

Parenting Interventions for ADHD: a systematic literature review and meta-analysis

Janine Coates PhD¹, John Taylor PhD^{2,3}, Kapil Sayal MRCPsych, PhD^{2,3}

Affiliations: ¹Division of Psychology, Nottingham Trent University. ²NIHR Collaboration for Leadership in Applied Health Research and Care Nottinghamshire, Derbyshire and Lincolnshire. ³Division of Psychiatry and Applied Psychology and Institute of Mental Health, University of Nottingham.

Address Correspondence to: Kapil Sayal, Developmental Psychiatry, E Floor, South Block, Queen's Medical Centre, Nottingham NG7 2UH, UK

E.mail: Kapil.sayal@nottingham.ac.uk Tel 00 44 115 823 0264

Short title: A Systematic review of Parent Interventions for ADHD

Abbreviations: AAP – American Academy of Pediatrics, ADHD – attention deficit hyperactivity disorder, NICE - National Institute for Health and Clinical Excellence, RCT – randomized controlled trial, TAU - treatment as usual, WLC – wait-list control

Keywords: Attention deficit hyperactivity disorder, ADHD, Parenting interventions, behavioral interventions

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ABSTRACT

Objective

To evaluate the evidence base relating to the effectiveness of parent-administered behavioral interventions for ADHD.

Methods

A systematic review of randomized controlled trials or non-randomized but adequately controlled trials for children with ADHD or high levels of ADHD symptoms was carried out across multiple databases. For meta-analyses, the most proximal ratings of child symptoms were used as the primary outcome measure.

Results

Eleven studies met inclusion criteria (603 children, age range 33-144 months). Parenting interventions were associated with reduction in ADHD symptoms (Standardized Mean Difference (SMD) = 0.68; 95% CI 0.32,1.04). There was no evidence of attenuation of effectiveness after excluding studies where medication was also used. Parenting interventions were also effective for comorbid conduct problems (SMD = 0.59; 95% CI 0.29,0.90) and parenting self-esteem (SMD = 0.83; 95% CI 0.56,1.10).

Conclusions

These findings support clinical practice guidelines and suggest that parenting interventions are effective. There is a need to ensure the availability of parenting interventions in community settings.

INTRODUCTION

Attention-Deficit/Hyperactivity Disorder (ADHD) is a neuro-developmental disorder often diagnosed clinically in early childhood, and is characterized by developmentally inappropriate levels of inattention, impulsivity and/or hyperactivity. These characteristics can lead to impairment in academic and social functioning.¹ ADHD is a common disorder, affecting at least 5% of school-aged children.² Co-morbidity with other childhood behavioral and developmental disorders, such as oppositional defiant disorder, conduct disorder and learning disorders, is frequent. ADHD is also a risk factor for the development of disruptive behavior and other mental health disorders, accidents, obesity, academic difficulties, and poor outcomes in adulthood.³ Given these factors, there is an important role for early recognition and intervention.

In relation to the treatment of children with ADHD, recent clinical practice guidelines from the American Academy of Pediatrics (AAP) recommend the role of behavioral interventions particularly for pre-school aged children.⁴ These recommendations are based on existing evidence including reviews of the literature focusing on pre-schoolers⁵ and other literature reviews^{6,7} which consider the effectiveness of psychosocial interventions for ADHD in children. Clinical practice guidelines from other countries such as those from the National Institute for Health and Clinical Excellence (NICE) in England have gone even further, recommending behavioral interventions first where the severity of ADHD is mild or moderate.⁸ As previous reviews^{6,7,9} assessing the role of behavioral interventions for ADHD have tended to include different types of psychological treatments (e.g. parent-administered, teacher-administered, and combined parent- and teacher- administered behavioral interventions as well as direct work with affected children and adolescents), there is a need for a focused systematic review of the

evidence base for parent-administered behavioral interventions. This specific focus on studies that evaluate parent-administered interventions is important as these interventions might be relatively more feasible to offer and implement in routine clinical practice.

METHODS

A systematic review and meta-analysis of relevant peer-reviewed, published literature was undertaken to collate available empirical evidence relating to the effectiveness of parent-administered behavioral interventions for reducing symptoms associated with ADHD. For the purpose of this review, parent-administered behavioral interventions were defined as those interventions directed towards the parents of children with ADHD or with high levels of ADHD symptoms involving inattention, hyperactivity and impulsivity. Research evaluating interventions aiming to provide parents with strategies to manage their child's behavior with the goal of reducing undesirable behaviors, such as inattention, hyperactivity and impulsivity, were considered suitable for inclusion in this review.

Search terms and inclusion criteria

Initial search keywords were developed to identify the literature relating to behavioral interventions for ADHD – within which parenting interventions are included. This was done for a larger systematic review of non-pharmacological interventions for ADHD⁹ and all papers identified were categorized in terms of their relevance to this specific review based upon the inclusion criteria shown below. The search terms used are shown in Appendix 1 and search databases can be found in Appendix 2. Searches were carried out several times to ensure that up-

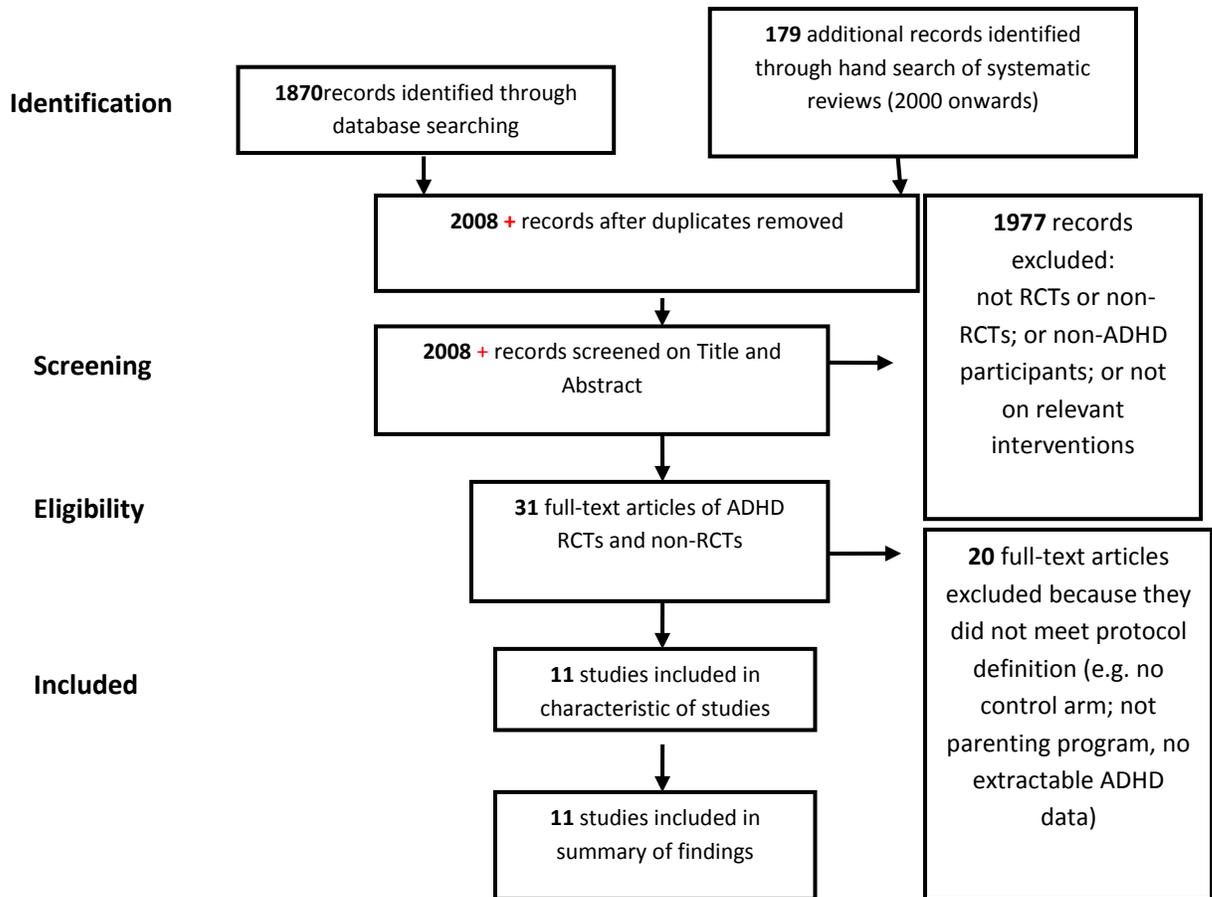
to-date literature was captured, with a final search conducted on *Feb 3rd 2013*. As well as the database searches, hand-searching of identified systematic reviews was also carried out.

The inclusion criteria for this review were as follows:

- Papers had to have been peer-reviewed and written in English.
- Participants either had an ADHD diagnosis or were above cut-off point on a validated ADHD measure or ADHD sub-scale on a broad-band rating scale (e.g. the Strengths and Difficulties Questionnaire¹⁰).
- Children were between 3-18 years of age.
- Studies were randomized controlled trials (RCTs) or non-randomized but adequately controlled trials.
- All trials were included irrespective of intervention quality/characteristics. Trials were only excluded if a specific co-morbidity was an inclusion criterion into the study (e.g. Fragile X).
- Only studies where the unique effect of parent training on ADHD outcomes could be analyzed were included. We therefore excluded studies where the parenting intervention was combined with a teacher and/or child intervention so that the unique of impact of parent training could not be established.
- Trials were included irrespective of control arm type. The control arm quality order was designated: (i) placebo (ii) active control (iii) Treatment as Usual (TAU) (iv) no treatment, wait-list Control (WLC). Where trials had two comparator arms (e.g. WLC and attention control as well as the active treatment), the arm representing the most rigorous control was selected (i.e. attention control over a WLC).

All studies meeting the above criteria were included regardless of the focus of the study (e.g. symptom reduction, parental function, etc.) and/or outcomes measured (as long as there was at least one ADHD specific outcome). The PRISMA flow chart (Figure 1) demonstrates the number of papers identified in the initial search and the process of identifying the final papers included in this review. All papers were reviewed by two independent researchers at each stage and any discrepancies were resolved through discussion within the review team.

Figure 1: PRISMA flow chart



Data extraction

Design and sample information from included trials was entered into Review Manager software (RevMan 5.1; Nordic Cochrane Center, Copenhagen, Denmark) in order to create a systematic record of study features. Data were extracted for the following areas: study characteristics; participant characteristics; intervention and control characteristics; outcomes and main findings. Pre- and post- means and standard deviations were extracted for all papers, where possible, on the following outcome variables: ADHD characteristics (primary outcome); conduct problem symptoms; parental well-being; parental sense of competence (parenting self-esteem); parenting stress and parenting behavior. Data were extracted by one researcher and independently checked by another. Variables examined for the meta-analysis were based on a pragmatic assessment of the outcomes included in each study. While there is no recognized minimum number of studies necessary for a meta-analysis, the literature suggests that the median number of studies included meta-analyses tends to be three.¹¹ Therefore, for the purposes of analysis, only variables where three or more studies presented relevant data were included in the analysis.

Statistical analysis

Individual effect sizes [i.e. standardized mean difference] for each study were based on the recommended formula: mean pre-post intervention group change minus the mean pre-post control group change divided by the pooled pre-test standard deviation with a bias adjustment. Standardized mean differences for trials in each domain were combined using the inverse-variance method where the reciprocal of their variance is used to weight the standardized mean difference from each trial before being combined to give an overall estimate. Given the heterogeneity of studies included in terms of their assessments of ADHD, their sample

characteristics and the implementation of treatments within domains, we decided *a priori* to use a random effects model.¹²

RESULTS

Eleven studies involving 603 children were included in the meta-analysis.¹³⁻²³ Table 1 provides details of study characteristics and Table 2 a breakdown of outcome measures used in each study relating to variables included in the meta-analysis.

Insert Tables 1 and 2 here

ADHD symptoms. All eleven¹³⁻²³ studies had a child ADHD symptom outcome (assessed using clinical interview or validated parental reported questionnaire). The overall standardized mean difference in the analysis for ADHD symptoms was significant and moderate (SMD = 0.68; 95% CI 0.32,1.04). Heterogeneity was also significant ($\chi^2=46.79$; $I^2=79\%$; $p<0.001$) (see Figure A). A sensitivity analysis which removed the five studies^{13,16,18,22,23} that had allowed medication not only demonstrated that these findings were independent of medication status but that the strength of the association increased (SMD = 0.77; 95% CI 0.35,1.19). Heterogeneity for this sensitivity analysis remained significant ($\chi^2=17.54$; $I^2=71\%$; $p=0.004$). A *sensitivity analysis which removed the three studies^{13,16,22} with children with a mean age of over 60 months revealed that results were maintained for younger children (SMD = 0.63; 95% CI 0.20,1.07). Heterogeneity for this sensitivity analysis remained significant ($\chi^2 = 27.04$; $I^2=78\%$; $p<0.001$).*

Insert Figure A here

Conduct Problems. Five studies^{15,16,19,21,23} had a child conduct problem outcome (assessed using clinical interview or validated parental reported questionnaire). The overall standardized mean difference in the analysis for conduct problems was moderate (SMD = 0.59; 95% CI 0.29,0.90). Heterogeneity was not significant (see Figure B).

Insert Figure B here

Parenting Self-esteem. Five studies^{13,15,16,19,20} included a measure of parenting self-esteem, all assessed using a parental self-report questionnaire²⁴. The overall standardized mean difference in the analysis for parenting self-esteem was significant and large (SMD = 0.83; 95% CI 0.56, 1.10). Heterogeneity was also significant ($\chi^2=10.11$; $I^2=60\%$; $p<0.05$) (see Figure C).

Insert Figure C here

Parenting Stress. Three studies^{13,16,22} included a measure of parenting stress, all assessed using parental self-report questionnaires. The overall standardized mean difference in the analysis for parenting stress was moderate but not significant (SMD = 0.50; 95% CI -0.12,1.12) Heterogeneity was not significant ($\chi^2=5.29$; $I^2=62\%$; $p=0.07$).

Parental well-being. Four studies^{16,19,20,21} included measures of parental well-being, all assessed using parental self-report questionnaires. The overall standardized mean difference in the analysis for parental well-being was not significant (SMD = 0.23; 95% CI -0.26,0.73) while heterogeneity was significant ($\chi^2=8.88$; $I^2=66\%$; $p<0.001$).

Parental Behavior. Four studies^{15,16,18,21} included measures of negative parental behavior, assessed using structured observation or parent self-report questionnaire. The overall

standardized mean difference in the analysis for parental negative behavior was not significant (SMD = 0.34; 95% CI -0.27,0.95) while heterogeneity was significant ($\chi^2=9.69$; $I^2=69\%$; $p<0.001$).

DISCUSSION

For children with or at risk of ADHD, this systematic literature review revealed improvements in two important symptom-related outcomes as a result of parent-administered behavioral interventions. Specifically, it demonstrated that parent-administered behavior interventions led to a moderate reduction in both ADHD symptoms and conduct problems. By focusing this review on parent-administered behavioral interventions, the findings provide considerable evidence to support the role of parenting interventions for children with ADHD and support the AAP clinical guidelines.⁴ The sensitivity analyses were particularly pertinent for these guidelines as the improvement in ADHD symptoms was maintained for pre-school populations, suggesting that parent-administered behavioral interventions are effective for this group. Medication did not appear to enhance the improvements found and, in fact, the strength of the association was further increased when studies including medication were removed. This finding supports the growing body of evidence supporting the use of parent-administered behavioral interventions as opposed to medication for children with ADHD under the age of 6, thus providing further evidence to support clinical guidelines.^{4,8} It is worth highlighting that while this review considers international evidence, six of the eleven included studies used interventions developed in the USA and Canada.^{13,14,17,18,22,23} Furthermore, the interventions used in the studies were reasonably short-term in duration, ranging from 8–17 weeks. This suggests that parent-administered

behavioral interventions might be a cost-effective treatment option. As these interventions are potentially accessible, they should be considered a feasible treatment option for young children with or at risk of ADHD.

These interventions also improved parental self-esteem, suggesting that engagement in parent-administered interventions not only benefits the child but also the parent. However, we found no evidence for an improvement in parental well-being and a non-significant but moderate improvement for parental stress. There is evidence to suggest that parents of children with ADHD experience increased levels of stress and depression and reduced self-esteem³⁶ and so while it is encouraging that parent-administered interventions increase parental self-esteem, it is a concern that there were not similar improvements in parental well-being and parental stress. It is possible that the non-significant effect found for parental stress might be due to the lack of studies available to assess this outcome and an increased number of studies might yield more favorable results. In contrast, parental well-being changes only showed a small effect. There is the possibility that parent-administered behavioral interventions might exacerbate symptoms of depression in parents, due to their requirement for parents to confront their difficulties with parenting. Greater consideration should therefore be given to the role of parental mood when using parent-administered behavioral interventions to treat ADHD. Practitioners considering the use of these interventions should prepare parents prior to their engagement in interventions by assessing mood and, if appropriate, consider parental referral for anti-depressant medication or cognitive behavioral therapy (CBT). For example, CBT has been shown to be a useful tool for mothers of children with ADHD following a parent-administered intervention program in terms of improving mothers' depressive symptoms, self-esteem, and stress.³⁷ This study also demonstrated improvements in maternal expectations and attributions relating to their child's

disruptive behavior and overall family impairment.³⁷ This suggests that for interventions where the parent is the agent of change, their well-being should be considered in order to optimize the outcome for the child and this should form part of the treatment plan.

Strengths and Limitations

There are a number of factors which limit the breadth of this review. First, it was not possible to explore different mediators which might allow for an assessment of underlying mechanisms of change. Second, no data were available to elicit what impact ADHD symptoms had on other aspects of child functioning and how the interventions might affect this, for example school readiness, academic attainment, and child social skills. Third, it was not possible to assess the possible role of moderators of outcome, particularly severity of the ADHD or parental mental health difficulties, including parental ADHD symptoms, which may also impact on treatment effectiveness. Fourth, the mode of delivery (e.g. group versus individual intervention) and implementation fidelity of each intervention might also lead to differing outcomes which were not assessed within this review. Finally, it is possible that the underlying philosophy of each program might lead to differences in effectiveness outcomes. The studies included in this review used a number of different interventions designed for different purposes. Two studies^{15,16} used Triple P – an intervention designed and evaluated in Australia that assists parents of children with conduct disorder and associated difficulties. Three studies^{13,14,18} used interventions developed and evaluated in North America, mostly designed to assist parents of children with disruptive behavior. Two studies^{17,22} used interventions developed in North America that were used to treat disruptive behavior problems more generally but evaluated in the UK and Netherlands. One ADHD-specific program was used in the other three studies.¹⁹⁻²¹ The New

Forest Parenting Program, designed and evaluated in the UK, has a focus on children with high levels of ADHD characteristics. Whilst these programs have demonstrated effectiveness overall, the success of individual treatment program types was beyond the scope of this review. However, it is possible that philosophical variance in the content and design of the intervention might lead to differences in their effectiveness.

This meta-analysis used ratings from participants who were most proximal to the intervention delivery (parent ratings). This might have resulted in rating bias, leading to inflated effect sizes for interventions due to the time-investment parents make.⁹ Reported results may also reflect changes in parental perceptions or tolerance of symptoms rather than actual changes in ADHD behaviours. However, parent ratings reflect outcomes that clinicians would collect if evaluating interventions in real world non-research settings. Furthermore, findings showed that parental well-being, stress and negative parental behavior did not improve. It is likely that if there was rating bias, similar improvements would also have been seen for these variables and, as such, this suggests that parent ratings are valid measures for evaluating outcomes following parent-administered behavioral interventions.

Clinical Implications and Implications for Future Research:

Limited data were available on the long-term effectiveness of interventions. All but two studies^{14,17} collected long-term follow-up data for interventions at more than one post-intervention time point, however only three studies^{18,19,21} provided follow-up data for pre-, post- and follow-up time points for both intervention and control groups. Only two studies^{19,21} provided data in a format suitable for meta-analysis. As such, a meta-analysis of long-term outcomes could not be carried out in this review. Future studies should therefore incorporate

follow-up assessments to assess long-term outcomes of the interventions and these should be reported for both intervention and control groups. Making these data readily available would allow for more robust analyses of the longer-term effectiveness of parent-administered behavioral interventions. This is important for future research because despite short-term benefits of behavioral interventions, the underlying ADHD may well persist and require further interventions.

Furthermore, none of the studies included cost-effectiveness analyses and therefore the potential economic benefits of parenting interventions can only be estimated through modeling assumptions. It is important that future RCTs of parenting interventions assess both the effectiveness and cost-effectiveness of interventions. Other studies exploring the effectiveness of parenting interventions for general disruptive behaviors have included these analyses and report that parenting interventions can be more cost-effective than other clinical interventions.³⁸ This should therefore be considered in future trials assessing the effectiveness of parent-administered interventions for ADHD.

Finally, it is understandable that clinicians might require more immediate options whilst considering the availability of and access to parenting interventions in their own clinical practice. Given this, clinicians could consider suggesting self-directed parenting interventions to parents of children with ADHD during the waiting period before behavioral interventions can be offered locally. Self-directed interventions, such as self-directed Triple P, have been evaluated for effectiveness in reducing conduct problems with some success,³⁹ although practitioner-led programs were shown to be more effective. Nevertheless, maintenance of outcomes has been found for this self-directed program.⁴⁰ Self-directed interventions are a potentially feasible,

effective and lower-cost option for parents of children with or at risk of ADHD. There is a need for robust research to assess their cost-effectiveness and acceptability for parents of children with or at risk of ADHD.

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REFERENCES

1. Chronis A, Jones H, Raggi V. Evidence-based psychosocial treatments for children and adolescents with attention-deficit/hyperactivity disorder. *Clin Psychol Rev.* 2006;26(4):486–502.
2. Polanczyk G, de Lima MS, Horta BL, Biederman, J, Rohde LA. The worldwide prevalence of ADHD: a systematic review and metaregression analysis. *Am J Psychiatry.* 2007;164(6):942-948.
3. Shaw M, Hodgkins P, Herve C, et al. A systematic review and analysis of long-term outcomes in attention deficit hyperactivity disorder: effects of treatment and non-treatment. *BMC Med.* 2012;10(1):99.
4. American Academy of Pediatrics. ADHD: Clinical practice guideline for the diagnosis, evaluation, and treatment of Attention-Deficit/Hyperactivity Disorder in children and adolescents. *Pediatrics.* 2011;128:1007–22.
5. Charach A, Carson P, Fox S, Ali MU, Beckett J, Lim CG. Interventions for Preschool Children at High Risk for ADHD: A Comparative Effectiveness Review. *Pediatrics.* 2013;131(5):e1584-e1604.
6. Pelham Jr WE, Wheeler T, Chronis A. Empirically supported psychosocial treatments for attention deficit hyperactivity disorder. *J Clin Child Psychol.* 1998;27(2):190-205.
7. Pelham Jr W. E., Fabiano GA. Evidence-based psychosocial treatments for attention-deficit/hyperactivity disorder. *J Clin Child Psychol.* 2008;37(1):184-214.
8. National Institute for Health and Clinical Excellence (NICE). *Attention Deficit Hyperactivity Disorder: diagnosis and management of ADHD in children, young people, and adults (Clinical Guideline 72)*, London, UK: NICE; 2008.
9. Sonuga-Barke EJ, Brandeis D, Cortese S, et al. Nonpharmacological interventions for ADHD: systematic review and meta-analyses of randomized controlled trials of dietary and psychological treatments. *Am J Psychiatry.* 2013;170(3):275-289.

10. Goodman R. The Strengths and Difficulties Questionnaire: a research note. *J Child Psychol Psychiatry*. 1997;38(5):581-586.
11. Davey J, Turner RM, Clarke MJ, Higgins JP. Characteristics of meta-analyses and their component studies in the Cochrane Database of Systematic Reviews: a cross-sectional, descriptive analysis. *BMC Med Res Methodol*. 2011;11(1):160.
12. Field AP, Gillett R. How to do a meta-analysis. *Br J Math Stat Psychol*. 2010;63:665–694.
13. Anastopoulos AD, Shelton TL, DuPaul GJ, Guevremont DC. Parent training for attention-deficit hyperactivity disorder: Its impact on parent functioning. *J Abnorm Child Psychol*. 1993; 21(5):581-596.
14. Barkley RA, Shelton TL, Crosswait C, et al. Multi-method Psycho-educational Intervention for Preschool Children with Disruptive Behavior: Preliminary Results at Post-treatment. *J Child Psychol Psychiatry*. 2000;41(3):319-332.
15. Bor W, Sanders MR, Markie-Dadds C. The effects of the Triple P-Positive Parenting Program on preschool children with co-occurring disruptive behavior and attentional/hyperactive difficulties. *J Abnorm Child Psychol*. 2002;30(6):571-587.
16. Hoath FE, Sanders MR. A feasibility study of Enhanced Group Triple P—positive parenting program for parents of children with attention-deficit/hyperactivity disorder. *Behav Change*. 2002;19(04):191-206.
17. Jones K, Daley D, Hutchings J, Bywater T, Eames, C. Efficacy of the Incredible Years Basic parent training program as an early intervention for children with conduct problems and ADHD. *Child Care Health Dev*. 2007;33(6):749-756.
18. Pisterman S, Firestone P, McGrath P, et al. The role of parent training in treatment of preschoolers with ADDH. *Am J Orthopsych*. 1992;62(3):397-408.
19. Sonuga-Barke EJ, Daley D, Thompson M, Laver-Bradbury C, Weeks A. Parent-based therapies for preschool attention-deficit/hyperactivity disorder: a randomized, controlled trial with a community sample. *J Am Acad Child Adolesc Psychiatry*. 2001;40(4):402-408.
20. Sonuga-Barke EJ., Thompson M, Daley D, Laver-Bradbury C. Parent training for Attention Deficit/Hyperactivity Disorder: Is it as effective when delivered as routine rather than as specialist care? *Br J Clin Psychol*. 2004;43(4):449-457.
21. Thompson MJ., Laver-Bradbury C, Ayres M, et al. A small-scale randomized controlled trial of the revised new forest parenting program for preschoolers with attention deficit hyperactivity disorder. *Eur Child Adolesc Psychiatry*. 2009;18(10):605-616.
22. Van Den Hoofdakker BJ, Van der Veen-Mulders L, Sytema S, Emmelkamp PM, Minderaa RB, Nauta MH. Effectiveness of behavioral parent training for children with ADHD in routine clinical practice: a randomized controlled study. *J Am Acad Child Adolesc Psychiatry*. 2007;46(10):1263-1271.
23. Herbert SD, Harvey EA, Roberts JL, Wichowski K, Lugo-Candelas CIA randomized controlled trial of a parent training and emotion socialization program for families of hyperactive preschool-aged children. *Behav Ther*. 2013;44(2):302-16.

24. Johnston C, Mash E.J. A measure of parenting satisfaction and efficacy. *J Clin Child Psychol.* 1989;18(2):167-175.
25. Barkley RA. *Defiant children: A clinician's manual for parent treating.* New York: Guilford Press, 1987.
26. Barkley RA. *Attention deficit hyperactivity disorder: A handbook for diagnosis and treatment.* New York: Guilford Press, 1990.
27. Forehand R, McMahon, R. *The noncompliant child.* New York: Guilford Press, 1981.
28. DuPaul GJ. Parent and teacher ratings of ADHD symptoms: Psychometric properties in a community based sample. *J Clin Child Psychol.* 1991;20(3):245-253.
29. Conners CK. *Conners Rating Scales-Revised.* North Tonawanda, New York: Multihealth Systems; 2001.
30. Eyberg, S. M., & Pincus, D. *Eyberg Child Behavior Inventory and Sutter-Eyberg Student Behavior Inventory: Professional manual.* Odessa, FL: Psychological Assessment Resources; 1999.
31. Lovibond PF, Lovibond SH. The structure of negative emotional states: Comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. *Behav Res Ther.* 1995;33(3):335-343.
32. Arnold DS, O'Leary SG, Wolff LS, Acker MM. The Parenting Scale: A measure of dysfunctional parenting in discipline situations. *Psychol Assessment.* 1993;5(2):137-144.
33. Taylor EA, Sandberg S, Thorley G, Giles S. The epidemiology of childhood hyperactivity. Institute of Psychiatry. *Maudsley Monographs.* Oxford University Press, London; 1991.
34. Goldberg D. *General health questionnaire manual.* NFER:Windsor; 1982.
35. Brotman LM, Calzada E, Dawson-McClure S. *GIPCI-R unpublished manuscript.* New York University, 2005.
36. Johnston C, Mash EJ. Families of children with attention deficit hyperactivity disorder: Review and recommendations for future research. *Clin Child Fam Psych.* 2001;4(3):183-207.
37. Chronis AM, Gamble SA, Roberts JE, Pelham Jr WE. Cognitive-behavioral depression treatment for mothers of children with attention-deficit/hyperactivity disorder. *Behav Ther.* 2006;37(2):143-158.
38. Cunningham CE, Bremner R, Boyle M. Large Group Community-Based Parenting Programs for Families of Preschoolers at Risk for Disruptive Behaviour Disorders: Utilization, Cost Effectiveness, and Outcome. *J Child Psych Psychiatry.* 1995;36(7):1141-1159.
39. Sanders MR, Markie-Dadds C, Tully LA, Bor W. The triple P-positive parenting program: a comparison of enhanced, standard, and self-directed behavioral family intervention for parents of children with early onset conduct problems. *J Consult Clin Psychol.* 2000;68(4):624-640.

40. Sanders MR, Bor W, Morawska A. Maintenance of treatment gains: a comparison of enhanced, standard, and self-directed Triple P-Positive Parenting Program. *J Abnorm Child Psychol.* 2007;35(6):983-998.

APPENDIX 1

SEARCH TERMS

Participants set

ADHD OR adhd OR attention deficit disorder with hyperactivity OR minimal brain disorders OR syndrome hyperkinetic OR hyperkinetic syndrome OR hyperactivity disorder OR hyperactive child syndrome OR childhood hyperkinetic syndrome OR attention deficit hyperactivity disorders OR attention deficit hyperactivity disorder OR adhd attention deficit hyperactivity disorder OR addh OR overactive child syndrome OR attention deficit hyperkinetic disorder OR hyperkinetic disorder OR attention deficit disorder hyperactivity OR attention deficit disorders hyperactivity OR child attention deficit disorder OR hyperkinetic syndromes OR syndromes hyperkinetic OR hyperkinetic syndrome childhood OR *Attention deficit disorder / OR ((atten\$) adj3 (deficit\$ OR disorder\$ or hyperactiv\$ OR hyper?activ\$ OR adhd OR addh OR ad??hd)) OR ((hyperkin\$ OR hyper?kin\$) adj3 (deficit\$ OR disorder\$ OR hkd))*

NB additional terms for OVID databases in italics.

Design set

RCT or cluster RCT or clinical trial* or controlled clinical trial* or crossover procedure or cross over stud* or crossover design or double blind procedure or double blind method or double blind stud* or single blind procedure or single blind method or single blind stud* or random allocation or randomization or random assignment or randomized controlled trial*

Behavioral interventions

contingency manag* OR manag* technique* OR contingency technique* OR psychosocial intervention* OR psychosocial treatment OR psychosocial therapy OR social skills train* OR social skills intervention OR social skills treatment OR problem solv* intervention OR problem solv* treatment OR problem solv* train* OR problem solv* therapy OR behavio* modification OR cognitive behavio* treatment OR cognitive behavio* therapy OR cognitive behavior* training OR parent* train* OR parent* counsel* OR parent* support OR school-based OR classroom-based OR school intervention* OR classroom intervention* OR teacher train* OR after-school OR remedial teach* OR peer tutor* OR computer assist* learn* OR task modificati* OR curriculum modificati* OR classroom management OR education* intervention OR multimodal intervention OR multimodal treatment OR multimodal therapy OR multimodal intervention OR multimodal treatment OR multimodal therapy OR education* intervention OR verbal self-instruction train*

APPENDIX 2

SEARCH DATABASES

Science Citation Index Expanded (SCI-Expanded)

Social Sciences Citation Index (SSCI)

Arts & Humanities Citation Index (A&HCI)

Conference Proceedings Citation Index - Science (CPCI-S)

Conference Proceedings Citation Index - Social Sciences & Humanities (CPCI-SSH)

Index Chemicus (IC)

Current Chemical Reactions (CCR-Expanded)

Current Contents Connect®

Derwent Innovations IndexSM

Biological Abstracts®

BIOSIS Previews®

CABI: CAB Abstracts® and Global Health®

Food Science and Technology Abstracts (FSTA)®

Inspec®

MEDLINE®

Zoological Record®

Ovid MEDLINE(R)

PsycINFO

EMBASE Classic+EMBASE

Web of science

ERIC

CINHAL

Tables and Figures

Table 1: Characteristics of studies included in the meta-analysis

Study	Diagnosis	Design	Duration of treatment	Concurrent stimulant medication %	Participant selection By treatment response?	Treatment	Control condition	N ^A T C	Age range in months	Gender % male
Anastopoulos (1993) ¹³	DSM IIIR	2 group controlled but not randomized trial comparing parent training only against a waiting list control	9 weekly sessions	21% (n=7), no breakdown for intervention and control	No selection	Behavioral Parent Training	Waiting list	19 15	75-123 Mean= 97.7	74
Barkley (2000) ¹⁴	DSM IIIR or CPRS	4 group comparing Parent Training PT only against Special Treatment Classroom STC only against PT and STC against no treatment control	10 weekly parent training sessions plus monthly booster sessions,	No	No selection	Behavioral parent training	No Treatment Control	39 42	54 - 72	64
Bor (2002) ¹⁵	DSM-IV	3 group RCT comparing standard and enhanced	15 wk Standard 17 wk enhanced	No	No selection	Enhanced behavioral Family Intervention	Waiting list	15 27	Enhanced 40.41 (mean) ^c WLC 42.81	68 ^c

		behavioral intervention against Waiting list control				(Triple P) plus additional partner support and coping skills training.			(mean) ^c	
Herbert (2013) ²³	DISC and BASC 2-PRS	2 group RCT comparing behavioral intervention against waiting list control	14 sessions	23% (n=4) in intervention; 7% (n=1) in control	No selection	Behavioral parent training (The Parenting your Hyperactive Preschooler)	Waiting list	17 14	34 - 76 (mean= 54.92)	74 ^b
Hoath (2002) ¹⁶	Yes but type not specified	2 group RCT comparing behavioral intervention against Waiting list control	9 sessions (5 weekly group sessions followed by 4 weekly telephone consultations)	80% in intervention and 64% in control	No selection	Enhanced Behavioral Family Intervention (Triple P) plus additional partner support and coping skills training	Waiting list	9 11	60 – 108 Intervention 95.78 (mean) Control 89.55 (mean)	80
Jones (2007) ¹⁷	SDQ	2 group RCT comparing behavioral intervention against Waiting list control	12 week	No	No selection	Behavioral Parent training (Incredible Years BASIC 12) based on principles of social learning theory.	Waiting list	50 29	Behavioral 46.5 Control 45.9	68
Pisterman (1992) ¹⁸	Parent or Teacher SNAP	2 group RCT comparing behavioral intervention against waiting list control	12 sessions usually weekly	9% intervention and 5% control ^d	No selection	Attention training behavioral intervention aimed at shaping on-task behavior, enhancing	Waiting list	23 22	Behavioral mean = 46.78 Control mean = 52.41	91

						compliance and implementing time-out procedures for non-compliance.				
Sonuga-Barke (2001) ¹⁹	PACS	3 group RCT comparing Behavioral parent training against parent counselling against waiting list control	8 week	no	No selection	Behavioral parent training (New Forest Parenting Program) which included introducing parents to a range of strategies specifically designed to target the underlying etiology of ADHD.	Parent Counseling. Eight 1 hour sessions which did not contain any training in behavioral strategies but which discussed and explored issues of concern to the parent.	30 28	33 - 39	62 ^b
Sonuga-Barke (2004) ²⁰	PACS	2 group RCT comparing Behavioral Parent Training against Waiting list control	8 week	no	No selection	Behavioral parent training (New Forest Parenting Program) which included introducing parents to a range of strategies specifically designed to target the underlying etiology of ADHD.	Waiting list	59 30e	33 - 39	Not reported

Thompson (2009) ²¹	PACS	2 group RCT comparing Behavioral Parent Training against treatment as usual	8 week	no	No selection	Behavioral parent training (New Forest Parenting Program) which included introducing parents to a range of strategies specifically designed to target the underlying etiology of ADHD.	Treatment as usual. Participants received no treatment from study, but received contact information for other health professionals and agencies. ^f	17 13	30 - 77	76
Van Den Hoofdakker (2007) ²²	DSM-IV DISC	2 group RCT comparing behavioral parent training and TAU against treatment as usual alone	12 sessions over 5 months	50% no breakdown for intervention and control	No selection	Twelve 120 minute sessions of behavioral parent training that drew on the techniques of Barkley ^{25, 26} and Forehand & McMahon ²⁷	Treatment as usual. Clinicians were instructed to provide care as usual including medication, psycho-education, counseling, and crisis management whenever necessary.	47 47	48 – 144 Mean = 89	81

DSM - Diagnostic and Statistical Manual; CPRS - Conners' Parent Rating Scale; BASC 2-PRS - Behavior Assessment System for Children 2-Parent Report Scale; SDQ - Strength and Difficulties Questionnaire; SNAP - Swanson Nolan and Pelham Questionnaire; PACS - Parent Account of Childhood Symptoms interview; DISC - Diagnostic Interview Schedule for Children; RCT - Randomized Controlled Trial.

^a N is the number of individuals in the Treatment (T) and Control (C) condition.

^b in full sample

^c Values only reported for entire sample, before considerable attrition and intention to treat analysis was not used.

^d Medication status was considered during randomization procedure

^e 20 out of the 30 control in this study were shared with the control group from Jones (2007)¹⁷

^f None of the treatment as usual group received any intervention or parent training during the course of the study, so the group functioned as a no treatment group

Table 2: Study outcome measures

Study	ADHD	Conduct Problems	Parental Self-esteem	Parental Well-being	Parental Stress	Parenting
Anastopoulos (1993) ¹³	ADHDRS	Not applicable (NA)	PSOC	NA	PSI	NA
Barkley (2002) ¹⁴	CPRS	NA	NA	NA	NA	NA
Bor (2002) ¹⁵	ECBI inattention	ECBI ODD & CD	PSOC	NA	NA	PS
Herbert (2012)	DBRS	DBRS - ODD	NA	NA	NA	PS & Home Obs
Hoath (2002) ¹⁶	CAP	ECBI	NA	DASS	DASS	PS
Jones (2007) ¹⁷	CPRS	NA	NA	NA	NA	NA
Pisterman (1992) ¹⁸	Home Obs Attention	Home Obs Non-compliance	NA	NA	NA	Home Obs Compliance & reinforcement
Sonuga-Barke (2001) ¹⁹	PACS ADHD	PACS Conduct	PSOC	GHQ 30	NA	NA
Sonuga-Barke (2004) ²⁰	PACS ADHD	NA	PSOC	GHQ30	NA	NA
Thompson (2009) ²¹	PACS ADHD	PACS conduct	PSOC	GHQ12	NA	GIPCI
Van Den Hoofdakker (2007) ²²	CPRS	NA	NA	NA	PSI	NA

ADHDRS - Attention Deficit Hyperactivity Disorder Rating Scale²⁸. PSOC - Parenting Sense of Competence²⁴. CPRS - Conners Parent Rating Scale²⁹. ECBI - Eyberg Child Behavior Inventory³⁰. DBRS - Disruptive Behavior Rating Scale;. DASS - Depression, Anxiety & Stress Scale³¹. CAP - Childhood Attention Scale (Edelbrock 1987, cited in²⁶). PS - Parenting Scale³². Home obs - Home observation. PACS - Parental Account of Childhood Symptoms interview³³. GHQ - General Health Questionnaire³⁴. GIPCI - Global Impressions of Parent Child Interaction³⁵.

Figure A: Effect of Parent-administered Behavior Training on ADHD Symptoms

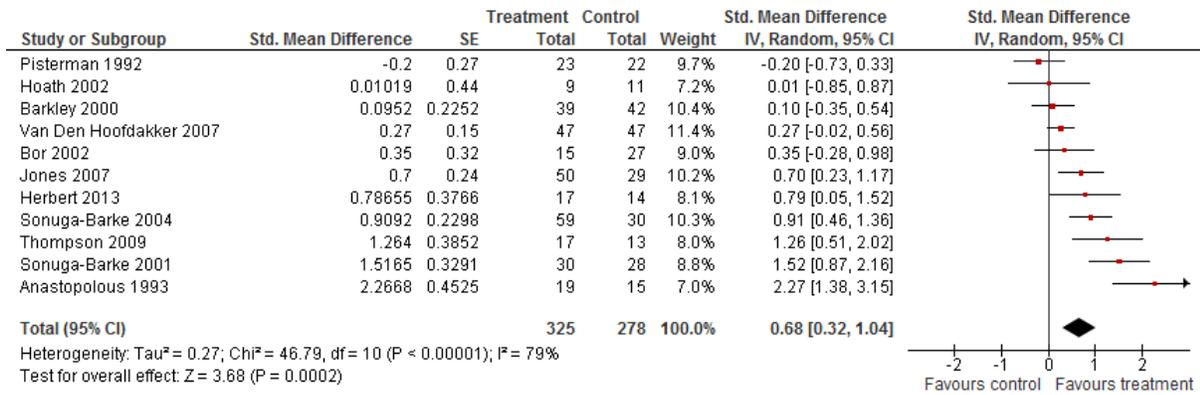


Figure B: Effect of Parent-administered Behavior Training on Conduct Problems

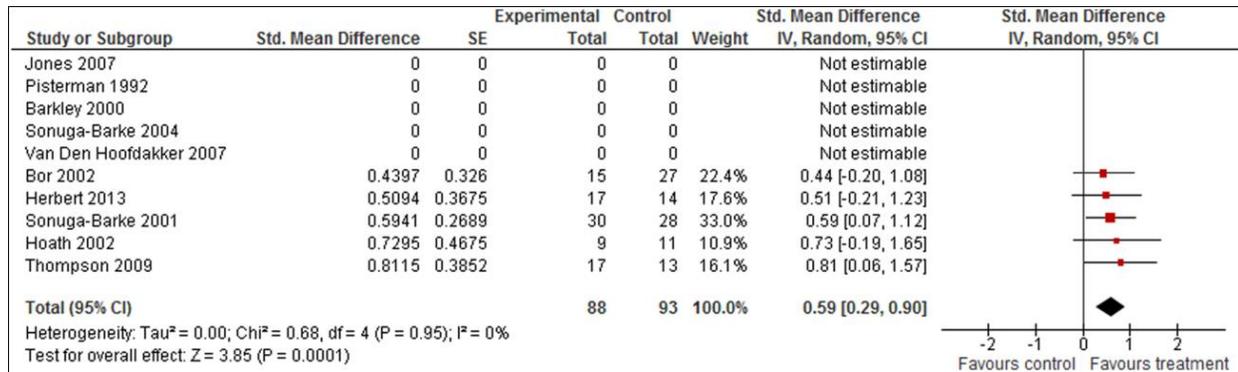
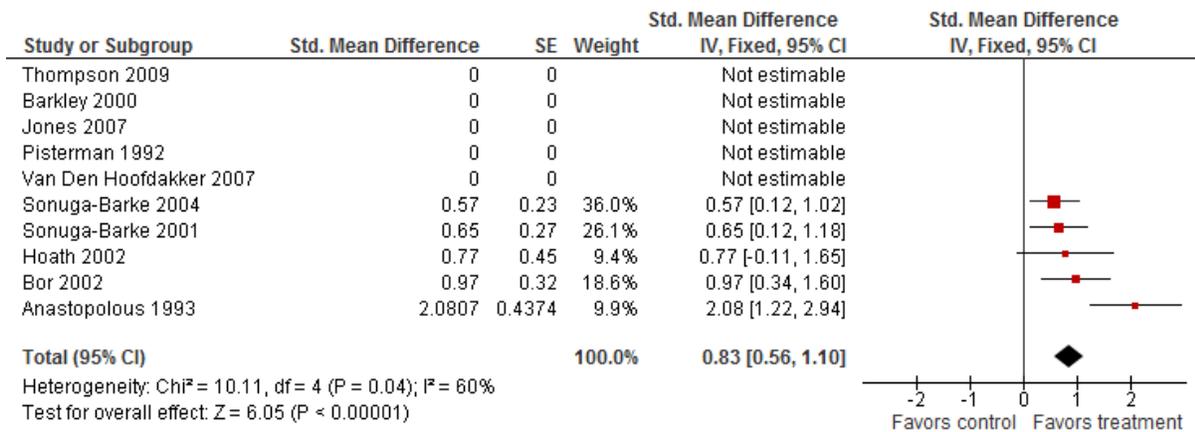


Figure C: Effect of Parent-administered Behavior Training on Parental Self-Esteem



Excluded studies Table

Study	References	Reasons for exclusion
Al Ansari (2012)	al Ansari A, Asiri MM. The impact of multimodal psychosocial intervention among children with attention deficit hyperactivity disorder. <i>Bahrain Medical Bulletin</i> , 2012; 34(1):1-6.	No specific ADHD outcome
Antshel (2003)	Antshel KM, Remer R. Social skills training in children with Attention Deficit Hyperactivity disorder: a randomized-controlled clinical trial. <i>J Clin Child Psychol</i> . 2003;1:153-165.	No Parent Training
Barkley (1992)	Barkley RA, Guevremont DC, Anastopoulos AD, Fletcher KF. A comparison of three family therapy programs for treating family conflicts in adolescents with Attention-Deficit Hyperactivity Disorder. <i>J Consult Clin Psychol</i> . 1992;60(3):450-462.	No control
Cunningham (1995)	Cunningham CE, Bremner R, Boyle R. Large group community based parenting programs for families of preschoolers at risk for disruptive behavior disorders: Utilization, cost effectiveness and outcomes. <i>J Child Psychol Psychiatry</i> . 1995;36(7),1141–1159.	Not a specific ADHD sample
Fabiano (2012)		No specific ADHD outcome
Fehlings et al (1991)	Fehlings DL, Roberts W, Humphries T, Dawe G: Attention deficit hyperactivity disorder: does cognitive behavioral therapy improve home behavior? <i>J Dev Behav Pediatr</i> . 1991;12:222–228.	Parent and Child intervention
Frankel (1997)	Frankel F, Myatt R, Cantwell DP, Feinberg DT. Parent-assisted transfer of children's social skills training: effects on children with and without attention-deficit hyperactivity disorder. <i>J Am Acad Child Adolesc Psychiatry</i> . 1997;36(8):1056-64.	Children with and without ADHD in one sample
Horn (1987)	Horn WF, Ialongo N, Popovich S, Peradotto D. Behavioral parent training and cognitive-behavioral self-control therapy with ADD-H children: Comparative and combined effects. <i>J Clin Child Psychol</i> . 1987;16(1):57-68.	No control group

Horn (1990)	Horn WF, Ialongo N, Greenberg G, Packard T. Additive effects of behavioral parent training and self-control therapy with attention deficit hyperactivity disorder children. <i>J Clin Child Psychol.</i> 1990;19(2); 98-110.	No control group
Horn (1991)	Horn WF, Ialongo NS, Pascoe JM, Greenberg G, Packard T, Lopez M et al. Additive effects of psychostimulants, parent training, and self-control therapy with ADHD children. <i>J Am Acad Child Adolesc Psychiatry.</i> 1991;30:233–240.	Parent and Child intervention
Ialongo (1993)	Ialongo NS, Horn WF, Pascoe JM, Greenberg G, Packard T, Lopez M et al. The effects of a multimodal intervention with attention-deficit hyperactivity disorder children: a 9-month follow-up. <i>J Am Acad Child Adolesc Psychiatry.</i> 1993; 32(1):182-9.	Same dataset as Horn et al 1990 No control group.
Molina (2008)	Molina BS, Flory K, Bukstein OG, Greiner AR, Baker JL, Krug V, Evans SW. Feasibility and preliminary efficacy of an after-school program for middle schoolers with ADHD: A randomized trial in a large public middle school. <i>J Attention Disord.</i> 2008;12(3):207-17.	No specific ADHD outcomes
MTA study (1999)	MTA Cooperative Group (Multimodal Treatment Study of Children With ADHD): A 14-month randomized clinical trial of treatment strategies for attention-deficit/hyperactivity disorder. <i>Arch Gen Psychiatry.</i> 1999; 56:1073–1086.	Parent, child and teacher intervention
Pisterman (1989)	Pisterman S, McGrath P, Firestone P, Goodman JT, Webster I, Mallory R. Outcome of parent-mediated treatment of preschoolers with attention deficit disorder with hyperactivity. <i>J Consult Clin Psychol.</i> 1989;57(5):628-35.	No ADHD outcomes
Sanders (2007)	Sanders MR, Bor W, Morawska A. Maintenance of treatment gains: a comparison of enhanced, standard, and self-directed Triple P-Positive Parenting Program. <i>J Abnorm Child Psychol.</i> 2007;35(6):983-98.	Not a specific ADHD sample
Schumann (1998)	Schuhmann EM, Foote RC, Eyberg SM, Boggs SR, Algina J. Efficacy of parent-child interaction therapy: Interim report of a randomised trial with	Not a specific ADHD sample No specific ADHD outcomes

	short term maintenance. <i>J Clin Child Psychol.</i> 1998;27(1):34 – 45.	
So (2008)	So CY, Leung PW, Hung SF. Treatment effectiveness of combined medication/behaviorbehavioral treatment with chinese ADHD children in routine practice. <i>Behav Res Ther.</i> 2008;46(9):983-92.	No control group
Strayhorn (1989)	Strayhorn JM, Weidman CS. Reduction of attention deficit and internalizing symptoms in preschoolers through parent-child interaction training. <i>J Am Acad Child Adolesc Psychiatry.</i> 1989;28(6):888-96.	Not a specific ADHD sample
Thorell 2009	Thorell, L.B. The Community Parent Education Program (COPE): treatment effects in a clinical and a community-based sample. <i>Clin Child Psychol Psychiatry.</i> 2009;14(3):373-87.	Not a specific ADHD sample
Webster-Stratton (2011)	Webster-Stratton CH, Reid MJ, Beauchaine T. Combining parent and child training for young children with ADHD. <i>J Clin Child Adolesc Psychol.</i> 2011;40:191–203.	Parent and child intervention