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## Original Article

## Effects of music therapy on mood, language, behavior, and social skills in children with autism: A meta-analysis

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## ABSTRACT

**Objective:** To investigate the effects of music therapy on mood, language, behavior, and social skills in children with autism.**Methods:** A literature search was conducted using the following Chinese databases: the China National Knowledge Infrastructure (CNKI), Wanfang Data, the Chinese Biomedical Literature (CBM) Database, and the VIP Chinese Science and Technology Periodicals Database. The search terms were “autistic children” or “children with autism” and “music therapy” or “music treatment.” Studies of randomized controlled trials (RCTs) were included, and each publication included was assessed for quality. A meta-analysis was conducted using RevMan 5.1.**Results:** Publications were selected based on the inclusion and exclusion criteria. Six research articles describing RCTs were included; the total sample size was 300 patients. The results of meta-analysis showed that music therapy improved mood [Risk ratio (RR) = 3.02, 95% confidence interval (CI) = 1.93–4.11, Z = 5.45, P < 0.000 01] and behavior (RR = 7.36, 95% CI = 4.28–10.44, Z = 4.69, P = 0.000 01) in children with autism. Additionally, music therapy improved language (RR = 4.05, 95% CI = 3.38–4.73, Z = 11.71, P = 0.000 01), sensory perception (RR = 4.62, 95% CI = 1.55–7.69, Z = 2.95, P = 0.003), and social skills (RR = 4.66, 95% CI = 1.90–7.42, Z = 3.31, P = 0.000 9) in children with autism.**Conclusions:** Music therapy can improve mood, language, sensory perception, behavior, and social skills in children with autism.© 2016 Shanxi Medical Periodical Press. Publishing services by Elsevier B.V. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

## 1. Introduction

Autism is the most common subtype of pervasive developmental disorder (PPD) with an onset in infancy. The condition is mainly manifested through communication and speech disorders and repetitive and stereotyped behavior (the “Kanner” triad) and is often associated with mental retardation and sensory perceptual and behavioral abnormalities. Autism is more common in boys; the male-to-female ratio is (4–6):1.<sup>1</sup> Some children with autism have lifelong disabilities, whereas others develop conduct disorders in adolescence and even commit crimes. These issues not only cause mental stress to their parents and result in financial burdens on families but also place a heavy burden on schools and society<sup>2</sup> and therefore, have attracted close attention in the fields of medicine,

psychology, and education. Since the 1990s, new breakthroughs have been made in autism intervention around the world. Research shows that musical ability is almost universal in children with autism. Despite their indifference to the outside world and even the lack of language skills in some cases, the majority of children with autism show great interest in music, and some even possess superb music perception and superior sound discrimination abilities.<sup>3</sup> Therefore, music therapy has stood out from the various autism interventions. In the present study, a meta-analysis was conducted to assess the effects of music therapy on children with autism to identify the optimal intervention.

## 2. Methods

## 2.1. Search strategy

A literature search was conducted using the following Chinese databases: the China National Knowledge Infrastructure (CNKI), Wanfang Data, the Chinese Biomedical Literature (CBM) Database,

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and the VIP Chinese Science and Technology Periodicals Database. The search terms were “autistic children” or “children with autism” and “music therapy” or “music treatment.” The search included relevant publications from August 2000 to August 2015.

## 2.2. Study design

This study included all research articles describing randomized controlled trials (RCTs) that evaluated the intervention effects of music therapy on children with autism. The subjects were included if they were children with autism who complied with the 1994 “American Diagnostic and Statistical Manual of Mental Disorders,” 4th edition (DSM-IV) H1<sup>4</sup> and the “Chinese Classification and Diagnostic Criteria of Mental Disorders,”<sup>5</sup> and music therapy was adopted alone or in conjunction with other therapies. Those adopting non-music therapy as an intervention were excluded. The subjects included 228 boys and 72 girls aged 2–7 years.

## 2.3. Intervention approach

The experimental group used music therapy or music therapy in conjunction with other therapies. The control group used non-music therapy. The music therapy included listening to music, singing, playing a musical instrument, performing music, and musical storytelling, among other methods.

## 2.4. Evaluation tools and indicators

Mood, language, behavior, sensory perception, and social skills in children with autism were evaluated using the Clancy Autism Behavior Scale, the Childhood Autism Rating Scale (CARS), the Autism Behavior Checklist (ABC), the Gesell Developmental Scale, and the Autism Treatment Evaluation Checklist (ATEC). The higher the score was, the more severe the manifestation of symptoms was. The two groups were comparable at a baseline before the interventions.

## 2.5. Publication quality assessment

Personnel who had experience with evidence-based learning assessed the quality of the preliminarily retrieved articles in accordance with the evaluation criteria for RCT research developed by the Australian JBI Evidence-Based Health Care Center (2008). Publication quality assessment followed the quality evaluation criteria of the Cochrane Handbook for Systematic Review of Intervention and considered the following points<sup>6</sup>: whether random assignment, a blind method, allocation concealment, withdrawal, or loss to follow-up were reported; whether intentional analysis was used; and whether baseline data were comparable. When all the above conditions were met, there was a minimal possibility of bias, and the publication was ranked as Grade A; when the conditions were partially satisfied, there was a moderate possibility of bias, and the publication was ranked as Grade B; and when the conditions were completely unsatisfied, there was a high possibility of bias and the publication was ranked as Grade C.

## 2.6. Data extraction and analysis

The authors independently extracted data, including the study population (inclusion and exclusion criteria, group, and sample size), sampling method, intervention approach (intervention time and details of the intervention measures), and outcome measures (measure name, assessment tool, baseline, and evaluation time). A formal publication information extraction table was developed after consensus was reached between the two authors by discussion.

A meta-analysis was performed on the data using RevMan 5.1. The heterogeneity across the studies was tested using the  $\chi^2$  test;  $P > 0.1$  and  $I^2 < 50\%$  were considered indications of homogeneity, and a fixed-effects model was chosen for meta-analysis;  $P > 0.1$  and  $I^2 \geq 50\%$  were considered indications of heterogeneity between groups, and a random-effects model was chosen for meta-analysis.

## 3. Results

### 3.1. General information on the included research articles

Sixty-nine relevant articles were retrieved by database searches, all of which were Chinese publications. Twenty-five articles were preliminarily selected by reading their titles and abstracts, and sixteen of them were obtained after duplicates were eliminated. Six articles describing RCTs were identified by reading the full text, and all the articles were ranked as Grade B using the quality assessment criteria. The meta-analysis combined the experimental data to assess the risk ratio (RR) and the 95% confidence interval (CI). General information on the articles included in the meta-analysis is summarized in Table 1.

### 3.2. Effect of music therapy on mood in children with autism

Three articles<sup>7,11,12</sup> containing a total of 108 cases were included. There were 54 cases in the experimental group and 54 cases in the control group. The meta-analysis showed that for the three studies, the transverse line of the 95% CI fell on the right side of the vertical line designating invalidity. This indicates that there was a significant difference in the mood scores of the two groups after intervention. In the test for heterogeneity,  $\chi^2 = 0.04$ ,  $P = 0.84$  ( $>0.1$ ), and  $I^2 = 0\%$ , which indicated homogeneity across the studies. Therefore, a fixed-effect model was chosen for the combined analysis. The results were  $RR = 3.02$ ,  $95\% CI = (1.93, 4.11)$ ,  $Z = 5.45$ , and  $P < 0.0001$ , which indicated that music intervention was conducive to mood improvement in children with autism (Fig. 1).

### 3.3. Effect of music therapy on social skills in children with autism

Six articles<sup>7–12</sup> containing a total of 300 cases were included. There were 160 cases in the experimental group and 140 cases in the control group. In test for homogeneity,  $P = 0.010$  ( $<0.1$ ) and  $I^2 = 67\%$ , which indicated heterogeneity across the studies. Therefore, a random-effects model was used for the combined analysis. The results were  $RR = 4.66$ ,  $95\% CI = (1.90, 7.42)$ ,  $Z = 3.31$ , and  $P = 0.0009$ , which indicated that music intervention was conducive to improvement in the social skills of children with autism (Fig. 2).

### 3.4. Effect of music therapy on behavior in children with autism

Six articles<sup>7–12</sup> containing a total of 300 cases were included. There were 160 cases in the experimental group and 140 cases in the control group. In the test for heterogeneity,  $\chi^2 = 31.86$ ,  $P < 0.0001$  ( $<0.1$ ), and  $I^2 = 84\%$ , which indicated heterogeneity between studies. Therefore, a random-effects model was selected for the combined analysis. The meta-analysis showed that  $RR = 7.36$ ,  $95\% CI = (4.28, 10.44)$ ,  $Z = 4.69$ , and  $P = 0.0001$ , which indicated that music intervention was conducive to behavior improvement in children with autism (Fig. 3).

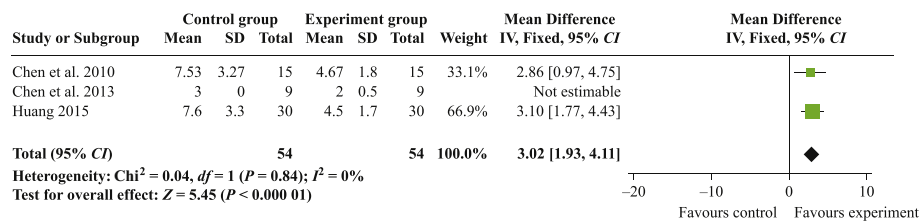
### 3.5. Effect of music therapy on sensory perception in children with autism

Four articles<sup>7,9,11,12</sup> containing a total of 160 cases were included. There were 80 cases in the experimental group and 80 cases in the

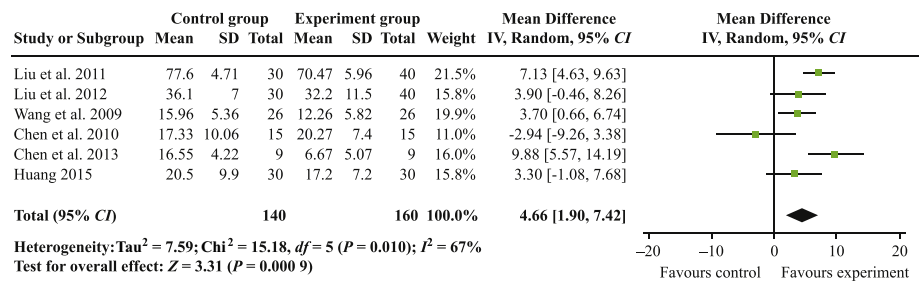
**Table 1**  
General information on the six articles included in the meta-analysis.

Study reference	Type of study	Sample size	Intervention measure		Intervention time	Outcome measures
			Experimental group	Control group		
Huang 2015 <sup>7</sup>	RCT	60	Music therapy based on integration therapy	Integration therapy	6 times/week, 30 min/time, for 6 weeks	Mood, social skills, behavior, and sensory perception
Liu et al. 2011 <sup>8</sup>	RCT	70	Music therapy combined with scalp acupuncture	TEACCH	1 time/day, 60 times	Social adaptability, communication skills, intelligence, and language scores
Wang et al. 2009 <sup>9</sup>	RCT	52	Conventional rehabilitation therapy plus music therapy	Conventional rehabilitation therapy	Unspecified	Language, social skills, behavior, and sensory perception
Liu et al. 2012 <sup>10</sup>	RCT	70	Chinese medicine five-element music therapy combined with acupuncture massage	TEACCH	1 time/day, 60 times	Social adaptability, communication skills, intelligence, and language scores
Chen et al. 2013 <sup>11</sup>	RCT	18	Combination of medicine and education plus music therapy with social stories as the main content	Combination of medicine and education	2 times/week, 50 min/time, for 3 months	Language, social skills, behavior, sensory perception, and body movement
Chen et al. 2010 <sup>12</sup>	RCT	30	Combination of medicine and education plus music therapy	Combination of medicine and education	4 times/week, 30 min/time, for 3 months	Mood, social skills, behavior, and sensory perception

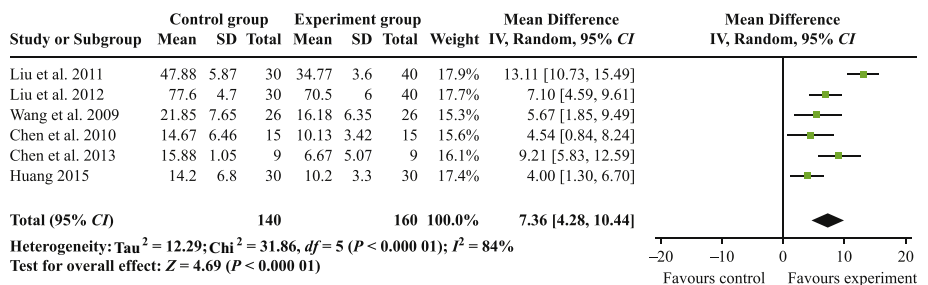
Note: RCT, randomized controlled trial; TEACCH, treatment and education of autistic and communication-handicapped children.



**Fig. 1.** Meta-analysis of the effect of music therapy on mood in children with autism.



**Fig. 2.** Meta-analysis of the effect of music therapy on social skills in children with autism.



**Fig. 3.** Meta-analysis of the effect of music therapy on behavior in children with autism.

control group. In the test for homogeneity,  $P = 0.66 (>0.1)$  and  $I^2 = 0\%$ , which indicated homogeneity across the studies. Therefore, a fixed-effect model was used for the combined analysis. The results were  $RR = 4.62$ ,  $95\% CI = (1.55, 7.69)$ ,  $Z = 2.95$ , and  $P = 0.003$ , which indicated that music intervention was conducive to improvement in the sensory perception of children with autism (Fig. 4).

3.6. Effect of music therapy on language in children with autism

Four articles<sup>8–11</sup> containing a total of 210 cases were included. There were 115 cases in the experimental group and 95 cases in the control group. The results of the meta-analysis were  $P = 0.72 (>0.1)$  and  $I^2 = 0\%$  in the test for homogeneity, which indicated homogeneity across the studies. Therefore, a fixed-effect model was used for the combined analysis. The results were  $RR = 4.05$ ,  $95\% CI = (3.38, 4.73)$ ,  $Z = 11.71$ , and  $P = 0.000 01$ , which indicated that music intervention was conducive to improvement in the language skills of children with autism (Fig. 5).

4. Discussion

4.1. Onset of autism in children and their ability to perceive music

Autism is a representative condition of a pervasive developmental disorder (PDD) and is a psychological development disorder that begins in infancy. The symptoms are often prominent before five years of age; the younger the age of onset is, the more severe the symptoms are. Autism is mainly manifested as abnormalities in social contact, communication, interest, and behavior. Autism was considered a rare disease at first, when its prevalence was relatively low. The prevalence of autism reached 0.07%–0.14% in the 1970s and 1980s and further increased in the late 1990s. An influential journal in the United States reported that there is one child with autism in every 250 children, and the prevalence of autism was reported to be 1/166 in 2005.<sup>13</sup> The majority of children with autism have sensory abnormalities, particularly sensitive hearing,<sup>14</sup> which manifests through the child covering the ears, being irritable or angry, crying, or throwing things after

hearing particular sounds in the environment. There is a direct relationship between language disorders and hearing disorders in children with autism.<sup>15</sup> Autistic children have been found to possess an even higher ability to mimic music than some normal children with musical talent.<sup>16</sup> Dr. Rimland, the Director of the Autism Research Institute, believed that musical ability is almost universal in children with autism. Although they are indifferent to the outside world and some even lack language skills, these children are very interested in music, and some even exhibit superb music perception and superior sound discrimination abilities. Therefore, music therapy has unique advantages over many intervention approaches.

4.2. Advantages and mechanism of music therapy for autism

The science of music therapy is a comprehensive interdisciplinary field that integrates psychology, medicine, music, and education. Music plays a role in healing and fitness. The primitive tribal shaman has set a precedent for treating illness using music. Specifically, dance and music have been used to provide mental and emotional support to patients. In 1950, the National Association of Music Therapy was founded in the United States, and there are currently more than 7000 music therapists. In 1984, music therapy was first used in Mawangdui Nursing Home in Changsha, Hunan Province, China. In 1985, Huilongguan Hospital cooperated with the China Central Conservatory of Music in Beijing to treat chronic schizophrenia. The Chinese Music Therapy Association was founded in 1989, which indicates that music therapy had become a new career field in China. The principles underlying music therapy include neuroendocrine theory, resonance theory, its psychological mechanism, and the energy spectrum of music wave theory. The acoustic waves of music act on the brain's limbic system and reticular formation of the brainstem and thereby, improve the excitability of nerve cells. Music forms complex auditory stimuli through the rhythm and melody. Music causes emotional resonance through exposure to different music information. Music therapy can promote brain development in children while it facilitates the development of multiple abilities, including attention, memory, imagination, abstract thinking, and language. Music

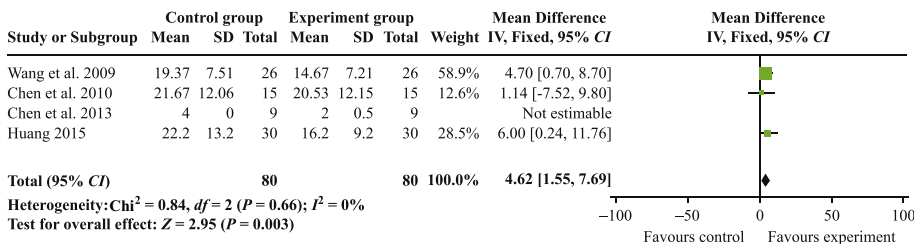


Fig. 4. Meta-analysis of the effect of music therapy on sensory perception in children with autism.

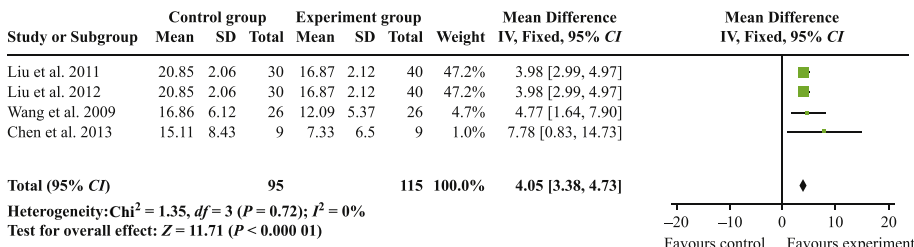


Fig. 5. Meta-analysis of the effect of music therapy on language in children with autism.

intervention can enhance autistic children's sense of participation in learning and social activities. Moreover, singing, playing musical instruments, rhythm training, music games, and listening to music can be used to rebuild, maintain, and promote mental and physical health,<sup>17</sup> which promotes the development of language and social skills and moods as well as the improvement of cognitive ability and the ability to understand in children with autism. When music therapy is used with autistic children, attention should be paid to the specific music selected. Appropriate musical composition and rhythm can be selected according to age and disease condition, and group therapy can be combined with individualized therapy. The timing of music therapy is worth attending to, and the intervention requires at least three months.

#### 4.3. Limitations of the study

The articles included in the study were Chinese publications from the last ten years; therefore, the collection of publications might be incomplete. During the literature search, we found some research articles that were unstandardized, incomplete, or lacking supportive data, which caused certain difficulties with the data collection and analysis. Some of the research data were unusable and therefore, were discarded, which resulted in a loss of information. Only six research articles were included in the meta-analysis, and none of the articles were higher in quality than Grade B. The six articles reported RCTs, but they did not mention specific randomization and setting of control methods, and only two described the number of withdrawal cases, which, to some extent, affected the quality of the results of the meta-analysis. Therefore, more rigorously designed, multi-center, large-sample RCTs are needed to further verify the effects of music therapy intervention in children with autism through systematic, in-depth, and comprehensive analysis.

#### Conflicts of interest

All contributing authors declare no conflicts of interest.

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