Journal of Rural Medicine

## Review

# Effects of music therapy on functional ability in people with cerebral palsy: a systematic review

Sohei Yanagiwara[1], Tsubasa Yasuda[1], Minami Koike[2], Takatsugu Okamoto[3], Kenta Ushida[1], and Ryo Momosaki[1]

[1]*Department of Rehabilitation Medicine, Mie University Graduate School of Medicine, Japan*
[2]*Department of Nursing, Tsushimi Hospital, Japan*
[3]*Department of Rehabilitation Medicine, Nishi-Hiroshima Rehabilitation Hospital, Japan*

### Abstract

**Objective:** This review aimed to investigate the effects of music therapy on functional ability in people with cerebral palsy.
**Materials and Methods:** An electronic search of the CENTRAL, MEDLINE, and EMBASE databases was conducted. Randomized controlled trials that examined the effects of music therapy in patients with cerebral palsy were included.
**Results:** Eight trials were eligible for inclusion in this study. We found a low risk of bias in random sequence generation and allocation concealment in all trials. The risk of bias in blinding of the outcome assessment was low in all studies. We found that music therapy had a significant effect on the Gross Motor Function Measure score (standardized mean difference [SMD] −0.42), Functional Independence Measure for Children score (SMD 0.38), and Goal Attainment Scale score (SMD −1.43). Music therapy had no significant effect on any of the other items.
**Conclusion:** There is limited evidence that music therapy improves gross motor function and activities of daily living in patients with cerebral palsy. However, this was insufficient to allow for generalizable conclusions. Further studies with larger sample sizes are required to confirm the effects of music therapy in this population.

**Key words:** music therapy, cerebral palsy, systematic review, disability, physiotherapy

(J Rural Med 2022; 17(3): 101–107)

## Introduction

Cerebral palsy (CP) comprises a heterogeneous group of early onset, non-progressive, neurodevelopmental disorders caused by an insult to the developing brain, most often before birth. CP is a leading cause of disability in children, with a prevalence of approximately 2 per 1,000 live births[1]. Globally, an estimated 17 million people living with CP[1]. In general, CP causes impaired movement associated with abnormal reflexes, floppiness or rigidity of the limbs and trunk, abnormal posture, involuntary movements, unsteady gait, or a combination of these. The effect of CP on function varies widely. Some affected individuals can walk, whereas others require assistance.

The use of music in neurorehabilitation is grounded in neurophysiological theory and research on the influence of music on cognitive processes and motor learning principles and has been applied to neurological disorders, including CP[2, 3]. The therapeutic approach called neurologic music therapy (NMT) was established 20 years ago in the US and is known to be effective in neurorehabilitation[4]. Conceptually, NMT is based on three main sensorimotor techniques, with the improvement of motor skills as the overall goal. The first technique is rhythmic auditory stimulation (RAS), which aims to develop and maintain physiological rhythmic motor activity (gait) using rhythmic auditory cues. The second is patterned sensory enhancement (PSE), the objective of which is to facilitate movements associated with the activities of daily living. PSE is not necessarily rhythmic in nature and uses complex elements of music, such as pitch, dynamics, harmony, meter, and rhythm, to enhance and organize movement patterns in time and space and to improve activity, muscle coordination, strength, balance, postural

Received: March 19, 2022
Accepted: April 12, 2022
Correspondence: Ryo Momosaki, Department of Rehabilitation Medicine, Mie University Graduate School of Medicine, 2-174 Edobashi, Tsu, Mie 514-8507, Japan
E-mail: momosakiryo@gmail.com
This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial No Derivatives (by-nc-nd) License <http://creativecommons.org/licenses/by-nc-nd/4.0/>.

©2022 The Japanese Association of Rural Medicine 

control, and range of motion[5]. The third technique is therapeutic instrumental music performance, in which playing a musical instrument is used as an orientation training task to simulate and facilitate functional movement. This technique most commonly uses percussion instruments played in a traditional or non-traditional manner to improve range of motion, limb coordination, postural control, dexterity, body perception, and sensation[6, 7]. NMT has been shown to improve walking performance in patients with neurological diseases, and musical training with instruments allows interrelationships between movement, emotions, and cognition for task-based learning to improve motor control[8–10].

Several clinical trials have examined the use of music therapy in patients with CP. One randomized controlled trial investigated the effects of a combination of PSE music and resistance exercise in children with spastic diplegia and found that those who exercised with PSE music showed statistically significant improvements in gross motor capacity compared with controls who exercised without music, and that these effects lasted at least 3 months[8]. However, there have been no systematic reviews of the findings of available studies on the effect of music therapy in the CP population. It remains unclear whether music therapy is useful in patients with CP. Moreover, studies on music therapy tend to include small sample sizes. Therefore, a systematic review of trials is required to evaluate the effectiveness of music therapy. This study aimed to investigate the effect of music therapy on the functional ability of people with CP.

## Materials and Methods

### Search strategy

We searched the MEDLINE, Cochrane Central Register of Controlled Trials (CENTRAL), and EMBASE databases from January 1980 to December 2020. The review protocol, including the search strategy, was registered before starting the review[11]. We also searched the reference lists of included studies to identify additional relevant trials.

### Eligibility criteria

Participants

CP describes a group of permanent disorders of movement and posture that limit activity, and are attributed to non-progressive disturbances in the developing fetal or infant brain. Motor disorders in CP are often accompanied by disturbances in sensation, perception, cognition, communication, behavior, epilepsy, and secondary musculoskeletal problems.

### Interventions

Music therapy is an evidence- and art-based discipline that uses musical experiences within a therapeutic relationship to address clients' physical, emotional, cognitive, and social needs[12]. Music therapy includes the following interventions: listening and moving to live, improvised, or prerecorded music, as well as RAS; therapeutic use of music and rhythm as a driving force to facilitate better quality of movement and PSE; performing or creating music using an instrument and therapeutic instrumental music performance; improvising music spontaneously using voice, instruments, or both; singing or vocal activities set to music; composing music; and music combined with other modalities.

### Comparator

No intervention, usual care, or alternative intervention.

### Study design

Randomized controlled trials, quasi-randomized trials, and cluster randomized trials were included. The Crossover trials were excluded.

### Outcomes

The main outcome was gross motor function, which was assessed using the gross motor function measure (GMFM), energy expenditure index, gross motor performance measure (GMPM), or simple motor test for Cerebral Palsy.

Additional outcomes were as follows: muscle strength, assessed by grip strength or the Medical Research Council scale score; spasticity, assessed by the Modified Ashworth Scale or (Modified) Tardieu Scale score; respiratory function, evaluated by vital capacity or forced expiratory volume in 1 s; physical fitness, assessed by the 6-min walk test and cardiopulmonary exercise testing; lower limb function, measured by gait velocity (cm/s) and the Timed Up and Go test; upper limb function, assessed by the ABILHAND-kids Scale, Shriners Hospitals for Children Upper Extremity Evaluation, Melbourne Assessment of Unilateral Upper Limb Function, Assisting Hand Assessment, or Quality of Upper Extremity Skills Test (QUEST); activities of daily living, measured by the Functional Independence Measure for Children (WeeFIM), Pediatric Evaluation of Disability Inventory (PEDI), Goal Attainment Scaling (GAS) score, Canadian Occupational Performance Measure, Assessment of Motor and Process Skills, or School Function Assessment; participation, assessed by the Participation Survey/Mobility tool; quality of life, assessed by the Pediatric Outcomes Data Collection Instrument; and secondary complications. We explored the outcomes at the end of treatment and at the end of the scheduled follow-up.

### Data extraction and quality assessment

Two researchers (SY and TY) independently selected the reviews included in the analysis. One researcher (SY) extracted the data and a second researcher (TY) independently checked the data extraction forms for accuracy and completeness. Any discrepancy was resolved by discussion, with the final decision made by a third investigator (RM). Two authors independently assessed the risk of bias using the Cochrane risk of bias' tool[13]. Any disagreements concerning the risk of bias or quality of evidence in the included studies were resolved by discussion.

### Statistical analysis

We performed a quantitative synthesis of the findings of the included studies and a summary of the effects of intervention for each study by calculating the risk ratio (RR) for dichotomous outcomes and standardized mean difference (SMD) for continuous outcomes. We anticipated that there would be a limited scope for meta-analysis because of the range of different outcomes measured across a small number of existing trials. However, when studies had used the same intervention, comparator, and outcome measure, we pooled the results using a random effects meta-analysis with SMDs for continuous outcomes and RRs for binary outcomes and calculated the 95% confidence intervals and two-sided *P*-values for each outcome. Heterogeneity in the measures of effect between the studies was assessed using the $\chi^2$ test and $I^2$ statistic. An $I^2$ value >60% indicated substantial heterogeneity.

## Results

After screening the 314 records, 25 potentially relevant studies were identified. Eight of these 25 studies met the study inclusion criteria[8, 14–20] (Figure 1). The details of each study are presented in Table 1.

### Study characteristics

Two of the eligible studies included patients with a Gross Motor Function Classification System score of I–IV[8, 14, 15]. None of the studies included participants with conditions other than CP. In almost all studies, the participants were under 20 years of age. The sample sizes ranged from 11[14] to 120[15]. Three studies used RAS provided by music therapists[14, 18, 20]. The intervention involved listening to music in two studies[15, 19], a music therapist using PSE in two studies[8, 17], and a patient playing an instrument in one study[16].

Almost all studies included some form of gross motor function as an outcome[8, 14–20]. Three studies included limb function measures[14, 16, 20], three included activities of daily living[8, 15, 19], one study included WeeFIM[15], another included PEDI[8], and another included the GAS T-score as an outcome[19]. Only one study assessed upper limb function (using QUEST). Three studies included lower limb function as an outcome[8, 18, 20], three studies included velocity, two included cadence[18, 19], and one study included grip strength[19].

### Study quality

Six trials included the appropriate sequence generation (Table 2). Two studies that did not report the methods used for random sequence generation were classified as unclear[16, 18]. Three studies did not report allocation concealment[16–18]. Fifty percent of the trials included blinding of

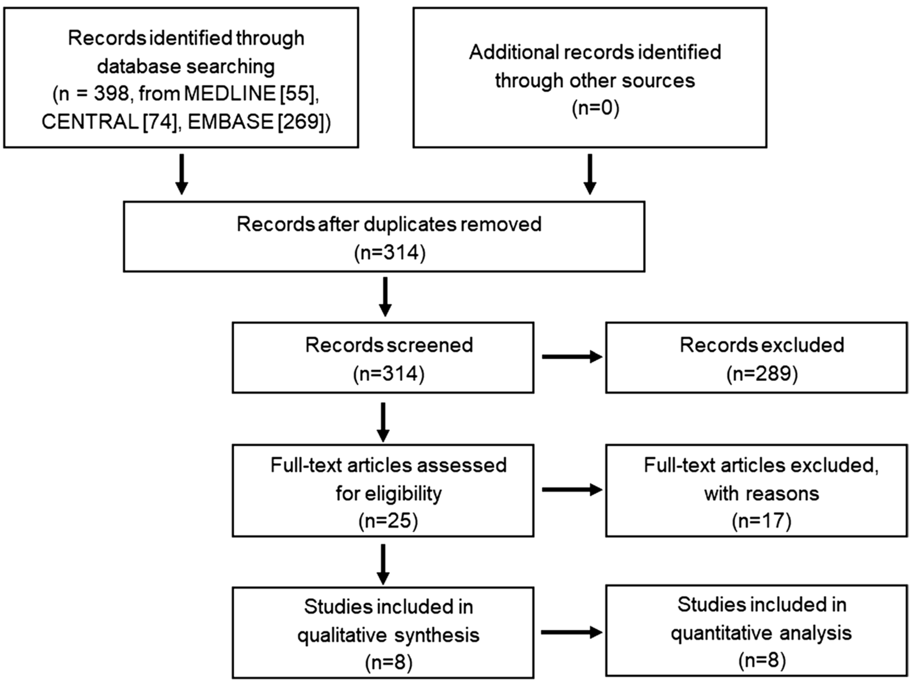


**Figure 1** Study flow diagram.

**Table 1** Characteristics of included studies

| Study | Country | Participant characteristics | Number (I/C) | Intervention group | Control group | Outcomes |
|---|---|---|---|---|---|---|
| López–Ortiz 2016[14] | USA | GMFCS score of II–IV<br>Age 6–15 years<br>Ability to follow two-step directions<br>Medically stable<br>No history of surgery or seizures within past 6 months | 11 (5/6) | TDC for 1 h three times weekly for 4 weeks + physical therapy and occupational therapy | Physical and occupational therapy | Changes in clinical balance<br>Upper limb function |
| Duymaz 2018[15] | Turkey | Age 5–11 years<br>Diagnosis of spastic-type CP<br>Able to understand and cooperate with commands<br>Not using technical or mobility aids<br>No hearing problems<br>GMFCS level I–III | 120 (60/60) | NDT while listening to a classical music disc for 45 minutes | NDT only | GMFM-88<br>WeeFIM<br>FACES |
| Wang 2013[8] | Taiwan | Age 5–13 years<br>Spastic diplegia,<br>GMFCS score I–III<br>Able to stand independently without falling<br>Able to follow and cooperate with verbal instructions<br>Parental commitment to supervise the training program without altering current therapy or activities | 36 (18/18) | PSE music combined with sit-to-stand exercise | Exercise with no music | GMFM dimensions D and E<br>Daily mobility and self-care functions<br>Functional strength<br>Walking speed |
| Yu 2009[16] | China | Diagnosis of CP<br>Age <14 years<br>No severe organic disease, acute or chronic infection or coagulopathy, severe visual or hearing impairment, or progressive brain disease (brain tumor, moyamoya disease, etc.) | 60 (30/30) | Playing a musical instrument for children | Needle therapy | Scoring for comprehensive functions<br>Scoring for gross motor function |
| Teixeira–Machado 2017[17] | USA | Diagnosis of CP<br>Age 15–29 years<br>Increased muscle tone<br>No physical activity during the study protocol<br>No cardiopathy or neoplasia | 26 (13/13) | Global range of motion with coordinated and rhythmic dynamic floor exercises<br>Motor coordination<br>Body image<br>Skill and agility | Traditional kinesiotherapy exercises | FIM<br>WHODAS<br>GMFCS |
| Kwak 2007[18] | USA | Spastic-type CP<br>Age 6–20 years | 18 (9/9) | Conventional gait training enhanced by RAS provided by both a physical therapist and a music therapist | Conventional gait training by a physical therapist while a music therapist observed | Neurological damage<br>How RAS could affect gait training |
| Ben–Pazi 2018[19] | USA | Age 2–18 years<br>Hypertonia interfering with daily functions<br>Ability to use headphones for at least 10 min | 18 (9/9) | Exposure to audio stimulation for at least 10 min; each session lasting preferably for 30 min four times a week | Music alone | CCHQ<br>GAS<br>GMFM-88<br>QUEST |
| Kim 2012[20] | Korea | No discernible hearing deficit<br>Able to walk at least 10 m without a walking aid or a helper<br>Able to understand the command to walk following rhythmic auditory stimulation | 28 (15/13) | Rhythmic auditory stimulation using a combination of a metronome beat set to the individual's cadence and rhythmic cueing from a live keyboard | NDT | Gait pathology<br>Kinematic data for the pelvis, hip joint, knee, ankle, and foot |

C: control; CCHQ: Care and Comfort Hypertonicity Questionnaire; CP: cerebral palsy; FACES: Wong-Baker Faces Pain Rating Scale; FIM: Functional Independence Measure; GAS: Goal Attainment Scale; GMFM: Gross Motor Function Measurement; GMFCS: Gross Motor Function Classification System; I: intervention; NDT: neurodevelopmental treatment; PSE: patterned sensory enhancement; QUEST: Quality of Upper Extremity Skills Test; RAS: rhythmic auditory stimulation; TDC: Training Dance Control; WHODAS: World Health Organization Disability Assessment Schedule.

**Table 2** Risk of bias summary

| López–Ortiz 2016[14] | Duymaz 2018[15] | Wang 2013[8] | Yu 2009[16] | Teixeira–Machado 2017[17] | Kwak 2007[18] | Ben–Pazi 2018[19] | Kim 2012[20] | |
|---|---|---|---|---|---|---|---|---|
| Low | Low | Low | Unclear | Low | Unclear | Low | Low | Random sequence generation |
| Low | Low | Low | Unclear | Unclear | Unclear | Low | Low | Allocation concealment |
| Low | Low | Low | High | High | High | Low | High | Blinding of participants and personnel |
| Low | Unclear | Low | Unclear | Unclear | Unclear | Low | Low | Blinding of outcome assessment |
| Low | Low | Low | Low | Low | Low | Low | Low | Incomplete outcomes data |
| Unclear | Unclear | Unclear | Unclear | Unclear | Unclear | Low | Unclear | Selective reporting |
| Low | Low | Low | Low | Low | Low | Low | Low | Other bias |

**Table 3** Summary of results of meta-analysis for outcomes

| Outcome | Studies, n | Participants (intervention/control), n | SMD (95% CI) | Inconsistency value $I^2$ (%) |
|---|---|---|---|---|
| QUEST | 1 | 18 (9/9) | −0.07 (−0.99, 0.86) *P*=0.87 | - |
| WeeFIM | 1 | 120 (60/60) | 0.38 (0.01, 0.74) *P*=0.04 | - |
| WeeFIM (after follow-up) | 1 | 120 (60/60) | 0.39 (0.03, 0.75) *P*=0.04 | - |
| GMFM | 3 | 174 (87/87) | 0.42 (0.12, 0.72) *P*=0.01 | 0 |
| GMFM (after follow-up) | 2 | 156 (78/78) | 0.58 (0.26, 0.90) *P*=0.0004 | 42 |
| Velocity | 3 | 82 (42/40) | 0.29 (−0.16, 0.74) *P*=0.21 | 71 |
| Velocity (after follow-up) | 1 | 36 (18/18) | 0.17 (−0.49, 0.82) *P*=0.62 | - |
| Cadence | 2 | 46 (24/22) | 0.20 (−0.39, 0.79) *P*=0.51 | 40 |
| PEDI | 1 | 36 (18/18) | 0.05 (−0.61, 0.70) *P*=0.89 | - |
| PEDI (after follow-up) | 1 | 36 (18/18) | 0.14 (−0.52, 0.79) *P*=0.68 | - |
| Grasp | 1 | 18 (9/9) | 0.08 (−0.84, 1.01) *P*=0.86 | - |
| GAS T-score | 1 | 18 (9/9) | −1.43 (−2.49, −0.36) *P*=0.01 | - |

CI: confidence interval; GAS: Goal Attainment Scale; GMFM: Gross Motor Function Measurement; PEDI: Pediatric Evaluation of Disability Inventory; QUEST: Quality of Upper Extremity Skills Test; SMD: standardized mean difference; WeeFIM: Functional Independence Measure for Children.

both study participants and observers, and were judged to have a high risk of bias[16–18, 20]. Half of the studies did not include blinding of the outcome assessors[15–18]. Incomplete outcome data bias was judged to be low in all studies. Study protocols were not available for any of the included studies. No other potential sources of bias were identified in the available data. Outcome data were missing for three studies and could not be obtained. Therefore, only five studies were included in the quantitative analysis (Table 3).

## Effectiveness

Gross motor function

Three trials (including 174 participants) included GMFM data[8, 15–19]. Meta-analysis showed that music therapy had a significant effect on the GMFM score (SMD, −0.42; 95% CI, −0.12, 0.72; *P*=0.01; $I^2$=0%).

## Activities of daily living

Only one trial (120 participants) reported the WeeFIM data[15]. It was found that music therapy had a significantly positive effect on the WeeFIM score (SMD, 0.38; 95% CI 0.01, 0.74; *P*=0.04). Only one trial (with 36 participants) assessed the PEDI[8], and no significant effect of music therapy was found (SMD 0.05; 95% CI −0.61, 0.7; *P*=0.89). Another trial (with 18 participants) assessed the GAS T-score[19] and found a significant effect of music therapy (SMD, −1.43; 95% CI, −2.49, −0.36; *P*=0.01).

## Upper limb function

One trial (with 18 participants) assessed upper limb function using QUEST[19] and did not find any significant effect of music therapy (SMD, −0.07; 95% CI, −0.99, 0.86; *P*=0.87).

## Lower limb function

Three trials (including 82 participants) reported data on velocity[8, 18, 20]. Meta-analysis showed that music therapy had no significant effect on walking velocity (SMD: 0.29; 95% CI: −0.16, 0.74; *P*=0.21; $I^2$=71%). Two trials (including 46 participants) included data on cadence[18, 20] and found no significant effect of music therapy (SMD 0.20; 95% CI −0.39, 0.79; *P*=0.51; $I^2$=40%).

### Muscle strength

Only one trial (with 18 participants) investigated grip strength[19] and found that music therapy had no significant positive effect (SMD 0.08; 95% CI −0.84, 1.01; $P$=0.86).

## Discussion

Eight trials (with 317 participants) were eligible for inclusion in this review on the effects of music therapy in patients with CP. We found a low risk of bias for random sequence generation and allocation concealment in all the trials. However, the risk of bias in the blinding of the study participants was high in half of the studies. However, the risk of bias in the blinding of the outcome assessment was low in all studies. This meta-analysis found that music therapy had a significant effect on WeeFIM and GMFM scores and on the GAS T-score but not on any other items in participants with CP. No adverse events were observed.

In terms of study heterogeneity, the music therapy content varied widely, and one study[17] included adults with CP. The sample sizes in the included studies were small, ranging from 11 to 120 participants, which may have resulted in inadequate statistical power to detect the significant effects of music therapy in the CP population.

We did not find a high risk of selective reporting, other biases, or any major problems with the overall certainty of the evidence. However, due to insufficient sample size, the results of this meta-analysis may come into question when the results of larger-scale studies become available in the future.

To the best of our knowledge, there has been no comprehensive review of the effects of music therapy in patients with CP. We found only one limited systematic review of the effects of music therapy in neurorehabilitation of children and adults with CP[21]. This review showed that dance and RAS have a potentially positive impact on body function, emotional expression, social participation, and attitudinal change. However, only RAS and dance have been investigated, and no meta-analysis has been performed.

Although music therapy for CP is used in actual clinical practice, the main reason for the lack of randomized controlled trials is probably the lack of researchers studying both CP and music therapy. However, research on music therapy has been increasing in recent years[22], future scholars are focusing on the clinical significance of music therapy. In the rehabilitation of children with CP, music therapy is an alternative tool for making the process more enjoyable and improve exercise adherence[23]. Further studies are needed to investigate the effects of music therapy on adherence to exercise in patients with CP. In addition, music therapy does not require special equipment or skills, which makes it easy to introduce in rural areas where human medical resources are limited. The recent pandemic of coronary infections has made face-to-face interventions more difficult, and music therapy using virtual reality (VR) technologies has been implemented[24]. Since virtual reality technology can intervene remotely, we believe that it can easily be utilized in rural areas.

Finally, despite our literature search strategy, the possibility of a selection bias cannot be excluded. This review did not include unpublished data, articles in the press, studies published in languages other than English, or studies for which only an abstract has been published.

## Conclusions

We found limited evidence that music therapy could improve gross motor function and activities of daily living in the CP population. However, we could not find sufficient data to allow generalizable conclusions regarding the effects of music therapy in this population. No randomized controlled trials have used singing or vocal activities in music therapy for CP. Furthermore, there have been no randomized controlled trials on music therapy for spasticity, physical fitness, participation restrictions, or quality of life as outcomes of CP. Future studies with larger sample sizes are needed to determine the effects of music therapy in patients with CP.

**Funding:** No benefits in any form have been received or will be received by the authors directly or indirectly related to the subject of this article.

**Conflict of interest:** The authors report no conflicts of interest.

## References

1. Khandaker G, Muhit M, Karim T, *et al*. Epidemiology of cerebral palsy in Bangladesh: a population-based surveillance study. Dev Med Child Neurol 2019; 61: 601–609. [Medline] [CrossRef]
2. Bayona NA, Bitensky J, Salter K, *et al*. The role of task-specific training in rehabilitation therapies. Top Stroke Rehabil 2005; 12: 58–65. [Medline] [CrossRef]
3. Kitago T, Krakauer JW. Motor learning principles for neurorehabilitation. Handb Clin Neurol 2013; 110: 93–103. [Medline] [CrossRef]
4. Thaut MH. Rhythm music and the brain: scientific foundations and clinical applications. Taylor & Francis Group, New York, 2005; 84–99.
5. Thaut C, Thaut MH, Hoemberg V. Patterned sensory enhancement (PSE). In: Handbook of Neurologic Music Therapy. Oxford University Press, Oxford,

2014; 106–115.
6. Thaut C. Training manual for neurologic music therapy. Fort Collins, Colorado, 1999; 123–136.
7. Mertel K, Thaut MH, Hoemberg V. Therapeutic instrumental music performance (TIMP). In: Handbook of Neurologic Music Therapy. Oxford University Press, Oxford, 2014; 116–139.
8. Wang TH, Peng YC, Chen YL, *et al*. A home-based program using patterned sensory enhancement improves resistance exercise effects for children with cerebral palsy: a randomized controlled trial. Neurorehabil Neural Repair 2013; 27: 684–694. [Medline] [CrossRef]
9. Alves-Pinto A, Turova V, Blumenstein T, *et al*. The case for musical instrument training in cerebral palsy for neurorehabilitation. Neural Plast 2016; 2016: 1072301. [Medline] [CrossRef]
10. Marrades-Caballero E, Santonja-Medina CS, Sanz-Mengibar JM, *et al*. Neurologic music therapy in upper-limb rehabilitation in children with severe bilateral cerebral palsy: a randomized controlled trial. Eur J Phys Rehabil Med 2018; 54: 866–872. [Medline]
11. Yanagihara S, Yasuda T, Minami K, *et al*. Music therapy for cerebral palsy: systematic review protocol. Figshare 2020. Online resource. [CrossRef].
12. American Music Therapy Association What Is Music Therapy. https://www.musictherapy.org/about/musictherapy/ (Accessed Jan. 1, 2022)
13. Higgins JP, Altman DG, Gøtzsche PC, *et al.* Cochrane Bias Methods Group; Cochrane Statistical Methods Group. The Cochrane Collaboration’s tool for assessing risk of bias in randomised trials. BMJ 2011; 34: 3d5928.
14. López-Ortiz C, Egan T, Gaebler-Spira DJ. Pilot study of a targeted dance class for physical rehabilitation in children with cerebral palsy. SAGE Open Med 2016; 4: 2050312116670926. [Medline] [CrossRef]
15. Duymaz T. The effects of music therapy on gross motor functions, pain and level of functional independence in children with cerebral palsy. Ann Clin Anal Med 2020; 11: 115–119.
16. Yu HB, Liu YF, Wu LX. Acupuncture combined with music therapy for treatment of 30 cases of cerebral palsy. J Tradit Chin Med 2009; 29: 243–248. [Medline] [CrossRef]
17. Teixeira-Machado L, Azevedo-Santos I, DeSantana JM. Dance improves functionality and psychosocial adjustment in cerebral palsy: a randomized controlled clinical trial. Am J Phys Med Rehabil 2017; 96: 424–429. [Medline] [CrossRef]
18. Kwak EE. Effect of rhythmic auditory stimulation on gait performance in children with spastic cerebral palsy. J Music Ther 2007; 44: 198–216. [Medline] [CrossRef]
19. Ben-Pazi H, Aran A, Pandyan A, *et al*. Auditory stimulation improves motor function and caretaker burden in children with cerebral palsy- A randomized double blind study. PLoS One 2018; 13: e0208792. [Medline] [CrossRef]
20. Kim SJ, Kwak EE, Park ES, *et al*. Differential effects of rhythmic auditory stimulation and neurodevelopmental treatment/Bobath on gait patterns in adults with cerebral palsy: a randomized controlled trial. Clin Rehabil 2012; 26: 904–914. [Medline] [CrossRef]
21. López-Ortiz C, Gaebler-Spira DJ, Mckeeman SN, *et al*. Dance and rehabilitation in cerebral palsy: a systematic search and review. Dev Med Child Neurol 2019; 61: 393–398. [Medline] [CrossRef]
22. Li K, Weng L, Wang X. The state of music therapy studies in the past 20 years: a bibliometric analysis. Front Psychol 2021; 12: 697726. [Medline] [CrossRef]
23. Johnson G, Otto D, Clair AA. The effect of instrumental and vocal music on adherence to a physical rehabilitation exercise program with persons who are elderly. J Music Ther 2001; 38: 82–96. [Medline] [CrossRef]
24. Kantorová L, Kantor J, Hořejší B, *et al*. Adaptation of music therapists’ practice to the outset of the COVID-19 pandemic—going virtual: a scoping review. Int J Environ Res Public Health 2021; 18: 5138. [Medline] [CrossRef]