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Social skills training for attention deficit hyperactivity disorder (ADHD) in children aged 5 to 18 years (Review)

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[Intervention Review]

Social skills training for attention deficit hyperactivity disorder (ADHD) in children aged 5 to 18 years

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ABSTRACT

Background

Attention deficit hyperactivity disorder (ADHD) in children is associated with hyperactivity and impulsivity, attention problems, and difficulties with social interactions. Pharmacological treatment may alleviate the symptoms of ADHD but this rarely solves difficulties with social interactions. Children with ADHD may benefit from interventions designed to improve their social skills. We examined the benefits and harms of social skills training on social skills, emotional competencies, general behaviour, ADHD symptoms, performance in school of children with ADHD, and adverse events.

Objectives

To assess the beneficial and harmful effects of social skills training in children and adolescents with ADHD.

Search methods

In July 2018, we searched CENTRAL, MEDLINE, Embase, PsycINFO, 4 other databases and two trials registers.We also searched online conference abstracts, and contacted experts in the field for information about unpublished or ongoing randomised clinical trials. We did not limit our searches by language, year of publication, or type or status of publication, and we sought translation of the relevant sections of non-English language articles.

Selection criteria

Randomised clinical trials investigating social skills training versus either no intervention or waiting-list control, with or without pharmacological treatment of both comparison groups of children and adolescents with ADHD.

Data collection and analysis

We conducted the review in accordance with the *Cochrane Handbook for Systematic Reviews of Intervention.* We performed the analyses using Review Manager 5 software and Trial Sequential Analysis. We assessed bias according to domains for systematic errors. We assessed the certainty of the evidence with the GRADE approach.

Main results

We included 25 randomised clinical trials described in 45 reports. The trials included a total of 2690 participants aged between five and 17 years. In 17 trials, participants were also diagnosed with various comorbidities.

The social skills interventions were described as: 1) social skills training, 2) cognitive behavioural therapy, 3) multimodal behavioural/psychosocial therapy, 4) child life and attention skills treatment, 5) life skills training, 6) the "challenging horizon programme", 7) verbal self-instruction, 8) meta-cognitive training, 9) behavioural therapy, 10) behavioural and social skills treatment, and 11) psychosocial treatment. The control interventions were no intervention or waiting list.

The duration of the interventions ranged from five weeks to two years. We considered the content of the social skills interventions to be comparable and based on a cognitive-behavioural model. Most of the trials compared child social skills training or parent training combined with medication versus medication alone. Some of the experimental interventions also included teacher consultations.

More than half of the trials were at high risk of bias for generation of the allocation sequence and allocation concealment. No trial reported on blinding of participants and personnel. Most of the trials did not report on differences between groups in medication for comorbid disorders. We used all eligible trials in the meta-analyses, but downgraded the certainty of the evidence to low or very low.

We found no clinically relevant treatment effect of social skills interventions on the primary outcome measures: teacher-rated social skills at end of treatment (standardised mean difference (SMD) 0.11, 95% confidence interval (CI) 0.00 to 0.22; 11 trials, 1271 participants; I^2 = 0%; P = 0.05); teacher-rated emotional competencies at end of treatment (SMD −0.02, 95% CI −0.72 to 0.68; two trials, 129 participants; I^2 = 74%; P = 0.96); or on teacher-rated general behaviour (SMD −0.06 (negative value better), 95% CI −0.19 to 0.06; eight trials, 1002 participants; I^2 = 0%; P = 0.33). The effect on the primary outcome, teacher-rated social skills at end of treatment, corresponds to a MD of 1.22 points on the social skills rating system (SSRS) scale (95% CI 0.09 to 2.36). The minimal clinical relevant difference (10%) on the SSRS is 10.0 points (range 0 to 102 points on SSRS).

We found evidence in favour of social skills training on teacher-rated core ADHD symptoms at end of treatment for all eligible trials (SMD −0.26, 95% CI −0.47 to −0.05; 14 trials, 1379 participants; I^2= 69%; P = 0.02), but the finding is questionable due to lack of support from sensitivity analyses, high risk of bias, lack of clinical significance, high heterogeneity, and low certainty.

The studies did not report any serious or non-serious adverse events.

Authors' conclusions

The review suggests that there is little evidence to support or refute social skills training for children and adolescents with ADHD. We may need more trials that are at low risk of bias and a sufficient number of participants to determine the efficacy of social skills training versus no training for ADHD. The evidence base regarding adolescents is especially weak.

PLAIN LANGUAGE SUMMARY

Social skills training for children aged between 5 and 18 with attention deficit hyperactivity disorder (ADHD)

Review question

What are the benefits and harms of social skills training for children and adolescents with attention deficit hyperactivity disorder (ADHD)?

Background

Children and adolescents with ADHD experience hyperactivity, impulsivity, attention problems, and difficulties with social interactions. Social skills training for ADHD seeks to improve and maintain social interaction and prevent interpersonal difficulties. Programs tend to focus on problem solving, control of emotions, and improving verbal and non-verbal communication. We examined the benefits and harms of social skills training on the following outcomes: social skills, emotional competencies, general behaviour, ADHD symptoms, and performance in school.

Study characteristics

We found 25 randomised clinical trials (studies where participants with ADHD were randomly assigned to one of two or more groups) involving a total of 2690 participants. The trials lasted between five weeks and two years. The social skills training generally focused on teaching the children how to 'read' the subtle cues in social interaction, such as learning to wait for their turn, knowing when to shift topics during a conversation, and being able to recognise the emotional expressions of others. Social skills training often consists of role play, exercises and games, as well as homework. Children in the control groups either received no intervention or were placed on a waiting list.

Key results

We found no significant differences between social skills training versus controls on social skills, emotional competencies, and general behaviour as assessed by teachers. Compared with the children who had no social skills training, teachers rated those who had been in the

social skills groups as having fewer ADHD symptoms at the end of treatment.. However, this finding was questionable because our other analyses did not support it. We found no indications of harmful effects.

All trials suffered from methodological problems such as overestimation of benefits and underestimation of harms. Many studies were also difficult to compare because they involved different interventions. The results from some trials were not very precise, which means it is difficult to be confident in the results. In seven trials, study authors were board members of pharmaceutical companies, had received funding from such companies, or had performed previous research on the topic.

Intepretation

We are unable to conclude whether social skills training is beneficial or not for children with ADHD. We need more randomised clinical trials on social skills training for children and adolescents with ADHD that have a sufficient number of participants and higher methodological quality.The evidence base regarding adolescents is especially weak. We found no adverse treatment effects.

SUMMARY OF FINDINGS

Summary of findings for the main comparison. Social skills training compared to no intervention

Social skills training compared to no intervention

Patient or population: children aged five to 18 years with ADHD
Settings: outpatient clinic; inpatient hospital wards; elementary schools; community mental health centre
Intervention: social skills training
Comparison: no intervention

Outcomes	Illustrative comparative risks* (95% CI)		Relative effect (95% CI)	Number of participants (studies)	Certainity of the evidence (GRADE)	Comments
	Assumed risk	Corresponding risk				
	No intervention	Social skills training				
Teacher-rated social skills Measured by: Conners Behavior Rating Scale: Social Problems Index; Strength and Difficulties Questionnaire: Prosocial Behaviour Subscale (teacher-rated); Social Skills Improvement System; Social Skills Rating Scale: Coorperation Subscale Follow-up: at end of treatment	-	The mean score for teacher-rated social skills at end of treatment in the intervention groups was **0.11 standard deviations higher** (0.00 lower to 0.22 higher)[e]	-	1271 (11 studies)	⊕⊖⊖⊖ **Very low** **a,b,c**	Social skills training may have no effect on teacher-rated social skills
Parent-rated social skills Measured by: Social Skills Rating Scale; Weiss Functional Impairment Scale: Social Acitivities Domain (parent-rated); Strength and Difficulties Questionnaire: Prosocial Behavior Subscale; Social Skills Improvement System Follow-up: at end of treatment	-	The mean score for parent-rated social skills at end of treatment in the intervention groups was **0.19 standard deviations higher** (0.06 higher to 0.32 higher)	-	1609 (15 studies)	⊕⊖⊖⊖ **Very low** **a,b,c**	Social skills training may have no effect on parent-rated social skills
Teacher-rated emotional competencies Measured by: Strengths and Difficulties Questionnaire: Emotional Symptoms Subscale; Conners Behavior Rating Scale: Emotional Index Score	-	The mean score for teacher-rated emotional competencies at end of treatment in the intervention groups was **0.02 standard deviations low-**	-	129 (two studies)	⊕⊖⊖⊖ **Very low** **a,b,c**	Social skills training may have no effect on teacher-rated emotional competencies

Follow-up: at end of treatment		**er** (0.72 lower to 0.68 higher)				
Teacher-rated general behaviour Measured by: Self-Control Rating Scale; Conners Behavior Rating Scale: Aggressiveness Index; Disruptive Behavior Disorders Rating Scale; Conners Teacher Rating Scale: Conduct Problems Index; Strengths and Difficulties Questionnaire: Conduct Problems Subscale (teacher-rated); Child Symptom Inventory: ODD Scale (teacher-rated); Child Behavior Checklist Follow-up: at end of treatment	-	The mean score for teacher-rated general behaviour at end of treatment in the intervention groups was **0.06 standard deviations lower** (0.19 lower to 0.06 higher)	-	1002 (eight studies)	⊕⊕⊖⊖ **Low** **a,d**	Social skills training may have no effect on teacher-rated general behaviour
Parent-rated general behaviour Measured by: Strengths and Difficulties Questionnaire (parent-rated; total scores); Conners Behavior Rating Scale: Aggressiveness Index; Disruptive Behavior Disorders Rating Scale; Behavior Rating Inventory of Executive Function; SDQ: Conduct Problems Subscale (parent-rated); Child Symptom Inventory; Child Behavior Checklist Follow-up: at end of treatment	-	The mean score for parent-rated general behaviour at end of treatment in the intervention groups was **0.38 standard deviations lower** (0.61 lower to 0.14 lower)		995 (eight studies)	⊕⊖⊖⊖ **Very low** **a,b,c,d**	Social skills training may slightly improve parent-rated general behaviour
Teacher-rated ADHD symptoms Measured by: Disruptive Behavior Disorders Rating Scale; ADHD Rating Scales: Hyperactivity and Impulsivity Subscales (total scores); Conner Teacher Rating Scale: Hyperactivity Index; Strengths and Weaknesses of ADHD Symptoms and Normal Behaviors; ADHD Symptom Checklist; Child Symptom Inventory (ADHD (inattention) scale score); SNAP-IV (teacher rating scale) Follow-up: at end of treatment	-	The mean score for teacher-rated ADHD symptoms at end of treatment in the intervention groups was **0.26 standard deviations lower** (0.47 lower to 0.05 lower)	-	1379 (14 studies)	⊕⊖⊖⊖ **Very low[a,b,c]**	Social skills training may slightly improve teacher-rated ADHD symptoms
Parent-rated ADHD symptoms	-	The mean score for parent-rated ADHD symptoms at end of treatment	-	1206 (11 studies)	⊕⊖⊖⊖ **Very low[a,b,c]**	Social skills training may slightly improve

Measured by: Conners Parent Rating Scale: Hyperkinesis Index; Disruptive Behavior Disorders Rating Scale; Strengths and Weaknesses of ADHD Symptoms and Normal Behaviors; Sluggish Cognitive Tempo; ADHD Symptom Checklist; ADHD Rating Scales; Child Symptom Inventory: Inattention; SNAP-IV (teacher rating scale); Child Attention Profile Follow-up: at end of treatment		in the intervention groups was **0.54 standard deviations lower** (0.81 lower to 0.26 lower)		parent-rated ADHD symptoms

*The basis for the **assumed risk** (e.g. the median control group risk across studies) is provided in footnotes. The **corresponding risk** (and its 95% CI) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).

ADHD: Attention deficit hyperactivity disorder; **CI:** Confidence interval; **ODD:** Oppositional defiant disorder; **SNAP-IV:** Swanson, Nolan and Pelham rating scale - Fourth Version.

GRADE Working Group grades of evidence
High quality: we are very confident that the true effect lies close to that of the estimate of the effect.
Moderate quality: we are moderately confident in the effect estimate; the true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low quality: our confidence in the effect estimate is limited; the true effect may be substantially different from the estimate of the effect.
Very low quality: we have very little confidence in the effect estimate; the true effect is likely to be substantially different from the estimate of effect.

[a]Downgraded one level due to high risk of bias (systematic errors leading to overestimation of benefits and underestimation of harms) in several 'Risk of bias' domains, including lack of sufficient blinding and selective outcome reporting (many of the included studies did not report on this outcome)
[b]Downgraded one level due to inconsistency: moderate statistical heterogeneity (I^2 = 30% to 50%)
[c] Downgraded one level due to imprecision: wide CI
[d]Downgraded one level due to indirectness (children's general behaviour was assessed by different types of rating scales, each with a different focus on behaviour)
[e]The effect on the primary outcome, teacher-rated social skills at end of treatment, corresponds to a MD of 1.22 points on the social skills rating system (SSRS) scale (95% CI 0.09 to 2.36). The minimal clinical relevant difference (10%) on the SSRS is 10.0 points (range 0 to 102 points on SSRS).

BACKGROUND

Description of the condition

Attention deficit hyperactivity disorder

Attention deficit hyperactivity disorder (ADHD) affects 3% to 5% of all children (Polanczyk 2007; Thomas 2015). The main symptoms of ADHD include problems with attention, impulsiveness, and hyperactivity (Sergeant 2003; Pasini 2007). Individuals with ADHD also present with difficulties in the domains of attentional and cognitive functions, such as problem-solving, planning, orienting, flexibility, sustained attention, response inhibition, and working memory (Sergeant 2003; Pasini 2007). Other difficulties involve affective components such as motivation delay and mood regulation (Nigg 2005; Castellanos 2006; Schmidt 2009). These latter difficulties are closely related to the condition and are the fundamental basis for these children's problems with social skills (Whalen 1985; Landau 1991),

Prevalence estimates for ADHD vary across the international literature. A large survey in the UK found that 3.6% of boys aged five to 15 years had ADHD; for girls of the same age, this study reported a prevalence of 0.9% (Ford 2003). In one study from Columbia, the reported prevalence was considerably higher: 19.9% for boys and 12.3% for girls (Pineda 2003). A systematic review on the prevalence of ADHD reported a mean proportion of 5.3% children and adolescents having ADHD overall, and concluded that much of the variation is derived from differences in methods used to diagnose the condition (Polanczyk 2007). Among US children and adolescents, the estimated prevalence of diagnosed attention deficit hyperactivity disorder increased from 6.1% in 1997-1998 to 10.2% in 2015-2016 (Xu 2018).

The aetiology of ADHD involves genetic, environmental, and social factors that are not clearly understood. Family and twin studies have shown a high heritability and with no sex differences of heritability (Neale 2010; Franke 2012). Furthermore, genetic factors may be involved in determining the persistence of ADHD into adulthood (Faraone 2000; Franke 2012). Although family studies have shown high heritability, and there are many candidate genes that may be involved in the disorder (Neale 2010), genome-wide studies have yet to find any clear associations. Environmental risk factors include prenatal substance exposures, heavy metal and chemical exposures, nutritional factors, and lifestyle/psychosocial factors (Froehlich 2011).

A diagnosis of ADHD is made through recognition of excessive inattention, hyperactivity, and impulsivity (according to the presence of 18 symptoms) in a child, before 12 years of age, that causes impairment to his/her functioning or development (DSM-5; ICD-10). The principal classification systems for diagnosing ADHD are: *International Classification of Diseases - 10th Version* (ICD-10); and the *Diagnostic and Statistical Manual of Mental Disorders* (DSM) *Fourth Edition* (DSM-IV), *Fourth Edition - Text Revision* (DSM-IV-TR), and*Fifth Edition* (DSM-5).

In the DSM-IV and DSM-5, there are three different subdiagnoses, where particular symptoms are identified and classified: the 'predominantly inattentive type'; the 'predominantly hyperactive-impulsive type'; and the 'combined' type, which presents with both hyperactive-impulsive and inattentive symptoms (Willcut 2012).

Comorbid disorders, such as behavioural disorders (e.g. oppositional defiant disorder, conduct disorder), depression, anxiety, bipolar disorder, tics, motor skill development disturbance, learning difficulties, and verbal and cognitive difficulties are common in ADHD (Newcorn 2008; Schmidt 2009; Yoshimasu 2012; Czamara 2013; Perroud 2014).

ADHD is associated with negative social outcomes such as severe social incompetence, and displays of off-task, disruptive and rule-violating behaviour (Kolko 1990; Landau 1991), health problems such as abuse of drugs or alcohol, and criminality later in life (Barkley 2002; Dalsgaard 2002; Storebø 2014; Koisaari 2015).

ADHD is also associated with negative psychological outcomes such as an increased risk of developing personality disturbances and possibly psychotic conditions (Keshavan 2003; Storebø 2014).

Excessive weight and obesity are found in children with ADHD compared to children without ADHD (Cortese 2016). ADHD is associated with both early-onset tobacco and alcohol use (Chang 2012). Similarly, ADHD comorbidity with conduct disorder can lead to adverse outcomes in academic achievement, failure to complete high school, criminality, substance use disorder, and unemployment (Erskine 2016).

ADHD seems to increase premature mortality by 50%, compared to individuals without ADHD, in a 24.9 million person-years Danish cohort study (Dalsgaard 2015). A weakness of this study is that it did not include medical treatment of ADHD in the analysis as a possible confounder for the relationship between ADHD and mortality (Dalsgaard 2015). There have been some reports of sudden death in children and adults treated with stimulant treatment but it is unclear if these are related directly to methylphenidate (US FDA 2011). More research is being conducted on this topic.

Pharmacological management of ADHD

The drug most commonly used for the treatment of ADHD in children and adolescents is methylphenidate (a stimulant); atomoxetine, and dexamphetamine (another stimulant) are used less often (NICE 2009; NICE 2018). Storebø and colleagues conducted a comprehensive Cochrane Review investigating the short-term benefits and harms of methylphenidate for children and adolescents. This review concluded that there is a possible small beneficial effect on ADHD symptoms, general behaviour, and quality of life, and that methylphenidate does not seem to increase the risk of serious adverse events in the short-term but is associated with a relatively high risk of non-serious adverse events in general (Storebø 2015). However, there were a number of limitations in the included trials such as lack of blinding in spite of placebo use, outcome reporting bias, and heterogeneity, which resulted in the evidence being rated as low to very low. The authors concluded that there is high need for long-term randomised placebo tablet ('active placebo')-controlled clinical trials, without risks of systematic errors, that investigate the effect of methylphenidate treatment for children and adolescents with ADHD (Storebø 2015). Whilst medication can help in the management of core behavioural symptoms, it is not designed to address skills deficits.

The most common adverse effects associated with methylphenidate are: headache, sleep problems, tiredness, and decreased appetite (Storebø 2018). Methylphenidate also affects the children's height and weight curves (Schachar 1997; Swanson

2007). Dexamphetamine seems to affect children's sleep and can result in dry mouth, thirst, weight loss, decreased appetite and stomach ache, and increase the risk of regressive, dependent behaviour and psychosis (Punja 2016). Atomoxetine is associated with pain, nausea and vomiting, decreased appetite with associated weight loss, dizziness, and slight increases in heart rate and blood pressure (Wolraich 2007).

Research on the neurochemical basis of ADHD has primarily focused on the neurotransmitters noradrenaline and dopamine, and their receptors in the central nervous system. Although the neurophysiological mechanism of the medications are not clearly known, it is presumed that their effects on symptoms of ADHD are explained primarily by the stimulant effects of dopaminergic and, to some extent, noradrenergic neurotransmission(Kadesjö 2002). Selective noradrenaline-acting tricyclic medications and alpha-2-adrenergic agonists have also been observed to reduce symptoms of ADHD in children (Zametkin 1987).

Description of the intervention

Social skills training is developed with the characteristics of ADHD in mind in order to improve and maintain the individual's social skills and prevent or alleviate social difficulties. Social skills are complex and involve different aspects of cognitions, emotions, and behaviour. Programmes vary in their focus on different aspects of social skills but tend to focus on problem-solving, control of emotions, and verbal and non-verbal communication. The training generally focuses on teaching the children how to 'read' the subtle cues in social interaction such as learning to wait for their turn, knowing when to shift topics during a conversation, and being able to recognise the emotional expressions of others (Fohlmann 2009a; Fohlmann 2009b [pers comm]). The children may be taught to practice how to adjust their verbal and non-verbal behaviour in their social interactions. It may also include efforts to change the children's cognitive assessment of the 'social world'. Social skills training also includes teaching social norms, social 'rules', and expectations of others (Liberman 1988).

Training may also focus on emotion regulation, such as the child's ability to deal with, manage, express, and control his or her emotions. An inability to regulate both positive and negative emotion has been associated with disorders such as ADHD and conduct disorder (Walcott 2004). Emotional self-regulation is an important aspect of resilience. Children who have effective strategies for dealing with disappointment, loss, and other upsetting events are more likely to bounce back from adversity than those who do not. Managing positive emotion is also important. Success socially and at school depends on the ability to control exuberance, when appropriate.

Social skills training often consists of role play, exercises and games, as well as homework. Social skills training is often taught in groups and is a relatively short intervention typically lasting between eight and 12 weeks. The duration of each group session is usually 50 to 90 minutes. Treatment frequency can range from a couple of times per month to several times a week. Often the programme also involves parents or teachers. Parental groups are typically included to give the parents the opportunity to support the children's training in the social skills groups by understanding the nature of ADHD and the content of the treatment programme. Teachers are often included to facilitate learning objectives and to coordinate social skills training domains, such as homework.

How the intervention might work

The effect of the intervention may be measured by looking at social skills per se, or by looking at a more global assessment of psychological functioning such as the quality of peer relationships, emotional competences, and general behaviour. Social skills training includes procedures to identify problems and set goals in collaboration with the participant. Through role play, exercises and games, participants demonstrate the required skills, and positive or corrective feedback is given to them accordingly. By social modelling and behavioural practice, participants observe and repeat the skills until they become more generalised. Homework assignments are then given to motivate participants to implement these communications in real-life situations (Almerie 2015).

Why it is important to do this review

Several randomised clinical trials suggest that social skills training may help children with ADHD (Pfiffner 1997; Antshel 2003; Pfiffner 2007). Social skills training may be effective alone, as an adjunct to medication, or both. However, the evidence on social skills training is unclear, and systematic reviews are necessary to evaluate its effectiveness and potential harms. It is always important to investigate the benefits and harms of interventions in order to not waste valuable resources in clinical practice.

Like medical treatments, the effects of social skills training do not always appear to endure. Some trials indicate that not all children benefit from social skills training, potentially due to lack of parental engagement during treatment (Kadesjö 2002). Some have argued that social skills training groups can have a negative effect on children with behavioural problems because the children's aggressive and restless behaviour can limit their ability to learn social skills. This, paradoxically, can increase negative behaviour (Mager 2005).

This review is an update of our systematic review published in 2011, which, at the time, was the only high-quality review on the topic (Storebø 2011). Many new trials have been conducted since 2011 and this update includes more than the double number of trials compared to our original review.

We have identified two meta-analyses and one review investigating the efficacy of social skills or psychosocial training for children with ADHD. Two of these studies found a significant effect of social skills and psychosocial treatment (De Boo 2007; Majewicz-Hefley 2007) and one did not find any significant effect (Van der Oord 2008). We also found a meta-analysis which assessed the effectiveness of social skills training for students with behaviour disorders (Kavale 1997). This meta-analysis also did not find any significant benefit from social skills training. The review and these meta-analyses have serious methodological deficits. None of them were systematic reviews like ours and they all lacked a published protocol before they were conducted. Furthermore, none of them systematically evaluated systematic errors (bias) or random errors (play of chance), and therefore their results are questionable. A systematic review published in 2019 on stand-alone social skills training for youth with ADHD concluded that social skills training implemented without additional treatment components like parent support, showed improvements on some areas of social functioning (Willis 2019). However, this review suffered from a very limited search strategy and did not evaluate systematic errors (bias) in the included trials. In our Cochrane review in 2011 on the topic,

we were unable to demonstrate clear benefits or harms of social skills training (Storebø 2011).

OBJECTIVES

To present the available evidence on the beneficial and harmful effects of social skills training in children and adolescents with ADHD.

METHODS

Criteria for considering studies for this review

Types of studies

Randomised clinical trials (RCTs) investigating social skills training alone or as an adjunct to pharmacological treatment compared to pharmacological treatment. The comparison groups were no intervention or waiting-list control.

Types of participants

Children and adolescents between five and 18 years of age and diagnosed with ADHD according to the DSM-IV, DSM-IV-TR or DSM-5, or with hyperkinetic disorder according to the ICD-10. The main term used in the DSM-IV is 'ADHD 314', which is divided into three subdiagnoses: 'predominantly inattentive type' (314.00), 'predominantly hyperactive/impulsive type' (314.01), and 'combined type' (314.02). We also included trials that used the DSM-IV diagnosis of 'ADHD unspecified' (314.9), as well as other diagnostic categories from earlier DSM systems (DSM-III; DSM-IV-R), and 'hyperkinetic disorder' from the ICD-9.

In addition, we included participants with a diagnosis of ADHD based on a cut-off score from a validated diagnostic assessment instrument: for example, Conners' Parent Rating Scales (Conners 1998). We also included participants with different kinds of comorbidity such as conduct or oppositional disorders, depression, attachment disorder, or anxiety disorders.

Types of interventions

We considered all forms of social skills training where training focused on behavioural and cognitive-behavioural efforts to improve social skills and emotional competence. This included behavioural and cognitive treatments focusing on teaching the children how to 'read' the subtle cues in social interaction, such as learning to wait for their turn, knowing when to shift topics during a conversation, and being able to recognise the emotional expressions of others, as well as social 'rules', and expectations of others.

We included trials comparing social skills training versus either no intervention or waiting-list control. We considered these control groups to be equal. Therefore, we did not distinguish between the control groups, but analysed the trials with relevant outcomes together in the same comparison. We also included trials with concurrent medical treatment if the medication was administered equally in both groups. In further updates of the review, we will include trials with social skills training versus placebo or sham intervention, as described in our protocol (Storebø 2010).

Types of outcome measures

Primary outcomes

1. Social skills in school or at home, measured at post-treatment and longest follow-up, by well-established and validated instruments such as the Social Skills Rating System (SSRS; Gresham 1990) or Conners' Behaviour Rating Scales (CBRS;Conners 2008a).
2. Emotional competencies in school or at home, measured at post-treatment and longest follow-up, by well-established and validated instruments such as the Emotion Regulation Checklist (ERC; Hannesdottir 2017).
3. General behaviour in school or at home, measured at post-treatment and longest follow-up, by well-established and validated instruments such as the Achenbach Child Behavior Checklist (Achenbach 1991).

Secondary outcomes

1. Core ADHD symptoms of inattention, impulsivity, and hyperactivity, measured at post-treatment and longest follow-up, by well-established and validated instruments such as Conners' Parents' Rating Scales (Conners 1998; Conners 2008b).
2. Performance and grades in school, measured at post-treatment and longest follow-up, by well-established and validated instruments.
3. Participant or parent (or both) satisfaction with treatment, measured as continuous outcomes by psychometrically validated instruments such as the Client Satisfaction Questionnaire (Attkisson 1982).
4. Adverse events. We included both severe and non-severe adverse events. We defined serious adverse events as any event that led to death, was life-threatening, required inpatient hospitalisation or prolongation of existing hospitalisation, resulted in persistent or significant disability, or any important medical event that may have jeopardised the participant's health or required intervention to prevent it (ICH 1996). We considered all other adverse events as non-serious.

Search methods for identification of studies

We ran searches for the previous review up to March 2011, using the search strategies reported in Storebø 2011. For this update, we made some changes to the databases we searched (see Differences between protocol and review).

Electronic searches

For this update, we searched the following electronic databases up to July 2018.

1. Cochrane Central Register of Controlled Trials (CENTRAL; 2018, Issue 6), in the Cochrane Library (searched 11 July 2018).
2. MEDLINE Ovid (1948 to 11 July 2018).
3. Embase Ovid (1980 to 11 July 2018).
4. ERIC EBSCOhost (Education Resources Information Center; 1966 to 11 July 2018).
5. CINAHL EBSCOhost (Cumulative Index to Nursing and Allied Health Literature; 1980 to 11 July 2018).
6. PsycINFO Ovid (1806 to 11 July 2018).
7. Sociological Abstracts ProQuest (1952 to 11 July 2018).
8. ProQuest Dissertations & Theses Global (searched 11 July 2018).

9. ClinicalTrials.gov (clinicaltrials.gov; searched 12 July 2018).
10. World Health Organization International Clinical Trials Registry Platform (WHO ICTRP; www.who.int/ictrp/en; searched 12 July 2018).

The search strategies for this update are shown in Appendix 1. We did not limit our searches by language, year of publication, or type or status of publication. We sought translation of the relevant sections of non-English language articles.

Searching other resources

We searched the following online proceedings for potentially relevant conference abstracts.

1. 2nd International Congress on ADHD: from childhood to adult disease; 2009 May 21 to 24; Vienna, Austria (International Congress on ADHD 2009).
2. 3rd International Congress on ADHD: from childhood to adult disease; 2011 May 26 to 29; Berlin, Germany (World Congress on ADHD 2011).
3. 4th World Congress on ADHD: from childhood to adult disease; 2013 June 6 to 9; Milan, Italy (World Congress on ADHD 2013).
4. 5th World Congress on ADHD: from child to adult disorder; 2015 May 28 to 31; Glasgow, Scotland (World Congress on ADHD 2015).
5. 6th World Congress on ADHD: from child to adult disorder; 2017 Apr 20 to 23; Vancouver, Canada (World Congress on ADHD 2017).
6. Eunethydis 1st International ADHD Conference: from data to best clinical practice; 2010 May 26 to 28; Amsterdam, The Netherlands (Eunethydis 2010).
7. Nordic ADHD Konference: livslange perspektiver og specielle behov [lifelong perspectives and special needs]; 2010 May 19 to 20; Aalborg, Denmark (Nordic ADHD konference 2010).
8. International Society for Research in Child and Adolescent Psychopathology (ISRCAP) conference; 2009 June 17-20; Seattle, Washington, USA.
9. CADDRA: 14th Annual ADHD Conference; 2018 Nov 10 to 11; Calgary, Canada.

In addition, we contacted 176 experts in the field for information about possible unpublished or ongoing RCTs, and received responses from 15 (a list of those contacted is available from the review contact author).

Data collection and analysis

We conducted the review according to the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011). In the following section, we report only the methods that we were able to use in this update. Methods that we had planned to use as per our published protocol (Storebø 2010), but could not (e.g. cluster-randomised trials), are reported in Table 1.

Selection of studies

Eight reviewers (OJS, NP, EGF, MEA, BT, MS, HC and SJ) independently evaluated and selected trials for inclusion. Having removed duplicates, they assessed the titles and abstracts of all records generated by the search and excluded those that clearly did not meet the inclusion criteria: for example, non-randomised trials or trials with participants outside the specified age range (Criteria for considering studies for this review). Next, they retrieved the full-text reports for those trials deemed relevant or for which more information was needed to determine relevance and assessed them for eligibility. The review authors discussed differing interpretations regarding eligibility and consulted a third review author (ES) for those cases where they could not reach an agreement.

We have listed relevant RCTs that did not fulfil the inclusion criteria with reasons for exclusion in the Characteristics of excluded studies table. We recorded our selection process in a study flow diagram (Moher 2009).

Dealing with duplicate publication

We collected multiple reports of the same study to maximise data collection.

Data extraction and management

Working in pairs, eight review authors (OJS, MEA, EGF, BT, HC, SJH, NP, and MS) independently extracted data onto a data collection form (Appendix 2). We extracted data on participants, study design and methods, interventions, outcomes, and relevant data for 'Risk of bias' assessments. We resolved differences by discussion.

OJS entered the data into Review Manager 5 (RevMan 5) (Review Manager 2014).

In cases of lack of data, for the use of e.g. tables with sociodemographic data, 'risk of bias' assessment, or the analysis, or where data in the published study reports were unclear, we contacted the trial authors requesting them to clarify the missing information (see Dealing with missing data).

Assessment of risk of bias in included studies

For each included RCT, eight review authors (OJS, MEA, EGF, BT, HC, SJH, NP, and MS), working in pairs, independently evaluated the following 'Risk of bias' components: random sequence generation; allocation concealment; blinding of participants and personnel; blinding of outcome assessment; incomplete outcome data; selective outcome reporting; vested interest bias; and other sources of bias. We assigned trials to one of three categories (low risk of bias, uncertain risk of bias, and high risk of bias), according to guidelines in the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011, section 8.2.1) and from the Cochrane Hepato-Biliary Group (Cochrane Hepato-Biliary Group 2019) (see Appendix 3). We resolved disagreements by discussion. We used the results of the 'Risk of bias' assessment to inform the GRADE assessment.

Measures of treatment effect

Continuous data

We compared the mean score between the two intervention groups to give a mean difference (MD) and presented this with 95% confidence intervals (CIs). We wanted to use the overall MD, where possible, to compare the outcome measures from trials. However, because many of the included trials used different rating scales for measuring the same construct we used the standardised mean difference (SMD) in many analyses. For the primary outcome, teacher-rated social skills at end of treatment, we transformed the MD and standard deviation (SD) from the different rating scales used in this analysis to the MD and SD of a commonly used scale, namely the Social Skills Rating Scale (SSRS). We reported this MD in

the results section as well as in the abstract and we compared it to a plausible minimal relevant difference of 10% on this scale.

Unit of analysis issues

We did not encounter any unit of analysis issues. Our strategies for dealing with these can be found in Table 1 (see also Storebø 2010).

Dealing with missing data

We sought to retrieve any missing data from the trial authors. Overall, we wrote to 17 authors, eight of whom supplied us with missing sociodemographic data and missing information about methodology; some also supplied us with missing statistics. If data remained unavailable, we tried to estimate the missing data using the available information (e.g. if the standard deviation (SD) was missing, we estimated it from the standard error, if reported). When we were not able to obtain missing data, we conducted analyses using available (incomplete) data.

Assessment of heterogeneity

We assessed clinical heterogeneity by examining variability in the participants, interventions, and outcomes described in each included trial. We assessed methodological heterogeneity by inspecting variability in the designs of the trials, and statistical heterogeneity by assessing the difference in the trials' intervention effects. We assessed heterogeneity between trials by visual inspection of the forest plot for overlapping CIs, using the Chi^2 test for homogeneity with a significance level of α (alpha) = 0.10, and the I^2 statistic for quantifying inconsistency (estimating the percentage of variation in effect estimates due to heterogeneity rather than sampling error). We judged I^2 values of 0% to 40% to indicate little heterogeneity; 30% to 60%, moderate heterogeneity; 50% to 90%, substantial heterogeneity; and 75% to 100%, considerable heterogeneity (Higgins 2011). Furthermore, we explored potential reasons for the heterogeneity by examining individual trial characteristics and conducting subgroup analyses (Subgroup analysis and investigation of heterogeneity).

Assessment of reporting biases

We handled different forms of reporting bias, especially publication bias and outcome reporting bias, according to the recommendations in the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011, Section 10.1). We drew funnel plots (estimated differences in treatment effects against their standard error), and we performed Egger's statistical test for small-study effects (Egger 1997). There are several reasons for the asymmetry of a funnel plot; for example, true heterogeneity, poor methodological quality, or publication bias (Higgins 2011, section 10.4.1).

Data synthesis

We included and analysed trials undertaken in any setting; for instance, in groups, in the home, or at a centre. We summarised data in a meta-analysis when they were available and if clinical heterogeneity was not excessive (for example, there was not too much variability in participants' characteristics). We performed statistical analysis in RevMan 5 (Review Manager 2014), according to recommendations in the latest version of the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011, Section 9.4.1). We synthesised data by using final values and the inverse variance method in the meta-analyses. We generally used the random-effects model because we expected differences in the treatments. The fixed-effect model is used when there is an assumption that the observed differences between the study results are just due to 'play of chance'. When there is heterogeneity that cannot be explained as 'play of chance', it is common to use the random-effects model. A random-effects model has the assumption that apparent differences between study effects are random, but the estimated difference follows a normal distribution. This method gives more weight to small trials, whereas the fixed-effect model gives more weight to large trials. We therefore conducted both fixed-effect and random-effects models, and checked for differences between these methods of analyses (Higgins 2011, Section 9.5.4). If both models gave the same results, we reported the results from the random-effects model only. For some outcomes we were unable to conduct a meta-analysis because the outcomes were reported only in a single study. For these outcomes, we provided a narrative description of the results.

Diversity-adjusted required information size and Trial Sequential Analysis

Trial Sequential Analysis (TSA) is a tool for controlling risks of type I and type II errors in cumulative meta-analyses, and gives a valuable overview of the number of participants needed to make a firm evaluation of a possible intervention effect (Brok 2008; Wetterslev 2008; Brok 2009; Thorlund 2009; Wetterslev 2009; Wetterslev 2017).

Comparable to the a priori sample size estimation in a single RCT, a meta-analysis should include an information size (IS) at least as large as the sample size of an adequately powered single study to reduce the risks of random errors. The TSA provides the required information size (RIS) for a meta-analysis, adjusting the significance level for sparse data and repetitive testing on accumulating data, to avoid the increased risk of random error (Wetterslev 2008; Wetterslev 2009; Wetterslev 2017).

Multiple analyses of accumulating data from new emergent trials leads to 'repeated significant testing', and use of the conventional P value is prone to exacerbate the risk of a type I random error (Lau 1995; Berkley 1996). Meta-analyses that do not reach the RIS are analysed with trial sequential monitoring boundaries, which are analogous to interim monitoring boundaries in a single study (Wetterslev 2008; Wetterslev 2017). This approach is crucial in coming updates of this review.

We used an a priori assumption that the minimal relevant clinical intervention effect was 4.0 points. This is approximately ½ SD on the used scale, which can be used as a minimal clinical relevant difference (Norman 2003).

We calculated the diversity-adjusted required information size (DARIS; that is the number of participants required to detect or reject a specific intervention effect in a meta-analysis), and performed a TSA for the primary outcome (teacher-rated social skills competences) at the end of treatment, based on the following a priori assumptions:

1. the SD of the primary outcome of 9.5 points;
2. an anticipated minimal relevant difference (MIREDIF) of 4.0 points;
3. a maximum type I error of 2.5% (due to three primary outcomes; Jakobsen 2014);

4. a maximum type II error of 10% (minimum 90% power; Castellini 2018); and
5. the diversity observed in the meta-analysis.

Subgroup analysis and investigation of heterogeneity

We conducted subgroup analysis both where we found statistically significant differences between intervention groups, and in other cases to make hypotheses about the subgroups mentioned below.

We performed the following subgroup analyses.

1. Children aged five to 11 years compared to children aged 12 to 18 years;
2. ADHD with comorbidity compared to ADHD without comorbidity;
3. Social skills training only compared to social skills training supported by parent training;
4. Social skills training, parent training and medication compared to social skills training and parent training without medication;
5. No-intervention control group compared to waiting-list control group with possible minor active intervention components.

Sensitivity analysis

We assessed the robustness of the results by conducting sensitivity analyses in which we repeated the analysis:

1. excluding the trial with longest treatment duration or the largest trial; and
2. using different statistical models (fixed-effect or random-effects models) (Higgins 2011).

'Summary of findings' table

We constructed 'Summary of findings' tables using GRADE software (GRADEpro GDT 2015) for the comparison 'social skills training compared to no intervention'. We included three primary outcomes (social skills, emotional competencies and general behaviour) and one secondary outcome (ADHD core symptoms) assessed at end of treatment in the table.

We used the GRADE approach to assess the quality of the evidence associated with each of these outcomes (Guyatt 2008). The GRADE approach appraises the quality of a body of evidence based on the extent to which one can be confident that an estimate of effect or association reflects the item being assessed. Considerations are due to: within-study risk of bias; directness of evidence; heterogeneity of the data; precision of effect estimates; and risk of publication bias (Balshem 2011; Guyatt 2011a; Guyatt 2011b; Guyatt 2011c; Guyatt 2011d; Guyatt 2011e; Guyatt 2011f; Guyatt 2011g; Andrews 2013a; Andrews 2013b; Brunetti 2013; Guyatt 2013a; Guyatt 2013b; Guyatt 2013c; Mustafa 2013).

RESULTS

Description of studies

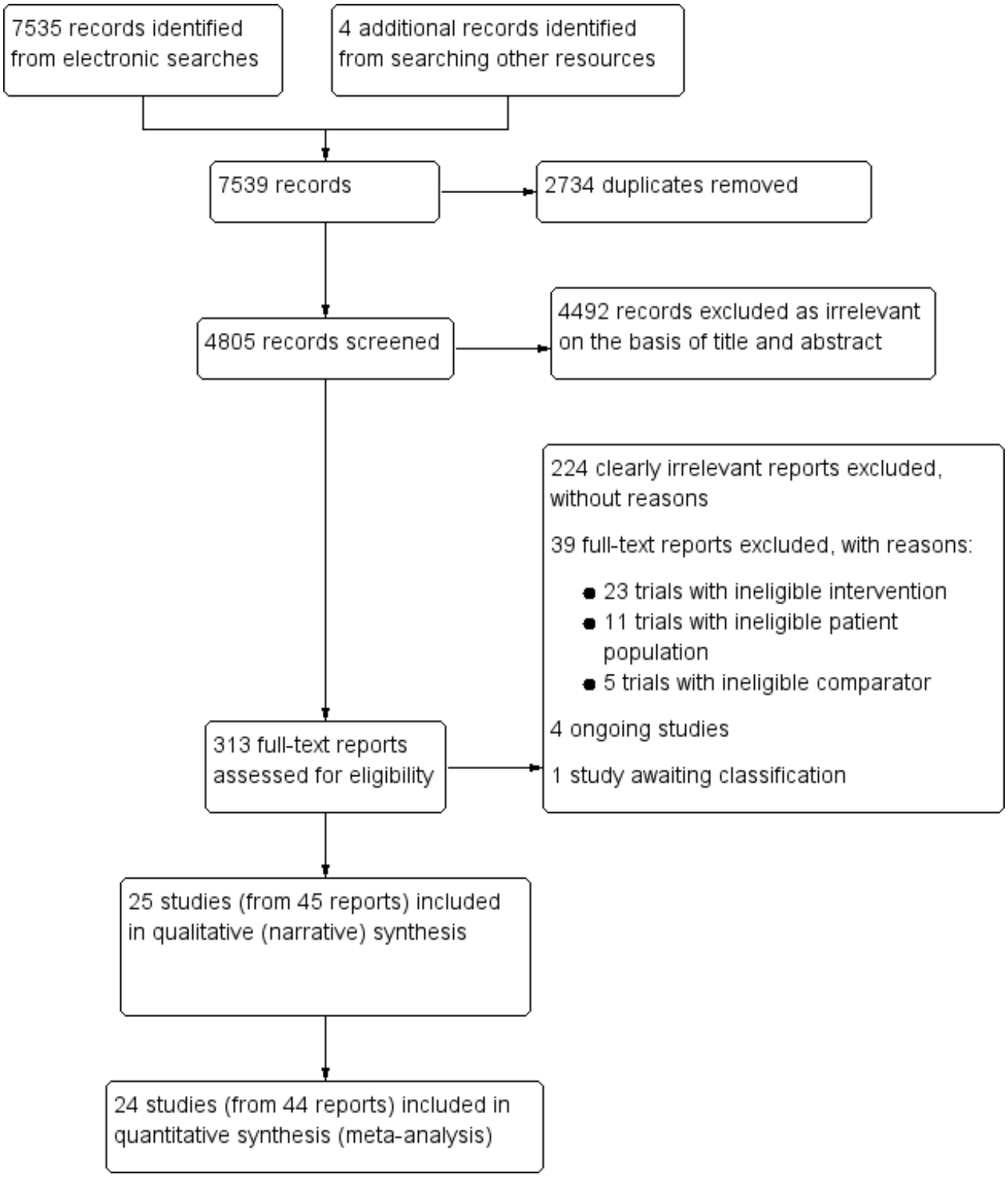
Results of the search

This updated review fully incorporates the results of searches conducted up to July 2018. We carried out electronic searches over five time periods: up to February 2009; February 2009 to June 2010; June 2010 to March 2011; March 2011 to May 2017; and May 2017 to July 2018. The number of unique records (i.e. number of records after duplicates were removed) generated by these searches were as follows.

1. Up to February 2009 = 2500 (out of 3045);
2. February 2009 until June 2010 = 200 (out of 643)
3. June 2010 until March 2011 = 165 (out of 208)
4. March 2011 until May 2017 = 1616 (out of 3229)
5. May 2017 until July 2018 = 324 (out of 410)

To date, the electronic searches for this review have found 7535 records, plus an additional four records from searching other resources. Having removed duplicates, we screened 4805 records, and subsequently excluded 4492 as clearly irrelevant on the basis of title and abstract. We retrieved the full texts of the remaining 313 reports, which we assessed for eligibility against our selection criteria (Criteria for considering studies for this review). From these, we excluded 224 as irrelevant, formally excluded a further 39 with reasons (see Excluded studies), and included 25 trials (from 45 reports). We also identified four ongoing trials, and one which is awaiting classification (see Figure 1).

Figure 1. Study flow diagram.



Included studies

This review includes 25 RCTs described in 45 reports. Of these 25 trials, one, Cohen 1981, did not have usable data to be included in the quantitative analysis (meta-analysis). Another one of the trials had extreme values in some of the outcomes and we did not use the data on these outcomes (Tabaeian 2010).

See Characteristics of included studies tables for further details on each included study.

Setting

Thirteen trials were carried out in North America: 12 in the US (Bloomquist 1991; Pfiffner 1997; MTA 1999; Antshel 2003; Tutty

2003; Abikoff 2004; Pfiffner 2007; Waxmonsky 2010; Pfiffner 2014; Evans 2016; Pfiffner 2016; Waxmonsky 2016). Of the remaining 12 trials, six were carried out in Asia; three in Iran (Tabaeian 2010; Azad 2014; Meftagh 2014a), two in China (Yuk-chi 2005; Qian 2017), and one in South Korea (Choi 2015). Five trials were conducted in Europe; one apiece in Denmark (Storebø 2012), Iceland (Hannesdottir 2017), Germany (Schramm 2016), The Netherlands (Van der Oord 2007), and one which took place in both Belgium and The Netherlands (Bul 2016): One trial was conducted in Australia (Wilkes Gillan 2016), and one in Canada (Cohen 1981).

The majority of trials were conducted in an outpatient setting; six trials were carried out in a clinical setting (Pfiffner 1997; Tabaeian 2010; Storebø 2012; Azad 2014; Hannesdottir 2017; Qian 2017).

Participants

The 25 RCTs included a total of 2690 participants. The majority of trials included children between five and 13 years of age; a single trial included adolescents between 12 and 17 years of age (Schramm 2016). All participants were diagnosed with ADHD using tools that had been accepted for inclusion in this review. All of these diagnostic tools were based on the international DSM (DSM-III; DSM-IV; DSM-IV-R; DSM-IV-TR; DSM-5) or ICD diagnostic systems ICD-10), or a cut-off score from the Conners' Rating Scale (Conners 1998; Conners 2008a; Conners 2008b).

Six trials did not specify intelligence (IQ) as inclusion or exclusion criteria (Pfiffner 1997; Tutty 2003; Tabaeian 2010; Meftagh 2014a; Azad 2014; Schramm 2016), and the remaining trials excluded children with low IQ (ranging from < 70 to < 90).

All but seven trials (Pfiffner 1997; Antshel 2003; Van der Oord 2007; Azad 2014; Meftagh 2014a; Choi 2015; Schramm 2016) excluded patients with one or more comorbid mental disorders – typically autism spectrum disorder, psychosis, or neurological disorder. Two trials used comorbidity as an exclusion criterion (Tutty 2003; Tabaeian 2010). Eighteen trials reported on different types of comorbidities, such as oppositional defiant disorder, conduct disorder, and anxiety disorder for the children in addition to the ADHD diagnosis.

The distribution of boys to girls was almost equal in two trials (Pfiffner 2014; Choi 2015). In the remaining trials, boys outnumbered girls. The number of boys to girls was: 2:1 in seven trials (Bloomquist 1991; Pfiffner 1997; Pfiffner 2007; Storebø 2012; Evans 2016; Waxmonsky 2016; Hannesdottir 2017); 3:1 in three trials (Antshel 2003; Tutty 2003; Pfiffner 2016); 4:1 in four trials (MTA 1999; Waxmonsky 2010; Bul 2016; Qian 2017); 6:1 in two trials (Schramm 2016; Wilkes Gillan 2016); 7:1 in one trial (Cohen 1981); 9:1 in one trial (Yuk-chi 2005) and 14:1 in one trial (Abikoff 2004). The participants were all males in one trial (Tabaeian 2010), and three trials provided no information on the sex of the participants (Van der Oord 2007; Azad 2014; Meftagh 2014a).

Participants were between 80% and 100% Caucasian in six trials (Bloomquist 1991; Pfiffner 1997; Antshel 2003; Abikoff 2004; Van der Oord 2007; Waxmonsky 2010). Ethnicity was more mixed in seven other trials: 16% to 74% Caucasian; 3% to 75% Hispanic; 0% to 16% Asian; and 5% to 20% Afro-American (MTA 1999; Tutty 2003; Pfiffner 2007; Pfiffner 2014; Evans 2016; Pfiffner 2016; Waxmonsky 2016). In four trials, ethnicity was stated with reference to the country of origin, with all or almost all being Canadian (Cohen 1981), Chinese (Yuk-chi 2005), Iranian (Tabaeian 2010), or Australian (Wilkes Gillan 2016). Ethnicity was not explicitly described in eight trials (Storebø 2012; Azad 2014; Meftagh 2014a; Choi 2015; Bul 2016; Schramm 2016; Hannesdottir 2017; Qian 2017). Eleven trials included and controlled for a measure of socioeconomic status (Pfiffner 1997; Yuk-chi 2005; Pfiffner 2014; Evans 2016; Pfiffner 2016; Schramm 2016; Waxmonsky 2016; Tutty 2003; Van der Oord 2007; Waxmonsky 2010; Wilkes Gillan 2016).

Sample size

There was considerable variation in sample sizes between trials. The number of participants randomised per study ranged from 24 to 576 participants in all trials. Only three trials reported a sample size calculation before the start of the study (MTA 1999; Storebø 2012; Bul 2016).

Interventions

Experimental

The 25 trials had different but comparable experimental interventions. The interventions named were: social skills training (Pfiffner 1997; Antshel 2003; Tabaeian 2010; Storebø 2012; Choi 2015; Hannesdottir 2017); cognitive behavioural intervention (Cohen 1981; Bloomquist 1991); meta-cognitive training (Azad 2014); multimodal behavioural/psychosocial therapy (MTA 1999; Abikoff 2004; Van der Oord 2007); behavioural therapy/treatment (Pfiffner 2007; Waxmonsky 2010); behavioural and social skills treatment (Tutty 2003; Waxmonsky 2016); challenging horizon program (CHP; Evans 2016); children's verbal self-instruction training (Meftagh 2014a); child life and attention skills treatment (CLAS; Pfiffner 2014; Pfiffner 2016), executive skills training (Qian 2017); learning skills training (Schramm 2016); different play or game-based intervention (Bul 2016; Wilkes Gillan 2016); and psychosocial treatment (Yuk-chi 2005). We considered that all these interventions were comparable and based on a cognitive behavioural model. Throughout the rest of the review, we referred to the experimental child interventions as 'child social skills training', in accordance with the Description of the intervention section.

The duration of the intervention varied between five and eight weeks in seven trials (Pfiffner 1997; Antshel 2003; Tutty 2003; Waxmonsky 2010; Storebø 2012; Azad 2014; Hannesdottir 2017), and between 10 and 16 weeks in 13 trials (Cohen 1981; Bloomquist 1991; Pfiffner 2007; Van der Oord 2007; Tabaeian 2010; Meftagh 2014a; Pfiffner 2014; Choi 2015; Bul 2016; Pfiffner 2016; Waxmonsky 2016; Wilkes Gillan 2016; Qian 2017). In two trials, the intervention lasted for 24 weeks (Yuk-chi 2005; Schramm 2016), and, in one trial apiece, the intervention lasted for one year (Evans 2016), 14 months (MTA 1999), and two years (Abikoff 2004).

Five trials used social skills training for children plus parent training (Cohen 1981; Antshel 2003; Tutty 2003; Abikoff 2004; Waxmonsky 2010); one of these trials also administered academic organisational skills training and individual psychotherapy (Abikoff 2004). Seven trials used a combination of social skills training for children, parent training, and teacher consultations in the experimental group (Bloomquist 1991; Yuk-chi 2005; Pfiffner 2007; Van der Oord 2007; Pfiffner 2014; Pfiffner 2016; Schramm 2016). One trial used social skills training for children, parent training, teacher consultations, and classroom behavioural intervention in the experimental group (MTA 1999), and another used social skills

training for children and parent training plus standard treatment in the experimental group (Storebø 2012). One trial used either social skills training for children or social skills training for children plus parent training (Pfiffner 1997).

One trial used social skills training only in the experimental group (Choi 2015). Another trial included the Challenging Horizons Program, which is designed to target different skills such as organisational and social skills (Evans 2016), whereas other trials used life skills (Pfiffner 2014) and group-based social skills training as the experimental intervention (Hannesdottir 2017). One trial used verbal self-instruction as the experimental programme (Meftagh 2014a), and another used a play-based intervention (Wilkes Gillan 2016). Finally, one trial used a specific intervention targeting skills related to mood and behaviour (Waxmonsky 2016).

Two trials used meta-cognitive training (Azad 2014; Qian 2017); one had a social game intervention, which targeted cooperation and planning skills among others (Bul 2016), and the other used behavioural and cognitive training (Schramm 2016).

Seven trials included concurrent medical treatment with ADHD medication in both the experimental and control groups (Cohen 1981; Antshel 2003; Tutty 2003; Abikoff 2004; Waxmonsky 2010; Tabaeian 2010; Storebø 2012).

Control

Eight trials used medications in the experimental group and as the only treatment in the control group (Cohen 1981; MTA 1999; Antshel 2003; Tutty 2003; Abikoff 2004; Yuk-chi 2005; Van der Oord 2007; Waxmonsky 2010); one of these trials also included a no-treatment control group (Cohen 1981). Two trials used standard treatment in the experimental group and as the only treatment in the control group (Storebø 2012; Bul 2016). Nine trials used a waiting-list or no-intervention control group without medication in any of the groups (Bloomquist 1991; Pfiffner 1997; Pfiffner 2007; Tabaeian 2010; Azad 2014; Choi 2015; Schramm 2016; Wilkes Gillan 2016; Hannesdottir 2017). One trial used parent training in the experimental group and as the only treatment in the control group (Pfiffner 2014). Four trials used a control group with some active intervention elements, however, the researchers did not provide any direct intervention to the individuals in this condition (Pfiffner 2014; Evans 2016; Waxmonsky 2016; Qian 2017). One trial did not describe the control group (Meftagh 2014a).

Outcome measures

In the following section, we did not describe the measures used in one study, Tabaeian 2010, as we were not able to identify these reliably from the information provided in the translated report.

Social skills

See Table 2.

Nineteen trials measured social skills using a variety of scales (Cohen 1981; Bloomquist 1991; Pfiffner 1997; MTA 1999; Antshel 2003; Abikoff 2004; Pfiffner 2007; Van der Oord 2007; Waxmonsky 2010; Storebø 2012; Pfiffner 2014; Bul 2016; Evans 2016; Pfiffner 2016; Schramm 2016; Waxmonsky 2016; Wilkes Gillan 2016; Hannesdottir 2017; Qian 2017). Ten trials used the Social Skills Rating Scale (Pfiffner 1997; MTA 1999; Antshel 2003; Abikoff 2004; Pfiffner 2007; Van der Oord 2007; Waxmonsky 2010; Bul 2016; Waxmonsky 2016; Hannesdottir 2017); one trial used the Cooperation Subscale (Bul 2016), whereas the nine remaining trials used the full Social Skills Rating Scale. Three trials used the Social Skills Improvement System (Pfiffner 2014; Evans 2016; Pfiffner 2016). The remaining studies each used different measures to assess social skills.

Seven of the 19 trials used more than one informant to measure social skills: two used teacher, parent and observer ratings (Pfiffner 1997; Abikoff 2004); one used teacher, parent and child ratings (Schramm 2016); and four used teacher and parent ratings (MTA 1999; Antshel 2003; Pfiffner 2014; Bul 2016). Of the 12 remaining trials, nine used only teacher ratings (Bloomquist 1991; Pfiffner 2007; Van der Oord 2007; Waxmonsky 2010; Storebø 2012; Evans 2016; Pfiffner 2016; Waxmonsky 2016; Hannesdottir 2017), two used only observer-ratings (Cohen 1981; Wilkes Gillan 2016), and one used only parent ratings (Qian 2017).

Emotional competencies

See Table 3.

Six trials measured emotional competencies, each using a different measure (Cohen 1981; Choi 2015; Storebø 2012; Schramm 2016; Hannesdottir 2017; Qian 2017). Of these, only one trial, Schramm 2016, used ratings from more than one type of informant: teacher, parent and child. The five remaining trials used only parent ratings (Cohen 1981; Hannesdottir 2017; Qian 2017), teacher ratings (Storebø 2012), or child ratings (Choi 2015). No trials used observer ratings.

General behaviour

See Table 4.

Thirteen trials measured general behaviour using a large variety of measures (Cohen 1981; Bloomquist 1991; MTA 1999; Abikoff 2004; Pfiffner 2007; Waxmonsky 2010; Storebø 2012; Evans 2016; Pfiffner 2016; Schramm 2016; Waxmonsky 2016; Hannesdottir 2017; Qian 2017). Of these 13 trials, six used more than one informant; one used teacher, parent and child ratings (Schramm 2016) and five trials used teacher and parent ratings (Cohen 1981; MTA 1999; Pfiffner 2007; Evans 2016; Pfiffner 2016). Of the seven remaining trials, three apiece used only teacher ratings (Bloomquist 1991; Abikoff 2004; Storebø 2012) or parent ratings (Waxmonsky 2016; Hannesdottir 2017; Qian 2017), and one trial used only observer ratings (Waxmonsky 2010).

Core ADHD symptoms

See Table 5.

Eighteen trials measured ADHD symptoms using a variety of measures (Bloomquist 1991; Abikoff 2004; MTA 1999; Tutty 2003; Yuk-chi 2005; Pfiffner 2007; Van der Oord 2007; Waxmonsky 2010; Storebø 2012; Azad 2014; Meftagh 2014a; Pfiffner 2014; Evans 2016; Pfiffner 2016; Schramm 2016; Waxmonsky 2016; Hannesdottir 2017; Qian 2017). Of these 18, 10 trials used ratings from more than one type of informant; 10 trials used both teacher and parent ratings (MTA 1999; Tutty 2003; Yuk-chi 2005; Pfiffner 2007; Van der Oord 2007; Waxmonsky 2010; Pfiffner 2014; Evans 2016; Pfiffner 2016; Waxmonsky 2016), and one trial apiece used teacher and observer ratings (Bloomquist 1991), parent and observer ratings (Abikoff 2004), or teachers, parents and child ratings (Schramm 2016). Of the five remaining trials, three used only parent ratings (Azad 2014;

Hannesdottir 2017; Qian 2017) and one apiece used only teacher ratings (Storebø 2012) or observer ratings (Meftagh 2014a).

Performance and grades in school

See Table 6.

Six trials measured performance and grades in school, each using a different measure (MTA 1999; Waxmonsky 2010; Storebø 2012; Evans 2016; Schramm 2016; Pfiffner 2016). Five of these trials used teacher ratings (Evans 2016; Pfiffner 2016; Storebø 2012; Schramm 2016; Waxmonsky 2010) while one trial used observer ratings (MTA 1999).

Satisfaction with treatment

Ten trials reported on participants', parents', teachers' and/or mental health professionals' satisfaction with the treatment (Pfiffner 1997; MTA 1999; Yuk-chi 2005; Pfiffner 2007; Waxmonsky 2010; Storebø 2012; Pfiffner 2014; Bul 2016; Pfiffner 2016; Waxmonsky 2016). Four trials used the Consumer Satisfaction Questionnaire, which is rated on a seven-point Likert scale (Pfiffner 1997; MTA 1999; Yuk-chi 2005; Pfiffner 2007). One trial, Pfiffner 2016, developed a seven-item measure (rated on a five-point Likert scale) specifically for the study. The five remaining trials measured treatment satisfaction using a single-item question that was rated on a five-point Likert scale in two trials (Pfiffner 2014; Waxmonsky 2016), a seven-point Likert scale in one trial (Waxmonsky 2010), and a 10-point Likert scale in two trials (Storebø 2012; Bul 2016).

Adverse events

Only two trials reported data on adverse events (Storebø 2012; Bul 2016). They assessed adverse events as spontaneous reporting and reported no adverse events.

Funding

Fourteen studies reported funding sources. Two of these were funded by pharmacological companies (Waxmonsky 2010; Bul 2016) and the remaining 12 trials were funded by university national foundations (Cohen 1981; MTA 1999; Tutty 2003; Pfiffner 2007; Storebø 2012; Meftagh 2014a; Pfiffner 2014; Pfiffner 2016; Evans 2016; Waxmonsky 2016; Wilkes Gillan 2016; Qian 2017). Two studies reported that they did not receive any funding for the trials (Choi 2015; Hannesdottir 2017) and we did not find any information on funding for the nine remaining trials (Bloomquist 1991; Pfiffner 1997; Antshel 2003; Abikoff 2004; Yuk-chi 2005; Van der Oord 2007; Tabaeian 2010; Azad 2014; Schramm 2016).

Excluded studies

We excluded 263 full-text reports in total. Of these, we excluded 224 clearly irrelevant reports. We formally excluded a further 39 full-text reports, providing reasons for exclusion in the Characteristics of excluded studies tables. Of these 39 reports, we excluded 23 trials with ineligible interventions, 11 trials with ineligible patient populations, and five trials with ineligible comparators.

Ongoing studies

We included four ongoing trials (NCT01330849; Yang 2015; IRCT201609186834N11; NCT02937142). All trials used different methods to investigate the benefits of different types of social skills training or comparable cognitive behaviour training for children and adolescents with ADHD.

Studies awaiting classification

We included one study awaiting classification (NCT01019252).

Risk of bias in included studies

We assessed the risk of bias of each included trial using the Cochrane 'Risk of bias' tool (Higgins 2011). A summary of our assessment is provided below, and in Figure 2 and Figure 3. Further details can be found in the 'Risk of bias' tables (in the Characteristics of included studies tables). We also drew a funnel plot to visually assess whether the effect was associated with the size of the trial; it seemed to be symmetrical with no clinical significant effect. Eggers' test, moreover, was not statistically significant (Egger's regression intercept (bias) = 1.13 (two-tailed P = 0.17)) in the conclusion of whether or not there was publication bias in the meta-analysis on this outcome.

Figure 2. Risk of bias summary: review authors' judgements about each risk of bias item for each included study

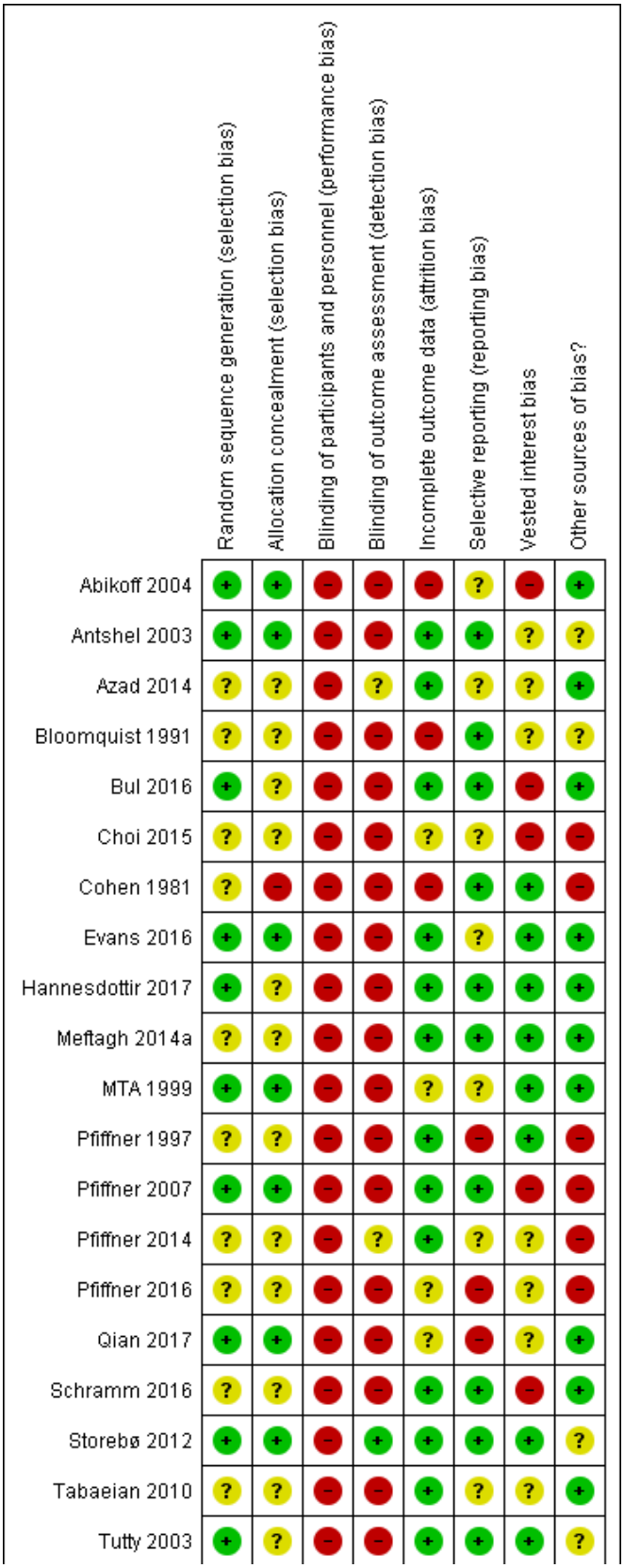


Figure 2. (Continued)

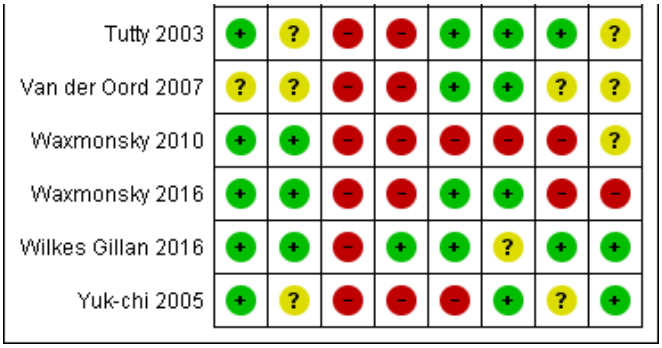
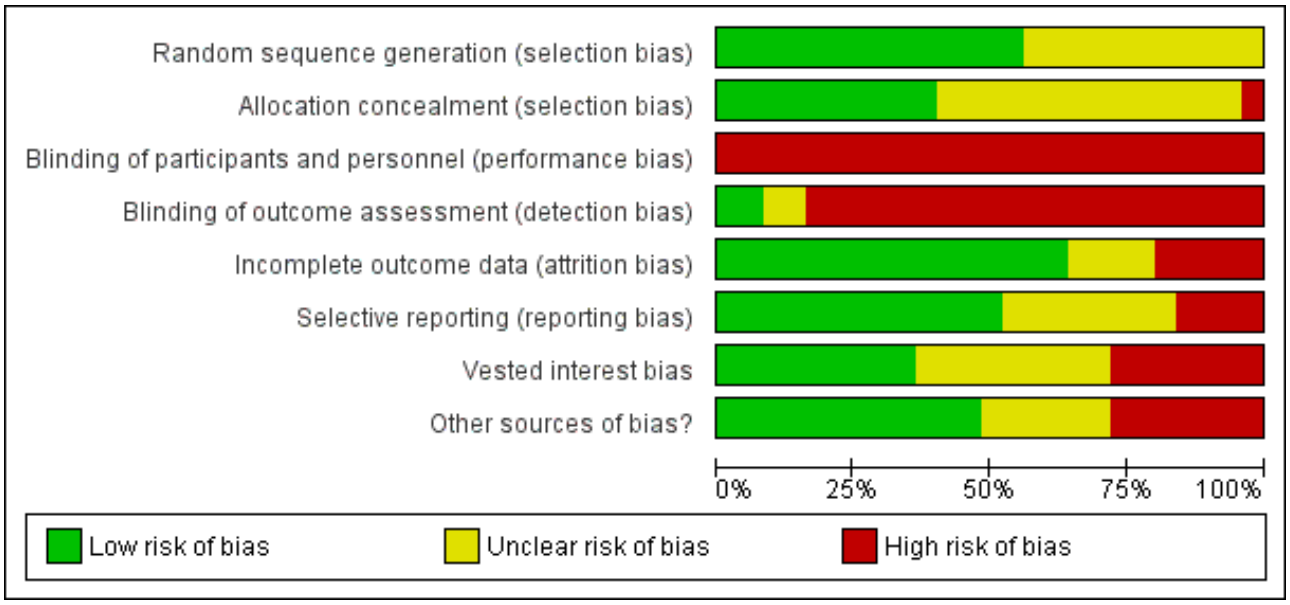


Figure 3. Risk of bias graph: review authors' judgements about each risk of bias item presented as percentages across all included studies



Allocation

Generation of the allocation sequence

We considered the random sequence generation to be at low risk of bias in 14 trials that assigned allocation by computer-generated random numbers derived from a table or by the coin-toss method (MTA 1999; Antshel 2003; Tutty 2003; Abikoff 2004; Yuk-chi 2005; Pfiffner 2007; Waxmonsky 2010; Storebø 2012; Bul 2016; Evans 2016; Qian 2017; Waxmonsky 2016; Wilkes Gillan 2016; Hannesdottir 2017). We rated 11 trials that did not state the method used to generate the random sequence to be at unclear risk of bias (Cohen 1981; Bloomquist 1991; Pfiffner 1997; Van der Oord 2007; Tabaeian 2010; Azad 2014; Meftagh 2014a; Pfiffner 2014; Choi 2015; Pfiffner 2016; Schramm 2016). We rated no trials at high risk of bias on this domain.

Allocation concealment

We judged 10 trials to be at low risk of bias due to adequate concealment of the allocation (MTA 1999; Antshel 2003; Abikoff 2004; Pfiffner 2007; Waxmonsky 2010; Storebø 2012; Evans 2016; Waxmonsky 2016; Wilkes Gillan 2016; Qian 2017). Fourteen trials did not describe allocation concealment, so we considered them to be at unclear risk of bias (Bloomquist 1991; Pfiffner 1997; Tutty 2003; Yuk-chi 2005; Van der Oord 2007; Tabaeian 2010; Azad 2014; Meftagh 2014a; Pfiffner 2014; Choi 2015; Bul 2016; Pfiffner 2016; Schramm 2016; Hannesdottir 2017). We rated one trial, Cohen 1981, to be at high risk of bias because four participants were moved between groups after randomisation due to adverse reactions.

Blinding

We do not believe it is possible to blind participants or personnel involved in the delivery of social skills interventions, and consequently, rated all trials at high risk of performance bias.

It is possible, however, to blind those that perform the ratings and observations. Two trials had blinded ratings and observations and we rated them to be at low risk of detection bias (Storebø 2012; Wilkes Gillan 2016). We rated two other trials to be at uncertain risk of detection bias because it was unclear if raters were blinded (Azad 2014; Pfiffner 2014). We rated the remaining 21 trials as having high risk of detection bias since none of them used blinded ratings and observations for all outcomes (Cohen 1981; Bloomquist 1991;

Pfiffner 1997; Abikoff 2004; MTA 1999; Antshel 2003; Tutty 2003; Yuk-chi 2005; Pfiffner 2007; Van der Oord 2007; Waxmonsky 2010; Tabaeian 2010; Meftagh 2014a; Choi 2015; Bul 2016; Evans 2016; Pfiffner 2016; Schramm 2016; Waxmonsky 2016; Hannesdottir 2017; Qian 2017).

Five trials used blinding for at least one outcome, but we did not use these outcomes in our meta-analyses as they were not outcomes prespecified for our review.

Incomplete outcome data

We rated 16 trials to be at low risk of attrition bias, as they adequately addressed incomplete outcome data (Pfiffner 1997; Antshel 2003; Tutty 2003; Pfiffner 2007; Van der Oord 2007; Tabaeian 2010; Storebø 2012; Azad 2014; Meftagh 2014a; Pfiffner 2014; Bul 2016; Evans 2016; Schramm 2016; Waxmonsky 2016; Wilkes Gillan 2016; Hannesdottir 2017). We assessed five trials to be at high risk of attrition bias (Cohen 1981; Bloomquist 1991; Abikoff 2004; Yuk-chi 2005; Waxmonsky 2010). Of these five trials, one reported that 22 out of 103 children failed to complete the trial (Abikoff 2004); another permitted up to 50% missing items on indexes, and dropped participants when there were not enough data (Waxmonsky 2010); while the other three trials did not adequately address incomplete outcome data (Cohen 1981; Bloomquist 1991; Yuk-chi 2005). We considered the remaining four trials to be at unclear of risk of attrition bias due to a lack of information (MTA 1999; Choi 2015; Pfiffner 2016; Qian 2017).

Selective reporting

We rated 13 trials (which had protocols published before the trial started, and reported on all protocol specified outcomes) to be at low risk of reporting bias (Cohen 1981; Bloomquist 1991; Antshel 2003; Tutty 2003; Yuk-chi 2005; Pfiffner 2007; Van der Oord 2007; Storebø 2012; Meftagh 2014a; Bul 2016; Schramm 2016; Waxmonsky 2016; Hannesdottir 2017). We rated four trials to be at high risk of reporting bias (Pfiffner 1997; Pfiffner 2016; Qian 2017; Waxmonsky 2010). While most trials reported on all outcomes expected to be addressed as described in their published trial protocol, Pfiffner 1997 did not report on two important outcomes (the Swanson, Nolan and Pelham (SNAP) rating scale and the Conners, Loney, and Milich (CLAM) scale used in pre- and post-treatment assessments) and there was an inconsistency between the published report and the description of the trial (protocol) on clinicaltrials.gov in Waxmonsky 2010, Pfiffner 2016 and Qian 2017. We rated the eight remaining trials to be at unclear risk of reporting bias due to a lack of information (MTA 1999; Abikoff 2004; Tabaeian 2010; Azad 2014; Pfiffner 2014; Choi 2015; Evans 2016; Wilkes Gillan 2016): we were unable to find reports on all prespecified outcomes in one trial (MTA 1999); another trial published reports on both the design of the trial and the results simultaneously (Abikoff 2004); another trial registered the protocol retrospectively (after participant enrolment), and did not report on all prespecified outcomes thus making it difficult to assess if there had been selective reporting (Wilkes Gillan 2016); and five trials had no published design report or trial registration and thus no information to assess this domain (Tabaeian 2010; Azad 2014; Pfiffner 2014; Choi 2015; Evans 2016).

Vested interest

We assessed seven trials to be at high risk of bias on this domain because the trial authors were board members in pharmaceutical companies, had received funding from pharmaceutical companies, or had performed previous research on the topic (Abikoff 2004; Pfiffner 2007; Waxmonsky 2010; Choi 2015; Bul 2016; Schramm 2016; Waxmonsky 2016). We rated nine trials to be at unclear risk of bias because of a lack of information on vested interests (Bloomquist 1991; Antshel 2003; Yuk-chi 2005; Van der Oord 2007; Tabaeian 2010; Azad 2014; Pfiffner 2014; Pfiffner 2016; Qian 2017). We rated the remaining nine trials to be at low risk of bias (Cohen 1981; Evans 2016; Hannesdottir 2017; Meftagh 2014a; MTA 1999; Pfiffner 1997; Storebø 2012; Tutty 2003; Wilkes Gillan 2016).

Other potential sources of bias

We rated 14 trials to be at low risk of other bias due to no other potential risk of bias (MTA 1999; Abikoff 2004; Yuk-chi 2005; Tabaeian 2010; Azad 2014; Meftagh 2014a; Bul 2016; Evans 2016; Schramm 2016; Wilkes Gillan 2016; Hannesdottir 2017; Qian 2017).

We considered seven trials to be at high risk of other bias (Cohen 1981; Pfiffner 1997; Pfiffner 2007; Pfiffner 2014; Pfiffner 2016; Choi 2015; Waxmonsky 2016). In five of these trials (Pfiffner 1997; Pfiffner 2007; Pfiffner 2014; Pfiffner 2016; Waxmonsky 2016), the families and teachers were paid for doing the assessment at follow-up, leading to potential bias from those who were prone to this incentive. In Pfiffner 1997, 44% of participants were medicated with stimulant medication, but the number of medicated children in the comparison group was not stated. One trial provided no information about the between-group balance of stimulant medication (Cohen 1981), and there was no description of the participant selection procedure in another trial (Choi 2015).

With the exception of one trial where all kinds of medication were balanced between groups (MTA 1999), the remaining trials provided no information about any co-medication for comorbid disorders.

We judged six trials to be at unclear risk of other bias due to a lack of information (Bloomquist 1991; Antshel 2003; Tutty 2003; Van der Oord 2007; Waxmonsky 2010; Storebø 2012).

We assessed all trials to be at high risk of bias overall.

Effects of interventions

See: **Summary of findings for the main comparison** Social skills training compared to no intervention

We present the results for each of the three primary and four secondary outcomes below. We calculated and presented the effect sizes as SMD and, where possible, as MD. We considered a SMD effect size of: 0.15 or less to have no clinically meaningful effect; 0.15 to 0.40 to have a clinical meaningful but small effect ; 0.40 to 0.75 to have a moderate effect; and greater than 0.75 to have a large treatment effect (Thalheimer 2002). We only used the outcomes from included trials, which we had predefined in our protocol that we wanted to use in this review. For those trials for which we were unable to obtain the necessary data to calculate an effect size, or used outcomes that could not be included in the meta-analyses, we reported the results in the same way as the original report as single study results. We contacted the authors of 17 trials with unclear or missing data and requested the necessary data (some of them several times) (Bloomquist 1991; Pfiffner 1997; MTA 1999; Antshel 2003; Tutty 2003; Abikoff 2004; Pfiffner 2007; Van der Oord 2007; Tabaeian 2010; Waxmonsky 2010; Azad 2014; Choi 2015; Evans 2016; Pfiffner 2016; Wilkes Gillan 2016; Hannesdottir 2017; Qian 2017).

We received information back from eight trial groups (Pfiffner 1997; Antshel 2003; Abikoff 2004; Pfiffner 2007; Waxmonsky 2010; Evans 2016; Wilkes Gillan 2016; Hannesdottir 2017).

For 14 trials, we used all of their outcomes in meta-analyses (Antshel 2003; Pfiffner 2007; Van der Oord 2007; Tabaeian 2010; Storebø 2012; Meftagh 2014a; Pfiffner 2014; Evans 2016; Pfiffner 2016; Schramm 2016; Waxmonsky 2016; Wilkes Gillan 2016; Qian 2017; Hannesdottir 2017). For seven trials, we reported some outcomes separately and used some in meta-analyses (Bloomquist 1991; Pfiffner 1997; MTA 1999; Tutty 2003; Abikoff 2004; Yukchi 2005; Waxmonsky 2010). Only Cohen 1981 had no outcomes included in a meta-analysis; we reported all outcomes from this trial separately.

One of the trials did not report means and SD but P values connected to F values (Cohen 1981). We tried to transform these into SD, but this was not possible because we did not have the necessary between-group values. For one trial, Pfiffner 2007, we received raw data on the SSRS parent- and teacher-rated scores and used these for calculations.

Primary outcomes

Social skills

Twenty trials reported data on social skills (Bloomquist 1991; Pfiffner 1997; MTA 1999; Antshel 2003; Abikoff 2004; Pfiffner 2007; Van der Oord 2007; Tabaeian 2010; Waxmonsky 2010; Storebø 2012; Pfiffner 2014; Choi 2015; Bul 2016; Evans 2016; Pfiffner 2016; Schramm 2016; Waxmonsky 2016; Wilkes Gillan 2016; Hannesdottir 2017; Qian 2017).

Meta-analysis results

We combined data from 11 eligible trials in a primary meta-analysis of teacher-rated social skills at end of treatment (Pfiffner 1997; MTA 1999; Pfiffner 2007; Van der Oord 2007; Waxmonsky 2010; Storebø 2012; Pfiffner 2014; Bul 2016; Evans 2016; Pfiffner 2016; Schramm 2016). We found no evidence of an effect of the intervention (SMD 0.11, 95% CI −0.00 to 0.22; 11 trials, 1271 participants; I^2 = 0%; P = 0.05). We rated the certainty of the evidence as very low certainty due to high risk of bias, inconsistency, and imprecision. The primary outcome, teacher-rated social skills at end of treatment, corresponds to a MD of 1.22 points on the SSRS scale (95% CI 0.09 to 2.36). The minimal clinical relevant difference (10%) on the SSRS is 10.2.

We tested the robustness of this result by conducting a sensitivity analysis in which we excluded the three trials with the longest treatment duration (MTA 1999; Pfiffner 2014; Evans 2016), and again found no evidence of an effect (SMD 0.11, 95% CI −0.05 to 0.27; eight trials, 620 participants; I^2 = 0%; P = 0.17; Analysis 1.1).

We conducted four further secondary meta-analyses (Analysis 1.2), and found that, compared with no intervention, social skills training:

1. did not improve teacher-rated social skills at longest follow-up (SMD 0.06, 95% CI −0.22 to 0.35; three trials, 192 participants, I^2 = 0%; P = 0.66; Pfiffner 1997; Storebø 2012; Pfiffner 2014);
2. did improve parent-rated social skills at end of treatment for all eligible trials (SMD 0.19, 95% CI 0.06 to 0.32; 15 trials, 1609 participants; I^2 = 33% ; P = 0.003; very low-certainty evidence; Pfiffner 1997; Abikoff 2004; MTA 1999; Antshel 2003; Pfiffner 2007; Van der Oord 2007; Waxmonsky 2010; Pfiffner 2014; Bul 2016; Evans 2016; Pfiffner 2016; Schramm 2016; Waxmonsky 2016; Hannesdottir 2017; Qian 2017);
3. did not improve parent-rated social skills at longest follow-up (SMD 0.13, 95% CI −0.35 to 0.62; two trials, 445 participants; I^2 = 80% ; P = 0.59; Pfiffner 2014; Evans 2016); and
4. did not improve participant-rated social skills at end of treatment for all eligible trials (SMD 0.28, 95% CI −0.68 to 1.23; five trials, 344 participants; I^2 = 92%; P = 0.57; Abikoff 2004; Antshel 2003; Tabaeian 2010; Choi 2015; Schramm 2016).

We conducted the analyses using a random-effects model, and obtained similar results when repeating the analyses using a fixed-effect model.

Single study results

Below, we present the data from six studies, which assessed social skills using different measures and thus could not be included in the aforementioned meta-analyses (Cohen 1981; Bloomquist 1991; Pfiffner 1997; Abikoff 2004; Tabaeian 2010; Wilkes Gillan 2016).

The Cohen 1981 trial reported no significant group differences from observing children for three eight-minute periods during a one-hour period for two categories of behaviour in classrooms: play behaviour and social behaviour.

The Wilkes Gillan 2016 trial reported improved observer-rated social skills at end of treatment for all eligible trials (SMD 2.88, 95% CI 1.80 to 3.96; one trial, 29 participants; P < 0.001; Analysis 1.2.4).

The Tabaeian 2010 trial reported a significant difference between the groups in favour of participant-rated social skills at longest follow-up (SMD 1.60, 95% CI 0.77 to 2.44; one trial, 30 participants; P=0.0002; Analysis 1.2.6).

The Bloomquist 1991 trial found no significant difference between the groups for social skills assessed using the teacher-reported version of the Walker-McConnell Scale of Social Competence and School Adjustment (five-point scale ranging from 'never occurs' to 'frequently occurs'; higher scores indicate better social skills): MD 1.06 points, 95% CI −0.47 to 2.59; one trial, 46 participants; P = 0.18; Analysis 1.3.(fixed-effects analysis).

The Pfiffner 1997 trial found evidence of a large treatment effect in favour of social skills training using the parent-rated Social Skills Scale (UCI) UC Irvine Health Child Development School (higher scores indicate better social skills): MD 9.70 points, 95% CI 6.07 to 13.33; one trial, 18 participants; P < 0.001; Analysis 1.4. Pfiffner 1997 also found a significant difference between the groups when using the child-rated Test of Social Skill Knowledge (scored by blinded raters; ranging from one (low knowledge) to 15 (high knowledge); higher scores indicate better social skills): MD 4.20 points, 95% CI 1.99 to 6.41; one trial, 18 participants; P < 0.001; Analysis 1.5.

Abikoff 2004 reported no significant difference between the groups in negative behaviour assessed by the Social Interaction Observation Code, which records the frequency of positive, negative, or neutral behaviour, including observations of negative behaviour (higher scores equate to more negative behaviour) (MD 0.20 points, 95% CI -0.11 to 0.51; one trial, 68 participants; P = 0.21; Analysis 1.6).

Emotional competencies

Five trials reported data on emotional competencies (Storebø 2012; Choi 2015; Schramm 2016; Hannesdottir 2017; Qian 2017).

Meta-analysis results

We combined data from two trials in a meta-analysis (Storebø 2012; Schramm 2016). We found no evidence of an effect of the intervention for the primary meta-analysis of teacher-rated emotional competencies at end of treatment (SMD −0.02, 95% CI −0.72 to 0.68; two trials, 129 participants; I^2 = 74%; P = 0.96; Analysis 2.1). We rated the certainty of the evidence as very low due to high risk of bias, inconsistency, and imprecision.

We also conducted two secondary meta-analyses (Analysis 2.2), and found no evidence of an effect of the intervention on:

1. parent-rated emotional competencies (SMD −0.27, 95% CI −0.59 to 0.05; three trials, 173 participants; I^2 = 8%; P = 0.09; Schramm 2016; Hannesdottir 2017; Qian 2017);
2. participant-rated emotional competencies (SMD −0.27, 95% CI −0.62 to 0.09; two trials, 125 participants; I^2 = 0% ; P = 0.14; Choi 2015; Schramm 2016).

We conducted the analyses using a random-effects model, and obtained similar results when repeating the analyses using a fixed-effect model.

Single study results

The Storebø 2012 trial reported parent-rated emotional competencies at longest follow-up (SMD 0.19, 95% CI −0.34 to 0.72; one trial, 56 participants; P = 0.49).

General behaviour

Eleven trials reported data on general behaviour (Bloomquist 1991; MTA 1999; Abikoff 2004; Pfiffner 2007; Storebø 2012; Evans 2016; Pfiffner 2016; Schramm 2016; Waxmonsky 2016; Hannesdottir 2017; Qian 2017).

Meta-analysis results

We combined data from eight trials in a meta-analysis (Bloomquist 1991; MTA 1999; Abikoff 2004; Storebø 2012; Evans 2016; Pfiffner 2016; Schramm 2016; Waxmonsky 2016). We found no evidence of an effect for the primary meta-analysis of teacher-rated general behaviour at the end of treatment (SMD −0.06, 95% CI −0.19 to 0.06; eight trials, 1002 participants; I^2 = 0%; P = 0.33; Analysis 3.1). We rated the quality of the evidence as low due to high risk of bias, inconsistency, and imprecision.

We tested the robustness of this result by conducting two sensitivity analyses, both of which found no evidence of an effect:

1. sensitivity analysis excluding the two trials with the longest treatment duration (MTA 1999; Evans 2016): SMD −0.09, 95% CI −0.28 to 0.10; six trials, 422 participants; I^2 = 0%; P = 0.36; and
2. sensitivity analysis excluding the two largest trials (MTA 1999; Evans 2016): SMD −0.09, 95% CI −0.28 to 0.10; six trials, 422 participants; I^2 = 0%; P = 0.36.

We also conducted two secondary meta-analyses (Analysis 3.2), and found that, compared with no intervention, social skills training:

1. did not improve teacher-rated general behaviour at longest follow-up (SMD −0.10, 95% CI −0.27 to 0.07; four trials, 637 participants; I^2 = 7% ; P = 0.24; Bloomquist 1991; MTA 1999; Storebø 2012; Evans 2016);
2. did improve parent-rated general behaviour at end of treatment (SMD −0.38, 95% CI −0.61 to −0.14; eight trials, 995 participants; I^2 = 64%; P = 0.002; very low-quality evidence; MTA 1999; Storebø 2012; Evans 2016; Pfiffner 2016; Schramm 2016; Waxmonsky 2016; Hannesdottir 2017; Qian 2017).

We conducted the analyses using a random-effects model, and obtained similar results when repeating the analyses using a fixed-effect model.

Single study results

The Pfiffner 2007 trial measured general behaviour using parent and teacher ratings of the Clinical Global Impression Scale, and found that the intervention group showed significantly greater improvement than the control group (parents: $F_{1, 51}$ = 28.46, P < 0.001; teachers: $F_{1, 51}$ = 11.73, P = 0.001; one trial, 69 participants).

The Evans 2016 trial reported parent-rated general behaviour at longest follow-up (SMD −0.21, 95% CI 0.44 to 0.03; one trial; 326 participants; P = 0.08).

The Schramm 2016 trial reported participant-rated general behaviour at end of treatment (SMD −0.07, 95% CI −0.52 to 0.38; one trial, 76 participants; P = 0.76).

Secondary outcomes

Core ADHD symptoms

Nineteen trials reported data on ADHD symptoms (Bloomquist 1991; Tutty 2003; Abikoff 2004; MTA 1999; Yuk-chi 2005; Pfiffner 2007; Van der Oord 2007; Tabaeian 2010; Waxmonsky 2010; Storebø 2012; Azad 2014; Meftagh 2014a; Pfiffner 2014; Evans 2016; Pfiffner 2016; Schramm 2016; Waxmonsky 2016; Hannesdottir 2017; Qian 2017).

Meta-analysis results

We combined data from 14 eligible trials in a meta-analysis of the primary meta-analysis of teacher-rated ADHD symptoms at end of treatment (Bloomquist 1991; Abikoff 2004; MTA 1999; Yuk-chi 2005; Van der Oord 2007; Waxmonsky 2010; Storebø 2012; Pfiffner 2014; Evans 2016; Pfiffner 2016; Schramm 2016; Waxmonsky 2016; Hannesdottir 2017; Qian 2017). We found evidence of an effect in favour of the intervention (SMD −0.26, 95% CI −0.47 to −0.05; 14 trials, 1379 participants; I^2 = 69%; P = 0.02; Analysis 4.1). We rated the quality of the evidence as very low due to high risk of bias, inconsistency, and imprecision.

We tested the robustness of this result by conducting two sensitivity analyses, both of which showed no evidence of an effect:

1. sensitivity analysis excluding the three trials with the longest treatment duration (MTA 1999; Pfiffner 2014; Evans 2016): SMD −0.24, 95% CI −0.52 to 0.04; 11 trials, 677 participants, I^2 = 69%; P = 0.10); and
2. sensitivity analysis excluding the three largest trials (MTA 1999; Pfiffner 2014; Evans 2016): SMD −0.24, 95% CI −0.52 to 0.04; 11 trials, 677 participants; I^2 = 69%; P = 0.10).

We also drew a funnel plot to visually assess whether the effect was associated with the size of the trial; it seemed to be symmetrical with no clinically significant effect. Eggers' test, moreover was not statistically significant (Egger's regression intercept (bias) = 0.40 (two-tailed P = 0.78)) for the conclusion whether or not there was publication bias in the meta-analysis for this outcome.

We conducted five further secondary meta-analyses (Analysis 4.2), and found that, compared with no intervention, social skills training:

1. did not reduce teacher-rated ADHD symptoms at longest follow-up (SMD −0.11, 95% CI −0.28 to 0.06; five trials, 582 participants; I^2 = 0%; P = 0.20; Bloomquist 1991; Yuk-chi 2005; Storebø 2012; Pfiffner 2014; Evans 2016);
2. did reduce parent-rated ADHD symptoms at end of treatment for all eligible trials (SMD −0.54, 95% CI −0.81 to −0.26; 11 trials, 1206 participants; I^2 = 79%; P < 0.001; very low-quality evidence; Tutty 2003; Abikoff 2004; MTA 1999; Yuk-chi 2005; Pfiffner 2007; Van der Oord 2007; Waxmonsky 2010; Azad 2014; Pfiffner 2014; Evans 2016; Schramm 2016);
3. did reduce parent-rated ADHD symptoms at longest follow-up (SMD −1.36, 95% CI −2.48 to −0.25; three trials, 476 participants; I^2 = 95%; P = 0.02; Azad 2014; Pfiffner 2014; Evans 2016);
4. did not reduce participant-rated ADHD symptoms at end of treatment (SMD −0.77, 95% CI −2.31 to 0.78; two trials, 106 participants; I^2 = 91%; P = 0.33; Tabaeian 2010; Schramm 2016); and
5. did not reduce observer-rated ADHD symptoms at end of treatment for all eligible trials (SMD −3.15, 95% CI -9.88 to 3.57; two trials, 107 participants; I^2 = 98%; P = 0.36; Meftagh 2014a; Schramm 2016).

We conducted the analyses using a random-effects model. We obtained similar results when repeating the analyses using a fixed-effect model, except for sensitivity analyses 4.1.2 and 4.1.3, both of which showed a statistical significant effect when analysed with fixed-effect model. However, the random-effects model is more appropriate because of the heterogeneity in these analyses.

Single study results

The Meftagh 2014a trial found a significant difference between groups for observer-rated ADHD symptoms at longest follow-up (SMD 3.95, 95% CI 2.66 to 5.23; one trial, 30 participants; P < 0.001).

The MTA 1999 trial found no significant difference between the groups on teacher-rated ADHD symptoms (inattention) at end of treatment (SMD 0.01, 95% CI −0.23 to 0.26; one trial, 254 participants; P = 0.92).

The Pfiffner 2007 trial also found no significant difference between the groups on teacher-rated ADHD symptoms (sluggish cognitive tempo) at end of treatment (SMD −0.29, 95% CI −0.78 to 0.20; one trial, 66 participants; P = 0.24).

The Tabaeian 2010 trial found a significant difference between groups on participant-rated ADHD symptoms at longest follow-up (SMD 1.62, 95% CI 0.78 to 2.46; one trial, 30 participants; P < 0.001).

Performance and grades in school

Five trials measured performance in school (MTA 1999; Waxmonsky 2010; Storebø 2012; Evans 2016; Pfiffner 2016).

Meta-analysis results

We pooled the data in a meta-analysis and found that social skills training did not improve teacher-rated performance in school at end of treatment (SMD 0.15, 95% CI -0.01 to 0.31; five trials, 642 participants; I^2= 0% ; P = 0.07; Analysis 5.1; Waxmonsky 2010; Storebø 2012; Evans 2016; Schramm 2016, Pfiffner 2016) or at longest follow-up (SMD −0.01, 95% CI −0.22 to 0.20; two trials, 379 participants; I^2 = 0%; P = 0.92; Analysis 5.2; Storebø 2012; Evans 2016).

We conducted the analyses using a random-effects model, and obtained similar results when repeating the analyses using a fixed-effect model.

Single study results

The MTA 1999 trial found no significant difference between groups for observer-rated performance in school (MD 1.50 points, 95% CI −2.06 to 5.06; measured using Wechsler Individual Achievement Test (WIAT); (higher score indicates better performance); one trial, 260 participants; P = 0.41; Analysis 6.1).

Participant or parent (or both) satisfaction with the treatment

Four trials (233 participants) measured satisfaction with treatment (Pfiffner 1997; Pfiffner 2007; Waxmonsky 2010; Yuk-chi 2005). Although satisfaction with treatment was high in all four trials, two trials found no significant difference between the intervention and control groups (Pfiffner 1997; Waxmonsky 2010), and two trials did not report on differences between the groups (Pfiffner 2007; Yuk-chi 2005).

Adverse events

Only two trials (226 participants) reported data on adverse events (Storebø 2012; Bul 2016).They assessed adverse events as spontaneous reporting and reported no adverse events in the trial.

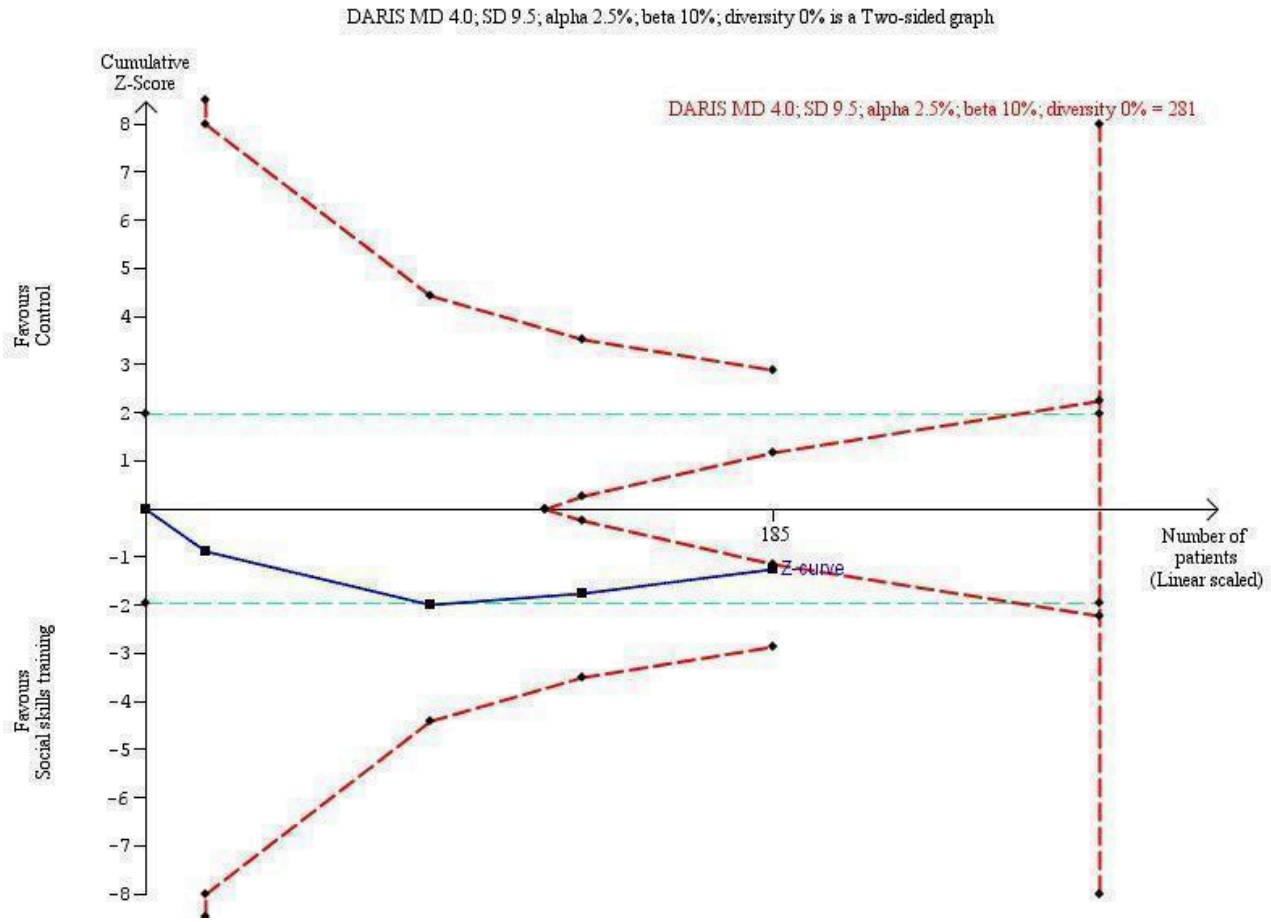
Trial Sequential Analysis (TSA)

We conducted a TSA of the primary outcome, social skills rated by teachers at end of treatment, with data from four trials (Pfiffner 1997; Pfiffner 2007; Van der Oord 2007; Waxmonsky 2010). Using an a priori assumption that the minimal relevant clinical intervention effect was 4.0 points, we found that the intervention effect almost reached the futility area (between the two widening dotted red lines), possibly signalling that the social skills intervention had no effect on teacher-rated social skills at the end of treatment (MD 1.80, 95% CI -1.01 to 4.62; four trials, 185 participants; Analysis 7.1; Figure 4). We used a power of 90% in the analysis and this gives a maximum type II error of 10%, and therefore there is a 10% risk of overlooking a true effect.

Figure 4. Trial Sequential Analysis of teacher-rated social skills - SSRS *Footnotes* DARIS: diversity-adjusted required information size

MD: mean difference

SSRS: Social Skills Rating Scale

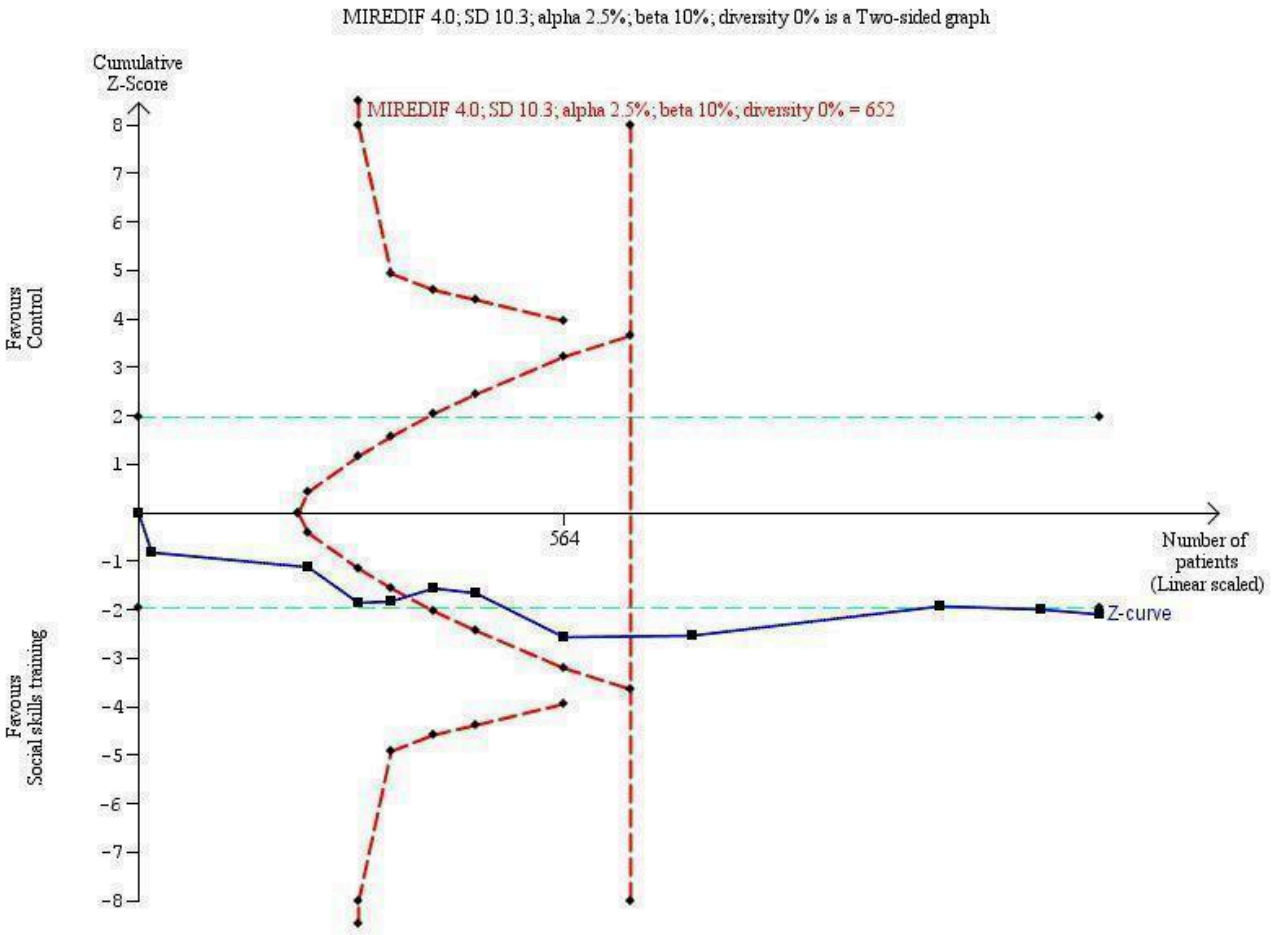


We also conducted a post hoc TSA of social skills rated by teachers for all eligible trials; 11 trials in total provided data (Pfiffner 1997; MTA 1999; Pfiffner 2007; Van der Oord 2007; Waxmonsky 2010; Storebø 2012; Pfiffner 2014; Bul 2016; Evans 2016; Pfiffner 2016; Schramm 2016). To do this, we transformed the MD and SD from the different rating scales used in this analysis to the MD and SD of a commonly used scale, namely the SSRS, using the following formula: MD = SMD*SD (Thorlund 2011). In the TSA we found that the cumulative z scores (blue line) crossed into the areas of futility (in between the two widening dotted red lines) (SMD 0.11, 95% CI −0.00 to 0.22; 11 trials, 1271 participants; Analysis 7.1; Figure 5).

Figure 5. Trial Sequential Analysis of teacher-rated social skills - all studies transformed to SSRS *Footnotes* MIREDIF: minimum relevant difference

SD: standard deviation

SSRS: Social Skills Rating Scale



Subgroup analyses

We performed five subgroup analyses, none of which showed significant differences in intervention effects.

- Children aged five to 11 years compared to children aged 12 to 18 year:

Teacher-rated social skills at end of treatment: children aged five to 11 years (10 trials, 1194 participants: Pfiffner 1997; MTA 1999; Pfiffner 2007; Van der Oord 2007; Waxmonsky 2010; Storebø 2012; Pfiffner 2014; Bul 2016; Evans 2016; Pfiffner 2016) compared to children aged 12 to 18 years (one trial, 77 participants: Schramm 2016). Test for subgroup differences: $Chi^2 = 0.06$, df = 1 (P = 0.81), $I^2 = 0\%$; Analysis 8.1.

- ADHD with comorbidity compared to ADHD without comorbidity:

Parent-rated ADHD symptoms at end of treatment: ADHD with comorbidity (eight trials, 1003 participants: Abikoff 2004; MTA 1999; Yuk-chi 2005; Pfiffner 2007; Van der Oord 2007; Waxmonsky 2010; Pfiffner 2014; Evans 2016) compared to ADHD without comorbidity (two trials, 173 participants: Tutty 2003; Schramm 2016). Test for subgroup differences: $Chi^2 = 0.10$, df = 1 (P = 0.75), $I^2 = 0\%$; Analysis 9.1.

- Social skills training only compared to social skills training supported by parent training:

Teacher-rated social skills at end of treatment: social skills training only (four trials, 336 participants: Pfiffner 1997; Pfiffner 2014; Bul 2016; Evans 2016) compared to social skills training supported by parent training (four trials, 632 participants: Pfiffner 1997; Storebø 2012; Pfiffner 2014; Schramm 2016). Test for subgroup differences: $Chi^2 = 0.16$, df = 1 (P = 0.69), $I^2 = 0\%$; Analysis 10.1.

- Social skills training, parent training and medication compared to social skills training and parent training without medication:

Parent-rated social skills at end of treatment: social skills training, parent training and medication (four trials, 299 participants: Abikoff 2004; Antshel 2003; Waxmonsky 2010; Waxmonsky 2016) compared to social skills training and parent training without medication (four trials, 337 participants: Pfiffner 1997; Pfiffner 2007; Pfiffner 2014; Pfiffner 2016). Test for subgroup differences: $Chi^2 = 2.61$, df = 1 (P = 0.11), $I^2 = 61.6\%$; Analysis 11.1.

- No-intervention control group compared to waiting-list control group with possible minor active intervention components:

Teacher-rated social skills at end of treatment: no-intervention control group (eight trials, 693 participants: Pfiffner 1997; MTA 1999; Pfiffner 2007; Van der Oord 2007; Waxmonsky 2010; Storebø 2012; Bul 2016; Schramm 2016) compared to waiting-list control group with possible minor active intervention components (three trials, 578 participants: Pfiffner 2014; Evans 2016; Pfiffner 2016). Test for subgroup differences: $Chi^2 = 0.02$, df = 1 (P = 0.89), $I^2 = 0\%$; Analysis 12.1.

We conducted the analyses using a random-effects model, and obtained similar results when repeating the analyses using a fixed-effect model.

Single study result

One trial (576 participants) reported on subgroup analyses comparing children with ADHD only to children with ADHD and comorbid anxiety disorder (MTA 1999). This analysis found significant differences in teacher-rated hyperactivity/impulsivity (F = 1.64, P = 0.04) and teacher-rated social skills (F = 1.68, P = 0.03) between the two subgroups of children in connection with all four active treatments used in this trial. The subgroup with ADHD and comorbidity of anxiety disorder showed better results (MTA 1999).

DISCUSSION

We conducted this systematic review to examine the effects of social skills training for children and adolescents with ADHD. We considered a total of 313 full-text reports from which we included 25 trials published in 45 articles in this review. Of these 25 trials, we used the results from 24 in meta-analyses.

Summary of main results

We included 25 trials published in 45 reports. Altogether these trials randomised 2690 participants. All trials included children aged between five and 13 years, except for a single study which included adolescents between 12 and 17 years of age. The duration of the trials ranged from five weeks to two years. Most were conducted in outpatient clinics in the USA, Asia, and Europe. We assessed all trials as having high risk of bias, which might lead to systematic errors: overestimation of benefits and underestimation of harms. We considered the parent-rated findings to be more questionable than our primary analyses, which were based on teacher-rated outcomes, due to high risk of systematic errors (lack of blinding) in the parent-rated outcomes (Daley 2014b).

In accordance with the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011), we combined all relevant trials in a meta-analysis to investigate common features of treatment effects. We found no significant differences between the group given social skills training and the groups given no intervention or assigned to a waiting list. There was a beneficial effect on some of the parent-rated primary outcomes and the secondary outcome of teacher-rated ADHD symptoms at end of treatment, but the finding was questionable due to lack of support from sensitivity analyses with low clinical significance and low-certainty evidence. We found no indications of harmful effects.

We presented all results using the random-effects model, thus giving more weight to smaller trials; however, the conclusions on the effect of intervention did not change when we applied a fixed-effect model. Thus, we conclude that the observed statistical heterogeneity does not seem to be of importance for the results of the present review.

Overall completeness and applicability of evidence

We were able to include most of the data from the trials in our meta-analyses, which provides a good basis for the evidence in this review. However, the interventions might be considered too heterogeneous to combine in a meta-analysis and the multiplicity of different outcome measures might limit the external validity of this review. We found a small treatment effect for some of the outcomes, but all of the trials were at high risk of bias.

Components and duration of the interventions

All but three trials (Cohen 1981; Pfiffner 1997; Antshel 2003) used manual-based interventions. The social skills interventions in the trials were, in general, cognitive behaviour-based treatments but varied in form, content, and in the use of specific behaviour techniques. Most manuals were structured around specific themes, with most trials focusing on problem-solving and emotion regulation and a few trials focusing more specifically on academic organisational skills (Evans 2016) or play skills (Wilkes Gillan 2016).

The duration of the treatment also differed greatly, from five weeks to 24 months. However, there were no differences in the results when we excluded the study with the longest intervention from the analyses of social skills and ADHD symptoms.

Parent training

Most trials included specific parent training in the social skills intervention. One study involved parents before the onset of training (Hannesdottir 2017) or as part of the first or last session (Qian 2017), in order that parents might understand the concept of the training and be able to support the children in home assignments or in applying what they learned at home. Other trials did not describe parental involvement in the training (Azad 2014; Meftagh 2014a; Choi 2015; Bul 2016; Evans 2016).

Teacher training

More than half of the trials included teacher training or teacher consultations as part of the social skills training. The inherent differences in the interventions accorded with this review's inclusion criteria (criteria for considering studies for this review), but were likely to produce heterogeneity in the analysis.

Treatment effects

Although the measurable beneficial effects of social skills training were small and questionable due to the low certainty of the evidence, participant, parent, and teacher satisfaction with the intervention was overall in the positive direction, as the level of satisfaction was rated as high in all of the included studies. However, in half of the trials measuring this outcome, there was no significant difference in the level of satisfaction when comparing the experimental and control group. The other half of the trials did not report on between-group differences. This is a problem as participant satisfaction with treatment is often used as an argument for this kind of treatment.

In the MTA 1999 trial, the multimodal treatment had a superior treatment effect on children with ADHD and comorbid anxiety disorder compared to those without that comorbidity. This was an interesting subgroup finding and suggested that future trials on this topic should investigate these findings further by planning for subgroup analyses on children with and without comorbid anxiety disorder. Moreover, we know very little about the effects of social skills training in adolescents.

Limitations of the evidence

In all meta-analyses that achieved significant findings with 95% confidence intervals, the findings could be due to bias and overestimation of beneficial intervention effects. We conducted TSA to control the risk of type I and type 2 errors and to estimate how far we were from obtaining the diversity adjusted required information size (DARIS) to detect or reject a certain plausible intervention effect. Moreover, the TSAs showed that the observed intervention effects could be due to type I errors. This highlights the need for more clinical research on this topic without risks of bias. Both the a priori and post hoc TSA showed that there is a need for more participants in order to reach a firm conclusion in the meta-analyses.

A serious limitation of these types of trials was the lack of blinding or inability to blind. This introduced a high risk of bias in the assessment of outcomes (Schultz 1995; Kjaergard 2002; Wood 2008; Savovíc 2012; Savovic 2018). Statistical heterogeneity was low (0%) in most meta-analyses, most likely due to inherent features of the trials leading to wide CIs of the estimates, and therefore was not mirroring the clinical and methodological heterogeneity.

RCTs are generally considered to be the highest level of evidence, but most of the trials included in this systematic review were at high risk of bias and the vast majority were at high risk of random errors due to their low sample sizes. Generally, we rated the certainty of the evidence as low or very low using the GRADE approach (GRADE Working Group), downgrading the certainty of the evidence by two or three levels due to high risk of bias, imprecision and inconsistency. Further research may change the estimates of the treatment effect, but such trials ought to be conducted without risk of systematic errors (bias), random errors (play of chance), and design errors (Keus 2010).

Quality of the evidence

Our review has some limitations. Our results were based on only 25 trials with a limited number of participants (n = 2690). Many of the trials were prone to selection bias due to unclear or inadequate generation of the allocation sequence or allocation concealment. All 25 trials had an overall assessment as having 'high risk of bias', so our results might not be robust and reliable (Figure 2).

Funnel Plots

We drew funnel plots of the following two outcomes for all eligible trials to visually assess whether effects were associated with the size of the study: 1) teacher-rated social skills and 2) teacher-rated ADHD symptoms. Both outcomes seemed to be symmetrical with no clinically significant effect. An Eggers' test for both the outcomes was not statistically significant so we were unable to conclude whether or not there was publication bias in the meta-analysis of these outcomes.

There is, therefore, currently insufficient evidence to draw any conclusions about any form of social skills training as having an effect on ADHD patients.

The important methodological limitations, which have been elaborated above, reduced the reliability of the results of most of the trials included in this review.

Potential biases in the review process

We sought to minimise potential biases in the review process in the following ways. We published a protocol before we embarked on the review itself. We conducted extensive searches of relevant databases. Two review authors, working independently, selected trials for inclusion and extracted data. Disagreements were resolved by discussion with team members. We assessed risk of bias in all trials according to the recommendations provided in Chapter 8 of the *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins 2011). We recognise, however, that there are some limitations in the review process. In particular, we did not assess quality of life as an outcome and we defined serious adverse events as a secondary outcome when it should have been a primary outcome (though these were reported in the review). Furthermore, we believe that the outcomes of emotional competencies and general behaviour should have been secondary outcomes; we will change this in the next update of this review. Conduct disorder was used in two out of the 10 trials that were included in the analysis of general behaviour, and we took the decision to include this in a meta-analysis of the impact of social skills training on behaviour more generally. Some might take issue with this, but we believe this was a sensible approach.

Agreements and disagreements with other studies or reviews

Four earlier meta-analyses examined the effects of social skills training for children with ADHD. Two of these concluded that there was no effect of social skills training for children with ADHD (Kavale 1997; Van der Oord 2008); the other two concluded that there was a beneficial effect (De Boo 2007; Majewicz-Hefley 2007). The obvious limitation of all four reviews is that all are at least 10 years old, and suffer from several methodological weaknesses; for example, none of these reviews evaluated systematic errors (bias) in the included trials. The conclusion in this update reinforces the conclusion in our original review where we wrote that "there is little evidence to support or refute social skills training for adolescents with ADHD (Storebø 2011). There is need for more trials, with low risk of bias and with a sufficient number of participants, investigating the efficacy of social skills training versus no training for both children and adolescents." (Storebø 2011). A new systematic review published in 2019 investigating the effectiveness of stand-alone social skills training for youth with ADHD concluded that social skills training implemented without additional treatment components like parent support, showed improvements on some areas of social functioning (Willis 2019). However, this review suffered from a very limited search strategy and did not evaluate systematic errors (bias) in the included trials.

AUTHORS' CONCLUSIONS

Implications for practice

We generally found no beneficial effects in favour of social skills training for children and adolescents with ADHD. In the primary

analyses, we found no evidence of an effect on social skills, emotional competencies, and general behaviour. In the secondary analyses, we did find favourable effects on ADHD symptoms, indicating that social skills training could exert clinically useful effects in this domain, but we need more evidence to confirm this. Social skills training did not seem to affect child and adolescent school performance and was not associated with any adverse events. We cannot rule out that social skills training is associated with harms. On the basis of the evidence considered in this review, we are unable to conclude whether social skills training is beneficial for children with ADHD or whether it is a waste of scarce resources in clinical practice.

Implications for research

We need more high-quality trials that are at low risk of bias and have sufficient sample sizes to investigate social skills training versus no training for children and adolescents with ADHD. Such trials should include adolescents since only one study in this review assessed this group. Future trials should be based on pre-published protocols to combat the problem of publication bias. Moreover, future trials should be designed according to the SPIRIT statement (Chan 2013), and reported according to the CONSORT statement (Schulz 2010). Social skills problems is an important area of intervention for children and adolescents with ADHD. Untreated social skills problems may decrease self-confidence in these children due to limited positive social experiences.

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* Indicates the major publication for the study

CHARACTERISTICS OF STUDIES

Characteristics of included studies [ordered by year of study]

Cohen 1981

Methods	**Design:** RCT
Participants	**Country:** ethnicity: 100 % Canadian, so Canada was assumed **Setting:** not reported **Sample size calculation:** not reported **Sample size:** 24 children **Sex:** 21 (87.5%) = boys, three (12.5%) = girls **Age:** range = five-six years **Ethnicity:** Canadian **Socioeconomic status:** not reported **IQ:** IQ ≥ 80 on WPPSI **ADHD diagnosis:** subtypes not reported **ADHD medication:** not reported **Comorbidity:** not reported **Medications for comorbid disorders:** not reported **Inclusion criteria:** 1. scores ≥ 1.5 on CTRS 2. IQ ≥ 80 on WPPSI 3. no neurological damage or psychosis **Exclusion criteria:** no neurological damage or psychosis **Baseline characteristics:** no information about medication balance between groups
Interventions	24 children allocated to one of four groups 1. **Group one (n = 6):** cognitive behaviour modification. Individual training to teach children to slow down, develop better problem-solving ability, and evaluate his/her own performance. one-hour × twice-weekly sessions for 10 weeks (total of 20 sessions) 2. **Group two (n = 8):** methylphenidate only. Drug dosage individually titrated and ranged from 10 mg to 30 mg methylphenidate per day 3. **Group three (n = 6):** cognitive behaviour modification as described in group one + methylphenidate as administered in group two 4. **Group four (n = 4):** no intervention **Attendance:** not reported
Outcomes	**Primary outcomes**

Cohen 1981 *(Continued)*

1. Social skills: observations in classrooms, observer-rated
2. Emotional competencies: Richman-Graham scale, parent-rated
3. General behaviour: CBRS, teacher- and parent-rated

Outcome assessment: end of treatment

Notes	**Study ID:** not reported **Sponsorship source:** grants from the Ontario Mental Health Foundation (Grant No. 701-76/78) and The Hospital for Sick Children Foundation (Grant No. 77-22) **Year conducted:** not stated **Duration of the study:** 15 months **Comments:** none **Lead author's name:** NJ Cohen **Institution:** Psychiatric Research Unit, The Hospital for Sick Children **Email:** not reported **Address:** 555 University Avenue, Toronto, Ontario, Canada MSG 1X8.

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	**Comment:** unclear
Allocation concealment (selection bias)	High risk	**Comment:** allocation concealment not described, but four patients were moved between groups
Blinding of participants and personnel (performance bias) All outcomes	High risk	**Comment:** no blinding
Blinding of outcome assessment (detection bias) All outcomes	High risk	**Comment:** blinding on at least one of this review's primary outcomes, but no blinding for the rest of the outcomes
Incomplete outcome data (attrition bias) All outcomes	High risk	**Comment:** many tables different from text and no explanation provided. Lack of teacher responses
Selective reporting (reporting bias)	Low risk	**Comment:** all apparent assessments were made.
Vested interest bias	Low risk	**Comment:** no other apparent biases, no previous research on the topic
Other sources of bias?	High risk	**Comment:** selection procedure of patients not stated in report

Bloomquist 1991

Methods	**Design:** RCT

Bloomquist 1991 *(Continued)*

Participants	**Country:** USA **Setting:** outpatient, 3 suburban elementary schools in the same school district **Sample size calculation:** not reported **Sample size:** 52 children **Sex:** 36 (69%) = boys, 16 (31%) = girls **Age:** range = eight-nine years **Ethnicity:** Caucasian = 95% **Socioeconomic status:** not reported **IQ:** mental retardation excluded **ADHD diagnosis:** subtypes not reported **ADHD medication:** not reported **Comorbidity:** ODD = 18 (35%) **Medications for comorbid disorders:** not reported **Inclusion criteria:** 1. T-score ≥ 60 on the CBCL-Teacher 2. signed consent form 3. T-score ≥ 65 on the CBCL-Parent 4. ADHD diagnosis on the basis of DIACA-R **Exclusion criteria:** 1. mental retardation 2. epilepsy 3. severe emotional disorder 4. pervasive development disorder **Baseline characteristics:** groups were highly comparable on descriptive and subjective identification measures; age, IQ, academic achievement, hyperactivity and self-control behaviour, externalising and internalising behaviour at baseline.
Interventions	52 children with ADHD were allocated to one of three groups. Only group one and three were included in the analysis. 1. **Group one (n = 20):** multicomponent CBT based on Braswell and Bloomquist (1991) and Bloomquist and Braswell's (Bloomquist 1991) CBT programme for ADHD children, which included coordinated child, parent, and teacher training components a. **Child component:** used a variety of cognitive- behavioural techniques such as didactic instructions, modelling, role-play exercises and so on. It was led by a school psychologist and consisted of two × one-hour group sessions each week over a 10-week period (20 sessions). b. **Parent component:** targeted to teach the parents about ADHD, to establish a positive trusting atmosphere among the parents, and to teach them cognitive/behavioural principles identical to those addressed in the teacher training component. It was led by a therapist and consisted of seven × 90-minute group sessions. c. **Teacher training component:** focused on, for example, problem-solving in the classroom and on reinforcing appropriate behaviour and consequating disruptive behaviour. It was led by a consultant and consisted of one × two-hour in service and six × 45 to 60-minute consultations over a 10-week period.

Bloomquist 1991 *(Continued)*

	2. **Group two (n = 16):** teacher intervention. Same teacher component as above but without the child only and the parent components 3. **Group three (n = 16):** waiting list, consisting of no intervention **Attendance:** almost 100% for child and teacher interventions
Outcomes	**Primary outcomes** 1. Social skills: Teacher Report-Walker-McConnell Scale of Social Competance and School Adjustment, teacher-rated 2. General behaviour: Self-Control Rating Scale, teacher-rated **Secondary outcomes** 1. Core ADHD symptoms: CTRS, teacher-rated **Outcome assessment:** post-intervention assessment
Notes	**Study ID:** not reported **Sponsorship source:** not reported **Year conducted:** not stated **Duration of the study:** 16 weeks **Comments:** authors referred to unpublished paper with the treatment manual by Bloomquist and Braswell (Bloomquist 1991) **Lead author:** Michael L. Bloomquist, PhD **Institution:** Division of Child and Adolescent Psychiatry **Email:** not reported **Address:** Box 95, University of Minnesota Hospital and Clinic, Harvard Street at East River Road, Minneapolis, Minnesota 55455 **Year conducted:** not reported **Duration of the study:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	**Comment:** no description of the randomisation method used
Allocation concealment (selection bias)	Unclear risk	**Comment:** no description of the allocation method used
Blinding of participants and personnel (performance bias) All outcomes	High risk	**Comment:** no blinding
Blinding of outcome assessment (detection bias) All outcomes	High risk	**Comment:** observers were blinded to treatment assignment but teachers were not. No blinding on primary outcomes

Bloomquist 1991 *(Continued)*

Incomplete outcome data (attrition bias) All outcomes	High risk	**Comment:** 16 excluded data sets with much likelihood of biasing results
Selective reporting (reporting bias)	Low risk	**Comment:** all measures of interest reported
Vested interest bias	Unclear risk	**Comment:** no funding sources stated
Other sources of bias?	Unclear risk	**Comment:** no test for compliance of intervention groups

Pfiffner 1997

Methods	**Design:** RCT
Participants	**Country:** USA **Setting:** university-based behavioural paediatric clinic specialising in ADHD and related disorders. Participants were recruited from newspaper advertisement and from consecutive referrals. **Sample size calculation:** not reported **Sample size:** 27 children **Sex:** 19 (70%) = boys, eight (30%) = girls **Age:** range = eight-10 years **Ethnicity:** all Caucasian except for one boy, who was African American **Socioeconomic status:** middle- to upper-middle class; two children were from single-parent families **IQ:** not reported **ADHD diagnosis:** following DSM-III-R, 25 children met criteria for ADHD and two met criteria for undifferentiated ADHD **ADHD medication:** n = 12 (44%) received stimulant medication **Comorbidity:** ODD = 19, CD = 3, separation anxiety disorder = four, overanxious disorder = five, dysthymic disorder = two **Medication for comorbid disorder:** no information **Inclusion criteria:** 1. diagnosis of ADHD or undifferentiated ADHD following DSM-III-R criteria 2. mean score at or above 1.5 on at least one of the parent-completed subscales assessing ADHD. behaviour from the CLAM rating scale or the SNAP-R, a T score of at least 60 on the Attention Problem subscale of the CBCL **Exclusion criteria:** not reported. We attempted to get this information from the study investigators but have not succeeded in this attempt. **Baseline characteristics:** at pretreatment, no significant difference in age, socioeconomic status, medication status and number of symptoms of ADHD, and comorbid disorders or on parent and teacher ratings of social skills and behaviour
Interventions	18 participants allocated to one of three groups (see below). Both treatment groups had a protocol and were led by psychologist and the same two therapists taught in the childrens' groups. The two treat-

Pfiffner 1997 *(Continued)*

ment groups attended eight group sessions. Children in both treatment groups received 90-minute group sessions during consecutive weeks. Assessment was at pre- and post-treatment and follow-up (3-4 months post-treatment).

1. **Group one (n = 9):** social skills training (SST) for children, which covered six themes/modules: 1) good sportsmanship; 2) accepting consequences; 3) assertiveness; 4) ignoring provocations; 5) problem-solving; and 6) recognising and dealing with feelings. Children were assigned homework to practice at home. The children received points for following the rules of the groups, participating, and attending the sessions. The points could be exchanged for child-selected games and activities during the last 10 minutes for each group.
2. **Group two (n = 9):** SST for children with parent-mediated generalisation. Parents were used as a primary vehicle to programme generalisation of the social skills learned in the SST groups to home and school settings. The parents went through the same group themes or agendas as the children did. The parents met with their children's teacher and gave the teacher a template for the scorecard, also called the daily report card. The teacher scored the child on a four-point scale and parents rewarded the child when the child scored high on the scale.
3. **Group three (n = 9):** waiting list

Attendance: two families each missed one session

Outcomes	**Primary outcomes** 1. Social skills: SSRS, parent-, teacher and parent-rated; Test of Social Skill Knowledge, observer-rated (interviewers, scored by blinded raters) **Secondary outcomes** 1. Satisfaction with treatment: Consumer Satisfaction Questionnaire, parent-rated **Outcome assessment:** post-intervention and follow-up three to four months after post-intervention assessment
Notes	**Study ID:** not reported **Sponsorship source:** not reported **Year conducted:** not stated **Duration of the study:** 8 months **Comments:** none **Lead author:** Linda J Pfiffner **Institution:** Department of Psychiatry, The University of Chicago **Email:** not reported **Address:** 5841 South Maryland Avenue, MC 3077, Chicago, Illinois 60637

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	**Comment:** no information given in the article. We requested clarification from the study investigators and they reported in an email on 26 May 2011 that it was not possible to obtain these data at that time (Pfiffner 2011 [pers comm]).
Allocation concealment (selection bias)	Unclear risk	**Comment:** no information given in the article. We requested clarification from the study investigators and they reported in an email 26 May 2011 that it was not possible to find these data at that time (Pfiffner 2011 [pers comm]).

Pfiffner 1997 *(Continued)*

Blinding of participants and personnel (performance bias) All outcomes	High risk	**Comment:** no blinding
Blinding of outcome assessment (detection bias) All outcomes	High risk	**Comment:** blinding on at least one of this study's primary outcomes; no blinding for the rest of the outcomes
Incomplete outcome data (attrition bias) All outcomes	Low risk	**Comment:** three participants started medication after post-intervention assessment but before follow-up assessment. Individual scores for these participants were replaced by the grand mean of all other participants at follow-up to avoid possible confounds associated with the medication treatment.
Selective reporting (reporting bias)	High risk	**Comment:** the author informed us in an email (Pfiffner 2011 [pers comm] that the CLAM and SNAP were used post-treatment, but were not reported in the article. We were not able to get the data because they had been lost over time.
Vested interest bias	Low risk	**Comment:** no other apparent biases, no previous research on the topic
Other sources of bias?	High risk	**Comment:** Teachers were paid $10 for post-intervention assessment and $25 for follow-up assessment and families were paid $12 for follow-up assessment.

Abikoff 2004

Methods	**Design:** RCT
Participants	**Country:** USA and Canada **Setting:** outpatient clinics in two large medical centres in New York and Montreal **Sample size calculation:** not reported **Sample size:** 103 children **Sex:** 93% = boys, 7% = girls **Age:** range = 7-9.9 years **Ethnicity:** white = 84%, African-American = 13%, Hispanic = 2%, other = 1% **Socioeconomic status:** 84 children (81.2%) lived with both parents, 13 (12.6%) with one parent, and six (5.8%) with their mother and stepfather **IQ:** normal IQ (i.e. WISC-R ≥ 85) **ADHD diagnosis:** subtypes not reported **ADHD medication:** all participants received psychostimulants **Comorbidity:** ODD = 53.4%, CD = 30%, anxiety disorder = 16.5% **Medications for comorbid disorders:** not reported **Inclusion criteria:** 1. diagnosis of ADHD based on the DISC-P2 conducted by a clinical psychologist. The diagnosis had to be confirmed by a child psychiatrist based on a comprehensive clinical interview with the child and parent and teacher reports. The children had to, on two different occasions, receive a mean teacher

Abikoff 2004 *(Continued)*

	rating of at least 1.5 on the hyperactivity factor or the Hyperactivity Index of the Conners Teachers Rating Scale (Conners 1998). 2. children had to be medication-free for at last two weeks before evaluation. 3. normal IQ (i.e. WISC-R ≥ 85) 4. living with at least one parent, with telephone access 5. positive response to methylphenidate **Exclusion criteria:** 1. children with diagnosable neurological disorders 2. psychosis 3. significant medical illness 4. current physical or sexual abuse 5. chronic tic disorder or Tourette's disorder 6. DSM-III-R-based developmental reading or arithmetic disorder, defined as a standard score in reading or mathematics on the Kaufmann Test of Educational Achievement of 85 or less 7. children with a diagnosis of conduct disorder **Baseline characteristics:** no between-group differences except on socioeconomic status, where there were differences between the group given methylphenidate alone and the group given methylphenidate + attention control treatment
Interventions	103 participants allocated to one of three groups 1. **Group one (n = 34):** medical manual and methylphenidate (effort was made to give each child a maximal dose of methylphenidate). Five-week open methylphenidate titration study before randomisation 2. **Group two (n = 34):** methylphenidate + Multimodal Psychosocial Treatment (MPT) comprising parent training/family therapy, academic organisational skills training, individualised academic assistance, reading remediation (when necessary), social skills training, and individual psychotherapy. All treatment modules were fully manual-based and the manual was developed before the start of the study. Each component was delivered once a week in the first year and once a month during the second year. Parents received parent management training and counselling. Daily report cards were completed by teachers and formed the basis for a home-based reinforcement programme for targeted school behaviour and academic performance. 3. **Group three (n = 35):** methylphenidate + attention control treatment (ACT) consisting of components parallel to those in MPT but excluding the therapeutic content. Delivered once a week in the first year and once monthly during the second year **Attendance:** 75% attendance required. 22 children (methylphenidate = 10, methylphenidate + MPT = 6, methylphenidate + ACT = 6)
Outcomes	**Primary outcomes** 1. Social skills: SSRS, parent- and child-rated; Social Interaction Observation Code 2. General behaviour: CTRS, Conduct Problems Factor, teacher-rated **Secondary outcomes** 1. Core ADHD symptoms: CPRS, Hyperkinesis Index, parent-rated; CTRS, Hyperactivity Factor, teacher-rated; CTRS Hyperkinesis Index, observer-rated **Outcome assessment:** end of treatment
Notes	**Study ID:** not reported **Sponsorship source:** not reported **Year conducted:** not stated **Duration of the study:** 2 years

Abikoff 2004 *(Continued)*

Comments: none

Lead author's name: Howard Abikoff

Institution: NYU Child Study Center, New York University School of Medicine

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Address: NYU Child Study Center, New York University School of Medicine, New York

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	**Comment:** we requested clarification from one of the study investigators. Howard Abikoff informed us in an email on 28 January 2011 (Abikoff 2011 [pers comm]) that they had used a block randomisation scheme with blocks of four children. The groups were balanced for age, sex, ODD, and ethnicity.
Allocation concealment (selection bias)	Low risk	**Comment:** we requested clarification from 1 of the study investigators. Howard Abikoff informed us in an email as above (Abikoff 2011 [pers comm]) that they had used sealed envelopes.
Blinding of participants and personnel (performance bias) All outcomes	High risk	**Comment:** no blinding
Blinding of outcome assessment (detection bias) All outcomes	High risk	**Comment:** blinding on at least one of this review's primary outcomes but no blinding for the rest of the outcomes
Incomplete outcome data (attrition bias) All outcomes	High risk	**Comment:** 22 out of 103 children failed to complete the study.
Selective reporting (reporting bias)	Unclear risk	**Comment:** no prior statement of assessment tools. Design article published at the same time as study article
Vested interest bias	High risk	**Comment:** the study was based in two large medical centres and the centres have extensive previous experience with research focused on ADHD and behavioural treatment. Dr Klein is a member of a pharmaceutical board.
Other sources of bias?	Low risk	**Comment:** no other sources identified

MTA 1999

Methods	**Design:** RCT
Participants	**Country:** USA **Setting:** six multisite outpatient clinics **Sample size calculation:** 576 participants required **Sample size:** 576 children **Sex:** 465 (81%) = boys, 111 (19%) = girls

MTA 1999 *(Continued)*

Age: range 7.0 to 9.9 years

Ethnicity: white = 61%, African-American = 20%, Hispanic = 8%

Socioeconomic status: not reported

IQ: below 80 excluded

ADHD diagnosis: DSM-IV, ADHD combined type

ADHD medication: 97% received methylphenidate

Comorbidity: anxiety disorder = 33.5%, conduct disorder = 14.3%, ODD = 39.9%, affective disorder = 3.8%, tic disorder = 10.9%, other = 2.2% such as bulimia, enuresis

Medications for comorbid disorders: balanced between groups.

Inclusion criteria:

1. boys and girls
2. 7-9.9 years of age (1st-4th grades)
3. residing with primary caretakers for at least six months
4. meet dimensional criteria for hyperactivity on the basis of parent and teacher rating scales and full diagnostic criteria for ADHD combined type

Exclusion criteria:

1. currently in hospital (inability to obtain school assessments)
2. currently in another treatment study (confounding of assessments and treatments)
3. below 80 on WISC-III Verbal IQ, Performance IQ or Full Scale IQ scores, and on Scales of Independent Behavior (insufficient ability to participate in psychosocial interventions)
4. bipolar disorder, psychosis, pervasive developmental disorder, severe obsessive-compulsive disorder (treatment may be incompatible with the study intervention)
5. chronic, serious tics or Tourette's Disorder (possible contraindication for stimulant treatment)
6. neuroleptic treatment in previous six months (may need resumption, which is incompatible with the study intervention)
7. major neurological or medical illness that would interfere with study participation or require medications incompatible with the medications used in the study (inability to participate in the study intervention)
8. history of intolerance to MTA medications (dangerous if participants assigned to arm involving medications)
9. suicidal or homicidal (needs more intensive treatment than the study intervention provides)
10. ongoing or previously undisclosed child abuse (risk of removal from home precludes parent intervention and consistent parent data)
11. missed more than 25% of school days in previous two months (interference with teacher assessments and school intervention)
12. another child in household already participating in the study intervention (cross-arm contamination if two children in same household randomised to different arms)
13. same classroom as child already participating in the study intervention (cross-arm contamination if two pupils in same classroom are randomised to different arms)
14. parental stimulant/cocaine abuse in past two years (possible co-opting of child's medications)
15. inability of parent to speak English (inability to participate in parent training)
16. no telephone (inability to participate in telephone calls with therapists)

Baseline characteristics: no significant differences among study groups

Interventions	576 children allocated to one of four groups 1. **Group one (n = 144):** medication. In total, 14 months of medical intervention implemented as follows: one month of blind titration with methylphenidate for best dose, if unsatisfactory, then open titration

MTA 1999 *(Continued)*

with d-amphetamine, pemoline, imipramine, and others. Supplementary general advice and selected readings without systematic behavioural intervention. Monthly visits after the titration period, doses adjusted as indicated by monthly monitors

2. **Group two (n = 144):** psychosocial. Intensive behavioural treatment consisting of three major components: 1) 27 group and eight individual sessions of parent training; 2) school intervention comprising teacher consultations (six to 20 sessions) and 12 weeks with classroom behavioural specialist for half the time in the classroom; and 3) a child treatment component anchored in an intensive 8-week, full-time, summer treatment programme. No medication
3. **Group 3 (n = 145):** combined treatment. Integration of all treatment components in medication + psychosocial treatment groups and standard community care
4. **Group 4 (n =143):** standard community care. Treatment of own choosing in the community; no treatment provided by the study group

Attendance: in group two and three, the families attended an average of 77.8% of the parent training sessions and 36.2 of 40 possible summer treatment programme days. In the school component, there was an average of 10.7 teacher consultation visits and 47.6 out of 60 possible days of work with a classroom aid

Outcomes

Primary outcomes

1. Social skills: SSRS, parent-, child- and teacher-rated
2. General behaviour: CBCL, parent- and teacher-rated

Secondary outcomes

1. Core ADHD symptoms: Swanson, Nolan and Pelham Rating Scale, teacher- and parent-rated
2. Performances and grades in school: Wechsler Individual Achievement Test (WIAT)

Outcome assessment: post-intervention, end of treatment and follow-up data

Notes

Study ID: NCT00000388

Sponsorship source: The study was supported by grants from the National Institute of Mental Health (UO1 MH50461, U01 MH50447, U01 MH5044, Uo1 MH50453, U=1 MH 50454 and U01 MH50467).

Year conducted: not stated

Duration of the study: 38 months

Comments: The Multimodal Treatment Study (MTA study) is a cooperative study, performed by six independent research teams in collaboration with the National Institute of Mental Health, Rockville, MD, and the Office of Special Education Programs, US Department of Eduation, Washington, DC.

Lead author: MTA Cooperative Group. Corresponding author: Peter S Jensen

Institution: Department of Child Psychiatry, Unit 78, Center for the Advancement of Children's Mental Health, New York State Psychiatric Institute/Columbia University

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Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	**Comment:** adequate method used
Allocation concealment (selection bias)	Low risk	**Comment:** adequate method used

MTA 1999 *(Continued)*

Blinding of participants and personnel (performance bias) All outcomes	High risk	**Comment:** no blinding
Blinding of outcome assessment (detection bias) All outcomes	High risk	**Comment:** blinded and unblinded raters
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	**Comment:** used imputation
Selective reporting (reporting bias)	Unclear risk	**Comment:** where is the consumer satisfaction and the CBCL data reported? We requested clarification from one of the study investigators, but had received no response when this review was finished.
Vested interest bias	Low risk	**Comment:** no vested interest
Other sources of bias?	Low risk	**Comment:** no other apparent sources of bias

Tutty 2003

Methods	**Design:** RCT
Participants	**Country:** USA **Setting:** outpatient clinic in Washington **Sample size calculation:** not reported **Sample size:** 100 children **Sex:** 75 (75%) = boys, 25 (25%) = girls **Age:** range = five-12 years **Ethnicity:** (group one: white = 49 (83%), African-American = 4 (7%), Asian = 5 (8%), Hispanic = 1 (2%); group two: white = 38 (93%), African-American = 2 (5%), Asian = 1 (2%), Hispanic = 0 (0%)) **Socioeconomic status:** parent education (group one: grades nine-12 = nine (15%), grades 13-16 = 18 (64%), < grade 16 = 12 (20%); group two: grades nine-12 = 11 (27%), grades 13-16 = 25 (61%), < Grade 16 = five (12%)) **IQ:** not reported **ADHD diagnosis:** (group one: inattentive subtype = 25 (42%), combined subtype = 34 (58%); group two: inattentive subtype = 16 (39%), combined subtype = 25 (61%)) **ADHD medication:** a new prescription for stimulant medication had been filled in for all children **Comorbidity:** not reported, but range of comorbid difficulties (see below) were part of exclusion criteria **Medications for comorbid disorders:** allowed but not stated if it was balanced between groups **Inclusion criteria:** diagnosis of ADHD (DSM-IV), and filling in new prescription for stimulant medication (i.e. no stimulant medication use in past 120 days)

Tutty 2003 *(Continued)*

	Exclusion criteria: comorbid CD, ODD, Tourette syndrome, affective disorder, active alcohol or other substance abuse during previously 90 days or chronic mental illness, if children had been enrolled in a child social skills training at the involved centre in the past **Baseline characteristics:** mean baseline parented ADHD symptom scores were more symptomatic for the intervention group than for the control group, as well as the use of parent discipline practice. These between-groups differences were adjusted before follow-up analysis.
Interventions	100 participants allocated to one of two groups 1. **Group one (n = 59):** child social skills training and parent training plus medical treatment. Medication regimen was stabilised for the participants during the first three to four weeks before the social skills training commenced. The social skills training consisted of eight 50-minute group sessions that were delivered during 8 consecutive weeks. Each session was based on a structured session-by-session agenda and focused on the topics: listening, skills, expression of feelings, anger management, self control, conflict resolution, friendship skills, and self-esteem. During the sessions, the group was divided into child-only and parent-only groups. The children were further divided into child groups based on age to minimise age differences within the child group. Seven therapists participated in the study and each therapist had at least two years of direct experience treating this population in individual and group formats, possessed a master's degree in social work, counselling, or educational psychology, and had participated in three 2-hour preparation sessions with the study coordinator and a senior therapist to review session content, itinerary, and clinical/research protocols before facilitating the social skills training. 2. **Group two (n = 41) :** medical treatment alone **Attendance:** there was a 95% rate for completing all eight sessions in group one. Blinded follow-up measures completed by 97% and 98% of parent or guardian participants at three and six months after enrolment, respectively. Follow-up completion rates for teacher participants yielded 92% and 75% for three and six months after enrolment, respectively. Participants with missing data did not differ from participants with complete data sets across time or any clinical, functional, and demographic variables, according to the authors of the report. For the ADHD Rating Scale outcome, two children were lost to follow-up. For the Child Attention Profile outcome, 24 children in total were lost to follow-up (intervention = 16, control = eight).
Outcomes	**Secondary outcomes** 1. Core ADHD symptoms: ADHD Rating Scale, parent-rated (telephone interviews); Child Attention Profile, teacher-rated (telephone interviews) **Outcome assessment:** at three (post-intervention) and six months (follow-up) after enrolment
Notes	**Study ID:** not reported **Sponsorship source:** the study was supported by the Group Health Cooperative (GHC)/Kaiser Permanente Community Foundation through a grant to the GHC, Center for Attention Deficit Disorders, located in Redmond, Washington **Year conducted:** not stated **Duration of the study:** 12 months **Comments:** there was a third outcome used in this study, but it is not relevant for this review, because it measured the parents' discipline practice. **Lead author:** Steve Tutty **Institution:** Group Health Cooperative, Center for Health Studies **Email:** tutty.s@ghc.org **Address:** 1730 Minor Avenue, Suite 1600, Seattle, WA 98101

Tutty 2003 *(Continued)*

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	**Comment:** study used coin toss method performed by research assistant, which is an adequate method of randomly generating the sequence, according to the *Cochrane Handbook of Systematic Reviews of Interventions*
Allocation concealment (selection bias)	Unclear risk	**Comment:** no information reported. We requested clarification about the method of allocation concealment from the study investigators but received no information on this topic at the time of the original review.
Blinding of participants and personnel (performance bias) All outcomes	High risk	**Comment:** no blinding
Blinding of outcome assessment (detection bias) All outcomes	High risk	**Comment:** outcome assessment by telephone interviews of parents and teacher, which were performed by a blinded research assistant. The parents, however, were not blinded, which is not an adequate method.
Incomplete outcome data (attrition bias) All outcomes	Low risk	**Comment:** ITT method used
Selective reporting (reporting bias)	Low risk	**Comment:** all measures of interest reported. No protocol identified. Of the measures mentioned in the paper, all measures of interest for the review were reported.
Vested interest bias	Low risk	**Comment:** no apparent source of bias
Other sources of bias?	Unclear risk	**Comment:** co-medication not specified

Antshel 2003

Methods	**Design:** RCT
Participants	**Country:** USA **Setting:** outpatient clinic in Kentucky. Participants were recruited from newspaper advertisements and from consecutive referrals to a university-based behavioural paediatric clinic specialised in ADHD and related disorders. **Sample size calculation:** not reported **Sample size:** 120 children **Sex:** 90 (75%) = boys, 30 (25%) = girls **Age:** range = 8-12 years **Ethnicity:** Caucasian = 112, African-American = six, Asian-American = two **Socioeconomic status:** not reported **IQ:** IQ > 70 **ADHD diagnosis:** DSM-IV (DICA-R-P); (inattentive type = 59, combined type = 61)

Antshel 2003 *(Continued)*

ADHD medication: stimulant medication = 110, SSRIs = 10

Comorbidity: ODD = 53, mood disorders = 29, anxiety disorders = 11, tic disorders = five

Medication for comorbid disorders: SSRI balanced between groups

Inclusion criteria: children scoring > 1 SD above the mean on the CBCL Attention subscale

Exclusion criteria:

1. not having an ADHD diagnosis
2. 8-12 years of age
3. children with significant cognitive delays (IQ < 70)
4. Children with English as a second language (information received in an email from Kevin Antshel, 16 December 2010 Antshel 2010 [pers comm])

Baseline characteristics: no statistically significant between-group differences in age, sex, or classroom placement, duration and severity of ADHD symptoms, or comorbid conditions. No statistically significant between-group differences on medication type and dosage

Interventions	120 participants allocated to one of two groups 1. **Group one (n = 80):** eight weeks of intervention with sessions for the child group and the parent group. All sessions were conducted by the same two therapists, a male doctoral student in psychology and a female master's student in social work, both of whom followed a manual. Sessions were videotaped to ensure treatment consistency. a. **Child group:** there were 90-minute group sessions for the children during eight consecutive weeks. Sessions consisted of different methods to promote generalisation of social skills. There were six themes: 1) cooperation with peers; 2) learning how to take others' perspective; 3) problem-solving; 4) recognising and controlling anger; 5) assertiveness; and 6) conversations (giving and receiving compliments) b. **Parent group:** parents attended three parent sessions in weeks one, four, and eight. The sessions consisted of information about the themes and content in the children's group and discussion of how to assess and monitor homework completion. 2. **Group two (n = 40):** waiting list **Attendance:** mean attendance at the eight sessions was 94% for the diagnostically homogeneous and 92% for the diagnostically heterogenous treatment groups.
Outcomes	**Primary outcomes** 1. Social skills: SSRS, parent- and child-rated **Outcome assessment:** post-treatment assessment eight weeks after pre-test and follow-up assessment three months after the post-test
Notes	**Study ID:** not reported **Sponsorship source:** not reported **Year conducted:** not stated **Duration of the study:** 22 weeks **Comments:** none **Lead author's name:** Kevin M Antshel **Institution:** Children's Hospital, Boston University of Kentucky **Email:** Antshelk@upstate.edu

Antshel 2003 *(Continued)*

Address: SUNY Upstate Medical University, Department of Psychiatry, 750 East Adams Street, Syracuse, NY 13210

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	**Comment:** used a computer-generated randomisation process. Information received from Kevin Antshel in an email 13 July 2011 (Antshel 2011 [pers comm])
Allocation concealment (selection bias)	Low risk	**Comment:** Allocation was concealed. Information received from Kevin Antshel in an email 13 July 2011 (Antshel 2011 [pers comm])
Blinding of participants and personnel (performance bias) All outcomes	High risk	**Comment:** no blinding
Blinding of outcome assessment (detection bias) All outcomes	High risk	**Comment:** no blinded outcome assessors
Incomplete outcome data (attrition bias) All outcomes	Low risk	**Comment:** stated that there was 100% completion rate
Selective reporting (reporting bias)	Low risk	**Comment:** all measures of interest reported
Vested interest bias	Unclear risk	**Comment:** no funding source reported
Other sources of bias?	Unclear risk	**Comment:** Referral of patients. The selection of ADHD-I skewed the data.

Yuk-chi 2005

Methods	**Design:** RCT
Participants	**Country:** China **Setting:** community mental health centre: outpatient clinic in Hong Kong **Sample size calculation:** based on prior research, the assumption was made that effect sizes would be small to moderate, calculations showed that approximately 45 participants were required in each group. **Sample size:** 90 children **Sex:** 77 (90%) = boys, nine (10%) = girls (group one: 39 (87%) = boys, six (13%) = girls; group two: 38 (93%) = boys, three (7%) = girls) **Age:** range = seven to 9.9 years, mean = eight years (SD = 0.95) (group one; mean = 7.87 years (SD = 0.77); group two: mean = 8.15 years (SD = 1.11)) **Ethnicity:** Chinese children **Socioeconomic status:** mothers education: elementary or less = 17 (20%), junior high = 20 (23%), high school = 45 (50%), college = four (5%) (group one: elementary or less = six (13%), junior high = 10 (22%),

Yuk-chi 2005 *(Continued)*

high school = 28 (62%), college = one (2%), group two: elementary or less = 11 (27%), junior high = 10 (24%), high school = 15 (37%), college = three (7%))

IQ: Hong Kong WISC, short form, mean = 111.69 (SD = 13.5) (group one: mean = 111.2 (SD = 13.7); group two: mean = 112.25 (SD = 13.4))

ADHD diagnosis: ADHD combined type required for inclusion

ADHD medication: all participants received methylphenidate treatment

Comorbidity: anxiety = 29%, depression = 6%, ODD = 50%, CD = 6% (group one: anxiety = 27%, depression = 7%, ODD = 60%, CD = 9%, group two: anxiety = 32%, depression = 5%, ODD = 39%, CD = 2%)

Medications for comorbid disorders: not reported

Inclusion criteria:

1. ADHD-combined type based on DSM-IV criteria
2. seven to 9.9 years of age
3. studying first to fourth grade
4. living with a parent, who is the major caretaker
5. IQ > 80
6. no significant physical disability
7. no stimulant medication (methylphenidate) use for more than two weeks previously
8. parents willingness to accept stimulant medication and psychosocial intervention of this study
9. parents willingness to accept random allocation
10. no parent suffering from intellectual impairment or current psychosis

Exclusion criteria: refusal of group one intervention due to parental difficulties to apply leave from work

Baseline characteristics: no significant differences between the two treatment groups in demographic and socioeconomic status, comorbid conditions, and additional intervention received in the first six months of the treatment. No information about between group differences in the medical treatment

Interventions	90 children with ADHD allocated to one of two groups 1. **Group one (n = 45):** methylphenidate + psychosocial treatment consisting of three components a. **Child training*:** which provided a rich direct contingency management environment, in which the training of problem-solving's skills and anger control management was provided. All sessions were videotaped to check treatment integrity. Themes were, for example, feelings, games, problem-solving, stop & think, role play school and home. 24 weekly sessions each lasting from one hour and 30 minutes to two hours b. **Cognitive-behavioural parent training*:** themes were, for example, know yourself, attention rules, stress management, child mood management, and homework coaching. 18 weekly sessions in total, each lasting from one hour and 30 minutes to two hours c. **School consultations:** consisted of two telephone consultations in which the therapist in the child groups talked to the teachers about implementing classroom management strategies and reviewing the child's progress in school 2. **Group two (n = 41):** methylphenidate treatment alone based on the standard management practice at the outpatient clinic where the study took place. This practice was not described in further detail. **Attendance:** adherence in group two was defined as taking 80% of prescription without more than one month of discontinuation during school days. In group one, treatment adherence was defined as above in combination with at least 80% attendance in child and parent sessions. *The child training and the parent training were developed to be implemented concomitantly. No protocol violations to the programme were detected in either the child or the parent intervention.
Outcomes	**Secondary outcomes**

Yuk-chi 2005 *(Continued)*

	1. Core ADHD: SWAN (the Strengths and Weaknesses of ADHD symptoms and Normal behaviour rating scale), parent- and teacher-rated; Matching Familiar Figures Test (MFFT), clinician-rated 2. Satisfaction with treatment: single item rating of experience with the intervention, parent-rated **Outcome assessment:** post-intervention, six and 12-month follow-up
Notes	**Study ID:** not reported **Sponsorship source:** not reported **Year conducted:** "this study was planned in 1999" (quote) **Duration of the study:** 17.5 months **Comments:** none **Lead author:** Yuk-chi So **Institution:** Chinese University of Hong Kong **Email:** not reported **Address:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	**Comment:** table of random numbers, with block size of two
Allocation concealment (selection bias)	Unclear risk	**Comment:** unclear
Blinding of participants and personnel (performance bias) All outcomes	High risk	**Comment:** no blinding
Blinding of outcome assessment (detection bias) All outcomes	High risk	**Comment:** no blinding on this review's primary outcome
Incomplete outcome data (attrition bias) All outcomes	High risk	**Comment:** type of imputation method used was unclear
Selective reporting (reporting bias)	Low risk	**Comment:** low risk
Vested interest bias	Unclear risk	**Comment:** no information on funding
Other sources of bias?	Low risk	**Comment:** no other sources of bias identified

Van der Oord 2007

Methods	**Design:** RCT

Van der Oord 2007 *(Continued)*

Participants	**Country:** The Netherlands **Setting:** five different outpatient clinics **Sample size:** 50 children* **Sample size calculation:** not reported **Sex:** group one =1 (4.2%), group two = 4 (19.4%), in the paper it was not specified which sex these numbers referred to, but it was assumed to be female sex **Age:** range = eight to 12 years (group one: mean = 9.76 years (SD = 1.13), group two: mean = 9.96 years (SD = 1.31)) **Ethnicity:** Caucasian = 40 (89%), Caribbean = one (2%), mixed origin = four (9%) **Socioeconomic status:** Educational level mother (%): low:20%, medium:40%, high:36%. Educational level father (%): low:24%, medium:42%, high:24% **IQ:** total IQ of 75 or above required for inclusion **ADHD diagnosis:** subtype not reported **ADHD medication:** children with a history of methylphenidate treatment were excluded. All children received methylphenidate treatment as part of the study protocol. **Comorbidity:** (group one: ODD/CD = 10 (41.7%), group two: ODD/CD = 13 (61.9%)) **Medications for comorbid disorders:** not reported **Inclusion criteria:** 1. ADHD diagnosis based on DSM-IV established with the parent version of DISC-IV 2. total IQ of 75 or above based on the short version of WISC-R 3. parents had to give informed consent for their child to participate in the study **Exclusion criteria:** 1. inadequate mastering of the Dutch language by the child or both parents 2. a history of methylphenidate use **Baseline characteristic:** one-way ANOVAs and Chi^2 analyses showed no significant differences between the two conditions in terms of baseline demographic characteristics. Furthermore, one-way ANOVAs showed no significant group differences. The treatment groups did not differ on dose of methylphenidate either at baseline or post-treatment. *baseline characteristics were reported and analysed for children participating in the pre-intervention assessment, in total = 45, group one = 24, group two = 21.
Interventions	50 children allocated to one of two groups 1. **Group one (n = 27):** methylphenidate (as described in group two) + multimodal behaviour therapy consisting of child cognitive-behaviour therapy, parent behaviour therapy and teacher behavioural training, with manuals in all groups. To ensure treatment compliance, all therapists completed a treatment integrity checklist. a. **Child cognitive-behaviour therapy:** used cognitive-behaviour techniques and the programme for this group was adapted from Kendall and Braswell (Kendal 1982). Components included problem-solving techniques, relaxation techniques, contingency management techniques, role playing, and guided practice. It consisted of 10 weekly, 75-minute group sessions, provided by two therapists. b. **Parent behaviour therapy:** based on Barkley's training's manual "Defiant children: A clinicians manual for parent training (Barkley 1987). Components included, for example, psychoeducation on ADHD, structuring the environments, practicing positive attending skills, and contingency man-

Van der Oord 2007 *(Continued)*

agement skills. It consisted of 10 weekly sessions of 90 minutes of group therapy, provided by two therapists.

c. **Teacher behavioural training:** based on the teacher training manual by Pelham (Pelham 1992) and consisted of a two-hour workshop, which consisted of, for example, psychoeducation on ADHD, structuring the classroom environment, and a daily report card.

2. **Group two (n = 23):** methylphenidate was administered following the procedures described in the MTA study MTA 1999. In this titration trial, 5, 10, and 20 mg of methylphenidate and placebo were administered in a pseudo random order twice daily at breakfast (around 7.30 a.m.) and at lunch (around 12.30 p.m.). All children weighed above 22 kg, thus the highest dose never exceeded 0.9 mg per kg of the body weight. Coding of doses was kept at a hospital pharmacy and in case of immediate side effects the pharmacy could be reached to unblind the coding.

Attendance: attendance at 75% was set as a criterion for intervention attendance in group one. Mean attendance in the combined condition was 88.6%. Of the 50 randomised children, one declined participation in group two (the methylphenidate-only group) and two of the children in group one (combined intervention) discontinued the intervention. Furthermore, one child was lost to post-test and follow-up in the methylphenidate-only intervention, and one was omitted from analysis in the combined intervention group as the criteria of 75% attendance was not met.

Outcomes

Primary outcomes

1. Social skills: SSRS, parent- and teacher-rated

Secondary outcomes

1. Core ADHD symptoms: DBDRS, parent- and teacher-rated

Outcome assessment: post-intervention

Notes

Study ID: not reported

Sponsorship source: not reported

Year conducted: not stated

Duration of the study: 10 weeks

Comments: none

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Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	**Comment:** no information reported. We requested clarification about method of allocation concealment from the study investigators but received no information on this topic at the time of preparing the original review.
Allocation concealment (selection bias)	Unclear risk	**Comment:** no information reported. We requested clarification about the method of allocation concealment form the study investigators but received no information on this topic at the time of preparing the original review.
Blinding of participants and personnel (performance bias)	High risk	**Comment:** no blinding

Van der Oord 2007 *(Continued)*

All outcomes		
Blinding of outcome assessment (detection bias) All outcomes	High risk	**Comment:** no blinding
Incomplete outcome data (attrition bias) All outcomes	Low risk	**Comment:** stated numbers of all participants lost to follow-up. Lost to follow-up not believed to influence results
Selective reporting (reporting bias)	Low risk	**Comment:** no
Vested interest bias	Unclear risk	**Comment:** funding source not reported
Other sources of bias?	Unclear risk	**Comment:** co-medication not specified

Pfiffner 2007

Methods	**Design:** RCT
Participants	**Country:** USA **Setting:** outpatient clinic **Sample size calculation:** not reported **Sample size:** 69 children **Sex:** 46 (67%) = boys, 23 (33%) = girls **Age:** range = seven to 11 years **Ethnicity:** white = 51%, Asian = 16%, Hispanic = 10%, Afro-American = 6%, mixed = 17% **Socioeconomic status:** income range: $21,000-$150,000. Education level measured on scale from 1 (9th grade or less) to 6 (advanced graduate or professional degree), mothers = 5.0, fathers = 4.8 **IQ:** IQ > 80 on WASI **ADHD diagnosis:** ADHD-I required for inclusion **ADHD medication:** not reported **Comorbidity:** ODD = 23%, depression = 1%, anxiety = 12% **Medications for comorbid disorders:** not reported **Inclusion criteria:** 1. DSM-IV diagnosis of ADHD-I 2. IQ > 80 (based on WASI) 3. living with at least one parent for the past year 4. attending school full time 5. the school consenting to participate in school-based treatment **Exclusion criteria:** 1. families expecting to change medication status for their child during the study 2. children with visual or hearing impairment

Pfiffner 2007 *(Continued)*

3. severe language delay
4. major neurological illness
5. psychosis or pervasive development disorder
6. a child being in the same classroom as another participant or having a sibling who was already enrolled

Baseline characteristics: no significant differences between groups regarding child age, sex, race, symptoms of hyperactivity/impulsivity, comorbid oppositional defiant disorder, anxiety or depression, IQ, or academic achievement.

Interventions	69 participants allocated to one of two groups 1. **Group one: (n = 36)** Child Life and Attention Skills (CLAS) program. The treatment included three components, administrated concurrently over 12 weeks: child skills training; parent training; and teacher consultation (see below). All treatments were manual-based, and some changes were made to the manuals to refine the interventions based on feedback from clinicians, participants, teachers, and parents. a. **Child skills training:** divided into modules focused on skills for independence and skills for social competence, and involved behavioural interventions (for example, a reward-based contingency management programme) and cognitive-behavioural interventions (for example, problem-solving, the use of cues/verbal mediation strategies to stay on task and focused). Eight to 10 × 1½ hours a week groups with child skills training in the 12-week period b. **Parent training:** modules in the child group were reviewed each week and parents were taught methods to promote and reinforce the child's use of skills at home. The parents were also taught methods for managing ADHD. Parents completed eight to 10 × 1½-hour group sessions and four to five family sessions. c. **Teacher consultations:** a school-home daily report card was designed and used (Classroom Challenge (CC)), and a special notebook was created for each child containing copies of CC. The consultations involved a ½ hour overview of behavioural interventions and classroom-based accommodations for ADHD, followed by four to five × ½ hour meetings of teacher, child, and therapist over the 12-week period. 2. **Group two (n = 33):** no intervention **Attendance:** 1. Parents participated in more than 95% of the group meetings. 2. Children lost to follow-up: intervention = seven, control = eight
Outcomes	**Primary outcomes** 1. Social skills: SSRS, parent- and teacher-rated 2. General behaviour: CGI, parent- and teacher-rated **Secondary outcomes** 1. Core ADHD symptoms: CSI, parent- and teacher-rated 2. Satisfaction with treatment: Consumer Satisfaction Questionnaire, child-, parent- and teacher-rated **Outcome assessment:** post-intervention and follow-up assessment. Time of follow-up depended on what time of the school year the intervention ended.
Notes	**Study ID:** not reported **Sponsorship source:** supported by NIMH grant R21MH065927 **Year conducted:** not stated **Duration of the study:** 33 weeks **Comments:** none

Pfiffner 2007 *(Continued)*

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Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	**Comment:** random table. Information received from Pfiffner in an email 25 May 2011 (Pfiffner 2011b [pers comm])
Allocation concealment (selection bias)	Low risk	**Comment:** sealed envelopes
Blinding of participants and personnel (performance bias) All outcomes	High risk	**Comment:** no blinding
Blinding of outcome assessment (detection bias) All outcomes	High risk	**Comment:** no blinding
Incomplete outcome data (attrition bias) All outcomes	Low risk	**Comment:** used imputation
Selective reporting (reporting bias)	Low risk	**Comment:** all apparent assessments made
Vested interest bias	High risk	**Comment:** had done previous studies
Other sources of bias?	High risk	**Comment:** changes in treatment protocol. Timing for follow-up differed; same school year versus next school year (both approximately three months after treatment but summer break in between). Families and teachers were paid for each of the assessments (teachers = US$50, parents group one = US$30, group two = US$200) and teachers were paid for participating in meetings (US $50-100).

Waxmonsky 2010

Methods	**Design:** RCT
Participants	**Country:** USA **Setting:** outpatient **Sample size calculation:** not reported **Sample size:** 56 children **Age:** range = six to 12 years (group one: mean = 8.3 years (SD = 1.6), group two: mean = 8.9 years (SD = 1.5))

Waxmonsky 2010 *(Continued)*

Sex: 45 (80%) = boys, 11 (20%) = girls (group one: 24 (82.8%) = boys, 5 (17.2%) = girls; group two: 21 (77.8%) = boys, 6 (22.2%) = girls)

Ethnicity: white = 80.4%, African-American = 10.7%, mixed = 8.9%

Socioeconomic status: Nakao and Treas Socioeconomic Index (Nakao 1994): group one: mean = 61 (SD = 17), group two: mean = 53 (SD = 13)

IQ: WISC-III IQ score > 75**(**group one: mean = 101 (SD = 16), group two: mean = 97 (SD = 13))

ADHD diagnosis: DSM-IV-TR; combined type = 48 (85.7%), inattentive type = seven (12.5%), hyperactive/impulsive type = one (1.8%) (group one: combined type = 24 (82.8%), inattentive type = four (13.8%), hyperactive/impulsive type = one (3.4%), group two: combined type = 24 (88.9%), inattentive type = three (11.1%), hyperactive/impulsive type = zero (0%))

ADHD medication: stimulant naive at baseline (group one = 13 (44.8%), group two = eight (29.6%)), all patients received psychostimulant medications as part of the study

Comorbidity: CD = 22 (39.3%), ODD = 24 (42.9%), no comorbidity = 10 (17.9%) (group one: CD = 11 (37.9%), ODD = 15 (51.7%), no comorbidity = three (10.3%), group two: CD = 11 (40.7%), ODD = nine (33.3%), no comorbidity = seven (25.9%))

Medications for comorbid disorders: not reported

Inclusion criteria: ADHD based on DSM-IV

Exclusion criteria:

1. current or past history of seizures (not including benign febrile seizures)
2. other physical conditions that precluded administration of atomoxetine (for example, marked cardiac conduction delay)
3. documented failed study of atomoxetine, defined as three weeks or more on treatment with at least 0.8 mg/kg/d, or a documented inability to tolerate this dose
4. serious forms of psychopathology other than ADHD such as autism, bipolar disorder, schizophrenia, or any other psychopathology requiring urgent treatment with psychotropic medication
5. any history of major depression requiring treatment, or any past history of self-harm or serious suicidal ideation
6. an IQ of less than 75 (based on WISC-III)
7. no evidence of ADHD-related impairment at school

Baseline characteristics: no significant between group differences in mean doses of atomoxetine

Interventions	56 participants allocated to one of two groups 1. **Group one (n = 29):** medication (as described in group two) + behaviour therapy in eight-week intervention with three components: a. **Parent group:** received two-hour sessions once a week for eight weeks, following the manual of Community Oriented Parent Education Program (COPE). COPE uses the principles of social learning theory to help parents develop skills to target their children's behaviour and lack of impulse control. Group leaders were advanced graduate students or doctoral level clinicians. b. **Child group:** participated in a social skills training (SST) programme consisting of a two-hour session once a week for eight weeks. Group leaders were graduate students in clinical psychology. It was unclear if the child group intervention also was based on a manual. c. **Teacher group:** completed a daily report card which was sent to the parent daily. Parents were taught to monitor the report cards and provide appropriate consequences for their child based on the report cards (i.e. reward for positive performance and loss of privileges for negative performance). 2. **Group two (n = 27):** medication; all medication was dosed openly using atomoxetine. A weight-based protocol similar to previous studies using atomoxetine was used.

Waxmonsky 2010 *(Continued)*

	Attendance: 62% of parents attended eight sessions, 62% attended six or more sessions. The children's attendance in the SST group was not reported; seven children (12.5%) discontinued the study (five from group one (medication + behaviour therapy) and two from group two (medication alone)).
Outcomes	**Primary outcomes** 1. Social skills: SSRS, parent- and teacher-rated 2. General behaviour: CGI, observer-rated **Secondary outcomes** 1. Core ADHD symptoms: DBDRS, parent- and teacher-rated 2. Academic performance: Academic Performance Rating Scale, teacher-rated 3. Satisfaction with treatment: treatment satisfaction, parent-rated **Outcome assessment:** post-treatment
Notes	**Study ID:** NCT00918567 **Sponsorship source:** investigator-initiated trial funded entirely by Eli Lilly and Company **Year conducted:** conducted between 2008 and 2013 **Duration of the study:** 11 weeks **Comments:** none **Author name:** James G Waxmonsky, MD **Institution:** Center for Children and Families **Email:** jgw@buffalo.edu **Address:** 106 Diefendorf Hall, 3435 Main St., Bldg 20, Buffalo, NY 14214

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	**Comment:** clarification requested from one of the study investigators and Dan Waschbusch informed us in an email on 22 June 2011 that they had used a computer-generated randomisation process (Waschbusch 2011 [pers comm]).
Allocation concealment (selection bias)	Low risk	**Comment:** clarification requested from one of the study investigators and Dan Waschbusch informed us in an email on 22 June 2011 that the clinicians did not know the treatment assignment before it was assigned (Waschbusch 2011 [pers comm]).
Blinding of participants and personnel (performance bias) All outcomes	High risk	**Comment:** no blinding
Blinding of outcome assessment (detection bias) All outcomes	High risk	**Comment:** no blinding
Incomplete outcome data (attrition bias) All outcomes	High risk	**Comment:** We requested clarification from one of the study investigators and Dan Wascbusch informed us in an email that participants were dropped if there was not sufficient information. Scores in indexes were computed if at least 50% of the items in the index were answered; if not, they were counted as missing. Dan Wascbusch also informed us that they had essentially complete

Waxmonsky 2010 *(Continued)*

		data at pre-treatment and nearly complete data at post-treatment. They had a lower response rate for teachers. They included whatever they had in the analyses and dropped participants when there was insufficient information, repeating this for each analysis (Waschbusch 2011 [pers comm]
Selective reporting (reporting bias)	High risk	**Comment:** protocol published in Clinicaltrials.gov after study had been conducted. Publication was not consistent with the report in Clinicaltrials.gov
Vested interest bias	High risk	**Comment:** funding from, and collaboration with, Eli-Lilly
Other sources of bias?	Unclear risk	**Comment:** co-medication not specified

Tabaeian 2010

Methods	**Design:** RCT, parallel group
Participants	**Country:** Iran **Setting:** outpatient clinics **Sample size calculation:** not reported **Sample size:** 45 **Sex:** 100% = boys **Age:** not reported (based on the educational system in Iran, it should be eight to 10 years old) **Ethnicity:** reported as Iranian without other information **Socioeconomic status:** not reported **IQ:** not reported **ADHD diagnosis:** not reported **ADHD medication:** all participants (100%) were taking methylphenidate during the study. **Comorbidity:** children with comorbidity were excluded. **Medication of comorbid disorders:** not relevant **Inclusion criteria:** 1. males 2. school grade 3th-4th 3. problem with social skills 4. normal or higher than normal intelligence level 5. child had ADHD **Exclusion criteria:** comorbidity **Baseline assessment:** not reported
Interventions	45 participants allocated to one of three groups*. Number of participants in each group not reported 1. **Group one (n = 15*):** social skills training, which involved directly training students in the following: eye contact skill, verbal communication, emotions, causes of expressing emotions, setting the emotions, problem-solving. Consisted of 10 sessions, each lasting 90 minutes with 15 minutes rest and refreshments 40 minutes from start

Tabaeian 2010 *(Continued)*

	2. **Group two (n = 15*):** social skills training + parent training. Focus on understanding ADHD, listening to the child, eye contact, interaction, supporting expression of emotion, parent interaction and family interactions. Consisted of 10 sessions, each lasting 90 minutes and with a 15-minute break 3. **Group three (n = 15*):** no training **Attendance:** not reported *the number of participants in each group was not described explicitly but it is assumed that the participants were distributed equally
Outcomes	**Primary outcomes** 1. Social skills*: Peer relationship subscale, child-rated 2. General behaviour*: "Accepted social behaviour" subscale, child-rated **Secondary outcomes** 1. Core ADHD symptoms*: Impulsivity subscale, child-rated *****the specific assessment instrument was not possible to confirm based on the description and references in the paper and extracted **Outcome assessment:** post-intervention
Notes	**Study ID:** no information **Sponsorship source:** no funding reported **Year conducted:** 2010 **Duration of the study:** 10 weeks **Comments:** this extraction was based on extraction made by Ghasaleh Aali based on the Persian paper. **Lead author's name:** SR Tabaeian **Institution:** University of Isfahan **Email:** r.tabaeian@yahoo.com **Address:**

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	**Comment:** 2 centres randomly selected and participants randomly assigned to groups. How this randomisation was done, however, was not stated.
Allocation concealment (selection bias)	Unclear risk	**Comment:** not described. We contacted the corresponding author for more information but did not receive a reply.
Blinding of participants and personnel (performance bias) All outcomes	High risk	**Comment:** not described but, based on the intervention, we judged that blinding was not possible
Blinding of outcome assessment (detection bias) All outcomes	High risk	**Comment:** it was not clear what measure was used and if it was possible to blind the assessors. It seemed likely that it was a questionnaire, either for the child or the parents, and that it was not blinded.

Tabaeian 2010 *(Continued)*

Incomplete outcome data (attrition bias) All outcomes	Low risk	**Comment:** none reported. There were no dropouts.
Selective reporting (reporting bias)	Unclear risk	**Comment:** no protocol available. Based on the translation, it was difficult to identify the measure used and judge the appropriateness of the reported outcomes.
Vested interest bias	Unclear risk	**Comment:** funding source not reported
Other sources of bias?	Low risk	**Comment:** none reported

Storebø 2012

Methods	**Design:** RCT, parallel group
Participants	**Country:** Denmark **Setting:** clinical **Sample size calculation:** a sample size of 26 children in each group was needed based on a sample size calculation of 80% power in detecting a clinical relevant change of four points on the primary outcome measure of hyperactivity and impulsivity. **Sample size:** 56 children* **Sex:** 39 (71%) = boys, 16 (29%) = girls (group one: 19 (67.8%) = boys, nine (32.2%) = girls; group two: 20 (74%) = boys, seven (26%) = girls) **Age:** (group one: mean = 10.6 years (SD = 1.29); group two: mean = 10.2 years (SD = 1.34)) **Ethnicity:** Danish 100% **Socioeconomic status:** not reported **IQ:** both verbal and nonverbal IQ > 80 (group one: WISC verbal mean = 93.9 (SD = 15.7), group two: WISC non-verbal mean = 94.8 (SD = 19.0). **ADHD diagnosis:** group one: inattentive = 10 (35.7%), hyperactive-impulsive = 0 (0%), combined = 16 (57.2%), not otherwise specified = 2 (7.1%); group two: inattentive = 6 (22.2%), hyperactive-impulsive = 2 (7.4%), combined = 16 (59.2%), not otherwise specified = 3 (11.1%) **ADHD medication:** after assessment and confirmation, the family was offered medical treatment for the child following a medication protocol. The children had never previously received medical treatment for ADHD. **Comorbidity:** (group one: ODD = four (33.3%), anxiety disorder = four (33.3%), depressive disorder = one (8.3%), tics and OCD = zero (0%), enuresis = two (20%), stuttering = one (5%); group two: ODD = four (40%), anxiety disorder = two (20%), depressive disorder = one (10%), tics and OCD = 1 (10%), enuresis = two (20%), stuttering = zero (0%)) **Medication of comorbid disorders:** not reported **Inclusion criteria:** 1. ADHD diagnosis according to the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV, 1994) 2. eight to 12 years of age at the time of the start of assessment 3. parents willing to take part in study and give consent for medical treatment of child and for child's participation in study

Storebø 2012 *(Continued)*

	Exclusion criteria: 1. schizophrenia or all the autism diagnoses according to DSM-IV 2. violent and criminal children 3. both verbal and nonverbal (IQ) below 80 4. previously medicated for ADHD 5. resistance against participating *baseline characteristics were reported for 55 children as data from the child that withdrew from group two was not allowed to be analysed. **Baseline characteristics:** no significant difference in baseline demographics between the 2 groups
Interventions	56 participants were allocated to one of two groups 1. **Group one (28 participants):** SOSTRA which consisted of social skills training plus parental training combined with standard treatment (medication). The children were offered 90-minute, weekly social skills training sessions for a total of eight weeks, during which, the parents attended parental training. Social skills training aimed to improve and maintain the individual's social skills. The children were taught how to adjust their verbal and nonverbal behaviour in their social interactions. The training also included efforts to change the child's cognitive assessment of the 'social world' and generally focused on teaching the children to 'read' the subtle cues in social interaction such as learning to wait for their turn. The standard treatment offered encompassed the normal practice regarding ADHD patients at the Child Psychiatric Clinic in Holbaek: after assessment and confirmation of the ADHD diagnosis, the family was offered medical treatment for the child following a medication protocol; the children had never previously received medical treatment for ADHD. 2. **Group two (28 participants):** normal practice, as reported above for the intervention group **Attendance:** one participant in each group did not receive the allocated intervention and one participant in group two was lost to follow-up.
Outcomes	**Primary outcomes** 1. Social skills: CBRS, social problems subscale, teacher-rated 2. Emotional competencies: CBRS, emotional subscale, teacher-rated 3. General behaviour: CBRS, aggressiveness subscale, teacher-rated **Secondary outcomes** 1. Core ADHD symptoms: Conners 3, hyperactivity-impulsivity subscale, teacher-rated 2. Performance and grades in school: CBRS, academic score subscale, teacher-rated **Outcome assessment:** post-intervention and follow-up at three and six months after end of intervention
Notes	**Study ID:** NCT00937469 **Sponsorship source:** the SOSTRA study was financially supported by Region's Zealand University Hospital (RESUS), Region Zealand Research Foundation, and Psychiatric Research Unit, Region Zealand. Funding was also received from the Fru C. Hermansens Foundation, Slagtermester Max Wørzner and Inger Wøzners Foundation, and TrygFonden. **Year conducted:** 2012 **Duration of the study:** 8 weeks **Comments:** the study obtained approval from the Regional Ethics Committee of Zealand (SJ-85), was registered at the Danish Data Protection Agency DO50892, and registered at clinicaltrials.gov/NCT00937469. **Lead author's name:** Ole Jakob Storebø

Storebø 2012 *(Continued)*

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Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	**Comment:** adequate method was used. Randomisation was conducted using computer-generated, permuted randomisation sequences in blocks of four with an allocation ratio of 1:1 stratified for sex and comorbidity.
Allocation concealment (selection bias)	Low risk	**Comment:** adequate method was used. All data that could be used to identify the allocation before data entry was hidden and block size was unknown to the investigators.
Blinding of participants and personnel (performance bias) All outcomes	High risk	**Comment:** it was not possible to 'blind' participants, parents, treating physicians, or personnel in the Child Psychiatric Clinic in Holbaek.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	**Comment:** the involved parties were instructed not to inform the teachers, who rated the primary and secondary outcome measures, of the intervention allocated. The outcome assessors were thus kept unaware of group allocation.
Incomplete outcome data (attrition bias) All outcomes	Low risk	**Comment:** one child from each group dropped out after the randomisation. Outcome assessment was still obtained from the child allocated to group two. Another child from group two was lost to follow-up.
Selective reporting (reporting bias)	Low risk	**Comment:** matched study protocol. All outcome measures outlined in protocol were reported.
Vested interest bias	Low risk	**Comment:** no apparent source of bias. The funders of the study did not have a role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.
Other sources of bias?	Unclear risk	**Comment:** no other apparent sources of bias

Pfiffner 2014

Methods	**Design:** RCT, parallel group
Participants	**Country:** USA **Setting:** outpatient **Sample size calculation:** not reported **Sample size:** 125 children in the groups included in the analysis (199 children in the full study) **Sex:** 58% = boys (group one: 51.4% = boys; group two: 58.8% = boys) **Age:** mean = 8.6 years (range = seven to 11) (group one: mean = 8.8 years (SD = 1.15); group two: mean = 8.7 group two: mean = 8.4 years (SD = 1.13))

Pfiffner 2014 *(Continued)*

Ethnicity: Caucasian = 54%, Latino = 17%, Asian-American = 8%, African-American = 5%, self-identified as mixed race = 17% (group one: 55.4% Caucasian, 12.2% Latino, 9.5% Asian-American, 5.4% African-American, 17.6% self-identified as mixed race; group two: Caucasian (43.1%), Latino (25.5%), Asian-American (3.9%), African-American (3.9%), self-identified as mixed race (23.5%))

Socioeconomic status: total household income: below US $50,000 = 14.1%, $50,000-100,000 = 28.3%, $100,000-150,000 = 28.8%, and more than $150,000 = 28.8% of families. 81.2% of the primary parents reported having graduated from college, 13% of participants were living in single-parent families (group one: parent education = 83.6% college graduates, single-parent household = 9.5%; group two: parent education = 78.4% college grads, single-parent household = 11.8%)

IQ: group one: mean = 103.6 (SD = 11.0) on WISC FSIQ; group two: mean = 105.6 (SD = 11.6) on WISC FSIQ

ADHD diagnosis: only inattentive subtype

ADHD medication: stimulant medication = 4.5% (group one = 9.5%, group two = 2.0%). The small number of children taking stimulant medication (not otherwise specified) completed a one-week wash-out to assess behaviour and obtain ratings off-medication.

Comorbidity: group one: anxiety = 6.8%, depression = 1.7%, ODD = 5.1%; group two: anxiety = 5.3%, depression = 2.6%, ODD = 5.3%

Medications for comorbid disorders: not reported

Inclusion criteria:

1. primary DSM-IV diagnosis of ADHD-I (confirmed by the KSADS-PL)
2. IQ > 80 (confirmed with WISC-IV, (Wechsler 2003)
3. living with at least one parent for the past year
4. child age between seven to 11 years (grades 2th-5th)
5. attending school full time in a regular classroom
6. ability to participate in groups on the days scheduled
7. school proximity within 45 minutes of study site to allow for the clinician to conduct school meetings
8. teacher consents to participating in a school-based treatment

Exclusion criteria:

1. families of children who were taking nonstimulant psychoactive medication (because of difficulty withholding medication to confirm ADHD-I symptoms)
2. cases planning to initiate or change medication treatment (stimulant or otherwise) in the near term
3. children with significant developmental disorders (e.g. pervasive developmental disorder) or neurological illnesses

Baseline characteristics: only medication status at randomisation differed across treatment groups (P = 0.04), with significantly more CLAS (Child Life and Attention Skills) children reporting medication use (9.5%) than PFT children (1.4%), but not compared to TAU children (2.0%).

Interventions	199 participants allocated to one of three groups. Only group one and group three were included in the analysis. 1. **Group one (n = 74):** CLAS. This included three manualised coordinated components: (1) 10 × 90-minute parent group meetings, along with up to six × 30-minute family meetings (parent, child, and therapist); (2) 10 × 90-minute child group meetings; and (3) a teacher consultation, which included one × 30-minute orientation meeting involving the teacher and therapist and up to five subsequent 30-minute meetings with the parent, child, teacher, and therapist and monthly booster sessions. Parent and child groups contained between five and eight families. Treatment occurred over a 10- to 13-week period, with a follow-up at five to seven months post-treatment. 2. **Group two (n = 74):** parent-focused treatment consisting of the parent component described above under (1)

Pfiffner 2014 *(Continued)*

3. **Group three (n = 51):** TAU. This included a written diagnostic report based on the assessment conducted at baseline. Families in the TAU condition also received a list of community treatment providers but were not given specific treatment recommendations.

Attendance:

1. Teachers attended an average of 4.0 meetings (including the orientation).
2. Participants in group one and group two did not differ significantly in the number of individual parent meetings attended; however, group two parents participated in slightly fewer group meetings (mean = 8.8) compared to group one parents (mean = 9.3), P = 0.02 (d = 0.38).
3. Participation in the booster sessions varied across individuals, with a mean of 2.1 sessions for group one families (range = 0-6) and a mean of 2.1 sessions for group two families (range = 0-7).
4. Clinicians met with teachers of 11/74 (15%) children in group one during the subsequent school year as an extension of treatment to the new classroom setting; nine met once, two met twice.

Outcomes

Primary outcomes

1. Social skills: SSIS, teacher- and parent-rated

Secondary outcomes

1. Core ADHD symptoms: CSI: Inattentive symptoms, teacher- and parent-rated

Outcome assessment: post-intervention assessment and follow-up assessment five to seven months after end of intervention

Notes

Study ID: not reported

Sponsorship source: noncommercial. This research was supported by a grant from the National Institute of Mental Health MH077671.

Year conducted: 2014

Duration of the study: 4 years (2009-2012)

Comments: none

Lead author's name: Linda J Pfiffner

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Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	**Comment:** unclear how randomisation was done
Allocation concealment (selection bias)	Unclear risk	**Comment:** not reported
Blinding of participants and personnel (performance bias) All outcomes	High risk	**Comment:** participants not blinded

Pfiffner 2014 *(Continued)*

Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	**Comment:** not reported
Incomplete outcome data (attrition bias) All outcomes	Low risk	**Comment:** number of missing item values were reported as 0.8% at baseline, 3.3% at post-intervention assessment, and 10.6% at follow-up with most of the missing values at follow-up being related to attrition.
Selective reporting (reporting bias)	Unclear risk	**Comment:** no protocol, outcomes not prespecified
Vested interest bias	Unclear risk	**Comment:** study authors had conducted previous studies addressing same intervention.
Other sources of bias?	High risk	**Comment:** families were compensated for completion of post-intervention (group one and two US$50, group three US$150) and follow-up assessments (group one and two: US$100, group three: US$150); teachers were compensated at each time point (baseline assessment: US$50, post-intervention and follow-up: US$75). Further, the teachers received a total of US$100 for participating in the teacher consultation meetings.

Azad 2014

Methods	**Design:** RCT, parallel group
Participants	**Country:** Iran **Setting:** psychology and psychiatry clinic **Sample size calculation**: not reported **Sample size:** 30 children **Sex:** not reported **Age**: not reported; primary school students **Ethnicity:** not reported **Socioeconomic status:** not reported **IQ:** not reported **ADHD diagnosis**: subtypes not reported **ADHD medication**: not reported **Comorbidity:** not reported **Medication for comorbid disorders**: not reported **Inclusion criteria:** not reported **Exclusion criteria:** not reported **Baseline characteristics:** not reported
Interventions	30 participants allocated to one of two groups

Azad 2014 *(Continued)*

1. **Group one, experimental group (n = 15):** the intervention consisted of 16 sessions, three per week, each lasting 60 minutes.
   a. 1st session: pre-intervention assessment and explaining the objective of the research to the parents
   b. 2nd and 3rd sessions: elaborating the application and importance of the research, explaining to the students the role of using certain methods in the improvement of their educational and non-educational activities, and the fact that to have a better and more focused behaviour, they should take some steps
   c. 4th and 5th sessions: presenting the steps to the students, step one: the students imagine a new environment and a new behaviour, step two: the students interpret the new environment and the new behaviour, step 3: the students embed the appropriate behaviour in the new environment, step 4: the students think about the methods/strategies to express their behaviour, step 5: the students should guess the best method and choose it, step 6: the students should accurately appraise/review the cases
   d. 6th and 7th sessions: new cases were presented to the students and they were asked to follow the steps using a guide card.
   e. 8th and 9th sessions: transparent self-guidance: the students should repeat the presented cases aloud and do the expected behaviour using the learned steps and the guide card. If required, minor verbal advices were given.
   f. 10th and 11th sessions: reductive self-guidance: the objective of this session was to internalise the learned method. It was explained to the students that from now on they would practice the method that they had leaned internally. To do so, a new subjective environment was presented as a pattern and the proper reactive behaviours were suggested. The students were asked to act like this.
   g. 12th session: 6th session was repeated but the students were asked to minimise using a guide card.
   h. 13th and 14th sessions: presentation of proper and structured reactive behaviours without using guide card or presenting the steps
   i. 15th session: reviewing/appraising the precious sessions and reviewing the assignments
   j. 16th session: measuring the post-intervention outcome
2. **Group two (n = 15):** no training

Attendance: not reported

Outcomes	**Secondary outcomes** 1. Core ADHD symptoms: CPRS, parent-rated **Outcome assessment:** end of treatment and three month follow-up
Notes	**Study ID:** not reported **Sponsorship source:** not reported **Year conducted:** "This study enrolled the Isfahan primary school students afflicted with ADHD, during the educational years 2012-2013." (quote) **Duration of the study:** 5 weeks (15 sessions) **Comments:** ethics approval not reported **Lead author's name:** Azad Moslem Asli **Institution:** Islamic Azad University, Science and Research Branch Esfahan, Esfaran, Iran **Email:** Azzad2020@gmail.com **Address:** not reported

Risk of bias

Bias	Authors' judgement	Support for judgement

Azad 2014 *(Continued)*

Random sequence generation (selection bias)	Unclear risk	**Comment:** participants were described to be randomly assigned to the groups but no further details were reported.
Allocation concealment (selection bias)	Unclear risk	**Comment:** no details reported and not possible to retrieve further information from the study authors
Blinding of participants and personnel (performance bias) All outcomes	High risk	**Comment:** not reported, but probably not blinded
Blinding of outcome assessment (detection bias) All outcomes	Unclear risk	**Comment:** no details reported and it was not possible to retrieve further information from the study authors as the study authors did not respond to our email requests.
Incomplete outcome data (attrition bias) All outcomes	Low risk	**Comment:** no dropouts
Selective reporting (reporting bias)	Unclear risk	**Comment:** none known. No registered protocol available
Vested interest bias	Unclear risk	**Comment:** no other apparent biases
Other sources of bias?	Low risk	**Comment:** no other apparent biases

Meftagh 2014a

Methods	**Design:** RCT, parallel group
Participants	**Country:** Iran **Setting:** 15 male elementary schools from 4 educational areas in Shiraz **Sample size calculation:** not reported **Sample size:** 51 **Sex:** not reported **Age:** mean = 8.98 years (SD = 0.77) **Ethnicity:** not reported **Socioeconomic status:** not reported **IQ:** not reported **ADHD diagnosis:** subtypes not reported **ADHD medication:** not reported **Comorbidity:** not reported **Medications for comorbid disorders:** not reported **Inclusion criteria:** ADHD diagnosis in clinical interview with children who had been identified with ADHD based on both teacher and parent rating on Child Symptom Inventory **Exclusion criteria:** not reported

Meftagh 2014a *(Continued)*

	Baseline characteristics: no significant differences among study groups regarding age, family, and education
Interventions	51 patients allocated to one of three groups. Only group two and three were included in the analysis. 1. **Group one (n = 17):** Behavioral Mother Training consisting of 10 educational sessions focusing e.g. on explaining ADHD, shaping positive behaviour, and minimising undesirable behaviours using training points to reinforce child behaviour. Each session lasting about 60 minutes, for 10 weeks 2. **Group two (n = 17):** Verbal Self-Instruction for the children, based on Meichenbaum 1978. The elements in this intervention were as follows: 1) directed discovery verbal self-instruction that included identifying problems, determining the logical consequences and problems identification as the main causes of outcomes, identifying beneficial solutions, learning the self-instruction sentences; 2) didactic verbal self-instruction that included teaching five-step problem-solving strategy in verbal form; 3) faded rehearsal verbal self-instruction that included task selection, cognitive modelling, overt external guidance, overt self-guidance, modelling of faded overt self-guidance, child's practice of faded overt self-guidance, modelling of covert self-instruction, child practice of faded covert self-instruction. Delivered in 10 educational sessions, each lasting about 60 minutes, for 10 weeks 3. **Group three (n = 17):** format and duration of intervention provided to control group not reported **Attendance:** 15 children in each group completed the study. Attendance rate was not reported.
Outcomes	**Secondary outcomes** 1. Core ADHD symptoms:continuous performance test (omission error), observer-rated **Outcome assessment:** post-intervention and longest follow-up two months after end of intervention. Notes: data corresponded to change from pre-test to post-test
Notes	**Study ID:** not reported **Sponsorship source:** Research Committee of Shiraz University **Year conducted:** 2014 **Duration of the study:** 10 weeks intervention plus 4 months follow-up **Comments:** none **Lead author's name:** Sayyed Davood Meftagh **Institution:** Department of Psychology, Payame Noor University, Iran **Email:** a_najimi@hlth.mui.ac.ir **Address:** Department of Health Education Health Promotion , School of Health Isfahan University of Medical Sciences, Isfahan, Iran

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	**Comment:** no details on sequence generation
Allocation concealment (selection bias)	Unclear risk	**Comment:** no details
Blinding of participants and personnel (performance bias)	High risk	**Comment:** no description of blinding, probably not blinded

Meftagh 2014a *(Continued)*
All outcomes

Blinding of outcome assessment (detection bias) All outcomes	High risk	**Comment:** no description of blinding, probably not blinded
Incomplete outcome data (attrition bias) All outcomes	Low risk	**Comment:** no flow chart and no explanation as to why some children did not complete the study
Selective reporting (reporting bias)	Low risk	**Comment:** none detected
Vested interest bias	Low risk	**Comment:** the study authors declared no conflict of interest, no other sources of bias identified
Other sources of bias?	Low risk	**Comment:** no other apparent sources of bias

Choi 2015

Methods	**Design:** RCT, parallel group
Participants	**Country:** Korea **Setting:** outpatient **Sample size calculation:** not reported **Sample size:** 80 children **Sex:** 32 (44%) = boys, 40 (56%) = girls **Age:** mean = 11.2 years (SD = 0.93, range = 9-13) **Ethnicity:** not reported **Socioeconomic status:** not reported **IQ:** all IQ > 90 **ADHD diagnosis:** subtypes not reported **ADHD medication:** all participants were under medication at the time of intervention, type of medication not reported **Comorbidity:** not reported **Medications for comorbid disorders:** not reported **Inclusion criteria** 1. meeting ADHD DSM-IV criteria based on a structured interview by psychiatrist 2. total Wechsler Intelligence Scale for Children (WISC) IQ score above 90, based on the full-scale IQ (WISC, Revised Korean Version, Kwak, Park, Kim, 2001) (Kwak 2002) 3. Behavior Problem Scale score on Child Behavior Checklist (CBCL) within clinical range **Exclusion criteria:** not reported **Baseline characteristics:** no significant differences on study background variables or pretest measures

Choi 2015 *(Continued)*

Interventions	80 participants allocated to one of three groups 1. **Group one (n = 25):** Emotion Management Training (EMT), which is an emotion identification and expression treatment, and consists of four major components: (1) identification and labelling of emotional words; (2) emotional recognition and expression; (3) emotional understanding; and (4) emotional regulation in social situations. Each session began by discussing any problems or issues related to homework from the previous one, followed by exercises, and ending with an evaluation of the session. 50-minute × once-weekly sessions lasting 16 weeks. 2. **Group two (n = 28):** social skills training (SST) programme (based on studies conducted by Elliot 1991 and Pfiffner 1997). SST is a form of behavioural training focused on teaching various social skills to children with ADHD to improve their interaction with peers and teachers. It uses various behavioural techniques such as prompts, role play, and reinforcement. Each session was focused on teaching a particular social skill such as listening skills, conversation skills, joining in, and reacting to rejection, negotiating, and reacting to being teased and criticised. Each session started with discussing homework, followed by exercises, and ending with a new homework assignment and an evaluation of the session. 3. **Group three (n = 27):** waiting list. Children were later randomised into one of the two programs. **Attendance:** at least 12 of 16 sessions of either EMT or SST. Mean number of sessions attended by the 75 programme completers was 14.9 (SD = 1.3), with an overall attendance rate of 90.5%. No group differences in the number of sessions attended
Outcomes	**Primary outcomes** 1. Social skills: Peer Relational Skills Scale, child-rated 2. Emotional competencies: Emotion Expression Scale for Children, child-rated **Outcome assessment:** post-intervention, one week after end of intervention
Notes	**Study ID:** not reported **Sponsorship source:** the author(s) received no financial support for the research, authorship, and/or publication of this article. **Year conducted:** 2015 **Duration of the study:** 16 weeks **Comments:** ethics approval. The study was reviewed and approved by the Research Ethics Commitee of the university at which the experiment was conducted. **Lead author's name:** Eun Sil Choi Woo Kyeong Lee **Institution:** Kyungil University, Korea and Seoul Cyber University, Korea **Email:** wisemind96@iscu.ac.kr **Address:** 193-15, Miadong Kangbuk-gu, Seoul, 142-700, Korea

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	**Comment:** from descriptions, it was unclear if all children had been included before randomisation. However, the sentence describing how WL children after 16 weeks were pooled with newly selected children indicated that randomisation was made progressively. It was unclear who did the sampling in blocks, how these blocks were generated, and if this process was to be considered random.

Choi 2015 *(Continued)*

Allocation concealment (selection bias)	Unclear risk	**Comment:** it was unclear exactly how allocation concealment was done.
Blinding of participants and personnel (performance bias) All outcomes	High risk	**Comment:** parents, children and trainers were aware of group's status.
Blinding of outcome assessment (detection bias) All outcomes	High risk	**Comment:** the PICO measures of emotion expression and peer relational skills are both self-report questionnaires.
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	**Comment:** two children in the EMT group and three children in the SST group did not complete the study. The numbers of non-completion were small and balanced. However, while it was stated that the reason for non-completion was dropout during treatment, the reason for this dropout was not specified.
Selective reporting (reporting bias)	Unclear risk	**Comment:** as we did not locate a study registration, it was unclear whether all planned measures had been reported accordingly. However, the measures presented in the paper were all described in the results section.
Vested interest bias	High risk	**Comment:** it was not specified if the therapist delivering the interventions was also one of the authors. The first author is the author of the manual used in one of the intervention arms. There may have been a bias given the first author's investment in the first study arm programme.
Other sources of bias?	High risk	**Comment:** no information on comorbid disorders. It was mentioned that all participants were under medication at the time of the intervention but it was not clear if this referred to ADHD medication or medication for comorbid disorders. It was not specified whether, for example, autism would be a reason for exclusion.

Bul 2016

Methods	**Design:** RCT, cross-over
Participants	**Country:** Netherlands, Belgium **Setting:** outpatient **Sample size calculation:** 78 participants per group required to detect differences of a medium effect size **Sample size:** 170 children **Sex :** 137 (80.6%) = boys, 33 (19.4%) = girls (group one: 70 (79.5%) = boys, 18 (20.5%) = girls, group two: 67 (81.7%) = boys, 15 (18.3%) = girls) **Age:** mean = 9.85 years (SD = 1.26, range = 8-12) (group one: mean = 9.89 years (SD = 1.28), group two: mean = 9.82 years (SD = 1.24)) **Ethnicity:** not reported **Socioeconomic status:** not reported **IQ:** mean = 106.18 (SD = 14.79) (group one: mean = 105.40 (SD = 14.46), group two: mean = 107.02 (SD = 15.18)) **ADHD diagnosis:** subtypes not reported

Bul 2016 *(Continued)*

ADHD medication: n = 156 (91.8%) (group one: n = 80 (90.9%), group two: n = 76 (92.7%))

Comorbidity: ODD = 170 (149 (87.6%) = clinical, 21 (12.4%) = subclinical)) (group one: ODD = 88 (74 (84.1%) = clinical, 14 (15.9%) = subclinical), group two: ODD = 82 (75 (91.5%) = clinical, 7 (8.5%) = subclinical))

Medications for comorbid disorders: not reported

Inclusion criteria:

1. DSM-IV-TR diagnosis of ADHD, confirmed by the K-SADS
2. eight to 12 years of age
3. stable on pharmacological or psychological treatment (or both) for ADHD eight weeks before baseline (determined by healthcare professionals on the basis of medication data and behavioural observation)
4. no initiation or change of pharmacological or psychological treatment (or both) for ADHD during the study period
5. availability of a computer workstation at home with Internet and sound facilities
6. sufficient understanding of the Dutch language by the child and by at least one of the parents

Exclusion criteria:

1. estimated total IQ lower than 80 (determined by vocabulary and block design subtests of the WISC-III)
2. substance abuse problems (e.g. drugs, alcohol)
3. conduct disorder, previously diagnosed by healthcare professionals
4. autism spectrum disorder, previously diagnosed by healthcare professionals
5. comorbid acute psychiatric disorder (e.g. depression, mania; confirmed by the K-SADS)
6. participation in a previous pilot study with a prototype of Plan-It Commander
7. children with a severe physical disability (e.g. blindness, deafness) or learning disability (e.g. dyslexia) according to child's medical file and a standardised interview administered by phone to parents

Baseline characteristics: there was no significant difference in baseline demographics between the two groups.

Interventions	Participants allocated to one of two groups and then crossed over 1. **Group one (n= 88):** Plan-IT commander, which is an internet-based (online) mission-guided adventure game designed to improve the following domains of daily life: 1) time management; 2) planning/organising; and 3) cooperation skills. Participants had access to the game environment and to a closed social community where it was possible to ask others for help or to help others using predefined messages. Player profiles were presented within the community and badges were awarded to the profile following achievements in the game. The game was played for a maximum of 65 minutes, three times per week (minimum time not provided). It was not possible to play more than 65 minutes in one × 24-hour period. 2. **Group two (n= 82):** TAU. Given TAU for first 10 weeks, then crossed over to the game intervention plus TAU for the subsequent 10 weeks. **Attendance:** In group one, 77 % attended 20 weeks treatment. In group two, 89% attended 20 weeks treatment.
Outcomes	**Primary outcomes** 1. Social skills: SSRS, teacher- and parent-rated **Outcome assessment:** end of treatment
Notes	**Study ID:** ISRCTN62056259 **Sponsorship source:** Johnson Johnson was the funding source for game development and consultancy with regard to the design of the study. Flanders' Care provided funding to perform the study (DEM2012-02-07) at the University Hospital Gasthuisberg (Belgium).

Bul 2016 *(Continued)*

Year conducted: conducted from January to March 2013

Duration of the study: 20 weeks

Comments: none

Lead author's name: Kim CM Bul

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Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	**Comment:** 1:1 ratio and based on a prespecified computer-generated randomisation list. Allocation was stratified by study site and gender, and arranged in permutated blocks.
Allocation concealment (selection bias)	Unclear risk	**Comment:** Group assignment performed online using the next available number on the randomisation list, which corresponded to the site and gender of the participant.
Blinding of participants and personnel (performance bias) All outcomes	High risk	**Comment:** not possible to blind participants to their treatment allocation. After screening and baseline assessment, parents received an email with notification of group allocation.
Blinding of outcome assessment (detection bias) All outcomes	High risk	**Comment:** parent and child self-report. Detection bias due to child and parent knowledge of received intervention. Full blinding of researchers and teachers not guaranteed as participants could spontaneously talk about the game during the assessment or the study time.
Incomplete outcome data (attrition bias) All outcomes	Low risk	**Comment:** used intention-to-treat analyses and included all randomised participants. Used linear trend at point as an imputation method.
Selective reporting (reporting bias)	Low risk	**Comment:** all expected outcome measures reported. Only the satisfaction questionnaire was not mentioned in the protocol.
Vested interest bias	High risk	**Comment:** funders were Janssen-Cilag (Netherlands) and Flanders Care (Netherlands). Funders may have had an interest as they are in the medical industry. It was not clearly stated if there was a commercial aspect to the computer game. Additionally, two of the authors were employees of Janssen Pharmaceuticals; statistical study experts Luc Janssens (MSc), who works for the Research and Development Department of Janssen Pharmaceuticals in Beerse (Belgium), and Franky de Cooman (MSc), who works for Art Deco. The study was conducted in collaboration with the following partners: Parent Association Centre ZitStil (Belgium), Focuz Treatment Centre for Children and Youth (Rotterdam), Mental Health Care Organization Mondriaan (Heerlen), and the University Hospital Gasthuisberg (Belgium). Johnson & Johnson was the funding source for game development and consultancy with regard to the design of the study. Flanders' Care provided funding to perform the study (DEM2012-02-07) at the University Hospital Gasthuisberg (Belgium).
Other sources of bias?	Low risk	**Comment:** no other sources of bias identified

Waxmonsky 2016

Methods	**Design:** RCT, parallel group
Participants	**Country:** USA **Setting:** outpatient **Sample size calculation:** not reported **Sample size:** 68 children* **Sex:** 39 = boys, 17 = girls (group one: 20/31 (65%) = boys; group two: 19/25 (76%) = boys) **Age:** (group one: mean = 9.3 years (SD = 1.6), mean = 9.4 years (SD = 1.5)) **Ethnicity:** % defined as racial/ethnic minority: group one: = 12 (39%); group two = 9 (36%) **Socioeconomic status:** group one: mean = 42.3 (SD = 15.2) on Socioeconomic Index**, group two: mean = 42.03 (SD = 12.8) both on Nakao and Treas Socioeconomic Index (Nakao 1994) **IQ:** group one: mean = 100.6 (SD = 15.4); group two: mean = 100.7 (SD = 10.6) **ADHD diagnosis:** not reported **ADHD medication:** prior to therapy, phase psychostimulant doses were optimised for all participants. Thus, all participants received pharmacological treatment (group one: mean entry stimulant dose = 0.90 mg/kg/day (SD = 0.40); group two: mean entry stimulant dose = 0.90 mg/kg/day (SD = 0.43)) both in methylphenidate equivalents on a mg/kg/day. **Comorbidity:** (group one: CD = 4 (13%), ODD = 29 (94%), anxiety/subthreshold anxiety = 9 (29%); group two: CD = 1 (4%), ODD = 24 (96%), anxiety/subthreshold anxiety = 11 (44%)) **Medications for comorbid disorders:** balanced between groups **Inclusion criteria:** 1. seven to 12 years of age 2. combined subtype of ADHD and severe mood disorder 3. ADHD evaluations based on the Disruptive Behavior Disorders Structured Parent Interview **Exclusion criteria:** 1. IQ below 80 2. prominent traits of autism spectrum disorder 3. use of any nonstimulant psychotropic 4. bipolar I/II, or psychoses 5. children with suicidal ideation
Interventions	68 participants allocated to one of two groups 1. **Group one (n = 35):** medication + AIM (ADHD plus Impairments in Mood) consisting of 11 parallel-group sessions for parents and children with parent and child group run in parallel. Each session lasted 105 minutes. Sesssions focused on: emotion recognition in self and others; connections between emotions and cognitions (e.g. problem-solving when upset); application of coping tools and problem-solving skills at school and home. A contingency management system was implemented with points that could be exchanged for gift cards. 2. **Group two (n = 33):** medication + community psychosocial care. Encouraged to engaged with local psychosocial providers. Referrals but not treatment were provided from project staff. Use of community psychosocial care during the project period: 15 (60%) received other mental health services during the project period; of these two (8%) received school-based counselling only, 13 (52%) received individual sessions (for mixture of behaviour problems, anger management, and social skills issues).

Waxmonsky 2016 *(Continued)*

	Attendance: % of attendance was required. Completers were participants attending at least six of the 11 sessions (n = 29). Mean attendance = 9.7 out of 11 group sessions. All but two participants attended at least half of the group or make-up sessions.
Outcomes	**Primary outcomes** 1. Social skills: Social Skills Rating Scale (SSRS), parent-rated 2. General behaviour: SSRS: Problem Behaviour subscale, teacher-rated; DBDRS: ODD subscale - teacher version, parent-rated **Secondary outcomes** 1. Core ADHD symptoms: DBDRS: ADHD Symptoms subscale, teacher- and parent-rated **Outcome assessment:** assessment at following points (in weeks after baseline): mid-intervention (6 weeks), post-intervention (11 weeks) and group one at follow-up assessment (17 weeks)
Notes	**Study ID:** NCT00632619 **Sponsorship source:** National Institute of Mental Health (MH080791; Principal Investigator: Waxmonsky) **Year conducted:** 2016 **Duration of the study:** 11 sessions **Comments:** the study was approved by governing institutional review boards (IRBs) at both sites. **Lead author's name:** James G. Waxmonsky **Institution:** Pennsylvania State University, Department of Psychiatry **Email:** jwaxmonsky@hmc.psu.edu **Address:** Pennsylvania State University, Psychiatry, 500 University Dr. Dept of Psychiatry H073, Hershey Medical Center, Hershey, PA 17033

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	**Comment:** randomised using a computer-generated permutated blocking procedure. Randomisation occurred before the medication phase so parents would be aware of therapy status prior to making decisions about medication.
Allocation concealment (selection bias)	Low risk	**Comment:** assumed that the use of a computer blocking procedure would conceal the allocation
Blinding of participants and personnel (performance bias) All outcomes	High risk	**Comment:** blinding of participants and personnel not possible
Blinding of outcome assessment (detection bias) All outcomes	High risk	**Comment:** the PICO measures included were rated by parents or teachers. Clinician-rated assessments were completed by staff masked to therapy status, though this was not relevant for these measures.
Incomplete outcome data (attrition bias) All outcomes	Low risk	**Comment:** 3 dropped out of the CC group due to assignment. All dropout was well described and except the dropout due to assignment, the reasons did not indicate a bias.

Waxmonsky 2016 *(Continued)*

Selective reporting (reporting bias)	Low risk	**Comment:** all primary and secondary outcome measures stated in protocol were reported in paper. SSRS was also reported in the paper but this measure was not described in the study registration.
Vested interest bias	High risk	**Comment:** potential vested interest due to relationships with pharmaceutical companies
Other sources of bias?	High risk	**Comment:** potential bias in the data collected. Selection of informants prone to monetary incentive. The referral may have increased the service received in the CC group during the intervention period and thus may have provided a potential bias. At study registration, the authors also mentioned as a limitation that the study therapy group had more contact with study staff, which may have impacted results. Additionally, the first author seemed to be involved in the development of the treatment programme used in the study and thus there might be bias of interests.

Wilkes Gillan 2016

Methods	**Design:** RCT, cross-over
Participants	**Country:** Australia **Setting:** outpatient **Sample size calculation:** not reported **Sample size:** 31 children **Sex:** 25 (86%) = boys, four (14%) = girls (group one: 13 (87%) = boys, 2 (13%) = girls; group two: 12 (86%) = boys, 2 (14%) = girls) **Age:** group one: mean = 8.2 years (SD = 1.5); group two: mean = 8.5 years (SD = 1.7) **Ethnicity:** 26/29 born in Australia **Socioeconomic status:** (group one: parent with degree or diploma = 93%, occupation (requiring tertiary qualifications) = 60%; group two: parent with degree or diploma = 87%, occupation (requiring tertiary qualifications) = 57%) **IQ:** not reported **ADHD diagnosis:** (group one: predominantly inattentive = 5/15, predominantly hyperactive/impulsive = 1/15, combined subtype = 9/15; group two: predominantly inattentive = 6/14, predominantly hyperactive/impulsive = 0/14, combined subtype = 8/14)) **ADHD medication:** 20 of 29 (69%), specific type of medication not reported (group one = 60% , group two = 76%) **Comorbidity:** subscale T-scores on Connors Comprehensive Behaviour Rating scale, clinical cut-off T-score > 70 (group one: oppositional behaviour, mean = 75 (SD = 13.4), generalised anxiety disorder, mean = 71 (SD = 11.5); group two: oppositional behaviour, mean = 76 (SD = 13.0), generalised anxiety disorder, mean = 73 (SD = 12.9)) **Medication for comorbid disorders:** not reported **Inclusion criteria:** 1. five to 11 years

Wilkes Gillan 2016 *(Continued)*

2. a formal diagnosis of ADHD made by a paediatrician or psychiatrist using recognised diagnostic procedures such as the American Psychiatric Association's Diagnostic and Statistical Manual 4th edition (DSM-IV)
3. playmate aged five to 11 years without ADHD or other DD diagnosis
4. 1 parent attending clinic sessions and completing home activities
5. Connors Comprehensive behavior Rating Scales (CCBRS) > 69 for child with ADHD, and 66 for playmate

Comorbid difficulties accepted (i.e. language difficulties, conduct disorder) and current medication was permitted but asked to be maintained in the study period. The therapist monitored the consistency of the medication use throughout the study period.

Exclusion criteria: diagnosed with other major developmental disorders (i.e. intellectual disability, autism spectrum disorder)

Baseline characteristics: no significant difference in baseline demographics between the two groups:

*baseline characteristics in this table is based on analysis of 29 children followed up in the outcome assessment (group one = 15; group two = 14)".

Interventions	31 participants allocated to one of two groups and then crossed over 1. **Group one (n = 16):** play-based intervention. The intervention lasted 10 weeks in total. Each child was included together with a playmate and both children participated in one-hour play sessions in the clinic together with the child's parent and a therapist (in week 1-3, 5, 7 and 10) and in home. Each session consisted of video feedback and play with adult modelling and support in the beginning of the intervention and without adult modelling and support in the end of the intervention. The parent was given one hour of training in week one and instructed to support play at home and facilitated weekly 40-minute play dates at home where the playmate was invited home. 2. **Group two (n = 15):** waiting list **Attendance:** 98.3% (range 88-100%), no specific % was required, one child in group one never started the intervention, and one child in group two did not finish the wait-time.
Outcomes	**Primary outcomes** 1. Social skills: Test of Playfulness, observer-rated **Outcome assessment:** post-intervention
Notes	**Study ID:** ACTRN12614000973617 **Sponsorship source:** Rotary Club of Mosman and the University of Sydney's postgraduate research support scheme **Year conducted:** 2016 **Duration of the study:** 10-week intervention **Comments:** none **Lead author's name:** Sarah Wilkes-Gillan **Institution:** School of Allied Health, Australian Catholic University, North Sydney, NSW **Email:** Sarah.WilkesGillan@acu.edu.au **Address:** North Sydney, NSW, Australia

Risk of bias

Bias	Authors' judgement	Support for judgement

Wilkes Gillan 2016 *(Continued)*

Random sequence generation (selection bias)	Low risk	**Comment:** simple randomisation used to assign one of each two children who entered to each group (1:1 ratio). Once two parents had booked a baseline assessment, a sealed envelope from each group and the times of the baseline assessments were taken to an academic staff member not involved in the research. The person shuffled the envelopes and used a coin toss to pick one of the two, writing it on the sealed envelopes. The researcher left the room while the academic staff member completed the procedure.
Allocation concealment (selection bias)	Low risk	**Comment:** assessors were blinded to treatment allocation for all participants. While the researchers knew that children in the same family would receive the same allocation, treatment allocation was not revealed to them. The blinded raters were not aware of any familial relationships.
Blinding of participants and personnel (performance bias) All outcomes	High risk	**Comment:** participants and personnel were blinded at baseline assessment, but participants were then informed of allocation.
Blinding of outcome assessment (detection bias) All outcomes	Low risk	**Comment:** assessors were blind at baseline and outcome assessment. Blinded raters were used.
Incomplete outcome data (attrition bias) All outcomes	Low risk	**Comment:** reasons for dropout (death in family and change in sport schedule) unrelated to true outcome
Selective reporting (reporting bias)	Unclear risk	**Comment:** retrospectively registered; protocol submitted 2 September 2014 and approved 10 September 2014. Participants enrolled 1 June 2013 to 7 June 2014 and data collection was finished in October 2014. More measures described in protocol but not reported in paper (potentially published in other paper but we have not been able to identify other papers related to this study during the review process)
Vested interest bias	Low risk	**Comment:** funding organisation not found to have vested interests. A manual and DVD material were described which could indicate a potential commercial interest, however, we were unable to locate information on the material online.
Other sources of bias?	Low risk	**Comment:** no other sources of bias identified

Schramm 2016

Methods	**Design:** RCT, parallel group
Participants	**Country:** Germany **Setting:** outpatient **Sample size calculation:** not reported **Sample size:** 113 children **Sex:** 85% = boys (group one: 34 (85%) = boys; group two: 32 (86.5%= = boys)) **Age:** mean = 13.99 years (SD = 1.43) (group one: mean = 14.10 years (SD = 1.42; group two: mean = 13.83 years (SD = 1.28)) **Ethnicity:** not reported

Schramm 2016 *(Continued)*

	Socioeconomic status: not reported **IQ:** not reported **ADHD diagnosis:** not reported **ADHD medication:** number of children not receiving medication, type not specified = 50% (group one = 16 (40%); group two = 17 (47%) **Comorbidity:** not reported **Medications for comorbid disorders:** not reported **Inclusion criteria:** 1. ADHD diagnosis based on DSM-IV criteria established by a clinical interview and ADHD symptom criteria ratings DSM-IV-TR by parents and teachers based on Fremdbeurteilungsbogen für Hyperkinetische Störungen (FBB-HKS) 2. 12 to 17 years of age **Exclusion criteria:** meeting criteria for severe comorbid disorders (e.g. psychotic episode) **Baseline characteristics:** no significant difference found in baseline characteristics
Interventions	113 participants allocated to one of three groups. Only group one and group two were included in the review analysis. 1. **Group one (n = 40):** social skills training - Learning Skills Training for Adolescents with ADHD (ADHS-LeJA). This was a manualised, multimodal intervention combining an adolescent-directed training approach with a behavioural training component. 2. **Group two (n = 36):** waiting list. Participants were invited twice for data collection with an average interval of 5.76 (SD= 51.65) months in between and expected to start intervention after post-measurement, which was offered for ethical reasons. 3. **Group three (n = 37):** active control. The active (i.e. therapeutic attention) intervention consisted of an adaptation of a Progressive Muscle Relaxation (PMR) training. **Attendance:** rate not reported. Four dropped out (group one = two (one = familial difficulties, one = discontinued intervention), group two = two (no longer interested in participating))
Outcomes	**Primary outcomes** 1. Social skills: SDQ, prosocial subscale, teacher-, child- and parent-rated 2. Emotional competencies: SDQ, emotional symptoms subscale, teacher-, parents- and child-rated 3. General behaviour: SDQ, conduct problems subscale, teacher-, child- and parent-rated **Secondary outcomes** 1. Core ADHD symptoms: Fremdbeurteilungsbogen für Hyperkinetische Störungen Hyperactivity/Impulsivity subscale, teacher-, parent-, child-rated 2. Performance and grades in school: the German teacher-rated questionnaire for learning and working behaviour (Arbeitsverhalten Lehrer) (Lauth 2004), teacher-rated **Outcome assessment:** post-intervention assessment
Notes	**Study ID:** not reported **Sponsorship source:** not reported **Year conducted:** data were collected during the years of 2009-2012 **Duration of the study:** 6 months

Schramm 2016 *(Continued)*

Comments: approved by the Research Board of the Department of Special Education and Rehabilitation, University of Oldenburg, Germany

Lead author: Satyam Antonio Schramm

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Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	**Comment:** need more information. Trickle processing approach described as often being associated with corruption of assignment
Allocation concealment (selection bias)	Unclear risk	**Comment:** need more information
Blinding of participants and personnel (performance bias) All outcomes	High risk	**Comment:** trainers and children must have been aware of status, as training, active control or waiting list were blinded.
Blinding of outcome assessment (detection bias) All outcomes	High risk	**Comment:** parent and children were aware of group assignment. Teachers not described as effectively blinded
Incomplete outcome data (attrition bias) All outcomes	Low risk	**Comment:** results for all measures noted in methods section reported
Selective reporting (reporting bias)	Low risk	**Comment:** small (n = 2) loss to follow-up in waiting-list control group due to participants not wanting to wait anymore. One dropped out of the intervention group due to familial difficulties and one dropped out of the active control group due to an accident..
Vested interest bias	High risk	**Comment:** last study author was also the author of the published manual of the programme being investigated.
Other sources of bias?	Low risk	**Comment:** moderate level of missing data (6.4%), mostly due to incomplete teacher report (17.6%). Missing items were assumed to be missing at random and were imputed groupwise through expectation maximization algorithm.

Evans 2016

Methods	**Design:** RCT, parallel group
Participants	**Country:** USA **Setting:** outpatient **Sample size calculation:** not reported **Sample size:** 326 children (group one: 112, group two: 110, control :104)

Evans 2016 *(Continued)*

Sex: 232 (71%) = boys, 94 (29%) = girls (group one: 79 (71%) = boys, 33 (29%) = girls, group two: 76 (69%) = boys, 34 (31%) = girls, group three: 77 (74%), 27 (26%) = girls)

Age: mean = 12.1 years (SD: 0.9-1.0) (group one: mean = 12.1 years (SD = 0.9), group two: mean = 12.1 years (SD = 0.9), group three: mean = 12.1 years (SD = 1.0))

Ethnicity: group one: 7.1% African-American, 74.1% white, 14.3% biracial, 4.5% other, 2.7% Hispanic, group two: 14.5% African-American, 78.2% white, 5.5% biracial, 1.8% other, 5.5% Hispanic, group three: 14.4% African-American, 79.8% white, 4.8% biracial, 1% other, 1% Hispanic

Socioeconomic status: (group one: mean 56.500, SD 45.200 in thousand $, group two: mean 61.500, SD 52.400 in thousand $, group three: mean 63.500, SD 55.500 in thousand $)

IQ: means: group one: mean = 100.3 (SD = 14.2), group two: mean = 99.2 (SD = 13.1), group three: mean = 101.4 (SD = 13.7))

ADHD diagnosis: children with combined subtype: group one = 55 (49.1%), group two = 55 (50%), group three = 49 (47.1%)

ADHD medication: group one: 49 (43.8%), group two: 57 (51.8%), group three 47 (45.4%)

Comorbidity: ODD or CD: 55.%, anxiety disorders: 27%, depressive disorders: 13% (group one: anxiety disorder = 19.6%, depression = 8%, mean ODD symptoms = 4.5 (SD = 2.3), mean CD symptoms = 2.1 (SD = 1.9), group two: anxiety disorder = 21.1%, depression = 10.9%, mean ODD symptoms = 4.7 (SD = 2.3), mean CD symptoms = 1.9 (SD = 1.3), group three: anxiety disorder = 17.3%, depression = 7.7%, mean ODD symptoms = 4.4 (SD = 2.2), mean CD symptoms = 1.7 (SD = 1.4)

Medication for comorbid disorders: group one: 49 (43.8%), group two: 57 (51.8%), group three: 47 (45.4%)

Inclusion criteria:

1. attended one of the participating schools, grade six, seven, or eight
2. met full DSM–IV–TR diagnostic criteria for either ADHD–predominantly inattentive type or ADHD–combined type, based on the Parent Children's Interview for Psychiatric Syndromes (P-ChIPS; (Weller 2010) or combined with teacher ratings on the Disruptive Behavior Disorders Rating Scale (Van Eck 2010)
3. demonstrated impairment based on parent or teacher reports on the Impairment Rating Scale (IRS; score of 3 = impairment)
4. IQ of 80 or above, estimated using the Wechsler Intelligence Scale for Children—Fourth Edition (Wechsler 2003)

Exclusion criteria:

1. met diagnostic criteria for a pervasive developmental disorder or any of the following on the P-ChIPS: bipolar disorder, psychosis, or obsessive–compulsive disorder

Baseline characteristics: there were no statistically significant differences between groups on any demographic variables.

Interventions	326 participants allocated to one of three groups

1. **Group one (n = 112):** Challenging Horizons Program – After School version (CHP-AS). Occurred twice weekly for two hours and 15 minutes per day and included organisation, social functioning, and academic study skills interventions. Further organisation and task progress was monitored daily. Six to 10 students were assigned to a group. One to two students were each assigned to a primary counsellor (PC). The CHP-AS PCs were staffed by undergraduate students and a site supervisor (graduate student/postdoc fellow) who supervised the PCs and led group activities. All staff received nine hours of training prior to beginning the programme, and PCs received weekly supervision.
2. **Group two (n = 110):** Challenging Horizons Program – Mentoring version (CHP-M). Students were paired with a mentor (e.g. teacher) who was trained by a consultant to deliver a subset of the CHP-AS interventions during school. Mentor meet weekly with student and biweekly with research staff.

Evans 2016 *(Continued)*

3. **Group three (n = 104):** community care/TAU (no direct intervention was provided in community care/TAU). A list of available resources in the specific community setting was collated and distributed to the participants randomised to this group.

Attendance:

1. **Group one (CHP-AS):**
   a. mean number of sessions offered in the group was 53.80 (range = 47-68; median = 53.5).
   b. students attended a mean of 31.85 sessions (SD = 18.75, range = 0-59; median = 36).
   c. of the 112 students assigned to the after-school programme condition, 105 (94%) attended at least one session. Twenty-two percent of the participants withdrew from treatment during the academic year. The average number of meetings attended by parents was 1.67 (SD = 1.23, range = 0 to 3; median = 2).
2. **Group two (CHP-M):**
   a. average number of consultant-mentor meetings was 13.39 (SD = 3.65, range = 0-22; median = 14).
   b. average consultant-mentor meeting duration was 19.59 minutes (SD = 6.47, range = 8 to 44 minutes; median = 18.00).
   c. average number of mentor–student meetings (intervention sessions) was 25.17 (SD = 17.14; median = 22.5).
   d. average number of mentor–student feedback sessions completed was 1.84 (SD = 0.99; median = 2).
   e. average mentor–student intervention session duration was 12.12 minutes (SD = 7.17, range = 2 to 53 minutes; median = 10.33).
   f. mentor–student interventions involved organisational skills (75%), homework recording accuracy in assignment notebooks (53%), daily report cards (30%), missing assignment checks (20%), study skills (10%), or some other type of intervention (3%).
   g. mentor–student pairings involved one intervention (30%), two interventions (50%), three interventions (18%), and four interventions (2%).
   h. 3% of participants withdrew from treatment during the academic year (i.e. student discontinued meetings with mentor).
3. **Group three (TAU):** three children withdrew from the study. No other information reported

Outcomes

Primary outcomes

1. Social skills: SSIS, teacher- and parent-rated
2. General behaviour: DBDRS, ODD symptoms, teacher- and parent-rated
3. Core ADHD symptoms: DBDRS, Hyperactivity/impulsivity symptoms subscale, teacher- and parent-rated

Secondary outcomes

1. Performance and grades in school: Classroom Performance Survey (academic factor), teacher-rated

Outcome assessment: post-intervention and follow-up six months after end of intervention

Notes

Study ID: not identified

Sponsorship source: National Insitute of Mental Health (NIMH); R01MH082864, R01MH082865

Year conducted: 2016

Duration of the study: 1 academic year plus 6 months follow-up

Comments: none

Lead author's name: Evans SW

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Evans 2016 *(Continued)*

Address: Department of Psychology, Ohio University, Athens, OH45701

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	**Comment:** comment from author (Evans 2017 [pers comm]): "Randomization was conducted after the recruitment of each of the three cohorts. Our statistician (who was not involved in recruitment) generated a string of random numbers that led to the assignment of participants to condition. The statistician sent the PIs at each site the condition allocation for our sites".
Allocation concealment (selection bias)	Low risk	**Comment:** comment from author (Evans 2017 [pers comm]): "The statistician sent the PIs at each site the condition allocation for our sites".
Blinding of participants and personnel (performance bias) All outcomes	High risk	**Comment:** based on the type of intervention, it was not possible for participants and personnel to be blinded to group status. However, according to the study authors, parents had similar expectations for improvement in both active treatment conditions.
Blinding of outcome assessment (detection bias) All outcomes	High risk	**Comment:** the outcomes relevant for this review were parent and teacher ratings. The study author commented (Evans 2017 [pers comm]): "Teachers were minimally aware of condition as they completed assessments, but were not actively involved in any other activities for participants in any condition. Nevertheless, had they wanted to know the services a child was or was not receiving, the information was available to them. Thus, as most, if not all teachers remained unaware, they were not “blinded” to treatment condition".
Incomplete outcome data (attrition bias) All outcomes	Low risk	**Comment:** used intention-to-treat. In total, 12 children were included in the study but were not included in the outcome assessment. Eight children did not start the intervention (seven from group one and one from group two) and four children withdrew from the study (one from group one and three from group three).
Selective reporting (reporting bias)	Unclear risk	**Comment:** no study registration found, so it was not possible to judge if all outcome data were reported. Grade point average data were collected, however mean and SD were not reported.
Vested interest bias	Low risk	**Quote: t**he research was supported by grants from the National Institute of Mental Health (NIMH; R01MH082864, R01MH082865), no sources of bias identified.
Other sources of bias?	Low risk	**Comment:** no other sources of bias identified

Pfiffner 2016

Methods	**Design:** Cluster-RCT, parallel group
Participants	**Country:** USA **Setting:** outpatient **Sample size calculation:** sample size was based on medium to large effect sizes previously found by the authors. For the sample in the study, the estimated detectable effect size was 0.48. **Sample size:** 135 children **Sex:** (group one: 54 (75 %) = boys, 18 (25%) = girls; group two: 42 (67%) = boys, 21 (33%) = girls)

Pfiffner 2016 *(Continued)*

Age: (group one: mean = 8.3 years (SD = 1.1); group two: mean = 8.5 years (SD = 1.1))

Ethnicity: (group one: white = 31%, African-American = 8%, Asian = 22%, Hispanic/Latino = 21%, multiracial/multiethnic = 18%; group two: white = 22%, African-American = 10%, Asian = 19%, Hispanic/Latino = 27%, multiracial/multiethnic = 22%)

Socioeconomic status: % college graduates (group one: 65%; group two 55%)

IQ: on WASI FSIQ (group one: mean = 103.0 (SD = 13.0); group two: mean = 101.0 (SD = 14.7))

ADHD diagnosis: group one: combined = 54%, inattentive = 40%, hyperactive-impulsive = 6%; group two: combined = 62%, inattentive = 38%, hyperactive-impulsive = none

ADHD medication: group one: 9.7%, group two: 7.9%

Comorbidity: group one: ODD = 43%, group two: ODD = 59%

Medication for comorbid disorders: (balanced between groups)

Inclusion criteria:

1. high ratings of ADHD symptoms (i.e. equal or above six inattention symptoms and/or equal or above six hyperactive/impulsive symptoms) endorsed on the CSI by the parent or teacher as occurring often or very often
2. cross-situational impairment (home and school), documented as a score of at least three in at least one domain of functioning on parent and teacher Impairment rating scales
3. full-Scale IQ equivalent to higher than 79 on the WASI
4. caretaker available to participate in treatment; and a primary classroom teacher who agreed to participate in the classroom component
5. children taking medication providing their regimens were stable

Exclusion criteria: students with significant visual or hearing impairments,severe language delay, psychosis, or pervasive developmental disorder or who were in full-day special day classrooms

Baseline characteristics: groups did not differ on demographics or medication use at baseline.

Interventions	135 participants allocated to one of two groups 1. **Group one (n = 72):** Collaborative Life skills (CL). This is a 12-week programme delivered by school-based mental health providers. It is a psychosocial multicomponent treatment that integrates classroom interventions, parent training groups, and child skills groups. Social skills modules include, for example: good sportsmanship, accepting consequences, assertion, dealing with teasing, problem-solving, self-control, and friendship making. Independence modules include, for example: homework skills; completing chores and tasks independently; and establishing and following routines. Activities accommodated developmental needs (e.g. having older children take more of a leader/helper role in groups, providing age-appropriate examples of skill use). 2. **Group 2 (n = 63):** business as usual; i.e. usual school and community services **Attendance:** 1. Parent attendance at groups averaged above 79% (range 0–100%). More than 90% attended at least half the group sessions. 2. Child attendance averaged above 92% (range 67–100%).
Outcomes	**Primary outcomes** 1. Social skills: SSIS, teacher- and parent-rated 2. General behaviour: CSI, ODD subscale, teacher- and parent-rated **Secondary outcomes** 1. Core ADHD symptoms: CSI: ADHD subscale, teacher- and parent-rated 2. Performance and grades in school: SSIS: academic competence subscale, teacher-rated

Pfiffner 2016 *(Continued)*

	Outcome assessment: post-intervention assessment
Notes	**Study ID:** NCT01686724 **Sponsorship source:** supported by a grant from the Institute of Education Sciences, US Department of Education to the University of California-San Francisco (award number R324A120358) **Year conducted:** 2016 **Duration of the study:** 12-week programme **Comments:** none **Lead author's name:** Linda J Pfiffner **Institution:** Department of Psychiatry, University of California San Francisco **Email:** linda.pfiffner@ucsf.edu **Address:** Department of Psychiatry, University of California San Francisco, 401 Parnassus Avenue, Box 0984, San Francisco, CA 94143

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Unclear risk	**Comment:** unclear how the randomisation was done
Allocation concealment (selection bias)	Unclear risk	**Comment:** no details
Blinding of participants and personnel (performance bias) All outcomes	High risk	**Comment:** not mentioned, but it did not seem possible to blind participants and personnel in the study
Blinding of outcome assessment (detection bias) All outcomes	High risk	**Comment:** outcome measures were based on teacher and parent ratings and the authors commented that this might lead to rater bias.
Incomplete outcome data (attrition bias) All outcomes	Unclear risk	**Comment:** not clear
Selective reporting (reporting bias)	High risk	**Comment:** protocol available. The primary and secondary outcomes, including the time frame reported in the study, did not match the protocol.
Vested interest bias	Unclear risk	**Comment:** the study was supported by a grant from the Institute of Education Sciences. Authors had conducted previous studies on the same intervention.
Other sources of bias?	High risk	**Comment:** at each assessment point, parents and teachers were paid US$50 for completing the measurements.

Qian 2017

Methods	**Design:** RCT, parallel group

Qian 2017 *(Continued)*

Participants	**Country:** China **Setting:** clinical **Sample size calculation:** not reported **Sample size:** 86 children **Sex:** 54 = boys, 14 = girls (group one: 32 (84.2%) = boys, 6 (15.8%) = girls; group two: 22 (73.3%) = boys, 8 (26.7%) = girls) **Age:** 6-12 years (group one: mean = 8.3 years (SD = 1.3); group two: mean = 7.8 years (SD = 1.2)) **Ethnicity:** not reported **Socioeconomic status:** not reported **IQ:** group one: mean = 105.7 (SD = 13.9); group two: mean = 101.8 (SD = 10.4) **ADHD diagnosis:** group one: inattentive = 17 (44.7%), hyperactivity-impulsivity = 0 (0%), combined = 21 (55.33%); group two: inattentive = 16 (53.3%), hyperactivity-impulsivity = 1 (3.3%), combined = 13 (43.3%) **ADHD medication:** group one: 10 participants had maintained steady dosage of medications for more than a half year and remained unchanged during the entire study. New medications could not be initiated during the study. **Comorbidity:** group one: ODD = 7 (18.4%), learning disorder = 8 (21.1%), special phobia = 5 (13.2%); group two: ODD = 7 (23.3%), learning disorder = 4 (13.3%), special phobia = 2 (6.7%) **Medications for comorbid disorders:** not reported **Inclusion criteria:** 1. diagnosis of ADHD: meeting DSM-IV criteria based on parent ratings on ADHD-RS-IV confirmed by semi-structured interview by experienced paediatric psychiatrist using the clinical diagnostic interview scale 2. six to 12 years of age **Exclusion criteria:** 1. history of head injury 2. diagnosis of other congenital or acquired neurological conditions 3. estimated full-scale IQ < 80 4. diagnosis of autism spectrum disorder, psychosis, or an emergent psychiatric condition that needed immediate medication 5. new medications could not be initiated during the study. **Baseline characteristics:** no significant difference found in reported baseline characteristics
Interventions	86 participants allocated to one of two groups 1. **Group one (n = 44):** executive skills training based on Dawson Guare's (Dawson 2010) training with the content adapted culturally to ensure acceptability to Chinese children. Groups of six to eight families received 12 weekly × one-hour sessions in clinical setting. First and last sessions included parents; it was not clear whether the children participated. The first session focused on setting behavioural goals, action plans, environmental modifications and reward systems and how to help with homework. The last session was on how to continue to use the learned skills. Only children participated in sessions two to 11 and handbook-specified homework between sessions. 2. **Group two (n = 42):** waiting list *Analysis, including baseline characteristics, was based on the following sample sizes: intervention = 38 participants, waiting-list control = 30 participants

Qian 2017 *(Continued)*

	Attendance: 86.4% (38/44) of children in intervention group complied with the training, completing 10 or more sessions in the 12-session period. All missed group sessions were administered to the trainee individually. The percentage of the number of sessions administered individually was not specified.
Outcomes	**Primary outcomes** 1. Social skills: Weiss Functional Impairment Rating Scale, social activities subscale, parent-rated 2. Emotional competencies: BRIEF, emotional control subscale, parent-rated 3. General behaviour: BRIEF, total score, parent-rated **Secondary outcomes** 1. Core ADHD symptoms: ADHD-RS, fourth version, parent-rated **Outcome assessment:** post-intervention assessment
Notes	**Study ID:** NCT02327585 **Sponsorship source:** the study was supported by grants from the Beijing Municipal Science and Technology Commission (No. Z151100004015103), the Major State Basic Research Development Program of China (973 Program, No. 2014CB846100), National Key Research Plan of Ministry of Science and Technology of China (No. 2016YFC1306103), and the Capital Health Development Research Fund (No.2011-4024-04). **Year conducted:** 2017 **Duration of the study:** 12 weeks **Comments:** the study was conducted in accordance with the Declaration of Helsinki and was approved by the Institutional Review Board of Peking University Sixth Hospital. **Lead author's name:** Ying Qian **Institution:** Child Psychiatric Research Center, Peking University Sixth Hospital (Institute of Mental Health), National Clinical Research Center for Mental Disorders, Key Laboratory of Mental Health, Ministry of Health (Peing University) **Email:** yangli_pkuimh@bjmu.edu.cn, corresponding author Dr Li Yang **Address:** Beijing 100191, China

Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	**Comment:** randomised block design with participants randomised to a block that comprised a permutation of four participants, two for each group separately. The design was used to balance the individuals between the intervention and waiting-list groups.
Allocation concealment (selection bias)	Low risk	**Comment:** randomisation grouping concealed in envelopes and recruited participant notified of his or her group sequentially
Blinding of participants and personnel (performance bias) All outcomes	High risk	**Comment:** blinding not possible
Blinding of outcome assessment (detection bias) All outcomes	High risk	**Comment:** primarily used parent rating scales and parents were not blinded to group status. Unclear, however, if assessors of executive functioning performance tests were blinded to group status

Qian 2017 *(Continued)*

Incomplete outcome data (attrition bias) All outcomes	Unclear risk	**Comment:** 6/44 children in intervention group and 12/42 children in control (waiting-list) group dropped out. No reasons given for dropout. Baseline data for the 18 children who dropped out not provided and no analysis of attrition
Selective reporting (reporting bias)	High risk	**Comment:** The study registration specified the following secondary outcomes, which were not mentioned or reported in the paper: Conners; and Cambridge Neuropsychological Test Automatic Battery. The following measures were not mentioned in the study registration but were reported in the paper: BRIEF; WEISS Functional Impairment Scale-Parents.
Vested interest bias	Unclear risk	**Comment:** funding source not reported
Other sources of bias?	Low risk	**Comment:** no other sources of bias identified

Hannesdottir 2017

Methods	**Design:** RCT, cross-over
Participants	**Country:** Iceland **Setting:** clinical: Centre for Child Development and Behavior in Reykjavik **Sample size calculation:** not reported **Sample size:** 41 **Sex:** 29 (71%) = boys, 12 (29%) = girls **Age:** mean = 9.2 years (SD = 0.62, range = 8-10) **Ethnicity:** not reported **Socioeconomic status:** not reported **IQ:** IQ > 70 **Diagnosis:** ADHD combined = 36 (88%), ADHD inattentive = four (10%), ADHD hyperactive-impulsive = one (2%) **ADHD medication:** intervention = 100%, control = 85.7% **Cormorbidity:** not reported **Medications for comorbid disorders:** not reported **Inclusion criteria:** 1. aged eight to 10 years 2. previously diagnosed with ADHD by a licensed clinical psychologist and a medical doctor **Exclusion criteria:** 1. diagnosis of an autism spectrum disorder 2. IQ below 70 **Baseline characteristics:** significant difference in number of days between assessment. Concern with regard to practice effect, but this was not the case for the waiting-list control group, who had the fewest days between measurements.
Interventions	30 participants allocated to one of two groups and then crossed over

Hannesdottir 2017 *(Continued)*

1. **Group one (n = 16):** Participated in a social skills programme called "outSMARTers". A group of six children, worked in smaller groups of three children in a predetermined order at multiple training stations with a reward system for completing assignments and following rules. The therapists led discussions among the children necessary to solve the tasks and to reinforce appropriate behaviours in the group with tokens. Tokens could be used at the end of the session to buy rewards such as trading cards or movie tickets. 10 afternoon sessions of two hours each over the duration of five weeks.
2. **Group 2 (n = 14):** waiting list to receive the OutSMARTers programme later on

Attendance: no percentage of attendance reported as requirement. Participants in the intervention group attended more than 90% of the sessions and no child missed more than two sessions.

Outcomes

Primary outcomes

1. Social skills: SSRS, parent-rated
2. Emotional competencies: Emotion Regulation Checklist: Emotion Regulation subscale, parent-rated
3. General behaviour: SDQ, parent-rated

Secondary outcomes

1. Core ADHD symptoms: ADHD-RS: Hyperactivity/impulsivity subscale, parent-rated

Outcome assessment: post-intervention and follow-up three months after end of intervention

Notes

Study ID: none found

Sponsorship source: no financial support for the study reported

Year conducted: 2014

Duration of the study: 5 weeks plus 3 months follow-up

Comments: study was approved by the National Bioethics Committee in Iceland. We received additional information from authors on the randomisation procedure, allocation concealment, and assessment (Hannesdottir 2018 [pers comm]) and on the intervention and funding (Hannesdottir 2018b [pers comm]).

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Risk of bias

Bias	Authors' judgement	Support for judgement
Random sequence generation (selection bias)	Low risk	**Comment:** Parents who contacted the coordinator for their child to participate in the OutSMARTers programme were allocated the next number available (e.g. fifth parent to contact the coordinator got the number five). A computer-generated list with computer randomisation of numbers (1-50) allocated participants to either the treatment group or the waiting-list control group.
Allocation concealment (selection bias)	Unclear risk	**Comment:** allocation concealment not mentioned
Blinding of participants and personnel (performance bias)	High risk	**Comment:** it was not seen as possible to blind participants and personnel.

Hannesdottir 2017 *(Continued)*

All outcomes		
Blinding of outcome assessment (detection bias) All outcomes	High risk	**Comment:** outcomes were parent-reported (who were not blinded)
Incomplete outcome data (attrition bias) All outcomes	Low risk	**Comment:** only one child in intervention group one did not complete treatment, compared with two children in intervention group two.
Selective reporting (reporting bias)	Low risk	**Comment:** all measures described in methods section were reported in results tables. There was no study registration so it was not possible to judge whether any further measures had been included but not reported. It was not clear on what basis it was decided to use and report total scores or subscale scores for the included measures.
Vested interest bias	Low risk	**Comment:** the authors did not receive any funding for the study. The child centre is run by the government and is part of the primary healthcare service in Iceland. Thus, the government paid for the trainers/instructors and supplied the WISC subtests and other measures.
Other sources of bias?	Low risk	**Comment:** no other sources of bias identified

See Appendix 4

Characteristics of excluded studies [ordered by year of study]

Study	Reason for exclusion
Wolraich 1978	Ineligible intervention
Rosén 1984	Ineligible intervention
Horn 1990	Ineligible comparator
Kolko 1990	Ineligible patient population
Klein 1997	Ineligible intervention
Miranda 2002	Ineligible intervention
Kolko 1999	Ineligible intervention
Gonzalez 2002	Ineligible intervention
Feinfield 2004	Ineligible patient population
Döpfner 2004	Ineligible intervention
Corkum 2005	Parent training programme only
Gol 2005	Ineligible comparator
Langberg 2008	Ineligible intervention
Molina 2008	Ineligible comparator

Study	Reason for exclusion
Grasmann 2011	Ineligible patient population
Dodge 2011	Ineligible patient population
Lessard 2011	Ineligible patient population
Pumpuang 2012	Ineligible intervention
Power 2012a	Ineligible intervention
Cionek Szpak 2012	Ineligible intervention
Jans 2012	Ineligible intervention
ICBM 2012 Meeting	Ineligible intervention
Malti 2012	Ineligible patient population
Langberg 2012	Ineligible intervention
Ostberg 2012	Ineligible intervention
ESCAP 2013	Ineligible intervention
Abikoff 2013	Ineligible intervention
Lim-Ashworth 2013a	Ineligible patient population
Cipolla 2013	Ineligible patient population
Sibley 2013	Ineligible intervention
Sibley 2013a	Ineligible intervention
Vidal 2015	Adult population
Jans 2015	Ineligible intervention
Sibley 2016	Ineligible intervention
Bussing 2016	Ineligible patient population
Leung 2017	Ineligible patient population
NCT02574273	Ineligible comparator
Pfiffner 2018	Ineligible comparator
NCT03176108	Ineligible intervention

Characteristics of studies awaiting assessment [ordered by year of study]

NCT01019252

Methods	**Design:** RCT **Number of arms:** two
Participants	**Country:** USA **Sample size calculation:** not reported **Target sample size:** 66 **Eligible age:** age 14 to 18 years **Eligible sex:** all **Inclusion criteria:** 1. age 14 to 18 years 2. in high school 3. principal diagnosis of ADHD 4. stable prescription of medications for ADHD 5. childhood onset of ADHD 6. clinically significant ADHD symptoms **Exclusion criteria:** 1. comorbidity of: organic mental disorders; active substance abuse or dependence; diagnosis of conduct disorder; mental retardation or pervasive developmental disorder 2. active suicidality 3. other condition interfering with consent or participation 4. previous history of CBT therapy in adolescence
Interventions	1. **Group one:** behavioural: compensatory executive skills training, cognitive behavioural therapy. Participants provided with education about ADHD and instruction in organisational skills, reducing distractibility, and adaptive thinking. Twelve weekly treatment sessions 2. **Group two:** no intervention. Cross-over design with the participants on the waiting list receiving CBTafter the four-month assessment
Outcomes	1. ADHD symptoms: ADHD-RS, child- and parent-rated; CGI scale, clinician-rated 2. Secondary symptoms of ADHD (e.g. mood) **Time of assessment:** before randomisation, and at follow-up, four months and eight months after randomisation
Notes	**Study ID:** NCT01019252 **Sponsorship source:** R34MH083063, US NIH Grant/Contract; DDTR B4-TBI, National Institute of Mental Health **Study start date:** October 2009 **Study end date:** August 2012 **Status:** completed **Declared conflict of interest:** not reported **Comments:** none **Registrant's name:** Steven A Safren **Institution:** Massachusetts General Hospital

NCT01019252 *(Continued)*

Address: not reported

Email: not reported

Telephone: not reported

ADHD: attention deficit hyperactivity disorder
ADHD- RS: Attention Deficit Hyperactivity Disorder - Rating Scal
CBT: cognitive behavioural therapy
CGI: Clincal Global Impressions
RCT: randomised controlled trial

Characteristics of ongoing studies [ordered by year of study]

NCT01330849

Trial name or title	Toolkit for school behavior modification in children with attention-deficit/hyperactivity disorder (ADHD)
Methods	**Design:** RCT **Number of arms:** two
Participants	**Country:** Belgium **Sample size calculation:** not reported **Target sample size:** 100 **Eligible age:** five to 13 years old **Eligible sex:** all **Inclusion criteria:** 1. teacher must rate student's ADHD symptoms ≧ 90.9th percentile on the inattention or hyperactivity/impulsivity subscale of the VvGK (a Dutch translation of the Disruptive Behaviour Disorders Rating Scale) 2. maximum of two children per classroom may be included **Exclusion criteria:** 1. children with mental retardation (IQ < 70) automatically excluded from study, since study runs in schools
Interventions	1. **Group one:** behavioural: ADHD Toolkit. For children allocated to the active intervention arm, teachers will be trained to apply the ADHD Toolkit. Teachers will use the behaviour modification tool for 3 months. They will be trained to select target behaviours causing impairment for the child and will apply a systematic approach of increased intensity of monitoring and feedback for the behaviour, including training of appropriate behaviour. 2. **Group two:** waiting list control group. Children in the control group will receive no specific intervention, but are promised that their teachers will apply the school kit for them after the study.
Outcomes	1. Disruptive Behavior Disorder (DBD) Rating Scale: ADHD subscale, teacher-rated 2. DBD Rating Scale: ADHD subscale, parent-rated 3. DBD Rating Scale: Conduct Disorder and Oppositional Defiant Disorder subscales, teacher- and parent-rated 4. Target Behaviour Improvement Rating Scale, teacher-rated 5. Teacher Report Form: Internalising Problems subscale, teacher-rated 6. Child Behaviour Check List: Internalising Problems subscale, child-rated

NCT01330849 *(Continued)*

	7. Impairment Rating Scale, parent- and teacher-rated 8. Perceived Competence Scale for Children, child-rated 9. Student-Teacher Relationship Scale, rater not specified 10. Teachers Beliefs and Attitudes towards ADHD Scale, teacher-rated 11. Feasibility, Acceptability and Usefulness Scale, teacher- and child-rated **Time of assessment:** evaluation after using the ADHD Toolkit for a three-month period
Starting date	**Study start date:** December 2010 **Estimated study completion date:** June 2011 **Status:** unknown. Registered, with June 2011 as the estimated final date of data collection. No changes since registration. First posted 7 April 2011
Contact information	**Registrant name:** Marina Danckaerts **Institution:** Universitaire Ziekenhuizen, Leuven **Address:** Leuven, Vlaams-Brabant, Belgium, 3000 **Email:** marina.danckaerts@uzleuven.be **Telephone:** (+32)16343821
Notes	**Study ID:** NCT01330849 **Sponsorship source:** Universitaire Ziekenhuizen Leuven **Declared conflict of interest:** not reported **Comments:** none

Yang 2015

Trial name or title	Efficacy of an integrated behavioural therapy for children with attention-deficit/hyperactivity disorder: a randomized controlled trial
Methods	**Design:** RCT **Number of arms:** two
Participants	**Country:** China **Sample size calculation:** not reported **Target sample size:** 40 **Eligible age:** not reported **Eligible sex:** not reported **Inclusion criteria:** not reported **Exclusion criteria:** not reported
Interventions	1. **Group one:** integrated, behavioural, therapeutic programme for ADHD children. The integrated behavioural therapeutic programme was designed on the basis of Dawson and Guare's (2010) executive skill training programme, integrated with behaviour modification and social skill training.

Yang 2015 *(Continued)*

	Twelve weeks of group training, once a week, targeting time management, working memory, organisation, planning, and behaviour inhibition, etc. 2. **Group two:** waiting list control group
Outcomes	1. Attention Deficit Hyperactivity Disorder - Rating Scale 2. Behaviour Rating Inventory of Executive Function **Time of assessment:** pre- and post-training
Starting date	**Start date:** not reported **Estimated study completion date:** not reported **Status:** conference abstract but no publication identified
Contact information	**Lead author's name:** L Yang **Institution:** not reported **Address:** Beijing, China **Email:** not reported **Telephone:** not reported
Notes	**Study ID:** not reported **Sponsorship source:** not reported **Declared conflict of interest:** not reported **Comments:** none

IRCT201609186834N11

Trial name or title	The effect of psychoeducational group therapy of emotional intelligence on enhancing of emotional intelligence of adolescents with ADHD
Methods	**Design:** RCT **Number of arms:** two
Participants	**Country:** Iran **Sample size calculation:** not reported **Target sample size:** 76 **Eligible age:** 11 to 16 years old **Eligible sex:** both **Inclusion criteria:** • diagnosis of ADHD • age range of 11 to 16 years old • treated with methylphenidate • have no other physical illness or mental disorder according to the diagnosis of psychiatrist • have the ability to listen and sit in group therapy sessions and to respond to written questions

IRCT201609186834N11 *(Continued)*

	Exclusion criteria: • patients who discharge before the completion of group therapy sessions • patients with absence of more than two sessions of group therapy
Interventions	1. **Group one:** intervention group will receive group therapy (10 sessions) 2. **Group two:** control group will not receive any intervention
Outcomes	1. Emotional Intelligence Questionnaire 2. Revised Conner's Parent Rating Scale **Time of assessment:** before intervention, one week and three months after finishing the intervention
Starting date	**Study start date:** recruitment expected to start on 22 September 2016 **Estimated study completion date:** recruitment expected to end 19 February 2017 **Status:** no updates made to the registration
Contact information	**Registrant name:** Hossein Ebrahimi **Institution:** Tabriz University of Medical Sciences **Address:** Psychiatric Nursing Group, Tabriz Nursing and Midwifery Faculty, South Shariati Street **Email:** ebrahimih@tbzmed.ac.ir **Telephone:** +98 41 1475 1709
Notes	**Study ID:** IRCT201609186834N11 **Sponsorship source:** Research Vice- Chancellor, Tabriz University of Medical Sciences **Declared conflict of interest:** not reported **Comments:** none

NCT02937142

Trial name or title	Cognitive behavior group therapy in adolescents with attention deficit hyperactivity disorder
Methods	**Design:** RCT **Number of arms:** two
Participants	**Country:** Norway **Sample size calculation:** not reported **Target sample size:** 96 **Eligible age:** 14 to 18 years **Eligible sex:** all **Inclusion criteria:** • ADHD (ICD-10) • score ≧ 3 on CGI scale

NCT02937142 *(Continued)*

- informed consent patient
- informed consent parents
- if on medication, dosage is stable since at least two months

Exclusion criteria:

- mental retardation
- behavioural problems
- drug addiction
- psychosis
- suicidal

Interventions	1. **Group one:** cognitive behaviour group therapy, in weekly, 1.5-hour sessions during 12 weeks. Eight participants and two therapists per group, in addition to education on ADHD, and ADHD medication if indicated (TAU) 2. **Group two:** education on ADHD, and ADHD medication if indicated (TAU)
Outcomes	**Primary outcomes:** 1. Attention Deficit Hyperactivity Disorder - Rating Scale **Secondary outcomes:** 1. Clincal Global Impressions 2. Weiss Functional Impairment Rating Scale 3. Children's Global Assessment Scale 4. Screen for Child Anxiety Related Disorders 5. Mood and Feelings Questionnaire, Norwegian version 6. Adolescent Sleep Wake Scale 7. Rosenberg Self-Esteem Scale 8. General Perceived Self-Efficacy Scale 9. Behaviour Rating Inventory of Executive Function 10.Brief Problem Monitor **Time of assessment:** at baseline, immediately after the last group therapy session (after 12 weeks) and at follow-up (after nine months)
Starting date	**Study start date:** January 2017 **Estimated study completion date:** August 2020 **Status:** last verified January 2019
Contact information	**Registrant name:** Torunn Stene Nøvik, MD PhD **Institution:** St Olavs Hospital; Norwegian University of Science and Technology **Address:** not reported **Email:** torunn.stene.novik@stolav.no **Telephone:** not reported
Notes	**Study ID:** NCT02937142 **Sponsorship source:** St Olavs Hospital **Declared conflict of interest:** not reported **Comments:** none

ADHD: attention deficit hyperactivity disorder
CGI: Clincal Global Impressions
DBD: Disruptive behavior disorder
IQ: intelligence quotient
RCT: randomised clinical trial
TAU: treatment as usual
VvGK: Dutch translation of the Disruptive Behaviour Disorders Rating Scale
WFIRS: Weiss Functional Impairment Rating Scale

DATA AND ANALYSES

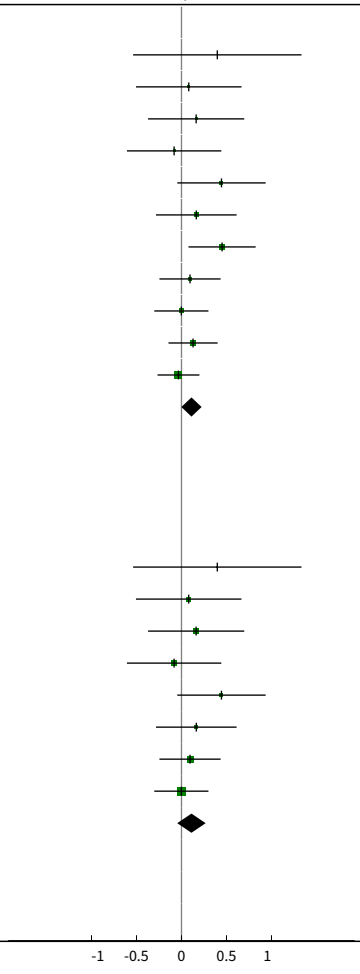
Comparison 1. Social skills

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Primary meta-analysis: Teacher-rated social skills at end of treatment	11		Std. Mean Difference (IV, Random, 95% CI)	Subtotals only
1.1 All eligible trials	11	1271	Std. Mean Difference (IV, Random, 95% CI)	0.11 [-0.00, 0.22]
1.2 Sensitivity analysis excluding the 3 trials with longest treatment duration	8	620	Std. Mean Difference (IV, Random, 95% CI)	0.11 [-0.05, 0.27]
2 Secondary meta-analyses: Social skills	19	2649	Std. Mean Difference (IV, Random, 95% CI)	0.29 [0.11, 0.47]
2.1 Teacher-rated social skills at longest follow-up	3	192	Std. Mean Difference (IV, Random, 95% CI)	0.06 [-0.22, 0.35]
2.2 Parent-rated social skills at end of treatment for all eligible trials	15	1609	Std. Mean Difference (IV, Random, 95% CI)	0.19 [0.06, 0.32]
2.3 Parent-rated social skills at longest follow-up	2	445	Std. Mean Difference (IV, Random, 95% CI)	0.13 [-0.35, 0.62]
2.4 Observer-rated social skills at end of treatment for all eligible trials	1	29	Std. Mean Difference (IV, Random, 95% CI)	2.88 [1.80, 3.96]
2.5 Participants-rated social skills at end of treatment for all eligible trials	5	344	Std. Mean Difference (IV, Random, 95% CI)	0.28 [-0.68, 1.23]
2.6 Participant-rated social skills at longest follow-up	1	30	Std. Mean Difference (IV, Random, 95% CI)	1.60 [0.77, 2.44]
3 Teacher-reported Walker-McConnell Scale of Social Competence and School Adjustment	1	46	Mean Difference (IV, Random, 95% CI)	1.06 [-0.47, 2.59]
4 Parent-rated Social Skills Scale (UCI)	1	18	Mean Difference (IV, Random, 95% CI)	9.70 [6.07, 13.33]
5 Child-rated Test of Social Skill Knowledge	1	18	Mean Difference (IV, Random, 95% CI)	4.20 [1.99, 6.41]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
6 Social Interaction Observation Code: Negative behaviour	1	68	Mean Difference (IV, Random, 95% CI)	0.20 [-0.11, 0.51]

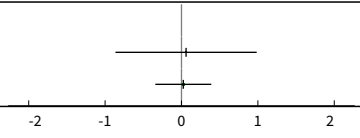
Analysis 1.1. Comparison 1 Social skills, Outcome 1 Primary meta-analysis: Teacher-rated social skills at end of treatment.

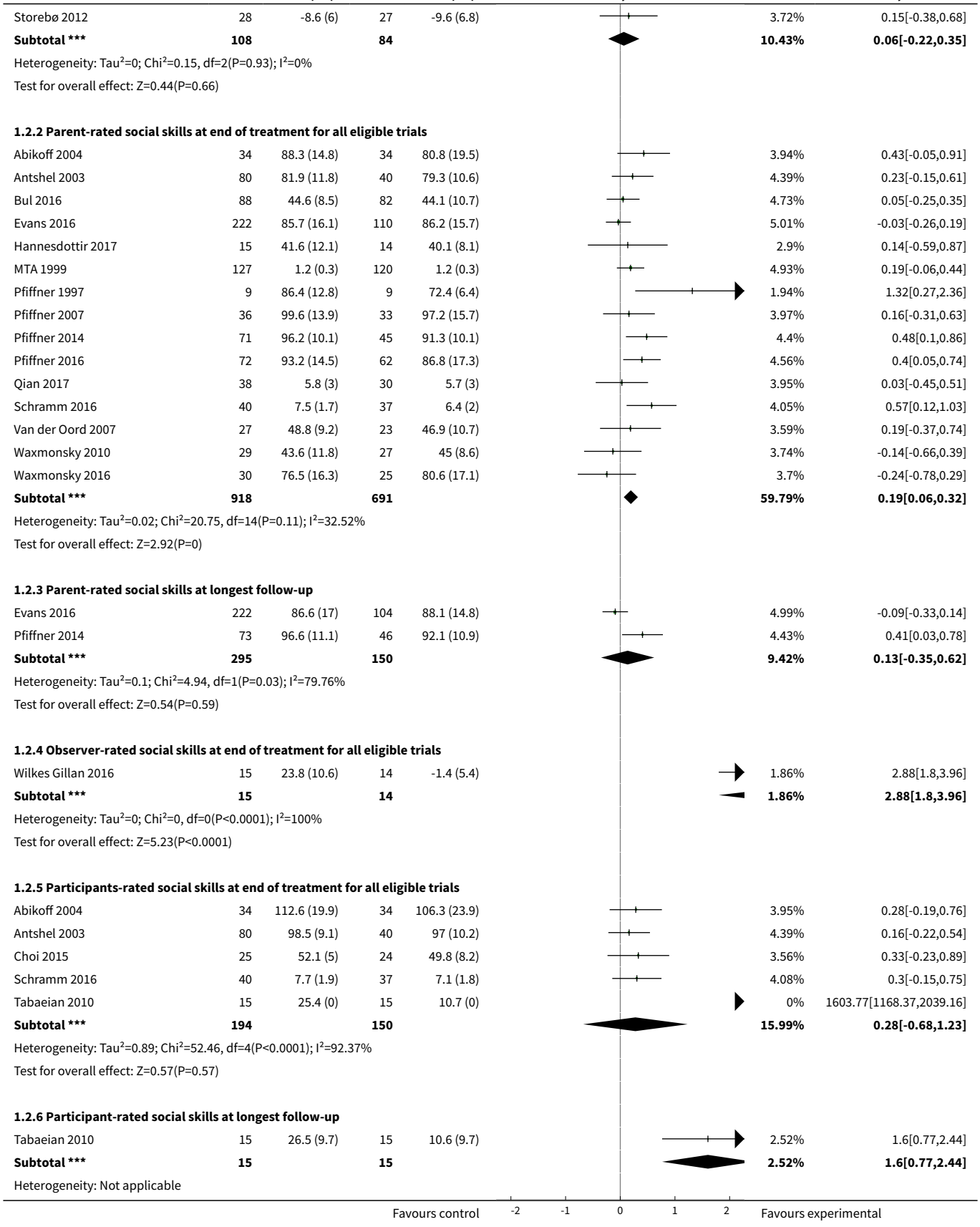
Study or subgroup	Experimental N	Experimental Mean(SD)	Control N	Control Mean(SD)	Std. Mean Difference Random, 95% CI	Weight	Std. Mean Difference Random, 95% CI
1.1.1 All eligible trials							
Pfiffner 1997	9	89.9 (13.5)	9	84.3 (13.3)		1.44%	0.4[-0.54,1.33]
Van der Oord 2007	24	36.6 (8.8)	21	35.8 (10.7)		3.68%	0.08[-0.51,0.67]
Storebø 2012	27	-6.9 (5.7)	27	-7.8 (5.9)		4.43%	0.16[-0.37,0.7]
Waxmonsky 2010	29	30.5 (10.4)	27	31.3 (8.2)		4.6%	-0.08[-0.61,0.44]
Pfiffner 2007	36	90.9 (8.8)	30	86.7 (10)		5.25%	0.44[-0.05,0.94]
Schramm 2016	40	5.9 (2)	37	5.5 (3)		6.31%	0.16[-0.28,0.61]
Pfiffner 2014	71	94.6 (10.1)	47	90.1 (9.6)		9.08%	0.45[0.08,0.82]
Pfiffner 2016	72	85.1 (11.4)	62	83.9 (13.8)		10.95%	0.09[-0.24,0.43]
Bul 2016	88	36.8 (6.9)	82	36.8 (7.2)		13.97%	-0[-0.3,0.3]
MTA 1999	108	1.2 (0.3)	99	1.2 (0.3)		16.97%	0.13[-0.14,0.4]
Evans 2016	222	10.2 (4.2)	104	10.3 (4.1)		23.31%	-0.03[-0.27,0.2]
Subtotal ***	**726**		**545**			**100%**	**0.11[-0,0.22]**
Heterogeneity: Tau²=0; Chi²=7.98, df=10(P=0.63); I²=0%							
Test for overall effect: Z=1.94(P=0.05)							
1.1.2 Sensitivity analysis excluding the 3 trials with longest treatment duration							
Pfiffner 1997	9	89.9 (13.5)	9	84.3 (13.3)		2.85%	0.4[-0.54,1.33]
Van der Oord 2007	24	36.6 (8.8)	21	35.8 (10.9)		7.27%	0.08[-0.51,0.67]
Storebø 2012	27	-6.9 (5.7)	27	-7.8 (5.9)		8.74%	0.16[-0.37,0.7]
Waxmonsky 2010	29	30.5 (10.4)	27	31.3 (8.2)		9.08%	-0.08[-0.61,0.44]
Pfiffner 2007	36	90.9 (8.8)	30	86.7 (10)		10.37%	0.44[-0.05,0.94]
Schramm 2016	40	5.9 (2)	37	5.5 (3)		12.45%	0.16[-0.28,0.61]
Pfiffner 2016	72	85.1 (11.4)	62	83.9 (13.8)		21.63%	0.09[-0.24,0.43]
Bul 2016	88	36.8 (6.9)	82	36.8 (7.2)		27.59%	-0[-0.3,0.3]
Subtotal ***	**325**		**295**			**100%**	**0.11[-0.05,0.27]**
Heterogeneity: Tau²=0; Chi²=3.3, df=7(P=0.86); I²=0%							
Test for overall effect: Z=1.37(P=0.17)							
Test for subgroup differences: Chi²=0, df=1 (P=1), I²=0%							



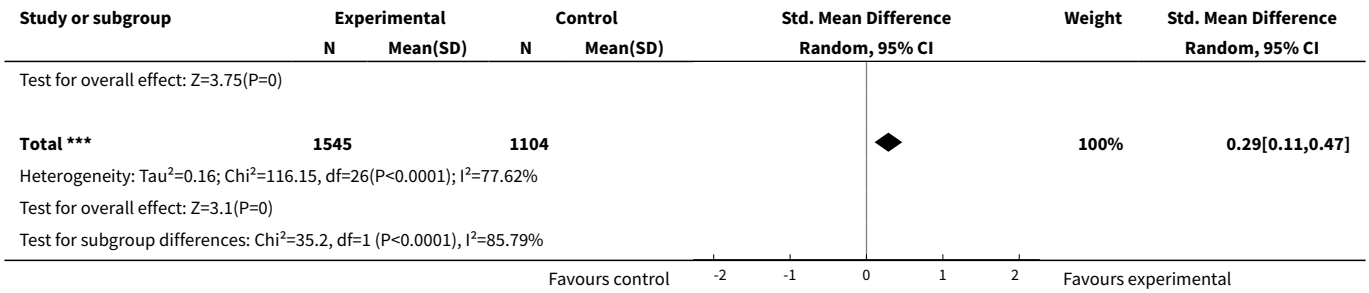
Analysis 1.2. Comparison 1 Social skills, Outcome 2 Secondary meta-analyses: Social skills.

Study or subgroup	Experimental N	Experimental Mean(SD)	Control N	Control Mean(SD)	Std. Mean Difference Random, 95% CI	Weight	Std. Mean Difference Random, 95% CI
1.2.1 Teacher-rated social skills at longest follow-up							
Pfiffner 1997	9	92.2 (14.2)	9	91.4 (11)		2.26%	0.06[-0.86,0.98]
Pfiffner 2014	71	93 (12.6)	48	92.7 (12.5)		4.45%	0.02[-0.34,0.39]

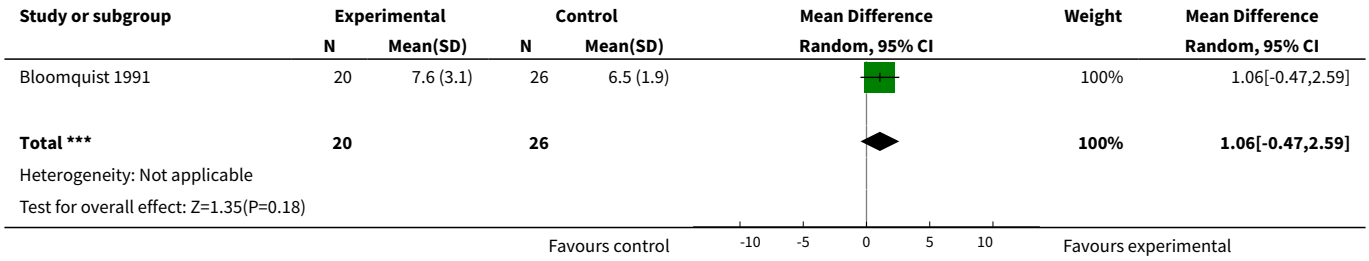




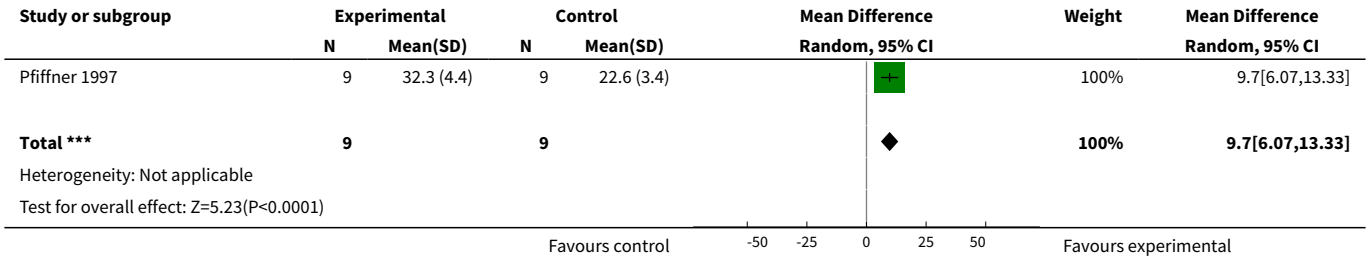
Study or subgroup	Experimental N	Experimental Mean(SD)	Control N	Control Mean(SD)	Std. Mean Difference Random, 95% CI	Weight	Std. Mean Difference Random, 95% CI
Storebø 2012	28	-8.6 (6)	27	-9.6 (6.8)		3.72%	0.15[-0.38,0.68]
Subtotal ***	**108**		**84**			**10.43%**	**0.06[-0.22,0.35]**
Heterogeneity: Tau²=0; Chi²=0.15, df=2(P=0.93); I²=0%							
Test for overall effect: Z=0.44(P=0.66)							
1.2.2 Parent-rated social skills at end of treatment for all eligible trials							
Abikoff 2004	34	88.3 (14.8)	34	80.8 (19.5)		3.94%	0.43[-0.05,0.91]
Antshel 2003	80	81.9 (11.8)	40	79.3 (10.6)		4.39%	0.23[-0.15,0.61]
Bul 2016	88	44.6 (8.5)	82	44.1 (10.7)		4.73%	0.05[-0.25,0.35]
Evans 2016	222	85.7 (16.1)	110	86.2 (15.7)		5.01%	-0.03[-0.26,0.19]
Hannesdottir 2017	15	41.6 (12.1)	14	40.1 (8.1)		2.9%	0.14[-0.59,0.87]
MTA 1999	127	1.2 (0.3)	120	1.2 (0.3)		4.93%	0.19[-0.06,0.44]
Pfiffner 1997	9	86.4 (12.8)	9	72.4 (6.4)		1.94%	1.32[0.27,2.36]
Pfiffner 2007	36	99.6 (13.9)	33	97.2 (15.7)		3.97%	0.16[-0.31,0.63]
Pfiffner 2014	71	96.2 (10.1)	45	91.3 (10.1)		4.4%	0.48[0.1,0.86]
Pfiffner 2016	72	93.2 (14.5)	62	86.8 (17.3)		4.56%	0.4[0.05,0.74]
Qian 2017	38	5.8 (3)	30	5.7 (3)		3.95%	0.03[-0.45,0.51]
Schramm 2016	40	7.5 (1.7)	37	6.4 (2)		4.05%	0.57[0.12,1.03]
Van der Oord 2007	27	48.8 (9.2)	23	46.9 (10.7)		3.59%	0.19[-0.37,0.74]
Waxmonsky 2010	29	43.6 (11.8)	27	45 (8.6)		3.74%	-0.14[-0.66,0.39]
Waxmonsky 2016	30	76.5 (16.3)	25	80.6 (17.1)		3.7%	-0.24[-0.78,0.29]
Subtotal ***	**918**		**691**			**59.79%**	**0.19[0.06,0.32]**
Heterogeneity: Tau²=0.02; Chi²=20.75, df=14(P=0.11); I²=32.52%							
Test for overall effect: Z=2.92(P=0)							
1.2.3 Parent-rated social skills at longest follow-up							
Evans 2016	222	86.6 (17)	104	88.1 (14.8)		4.99%	-0.09[-0.33,0.14]
Pfiffner 2014	73	96.6 (11.1)	46	92.1 (10.9)		4.43%	0.41[0.03,0.78]
Subtotal ***	**295**		**150**			**9.42%**	**0.13[-0.35,0.62]**
Heterogeneity: Tau²=0.1; Chi²=4.94, df=1(P=0.03); I²=79.76%							
Test for overall effect: Z=0.54(P=0.59)							
1.2.4 Observer-rated social skills at end of treatment for all eligible trials							
Wilkes Gillan 2016	15	23.8 (10.6)	14	-1.4 (5.4)		1.86%	2.88[1.8,3.96]
Subtotal ***	**15**		**14**			**1.86%**	**2.88[1.8,3.96]**
Heterogeneity: Tau²=0; Chi²=0, df=0(P<0.0001); I²=100%							
Test for overall effect: Z=5.23(P<0.0001)							
1.2.5 Participants-rated social skills at end of treatment for all eligible trials							
Abikoff 2004	34	112.6 (19.9)	34	106.3 (23.9)		3.95%	0.28[-0.19,0.76]
Antshel 2003	80	98.5 (9.1)	40	97 (10.2)		4.39%	0.16[-0.22,0.54]
Choi 2015	25	52.1 (5)	24	49.8 (8.2)		3.56%	0.33[-0.23,0.89]
Schramm 2016	40	7.7 (1.9)	37	7.1 (1.8)		4.08%	0.3[-0.15,0.75]
Tabaeian 2010	15	25.4 (0)	15	10.7 (0)		0%	1603.77[1168.37,2039.16]
Subtotal ***	**194**		**150**			**15.99%**	**0.28[-0.68,1.23]**
Heterogeneity: Tau²=0.89; Chi²=52.46, df=4(P<0.0001); I²=92.37%							
Test for overall effect: Z=0.57(P=0.57)							
1.2.6 Participant-rated social skills at longest follow-up							
Tabaeian 2010	15	26.5 (9.7)	15	10.6 (9.7)		2.52%	1.6[0.77,2.44]
Subtotal ***	**15**		**15**			**2.52%**	**1.6[0.77,2.44]**
Heterogeneity: Not applicable							



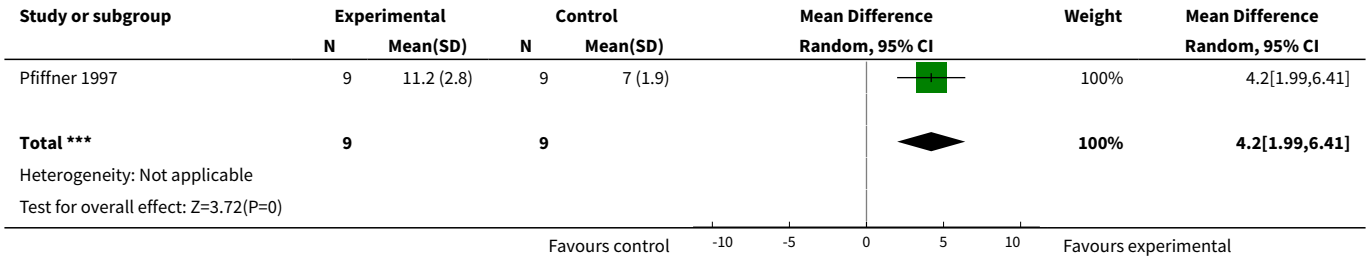
Analysis 1.3. Comparison 1 Social skills, Outcome 3 Teacher-reported Walker-McConnell Scale of Social Competence and School Adjustment.



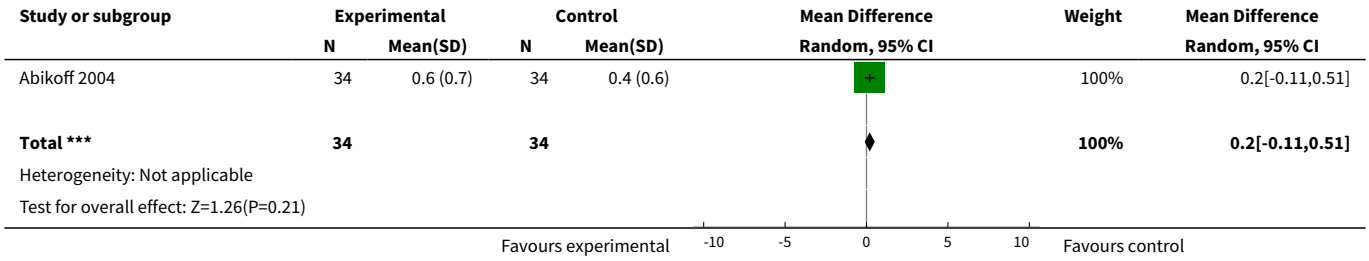
Analysis 1.4. Comparison 1 Social skills, Outcome 4 Parent-rated Social Skills Scale (UCI).



Analysis 1.5. Comparison 1 Social skills, Outcome 5 Child-rated Test of Social Skill Knowledge.



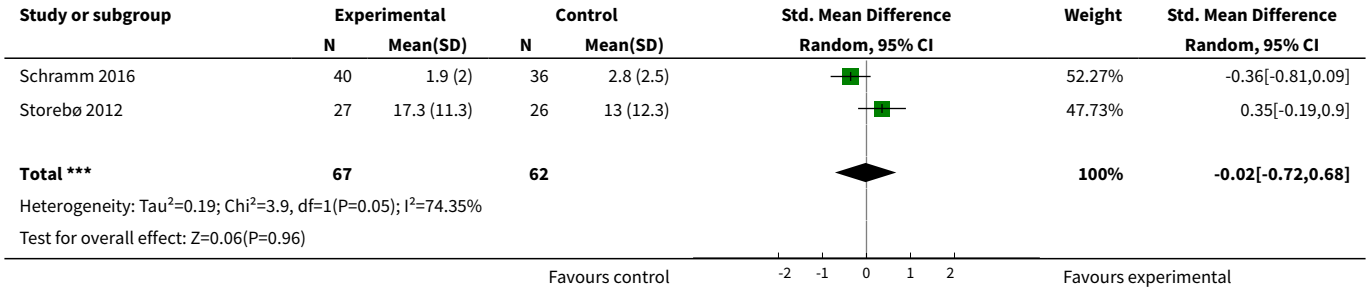
Analysis 1.6. Comparison 1 Social skills, Outcome 6 Social Interaction Observation Code: Negative behaviour.



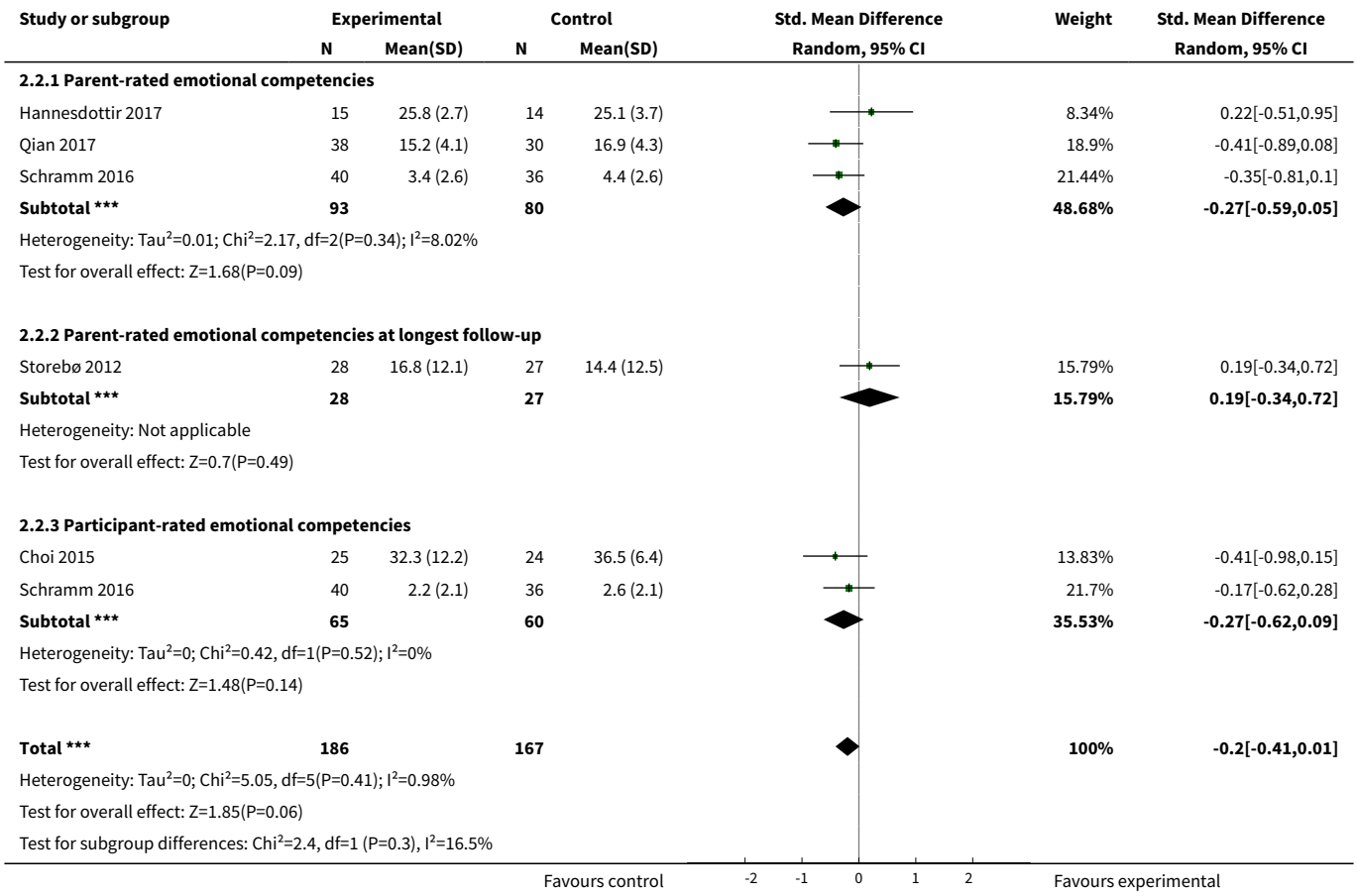
Comparison 2. Emotional competencies

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Primary meta-analysis: Teacher-rated emotional competencies at end of treatment	2	129	Std. Mean Difference (IV, Random, 95% CI)	-0.02 [-0.72, 0.68]
2 Secondary meta-analyses: Emotional competencies	5	353	Std. Mean Difference (IV, Random, 95% CI)	-0.20 [-0.41, 0.01]
2.1 Parent-rated emotional competencies	3	173	Std. Mean Difference (IV, Random, 95% CI)	-0.27 [-0.59, 0.05]
2.2 Parent-rated emotional competencies at longest follow-up	1	55	Std. Mean Difference (IV, Random, 95% CI)	0.19 [-0.34, 0.72]
2.3 Participant-rated emotional competencies	2	125	Std. Mean Difference (IV, Random, 95% CI)	-0.27 [-0.62, 0.09]

Analysis 2.1. Comparison 2 Emotional competencies, Outcome 1 Primary meta-analysis: Teacher-rated emotional competencies at end of treatment.



Analysis 2.2. Comparison 2 Emotional competencies, Outcome 2 Secondary meta-analyses: Emotional competencies.



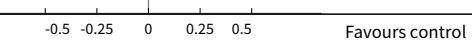
Comparison 3. General behaviour

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Primary meta-analysis: Teacher-rated general behaviour at end of treatment	8		Std. Mean Difference (IV, Random, 95% CI)	Subtotals only
1.1 All eligible trials	8	1002	Std. Mean Difference (IV, Random, 95% CI)	-0.06 [-0.19, 0.06]
1.2 Sensitivity analysis excluding the 2 trials with the longest treatment duration	6	422	Std. Mean Difference (IV, Random, 95% CI)	-0.09 [-0.28, 0.10]
1.3 Sensitivity analysis excluding the 2 largest trials	6	422	Std. Mean Difference (IV, Random, 95% CI)	-0.09 [-0.28, 0.10]
2 Secondary analyses: general behaviour	9	2034	Std. Mean Difference (IV, Random, 95% CI)	-0.26 [-0.40, -0.12]

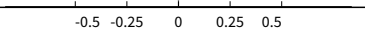
Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
2.1 Teacher-rated general behaviour at longest follow-up	4	637	Std. Mean Difference (IV, Random, 95% CI)	-0.10 [-0.27, 0.07]
2.2 Parent-rated general behaviour at end of treatment	8	995	Std. Mean Difference (IV, Random, 95% CI)	-0.38 [-0.61, -0.14]
2.3 Parent-rated general behaviour at longest follow-up	1	326	Std. Mean Difference (IV, Random, 95% CI)	-0.21 [-0.44, 0.03]
2.4 Participant-rated general behaviour at end of treatment	1	76	Std. Mean Difference (IV, Random, 95% CI)	-0.07 [-0.52, 0.38]

Analysis 3.1. Comparison 3 General behaviour, Outcome 1 Primary meta-analysis: Teacher-rated general behaviour at end of treatment.

Study or subgroup	Experimental N	Experimental Mean(SD)	Control N	Control Mean(SD)	Std. Mean Difference Random, 95% CI	Weight	Std. Mean Difference Random, 95% CI
3.1.1 All eligible trials							
Bloomquist 1991	20	1 (0.7)	16	0.9 (0.7)		3.72%	0.08[-0.57,0.74]
Storebø 2012	27	10 (12.6)	26	11.6 (11.9)		5.54%	-0.13[-0.67,0.41]
Waxmonsky 2016	30	5.3 (6.7)	25	5.7 (6.9)		5.71%	-0.05[-0.58,0.48]
Abikoff 2004	34	0.8 (0.5)	34	0.7 (0.6)		7.1%	0.18[-0.3,0.66]
Schramm 2016	40	1.9 (1.8)	36	1.9 (2)		7.94%	0.02[-0.43,0.47]
Pfiffner 2016	72	4.5 (4.4)	62	6.1 (5.1)		13.77%	-0.34[-0.68,0.01]
MTA 1999	134	0.6 (0.7)	120	0.7 (0.7)		26.53%	-0.06[-0.31,0.19]
Evans 2016	222	4.2 (5.6)	104	4.3 (5.2)		29.69%	-0.03[-0.26,0.2]
Subtotal ***	**579**		**423**			**100%**	**-0.06[-0.19,0.06]**
Heterogeneity: Tau^2=0; Chi^2=3.88, df=7(P=0.79); I^2=0%							
Test for overall effect: Z=0.98(P=0.33)							
3.1.2 Sensitivity analysis excluding the 2 trials with the longest treatment duration							
Bloomquist 1991	20	1 (0.7)	16	0.9 (0.7)		8.5%	0.08[-0.57,0.74]
Storebø 2012	27	10 (12.6)	26	11.6 (11.9)		12.65%	-0.13[-0.67,0.41]
Waxmonsky 2016	30	5.3 (6.7)	25	5.7 (6.9)		13.05%	-0.05[-0.58,0.48]
Abikoff 2004	34	0.8 (0.5)	34	0.7 (0.6)		16.21%	0.18[-0.3,0.66]
Schramm 2016	40	1.9 (1.8)	36	1.9 (2)		18.14%	0.02[-0.43,0.47]
Pfiffner 2016	72	4.5 (4.4)	62	6.1 (5.1)		31.44%	-0.34[-0.68,0.01]
Subtotal ***	**223**		**199**			**100%**	**-0.09[-0.28,0.1]**
Heterogeneity: Tau^2=0; Chi^2=3.72, df=5(P=0.59); I^2=0%							
Test for overall effect: Z=0.91(P=0.36)							
3.1.3 Sensitivity analysis excluding the 2 largest trials							
Bloomquist 1991	20	1 (0.7)	16	0.9 (0.7)		8.5%	0.08[-0.57,0.74]
Storebø 2012	27	10 (12.6)	26	11.6 (11.9)		12.65%	-0.13[-0.67,0.41]
Waxmonsky 2016	30	5.3 (6.7)	25	5.7 (6.9)		13.05%	-0.05[-0.58,0.48]
Abikoff 2004	34	0.8 (0.5)	34	0.7 (0.6)		16.21%	0.18[-0.3,0.66]
Schramm 2016	40	1.9 (1.8)	36	1.9 (2)		18.14%	0.02[-0.43,0.47]
Pfiffner 2016	72	4.5 (4.4)	62	6.1 (5.1)		31.44%	-0.34[-0.68,0.01]

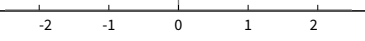


Study or subgroup	Experimental N	Experimental Mean(SD)	Control N	Control Mean(SD)	Std. Mean Difference Random, 95% CI	Weight	Std. Mean Difference Random, 95% CI
Subtotal ***	**223**		**199**			**100%**	**-0.09[-0.28,0.1]**
Heterogeneity: Tau²=0; Chi²=3.72, df=5(P=0.59); I²=0%							
Test for overall effect: Z=0.91(P=0.36)							
Test for subgroup differences: Chi²=0.08, df=1 (P=0.96), I²=0%							



Analysis 3.2. Comparison 3 General behaviour, Outcome 2 Secondary analyses: general behaviour.

Study or subgroup	Experimental N	Experimental Mean(SD)	Control N	Control Mean(SD)	Std. Mean Difference Random, 95% CI	Weight	Std. Mean Difference Random, 95% CI
3.2.1 Teacher-rated general behaviour at longest follow-up							
Bloomquist 1991	20	0.9 (0.4)	16	1.2 (0.8)		3.48%	-0.49[-1.16,0.18]
Evans 2016	222	4 (5.3)	104	3.8 (5.7)		11.07%	0.04[-0.19,0.27]
MTA 1999	119	0.5 (0.6)	101	0.6 (0.8)		10.14%	-0.19[-0.46,0.07]
Storebø 2012	28	10.5 (12.4)	27	12.8 (12.3)		4.9%	-0.18[-0.71,0.35]
Subtotal ***	**389**		**248**			**29.59%**	**-0.1[-0.27,0.07]**
Heterogeneity: Tau²=0; Chi²=3.23, df=3(P=0.36); I²=7.1%							
Test for overall effect: Z=1.17(P=0.24)							
3.2.2 Parent-rated general behaviour at end of treatment							
Evans 2016	222	8.3 (5.5)	104	8.6 (5.3)		11.07%	-0.05[-0.28,0.19]
Hannesdottir 2017	16	67.6 (11)	13	82.5 (9.6)		2.45%	-1.4[-2.22,-0.57]
MTA 1999	133	0.8 (0.6)	121	0.9 (0.7)		10.66%	-0.26[-0.51,-0.01]
Pfiffner 2016	72	6 (3.9)	62	9.4 (5.1)		7.98%	-0.76[-1.11,-0.4]
Qian 2017	38	135.9 (16.8)	30	146.1 (23.9)		5.49%	-0.5[-0.98,-0.01]
Schramm 2016	40	3.3 (2.1)	36	4 (1.8)		6%	-0.36[-0.82,0.09]
Storebø 2012	27	10 (12.6)	26	11.6 (11.9)		4.78%	-0.13[-0.67,0.41]
Waxmonsky 2016	30	116.8 (14.8)	25	119.5 (15.4)		4.87%	-0.18[-0.71,0.36]
Subtotal ***	**578**		**417**			**53.3%**	**-0.38[-0.61,-0.14]**
Heterogeneity: Tau²=0.07; Chi²=19.22, df=7(P=0.01); I²=63.57%							
Test for overall effect: Z=3.15(P=0)							
3.2.3 Parent-rated general behaviour at longest follow-up							
Evans 2016	222	7 (5.5)	104	8.1 (5.2)		11.05%	-0.21[-0.44,0.03]
Subtotal ***	**222**		**104**			**11.05%**	**-0.21[-0.44,0.03]**
Heterogeneity: Not applicable							
Test for overall effect: Z=1.73(P=0.08)							
3.2.4 Participant-rated general behaviour at end of treatment							
Schramm 2016	40	2.6 (1.6)	36	2.7 (1.6)		6.06%	-0.07[-0.52,0.38]
Subtotal ***	**40**		**36**			**6.06%**	**-0.07[-0.52,0.38]**
Heterogeneity: Not applicable							
Test for overall effect: Z=0.3(P=0.76)							
Total ***	**1229**		**805**			**100%**	**-0.26[-0.4,-0.12]**
Heterogeneity: Tau²=0.03; Chi²=26.61, df=13(P=0.01); I²=51.15%							
Test for overall effect: Z=3.6(P=0)							
Test for subgroup differences: Chi²=3.74, df=1 (P=0.29), I²=19.84%							

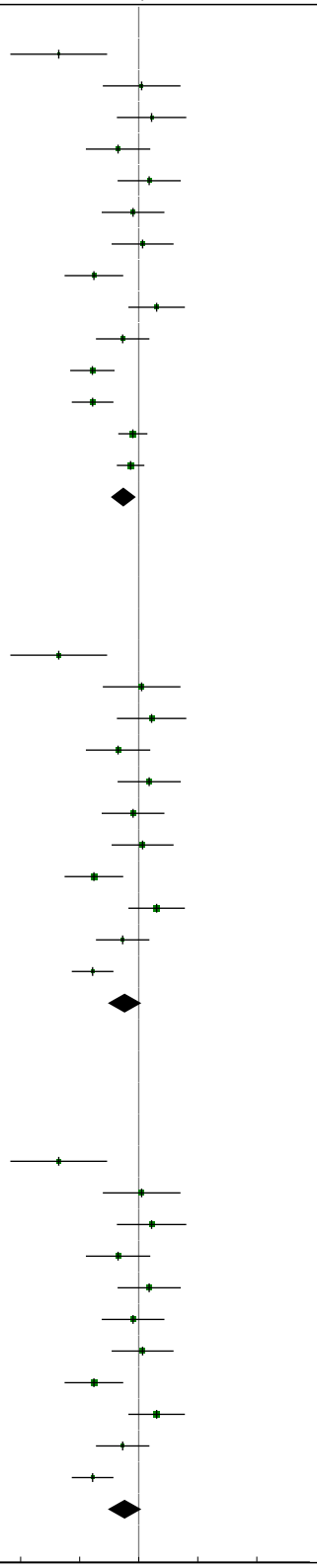


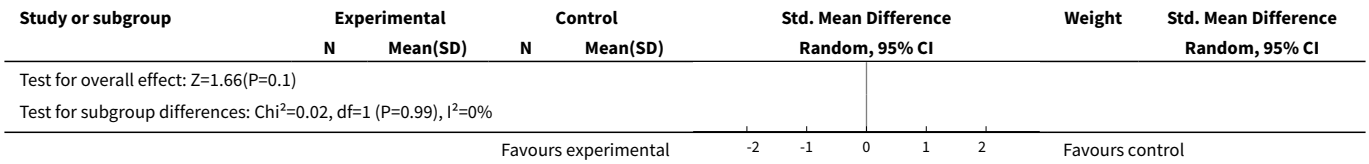
Comparison 4. Core ADHD symptoms

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Primary meta-analysis: Teacher-rated ADHD symptoms at end of treatment	14		Std. Mean Difference (IV, Random, 95% CI)	Subtotals only
1.1 All eligible trials	14	1379	Std. Mean Difference (IV, Random, 95% CI)	-0.26 [-0.47, -0.05]
1.2 Sensitivity analysis excluding the 3 trials with longest treatment duration	11	677	Std. Mean Difference (IV, Random, 95% CI)	-0.24 [-0.52, 0.04]
1.3 Sensitivity analysis excluding the 3 largest trials	11	677	Std. Mean Difference (IV, Random, 95% CI)	-0.24 [-0.52, 0.04]
2 Secondary meta-analyses: ADHD symptoms	15	2857	Std. Mean Difference (IV, Random, 95% CI)	-0.39 [-0.63, -0.15]
2.1 Teacher-rated ADHD symptoms at longest follow-up	5	582	Std. Mean Difference (IV, Random, 95% CI)	-0.11 [-0.28, 0.06]
2.2 Parent-rated ADHD symptoms at end of treatment for all eligible trials	11	1206	Std. Mean Difference (IV, Random, 95% CI)	-0.54 [-0.81, -0.26]
2.3 Parent-rated ADHD symptoms at longest follow-up	3	476	Std. Mean Difference (IV, Random, 95% CI)	-1.36 [-2.48, -0.25]
2.4 Participant-rated ADHD symptoms at end of treatment	2	106	Std. Mean Difference (IV, Random, 95% CI)	-0.77 [-2.31, 0.78]
2.5 Observer-rated ADHD symptoms at end of treatment for all eligible trials	2	107	Std. Mean Difference (IV, Random, 95% CI)	-3.15 [-9.88, 3.57]
2.6 Observer-rated ADHD symptoms at longest follow for all eligible trials	1	30	Std. Mean Difference (IV, Random, 95% CI)	3.95 [2.66, 5.23]
2.7 Single study result: Teacher-rated ADHD symptoms (inattention) at end of treatment	1	254	Std. Mean Difference (IV, Random, 95% CI)	0.01 [-0.23, 0.26]
2.8 Single study result: Teacher-rated ADHD symptoms (sluggish cognitive tempo) at end of treatment	1	66	Std. Mean Difference (IV, Random, 95% CI)	-0.29 [-0.78, 0.20]
2.9 Single study result: Participant-rated ADHD symptoms at longest follow-up	1	30	Std. Mean Difference (IV, Random, 95% CI)	1.62 [0.78, 2.46]

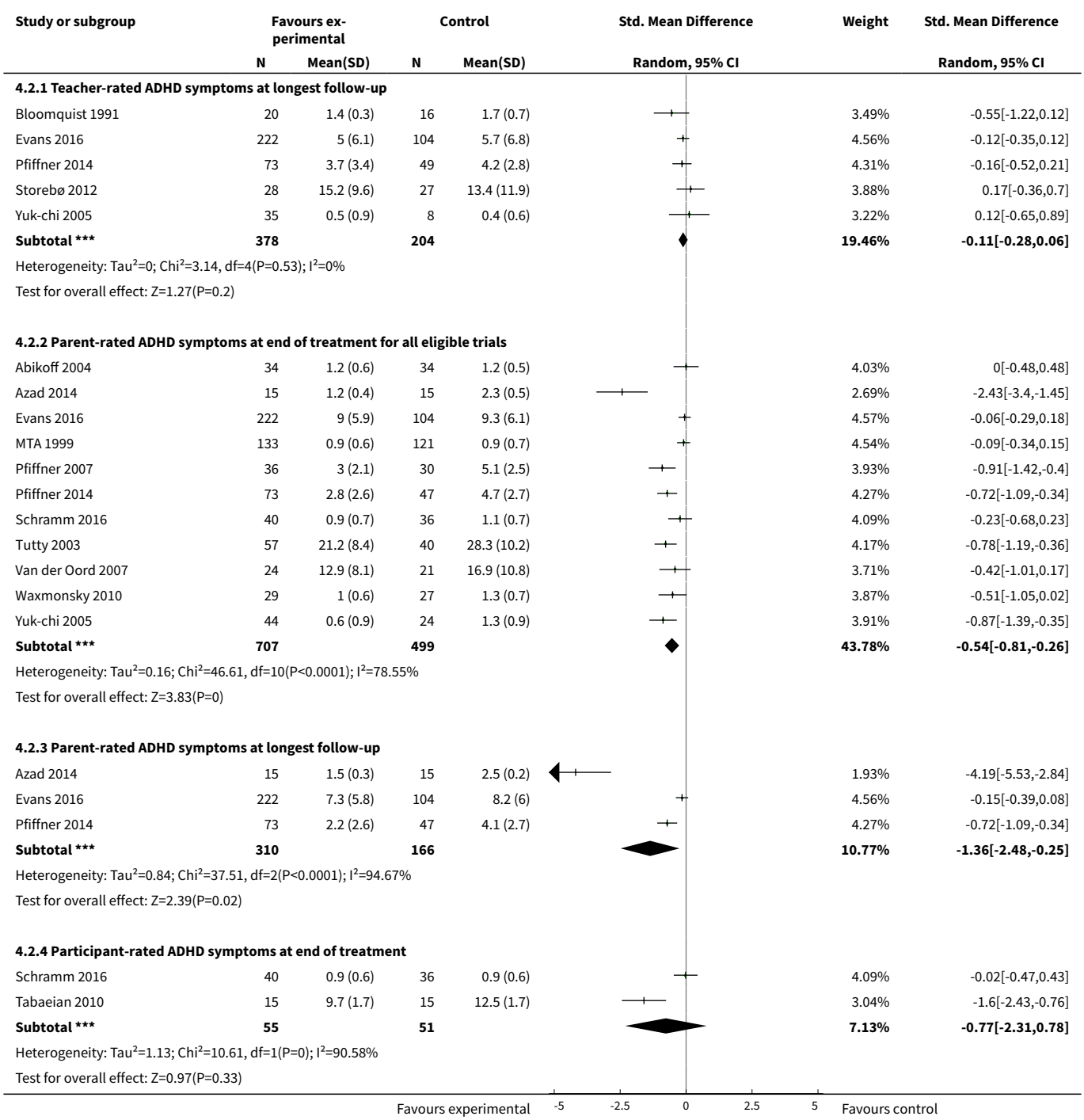
Analysis 4.1. Comparison 4 Core ADHD symptoms, Outcome 1 Primary meta-analysis: Teacher-rated ADHD symptoms at end of treatment.

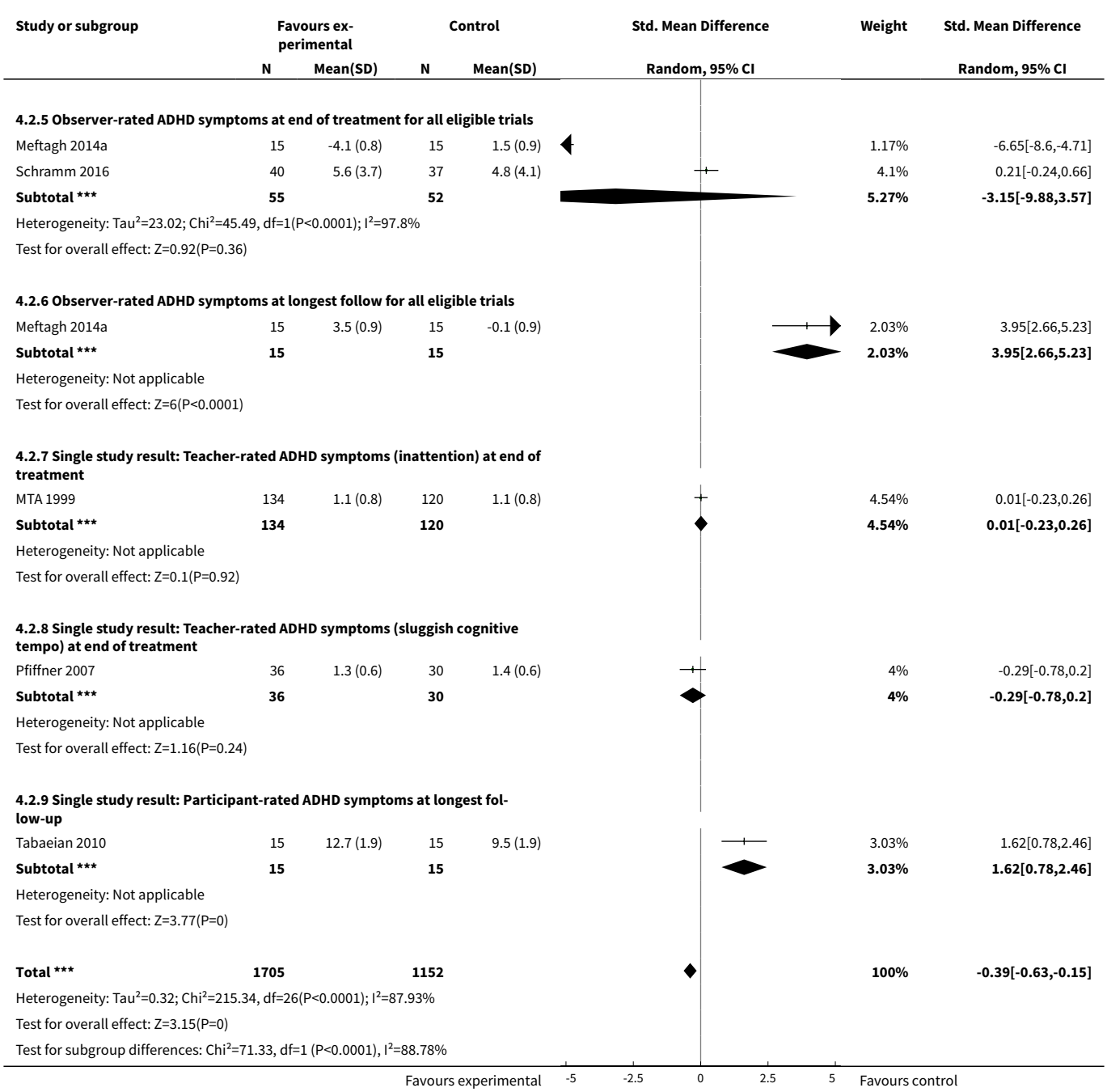
Study or subgroup	Experimental N	Experimental Mean(SD)	Control N	Control Mean(SD)	Std. Mean Difference Random, 95% CI	Weight	Std. Mean Difference Random, 95% CI
4.1.1 All eligible trials							
Hannesdottir 2017	15	61.7 (7.4)	14	71.4 (6.6)		4.2%	-1.35[-2.17,-0.54]
Bloomquist 1991	20	1.4 (0.6)	16	1.4 (0.6)		5.4%	0.05[-0.61,0.71]
Van der Oord 2007	24	15.9 (10.3)	21	13.8 (9)		6.03%	0.22[-0.37,0.81]
Yuk-chi 2005	35	0.5 (0.7)	21	0.8 (0.6)		6.45%	-0.35[-0.9,0.2]
Storebø 2012	27	16.2 (11.5)	27	13.9 (13.2)		6.56%	0.18[-0.36,0.71]
Waxmonsky 2016	30	17.9 (14)	25	19.3 (14.6)		6.59%	-0.1[-0.63,0.43]
Waxmonsky 2010	29	1 (0.8)	27	0.9 (0.7)		6.66%	0.07[-0.46,0.59]
Qian 2017	38	41.1 (7.5)	30	47.2 (8.5)		6.96%	-0.76[-1.26,-0.26]
Abikoff 2004	34	1.1 (0.7)	34	0.9 (0.6)		7.15%	0.3[-0.17,0.78]
Schramm 2016	40	0.6 (0.6)	36	0.8 (0.6)		7.44%	-0.27[-0.72,0.18]
Pfiffner 2014	73	2.9 (2.6)	49	5 (2.8)		8.31%	-0.78[-1.16,-0.41]
Pfiffner 2016	72	20 (9.3)	62	27.5 (9.8)		8.58%	-0.78[-1.13,-0.43]
MTA 1999	134	0.8 (0.7)	120	0.8 (0.7)		9.76%	-0.1[-0.35,0.15]
Evans 2016	222	5.3 (5.8)	104	6.1 (5.9)		9.9%	-0.14[-0.37,0.1]
Subtotal ***	**793**		**586**			**100%**	**-0.26[-0.47,-0.05]**
Heterogeneity: Tau^2=0.1; Chi^2=42.53, df=13(P<0.0001); I^2=69.43%							
Test for overall effect: Z=2.41(P=0.02)							
4.1.2 Sensitivity analysis excluding the 3 trials with longest treatment duration							
Hannesdottir 2017	15	61.7 (7.4)	14	71.4 (6.6)		6.36%	-1.35[-2.17,-0.54]
Bloomquist 1991	20	1.4 (0.6)	16	1.4 (0.6)		7.84%	0.05[-0.61,0.71]
Van der Oord 2007	24	15.9 (10.3)	21	13.8 (9)		8.57%	0.22[-0.37,0.81]
Yuk-chi 2005	35	0.5 (0.7)	21	0.8 (0.6)		9.03%	-0.35[-0.9,0.2]
Storebø 2012	27	16.2 (11.5)	27	13.9 (13.2)		9.14%	0.18[-0.36,0.71]
Waxmonsky 2016	30	17.9 (14)	25	19.3 (14.6)		9.18%	-0.1[-0.63,0.43]
Waxmonsky 2010	29	1 (0.8)	27	0.9 (0.7)		9.26%	0.07[-0.46,0.59]
Qian 2017	38	41.1 (7.5)	30	47.2 (8.5)		9.57%	-0.76[-1.26,-0.26]
Abikoff 2004	34	1.1 (0.7)	34	0.9 (0.6)		9.78%	0.3[-0.17,0.78]
Schramm 2016	40	0.6 (0.6)	36	0.8 (0.6)		10.07%	-0.27[-0.72,0.18]
Pfiffner 2016	72	20 (9.3)	62	27.5 (9.8)		11.2%	-0.78[-1.13,-0.43]
Subtotal ***	**364**		**313**			**100%**	**-0.24[-0.52,0.04]**
Heterogeneity: Tau^2=0.15; Chi^2=32.36, df=10(P=0); I^2=69.1%							
Test for overall effect: Z=1.66(P=0.1)							
4.1.3 Sensitivity analysis excluding the 3 largest trials							
Hannesdottir 2017	15	61.7 (7.4)	14	71.4 (6.6)		6.36%	-1.35[-2.17,-0.54]
Bloomquist 1991	20	1.4 (0.6)	16	1.4 (0.6)		7.84%	0.05[-0.61,0.71]
Van der Oord 2007	24	15.9 (10.3)	21	13.8 (9)		8.57%	0.22[-0.37,0.81]
Yuk-chi 2005	35	0.5 (0.7)	21	0.8 (0.6)		9.03%	-0.35[-0.9,0.2]
Storebø 2012	27	16.2 (11.5)	27	13.9 (13.2)		9.14%	0.18[-0.36,0.71]
Waxmonsky 2016	30	17.9 (14)	25	19.3 (14.6)		9.18%	-0.1[-0.63,0.43]
Waxmonsky 2010	29	1 (0.8)	27	0.9 (0.7)		9.26%	0.07[-0.46,0.59]
Qian 2017	38	41.1 (7.5)	30	47.2 (8.5)		9.57%	-0.76[-1.26,-0.26]
Abikoff 2004	34	1.1 (0.7)	34	0.9 (0.6)		9.78%	0.3[-0.17,0.78]
Schramm 2016	40	0.6 (0.6)	36	0.8 (0.6)		10.07%	-0.27[-0.72,0.18]
Pfiffner 2016	72	20 (9.3)	62	27.5 (9.8)		11.2%	-0.78[-1.13,-0.43]
Subtotal ***	**364**		**313**			**100%**	**-0.24[-0.52,0.04]**
Heterogeneity: Tau^2=0.15; Chi^2=32.36, df=10(P=0); I^2=69.1%							





Analysis 4.2. Comparison 4 Core ADHD symptoms, Outcome 2 Secondary meta-analyses: ADHD symptoms.

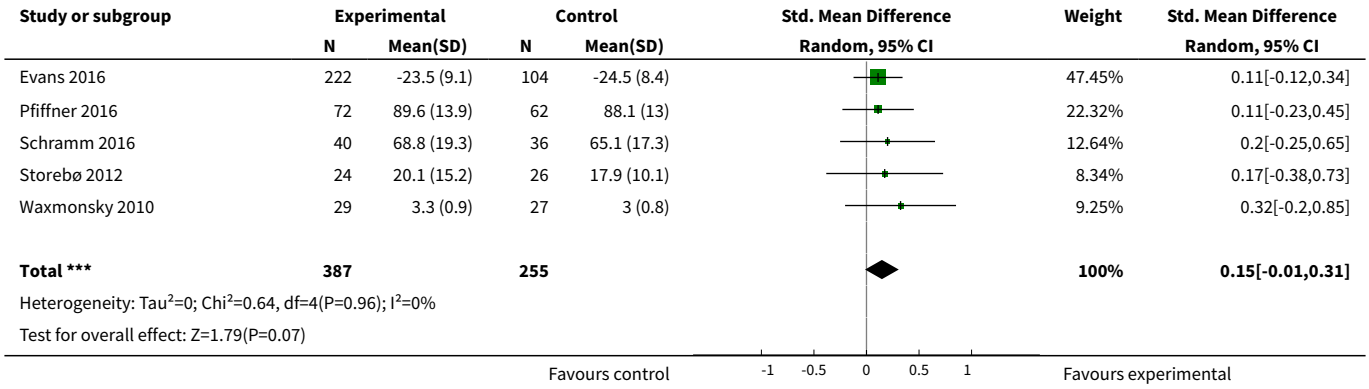




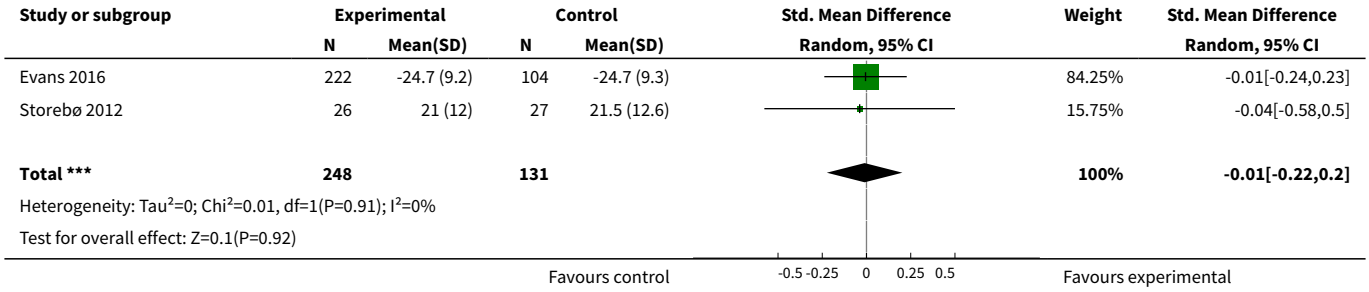
Comparison 5. Teacher-rated performance and grades in school

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 At end of treatment	5	642	Std. Mean Difference (IV, Random, 95% CI)	0.15 [-0.01, 0.31]
2 At longest follow-up	2	379	Std. Mean Difference (IV, Random, 95% CI)	-0.01 [-0.22, 0.20]

Analysis 5.1. Comparison 5 Teacher-rated performance and grades in school, Outcome 1 At end of treatment.



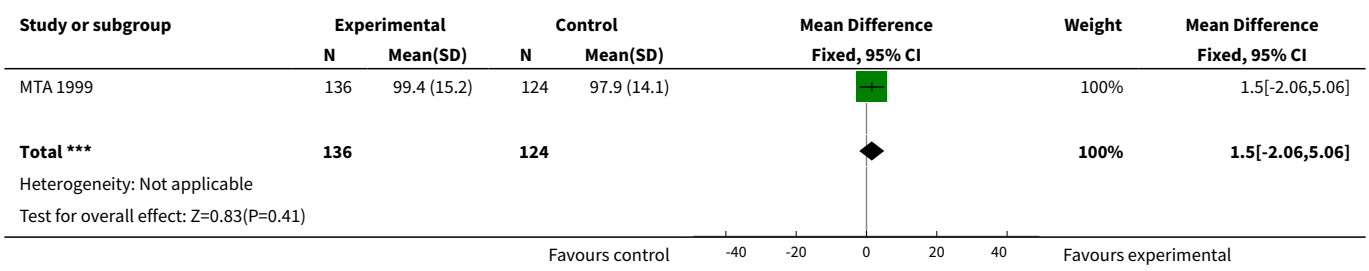
Analysis 5.2. Comparison 5 Teacher-rated performance and grades in school, Outcome 2 At longest follow-up.



Comparison 6. Observer-rated performance and grades in school

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Wescheler Individual Achievement Test	1	260	Mean Difference (IV, Fixed, 95% CI)	1.5 [-2.06, 5.06]

Analysis 6.1. Comparison 6 Observer-rated performance and grades in school, Outcome 1 Wescheler Individual Achievement Test.

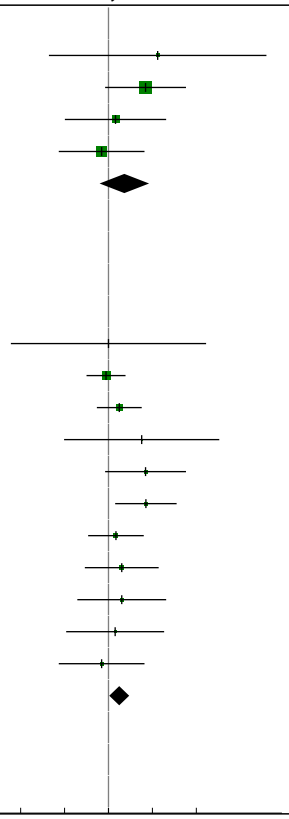


Comparison 7. TSA

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Teacher-rated social skills	11		Mean Difference (IV, Random, 95% CI)	Subtotals only
1.1 At end of treatment	4	185	Mean Difference (IV, Random, 95% CI)	1.80 [-1.01, 4.62]
1.2 All eligible trials	11	1271	Mean Difference (IV, Random, 95% CI)	1.22 [0.09, 2.36]

Analysis 7.1. Comparison 7 TSA, Outcome 1 Teacher-rated social skills.

Study or subgroup	Experimental N	Experimental Mean(SD)	Control N	Control Mean(SD)	Mean Difference Random, 95% CI	Weight	Mean Difference Random, 95% CI
7.1.1 At end of treatment							
Pfiffner 1997	9	89.9 (13.5)	9	84.3 (13.3)		5.18%	5.6[-6.78,17.98]
Pfiffner 2007	36	90.9 (8.8)	30	86.7 (10)		37.52%	4.22[-0.38,8.82]
Van der Oord 2007	24	36.6 (8.8)	21	35.8 (10.7)		23.91%	0.8[-4.96,6.56]
Waxmonsky 2010	29	30.5 (10.4)	27	31.3 (8.2)		33.38%	-0.78[-5.66,4.1]
Subtotal ***	**98**		**87**			**100%**	**1.8[-1.01,4.62]**
Heterogeneity: Tau²=0; Chi²=2.61, df=3(P=0.46); I²=0%							
Test for overall effect: Z=1.25(P=0.21)							
7.1.2 All eligible trials							
Bul 2016	88	35 (36.9)	82	35 (36.9)		1.04%	0[-11.11,11.11]
Evans 2016	222	90 (9.5)	104	90.3 (9.5)		26.16%	-0.28[-2.5,1.94]
MTA 1999	108	30 (9.4)	99	28.8 (9.4)		19.78%	1.23[-1.32,3.78]
Pfiffner 1997	9	87 (9.6)	9	83.2 (9.6)		1.65%	3.78[-5.05,12.61]
Pfiffner 2007	36	90.9 (8.8)	30	86.7 (10)		6.08%	4.22[-0.38,8.82]
Pfiffner 2014	71	90 (9.5)	47	85.7 (9.5)		10.53%	4.26[0.76,7.76]
Pfiffner 2016	72	80 (9.3)	62	79.2 (9.3)		12.86%	0.85[-2.31,4.01]
Schramm 2016	40	30 (9.4)	37	28.5 (9.4)		7.3%	1.51[-2.69,5.71]
Storebø 2012	27	30 (9.5)	27	28.5 (9.5)		5.04%	1.51[-3.55,6.57]
Van der Oord 2007	24	33 (9.5)	21	32.2 (9.5)		4.15%	0.76[-4.82,6.34]
Waxmonsky 2010	29	30.5 (10.4)	27	31.3 (8.2)		5.41%	-0.78[-5.66,4.1]
Subtotal ***	**726**		**545**			**100%**	**1.22[0.09,2.36]**
Heterogeneity: Tau²=0; Chi²=7.41, df=10(P=0.69); I²=0%							
Test for overall effect: Z=2.11(P=0.03)							
Test for subgroup differences: Chi²=0.14, df=1 (P=0.71), I²=0%							



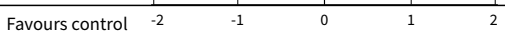
Comparison 8. Subgroup analysis 1: Children aged five to 11 years versus children aged 12 to 18 years

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Teacher-rated social skills	11	1271	Std. Mean Difference (IV, Random, 95% CI)	0.11 [-0.00, 0.22]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1.1 Children aged 5 to 11 years	10	1194	Std. Mean Difference (IV, Random, 95% CI)	0.11 [-0.01, 0.22]
1.2 Children aged 12 to 18 years	1	77	Std. Mean Difference (IV, Random, 95% CI)	0.16 [-0.28, 0.61]

Analysis 8.1. Comparison 8 Subgroup analysis 1: Children aged five to 11 years versus children aged 12 to 18 years, Outcome 1 Teacher-rated social skills.

Study or subgroup	Experimental N	Experimental Mean(SD)	Control N	Control Mean(SD)	Std. Mean Difference Random, 95% CI	Weight	Std. Mean Difference Random, 95% CI
8.1.1 Children aged 5 to 11 years							
Bul 2016	88	36.8 (6.9)	82	36.8 (7.2)		13.97%	-0[-0.3,0.3]
Evans 2016	222	10.2 (4.2)	104	10.3 (4.1)		23.31%	-0.03[-0.27,0.2]
MTA 1999	108	1.2 (0.3)	99	1.2 (0.3)		16.97%	0.13[-0.14,0.4]
Pfiffner 1997	9	89.9 (13.5)	9	84.3 (13.3)		1.44%	0.4[-0.54,1.33]
Pfiffner 2007	36	90.9 (8.8)	30	86.7 (10)		5.25%	0.44[-0.05,0.94]
Pfiffner 2014	71	94.6 (10.1)	47	90.1 (9.6)		9.08%	0.45[0.08,0.82]
Pfiffner 2016	72	85.1 (11.4)	62	83.9 (13.8)		10.95%	0.09[-0.24,0.43]
Storebø 2012	27	-6.9 (5.7)	27	-7.8 (5.9)		4.43%	0.16[-0.37,0.7]
Van der Oord 2007	24	36.6 (8.8)	21	35.8 (10.7)		3.68%	0.08[-0.51,0.67]
Waxmonsky 2010	29	30.5 (10.4)	27	31.3 (8.2)		4.6%	-0.08[-0.61,0.44]
Subtotal ***	**686**		**508**			**93.69%**	**0.11[-0.01,0.22]**
Heterogeneity: Tau^2=0; Chi^2=7.93, df=9(P=0.54); I^2=0%							
Test for overall effect: Z=1.81(P=0.07)							
8.1.2 Children aged 12 to 18 years							
Schramm 2016	40	5.9 (2)	37	5.5 (3)		6.31%	0.16[-0.28,0.61]
Subtotal ***	**40**		**37**			**6.31%**	**0.16[-0.28,0.61]**
Heterogeneity: Not applicable							
Test for overall effect: Z=0.72(P=0.47)							
Total ***	**726**		**545**			**100%**	**0.11[-0,0.22]**
Heterogeneity: Tau^2=0; Chi^2=7.98, df=10(P=0.63); I^2=0%							
Test for overall effect: Z=1.94(P=0.05)							
Test for subgroup differences: Chi^2=0.06, df=1 (P=0.81), I^2=0%							



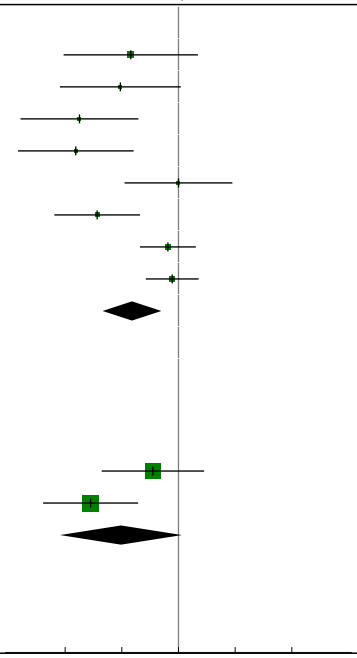
Comparison 9. Subgroup analysis 2: ADHD and comorbidity versus ADHD and no comorbidity

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Parent-rated ADHD symptoms at end of treatment	10		Std. Mean Difference (IV, Random, 95% CI)	Subtotals only
1.1 ADHD and comorbidity	8	1003	Std. Mean Difference (IV, Random, 95% CI)	-0.41 [-0.67, -0.15]

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1.2 ADHD and no comorbidity	2	173	Std. Mean Difference (IV, Random, 95% CI)	-0.51 [-1.05, 0.03]

Analysis 9.1. Comparison 9 Subgroup analysis 2: ADHD and comorbidity versus ADHD and no comorbidity, Outcome 1 Parent-rated ADHD symptoms at end of treatment.

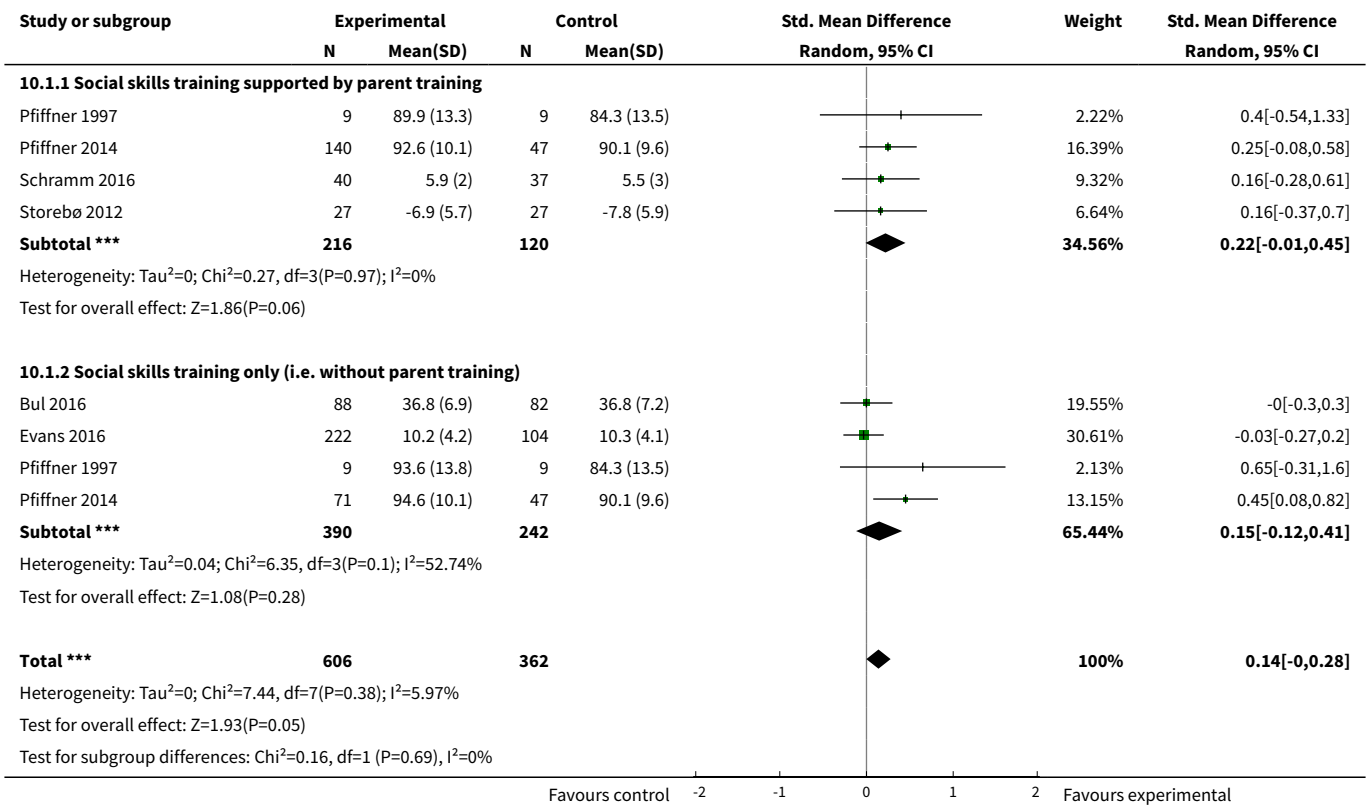
Study or subgroup	Experimental N	Experimental Mean(SD)	Control N	Control Mean(SD)	Std. Mean Difference Random, 95% CI	Weight	Std. Mean Difference Random, 95% CI
9.1.1 ADHD and comorbidity							
Van der Oord 2007	24	12.9 (8.1)	21	16.9 (10.8)		9.57%	-0.42[-1.01,0.17]
Waxmonsky 2010	29	1 (0.6)	27	1.3 (0.7)		10.57%	-0.51[-1.05,0.02]
Yuk-chi 2005	44	0.6 (0.9)	24	1.3 (0.9)		10.81%	-0.87[-1.39,-0.35]
Pfiffner 2007	36	3 (2.1)	30	5.1 (2.5)		10.99%	-0.91[-1.42,-0.4]
Abikoff 2004	34	1.2 (0.6)	34	1.2 (0.5)		11.64%	0[-0.48,0.48]
Pfiffner 2014	73	2.8 (2.6)	47	4.7 (2.7)		13.59%	-0.72[-1.1,-0.34]
MTA 1999	133	0.9 (0.6)	121	0.9 (0.7)		16.29%	-0.09[-0.34,0.15]
Evans 2016	222	9 (6)	104	9.3 (6.1)		16.54%	-0.06[-0.29,0.18]
Subtotal ***	**595**		**408**			**100%**	**-0.41[-0.67,-0.15]**
Heterogeneity: Tau^2=0.09; Chi^2=24, df=7(P=0); I^2=70.83%							
Test for overall effect: Z=3.1(P=0)							
9.1.2 ADHD and no comorbidity							
Schramm 2016	40	0.9 (0.7)	36	1.1 (0.7)		48.78%	-0.23[-0.68,0.23]
Tutty 2003	57	21.2 (8.4)	40	28.3 (10.2)		51.22%	-0.78[-1.19,-0.36]
Subtotal ***	**97**		**76**			**100%**	**-0.51[-1.05,0.03]**
Heterogeneity: Tau^2=0.1; Chi^2=3.05, df=1(P=0.08); I^2=67.26%							
Test for overall effect: Z=1.85(P=0.06)							
Test for subgroup differences: Chi^2=0.1, df=1 (P=0.75), I^2=0%							



Comparison 10. Subgroup analysis 3: Social skills training only versus social skills training supported by parent training

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Teacher-rated social skills at end of treatment	6	968	Std. Mean Difference (IV, Random, 95% CI)	0.14 [-0.00, 0.28]
1.1 Social skills training supported by parent training	4	336	Std. Mean Difference (IV, Random, 95% CI)	0.22 [-0.01, 0.45]
1.2 Social skills training only (i.e. without parent training)	4	632	Std. Mean Difference (IV, Random, 95% CI)	0.15 [-0.12, 0.41]

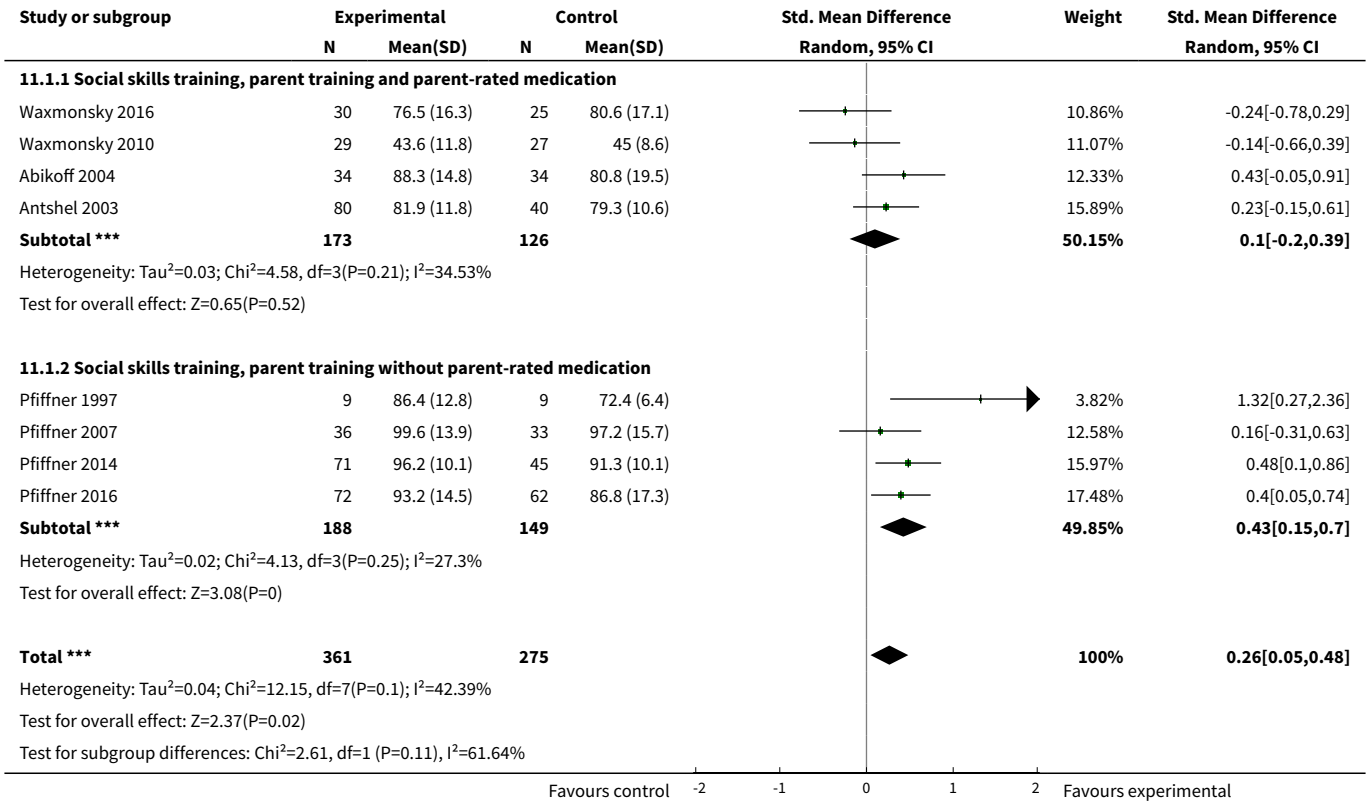
Analysis 10.1. Comparison 10 Subgroup analysis 3: Social skills training only versus social skills training supported by parent training, Outcome 1 Teacher-rated social skills at end of treatment.



Comparison 11. Subgroup analysis 4: Social skills training, parental training and medication versus social skills training and parental training without medication

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Parent-rated social skills at end of treatment	8	636	Std. Mean Difference (IV, Random, 95% CI)	0.26 [0.05, 0.48]
1.1 Social skills training, parent training and parent-rated medication	4	299	Std. Mean Difference (IV, Random, 95% CI)	0.10 [-0.20, 0.39]
1.2 Social skills training, parent training without parent-rated medication	4	337	Std. Mean Difference (IV, Random, 95% CI)	0.43 [0.15, 0.70]

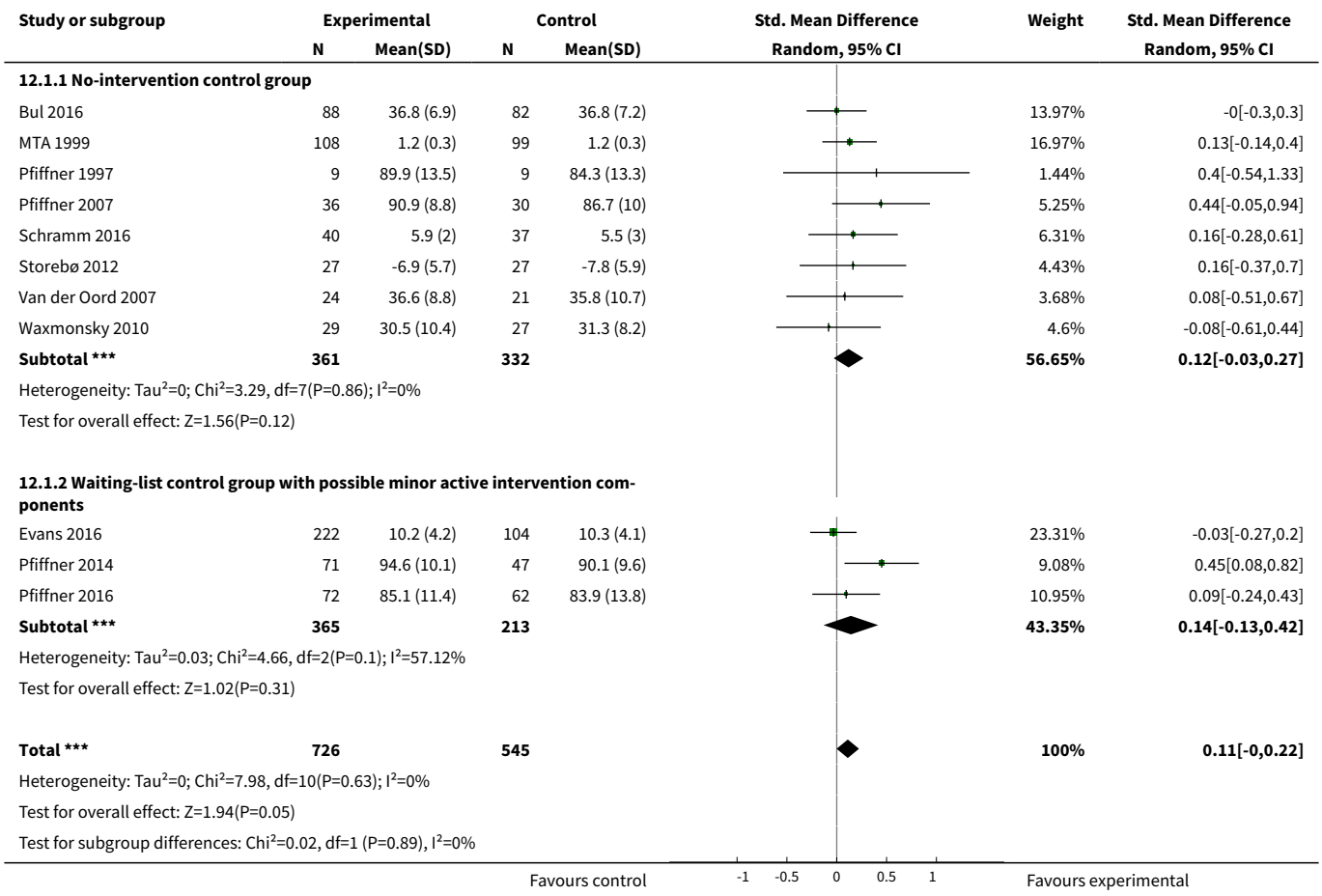
Analysis 11.1. Comparison 11 Subgroup analysis 4: Social skills training, parental training and medication versus social skills training and parental training without medication, Outcome 1 Parent-rated social skills at end of treatment.



Comparison 12. Subgroup analysis 5: No-intervention control group versus waiting-list control group with possible minor active intervention components

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Teacher-rated social skills at end of treatment	11	1271	Std. Mean Difference (IV, Random, 95% CI)	0.11 [-0.00, 0.22]
1.1 No-intervention control group	8	693	Std. Mean Difference (IV, Random, 95% CI)	0.12 [-0.03, 0.27]
1.2 Waiting-list control group with possible minor active intervention components	3	578	Std. Mean Difference (IV, Random, 95% CI)	0.14 [-0.13, 0.42]

Analysis 12.1. Comparison 12 Subgroup analysis 5: No-intervention control group versus waiting-list control group with possible minor active intervention components, Outcome 1 Teacher-rated social skills at end of treatment.



ADDITIONAL TABLES

Table 1. Methods not used in this update

Section	Protocol	Review
Types of outcome measures	We did not define what we meant by adverse events.	We added a definition of adverse events according to the International Committee of Harmonization guidelines (ICH 1996), because many of the studies included pharmaceutical treatment and it is not known whether social skills training might have adverse events.
	We stated that we would measure the three primary and the first two secondary outcomes at short-term (up to six months), medium-term (six to 12 months), and long-term (more than 12 months) follow-up.	We changed this to end of treatment and at the longest follow-up because we did not have data for the planned three time points.
	We did not prespecify the most important comparisons for the 'Summary of findings' table.	We reported a total of seven outcomes in the 'Summary of findings' table as

Table 1. Methods not used in this update *(Continued)*

		per Cochrane recommendations; three primary outcomes (social skills, emotional competencies and general behaviour) and the first secondary outcome (ADHD symptoms).
Assessment of risk of bias in included studies	We had not planned to evaluate blinding of participants and personnel.	We assessed the blinding of participants and personnel, as this is also important to assess in trials investigating psychosocial interventions, even if it is very difficult to do in these types of trials.
	We stated that we would only use studies at low risk (or lower risk) of bias in the meta-analysis.	We changed the decision to restrict the meta-analysis to studies at comparable risk of bias (for example, all low risk of bias, all unclear risk of bias, or all high risk of bias), and performed sensitivity analyses accordingly. We decided to change this as there were very few trials at low risk of bias in this field.
	We stated that we would assess 'baseline imbalance' and 'early stopping' as risk of bias domains.	We did not assess these baseline domains. The randomisation procedure should give an even distribution of confounding factors and baseline imbalance.
Dealing with missing data	We intended to assess the impact of missing dichotomous data in the results by applying procedures for 'intention-to-treat' and 'best-case/worst-case scenarios'.	We were unable to perform this analysis as there were no dichotomous data.
Measures of treatment effect	**Dichotomous data** We planned to analyse dichotomous data as risk ratios and present these with 95% confidence intervals (CIs), and to calculate the risk difference and, where there was a significant effect with the intervention and reasonable homogeneity of studies (that is, clinical, methodological, or statistical heterogeneity was within reasonable limits), the number needed to treat for an additional beneficial outcome (Higgins 2011, Section 9.2).	We did not do this as there were no dichotomous data.
Unit of analysis issues	**Cluster-randomised studies** We stated that we thought investigators would have presented their results after appropriately checking for clustering effects (robust standard errors or hierarchical linear models). We planed to contact the investigators for further information if this was unclear. Where appropriate checks were not used, we planned to request and re-analyse individual participant data using multilevel models that check for clustering. Following this, we planned to analyse effect sizes and standard errors in RevMan 5 (Review Manager 2014), using the generic inverse method (Higgins 2011, Section 9.3.2). If there was insufficient information to check for clustering, we would have entered outcome data into RevMan 5 using individuals as the units of analysis, and then conducting a sensitivity analysis to assess the potential biasing effects of inadequately controlled clustered studies (Donner 2002). See 'Sensitivity analysis' below.	We did not find any cluster-randomised trials.

Table 1. Methods not used in this update *(Continued)*

Assessment of reporting biases	We did not state that we would use Egger's test to test for small-study effects.	We performed Egger's statistical test for small-study effects.
Subgroup analysis and investigation of heterogeneity	We planned to perform subgroup analyses according to the following categories. 1. Social skills training in a group setting compared to individual social skills training 2. Children with ADHD plus depression, attachment disorder, or anxiety disorders compared to children with ADHD without these comorbidities 3. Studies with low risk of bias compared to studies with high risk	We were not able to perform these subgroup analyses due to lack of sufficient data.
Sensitivity analysis	We stated that we would repeat the analysis taking into consideration the different methods used to handle the missing data and the potential biasing effects of inadequately controlled clustered studies.	We did not perform this analysis due to a lack of necessary data and, consequently, have analysed the data as reported.

ADHD: attention deficit hyperactivity disorder.

Table 2. Measures of social skills from included studies

Measures	Description	Number of studies	Ratings			
			Teacher	Parent	Child	Observer
Social Skills Rating Scale (SSRS)	Three-point Likert scale, ranging from zero (never) to two (often); higher scores indicate better social skills	9	Pfiffner 1997	Pfiffner 1997	-	-
			MTA 1999	MTA 1999	MTA 1999	-
			Pfiffner 2007	-	-	-
			-	Antshel 2003	Antshel 2003	-
			-	Abikoff 2004	Abikoff 2004	-
			Van der Oord 2007	-	-	-
			Waxmonsky 2010	-	-	-
			-	Waxmonsky 2016	-	-
			-	Hannesdottir 2017	-	-
SSRS: Cooperation Subscale	Three-point Likert scale, ranging from zero (never) to two (often); higher scores indicate better cooperation	1	Bul 2016	Bul 2016	-	-

Table 2. Measures of social skills from included studies *(Continued)*

Social Skills Improvement System (SSIS)	Four-point rating scale, ranging from zero (never) to three (almost always); higher scores indicate better social skills.	3	Pfiffner 2014	Pfiffner 2014	-	-
			Evans 2016	Evans 2016	-	-
			Pfiffner 2016	Pfiffner 2016	-	-
Teacher Report - Walker-McConnell Scale of Social Competence and School Adjustment	Five-point rating scale, ranging from one (never occurs) to five (frequently occurs); higher scores indicate better social skills	1	Bloomquist 1991	-	-	-
Weiss Functional Impairment Scale - Parent Form (WFIRS-P): Social Activities Subscale	Four-point rating scale, ranging from zero (never or not at all) to three (very often or very much); higher scores indicate better social skills	1	-	Qian 2017	-	-
Strengths and Difficulties Questionnaire (SDQ): Prosocial Behavior Subscale	Three-point rating scale, ranging from zero (not true) to two (certainly true); higher scores indicate better social skills.	1	Schramm 2016	Schramm 2016	Schramm 2016	-
Conners Behavior Rating Scale (CBRS): Social Problems Subscale	Four-point rating scale, ranging from zero (not true at all) to three (very much true); higher scores indicate better social skills	1	Storebø 2012	-	-	-
Social Interaction Observation Code	Recording frequencies of positive, negative or neutral behaviour, including observations of negative behaviour	1	-	-	-	Abikoff 2004
Test of Social Skill Knowledge	Scored from one (low knowledge) to 15 (high knowledge); higher scores indicate better social skills	1	-	-	-	Pfiffner 1997
Observation in Classrooms	Observing children for three × eight-minute periods during a one-hour period for two categories of behaviour: play behaviour and social behaviour	1	-	-	-	Cohen 1981
Test of Playfulness: Skillfulness	Four-point rating scale, ranging from zero (unskilled) to three (highly skilled); higher scores indicate better social skills	1	-	-	-	Wilkes Gillan 2016

Table 3. Measures of emotional competencies from included studies

Measures	Description	Number of studies	Ratings			
			Teacher	Parent	Child	Observer
Emotion Expression Scale for Children	Five-point Likert scale, ranging from one (not at all) to five (extremely true); higher scores indicate poorer emotion awareness and greater reluctance to express emotion	1	-	-	Choi 2015	-
Emotion Regulation Checklist (ERC): Emotion Regulation Subscale	Four-point rating scale, ranging from one (never) to four (almost always); higher scores indicate better emotional regulation	1	-	Hannesdottir 2017	-	-
Behavior Rating Inventory of Executive Function (BRIEF): Emotion Control Subscale	Three-point rating scale, ranging from one (never) to three (often); lower scores indicate better emotional control.	1	-	Qian 2017	-	-
Conners Behavior Rating Scale (CBRS): Emotional Index	Four-point rating scale, ranging from zero (not true at all) to three (very much true); higher scores indicate better emotional competence	1	Storebø 2012	-	-	-
Strengths and Difficulties Questionnaire (SDQ): Emotional Symptoms Subscale	Three-point rating scale, ranging from zero (not true) to two (certainly true); higher scores indicate lower emotional competence	1	Schramm 2016	Schramm 2016	Schramm 2016	-
Richman-Graham Scale	Three-point rating scale, ranging from zero (no difficulties) to two (occurs frequently). Higher scores indicate lower emotional competence.	1	-	Cohen 1981	-	-

Table 4. Measures of general behaviour from included studies

Measures	Description	Number of studies	Ratings			
			Teacher	Parent	Child	Observer
Child Behavior Checklist (CBCL)	Three point rating scale, ranging from zero (not true) to two (often true); lower scores indicate better general behaviour	1	MTA 1999	MTA 1999	-	-
Clinical Global Impression (CGI) Scale	Seven-point rating scale, ranging from one (much worse) to seven (much improved); higher scores indicate improved general behaviour	2	Pfiffner 2007	Pfiffner 2007	-	Waxmonsky 2010

Table 4. Measures of general behaviour from included studies *(Continued)*

Disruptive Behavior Disorders Rating Scale: Oppositional Defiant Disorder index (DBDRS-ODD)	Four-point Likert scale, ranging from zero (not at all) to three (very much); lower scores indicate better general behaviour	2	Evans 2016 Waxmonsky 2016	Evans 2016	-	-
Child Symptom Inventory (CSI): Oppositional Defiant Disorder Subscale	Four-point rating scale, ranging from zero (never) to three (very often); lower scores indicate better general behaviour	1	Pfiffner 2016	Pfiffner 2016	-	-
Behavior Rating Inventory of Executive Function (BRIEF)	Three-point rating scale, ranging from one (never) to three (often); lower scores indicate better general behaviour	1	-	Qian 2017	-	-
Conners Behavior Rating Scale (CBRS): Conduct Problem Subscale	Four-point rating scale, ranging from zero (not true at all) to three (very much true); lower scores indicate better general behaviour	1	Cohen 1981	Cohen 1981	-	-
CBRS: Aggressiveness Subscale	Four-point rating scale, ranging from zero (not true at all) to three (very much true); lower scores indicate better general behaviour	1	Storebø 2012	-	-	-
Conners Teacher Rating Scale (CTRS)	Four-point Likert scale, ranging from zero (not at all true) to three (very true); lower scores indicate better general behaviour	1	Abikoff 2004	-	-	-
Strengths and Difficulties Questionnaire (SDQ): Total	Three-point rating scale, ranging from zero (not true) to two (certainly true); lower scores indicate better general behaviour	1	-	Hannesdottir 2017	-	-
SDQ: Conduct Problems Subscale	Three-point rating scale, ranging from zero (not true) to two (certainly true); lower scores indicate better general behaviour	1	Schramm 2016	Schramm 2016	Schramm 2016	-
Social Skills Rating Scale (SSRS): Problem Behaviour Subscale	Three-point Likert scale, ranging from zero (never) to two (often); lower scores indicate better general behaviour	1	-	Waxmonsky 2016	-	-
Self-Control Rating Scale	Seven-point continuum, ranging from one (indicating maximum level of self-control) to seven (indicating maximum level of impulsivity; lower scores indicate better general behaviour	1	Bloomquist 1991	-	-	-

Table 5. Measures of ADHD symptoms from included studies

Measures	Description	Number of studies	Studies reporting ratings from:			
			Teacher	Parent	Child	Observer
Disruptive Behavior Disorders Rating Scale (DBDRS)	Four-point Likert scale, ranging from zero (not at all) to three (very much); lower scores indicate fewer ADHD symptoms	4	Van der Oord 2007	Van der Oord 2007	-	-
			Waxmonsky 2010	Waxmonsky 2010	-	-
			Evans 2016	Evans 2016	-	-
			Waxmonsky 2016	Waxmonsky 2016	-	-
ADHD Rating Scales (ADHD-RS)	Five-point Likert scale, ranging from zero (never) to four (almost always); lower scores indicate fewer ADHD symptoms	2	-	Tutty 2003	-	-
			-	Qian 2017	-	-
ADHD-RS: Hyperactivity and Impulsivity Subscale	Five-point Likert scale, ranging from zero (never) to four (almost always); lower scores indicate fewer ADHD symptoms	1	-	Hannesdottir 2017	-	-
Child Symptom Inventory (CSI): Inattention Scale	Four-point rating scale, ranging from zero (never) to three (very often); lower scores indicate fewer ADHD symptoms	2	Pfiffner 2007	Pfiffner 2007	-	-
			Pfiffner 2014	Pfiffner 2014	-	-
Child Symptom Inventory (CSI): ADHD Scale	Four-point scale (never, sometimes, often, very often); lower scores indicate fewer ADHD symptoms	1	Pfiffner 2016	Pfiffner 2016	-	-
Conners Teacher Rating Scale (CTRS)	Four-point Likert scale, ranging from zero (not at all true) to three (very true); lower scores indicate fewer ADHD symptoms.	2	Bloomquist 1991	-	-	-
			Abikoff 2004	-	-	Abikoff 2004
Conners Parent Rating Scale (CPRS)	Four-point Likert scale, ranging from zero (not at all true) to three (very true); lower scores indicate fewer ADHD symptoms	2	-	Abikoff 2004	-	-
			-	Azad 2014	-	-
Conners 3: Hyperactivity/impulsivity Scale	Four-point Likert scale, ranging from zero (not at all true) to three (very much true); lower scores indicate fewer ADHD symptoms	1	Storebø 2012	-	-	-
ADHD Symptom Checklist (Fremdbeurteilungs-	Four-point scale ranging from one (not at all) to three (very much); lower scores indicate fewer ADHD symptoms	1	Schramm 2016	Schramm 2016	Schramm 2016	-

Table 5. Measures of ADHD symptoms from included studies *(Continued)*

bogen für Hyperkinetische Störungen)						
Swanson, Nolan and Pelham Teacher Rating Scale (SNAP)	Four-point rating scale, ranging from zero (not at al) to three (very often); lower scores indicate fewer ADHD symptoms	1	MTA 1999	MTA 1999	-	-
Child Attention Profile (CAP)	Three-point rating scale (1 = not true, 2 = sometimes true, 3 = very often true); lower scores indicate fewer ADHD symptoms	1	Tutty 2003	-	-	-
Strengths and Weaknesses of ADHD Symptoms and Normal Behaviors (SWAN)	Seven-point rating scale, including both positive and negative scores to reflect strengths and weaknesses, ranging from three (far below average) to minus three (far above average). Zero = normal/average	1	Yuk-chi 2005	Yuk-chi 2005	-	-
Structured Behavioural Observations	Child behaviour coded as 'on task', 'off task', or 'off task/disruptive'; lower scores indicate fewer ADHD symptoms	1	-	-	-	Bloomquist 1991
Continuous Performance Test (CPT): Omission Errors	CPT is a computerised test measuring impulse control and attention control based on the child's response to 150 stimuli, including 30 target stimuli. The omission errors reflect degree of inattention; higher score on omission errors indicate higher degree of inattention.	1	-	-	-	Meftagh 2014a

Table 6. Measures of performance in school from included studies

Measure	Description	Numbder of studies	Ratings			
			Teacher	Parent	Child	Observer
Classroom Performance Survey (CPS)	Five-point Likert scale, ranging from one (always) to five (never); higher scores indicate lower performance in school	1	Evans 2016	-	-	-
Conners Behavior Rating Scale (CBRS): Academic Performance Index;	Four-point rating scale, ranging from zero (not true at all) to three (very much true); higher scores indicate better performance in school	1	Storebø 2012	-	-	-
Social Skills Improvement System (SSIS): Aca-	Four-point scale, ranging from zero (never) to three (almost always); higher scores indicate better performance in school	1	Pfiffner 2016	-	-	-

Table 6. Measures of performance in school from included studies *(Continued)*

demic Competence Scale						
Academic Performance Rating Scale (APRS)	Five-point Likert scale, ranging from one (never or poor) to five (very often or excellent); higher scores indicate better performance in school	1	Waxmonsky 2010	-	-	-
Wechsler Individual Achievement Test (WIAT)	WIAT is a clinician-administered performance test including 16 subtests divided between Oral Reading, Math Fluency and Early Reading Skills; higher scores indicate better performance	1	-	-	-	MTA 1999
German teacher-rated questionnaire for learning and working behaviour (Arbeitsverhalten Lehrer)	German teacher-rated questionnaire for learning and working behaviour (Arbeitsverhalten Lehrer is a teacher-rated scale)	1	Lauth 2004	-	-	-

APPENDICES

Appendix 1. Search strategies

Cochrane Central Register of Controlled Trials (CENTRAL), in the Cochrane Library

#1 (intellect* disabl*):ti,ab,kw
#2 MeSH descriptor Attention Deficit Disorder with Hyperactivity explode all trees
#3 (adhd or addh):ti,ab,kw
#4 (attention near/3 deficit):ti,ab,kw
#5 (hyperactiv*):ti,ab,kw
#6 (hyperkinesis*):ti,ab,kw
#7 MeSH descriptor Hyperkinesis explode all trees
#8 (minimal brain near/3 disorder*):ti,ab,kw
#9 ((minimal brain near/3 dysfunction*) or (minimal brain near/3 damage*)):ti,ab,kw
#10 (#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9)
#11 (social skill training):ti,ab,kw
#12 (social skills education):ti,ab,kw
#13 (social competen*):ti,ab,kw
#14 ((behavior regulation) or (behaviour regulation)):ti,ab,kw
#15 (social near/10 skills):ti,ab,kw
#16 (learning near/25 social):ti,ab,kw
#17 (role play*):ti,ab,kw
#18 (psychosocial treatment):ti,ab,kw
#19 (parent education):ti,ab,kw
#20 (educat* near/10 parent*):ti,ab,kw
#21 MeSH descriptor Psychotherapy, Group explode all trees
#22 (behavior modification):ti,ab,kw
#23 (behaviour modification):ti,ab,kw
#24 (parent training):ti,ab,kw
#25 (#11 OR #12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24)
#26 (#10 AND #25)

Medline Ovid

1 exp Attention Deficit Disorder with Hyperactivity/
2 adhd.mp.
3 addh.mp.
4 (attention adj3 deficit).mp.
5 hyperactiv$.mp.
6 hyperkinesis$.mp.
7 exp Hyperkinesis/
8 (minimal adj brain adj3 disorder$).mp.
9 (minimal adj brain adj3 dysfunction$).mp.
10 (minimal adj brain adj3 damage$).mp.
11 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10
12 social skills training.mp.
13 social skills education.mp.
14 social competenc$.mp.
15 behavior regulation.mp.
16 behaviour regulation.mp.
17 (social adj10 skills).mp.
18 (learning adj25 social).mp.
19 role play$.mp.
20 psychosocial treatment.mp.
21 parent education.mp.
22 (educat$ adj10 parent$).mp.
23 exp psychotherapy, group/
24 behavior modification.mp.
25 behaviour modification.mp.
26 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25
27 randomized controlled trial.pt.
28 controlled clinical trial.pt.
29 randomized controlled trials.mp.
30 random allocation.mp.
31 double blind method.mp.
32 single blind method.mp.
33 clinical trial.pt.
34 (clin$ adj25 trial$).ti,ab.
35 ((singl$ or doubl$ or tripl$ or trebl$) adj25 (blind$ or mask$ or dummy$)).mp.
36 exp clinical trial/
37 placebos.mp.
38 placebo$.ti,ab.
39 random$.ti,ab.
40 comparative study.mp.
41 evaluation studies as topic/
42 exp clinical trials as topic/
43 follow up studies.mp.
44 prospective studies.mp.
45 (control$ or prospectiv$ or volunteer$).ti,ab.
46 27 or 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45
47 11 and 26 and 46

Embase Ovid

1 exp Attention Deficit Disorder/
2 adhd.mp.
3 addh.mp.
4 exp Hyperactivity/
5 Hyperkinesia/
6 (attention adj3 deficit).mp.
7 hyperactiv*.mp.
8 hyperkinesis*.mp.
9 (minimal adj brain adj3 disorder*).mp.
10 (minimal adj brain adj3 dysfunction*).mp.
11 (minimal adj brain adj3 damage*).mp.

12 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11
13 social skills training.mp.
14 social skills education.mp.
15 social competence*.mp.
16 behavior regulation.mp.
17 behaviour regulation.mp.
18 (learning adj25 social).mp.
19 (social adj10 skills).mp.
20 role play*.mp.
21 psychosocial treatment.mp.
22 parent training.mp.
23 parent education.mp.
24 (educat* adj10 parent*).mp.
25 exp behavior modification/
26 exp group therapy/
27 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26
28 controlled study.de.
29 clinical trial.de.
30 major clinical study.de.
31 randomized controlled trial.de.
32 double blind procedure.de.
33 clinical article.de.
34 random$.mp.
35 control$.mp.
36 follow up.mp.
37 ((singl$ or doubl$ or tripl$ or trebl$) adj (blind$ or mask$ or dummy)).mp.
38 placebo$.mp.
39 (clinic$ adj (trial$ or study or studies$)).mp.
40 exp comparative study/
41 28 or 29 or 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40
42 12 and 27 and 41

ERIC EBSCOhost

S1 DE attention deficit disorders
S2 DE attention deficit hyperactivity disorder
S3 DE hyperactivity
S4 TX adhd or addh
S5 TX attention within 3 deficit
S6 TX attention N3 deficit
S7 TX hyperkines*
S8 TX minimal N3 brain N3 disorder*
S9 TX minimal N3 brain N3 dysfunction*
S10 TX minimal N3 brain N3 damage*
S11 S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10
S12 KW randomi*
S13 AB random* N3 (allocat* or allot* or assign* or basis or divid* or order*)
S14 AB random* N4 (trial* OR study OR studies)
S15 AB (control* OR clinic* OR prospectiv*) N5 (trial* OR study OR studies)
S16 AB allocat* OR allot* OR assign* OR divid* OR order*) N4 (compar* OR control* OR experiment* OR intervent* OR therap* OR treatment*) N4 (group* OR class*)
S17 AB (singl* OR doubl* OR trebl* OR tripl*) N4 (blind* OR mask*)
S18 KW placebo*
S19 AB placebo*
S20 AB (compar* N5 (trial* OR study OR studies)
S21 AB (clinic* OR control*) N4 (trial* OR study OR studies)
S22 S12 OR S13 OR S14 OR S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21
S23 DE "interpersonal competence" or "daily living skills" or "emotional intelligence" or "extraversion introversion" or "interpersonal communication" or "prosocial behavior" or "sharing behavior" or "sensitivity training" or "interpersonal relationship" or "board administrator relationship" or "caregiver child relationship" or "collegiality" or "counselor client relationship" or "dating social" or "employer employee relationship" or "family relationship" or "parent child relationship" or "parent student relationship" or "sibling relationship" or "friendship" or "group unity" or "helping relationship" or "interpersonal attraction" or "interprofessional relationship" or

"supervisor supervisee relationship" or "teacher administrator relationship" or "marriage" or "teacher student relationship" or "parent caregiver relationship" or "peer relationship" or "physician patient relationship"
S24 DE behavior modification
S25 DE "group therapy" or "group counceling" or "sensitivity training"
S26 DE "role playing" or "dramatic play"
S27 DE "parent education"
S28 KW social skills training
S29 AB social skills training OR social skills education
S30 AB social competenc*
S31 AB behavior regulation
S32 AB behaviour regulation
S33 AB learning N5 social
S34 AB social N5 skill*
S35 AB psychosocial treatment
S36 AB parent training
S37 AB educat* N3 parent*
S38 S23 OR S24 OR S25 OR S26 OR S27 OR S28 OR S29 OR S30 OR S31 OR S32 OR S33 OR S34 OR S35 OR S36 OR S37
S39 S11 AND S22 AND S38

CINAHL EBSCOhost (Cumulative Index to Nursing and Allied Health Literature)

S42 S20 and S41
S41 S22 or S23 or S24 or S25 or S26 or S27 or S28 or S29 or S30 or S31 or S32 or S33 or S34 or S35 or S36 or S37 or S38 or S39 or S40
S40 TI behaviour modification or AB behaviour modification
S39 TI behavior modification or AB behavior modification
S38 TI learning N3 social or AB learning N3 social
S37 TI social N3 skills or AB social N3 skills
S36 TI educat* N2 parent* or AB educat* N2 parent*
S35 (MH "Psychotherapy, Group")
S34 (MH "Role Playing")
S33 TX parent education
S32 TX parent training
S31 TX psychosocial treatment
S30 TX behaviour regulation
S29 TX behavior regulation
S28 TX social competence*
S27 TX social skills education
S26 TX social skills training
S25 (MH "Social Skills")
S24 (MH "Social Behavior+/ED")
S23 (MH "Interpersonal Relations+/ED")
S22 (MH "Social Skills Training")
S21 S9 and S19
S20 S9 and S19
S19 S10 or S11 or S12 or S13 or S14 or S15 or S16 or S17 or S18
S18 TX (singl* OR doubl* OR tripl* OR trebl*) and TX (blind* OR mask* OR dummy*)
S17 TX clin* N25 trial*
S16 (MH "Placebos")
S15 TX placebo* OR random*
S14 TX control* OR prospectiv* OR volunteer*
S13 (MH "Evaluation Research+")
S12 (MH "Prospective Studies+")
S11 PT clinical trial
S10 (MH "Clinical Trials+")
S9 S1 or S2 or S3 or S4 or S5 or S6 or S7 or S8
S8 TX minimal N1 brain N3 damage*
S7 TX minimal N1 brain N3 dysfunction*
S6 TX minimal N1 brain N3 disorder*
S5 TX hyperkinesis*
S4 TX hyperactiv*
S3 TX attention N3 deficit
S2 TX adhd or addh

S1 (MH "Attention Deficit Hyperactivity Disorder")

PsycINFO Ovid

1 exp attention deficit disorder/
2 adhd.mp.
3 addh.mp.
4 (attention adj3 deficit).mp.
5 hyperactiv$.mp.
6 hyperkinesis$.mp.
7 exp Hyperkinesis/
8 (minimal adj brain adj3 disorder$).mp.
9 (minimal adj brain adj3 dysfunction$).mp.
10 (minimal adj brain adj3 damage$).mp.
11 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10
12 exp Social Skills Training/
13 exp Social Skills/
14 Skill Learning/
15 exp Human Relations Training/
16 exp Parent Training/
17 social skills training.mp.
18 social skills education.mp.
19 social competence$.mp.
20 behavior regulation.mp.
21 (social adj10 skills).mp.
22 (learning adj25 social).mp.
23 role play$.mp.
24 exp Communication skills training/
25 psychosocial treatment.mp.
26 exp Assertiveness training/
27 exp Behavior modification/
28 behaviour regulation.mp.
29 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28
30 random$.mp.
31 ((singl$ or doubl$ or trebl$ or tripl$) adj25 (blind$ or dummy or mask$)).mp.
32 placebo$.mp.
33 crossover.mp.
34 assign$.mp.
35 allocat$.mp.
36 ((clin$ or control$ or compar$ or evaluat$ or prospectiv$) adj25 (trial$ or studi$ or study)).mp.
37 exp placebo/
38 exp treatment effectiveness evaluation/
39 exp mental health program evaluation/
40 exp experimental design/
41 versus.id.
42 vs.id.
43 30 or 31 or 32 or 33 or 34 or 35 or 36 or 37 or 38 or 39 or 40 or 41 or 42
44 11 and 29 and 43

Sociological Abstracts ProQuest

SU.EXACT("Attention Deficit Disorder") OR ((add OR adds) OR (hyperactiv* OR hyperkines*) OR (minimal within 1 brain within 3 disorder) OR (minimal within 1 brain within 3 dysfunction*) OR (minimal within 1 brain within 3 damage) OR (attention within 3 deficit*)) AND if(random* NEAR/4 (trial OR study OR studies)) OR if(randomi*) OR if(random* NEAR/4 (allocat* OR assign* OR divid*)) OR if((control* OR clinic* OR divid*) WITHIN 5 (condition* OR experiment* OR treatment* OR control* OR group*)) OR if((singl* OR doubl*) NEAR/4 (blind* OR mask*)) OR if(placebo*) OR if((crossover OR cross over)) OR if((compar* WITHIN 5 (trial* OR study OR studies)))

ProQuest Dissertations and Theses Global

su(adhd OR addh OR add OR attention deficit hyperactivity disorder OR add OR adds OR attention deficit disorder) AND ab(social skill* OR role play OR psychosocial treatment OR parent education OR group therapy OR behavior modification OR behaviour modfication OR behavior regulation OR behaviour regulation OR social competence)

Clinical Trials (https://clinicaltrials.gov/)

attention deficit hyperactivity disorder OR adhd OR attention OR attention deficit disorder OR hyperactivity OR hyperkin* | social skills training OR social skills education OR social competenc* OR behavior regulation OR social skill* OR role play* OR psychosocial treatment OR parent education OR group therapy OR behavior modification OR behaviour modification | Child |

WHO ICTRP (http://www.who.int/ictrp/en/)

attention deficit hyperactivity disorder OR adhd OR attention OR attention deficit disorder OR hyperactivity OR hyperkin* | social skills training OR social skills education OR social competenc% OR behavior regulation OR social skill* OR role play* OR psychosocial treatment OR parent education OR group therapy OR behavior modification OR behaviour modification | Child |

Appendix 2. Data extraction sheet

Version number: 1:1. 08-10-2010

For notes

:Source

Study ID
Report ID
Year of publication
Year of conduct
Review author(s)
Citation source
Authors

Footnotes

ID: identifier

Eligibility

Confirm eligibility
Reasons for exclusion

Study

Design (e.g. randomised, blinded, placebo, etc.)

(Continued)

Location (e.g. hospital, outpatient clinic)		
Duration of study		
Inclusion criteria		
Exclusion criteria		
Outcomes	Primary	
	Secondary	

Risk of bias

Domain	Judgement (low/ uncertain/high)	Adequacy (yes/unclear/no)	Descriptions
Generation of the allocation sequence			Quote: Comment:
Allocation concealment			Quote: Comment:
Blinding of participants and personnel			Quote: Comment:
Blinding of outcome assessment			Quote: Comment:
Incomplete outcome data			Quote: Comment:
Selective outcome reporting			Quote: Comment:
Vested interest bias			Quote: Comment:
Other sources of bias: baseline imbalance			Quote: Comment:
Other sources of bias: early stopping			Quote:

(Continued)

	Comment:

Participants

Sample size or power calculation (yes/no):	Quote: Comment:
Total number (sample size):	Pre-randomisation: Post-randomisation:
Diagnostic criteria (e.g. ICD-10 number, DSM-IV number or by a cut-off score from report)	
Age	
Sex	
Comorbidity	
Sociodemographics (e.g. double or single parent families, low, middle or upper class)	
Country/ethnicity	
Co-medication	

Footnotes

DSM-IV: Diagnostic and Statistical Manual of Mental Disorders - Fourth Edition.
ICD-10: International Classification of Diseases - Tenth Revision.

Interventions

Intervention groups
Number of participants allocated per group
Number of patients lost to follow-up per group
Format and duration of the intervention (e.g. group base, individual, and setting)
Specific intervention (e.g. type of programme) and by whom (e.g. nurse, psychologist, teacher)
Content of the intervention
Treatment compliance (treatment to manual and participant to treatment)

Outcomes

Outcomes specified	Reported (yes/no)	Definition and unit of measurement	Type of scale	Summary statistic for each intervention group (short-, medium- or long-term)
Miscellaneous				

Funding source
Key conclusions of the study authors
References to other relevant studies
Correspondence required
Miscellaneous comments from the study authors
Miscellaneous comments from the review authors

Appendix 3. Criteria for assigning 'Risk of bias' judgements

We assessed the 'Risk of bias' components as follows.

Generation of the allocation sequence

- Low risk of bias: the method used was either adequate (for example, computer-generated random numbers or table of random numbers), or was unlikely to have introduced selection bias
- Uncertain risk of bias: there was not enough information to assess whether the method used could have caused bias
- High risk of bias: the method used was improper and likely to have introduced bias

Allocation concealment

- Low risk of bias: the method used (for example, central allocation) probably did not bias the observed intervention effect
- Uncertain risk of bias: there was not enough information to assess whether the method used could have biased the estimate of effect
- High risk of bias: the method (for example, open random allocation schedule) used probably biased the observed intervention effect

Blinding of participants and personnel

- Low risk of bias: the method of blinding was described and blinding was carried out satisfactorily
- Uncertain risk of bias: there was insufficient information to assess whether the type of blinding used could have biased the estimate of effect
- High risk of bias: no blinding or incomplete blinding

Blinding of outcome assessors

- Low risk of bias: the method of blinding was described and blinding was carried out satisfactorily
- Uncertain risk of bias: there was insufficient information to assess whether the type of blinding used could have biased the estimate of effect
- High risk of bias: no blinding or incomplete blinding

Incomplete outcome data

- Low risk of bias: the underlying reasons for the missing data probably did not affect the outcome measurement of the effect of the study, or valid methods were used to handle the missing data
- Uncertain risk of bias: there was not enough information to assess whether the missing data, or the method used to handle missing data, could have biased the estimate of effect

- High risk of bias: the crude estimate of effect was definitely biased due to the underlying reasons for the missing data, or the methods used to handle missing data were unsatisfactory

Selective outcome reporting

- Low risk of bias: the study protocol was available, or all prespecified outcomes that were of interest were reported
- Uncertain risk of bias: there was not enough information to assess whether the direction and magnitude of the observed effect was related to selective outcome reporting
- High risk of bias: not all of the prespecified primary outcomes were reported or participants were excluded after randomisation (selection bias)

Vested interest bias

- Low risk of bias: the study's source(s) of funding did not come from any parties that might have had conflicts of interest (for example, a drug or a device manufacturer), or the study author(s) had not conducted previous studies addressing the same interventions
- Uncertain risk of bias: the source of funding was not clear, or it was not clear if the study author(s) had conducted previous studies addressing the same interventions
- High risk of bias: the study was funded by parties that might have conflicts of interest (e.g. a manufacture of a drug or a device manufacturer), or potential conflicts of interest were reported by study authors

Other sources of bias

1. Low risk of bias: the study appeared to be free of other sources of bias
2. Uncertain risk of bias: there was inadequate information and therefore it was not possible to assess other possible sources of bias
3. High risk of bias: it is likely that potential sources of bias were present; for example, bias related to the specific design used, early termination due to some data-dependent process, or lack of power calculation, or other bias risks

We defined overall low risk of bias studies as studies that had low risk of bias in all domains. We considered studies with one or more unclear or high risk of bias domains as studies with high risk of bias overall.

Appendix 4. Glossary

Attention Control Treatment	ACT
Learning Skills Training for Adolescents with ADHD	ADHS-LeJA
ADHD plus Impairments in Mood	AIM
Academic Performance Rating Scale	APRS
Attention Deficit Hyperactivity Disorder	ADHD
Attention Deficit Hyperactivity Disorder - Inattentive subtype	ADHD-I
Attention Deficit Hyperactivity Disorder - Rating Scales	ADHD-RS
Behavior Rating Inventory of Executive Function	BRIEF
Child Behavior Checklist	CBCL
[Connors] Comprehensive Behavior Rating Scales	CBRS
Cognitive Behaviour Therapy	CBT
Classroom Challenge	CC
Conduct Disorder	CD
Clinical Global Impression	CGI

(Continued)

Challenging Horizons Program – After School version	CHP-AS
Challenging Horizons Program – Mentoring version	CHP-M
Confidence Interval	CI
Collaborative Life skills	CL
Clinical Linguistic and Auditory Milestone Scale	CLAM
Child Life and Attention Skills [program]	CLAS
Community Oriented Parent Education [program]	COPE
Conners Parent Rating Scale	CPRS
Classroom Performance Survey	CPS
Continuous Performance Test	CPT
Client Satisfaction Questionnaire	CSQ
Conners Teacher Rating Scale	CTRS
Comorbid disorder	Additional condition co-occurring with the primary condition
Diagnostic and Statistical Manual of Mental Disorders - Third edition - Revised	DSM-III-R
Diagnostic and Statistical Manual of Mental Disorders - Fourth edition	DSM-IV
Diagnostic and Statistical Manual of Mental Disorders - Fourth edition - Text Revision	DSM-IV- TR
Diagnostic and Statistical Manual of Mental Disorders - Fifth edition	DSM-5
Disruptive Behavior Disorders Rating Scale	DBDRS
Diversity-Adjusted Required Information Size	DARIS
Diagnostic Interview for Children & Adolescents - Revised	DIACA-R
Diagnostic Interview for Children and Adolescents - Revised Parent version	DICA-R-P
Parent interview with the Diagnostic Interview Schedule for Children	DISC-P2
Emotion Expression Scale for Children	EESC
Emotion Management Training	EMT
Emotion Regulation Checklist	ERC
Fremdbeurteilungsbogen für Hyperkinetische Störungen	FBB-HKS
Full Scale Intelligence Quotient	FSIQ

(Continued)

Information Size	IS
Intelligence Quotient	IQ
International Classification of Diseases - 10th version	ICD-10
International Committee of Harmonization guidelines	ICH
Impairment rating scale	IRS
Intention-To-Treat	ITT
Kiddie Schedule for Affective Disorders and Schizophrenia - Present and Lifetime version	K-SADS
Mean Difference	MD
Matching Familiar Figures Test	MFFT
Multimodal Psychosocial treatment	MPT
Multimodal Treatment of Attention Deficit Hyperactivity Disorder	MTA
Number Needed to Treat	NNT
Oppositional Defiant Disorder	ODD
Primary Counsellor	PC
Parent version of the Children's Interview for Psychiatric Syndromes	P-ChIPS
Parent-Focused Treatment	PFT
Principal Investigator	PI
Participant Intervention Comparison Outcome	PICO
Progressive Muscle Relaxation	PMR
Randomised Clinical Trial	RCT
Required Information Size	RIS
Risk Difference	RD
Risk Ratio	RR
Selective Serotonin Reuptake Inhibitor	SSRI
Self-Control Rating Scale	SCRS
Sluggish Cognitive Tempo	SCT
Social Skills Improvement System	SSIS
Social Skills Rating Scale	SSRS

(Continued)

Social skills training	SST
Standard Deviation	SD
Standardized Mean Difference	SMD
Social Skills Training Plus Parental Training Combined with Standard Treatment	SOSTRA
Strengths and Difficulties Questionnaire	SDQ
Strengths and Weaknesses of ADHD Symptoms and Normal Behaviors	SWAN
Swanson, Nolan and Pelham (- Revised) rating scale	SNAP (-R)
Treatment As Usual	TAU
Trial Sequential Analysis	TSA
Wechsler Abbreviated Scale of Intelligence	WASI
Wechsler Individual Achievement Test	WIAT
WEISS Functional Impairment Scale - Parent form	WFIRS-P
Wechsler Intelligence Scale for Children - Revised edition	WISC-R
Wechsler Intelligence Scale for Children - Third edition	WISC-III
Wechsler Intelligence Scale for Children - Fourth edition	WISC-IV
Wechsler Preschool and Primary Scale of Intelligence	WIPPSI
World Health Organization	WHO
Waiting List	WL

FEEDBACK

Comments on protocol by Peter Gøtzche, 16 February 2010

Summary

1. The Background notes that drugs have a beneficial effect on major symptoms in about 80% of the patients treated. Such a statement is meaningless when we don't know what the effect was in groups treated with placebo. The authors need to rectify this so that the readers can understand what the effect is.
2. Social skills training is the focus of the review and the authors state that "We have been unable to identify meta-analyses or systematic reviews on the topic". This statement is a bit surprising. A quick and simple search on PubMed on "(attention deficit hyperactivity disorder children) AND training", limited to meta-analysis, yielded 7 hits, of which one appears to be highly relevant for the authors' review, as they also want to review combination therapy: Majewicz-Hefley A, Carlson JS. A meta-analysis of combined treatments for children diagnosed with ADHD. J Atten Disord. 2007 Feb;10(3):239-50.
3. The following reference may also be relevant, particularly as the authors of the Cochrane protocol mention that training may increase negative behaviour, with reference to a single study. In contrast, based on its abstract, this reference seems to be to a meta-analysis, and had different findings: Weiss B, Caron A, Ball S, Tapp J, Johnson M, Weisz JR. Latrogenic effects of group treatment for antisocial youths. J Consult Clin Psychol. 2005 Dec;73(6):1036-44.

Reply

We thank Peter Gøtzsche for his interest in our review and for raising the comments.

Point 1

Peter Gøtzsche is correct that only giving the proportion of patients who respond to the active intervention and leaving out the response proportion among placebo-treated patients does not inform the reader with regard to the relative risk reduction between the two. We will amend the protocol accordingly to make it explicit that the response proportion of response from 'stimulant' drugs is about 80% while the placebo response proportion is about 3% to 10%, leading to a relative risk reduction of at least 77%. We thus acknowledge Peter Gøtzsche's vigilance, and have now taken steps to correct the mistake.

Point 2

We would argue, regarding this point, that the truth may be more complex than the statement above. Six of the meta-analyses identified by Dr Gøtzsche are not relevant to our review. The seventh, to which he makes particular reference, is potentially relevant. This is the meta-analysis by Majewicz-Hefley and Carlson (2007). The meta-analysis includes a total of eight studies. The article divides the outcomes into five different categories of outcome variables. The Social Skills variable was based on four studies. Two of the four studies are not relevant for our review. One concerns behaviour therapy (and not social skills training); the other one is not a randomised clinical trial. That leaves two studies in the meta-analysis of the social skills outcome variable, which we could have mentioned in the protocol, but chose not to. Both studies will of course be considered for the review, and be cited there.

Point 3

Our point in the protocol here was simply to show that we are aware of the possibility that group training can have adverse effects. We could have found articles (or meta-analyses) that suggested the opposite, viz., that group training of children with attention deficit hyperactivity disorder (ADHD) or conduct disorder has positive effects, as this finding is more common, but this also would have not been pertinent. Furthermore, the article Peter Gøtzsche refers to concerns antisocial youths, and this population is not the same as that diagnosed with ADHD or conduct disorder.

Contributors

This feedback was prepared by Jane Dennis, feedback editor for CDPLPG, in consultation with the submitter, the authors, the CDPLPG Co-ordinating Editor Geraldine Macdonald and the former CDPLPG Managing Editor Chris Champion.

WHAT'S NEW

Date	Event	Description
12 October 2018	New search has been performed	We updated the review following a new search in July 2018.
12 October 2018	New citation required but conclusions have not changed	We included 14 new studies.

HISTORY

Protocol first published: Issue 1, 2010
Review first published: Issue 12, 2011

Date	Event	Description
14 April 2010	Amended	US FDA reference corrected
16 March 2010	Feedback has been incorporated	Feedback comments from Peter Gøtzsche incorporated

CONTRIBUTIONS OF AUTHORS

Ole Jakob Storebø: development of protocol, study selection, data extraction, 'Risk of bias' assessment, data analysis, contact person, GRADE assessment, development of the final review - original and update

Mette Elmose Andersen: study selection, data extraction, 'Risk of bias' assessment, development of the final review - update

Maria Skoog: development of protocol, data extraction, 'Risk of bias' assessment, development of the final review - original and update

Signe Joost Hansen: study selection , data extraction, 'Risk of bias' assessment, development of the final review - update

Erik Simonsen: 'Risk of bias' assessment, development of the final review - original and update

Nadia Pedersen: study selection, data extraction, 'Risk of bias' assessment, development of the final review - update

Britta Tendal: study selection, data extraction, 'Risk of bias' assessment, development of the final review - update

Henriette E Callesen: trial selection, data extraction, 'Risk of bias' assessment, development of the final review - update

Erlend Faltinsen: trial selection, data extraction, 'Risk of bias' assessment, data analysis

Christian Gluud: development of protocol, advising on statistical methods and analysis, GRADE assessment, development of the final review - original and update

All authors read and approved the final version of the review before submission.

Ole Jakob Storebø is the guarantor for the review.

DECLARATIONS OF INTEREST

Ole Jakob Storebø is an Associate Editor with the Cochrane Developmental, Psycosocial and Learning Problems Group.
Mette Elmose Andersen - none known
Maria Skoog - none known
Signe Joost Hansen - none known
Erik Simonsen - none known
Nadia Pedersen - none known
Britta Tendal - none known
Henriette E Callesen - none known
Erlend G Faltinsen - none known
Christian Gluud - none known

Ole Jakob Storebø, Maria Skoog, Erik Simonsen, and Christian Gluud were involved in the Storebø 2012 trial, which is included in this review. This trial was assessed by Nadia Pedersen, Mette Elmose, Signe Joost, and Mathilde Holmsov. These authors independently assessed the eligibility of this study, extracted data from it, assessed the risk of bias within it and assessed the quality of the evidence provided by it.

SOURCES OF SUPPORT

Internal sources

- None, Other.

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  Support to develop search strategy and search databases
- Department of Psychology, University of Southern Denmark, Denmark.

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DIFFERENCES BETWEEN PROTOCOL AND REVIEW

We were unable to use all of our methods as specified in our protocol, Storebø 2010, in this review update. We have archived these for use in future updates of this review in Table 1.

There are some changes in the number of authors between the protocol published in 2010 and the original review version published in 2012 as Mette Elmose Andersen, Signe Joost Hansen, Nadia Pedersen, Britta Tendal, Britta Tendal, and Erlend G Faltinsen now are new authors. Christian Gluud, Erik Simonsen, and Ole Jakob Storebø have been authors of both versions of the review and the protocol. Dorte Damm, and Per Hove Thomsen, who were both authors of the published protocol as well as the original version of the review, are not authors of this updated version of the review. The reason for this change is that Dorte Dam and Per Hove Thomsen did not have the time to participate in the work with this update and therefore the new authors were invited to help with the work.

We changed the databases that we planned to search in the protocol because of: lack of access [AMED] and because no unique relevant records were identified in the previous search [AMED].

NOTES

An administrative error was made in the first published version of the protocol and important information about the declaration of interest of the authors was not included in the publication. This has now been rectified.

INDEX TERMS

Medical Subject Headings (MeSH)

*Attention Deficit Disorder with Hyperactivity [therapy]; *Behavior Therapy; *Social Skills; Cognitive Behavioral Therapy; Interpersonal Relations

MeSH check words

Adolescent; Child; Child, Preschool; Humans