Music-based intervention to reduce aggressive behavior in children and adolescents
A meta-analysis

Peijie Ye, MBa, Zhaohui Huang, MDc, Huan Zhou, MDLBD, Qishou Tang, MDLBD*®

Abstract
Background: We aimed to evaluate the effect of music-based intervention on the aggressive behavior in children and adolescents, and made a comparison of music medicine and music therapy.

Methods: We searched PubMed (MEDLINE), Ovid-Embase, and the Cochrane Central Register of Controlled Trials (CENTRAL) to identify relevant studies. Standardized mean differences (SMDs) were estimated with random-effect model.

Results: We included 10 studies and found a significant decrease of aggressive behavior (SMD = −0.99; 95% CI = −1.42 to −0.56) and a significant increase of self-control (SMD = 0.56; 95% CI: 0.19 to 0.93) in the music-based intervention group compared with the control group. The aggressive behavior was significantly decreased in the music therapy group compared with the control group (SMD = −1.79; 95% CI: −3.23 to −0.35); while, no difference was observed between music medicine group and control group. Sub-group analyses exhibited a more efficacious in reducing aggressive behavior in the children received ≥2 sessions per week, the children with a mean age > 10 years, the children whose behavior were reported by teachers, and the children with aggressive behavior before intervention. Sensitivity analyses yielded similar results.

Conclusion: Music-based intervention seemed to be more efficacious for reducing aggression and increasing self-control, especially music therapy.

Abbreviations: 95% CI = 95% confidence interval, AMTA = American Music Therapy Association, CAAI = child aggression assessment inventory, CBCL = Child Behavior Checklist, CDIH-I = Conners’ DSM-IV Hyperactive-Impulsive Scale, CGIR-I = Conners’ Global Index Restless-Impulsive, CSCR = child self-control rating scale, DBC = developmental behaviour checklist, DERS = difficulties in emotion regulation scale, I² = I-square, PAPS = physical aggression propensity scale, PBFS = problem behavior frequency Scale, RSABB = ratings of social and anti-social behaviour, SBQ = social behavior questionnaire, SDQ = strength and difficulty questionnaire, SMDs = standardized mean differences.

Keywords: adolescents, aggressive behavior, children, meta-analysis, music-based intervention

1. Introduction

Aggressive behavior was commonly reported in children and adolescents. In the USA more than 3% of children aged 12 to 18 years were reported to be victimized at campus during the first 6 months in 2015.[1] Aggressive behavior in children and adolescents has been a very important public health problem in the world and is related with various psychological behaviors, not just conduct and oppositional defiant disorders, but in fact, most psychiatric disorders. The negative associations of aggressive behavior with short- and long-term psychosocial adjustment (for example, academic achievement, delinquency, social adjustment, and so on) were reported by some prior studies.[2–5] Furthermore, child’s aggressive behavior also exhibited a good predictor of referral to psychiatric clinics and violent incidents later in adolescence and adulthood.[3–5]

Both pharmacologic and nonpharmacologic treatments are used to treat aggressive behavior among children and adolescents. Some systematic reviews have provided evidence to support the use of pharmacologic treatments in managing aggression, and antidepressant medication (for example trazodone) and atypical antipsychotics (for example risperidone) all exhibited a reduced effect on aggressive behavior among children and adolescent.[6,7] However, a retrospective cohort study reported that these medications might produce similar risk of
major osteoporotic fractures, falls, and death. Another study reported increased mortality with the increase of antipsychotics dose in patients with dementia. Therefore, the treatment guidelines on the management of aggression suggest that nonpharmacologic treatments, especially psychosocial therapy, should always be implemented first, and the psychosocial therapy in conjunction with pharmacologic treatments could be considered only when the symptoms are severe. Music-based intervention is an emerging type of psychotherapy and has been used to eliminate psychological behavior disorders. Some meta-analyses have reported a superior effect of music-based intervention on the decreased anxiety and depression levels in pregnant women, patients with cancer, and patients with surgical operation. A recent network meta-analysis by Watt et al. found that music-based intervention was more efficacious than pharmacologic interventions for reducing aggression and agitation in adults with dementia. During the past 10 years, a total of five meta-analyses regarding the therapeutic effects of music-based intervention on aggressive behavior were published; however, no study focused on children and adolescents. Today, it is widely accepted that music-based interventions should be divided into two major categories, namely music therapy and music medicine. Music therapy is the clinical and evidence-based use of music interventions to accomplish individualized goals within a therapeutic relationship by a credentialed music therapist who has completed an approved music therapy program, and needed a therapeutic relationship between the therapist and the client. However, music medicine commonly performed by a music teacher or music professional other than a music therapist, and the therapeutic relationship between the therapist and the client was not always needed. Music medicine mainly based on patients’ pre-recorded or rarely listening to live music and the direct effects of the music they listen to. In other words, music medicine aims to use music like medicines. Considering the clear distinction between music therapy and music medicine, it is clear that to evaluate the pooled effects of these two major categories together on aggression can be misleading. Moreover, the specific methods used in music therapy include music-assisted relaxation, music and imagery, guided imagery and music (Bonny method), and so on. Each of these may have different levels of effects on aggression. Therefore, we aimed to perform a meta-analysis of the following useful data:

1) randomized or quasi-randomized controlled trials;
2) the participants were children and adolescents without intellectual handicaps, psychiatric diagnosis, and dementia;
3) music-based interventions at the individual level or grouped level, whereas the control group received other type of intervention or no intervention;
4) aggressive behavior was the primary outcome, and aggression propensity, self-control behavior, hyperactivity-impulsivity, and prosocial behavior were the secondary outcomes.

The exclusive criteria were as follows:

1) non English-language papers;
2) non-human studies;
3) studies that contained overlapping data; and
4) studies not provided useable data (e.g., reviews, letters, protocols, abstracts, books and document, conference proceedings, etc.).

When there were multiple publications involving the same population, the paper containing the largest sample size was included. We excluded trials having a very small sample size (n < 10). When the children or adolescents were evaluated by different scales or different people (children or adolescents, parents, and teachers) from the same paper, we treated them individual trial. Two authors independently (YPJ, HZH) screened the papers. We first removed the duplicates using EndNote X7 software. Then, we checked the titles and abstracts of all identified studies for eligibility. Studies that appeared to be relevant were selected, and the full-text papers were subsequently assessed by the same two authors. Disagreements were resolved through discussions with a third author (TQS) until consensus was reached.

2.2. Data extraction

Two authors independently (ZH, HZH) extracted the raw data from the included papers. Disagreements were resolved through discussions with a third author (TQS) until consensus was reached. We developed a data abstraction form to extract the following useful data:

1) the characteristics of trials (authors, publish year, country);
2) the characteristics of children or adolescents (mean age, sex ratio, sample size, whether they had aggressive behaviors or not before intervention);
3) trial design (random allocation, allocation concealment, masking or blinding, selection process of participants, loss to follow-up);
4) the information on music intervention group and control group (intervention form, intervention duration, intervention sessions per week, details of the comparison);
5) outcome measures (aggressive behavior, prosocial behavior, hyperactivity-impulsivity, aggression propensity, self-control).

2.3. Assessment of risk of bias in included studies

The risk of bias in included studies were assessed by two of us (YPJ, HZH) using Cochrane Collaboration’s risk of bias assessment tool independently. Discrepancies were resolved...
through discussion with others (ZH, TQS). Seven domains of each study were rated as low risk, unclear, and high risk respectively.\[^{[20]}\]

### 2.4. Music-based intervention

Music-based intervention was divided into music therapy and music medicine. American Music Therapy Association (AMTA) defined music therapy as “the clinical and evidence-based use of music interventions to accomplish individualized goals within a therapeutic relationship by a credentialed professional who has completed an approved music therapy program.”\[^{[21]}\] While, music medicine mainly based on listening to prerecorded music provided by medical personnel or rarely listening to live music, so music is treated as medicine. The distinction between music therapy and music medicine was whether the therapeutic relationship between the therapist and the client was needed.\[^{[18]}\]

Music therapy was divided into active music therapy and receptive music therapy. Active music therapy was defined as playing musical instruments, singing, improvisation, and lyrics of adaptation. Receptive music therapy was defined as music listening, lyrics analysis, and drawing with musing. In other words, active music therapy means making music, and receptive music therapy means receiving music. In our study, active music therapy was divided into improvisational music therapy, creative music therapy, and compositional music therapy; receptive music therapy was divided into music-assisted relaxation, music and imagery, guided imagery and music, lyrics analysis, and so on.

### 2.5. The primary and second outcomes measures

The primary outcome measure was aggressive behavior, which was evaluated by Child Behavior Checklist (CBCL), Child Aggression Assessment Inventory (CAAI), Developmental Behaviour Checklist (DBC), Teacher Rating of Aggression (TRA), Problem Behavior Frequency Scale (PBFS), Social and Antisocial Behavior Scale (SABS), and self-developed questionnaire (Table 1).

The second outcome measures were aggression propensity, hyperactivity-impulsivity, prosocial behavior, and self-control. The aggression propensity was evaluated by Bullying Prevalence Questionnaire (BPQ) and Physical Aggression Propensity Scale (PAPS). Hyperactivity-impulsivity was evaluated by Conners’ Global Index Restless-Impulsive (CGIR-I), and CDIH-I (Conners’ DSM-IV Hyperactive-Impulsive Scale). Prosocial behavior was evaluated by Strength and Difficulty Questionnaire (SDQ) and Social Behavior Questionnaire (SBQ). Self-control was evaluated by Self-Control Rating Scale for children (SCRS) (Table 1)\[^{[22–34]}\] (Table 2).

### 2.6. Statistical analysis

Standardized mean differences (SMDs) with 95% confidence interval (95%CI) was estimated to evaluate the pooled effects of music-based intervention on the primary and second outcome measures because that the different instruments or scales were used to measure the same parameter. The heterogeneity between studies was assessed by I-square (I\(^2\)) and Q-statistic (P < .10), and a high I\(^2\) (>50%) was recognized as heterogeneous and a random-effect model was used.\[^{[13–37]}\] We divided music-based intervention into music therapy and music medicine, and made comparison of music therapy and music medicine. We also made comparison of improvisational music therapy and receptive music therapy and between active music therapy and receptive music therapy. We performed subgroup analyses by mean age (years) (≤10, >10), intervention duration (weeks) (≤12, >12), sessions per week (1 per week, ≥2 per week), the

### Table 1

Scales used in this study.

| Scales                              | Studies (n = 11) | Score                          | Validity and reliability | Source                        |
|-------------------------------------|------------------|--------------------------------|--------------------------|-------------------------------|
| **Evaluating aggressive behavior**  |                  |                                |                          |                               |
| PBFS (Original scale)               | 1                | Unavailable                     | Cronbach’s alpha = 0.7   | Farrell et al\[^{[22]}\]      |
| CBC (Derived from the CBCL)         | 1                | Unavailable                     | Cronbach’s alpha = 0.95  | Einfeld et al\[^{[23]}\]      |
| CAAI (Korean translated scale)      | 1                | Score range from 0 (never) to 48 (always) | Cronbach’s alpha = 0.94  | Lee et al\[^{[24]}\]          |
| CBCL (Original and Korean translated scale) | 2            | Score range from 0 (never) to 60 (always) | Cronbach’s alpha = 0.68  | European Center for Drug and Drug Addictor\[^{[26]}\] |
| RSASB (Original scale)              | 1                | Score range from 4 (never) to 20 (always) | Unavailable              | Kanchana et al\[^{[27]}\]    |
| **Self-developed questionnaire**    |                  |                                |                          |                               |
| BPQ (Original scale)                | 1                | Score range from 4 (never) to 24 (always) | Cronbach’s alpha = 0.75–0.78 | Rigby et al\[^{[28]}\]        |
| PAPS (Original scale)               | 1                | Unavailable                     | Cronbach’s alpha = 0.82  | Oh et al\[^{[29]}\]           |
| CGIR-I (Original scale)             | 1                | Unavailable                     | Cronbach’s alpha = 0.78–0.81 | Conners et al\[^{[30]}\]     |
| CDIH-I (Original scale)             | 1                | Unavailable                     | Cronbach’s alpha = 0.65  | Conners et al\[^{[31]}\]     |
| **Evaluating prosocial behavior**   |                  |                                |                          |                               |
| SDQ (Original scale)                | 2                | Score range from 0 (never) to 10 (most) | Cronbach’s alpha = 0.65  | Goodman et al\[^{[32]}\]      |
| SBQ (Modified scale)                | 2                | Score range from 0 (never) to 100 (most) | Cronbach’s alpha = 0.71  | Tremblay et al\[^{[33]}\]    |
| **Evaluating self-control**         |                  |                                |                          |                               |
| CSCR (Original scale)               | 2                | 10 items                        | Cronbach’s alpha = 0.73  | Rihrbeck et al\[^{[34]}\]    |
| DERS (Dutch translated scale)       | 1                | 32 items                        | A promising internal consistency and validity | Neumane et al\[^{[34]}\]    |

CAAI = child aggression assessment inventory, CBCL = child behavior checklist, CDIH-I = Conners’ DSM-IV Hyperactive-Impulsive Scale, CGIR-I = Conners’ Global Index Restless-Impulsive, CSCR = Child Self-control Rating Scale, DBC = Developmental Behaviour Checklist, DERS = difficulties in emotion regulation scale, PAPS = physical aggression propensity scale, PBFS = problem behavior frequency scale, RSASB = ratings of social and anti-social behaviour (Aggression), SBQ = social behavior questionnaire, SDQ = strength and difficulty questionnaire.
| Authors, year, country | Participants | Intervention form | Music intervention group | Control group | Primary outcome measures |
|------------------------|--------------|------------------|-------------------------|---------------|--------------------------|
| Alemán 2017, USA       | 2914 children aged 6 to 14 | Group intervention | Music intervention consisted of several times per week for 1 yr (early admission) | Received same music intervention, but intervention duration was reduced by half (delayed admission) | Aggressive behaviors assessed by PBFS and RSASB; self-control assessed by CSCR, prosocial behaviors assessed by SDQ, and aggression propensity assessed by PAPS. |
| Choi 2010, Korea       | 48 children aged 11 to 14 with highly aggressive behavior | Group intervention | Music intervention consisted of 50 min twice weekly for 15 consecutive weeks | Not received any intervention during the study period | Aggression assessed by CBCL and CAAI |
| Cook 2019, UK          | 49 children aged 10 to 11 | Group intervention | 11-week music intervention program | Received some music intervention on different participations | Presocial skills assessed by SBQ, aggression propensity assessed by BPQ |
| Fasano 2019, Italy     | 113 children aged 8 to 10 | Group intervention | The music intervention consisted of 50 min twice weekly for 12 consecutive weeks | Not received music intervention during the study period | Hyperactivity-impulsivity assessed by SDI and SDQ scales; impulsivity control assessed by MF-test |
| Kanchana 1993, India   | 20 children aged 10 to 14 | Group intervention | Music intervention (El Sistema program) consisted of 45 min once a week for 12 weeks | Not received music intervention, but played some in-door games during the study period | Self-reported aggression by 3 items |
| Montello 1999, USA     | 16 children aged 11 to 14; with emotional disturbances, learning disabilities, and attention deficit disorder | Group intervention | Music intervention consisted of 45 min once a week for 24 consecutive weeks. | Received passive music therapy during the study period | Aggression/hostility assessed by CBCL |
| Rickson 2003, New Zealand | 18 adolescents aged 11 to 15 with aggressive behaviors | Group intervention | Music therapy intervention consisted of 16 sessions of approximately 30–45 min, twice a week | A wait-list control group | Aggression assessed by DBC |
| Rickson 2006, New Zealand Schellenberg 2015, Canada | 13 adolescents aged 11 to 16 with a formal diagnosis of ADHD | Individual intervention | Music therapy intervention consisted of 16 sessions of 45 min | A wait-list control group | Hyperactivity-impulsivity assessed by CGIR-I and CDIH-I |
| Uhlig 2018, Netherlands | 84 children with a mean age of 8 yr | Group intervention | Music intervention consisted of weekly 40-min sessions over 10 months | Not received music intervention during the study period | Presocial skills assessed by SBQ |
| Schellenberg 2015, Canada | 190 children aged 8 to 12 | Group intervention | Music intervention consisted of weekly 45-min sessions over 16 consecutive weeks | Not received music intervention during the study period | Presocial behaviors assessed by SDQ, Self-control assessed by DERS |

ADHD = attention deficit hyperactivity disorder, CAAI = child aggression assessment inventory, CBCL = child behavior checklist, CDIH = Conners’ DSM-IV Hyperactive-Impulsive Scale, CGIR = Conners’ Global Index Restless-Impulsive, CSCR = child self-control rating scale, DBC = developmental behavior checklist, DERS = difficulties in emotion regulation scale, PAPS = physical aggression propensity scale, PBFS = problem behavior frequency scale; RSASB = ratings of social and anti-social behavior (Aggression); SDQ = social behavior questionnaire; SDI = strength and difficulty questionnaire.
scales were filled by whom (children, parents, teachers), and participators with aggressive behaviors (no, yes). The sensitivity analyses were performed to test the robustness of the results by re-estimating the pooled effects using fix effect model, combining outcomes measured by different scales from the same paper, excluding the paper with fewer than 20 participants, and excluding the paper with the largest sample size. Publication bias was investigated using a funnel plot as well as Egger linear regression test. The analyses were performed using Stata, version 11.0. All P values were two-sided. A P value of less than 0.05 was considered to be statistically significant.

3. Results

3.1. Characteristics of the eligible studies

Figure 1 depicts the study profile, a total of 10 studies were included in the present meta-analysis. Of the 10 studies, 3 studies were conducted in New Zealand, 2 studies were conducted in USA; the mean age of the included participators ranged from 8 to 13; the sample size of the included studies ranged from 13 to 2914; all studies had an intervention duration ≥8 weeks, and only 1 studies used individual music intervention; 5 studies included children or adolescents with aggressive behaviors.
behavior or other behavior disorders (autism, ADHD) before intervention (Table 2). Of the 10 studies, 5 studies evaluated music medicine and 5 studies evaluated music therapy; 9 studies made a comparison of active music intervention and no music intervention, and only one study made a comparison of active music intervention and receptive music therapy.

The risk-of-bias graph of the included studies is presented in Fig. 2. Half studies described the exact methods of randomization. However, the majority of included studies did not describe the detail regarding allocation concealment. Blinded methodology was rarely used in the included studies due to the nature of music intervention. The majority of included studies exhibited low risk of bias on incomplete outcome data and selective reporting.

### 3.2. The overall effects of music-based intervention

Seven trials in 4 studies evaluated the effect of music-based intervention on aggressive behavior, with high homogeneity between the trials ($I^2 = 94.4\%, P < .001$). Using a random-effects model, the aggressive behavior was significantly decreased in the music-based intervention group compared with the control group ($SMD = -0.99; 95\% CI = -1.42$ to $-0.56$). 4 trials in 3 studies evaluated the effect of music-based intervention on self-control, with high homogeneity between the trials ($I^2 = 96.5\%, P < .001$). Using a random-effects model, the self-control was significantly increased in the music-based intervention group compared with the control group ($SMD = 0.56; 95\% CI = 0.19$ to $0.93$) (Fig. 3).

Four trials in 2 studies evaluated the effect of music therapy on aggressive behavior and 3 trials in 2 studies evaluated the effect of music medicine on aggressive behavior. Using a random-effects model, the aggressive behavior was significantly decreased in the music therapy group compared with the control group ($SMD = -1.79; 95\% CI = -3.23$ to $-0.35$); while no difference was observed between music medicine group and control group (Fig. 6).

Only 2 trials in 1 study made a comparison of active music therapy and receptive music therapy. Using a random-effects model, no difference was observed between these 2 groups (Fig. 7).

### 3.3. Sub-group analyses

The results of sub-group analyses are presented in Table 3. We found that the music-based intervention was more efficacious in reducing aggressive behavior in the children received ≥2 sessions per week ($SMD = -1.79; 95\% CI = -3.23$ to $-0.34$), the children with a mean age ≥10 years ($SMD = -1.74; 95\% CI = -2.89$ to $-0.60$), the children whose behavior were reported by teachers ($SMD = -2.75; 95\% CI = -3.54$ to $-1.95$), and the children with aggressive behavior before intervention ($SMD = -1.79; 95\% CI = -3.23$ to $-0.35$). Furthermore, we found that the music-based intervention was more efficacious in increasing self-control in the children received ≥2 sessions per week ($SMD = 2.31; 95\% CI = 1.84$ to $2.79$) and the children whose behavior were reported by themselves ($SMD = 0.73; 95\% CI = 0.21$ to $1.24$).

### 3.4. Sensitivity analyses

The results of sensitivity analyses are presented in Table 4. We found that excluding trials with fewer than 20 participants yielded results similar to those of the primary analysis; Combining outcomes measured by different scales from the same paper and excluding the trial with the largest sample size yielded an increased effect size; while using fixed effect model yielded a significant reduced effect size. However, the results of sensitivity analyses indicated that the primary results was robust.

### 3.5. Evaluation of publication bias

We assessed publication bias using Egger linear regression test and funnel plot, and the results are presented in Figure 8 and Table 2. For aggressive behavior, an obvious asymmetry was
observed, which may indicate either the absence of trials obtaining negative results or publication bias.

4. Discussion

We firstly estimated the file://C:\Documents and Settings\Administrator\Local Settings\Application Data\youdao\dict\Application\7.5.2.\res\result\dict?Keyword=effect of music-based intervention on the aggressive behavior in children/adolescents using a meta-analysis. We found a significant decrease of aggressive behavior and an increase of self-control in the music-based intervention group compared with the control group in children/adolescents. Music therapy other than music medicine exhibited superior effect on reducing aggressive behavior compared with the control group. The results of sub-group analyses showed that intervention duration, sessions per week, children's age, children with aggressive behaviors before intervention, and the scales were filled by different roles were significantly associated with the intervention effect. Sensitivity analyses suggested that our pooled results were robust and
### Figure 4.
Comparison of reduced aggressive behavior between music medicine and music therapy.

- **Alemán X (2017a)** was assessed using PBFS; **Alemán X (2017b)** was assessed using RSASB; **Choi AN (2010a)** was assessed by guardian; **Choi AN (2010b)** was assessed by teacher; **Rickson DJ (2003a)** was assessed using DBC Disruptive Behaviour Subscales; **Rickson DJ (2003b)** was assessed using DBC Antisocial Subscale.

### Figure 5.
Comparison of reduced hyperactivity-impulsivity between music medicine and music therapy.

- **Fasano MC (2019a)** was assessed using SCAB; **Fasano MC (2019b)** was assessed using SDAI; **Rickson DJ (2016a)** was assessed by teacher using CGI-I; **Rickson DJ (2016b)** was assessed by guardian using CDIH-I; **Rickson DJ (2016c)** was assessed by teacher using CDIH-I; **Rickson DJ (2016d)** was assessed by teacher using CDIH-I.
Figure 6. Comparison of reduced aggressive behavior between improvisational music therapy and recreative music therapy. Alemán X (2017a) was assessed using PBFS; Alemán X (2017b) was assessed using RSASB; Choi AN (2010a) was assessed by guardian; Choi AN (2010b) was assessed by teacher; Rickson DJ (2003a) was assessed using DBC Disruptive Behaviour Subscales; Rickson DJ (2003b) was assessed using DBC Antisocial Subscale.

Figure 7. Comparison of reduced aggressive behavior between active music therapy and receptive music therapy. Montello L (1999a) assessing motivation problems using CBCL; Montello L (1999b) assessing hostility problems using CBCL.
### Table 3
Subgroup analyses of music-based interventions on aggressive behavior and other outcomes in children and adolescents.

| Outcomes                              | Trials number | Effects     | Heterogeneity | Egger test |
|---------------------------------------|---------------|-------------|---------------|------------|
|                                      |               | SMD (95%CI) | P             | F (%)      | a          | P    |
| Aggressive behavior                   |               |             |               |            |            |      |
| Mean age, yr                          |               |             |               |            |            |      |
| ≤10                                    | 2             | –0.01 (–0.08, 0.05) | .65 | 0 .988 | 12.64 .057 |      |
| >10                                   | 5             | –1.74 (–2.89, –0.60) | .003 | 26.94 <.001 | –2.7 <.001 |      |
| Intervention duration, weeks          |               |             |               |            |            |      |
| ≤12                                   | 3             | –0.86 (–1.83, 0.12) | .085 | 4.53 .104 | –7.96 .002 |      |
| >12                                   | 4             | –1.02 (–1.51, –0.53) | <.001 | 96.45 <.001 | –1.41 <.001 |      |
| Sessions per week                     |               |             |               |            |            |      |
| 1 per week                            | 3             | –0.06 (–0.22, 0.11) | .525 | 8.52 .014 | –2.86 <.001 |      |
| ≥2 per week                           | 4             | –1.79 (–3.23, –0.34) | .015 | 88.40 <.001 | 12.47 .135 |      |
| The scales were reported by whom?     |               |             |               |            |            |      |
| Children                              | 4             | –0.55 (–1.36, 0.25) | .179 | 11.48 .009 | –1.78 .067 |      |
| Parents                               | 2             | –1.59 (–4.73, 1.55) | .322 | 51.91 <.001 | –4.87 .038 |      |
| Teachers                              | 1             | –2.75 (–3.54, –1.95) | <.001 | 0 – | –9.11 <.001 |      |
| Participants with aggressive behaviors before intervention | | | | | | |
| No                                    | 3             | –0.05 (–0.22, 0.11) | .525 | 8.52 .014 | –3.24 .051 |      |
| Yes                                   | 4             | –1.79 (–3.23, –0.35) | .015 | 25.77 <.001 | –4.4 .015 |      |
| Aggression propensity                  |               |             |               |            |            |      |
| Intervention duration, weeks          |               |             |               |            |            |      |
| ≤12                                   | 1             | –0.31 (–0.88, 0.25) | .28 | – – | – – |      |
| >12                                   | 1             | –0.01 (–0.09, 0.07) | .786 | – – | – – |      |
| Participants with aggressive behaviors before intervention | | | | | | |
| No                                    | 1             | –0.01 (–0.03, 0.07) | .786 | – – | – – |      |
| Yes                                   | 1             | –0.31 (–0.88, 0.25) | .28 | – – | – – |      |
| Hyperactivity-impulsivity              |               |             |               |            |            |      |
| Mean age, yr                          |               |             |               |            |            |      |
| ≤10                                    | 2             | –0.26 (–1.13, 0.60) | .549 | 90.50 .001 | –160.39 – |      |
| >10                                   | 9             | –0.02 (–0.72, 0.68) | .955 | 69.40 .001 | –10.34 .11 |      |
| Intervention duration, weeks          |               |             |               |            |            |      |
| ≤12                                   | 7             | –0.05 (–0.58, 0.49) | .867 | 72.30 .001 | 0.8 .628 |      |
| >12                                   | 4             | –0.18 (–1.65, 1.29) | .81 | 82.00 .001 | –25.94 .403 |      |
| Sessions per week                     |               |             |               |            |            |      |
| 1 per week                            | 9             | –0.02 (–0.72, 0.68) | .955 | 69.40 .001 | –10.34 .11 |      |
| ≥2 per week                           | 2             | –0.26 (–1.13, 0.60) | .549 | 90.50 .001 | –160.39 – |      |
| The scales for                        |               |             |               |            |            |      |
| Children                              | 2             | 0.13 (–1.61, 1.88) | .882 | 91.50 .001 | 6.19 – |      |
| Parents                               | 4             | 0.70 (0.11, 1.28) | .019 | 0.00 .568 | 16.83 .03 |      |
| Teachers                              | 5             | –0.73 (–1.54, 0.07) | .074 | 70.50 .009 | –2.96 .009 |      |
| Participants with aggressive behaviors before intervention | | | | | | |
| No                                    | 3             | 0.09 (–0.75, 0.94) | .832 | 88.70 <.001 | 4.37 .586 |      |
| Yes                                   | 8             | –0.18 (–0.90, 0.43) | .636 | 66.20 .004 | –11.66 .343 |      |
| Prosocial behavior                    |               |             |               |            |            |      |
| Intervention duration, weeks          |               |             |               |            |            |      |
| ≤12                                   | 1             | 0.25 (–0.31, 0.81) | .379 | – – | – – |      |
| >12                                   | 5             | 0.08 (–0.12, 0.28) | .435 | 82.30 <.001 | 0.89 .694 |      |
| The scales for                        |               |             |               |            |            |      |
| Children                              | 4             | 0.19 (–0.29, 0.68) | .428 | 86.50 <.001 | 1.58 .573 |      |
| Parents                               | 1             | 0.06 (–0.02, 0.15) | .148 | – – | – – |      |
| Teachers                              | 1             | –0.05 (–0.49, 0.38) | .804 | – – | – – |      |
| Participants with aggressive behaviors before intervention | | | | | | |
| No                                    | 5             | 0.01 (–0.08, 0.10) | .838 | 29.30 .226 | 0.89 .694 |      |
| Yes                                   | 1             | 1 (0.54, 1.46) | <.001 | – – | – – |      |
| Self-control                          |               |             |               |            |            |      |
| Sessions per week                     |               |             |               |            |            |      |
| 1 per week                            | 4             | 0.08 (0.03, 0.13) | .001 | 0.00 .416 | 1.42 .22 |      |
| ≥2 per week                           | 1             | 2.31 (1.84, 2.79) | <.001 | – – | – – |      |
| The scales were reported by whom?     |               |             |               |            |            |      |
| Children                              | 3             | 0.73 (0.21, 1.24) | .006 | 97.50 <.001 | 10.97 .15 |      |
| Parents                               | 1             | 0.04 (–0.04, 0.11) | .305 | – – | – – |      |
| Teachers                              | 1             | 0.26 (–0.17, 0.07) | .235 | – – | – – |      |

SMD = standardized mean differences.
credible. Therefore, we suggested that greater emphasis should be placed on music-based intervention for treatment of aggression in children/adolescents, especially the older children with aggressive behaviors.

In our present meta-analysis, we found that the music-based intervention with shorter duration (<12 weeks) and more sessions per week (≥2 sessions per week) would be more efficient on reducing the aggressive behavior in children. This could have important implications for generalization of music-based intervention in school. We used to think that music intervention programs with duration of at least one year could yield effective results. 49 While an amount of financial resources required in the long duration of intervention not always affordable for institutions such as public schools. Implementing a short-term music intervention involving only few teachers for a limited period of time, and therefore less expensive but efficient music programs could make music training more accessible for schools.

Another interesting result was that the intervention effects varied significantly according to the different responders to aggression rating scales, for example, the effect size was −2.75 in the children whose behavior were reported by teachers, −1.59 in the children whose behavior were reported by parents, and −0.55 in the children whose behavior were reported by themselves. The observed differences might have been influenced by their different observer roles, as the teachers were always present during intervention sessions, and the parents were not. This discrepancy revealed some level of subjectivity that should be taken into consideration when evaluating the intervention effect on children and on the school context in general.42

During the past 10 years, a total of five meta-analyses have explored the music interventions effects on reducing the aggressive behavior in people with dementia. Van der Steen et al15,17 performed two meta-analyses in 2017 and 2018 respectively, and they found moderate-quality evidence that music-based therapeutic interventions might have little or no effect on agitation or aggression in people with dementia. A meta-analysis by Pedersen et al14 included 12 studies and reported a significant pooled effect size (d=0.61, 95%CI=0.38 to 0.84) of music intervention on aggression in people with dementia. A recent meta-analysis by Tsoi et al16 evaluated the effects on aggression between interactive and receptive music therapies for people with dementia, and 38 trials involving 1418 participants

| Fixed effect model | −0.11 (−0.16,−0.06)∗ | −0.02 (−0.10,0.06) | −0.15 (−0.39,0.09) | 0.03 (−0.03,0.09) | 0.10 (0.04,0.15)∗ |
| Excluding trials with fewer than 20 participants | −0.43 (−0.63,−0.23)∗ | −0.03 (−0.15,0.10) | 0.09 (−0.75,0.94) | 0.03 (−0.03,0.09) | 0.56 (0.19,0.93)∗ |
| Combining outcomes measured by different scales from the same paper | −0.70 (−1.19,−0.22)∗ | −0.03 (−0.15,0.10) | 0.14 (−0.72,1.00) | 0.03 (−0.05,0.11) | 0.86 (0.36,2.09)∗ |
| Excluding the paper by Alemán et al | −0.62 (−0.91,−0.34)∗ | −0.31 (−0.87,0.25) | −0.02 (−0.70,0.66) | 0.11 (−0.21,0.44) | 1.29 (−0.72, 0.66) |

∗ < 0.05.
with dementia were included in this study. A significant decrease on aggression was observed in the receptive music therapy group compared with control group in people with dementia in this meta-analysis; while no significant difference was observed between interactive music therapy group and usual care group. In the last, a network meta-analysis by Watt et al\[15\] pooled the comparative efficacy of pharmacologic and nonpharmacologic interventions for treating aggression and agitation in adults with dementia, and found that music combined with massage and touch therapy (SMD = -0.91, 95%CI: -1.75 to -0.07) were clinically more efficacious than usual care. Disappointingly, no meta-analysis of the effect of music interventions effects on reducing the aggressive behavior in health children or adolescents due to the limited studies so far. Our present study filled up the gaps in the previous studies.

Our meta-analysis has limitations. First, the study quality was decreased due to the lack of allocation concealment, blinding of participants and personnel, blinding of outcome assessment in the majority of included studies. The trials of evaluating music intervention effects rarely used blinded methodology due to the nature of music intervention, therefore the performance bias and the detection bias was common in music intervention study. Second, the majority of included studies had small sample sizes (<30), therefore, the pooled results should be explicated with caution. Third, the include studies were lack of same measurements of aggressive behavior, which may account for the high heterogeneity among the trials.

5. Conclusion

Our present study was the first meta-analysis to estimate the file:// C://Documents and Settings//Administrator//Local Settings//Application Data//youdao//dictApplication//7.5.2.0//result//dict?keyword=effect of music-based intervention on the aggressive behavior in children/adolescents. A significant decrease in aggressive behavior and an increase of self-control was observed in the children with music-based intervention compared with the control group. While, no significant difference in aggression propensity, hyperactivity-impulsivity, and prosocial behavior were observed. However, our results should be explicated with caution due to the high risk of performance bias and detection bias that existed in the majority of included studies.

Author contributions

Conceptualization: Qishou Tang.
Formal analysis: Zhaohui Huang.
Software: Zhaohui Huang.
Writing – original draft: Peijie Ye.
Writing – review & editing: Huan Zhou.

References

[1] Musu-Gillette L, Zhang A, Wang K, et al. Indicators of school crime and safety: 2016 (NCES 2017-064/NCJ 250650). Washington, DC: National Center for Education Statistics, US Department of Education, and Bureau of Justice Statistics, Office of Justice Programs, US Department of Justice; 2017.

[2] AMH, HF I, MG N, et al. Content, diagnostic, correlational, and genetic similarities between common measures of childhood aggressive behaviors and related psychiatric traits. J Child Psychol Psychiatry 2020.

[3] Moilanen KL, Shaw DS, Maxwell KL. Developmental cascades: externalizing, internalizing, and academic competence from middle childhood to early adolescence. Dev Psychopathol 2010;22:635–53.

[4] Mehari KR, Waasdorp TE, Leff SS. Measuring relational and overt aggression by peer report: a comparison of peer nominations and peer ratings. J Sch Violence 2019;18:362–74.

[5] Broidy LM, Nagon DS, Tremblay RE, et al. Developmental trajectories of childhood disruptive behaviors and adolescent delinquency: a six-site, cross-national study. Dev Psychol 2003;39:222–45.

[6] Kim S, Boylan K. Effectiveness of antidepressant medications for symptoms of irritability and disruptive behaviors in children and adolescents. J Child Adolesc Psychiatr Pharmacol 2016;26:694–704.

[7] Loy JH, Merry SN, Hetrick SE, et al. Atypical antipsychotics for disruptive behaviour disorders in children and youths. Cochrane Database Syst Rev 2017;8:CD008559.

[8] Watt JA, Gomes T, Bronskill SE, et al. Comparative risk of harm associated with trazodone or atypical antipsychotic use in older adults with dementia: a retrospective cohort study. CMAJ 2018;190: E1376–83.

[9] Maust DT, Kim HM, Seyfried LS, et al. Antipsychotics, other psychotropics, and the risk of death in patients with dementia: number needed to harm. JAMA Psychiatry 2015;72:438–45.

[10] Jensen PS. The role of psychosocial therapies in managing aggression in children and adolescents. J Clin Psychiatry 2008;69(Suppl 4):37–42.

[11] Li Y, Xing X, Shi X, et al. The effectiveness of music therapy for patients with cancer: a systematic review and meta-analysis. Journal of Adv Nurs 2020.

[12] Lin FH, Chang YC, Chou IH, et al. Effect of music intervention on anxiety during labor: a systematic review and meta-analysis of randomized controlled trials. PeerJ 2019;7:e6945.

[13] Watt JA, Goodarzi Z, Veroniki AA, et al. Comparative efficacy of interventions for aggressive and agitated behaviors in dementia: a systematic review and network meta-analysis. Ann Intern Med 2019;171:634–42.

[14] Pedersen SKA, Andersen PN, Lugo RG, et al. Effects of music on agitation in dementia: a meta-analysis. Front Psychol 2017;8:742.

[15] van der Steen JT, van Soest-Packert MC, van der Wouden JC, et al. Music-based therapeutic interventions for people with dementia. Cochrane Database Syst Rev 2017;5:CD003477.

[16] Tsoi KKF, Chan JYC, Ng YM, et al. Receptive music therapy is more effective than interactive music therapy to relieve behavioral and psychological symptoms of dementia: a systematic review and meta-analysis. J Am Med Dir Assoc 2018;19:568–76.e3.

[17] van der Steen JT, Smaling HJ, van der Wouden JC, et al. Music-based therapeutic interventions for people with dementia. Cochrane Database Syst Rev 2018;7:CD003477.

[18] Yingger OS, Gooong L. Music therapy and music medicine for children and adolescents. Child Adolesc Psychiatr Clin N Am 2014;23: 535–53.

[19] Bradt J, Potvin N, Kesslick A, et al. The impact of music therapy versus music medicine on psychological outcomes and pain in cancer patients: a mixed methods study. Support Care Cancer 2015;23:1261–71.

[20] Higgins J, Altman D, Sterne J. Chapter 8: Assessing risk of bias in included studies. In I, J. Higgins, R. Churchill, J. Chandler &M. Cumpston (Eds.), Cochrane Handbook for Systematic Reviews of Interventions version 5.2.0 (updated June 2017), Cochrane 2017.

[21] American Music Therapy Association (2020). Definition and Quotes about Music Therapy. Available online at: https://www.musictherapy.org/about/quotes/ [Accessed September 13, 2020].

[22] Farrell AD, Kung EM, White KS, et al. The structure of self-reported aggression, drug use, and delinquent behaviors during early adolescence. J Clin Child Psychol 2000;29:282–92.

[23] Einfeld SL, Tonge BJ. Developmental Behaviour Checklist, Primary Carer Version (DBC–P): School of Psychiatry, University of NSW, and Centre for Developmental Psychiatry, Monash University. 1994.

[24] Lee YA, Yi JS. A validity study of child aggression assessment inventory. J Educ Res 2002;22:143–60.

[25] Oh KJ, Hong KH, Lee HR. Manual for Child Behavior Checklist. Seoul, South Korea: CungAng Aptitude Publishing Co. Ltd; 1997.

[26] European Center for Drug and Drug Addiction. (n.d.) The social and antisocial behavior scale. http://www.emcdda.europa.eu/html/cfm/indexes3?EN.html.

[27] Kanchana, Bhat R, Koshy V, et al. Combating aggression in institutionalized children with physical exercise and music. Indian J Psychiatry 1993;35:93–5.

[28] Rugby K, Skee PT. The Peer Relations Questionnaire. Adelaide, SA, Australia: Institute of Social Research, University of South Australia; 1993.
[29] Chan W, Henry D. What would make you fight? A measure of motivation for aggression. Washington, DC: United States: Society for Prevention Research. XXX 2009.

[30] Conners CK. Conners’ Rating Scales–Revised. New York: MES; 1997.

[31] Goodman R. The strengths and difficulties questionnaire. J Child Psychol Psychiatry 1997;40:133745.

[32] Tremblay RE, Loebner R, Gagnon C, et al. Disruptive boys with stable and unstable high fighting behavior patterns during junior elementary school. J Abnorm Child Psych 1991;19:285–300.

[33] Rohrbeck CA, Azar ST, Wagner PE. Child self-control rating scale: validation of a child self-report measure. J Clin Child Psych 1991;20:179–83.

[34] Neumann A, van Lier PA, Gratz KL, et al. Multidimensional assessment of emotion regulation difficulties in adolescents using the Difficulties in Emotion Regulation Scale. Assessment 2010;17:138–49.

[35] JP H, SG T, JJ D, et al. Measuring inconsistency in meta-analyses. BMJ (Clinical research ed) 2003;327:557–60.

[36] JP H, SG T. Quantifying heterogeneity in a meta-analysis. Stat Med 2002;21:1539–38.

[37] Cochran WG. The combination of estimates from different experiments. Biometrics 1954;10:101–29.

[38] ME G, DS, MS, et al. Bias in meta-analysis detected by a simple, graphical test. BMJ (Clinical research ed) 1997;315:629–34.

[39] Rickson DJ, Watkins WG. Music therapy to promote prosocial behaviors in aggressive adolescent boys—a pilot study. J Music Ther 2003;40:283–301.

[40] Uhlq S, Jansen E, Scherder E. Being a bully isn’t very cool . . . “: Rap & Sing Music Therapy for enhanced emotional self-regulation in an adolescent school setting - a randomized controlled trial. Psychol Music 2018;46:568–87.

[41] Rickson DJ. Instructional and improvisational models of music therapy with adolescents who have attention deficit hyperactivity disorder (ADHD): a comparison of the effects on motor impulsivity. J Music Ther 2006;43:39–62.

[42] MC F, CS, RC, et al. Short-term orchestral music training modulates hyperactivity and inhibitory control in school-age children: a longitudinal behavioural study. Front Psychol 2019;10:750.

[43] L M, EE C. Effects of active versus passive group music therapy on preadolescents with emotional, learning, and behavioral disorders. J Music Ther 1999;35:49–67.

[44] Kanchana RB, VK, SM. Combating aggression in institutionalized children with physical exercise and music. Indian J Psychiatry 1993;35:93–5.

[45] Schellenberg EG, Corrigall KA, Dys SP, et al. Group music training and children’s prosocial skills. PLoS ONE 2015;10:e0141449.

[46] Cook A, Ogden J, Winstone N. The impact of a school-based musical contact intervention on prosocial attitudes, emotions and behaviours: a pilot trial with autistic and neurotypical children. Autism 2019;23:933–42.

[47] Choi A-N, Lee MS, Lee J-S. Group music intervention reduces aggression and improves self-esteem in children with highly aggressive behavior: a pilot controlled trial. Evid Based Complement Alternat Med 2010;7:213–7.

[48] Alemán X, Duryea S, Guerra NG, et al. The effects of musical training on child development: a randomized trial of El Sistema in Venezuela. Prev Sci 2017;18:865–78.

[49] NK, JS, ECT, et al. Music enrichment programs improve the neural encoding of speech in at-risk children. Journal Neurosci 2014;34:11913–8.