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ORIGINAL CONTRIBUTION

Online parent programs for children's behavioral problems: a meta-analytic review

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Abstract

A recent increase in the development of online parent programs calls for the need to understand how effective these strategies are for improving children's mental health. We meta-analyzed the effects of online parent programs on children's behavioral problems. Moreover, we explored the combinations of program components to yield stronger program effects. Medline, PsycINFO, Web of Science, and the Cochrane Library were searched. We included peer-reviewed randomized studies evaluating the effect of an online parent program. Effect sizes (Hedges' g) were calculated from post intervention means and standard deviations. We used Qualitative Comparative Analysis (QCA) to identify pathways to effectiveness and individual content and delivery components that seem sufficient or necessary for yielding high effectiveness. Of 2941 articles, 12 articles with a total of 2025 participants met the inclusion criteria. Online parent programs have significant effects on children's behavioral problems ($g = -0.32$; 95% CI, -0.47 to -0.17), emotional problems ($g = -0.22$; 95% CI, -0.31 to -0.13), and parental mental health problems ($g = -0.30$; 95% CI, -0.42 to -0.17). In the QCA, sending parents reminders to work on the program was the only one sufficient component. In conclusion, online support programs reduce children's behavioral and emotional problems and improve parental mental health. Sending parents reminders to work on the program seems to contribute to high effectiveness. *Review Registration* This study was registered with PROSPERO, number CRD42017080051.

Introduction

Prevalence estimates for children's behavioral problems typically range from 5 to 15% [1, 2]. These problems predict negative outcomes in later life (e.g., school underachievement and various mental health disorders) [3–5]. It is therefore important to effectively reduce these problems. Parent programs can successfully reduce children's behavioral problems [6, 7]. These programs work through improving the parent–child relationship and breaking coercive interaction cycles in which parents unwittingly reinforce children's behavioral problems [8]. The strong evidence-base for their effectiveness has led these programs to be widely recommended as the primary intervention strategy for reducing children's behavioral problems (e.g., United Kingdom's National Institute for Health and Care Excellence, United States' Centers for Disease Control and Prevention) [9].

A serious problem with most programs, however, is that they are not easily accessible. Many families of preschool children with behavioral problems do not receive

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an evidence-based parent program [10]. Access may depend on referral to child's mental health care services, long waiting lists [11], costs, and sometimes inconvenient locations [11, 12]. All of these impact on their ability to access the parent programs. Even if parents can access a parent program, keeping parents engaged is often challenging. A previous study suggests that on average only 60% of the parents complete the program [12]. Moreover, group-based sessions can generate psychological limitations including perceived stigma that can affect parental willingness to attend [11].

To increase their use, and thus the public health impact, programs need to become more accessible. Online programs may serve this goal. More than 60% of all people worldwide, including socioeconomically disadvantaged populations, have access to the internet, and this number is rising quickly [13]. This makes online parent programs a promising approach for reaching large numbers of families [14]. Online platform may have considerable potential to improve the accessibility of parent support programs [15]. Previous studies showed that both face-to-face and online psychological programs reduce mental health problems and their associated societal costs. However, because online programs tend to be less costly, they typically are the more cost-effective strategy [16]. It is not known, however, how effective these programs actually are at reducing children's behavioral problems.

There may be reasons to doubt their effectiveness. First, online programs rarely offer therapist contact, while families with severe problems may need this contact in order to sustainably change family dynamics. Online parent programs may not offer sufficient support to break the often-persistent family dynamics contributing related to children's behavior problems. It has been suggested that some families need face-to-face support to ensure skill acquisition by well-trained therapists. For example, while effective feedback is critical for skill development and utilization [17–19], this can be hard to realize in an online program. Second, most online programs are self-administered, which might make it difficult for parents to complete the program, if there are no set appointments or reminders to keep them engaged [20–22].

Understanding the effectiveness of parent programs is not only important to inform clinical practice, but also to increase our insights into the critical ingredients of psychosocial therapies. If online parent programs can effectively reduce children's behavior problems, this suggests face-to-face therapist contact is not essential for effective therapy. If, instead, online parent programs are relatively ineffective, this challenges trends to implement online parent support programs [20].

Are there secondary effects?

Although most online parent programs are developed to reduce children's behavioral problems (e.g., oppositional and defiant behavior), some suggest they might also reduce children's emotional problems (e.g., anxiety and depressive symptoms) [6, 7]. One possible explanation is that most parent programs target aspects of the parent–child relationship and daily parent–child interactions that underlie both behavioral and emotional problems [23]. However, the extent to which emotional problems are indeed improved by parent programs that are typically primarily designed to reduce behavioral problems is unclear. Some studies [24], but not others [25, 26], support this indirect effect. However, overall the evidence-base is relatively weak [27]. Thus, we also studied, in addition to effects on children's behavioral problems, how strong the effects are of online parent programs on children's emotional problems."

In addition, we studied the effects of online parent programs on parental mental health problems. Parent programs may improve parental mental health [28, 29] through, for example, learning problem solving and emotion regulation skills, or through improved child behavior [30, 31]. Previous meta-analyses indeed suggest that traditional group parent programs reduce parental depressive symptoms and stress [29]. In this review, we therefore also investigated the impact of online parent programs on various aspects of parental mental health (e.g., emotional problems, self-efficacy, stress, anxiety, and depression). We expected that online parent programs may benefit parental mental health, even they were primarily aimed to improve children's behavioral or emotional problems [31]. Reductions in children's behavior problems may reduce parental mental health problems, and parents may be able to apply some of the strategies (e.g., problem management and self-emotional regulation) more generally, in addition to using them to reduce children's behavior problems [29–31].

What makes programs less or more effective?

Knowing the content and delivery components that drive the effects of online parent programs can help optimize these programs by making them "leaner" to ease scaling up of these parent programs. For example, time and costs can be saved on phone calls or therapist involvement, if these components are not necessary for program success. We meta-analyzed the effects of online parent programs on children's behavioral problems, and on children's emotional problems and parental mental health. To explore

what makes programs effective, we used qualitative comparative analysis (QCA) to identify the program components that are associated with stronger program effects.

Methods

We meta-analyzed the effects of online parent programs on children's behavioral problems, and on children's emotional problems and parental mental health. To explore what makes programs effective, we used qualitative comparative analysis (QCA) to identify the program components that are associated with stronger program effects.

Meta-analysis

This meta-analysis was developed in line with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (www.prisma-statement.org). This study was registered with PROSPERO, number CRD42017080051.

Search strategy

We searched for studies evaluating online parent program studies that were published until June 30 2017 in the databases of Medline, PsycINFO, Web of Science, and Cochrane Library. eMethods includes our complete search strategy.

Study selection criteria

Studies were selected for inclusion if they (a) evaluated the effect of a parent program on children's behavioral or emotional problems (child mean age 2–12 years), (b) were written in English, (c) compared families receiving the program with families in a control condition (e.g., wait list or care as usual), (d) were a randomized or quasi-experimental study design (e.g., a matched-controlled group), (e) delivered more than 50% of the parent program online, (f) reported post-test scores of children's behavioral and/or emotional problems with sufficient detail to allow the calculation of an effect size, or the data could be requested from the authors, and (g) were published in a peer-reviewed journal. Unpublished studies were not sought. Although they can be helpful to prevent meta-analytic results from publication bias, their quality often cannot be guaranteed, because they have not undergone peer review.

We excluded studies if they (a) were directed at parents of children in foster care, with autism, or severe physical disabilities, (b) tested the effects of combinations of programs (e.g., parent and teacher programs), rather than of a parenting program specifically, and (c) had sample sizes smaller than $N = 10$.

One author assessed the abstracts and full texts of studies that were likely to meet inclusion criteria. Discrepancies and the final list of studies included in the review were assessed by two authors.

Data extraction

We extracted the following data: (1) means and standard deviations of post-test scores on measures of children's behavioral problems (e.g., conduct problems, disruptive behavior), emotional problems (e.g., anxiety, depression), and parent's mental health (e.g., stress, depression, anxiety); (2) methodological characteristics (e.g., sample size, study design); (3) program characteristics (e.g., number of sessions); (4) sample characteristics (e.g., participant's age and sex) and (5) level of prevention or treatment (e.g., universal prevention, targeting the general community; selective prevention, targeting families at higher risk for child's behavioral or emotional problems such as socioeconomically deprived families; indicated prevention, targeting families with children who were screened for the study purposes, and included only when they showed subclinical or clinical levels of behavioral or emotional problems; and treatment, targeting families referred to clinical settings).

To identify pathways to effectiveness in line with previous meta-analyses [16, 27–29], we coded the presence versus absence of each of the components provided in the eTable 1 for each study. The first nine components reflect the content of the program; the latter seven reflect the delivery process.

Effect size calculation

We calculated Hedges' g to decrease small sample bias for some of the included studies [32]. First, the difference between the mean post-test scores of families in the intervention and control condition were divided by the pooled standard deviation. Further, the estimate was corrected for small sample bias using Hedges correction [32].

Assessment of risk of bias

We used the Cochrane Collaboration Risk of Bias tool to categorize risk of bias in (1) random sequence generation, (2) blinding of participants and personnel, (3) incomplete outcome data, and (4) selective reporting [33]. Ratings of high, unclear or low were assigned for each domain within the 12 individual studies.

Data analyses

Meta-analysis

Three-level multilevel meta-analysis was used to account for the clustering of effects (e.g., from multiple measures and/or on multiple follow-up occasions) within the studies. Level 1 represents sampling variance for each effect size. Level 2 is implied for variance between effect sizes within a study. Level 3 represents variance between effect sizes across studies. We estimated the size of the intervention effect by fitting meta-analysis models without an intercept. The statistical analysis was designed to evaluate both within-study and between-study variables.

Heterogeneity was evaluated using Cochran's Q test of heterogeneity and the I^2 statistic, which measured the proportion of inconsistency among studies that could not be explained by chance.

Qualitative comparative analysis (QCA)

We used QCA to identify the single individual components and the combinations of components that were associated with either higher or lesser effectiveness. We also determined sufficient pathways (a set of components representing one of possibly several pathways to the outcome) and necessary pathways (a set of components within which every instance of the outcome occurs) to higher and lesser effectiveness. We chose to use QCA for this because QCA is specifically designed for small-n, multivariable analyses [34]. QCA is an analytic technique for identifying combinations of intervention characteristics associated with, as well as those not found to be associated with, higher and lesser program effectiveness. This technique begins with listing and counting all the components and the combinations of components observed in the data set, followed by determining which components tend to cluster in programs that are more effective and which components tend to cluster in programs that are less effective [34]. We used the–fuzzy–package in Stata version 15 to build the truth table [35]. The truth table gives an overview of all possible combinations of components (i.e., configurations) that have a similar outcome (i.e., highly effective versus less effective). Boolean minimization was used to arrive at solution sets that described pathways to high and less effectiveness. Using this method, we can minimize the most simplified combinations of components.

We classified studies as "highly effective" if the intervention group demonstrated a moderate to large effect on children's behavioral problems (effect size ≥ 0.3) [36]. We chose to use the threshold of 0.3 because effect sizes above 0.3 are of substantial policy interest [36]. We classified the studies with effect sizes below 0.3 as "less effective" [34]. Although included studies used a variety of behavioral outcomes measured, almost all studies (9 studies) used the Eyberg Child Behavior Inventory (ECBI) as the primary outcome. We therefore used the effect size based on ECBI for outcome set calibration. We calibrated the two studies that did not use the ECBI based on the effect sizes of the Strengths and Difficulties Questionnaire and Child Behavior Checklist.

eTable 1 maps the empirical components of the parent programs covered in the QCA on two types of components. We sent emails to all authors to ask them to code which components were included in each program. In the eTable 2, a score of one indicates presence of the component and 0 indicates absence.

Results

The first author and a research assistant independently reviewed all records for eligibility. 12 studies were eligible and are included in this review (Fig. 1). All studies were randomized controlled trials (RCTs) with two arms (comparing an intervention to a control condition) [37–48]. Sample sizes varied from 37 to 464. Study characteristics are presented in Table 1.

Most studies ($k = 10$) reported significant effects of the online parent programs on at least one measure of children's behavioral or emotional problems. Exceptions were Sanders et al. [39], and Breitenstein et al. [45], who did not find effects of the online program, compared to a control, on children's behavioral or emotional problems.

On average, programs reduced children's behavior problems with around a third of a standard deviation (Hedges' $g = -0.32$; 95% CI -0.47 to -0.17, heterogeneity, $Q = 72.66$, $P = <0.001$; $I^2 = 62.84\%$; Fig. 2). Programs also reduced children's emotional problems (Hedges' $g = -0.22$; 95% CI -0.30 to -0.13, heterogeneity, $Q = 6.77$, $P = 0.45$; $I^2 = 0\%$; Fig. 3), and improved parental mental health (Hedges' $g = -0.30$ (95% CI -0.42 to -0.17, heterogeneity, $Q = 78.69$, $P = <0.001$; $I^2 = 53.65\%$; Fig. 4).

As shown in Table 1, studies varied in terms of their level of prevention, primary outcome, type of control, and level of therapist contact. The majority of the studies ($k = 10$) included children with subclinical levels of behavior or emotional problems (i.e., indicated prevention) [39-44, 47, 48]. The other two studies targeted children growing up in families at higher risk for the development of problem child behavior (i.e., selective prevention) [45, 46]. Effect sizes did not differ by level of prevention ($Q = 0.45$, $P = 0.50$) [37-48]. The two selective prevention studies did vary from each other in terms of their reported effectiveness: the program

Fig. 1 PRISMA Flow Diagram
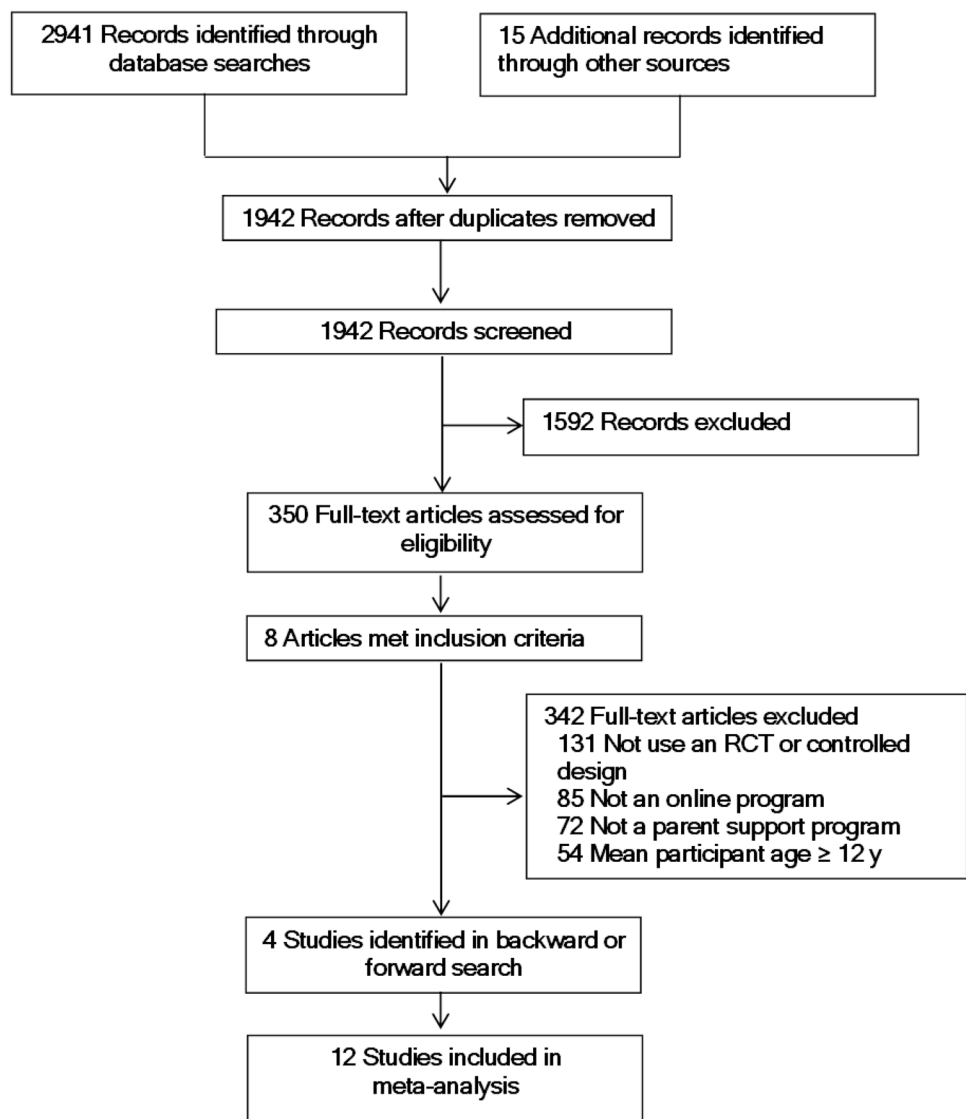
for parents with bipolar disorder reported the program was effective for reducing children's behavioral problems, while the program for low-income or ethnic minority parents was not.

The studies evaluated eight different programs, with a small majority of the studies ($k = 5$) evaluating the Triple P Positive Parenting Program. Across studies, however, Triple P was evaluated using different delivery components, at various levels of prevention, and tested against different types of control conditions. Almost all programs focused on teaching and practicing parenting skills and child management strategies to change negative coercive parent–child interactions (e.g., providing praise to positively reinforce positive child behavior and using time-out to decrease disruptive behavior). One program focused on reducing children's emotional problems specifically [37], teaching parenting techniques to reduce child anxiety (e.g., graded exposure, contingency

management, reducing overprotective behaviors), and one program focused on parental mental health [46], teaching parents to manage their own problems and feelings. These two programs [37, 46] yielded similar effects on children's behavioral and emotional problems (e.g., Cohen $d = 0.2$–0.3) compared to the other programs.

While most programs were delivered via a website [37–40, 42, 46–48], one program was delivered through downloadable Video [41], one through podcast [43], and one through an app [45]. Almost all programs were effective for reducing children's behavioral or emotional problems or improving parental mental health. However, one program delivered on a website [39] and one program delivered through an app [45] were not effective.

Eight studies used wait-list control groups [37, 40–44, 46, 47]. The waiting period varied between 6 weeks and 4 months. All studies with wait-list control groups offered

Table 1 Characteristics of included studies

Source	Sample size (N)	Child age range (mean)	% Boys	Country	Level of prevention	Primary outcome	Type of control	Type of program	Therapist contact	Program name
Morgan et al. [37]	433	3–6 (4.8)	47	Australia	Indicated	Anxiety	Waitlist	Website	Optional phone call, 2 summary emails	Cool little kids
Sourander et al. [38]	464	4–5 (4)	62	Finland	Indicated	Problem behaviors	Controlled online resources	Website	11 phone calls, 2 face-to-face coaching sessions	Strongest families smart website
Sanders et al. [39]	193	3–8 (5.63)	67	New Zealand	Indicated	Problem behaviors	Workbook	Website	–	Triple-P
Baker et al. [40]	200	2–9 (4.4)	55	Australia	Indicated	Problem behaviors	Waitlist	Website	–	Triple-P
Porzig-Drummond et al. [41]	84	2–10 (5.27)	50	Australia	Indicated	Problem behaviors	Waitlist	Video	–	1–2–3 magic parent program
Sanders et al. [42]	116	2–9 (4.7)	67	Australia	Indicated	Problem behaviors	Waitlist	Website	–	Triple-P
Morawska et al. [43]	165	2–10 (6.06)	62	Australia	Indicated	Problem behaviors	Waitlist	Podcast	–	Triple-P
Enebrink et al. [44]	104	3–12 (6.83)	58	Sweden	Indicated	Problem behaviors	Waitlist	Website	7 times written online feedback	Parent management training
Breitenstein et al. [45]	79	2–5 (NR)	43	US	Selective	Problem behaviors	Controlled online resources	App	–	Chicago parent program
Jones et al. [46]	97	3–10 (NR)	NR	UK	Selective	Problem behaviors	Waitlist	Website	–	Integrated bipolar parenting intervention
Antonini et al. [47]	37	3–9 (5.6)	63	US	Indicated	Problem behaviors	Controlled online resources	Website	9 online live coaching sessions	I-Interact
Franke et al. [48]	53	3–4 (4)	71.7	New Zealand	Indicated	Problem behaviors	Waitlist	Website	2 phone calls	Triple-P

NR not reported, RCT randomized controlled trial

Fig. 2 Forest plot displaying 28 effect sizes of online parent programs on children's behavioral problems. Abbreviations: *CAPES* child adjustment and parent efficacy scale, *CBCL* child behavior checklist, *ECBI* eyberg child behavior inventory, and *SDQ* strengths and difficulties questionnaire. The diamond indicates the overall multi-level random effect across all studies

Fig. 3 Forest plot displaying eight effect sizes of online parent programs on children's emotional problems. Abbreviations: *CAPES* child adjustment and parent efficacy scale; *CBCL* child behavior checklist; *PASR* preschool anxiety scale-revised, and *SDQ* strengths and difficulties questionnaire. The diamond indicates the overall multi-level random effect across all studies

usual services during the waiting period, although this typically meant that they did not provide any kind of information or intervention to the sample. Four studies offered alternative treatments to families in the control condition (active control condition), including controlled online resources, such as the health promotion or disease-specific website [38, 45, 48], or a hardcopy workbook [39]. This was, however, not the case: types of control condition (alternative treatment versus no alternative treatment) did not moderate study effect sizes ($Q = 1.42$, $P = 0.23$).

Author(s), Year	Measure	Hedges'g [95% CI]
Morgan et al, 2017	CAPES	-0.22 [-0.43, -0.00]
Morgan et al, 2017	OIP	-0.28 [-0.49, -0.07]
Sourander et al, 2016	PS	-0.13 [-0.31, 0.05]
Sourander et al, 2016	PS	-0.28 [-0.46, -0.10]
Sourander et al, 2016	DASS	-0.18 [-0.36, 0.00]
Sourander et al, 2016	DASS	-0.11 [-0.30, 0.07]
Sourander et al, 2016	DASS	-0.17 [-0.36, 0.01]
Sourander et al, 2016	DASS	-0.16 [-0.34, 0.02]
Sanders et al, 2014	PS	-0.04 [-0.33, 0.26]
Sanders et al, 2014	PS	-0.09 [-0.39, 0.20]
Sanders et al, 2014	PS	-0.07 [-0.36, 0.23]
Sanders et al, 2014	DASS	-0.06 [-0.36, 0.24]
Sanders et al, 2014	DASS	-0.29 [-0.59, 0.01]
Sanders et al, 2014	DASS	-0.13 [-0.43, 0.17]
Sanders et al, 2014	PS	-0.08 [-0.44, 0.28]
Sanders et al, 2014	PS	-0.12 [-0.48, 0.24]
Baker et al, 2017	PS	-0.27 [-0.54, 0.01]
Baker et al, 2017	PS	-0.20 [-0.48, 0.08]
Baker et al, 2017	PS	-0.49 [-0.77, -0.21]
Baker et al, 2017	DASS	-0.26 [-0.54, 0.02]
Baker et al, 2017	DASS	-0.21 [-0.48, 0.07]
Baker et al, 2017	DASS	-0.27 [-0.55, 0.01]
Sanders et al, 2012	PS	-0.53 [-0.92, -0.15]
Sanders et al, 2012	PS	-0.60 [-0.99, -0.22]
Sanders et al, 2012	PS	-0.56 [-0.95, -0.17]
Sanders et al, 2012	DASS	0.11 [-0.27, 0.49]
Sanders et al, 2012	DASS	0.11 [-0.27, 0.49]
Sanders et al, 2012	DASS	-0.18 [-0.56, 0.20]
Morawska et al, 2014	PS	-0.16 [-0.56, 0.23]
Morawska et al, 2014	PS	-0.31 [-0.71, 0.09]
Morawska et al, 2014	PS	-0.50 [-0.90, -0.10]
Breitenstein et al, 2016	PSI	-0.03 [-0.47, 0.40]
Jones et al, 2017	PSI	-0.54 [-1.01, -0.06]
Franke et al, 2016	PS	-1.86 [-2.43, -1.29]
Franke et al, 2016	PS	-1.06 [-1.71, -0.41]
Franke et al, 2016	PS	-0.85 [-1.49, -0.22]
Franke et al, 2016	DASS	-0.36 [-0.91, 0.18]
Franke et al, 2016	DASS	-0.56 [-1.11, -0.01]
Franke et al, 2016	DASS	-0.59 [-1.14, -0.04]
RE Model		-0.30 [-0.42, -0.17]

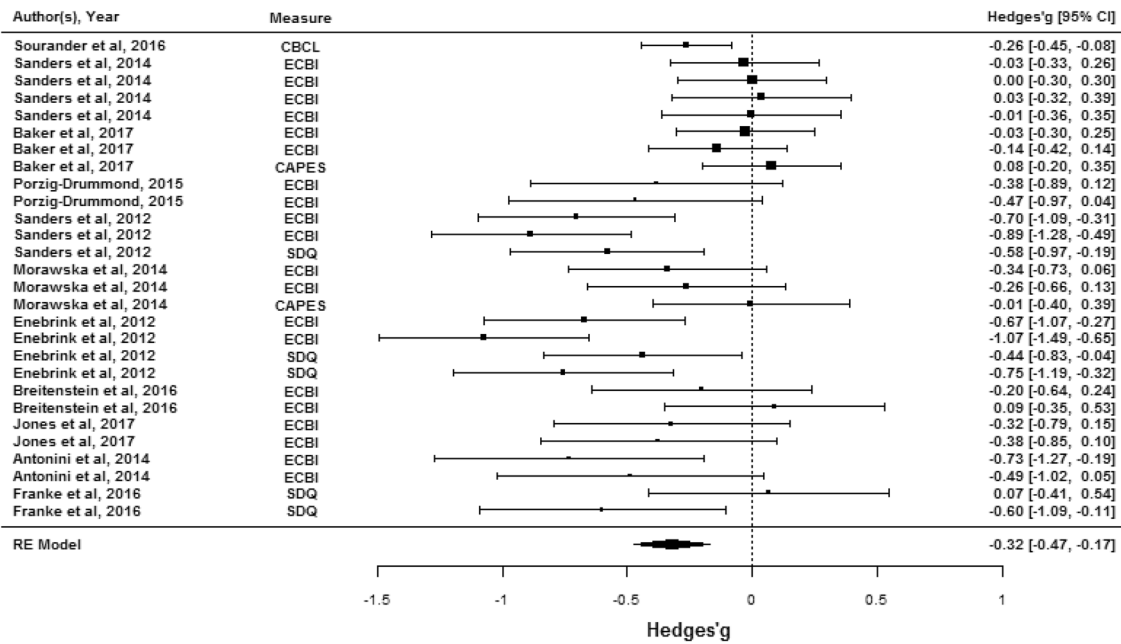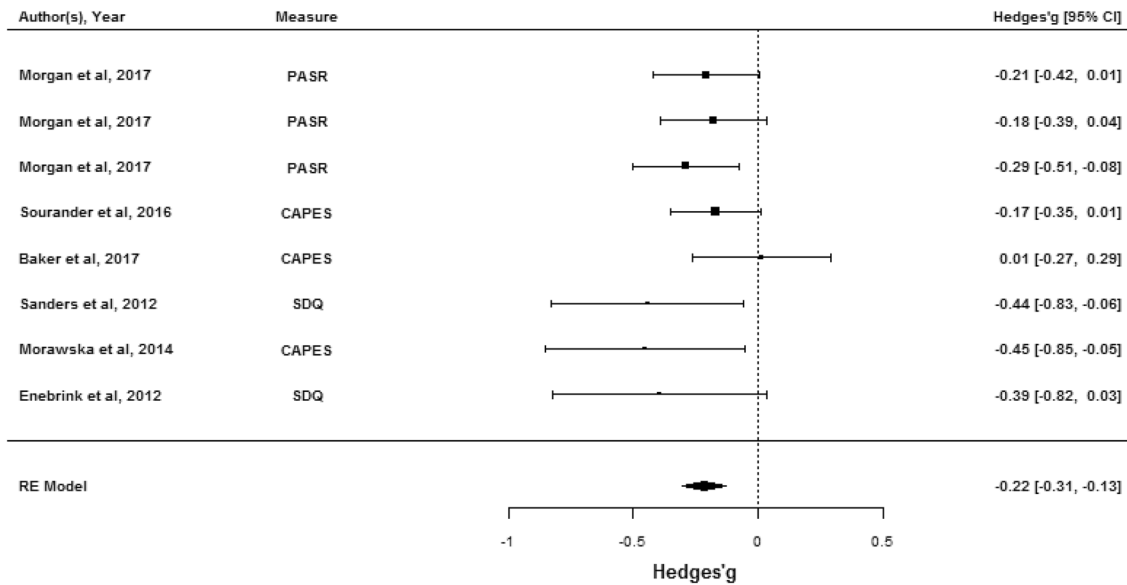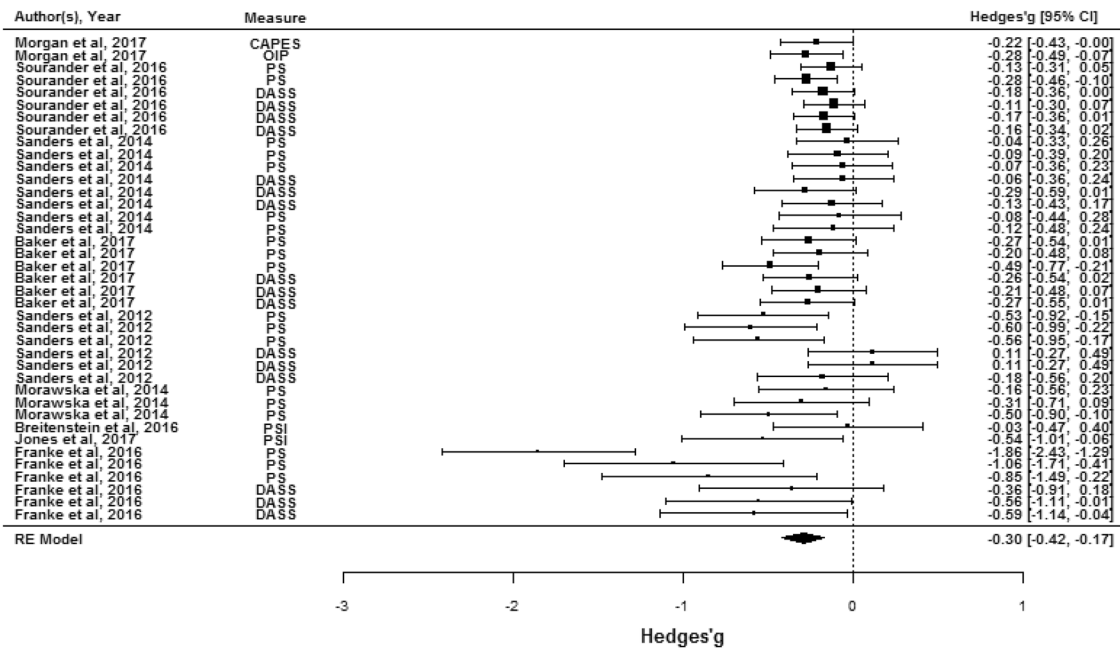**Fig. 4** Forest plot displaying 39 effect sizes of online parent programs on parental mental health. Abbreviations: *CAPES* child adjustment and parent efficacy scale, *DASS* depression, anxiety, and stress scale, *OIP* over-involved/protective parenting scale, *PS* parenting scale, and *PSI* parenting stress index. The diamond indicates the overall multilevel random effect across all studies

Table 2 Risk of bias at the study level

Source	Reporting bias (selective reporting)	Attrition bias (incomplete outcome data)	Performance bias (blinding of participants and personnel)	Selection bias (random sequence generation)
Morgan et al. [37]	Low	Low	High	Low
Sourander et al. [38]	Low	Low	High	Low
Sanders et al. [39]	Low	High	High	Low
Baker et al. [40]	Low	Low	High	Low
Porzig-Drummond et al. [41]	Low	High	High	Low
Sanders et al. [42]	Low	High	High	Low
Morawska et al. [43]	Low	Low	High	Low
Enebrink et al. [44]	Low	High	High	Low
Breitenstein et al. [45]	Low	High	High	Low
Jones et al. [46]	Low	High	High	Low
Antonini et al. [47]	Low	High	High	Low
Franke et al. [48]	Low	Low	Unclear	Low

A high risk of bias was assigned if the report made it clear that the method potentially introduced findings that could be biased. An unclear rating was assigned if the report made it unclear whether the study findings were likely to be biased. A low risk of bias was assigned if it was clear from the method and reporting that the issues assessed could not have biased the study

Risk of bias

All studies had low risk of bias for selective reporting. Most studies were rated as having a high risk of bias regarding the blinding of participants and personnel (91.7%), because blinding is virtually impossible to achieve in a psychological program. Study attrition was between 3 and 15% and only five studies reported intention-to-treat analysis. Risk of selection bias was low for all studies (Table 2).

QCA results

Six studies were classified as highly effective (Hedges' $g > -0.30$) [41–44, 46, 47]. Because nine components were

either present or absent in almost all studies (i.e., lack of variability; eTable 2), these components were excluded from the QCA model. The final QCA therefore included six components: three reflecting content (engage in child-led play, parental self-emotional regulation, and teaching parents how to support children problem solving, emotional regulation, or social skills for peer relations) and three reflecting delivery methods (additional phone calls, therapist feedback, and sending parents reminders).

Single components as paths to effectiveness

No single component was both necessary (i.e., all highly effective programs would have this component) and sufficient (i.e., all programs with this component would be highly effective) for high effectiveness. The only sufficient individual component for *more* improvement in children's behavioral problems was sending parents reminders to work on the program: all programs that included this component were *highly* effective (consistency 100%). The only sufficient individual component for *less* improvement was adding phone calls to the online program: all programs that included this component were *less* effective. There were no individual necessary components (Table 3).

Combinations of components as paths to effectiveness

With six components, there was a total of 64 (2^6) possible different combinations (i.e., "configurations") of components. Our included programs included eight of these possible 64 configurations, with good spread across the included programs (Table 3). None of these eight configurations were contradictory. This means that none of the configurations were present in both highly effective and in less effective programs. Instead, there were four configurations for highly effective programs and four configurations for less effective programs (solution consistency and coverage 100%; Table 3).

Figure 5 illustrates these four pathways for high effectiveness and four pathways for less effectiveness. A pathway to high effectiveness shared by three programs was teaching parents how to support children problem solving, emotional regulation, or social skills for peer relations and sending parents reminders to work on the programs. A pathway to less effectiveness shared by two programs that was included solely components on teaching parents how to support children problem solving, emotional regulation, or social skills for peer relations, and not providing other components. The other six pathways were unique for individual programs (Fig. 5).

Discussion

We studied the effectiveness of online parent support programs to improve children's behavioral problems. In this meta-analysis, we found that online parent programs reduce child's behavioral and emotional problems, and parental mental health. We identified four pathways for high effectiveness on reduced behavior problems, and showed that sending parents reminders to work on the program seemed the most important way to yield high effectiveness.

Although direct comparisons are not possible, due to potentially different target populations, the mean effect size of 0.32 suggests the effects of online parent support programs may not be inferior to the effects of face-to-face parent programs in indicated prevention settings [49] and to the effects of offline digital parent programs [27]. Effects on children's emotional problems and parental mental health were also similar to the effects of face-to-face parent programs [50, 51]. Program effects on emotional problems were, however, somewhat smaller than program effect on behavioral problems. Most online programs have not explicitly included strategies to prevent or manage child's emotional problems. In this review, there was only one online parent program that primarily aimed to prevent emotional problems [34]. However, although almost all online parent programs were focused on reducing child's behavioral problems, these online programs also targeted many of the proposed mechanisms and risk factors for children's emotional problems such as non-nurturing, unpredictable, and unstructured parenting behaviors [24]. This might explain why the programs also reduced children's emotional problems [52, 53]. However, the reason why these programs can improve children's emotional problems is beyond the scope of our study.

Although there was only one program that primarily aimed to improve parental mental health (bipolar parents) [46], the effects of online parent programs on parental mental health were significant and close in magnitude to the effect on child's behavioral problems. Our findings suggest that online programs also benefit parental mental health, even if programs are primarily aimed to improve children's behavioral or emotional problems. This meta-analysis however could not show whether the improvement was a result of the relief of children's behavior problems or strengthen parental skills to apply techniques learned in the program, such as problem solving, more generally.

The extent to which families benefit from a program may depend on individual family characteristics, such as baseline levels of problem severity. Baseline level of parental mental health problems varied substantially between studies. For example, in our sample, one study

Table 3 Coding framework as applied to included programs

Type of components	Intervention features	Highly effective programs						Less effective programs					Total highly effective (n=6)	Total less effective (n=5)
		Porzig-Drummond et al. [41]	Sanders et al. [42]	Morawska et al. [43]	Eneblink et al. [44]	Jones et al. [46]	Antonini et al. [47]	Sourander et al. [38]	Sanders et al. [39]	Baker et al. [40]	Breitenstein et al. [45]	Frankeet al. 2016		
1. Content components	Engage in child-led play (A)	0	0	0	1	1	0	1	0	0	1	0	2	2
	Parental self-emotional regulation (B)	1	0	0	0	1	1	1	0	0	1	0	3	2
	Teaching parents how to support children (C)	1	1	1	0	1	0	1	1	1	0	1	4	4
2. Delivery components	Additional phone call (D)	0	0	0	0	0	0	1	0	0	0	1	0	2
	Therapist analysis with feedback (E)	0	0	0	1	0	1	1	0	0	0	1	2	2
	Parent reminder (F)	1	1	1	0	0	1	0	0	0	0	0	4	0

A score of 1 indicates presence of the component and 0 indicates absence

Fig. 5 Configurations of parent program components. A Engage in child-led play; B, Parental self-emotion regulation; C Teaching parents how to support the child; D Additional phone call; E Therapist analysis with feedback; F Parent reminder

targeted parents with bipolar disorder [46]. Individual participant data meta-analyses are needed to identify whether online programs effects vary between subgroups of parents.

Different combinations of components (presence or absence of them) led to similar levels of effectiveness. It is well-known that different programs often yield similar effects, and that individual components rarely contribute to less or more effective psychotherapy [54, 55]. That said, we found that sending parents reminders to work on the program was the only single component that leaded to high effectiveness. Keeping parents engaged is a major challenge in any parent program, but particularly in online programs [56, 57]. Our finding suggests program generated reminders can be helpful to keep parents engaged. However, future research is needed to show how parents' engagement specifically contributes to parent program effects. Moreover, we did not find evidence for added value of phone calls to the online program. All programs with additional phone call classified as less effective. This result seems to support findings from previous studies on other psychological intervention that therapeutic alliance was less important in online psychological program than in traditional face-to-face programs [57] and that chat failed to make a significant effect to online program outcomes [58].

Nevertheless, some methodological limitations (e.g., qualitative nature, small N, similar program components) should be considered when interpreting the QCA results. Although future research would need to replicate the finding that program generated reminders are indeed sufficient to keep parents engaged, we preliminary conclude that intensive therapist involvement might not be necessary for successful online parent programs.

Limitations

Some limitations of this meta-analysis merit attention. Firstly, the quality of most of these studies is not yet as high as that of studies on traditional parent programs. For example, the majority of the studies in this meta-analysis suffered from high risk regarding attrition and performance bias (Table 2). Secondly, we were unable to evaluate publication bias because a standard assumption of test (e.g., funnel plots, Egger's test) is the independence of effect sizes. Because we included all relevant effect sizes from each study, the standard test of publication bias was applicable [33]. Thirdly, although we included any type of outcome measure, all available outcome measures were parent-reported, all available outcome measures were parent-reported, which cannot blind to condition. Some meta-analyses suggest program effects diminish or disappear when including only outcomes that are blinded to condition [59]. Other meta-analyses, however, suggest similar program effects when including either parent-reported or observed outcomes [29]. Fourthly, 8 out of 12 included studies did not report means and standard deviations based on intention to treat analysis. These studies might overestimate program outcomes, if parents who have negative program experiences are more likely to drop out and are not included in the analyses. Fifthly, most studies only tested the immediate effects of parent programs. We therefore do not know the longer-term effects of online parent programs [7]. Lastly, in the QCA, we had to exclude many components because the included studies did not vary in whether they included or excluded these components. Most online parent programs include similar components, including psychoeducation on positive parenting, proactive

parenting, and relationship building [37–48]. More differentiation in program content is needed to test the value of these components.

Implication for future research and clinical practice

Future research should invest in identifying the optimal program components of online parent programs, to increase their impact and efficiency. In addition, because online programs may not be appropriate for every family (e.g., families without access to the internet, parents with literacy problems), future research should test how individual family characteristics influence program outcomes. Finally, to draw stronger conclusions about whether online parent programs have similar effects on children's behavioral problems as traditional parent programs, direct comparisons of online versus traditional parent programs are needed. For clinical practice, because online parent programs seem effective for children's and parental health, our findings support the use of online parent programs to improve children's and parental mental health.

Conclusions

Our findings suggest that online parent programs reduce parent-reported children's behavioral and emotional problems, and improve parental mental health. The effect sizes are similar to the effects of face-to-face programs in prevention settings. Sending parents reminders was associated with high effectiveness. Our findings support the use of online parent programs, especially if they include program-generated reminders or online messaging to keep parents engaged. Research on online parent programs currently relies on parent-reported effects only, and should invest in including more objective outcome measures.

Compliance with ethical standards

Conflict of interest The authors have indicated they have no potential conflicts of interest to disclose.

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