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

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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 in children and adolescents, 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, I^2 = I-square, PAPS = physical aggression propensity scale, PBFS = problem behavior frequency Scale, RSASB = 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.[8] Another study reported increased mortality with the increase of antipsychotics dose in patients with dementia.[9] 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.[10]

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.[11,12] A recent network meta-analysis by Watt et al[13] 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 file://C:\Documents and Settings\Administrator\Local Settings\Application Data\youdao \dict\Application\7.5.2.0\resultui\dict\?keyword=effect of music-based intervention on aggressive behavior were published[13–17]; 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 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.[18,19] 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 file://C:\Documents and Settings\Administrator\Local Settings\Application Data\youdao \dict\Application\7.5.2.0\resultui\dict\?keyword=effect of music-based intervention on the aggressive behavior in children and adolescents, and make a comparison of therapeutic effectiveness between music therapy and music medicine and between different specific methods used in music therapy.

2. Materials and methods

2.1. Search strategy and selection criteria

This study was approved by the ethics committee of Bengbu Medical University. The patient consent was unavailable because that this systematic review did not involve patients consent. We searched PubMed (MEDLINE), Ovid-Embase, and the Cochrane Central Register of Controlled Trials (CENTRAL) to identify studies evaluating the effectiveness of music intervention to reduce aggressive behavior in children and adolescents from inception to March 2020. A broad search was performed using a combination of music, sing, musicotherapy, violence, aggression,

violent behavior, aggressive behavior, agitated behaviors, abuse, and bully. We also checked the reference lists of included studies and related systematic reviews. The inclusion criteria for our analysis were as follows:

(1) randomized or quasi-randomized controlled trials;
(2) the participators 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 participators, 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, re-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.[35–37] 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 recreative 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]
DBC (Derived from the CBCL)	1	Unavailable	Unavailable	Einfeld et al[23]
CAAI (Korean translated scale)	1	Score range from 0 (never) to 48 (always)	Cronbach's alpha = 0.95	Lee et al[24]
CBCL (Original and Korean translated scale)	2	Score range from 0 (never) to 60 (always)	Cronbach's alpha = 0.94	Oh et al[25]
RSASB (Original scale)	1	Score range from 4 (never) to 20 (always)	Cronbach's alpha = 0.68	European Center for Drug and Drug Addiction[26]
Self-developed questionnaire	1	Score range from 4 (never) to 12 (always)	Unavailable	Kanchana et al[27]
Evaluating aggression propensity				
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	Chan et al[29]
CGIR-I (Original scale)	1	Unavailable	Unavailable	Conners et al[30]
CDIH-I (Original scale)	1	Unavailable	Unavailable	Conners et al[30]
Evaluating prosocial behavior				
SDQ (Original scale)	2	Score range from 0 (never) to 10 (most)	Cronbach's alpha = 0.65	Goodman et al[31]
SBQ (Modified scale)	2	Score range from 0 (never) to 100 (most)	Cronbach's alpha = 0.76–0.81	Tremblay et al[32]
Evaluating self-control				
CSCR (Original scale)	2	10 items	Cronbach's alpha = 0.73	Rohrbeck et al[33]
DERS (Dutch translated scale)	1	32 items	A promising internal consistency and validity	Neumann 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.

Table 2

Characteristics of clinical trials included in the meta-analysis.

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 participators	Prosocial 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 SDAB and SDAI 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 /or 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 waitlist control group	Aggression assessed by DBC
Rickson 2006, New Zealand	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 CGIRI-I and CDIH-I
Schellenberg2015, Canada	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	Prosocial skills assessed by SBQ
Uhlig 2018, Netherlands	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	Prosocial behaviors assessed by SDQ, Self-control assessed by DERS

ADHD = attention deficit hyperactivity disorder, CAAI = child aggression assessment inventory, CBCL = child behavior checklist, CDIH-I = Conners' DSM-IV Hyperactive-Impulsive Scale, CGIRI-I = 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), SBQ = social behavior questionnaire, SDQ = 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.[38] The analyses were performed using Stata, version 11.0. All *P* values were two-sided. A *P* value of less than.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.[39–48] 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
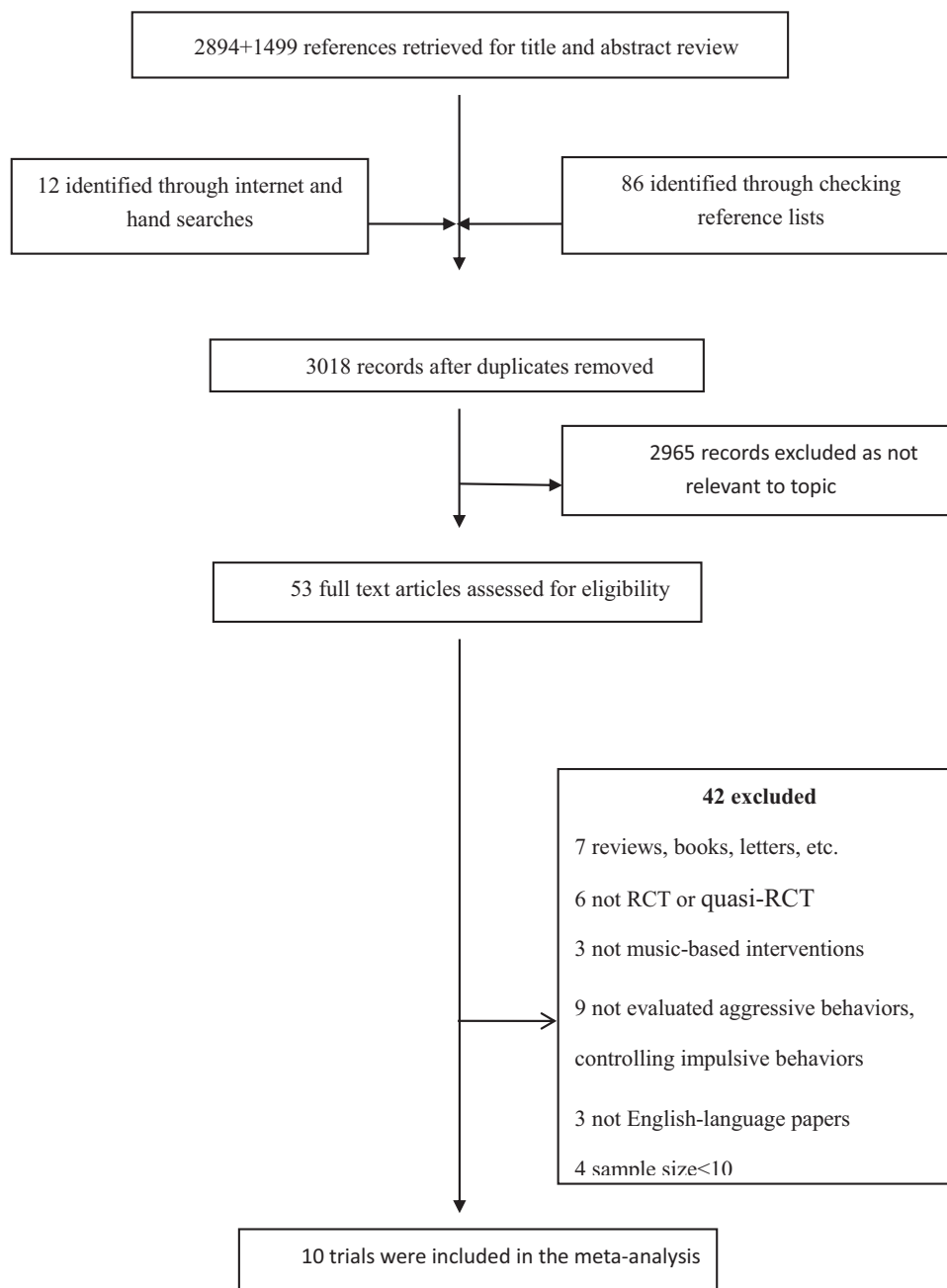

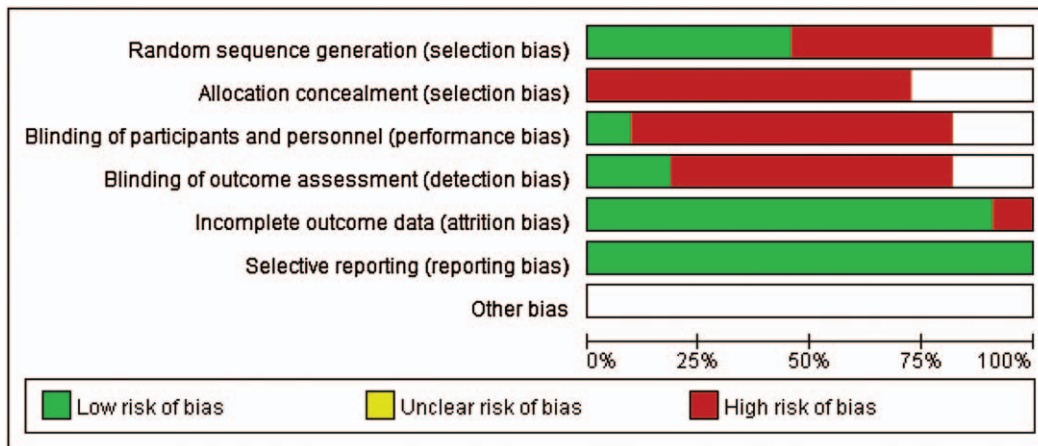**Figure 1.** Flow diagram for selecting a study for meta-analysis.

Figure 2. risk-of-bias graph and risk of bias summary graph.

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. 4). Fig. 5 depicts the comparison of reduced hyperactivity-impulsivity between music medicine and music therapy, and no difference was observed.

Five trials and 2 trials evaluated the effect of improvisational music therapy and recreative music therapy on aggressive behavior respectively. Using a random-effects model, the aggressive behavior was significantly decreased in the improvi-

sational music therapy group compared with the control group (SMD = −1.79; 95% CI = −3.23 to −0.35); while no difference was observed between recreative music therapy 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
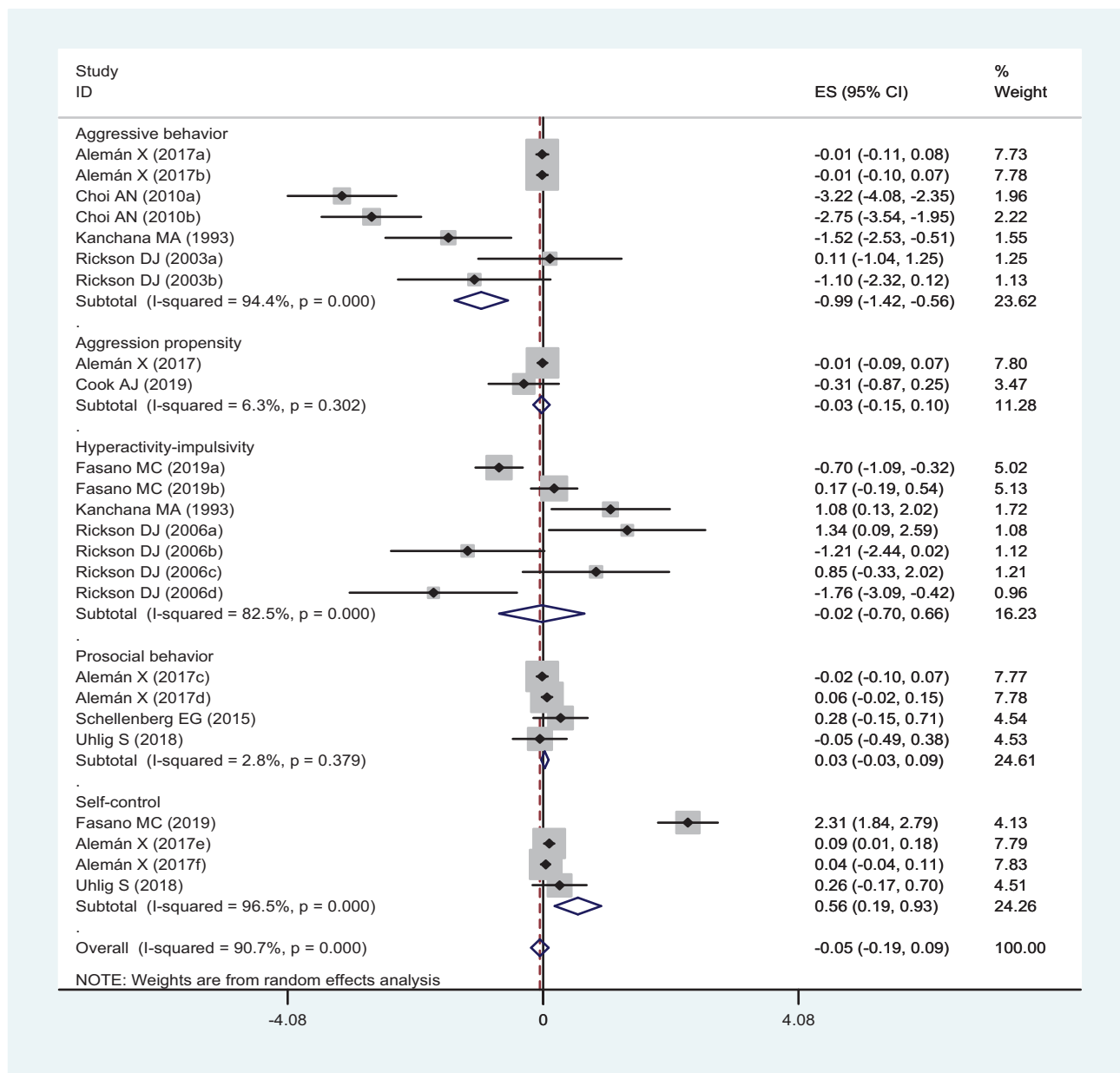
Figure 3. Effects of music-based interventions to reduce aggressive behavior and other outcomes in Children and Adolescents Alemán X (2017a) was assessed using PBFS; Alemán X (2017b) was assessed using RSASB; Alemán X (2017c) was assessed by children using SDQ; Alemán X (2017d) was assessed by guardian using SDQ; Alemán X (2017e) was assessed by children using CSCR; Alemán X (2017f) was assessed by guardian using CSCR; 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 (20.3b) was assessed using DBC Antisocial Subscale; Rickson DJ (2016a) was assessed by guardian using CGIR-I; Fasano MC (2019a) was assessed using SDAB; Fasano MC (2019a) was assessed using SDAI; Rickson DJ (2016b) was assessed by teacher using CGIR-I; Rickson DJ (2016c) was assessed by guardian using CDIH-I; Rickson DJ (2016b) was assessed by teacher using CDIH-I.

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\7.5.2.0\resultui\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
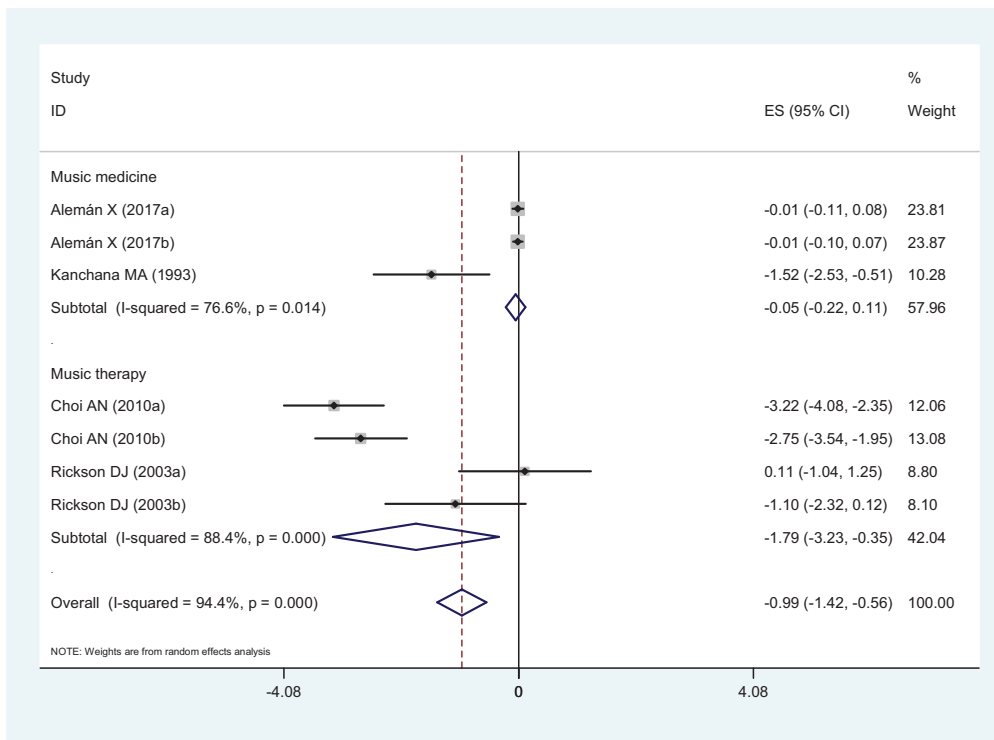
Figure 4. Comparison of reduced aggressive behavior between music medicine and music therapy Alemán X (2017a) was assessed using PBFS; Alemán X (2017b) was assessed using RSASB; Choi AN (2010a) was assessed by guardian; Choi AN (2010b) was assessed by teacher; Rickson DJ (2003a) was assessed using DBC Disruptive Behaviour Subscales; Rickson DJ (20.3b) was assessed using DBC Antisocial Subscale.
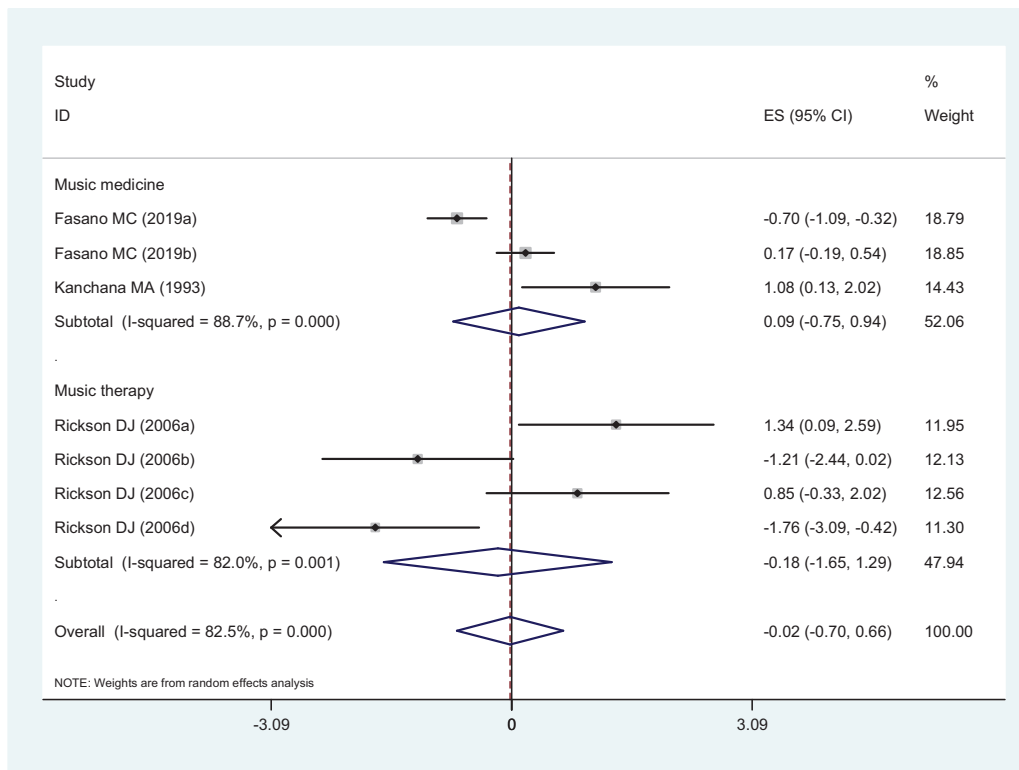
Figure 5. Comparison of reduced hyperactivity-impulsivity between music medicine and music therapy Fasano MC (2019a) was assessed using SDAB; Fasano MC (2019a) was assessed using SDAI; Rickson DJ (2016b) was assessed by teacher using CGIR-I; Rickson DJ (2016c) was assessed by guardian using CDIH-I; Rickson DJ (2016b) was assessed by teacher using CDIH-I.
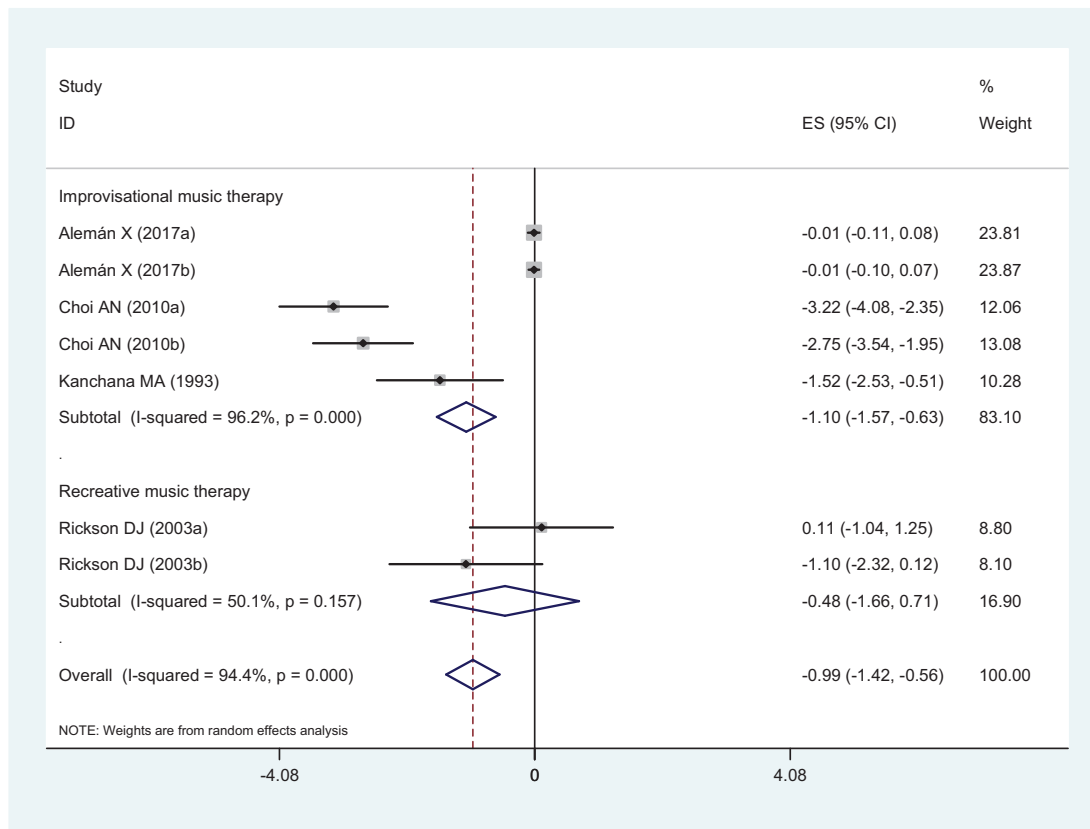
Figure 6. Comparison of reduced aggressive behavior between improvisational music therapy and recreative music therapy Alemán X (2017a) was assessed using PBFS; Alemán X (2017b) was assessed using RSASB; Choi AN (2010a) was assessed by guardian; Choi AN (2010b) was assessed by teacher; Rickson DJ (2003a) was assessed using DBC Disruptive Behaviour Subscales; Rickson DJ (20.3b) was assessed using DBC Antisocial Subscale.
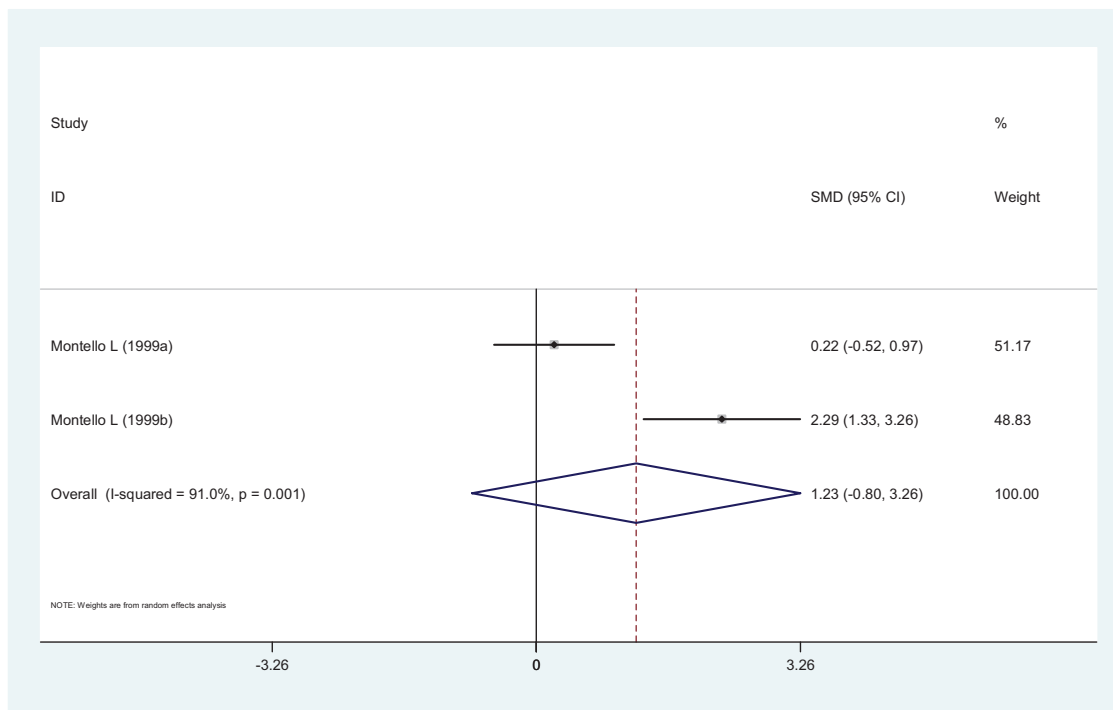

Figure 7. Comparison of reduced aggressive behavior between active music therapy and receptive music therapy Montello L (1999a) assessing motivation problems using CBCL; Montello L (1999b) assessing hostility problems using CBCL.

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	I^2 (%)	P	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	.069
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
Participators 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	−	−	−	−
Participators with aggressive behaviors before intervention							
No	1	−0.01 (−0.09, 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
Participators 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	−	−	−	−
Participators 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)	<0.001	−	−	−	−
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 (−0.17,0.70)	.235	−	−	−	−

SMD = standardized mean differences.

Table 4

Sensitivity analyses of the main outcomes [SMD (95%CI)].

	Aggressive Behavior	Aggression Propensity	Hyperactivity- Impulsivity	Prosocial Behavior	Self-Control
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.

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 al[15,17] 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 al[14] 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 al[16] evaluated the effects on aggression between interactive and receptive music therapies for people with dementia, and 38 trials involving 1418 participants
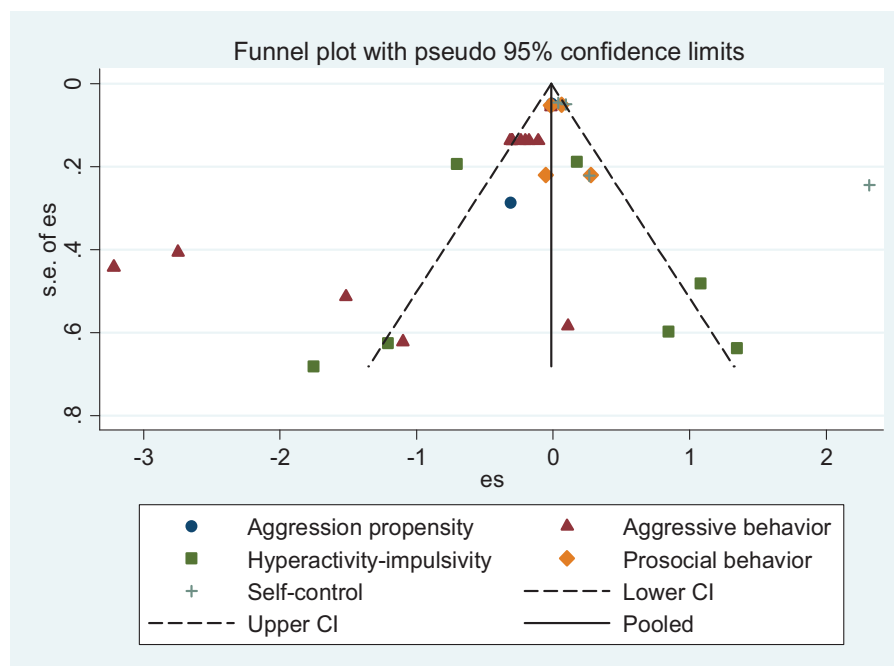

Figure 8. Funnel plot illustrating proneness to publication bias for the included studies.

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[13] 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. Discouragingly, 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 (<50), 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\dict\Application\7.5.2.0\resultui\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

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