periods from 2000 to 2024, Table 4 focuses specifically on the top 20 references with citation bursts that began in the recent years (from 2022 onward). These works reflect the most current research trends and emerging hotspots in the field of children's MT. The inclusion of both review articles and empirical studies in this table underscores the immediate academic impact and translational value of these recent contributions.

Emerging trends and new developments

The interconnected relationships among keywords form distinct clusters based on their thematic affinities, allowing for a more intuitive depiction of the key subfields within children's MT research.

In the first clustering phase (2000–2006), 72 articles were analyzed, resulting in 10 clusters, including #0 music therapy, #1 disability, and #2 evidence-based music therapy. During the second clustering phase (2007–2012), 186 articles were examined, yielding 12 clusters, such as #0 cerebral palsy, #1 emotion, and #2 mirror neuron system. The third clustering phase (2013–2018) expanded to 329 articles, generating 8 clusters, including #0 autism, #1 mental health, and #2 autism spectrum disorder. In the fourth clustering phase (2019–2024), a total of 796 articles were analyzed, producing 7 clusters, namely #0 autism spectrum disorder, #1 cancer, and #2 preterm infants, among others.

Comparing the research trends over the past 15 years, classic research areas such as MT have remained prominent. However, emerging research clusters, including #0 autism spectrum disorder, #1

Table 3: The references with citation bursts at different period

References	Year	Strength	Begin	End	2004 - 2024
Whipple J, 2004, J MUSIC THER, V41, P90, DOI 10.1093/jmt/41.2.90, DOI	2004	7.84	**2005**	2009	
Gold C, 2004, J CHILD PSYCHOL PSYC, V45, P1054, DOI 10.1111/j.1469-7610.2004.t01-1-00298.x, DOI	2004	5.82	**2005**	2007	
Brownell MD, 2002, J MUSIC THER, V39, P117, DOI 10.1093/jmt/39.2.117, DOI	2002	5.17	**2005**	2007	
Gold C, 2006, COCHRANE DB SYST REV, V0, P0, DOI 10.1002/14651858.CD004381.pub2, DOI	2006	7.52	**2007**	2011	
Klassen JA, 2008, AMBUL PEDIATR, V8, P117, DOI 10.1016/j.ambp.2007.12.005, DOI	2008	6.19	**2009**	2013	
Kim J, 2009, AUTISM, V13, P389, DOI 10.1177/1362361309105660, DOI	2009	8.66	**2010**	2014	
Kim J, 2008, J AUTISM DEV DISORD, V38, P1758, DOI 10.1007/s10803-008-0566-6, DOI	2008	7.96	**2010**	2012	
Reschke-Hernández AE, 2011, J MUSIC THER, V48, P169, DOI 10.1093/jmt/48.2.169, DOI	2011	5.98	**2013**	2016	
Simpson K, 2011, J AUTISM DEV DISORD, V41, P1507, DOI 10.1007/s10803-010-1172-y, DOI	2011	5.43	**2013**	2016	
Carter MJ, 2014, THER RECREAT J, V48, P275	2014	8.72	**2014**	2019	
Geretsegger M, 2012, BMC PEDIATR, V12, P0, DOI 10.1186/1471-2431-12-2, DOI	2012	6.81	**2014**	2017	
Finnigan E, 2010, AUTISM, V14, P321, DOI 10.1177/1362361309357747, DOI	2010	5.5	**2014**	2015	
Geretsegger M, 2014, COCHRANE DB SYST REV, V0, P0, DOI 10.1002/14651858.CD004381.pub3, DOI	2014	14.61	**2015**	2019	
Thompson GA, 2014, CHILD CARE HLTH DEV, V40, P840, DOI 10.1111/cch.12121, DOI	2014	8.23	**2015**	2019	
Srinivasan SM, 2013, FRONT INTEGR NEUROSC, V7, P0, DOI 10.3389/fnint.2013.00022, DOI	2013	5.74	**2015**	2018	
Geretsegger M, 2015, J MUSIC THER, V52, P258, DOI 10.1093/jmt/thv005, DOI	2015	6.33	**2017**	2020	
Bieleninik L, 2017, JAMA-J AM MED ASSOC, V318, P525, DOI 10.1001/jama.2017.9478, DOI	2017	12.26	**2018**	2022	
Bradt J, 2016, COCHRANE DB SYST REV, V0, P0, DOI 10.1002/14651858.CD006911.pub3, DOI	2016	7.36	**2018**	2021	
Porter S, 2017, J CHILD PSYCHOL PSYC, V58, P586, DOI 10.1111/jcpp.12656, DOI	2017	8.15	**2019**	2022	
Bieleninik L, 2016, PEDIATRICS, V138, P0, DOI 10.1542/peds.2016-0971, DOI	2016	6.27	**2019**	2021	

Carpente JA, 2017, MUSIC THER PERSPECT, V35, P160, DOI 10.1093/mtp/miw013, DOI	2017	5.42	**2019**	2022	
Robb SL, 2017, J PEDIATR PSYCHOL, V42, P208, DOI 10.1093/jpepsy/jsw050, DOI	2017	5.54	**2020**	2022	
Uggla L, 2018, ACTA PAEDIATR, V107, P1986, DOI 10.1111/apa.14515, DOI	2018	5.51	**2020**	2024	
Sharda M, 2018, TRANSL PSYCHIAT, V8, P0, DOI 10.1038/s41398-018-0287-3, DOI	2018	10.43	**2021**	2024	
Crawford MJ, 2017, HEALTH TECHNOL ASSES, V21, P1, DOI 10.3310/hta21590, DOI	2017	5.54	**2021**	2022	
Stegemann Thomas, 2019, MEDICINES (BASEL), V6, P0, DOI 10.3390/medicines6010025, DOI	2019	10.59	**2022**	2024	
Page MJ, 2021, BMJ-BRIT MED J, V372, P0, DOI 10.1136/bmj.n160, DOI	2021	9.15	**2022**	2024	
Mayer-Benarous H, 2021, FRONT PSYCHIATRY, V12, P0, DOI 10.3389/fpsyt.2021.643234, DOI	2021	7.61	**2022**	2024	
Geipel J, 2018, J AFFECT DISORDERS, V225, P647, DOI 10.1016/j.jad.2017.08.035, DOI	2018	5.91	**2022**	2024	
Facchini M, 2021, COMPLEMENT THER CLIN, V42, P0, DOI 10.1016/j.ctcp.2020.101289, DOI	2021	5.69	**2022**	2024	

cancer, #2 preterm infants, #3 cerebral palsy, #4 anxiety, and #6 recurrent neural network, have garnered increasing scholarly attention.

Further scrutiny of the forthcoming clusters discloses their intersection with some of the leading areas of children's MT research. Cluster #0, labeled as "autism spectrum disorder," includes 74 papers dealing with MT applied to those with diagnosed ASD. Cluster #1, labeled as "cancer," includes 68 studies for music-based therapy on cancer. Clusters #2 and #3, "preterm infants" and "cerebral palsy," contain 48 and 43 articles respectively, which investigate therapeutic applications in these populations. Cluster #4, "anxiety," contains 42 articles that examine music therapy for anxiety disorders. Of particular interest is Cluster #6, "recurrent neural network," with 18 studies that reflect the increasing application of artificial intelligence (AI) in this research area.

Timeline visualization by citation spanpresents a comprehensive picture of shifting, core, and declining research subjects. There are 16 clusters, ranked in size and vertically located by time. Clusters such as #2 (health care setting), #3 (alternative treatment), #4 (music therapy intervention treatment), #6 (autistic spectrum disorder), #7 (reporting guidelines), #8 (language ability), #15 (Rett syndrome), and #18 (epilepsy) have been described as long-standing problems that continue to dominate the discipline due to their extensive linkages with other clusters. Opposed to this are Clusters #9 (song), #10 (sad children), #11 (toddler), #12 (parent), #13 (identification of songs), #16 (test methods), and #17 (clinical setting assessment) that appear to be decreasing. They have fewer connections and less expansion in recent years. Active emerging clusters such as #0 (autism spectrum disorder), #1 (children with autism), #5 (dental fear), #14 (post-traumatic stress disorder), and #19 (behavioral management) remain active and may represent future emphasis. Table 5 provides a further detailed breakdown of these emerging themes.

To further explore the evolution of influential references, a reference burst detection analysis was conducted using CiteSpace. One of them, MT and Other Music-Based Interventions in Pediatric Health Care: An Overview, was assigned to Cluster #0 with 35 co-citations, reflective of the increasing recognition of music-based interventions as add-on methods in pediatric care. This overview integrates evidence from a number of systematic

Table 4: The references with citation bursts from beginning to 2024

Begin	End	Strength	Year	Type	Title
2022	2024	10.59	2019	Review	Music Therapy and Other Music-Based Interventions in Pediatric Health Care: An Overview
2021	2024	10.43	2018	Article	Music improves social communication and auditory-motor connectivity in children with autism
2022	2024	7.61	2021	Review	Music Therapy for Children with Autistic Spectrum Disorder and/or Other Neurodevelopmental Disorders: A Systematic Review
2023	2024	7.6	2022	Review	Music therapy for autistic people
2022	2024	5.91	2018	Review	Music-based interventions to reduce internalizing symptoms in children and adolescents: A meta-analysis
2022	2024	5.69	2021	Review	The role of music therapy in the treatment of children with cancer: A systematic review of literature
2020	2024	5.51	2018	Article	Music therapy supported the health-related quality of life for children undergoing haematopoietic stem cell transplants
2022	2024	4.93	2020	Article	A randomized controlled trial of 25 sessions comparing music therapy and music listening for children with autism spectrum disorder
2019	2024	4.78	2019	Article	The Therapeutic Relationship as Predictor of Change in Music Therapy with Young Children with Autism Spectrum Disorder
2021	2024	4.78	2020	Article	The influence of music therapy on preoperative anxiety in pediatric oncology patients undergoing invasive procedures
2023	2024	4.74	2021	Review	Effect of music therapy on preterm infants in neonatal intensive care unit: Systematic review and meta-analysis of randomized controlled trials
2022	2024	4.55	2019	Article	Assessing the Impact of Music Therapy on Sensory Gating and Attention in Children with Autism: A Pilot and Feasibility Study
2022	2024	4.55	2019	Review	Music therapy for children with autism: investigating social behavior through music
2021	2024	4.41	2018	Article	Meta-analysis evaluating music interventions for anxiety and pain in surgery
2022	2024	3.99	2020	Article	Music Interventions in Pediatric Surgery (The Music Under Surgery in Children Study): A Randomized Clinical Trial
2023	2024	3.79	2020	Article	A Survey of Music Therapists Working in Pediatric Medical Settings in the United States
2023	2024	3.79	2021	Review	MUSIC INTERVENTIONS IN PEDIATRIC ONCOLOGY: Systematic review and meta-analysis
2023	2024	3.79	2020	Article	Effects of music interventions on stress-related outcomes: a systematic review and two meta-analyses
2023	2024	3.79	2021	Article	Music as a coevolved system for social bonding
2023	2024	3.31	2022	Article	Music Therapy for Children with Oncology & Hematological Conditions and Their Families: Advancing the Standards of Psychosocial Care

reviews across various pediatric environments, including ASD, disabilities, epilepsy, mental health, neonatal care, pain management, oncology, and palliative care. While more robust research is still needed, existing evidence supports the effectiveness of music medicine and MT, particularly for ASD and neonatal interventions. The review also calls for therapist training and intervention personalization to maximize therapeutic impact. These numbers represent automatically generated clusters of highly cited references, with thematic similarity grouped using the log-likelihood ratio (LLR) method. For example, Cluster #1 includes literature related to auditory-motor connectivity and ASD communication skills, while Cluster #5 focuses on MT for pediatric anxiety and pain.In this context,

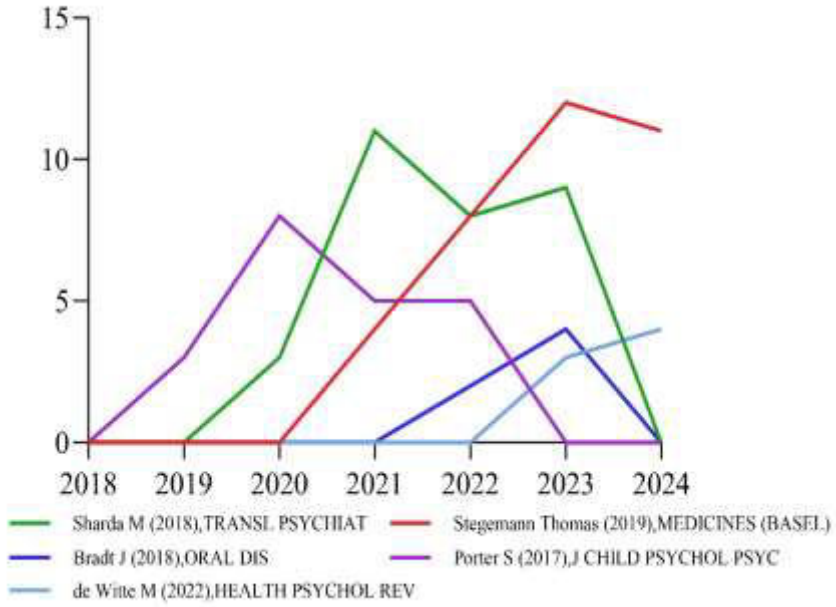

Figure 3: Changes in citations in these 5 articles

"emergency literature" refers to references with strong citation bursts—indicating a sudden and intense rise in academic attention over a short period. These references, clustered by co-citation patterns, reveal dynamic topic shifts and highlight emerging research priorities in the field.

Another influential article, Music Improves Social Communication and Auditory-Motor Connectivity in Children with Autism (Sharda M), has #1 rank with 31 co-citations in Cluster #1 and talks about the neurobiological effects of MT in school children with ASD. In this RCT, 51 children aged 6–12 years received either an improvisational music treatment (n = 26) or a non-musical behavioral treatment (n = 25) for 8–12 weeks. Pre- and post-testing measured social communication and brain connectivity in quantitative terms. Post-intervention results showed increased communication scores within the music intervention group (mean difference = 4.84, P =.01) and increased neural connectivity between sensory and motor sites (z = 3.16, P <.0001), but hyperconnectivity between sensory and visual sites diminished. These neurofunctional changes were strongly related to social interaction gains, providing the first empirical evidence of the potential of MT to modulate brain connectivity in ASD. The paper *MT for Children and Adolescents with Behavioral and Emotional Problems: A Randomized Controlled Trial*, part of Cluster #5 (21 co-citations), evaluates the clinical effectiveness of MT for mental illness in children and adolescents. Conducted in Northern Ireland at six CAMHS centers, the trial recruited 251 children aged 8-16 with behavioral and emotional problems. Participants were randomly assigned to receive standard care alone or standard care and 12 sessions of MT. While primary outcomes showed no difference in total communication skills at 13 weeks, subgroup analysis revealed significant improvement in adolescents aged over 13. Furthermore, members of the intervention group reported higher self-esteem and lower depressive symptoms. These findings suggest the clinical value of MT, but more research is needed to account for variability in outcomes.

The meta-analysis MT for Stress Reduction (Cluster #14) combines data from 47 studies with 2,747 participants to determine the impact of MT on stress. Differentiating MT from passive "music medicine," the review emphasizes therapist-administered interventions with focus on individual need. Results indicated a moderate to large effect size (d = 0.723, 95% CI 0.51–0.94), implying the therapeutic value of MT in alleviating both physiological and psychological stress. The citation patterns for these five seminal studies, as shown in Figure 3, give us a clearer view of the influence and power they have to guide future developments in children's MT research.

Discussion

This study provides a comprehensive scientometric analysis of music therapy (MT) research for children from 2000 to 2024, mapping key trends, collaborative networks, and emerging themes in the field. By analyzing influential publications and research trajectories, it reveals patterns of intellectual development and thematic evolution that highlight both current priorities and future directions for MT research and clinical application. The findings offer valuable insights to guide evidence-based practice and inform the next generation of interdisciplinary MT studies.

The co-citation burst and reference analysis indicate how the field has undergone radical thematic shifts, from general investigations of MT's therapeutic impact on child development to highly specialized interventions for autism spectrum disorder (ASD), child anxiety, cognitive rehabilitation, and neurodevelopmental disorders. Kim *et al*. and Whipple represented early efforts towards empirically founding support for the contribution of MT to developing social communication, joint attention, and emotional responsivity in ASD children[31,32]. The presence of meta-analyses and systematic reviews, such as Geretsegger *et al*. and Whipple, signals an increasing emphasis on evidence synthesis and cross-study validation in MT research. These studies provide quantitative assessments of intervention efficacy, shaping guidelines for clinical application and reinforcing the scientific legitimacy of music-based therapies[26,32]. Geretsegger *et al*., in particular, highlight the broad applicability of MT in improving social interaction and adaptive behaviors, strengthening its role as a mainstream therapeutic approach[26]. The frequent citation bursts of these meta-analyses indicate that they serve as benchmark references for future investigations, guiding research methodologies and influencing intervention designs.

A notable trend observed in this study is the increasing intersection between MT and cognitive neuroscience. Sharda *et al*. provide neurobiological insights into MT's impact on brain connectivity, demonstrating how music-based interventions enhance auditory-motor pathways and social communication networks in children with ASD[25]. The emergence of neuroscience-informed studies represents a paradigm shift, positioning MT not only as a behavioral intervention but also as a mechanism for neural plasticity and cognitive rehabilitation. This shift is reflected in the keyword evolution, where terms such as "brain connectivity," "auditory-motor integration," and "neuroplasticity" have become increasingly prominent in recent years.

The temporal variation of keyword clusters further reveals how the research landscape has diversified and specialized over time. Early research focused on broad developmental benefits of MT[33,34], whereas contemporary studies explore precision-based interventions for specific conditions such as pediatric oncology, cerebral palsy, and preterm infants. The increasing scholarly focus on RCTs and experimental designs, as seen in Bieleninik *et al*. and Porter *et al*., signifies the field's movement toward higher methodological rigor[24,28]. These large-scale clinical trials, often conducted across multiple countries, provide stronger empirical support for MT interventions, reinforcing their viability in evidence-based practice. Additionally, the study identifies emerging research priorities through citation bursts and thematic clustering. The presence of Stegemann *et al*. and De Witte, Pinho, *et al.* in the high-impact literature underscores the increasing importance of stress reduction, pain management, and mental health interventions in pediatric populations[3,2]. These works indicate a broader expansion of MT beyond ASD, aligning with contemporary healthcare challenges and interdisciplinary treatment models.

This study establishes a theoretical framework for future MT research by analyzing historical trends and emerging directions. Findings identify pivotal studies and methodological shifts while highlighting three key growth areas: (1) longitudinal designs, (2) cross-cultural applications, and (3) AI-enhanced therapies. The evidence-based roadmap provided serves researchers, clinicians and policymakers in advancing MT as an interdisciplinary evidence-based practice.

This study delivers valuable insights for clinicians, educators, policymakers, and researchers in pediatric music therapy. Through systematic analysis of landmark studies, emerging trends, and interdisciplinary connections, it establishes an evidence-based framework for clinical practice, educational programming, and policy development. Growing empirical support, including randomized controlled trials and meta-analyses, confirms the necessity of integrating music therapy into mainstream healthcare and education systems. The development of evidence-based interventions is

particularly recommended for children with autism spectrum disorder (ASD), anxiety disorders, and other neurodevelopmental challenges, with demonstrated efficacy in enhancing social interaction, emotional regulation, and cognitive development. Research such as Sharda *et al*.'s study further validates MT's positive impact on neural plasticity and sensory processing, emphasizing the critical need for interdisciplinary collaboration among music therapists, neurologists, and psychologists[25]. Establishing such integrated treatment models can optimize therapeutic outcomes and successfully incorporate music-based interventions into comprehensive child care frameworks.

Schools and universities should include music therapy (MT) training in special education programs. Research shows MT is shifting from general use to targeted treatments for cancer care, premature babies, and brain rehabilitation. Hospitals and schools need customized MT programs. Governments should fund AI-powered and high-tech MT solutions. Growing teamwork between MT experts, neuroscientists, and AI developers makes tech-based treatments like VR therapy more important.

The increasing recognition of MT in stress management, pain reduction, and mental health interventions suggests a growing demand for scalable, evidence-based programs that can be implemented in clinical and community settings. As studies such as De Witte, Pinho, *et al*. highlight the efficacy of MT for stress reduction, public health initiatives should consider incorporating music-based interventions into mental health services, particularly for children experiencing anxiety, trauma, and developmental challenges[2]. Growing evidence from RCTs supports music therapy's (MT) effectiveness, helping secure insurance coverage and policy recognition. MT is now established as a valuable intervention in child healthcare and education. This study connects research to practice, guiding stakeholders to improve MT implementation, strengthen collaborations, and enhance children's outcomes worldwide..

Conclusion

This scientometric analysis (2000–2024) tracks the evolution of music therapy (MT) research for children, revealing a shift from broad applications to targeted interventions—especially for autism (ASD), pediatric anxiety, preterm infants, and neurodevelopmental rehabilitation. Foundational studies (e.g., Kim *et al*.; Whipple; Geretsegger *et al.*)[31,32,26] remain influential, while emerging frontiers like AI-assisted MT and neuroscience-driven approaches mark the field's innovation. Keyword trends highlight a move toward precision-based, interdisciplinary, and technology-integrated methods, offering a roadmap for future research and clinical practice.

While this study offers valuable theoretical and practical contributions, its exclusive reliance on Web of Science data may have omitted relevant studies from other databases like Scopus or PubMed. The English-language focus might also overlook significant non-English research. Since bibliometric methods cannot assess study quality, future research should combine quantitative and qualitative approaches through systematic reviews and meta-analyses. To advance the field, longitudinal studies, large-scale clinical trials, and cross-cultural comparative research are needed. Emerging technologies like AI and virtual reality present promising avenues for innovative music therapy interventions. These comprehensive approaches could enhance both the scientific validity and practical application of music therapy in healthcare and educational settings. Future studies should adopt multi-database searches to ensure more inclusive representation of global research, while maintaining rigorous methodological standards to strengthen evidence-based practice in this growing field.

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