

A Meta-Analysis of the Effectiveness of EMDR and TF-CBT in Reducing Trauma Symptoms and Externalizing Behavior Problems in Adolescents

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Abstract

This multi-level meta-analysis tested if evidence-based trauma treatment was effective in reducing trauma symptoms and externalizing behavior problems in adolescents. Based on eight independent samples and 75 effect sizes, results indicated that Trauma Focused-Cognitive Behavioral Therapy (TF-CBT) and Eye Movement Desensitization Reprocessing (EMDR) had a large and significant overall effect ($d=0.909$) on reducing trauma symptoms and externalizing behavior problems. Trauma treatment significantly decreased trauma symptoms (large effect) and externalizing behavior problems (medium effect). Age and type of control group moderated treatment effects. Treatment was more effective in older adolescents. Trauma treatment for adolescents with externalizing behavior problems had a larger effect compared to no treatment, but not compared to treatment as usual. It seems important to provide a broad treatment offer for adolescents with severe externalizing behavior problems, in which, besides trauma treatment, attention is paid to reducing relevant individual risk factors for behavior problems.

Keywords

meta-analysis, externalizing behavior, trauma treatment, trauma symptoms, adolescents

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Worldwide, about 23% of the adolescents are exposed to traumatic events, such as physical or sexual violence, severe accidents, natural disasters, or chronic illnesses (Costello et al., 2002; Felitti et al., 1998; Putnam, 2003). One out of six adolescents (15.9%) develops Post-Traumatic Stress Disorder (PTSD) as result (Alisic et al., 2014). Adolescents who have been exposed to traumatic events may experience trauma symptoms that influence various developmental areas (Cloitre et al., 2009; D'Andrea et al., 2012). These developmental areas often relate to internalizing behavior problems, such as mood disorder symptoms, anxiety symptoms, or a negative self-image (Campbell et al., 2007; Green et al., 2010; McLaughlin et al., 2012). Recently, it has become increasingly evident that trauma symptoms relate to externalizing behavior problems as well, including violent behavior and other types of delinquency (e.g., Gold et al., 2011; Greenwald, 2014; Kerig & Becker, 2012; Mersky & Reynolds, 2007). Traumatic experiences may affect the development of executive functioning, such as behavioral control and inhibition (Cohen et al., 2011; Polak et al., 2012; Tarullo, 2012), which shows a clear relation to aggression problems and delinquent behavior (Tonnaer et al., 2016; Van Nieuwenhuijzen et al., 2017).

Trauma Relates to Externalizing Behavior Problems

A recent meta-analysis indicated that individuals who experienced childhood abuse had a greater chance of committing violence than individuals without such experiences: 17% of the abused individuals ended up committing violent acts compared to 10% of the non-abused individuals (Fitton et al., 2020). Another study showed that the extent of trauma symptoms in detained adolescents was related to the number of arrests and severity of their delinquent behavior (Becker & Kerig, 2011). Also, using a sample of 417 male and 170 female juvenile offenders, research showed that adolescents with PTSD recidivated more often within 3 years than adolescents without this diagnosis (Becker et al., 2012). Girls with PTSD were more likely to recidivate than boys with PTSD.

Given the clear connection between traumatic experiences and externalizing behavior problems, trauma treatment seems to be a sensible addition to treatment for adolescents with externalizing behavior and trauma symptoms. Therefore, it is necessary to investigate if trauma treatment is effective in reducing trauma symptoms in adolescents with externalizing behavior problems, and to investigate if a reduction of trauma symptoms leads to a reduction of externalizing behavior problems. The current meta-analysis examines the **overall effect** of trauma treatment on trauma symptoms and externalizing behavior problems in adolescents.

Trauma among Adolescents with Externalizing Behavior Problems

Thus far, it is clear that adolescents with severe externalizing behavior problems have relatively often experienced traumatic events (Hamerlynck et al., 2006; Maschi et al., 2008; Steiner et al., 2011). Studies in the USA showed that 90% to 95% of

justice-involved adolescents between 12 and 18 years old had experienced at least one traumatic event (Becker & Kerig, 2011; Dierkhising et al., 2013). Often this consisted of multiple or recurrent traumatic events that had started early in life, existed in various settings, and persisted for a long time (Dierkhising et al., 2013).

Adolescents with externalizing behavior problems more often have experienced abuse, neglect, or witnessed violence. These types of interpersonal traumatic incidents, as opposed to non-interpersonal traumatic incidents, such as natural disasters, more often lead to the development of PTSD (Alisic et al., 2014; Kerig et al., 2009). Among the victims of child abuse, up to 63% develop PTSD (Gabbay et al., 2004). PTSD is often under-diagnosed in adolescents with externalizing behavior problems compared to adolescents with internalizing behavior, probably because PTSD symptoms become less evident when there are co-occurring externalizing behavior problems that call for attention (Jonkman et al., 2013).

Adolescents with externalizing behavior problems and a high risk for recidivism often have complex comorbid diagnoses and various criminogenic risk factors (e.g., Carpentier et al., 2011; Maschi et al., 2008; Steiner et al., 2011; Wibbelink et al., 2017). Criminogenic risk factors include impulsivity, family dysfunction, recurrent feelings of anger, and cognitive distortions (Hoogsteder et al., 2018). The extent of antisocial behavior and the number of criminogenic risk factors increase the risk for delinquent behavior and criminal recidivism (Bonta & Andrews, 2017; Van der Laan & Blom, 2006). Treatment of delinquent behavior is more effective if it incorporates the various individual risk factors that are related to the problem behavior (Bonta & Andrews, 2017).

The relation between trauma symptoms, individual risk factors, and externalizing behavior problems becomes clearer by looking at the influence of chronic stress resulting from trauma symptoms (Levine, 2010; Vujanovic et al., 2011). Chronic stress connotes chronic activation of the sympathetic nervous system: the brain goes into survival mode (fight or flight). This can cause various difficulties. Chronic stress can increase negative emotionality (feelings of anger), impair emotion regulation, increase cognitive distortions, decrease inhibition, and increase impulsivity (Brady & Sinha, 2005; De Kloet et al., 2005; Perry, 2012; Sandi & Haller, 2015). This may lead to aggressive behavior, as situations are more easily perceived as threatening or negative (Orobio de Castro et al., 2002; Van der Kolk, 2003) and behavioral control is suppressed by an increase in impulsivity and a decrease in inhibition.

Interventions for Externalizing Behavior Problems

Various interventions have been developed to reduce severe externalizing behavior problems (including criminal behavior) such as systemic interventions and skills trainings, for example, Multi-Dimensional Family Therapy (Liddle, 2010), Multi-Systemic Therapy (MST) (Henggeler, 2001), or Equip (Gibbs et al., 1995). These promising interventions seem more or less effective in achieving specific treatment goals (e.g., less impulsive or aggressive behavior or more positive sociomoral development), yet, show less positive results when actual recidivism of criminal behavior is used as an

outcome measure (Barnoski & Aos, 2004; Deković et al., 2011; Van der Stouwe et al., 2014, 2020) or when long-term effects are studied (James et al., 2013; Van der Put et al., 2013). We must take into account the known limitations of recidivism as an outcome measure, such as varying definitions across studies or countries (Wibbelink et al., 2017), or the large number of unreported behaviors (Morgan & Truman, 2020). Still, it is possible that the impact of trauma symptoms in this target group is not sufficiently taken into account, which may negatively affect juveniles' responsiveness to these interventions.

Interventions for Trauma

Trauma-Focused Cognitive Behavioral Therapy (TF-CBT) and Eye Movement Desensitization and Reprocessing (EMDR) are both effective treatment methods to reduce PTSD symptoms in children and adolescents (John-Baptiste Bastien et al., 2020). Various studies confirm that TF-CBT leads to more reduced PTSD symptoms in children and adolescents compared to control conditions (Cary & McMillen, 2012; Gillies et al., 2013; Silverman et al., 2008). Other studies show that EMDR (Shapiro, 2007) effectively reduces PTSD symptoms in children and adolescents as well (De Roos et al., 2011, 2017; Rodenburg et al., 2009).

Some preliminary findings show that evidence-based forms of trauma treatment may also reduce externalizing behavior problems in adolescents (e.g., Farkas et al., 2010; Goldbeck et al., 2016; O'Callaghan et al., 2013). A review ($k=10$) found that Trauma-Focused Cognitive Behavioral Therapy (TF-CBT) reduced PTSD symptoms (large effect, $g=.671$) as well as behavior problems (small-medium effect, $g=.247$) compared to waitlist control conditions in which patients did not receive treatment yet. However, there were no differences between TF-CBT and active control conditions in which patients received an alternative type of treatment (Cary & McMillen, 2012). The effect on trauma symptoms was stable, but the effect on behavior problems had disappeared at the 12-month follow-up. The reason why trauma treatment could be effective for externalizing behaviors might be that a reduction of trauma-related stress and anger makes adolescents more responsive to treatment that targets other risk factors. EMDR and TF-CBT seem equally effective in treating trauma symptoms, but EMDR uses less time to achieve the same result (De Roos et al., 2011). We may assume that the same will be true for adolescents with externalizing behavior problems.

The Current Study

This study used a multilevel meta-analytic approach to investigate if evidence-based trauma treatment would be effective in reducing trauma symptoms and externalizing behavior problems in adolescents. In order to gain more knowledge on the effective elements of treatment, we investigated which moderators (intervention characteristics, adolescent characteristics, methodological characteristics, and publication characteristics) did influence the outcomes.

We hypothesized that trauma treatment would lead to a reduction of trauma symptoms and externalizing behavior problems in adolescents (given the clear connection between traumatic experiences and externalizing behavior problems, and because some studies show that trauma treatment may also reduce externalizing behavior problems in adolescents). Furthermore, we expected a larger effect in adolescents receiving trauma treatment in combination with additional treatment (i.e., “trauma-informed treatment”) than in adolescents who received trauma treatment only. Research shows that trauma treatment is less effective in adolescents who have multiple or complex symptoms (Miller-Graff & Campion, 2016). Also, when treating adolescents with externalizing behavior problems, it is most effective to incorporate multiple risk factors, such as impulsivity, emotion regulation problems or cognitive distortions (Bonta & Andrews, 2017; Greenwald et al., 2012; Hoogsteder et al., 2018). Furthermore, forensic psychiatric patients must be treated longer and more intensively when their problem behavior is more severe (Bonta & Andrews, 2017). Therefore, we assumed that the intensity of treatment would impact the effectiveness of treatment.

We hypothesized that age would affect the results. We expected greater treatment effectivity in older adolescents given previous meta-analytic findings with regard to trauma treatment (Gutermann et al., 2016; Newman et al., 2014; Trask et al., 2011). Furthermore, we included gender as a possible moderator. Meta-analyses showed that effectiveness of trauma treatment was lower in samples consisting of more female adolescents (e.g., Gutermann et al., 2016; Rodenburg et al., 2009). Also, women with severe trauma symptoms have shown to have a higher risk for relapse into delinquency (Alisic et al., 2014; Bernhard et al., 2018; Fitton et al., 2020). Additionally, we expected that parental involvement would improve treatment effectivity (Gutermann et al., 2016). Also, we hypothesized that the addition of a group component would have no added value to individual treatment. On the one hand, group therapy may decrease stigma and offer support in the processing of traumatic experiences (McMullen et al., 2013; O’Callaghan et al., 2015). On the other hand, we know that group-oriented forms of treatment for adolescents with externalizing and antisocial behavior may have a negative influence (James et al., 2013; Lipsey, 2006). Therefore, we expected no effect in this case.

Method

Inclusion Criteria and Search Strategy

Six criteria were used to include studies in this meta-analysis. First, it was important that the experimental group would receive an evidence-based (scientifically proven) trauma focused treatment (not specific EMDR or TF-CGT). Second, the samples had to include adolescents with a minimum age of 11 years and a maximum age of 21 years. Third, the study was a randomized controlled trial (RCT) in order to reliably prove treatment was effective and results could not be ascribed to alternative factors. Fourth, participants had trauma symptoms or (partial) PTSD and externalizing behavior problems (a clinical score at baseline was indicated) at the start of

treatment. Both problems were diagnosed and monitored with valid measures. Fifth, the treatment interventions were conducted with sufficient program integrity (judged by the authors). After all, a sufficient degree of program integrity is a necessary precondition to draw valid conclusions about whether or not a program is successful in changing behavior (Goense et al., 2016). Finally, studies included sufficient statistical data to calculate effect sizes for this multilevel meta-analysis, which means that studies included at least one pretreatment and posttreatment measurement.

Using these inclusion criteria, we conducted a systematic search strategy in four regular electronic databases, that is, PsychINFO, ERIC, Web of Science, and Medline, starting January 2019 until April 2019. Relevant search terms were chosen by means of preliminary investigation and the help of a library-technician. The search included the following terms (used in various combinations), including textual variations and synonyms, related to the current research design and selected moderator variables: trauma-focused, cognitive behavior therapy, TF-CBT, CBT, EMDR, trauma, traumatic-stress, PTSS, youth, externalizing problems, aggression, RCT. We inspected all the references and citations of the articles we found in this first step. Second, we inspected the reference sections of relevant systematic reviews and meta-analyses in order to find more studies that had not been included yet.

The search strategy resulted in eight individual studies meeting the inclusion criteria. Not all studies mentioned in the introductory section of this paper complied with the inclusion criteria. Besides the systematic search strategy, we manually searched references, reviews and meta-analyses regarding the target group, but this yielded no additional studies. Figure 1 shows the screening and selection process of this multilevel meta-analysis. Of the 997 studies reviewed, only eight met the selection criteria for the current meta analysis. Among the search results, only studies about TF-CBT and EMDR met the inclusion criteria. Therefore, we continue to write about TF-CBT and EMDR. Appendix 1 lists the characteristics of the included studies.

Coding

Various factors can influence the effect of trauma treatment. These moderator variables were categorized as intervention characteristics, adolescent characteristics, methodological characteristics, and publication characteristics. The following intervention factors were coded: treatment outcome (trauma symptoms and externalizing behavior problems), type of intervention (TF-CBT or EMDR), presence of a group therapy component (yes/no), parental involvement (yes/no), and presence of an additional treatment offer (yes/no). Age, sex, trauma type (type I or II), and mild intellectual disabilities were coded as adolescent characteristics. Regarding methodological factors, we coded presence of a follow-up measurement (yes/no), type of control group (treatment as usual [TAU] or no treatment), type of informant (adolescent, parent, or therapist), and inclusion of drop-outs (intention to treat or completer analysis). We coded year of publication and the impact factor of the publishing journal as publication factors. We wrote a research protocol, which contained all moderators that were tested. Studies were coded by the first, second, and fourth author. To determine

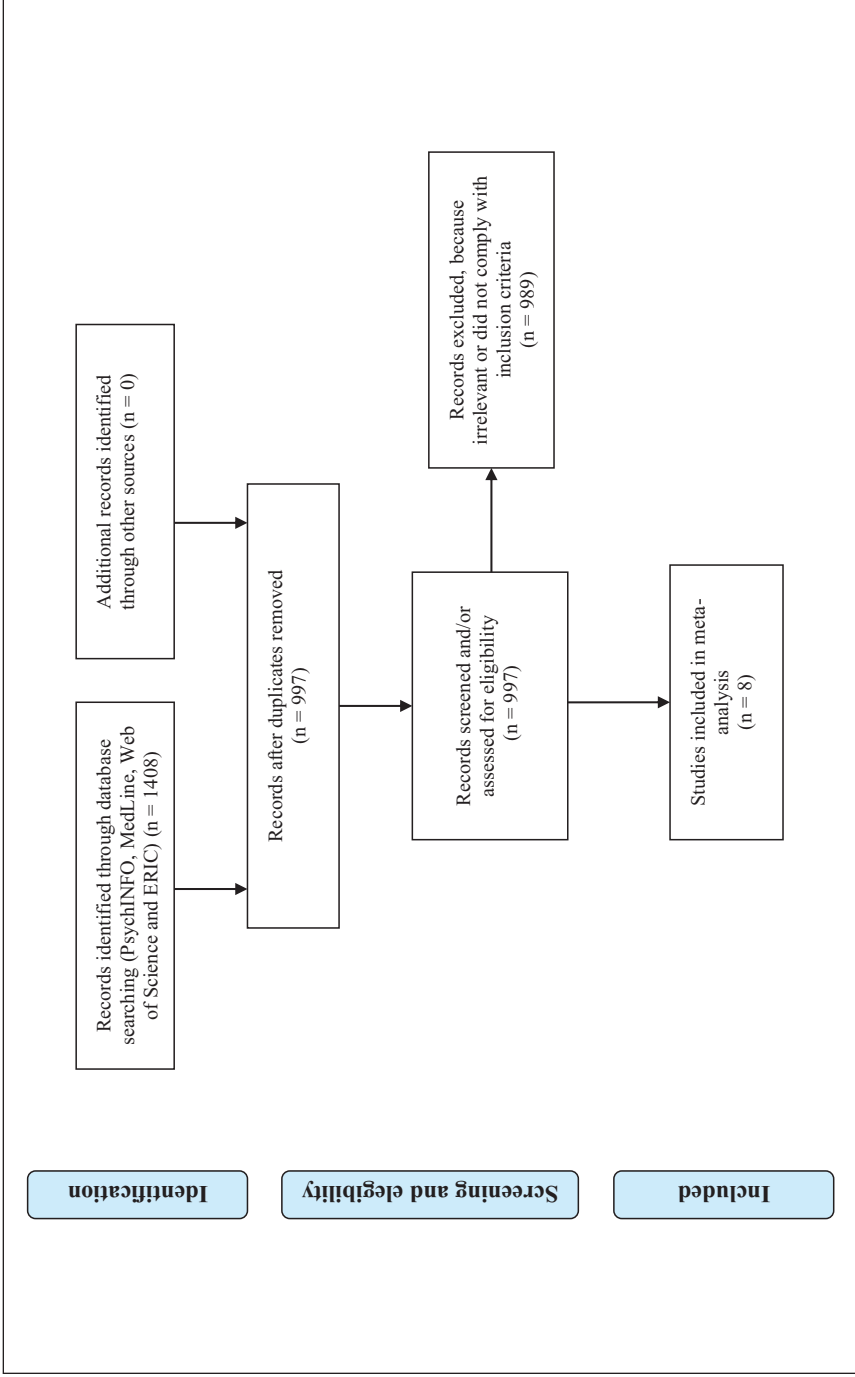


Figure 1. Screening and selection process of the included studies.

interrater reliability, four studies were double-coded. Interrater agreement ranged from 95% to 100%. For the other four studies, we reached consensus about coding.

Data Analysis

Cohen's d was used as the effect size, which was calculated per study consistent with the formula of Lipsey and Wilson (2001). The effect sizes were calculated for pre, post, and follow-up measurements. Subsequently, the post-measurement effect sizes were subtracted from the pre-measurement effect sizes. Categorical variables were transformed to dummy variables and continuous variables were mean centered. According to the benchmarks of Cohen (1992), an effect size of $d = .20$ is considered small, $d = .50$ medium, and $d = .80$ large.

We included multiple effect sizes per study. Therefore, we conducted a three-level meta-analysis to account for statistical dependency (Houben et al., 2015; Viechtbauer, 2010; Wibbelink & Assink, 2015). Level 1 is the sampling variance, or the variance of the observed effect size around the population effect size. Level 2 is the variance within studies and level 3 is the variance between studies. All calculations were done in the statistical software program R (www.r-project.org) using the syntaxes from Assink and Wibbelink (2016).

Two log-likelihood-ratio-tests were used to test for heterogeneity. Heterogeneity is assumed when significant variance is present among effect sizes within studies (level 2) or between studies (level 3). In that case, more variance is found than could be expected based on sampling variance, in which case a moderator analysis is advised to investigate which factors could explain this variance (Assink & Wibbelink, 2016).

A funnel plot was performed to investigate whether there could be missing data due to publication bias (Egger et al., 1997). A funnel diagram plots effect sizes against standard measurement error. In case of bias, the funnel plot is asymmetrical and the Egger's test is significant. A left-skewed funnel plot indicates publication bias, a right-skewed funnel plot indicates other forms of selection bias. In the case of bias, a trim and fill procedure is executed to assess the severity of the bias (Duval & Tweedie, 2000). In this procedure, missing effect sizes are filled by estimated values. The result is a new overall effect size, which takes the bias into account.

Results

Overall Effect

A total number of 566 participants were included in this multi-level meta-analysis (experimental groups $N_{exp} = 284$, control groups $N_{ctrl} = 282$), of which 35.99% boys ($M = 203.70$, $SD = 14.77$). The mean age of the total sample was 13.01 years ($SD = 1.59$).

Trauma treatment had a large, significant overall effect on trauma symptoms and externalizing behavior problems in adolescents ($d = 0.909$, 95% CI = [0.550, 1.268], $p < .001$; see Table 1). This means that, as expected, trauma treatment had

Table 1. Overall Effect of Trauma Treatment on Trauma Symptoms and Externalizing Behavioral Problems.

	<i>k</i>	#ES	<i>M d</i>	95% CI	<i>p</i>	$\sigma^2_{\text{level 2}}$	$\sigma^2_{\text{level 3}}$	% Var. Level 1	% Var. Level 2	% Var. Level 3
Overall effect	8	75	0.909	[0.550, 1.268]	<.001***	0.161***	0.215***	15.337	36.222	48.441

Note. *k* = number of independent studies; #ES = number of effect sizes; *M d* = average effect size Cohen's *d*; CI = confidence interval; $\sigma^2_{\text{level 2}}$ = variance within studies; $\sigma^2_{\text{level 3}}$ = variance between studies; % Var = percentage variance. **p* < .05. ***p* < .01. ****p* < .001.

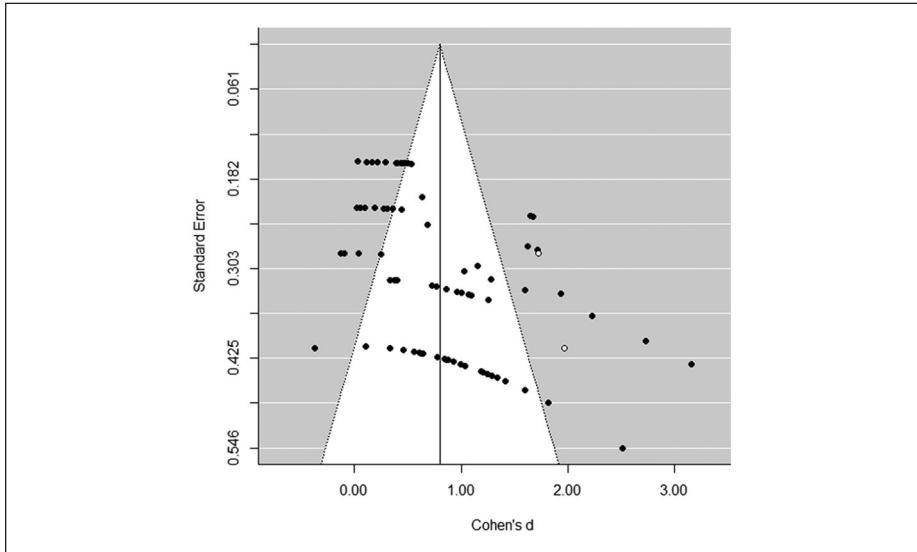


Figure 2. Funnel plot.

Note. Black dots indicate observed effect sizes, white dots indicate estimated missing effect sizes.

a positive effect on the reduction of trauma symptoms and externalizing behavior problems in adolescents.

There was no publication bias, as the funnel plot was not skewed to the left (see Figure 2). Also, there was no selection bias, as the two missing effect sizes on the right side did not significantly change the overall effect.

Results of the likelihood-ratio test showed significant variance of the effect sizes within studies (level 2), $\chi^2(1)=36.953, p < .001$, and significant variance of the effect sizes between studies (level 3), $\chi^2(1)=16.365, p < .001$. This justifies the use of moderator analyses to explain the heterogeneity on level 2 and level 3.

Moderator Analyses

Table 2 shows the results of the moderator analyses with adolescent, program, methodological, and publication characteristics as moderators for the overall treatment

Table 2. Moderator Analyses Effects of Trauma Treatment on Trauma Symptoms and Externalizing Behavioral Problems.

Moderator variables	<i>k</i>	# <i>ES</i>	<i>B₀/d</i>	<i>t₀</i>	<i>B₁</i>	<i>t₁</i>	<i>F(df₁, df₂)</i>
Intervention characteristics							
Treatment outcome							<i>F</i> (1,73) = 15.92***
Trauma symptoms	8	47	1.123	5.768***			
Externalizing problems	8	28	0.666	3.394**	-0.464	-3.898***	
Intervention type							<i>F</i> (1,73) = 0.053
TF-CBT	7	63	0.936	4.400***			
EMDR	1	12	0.804	1.492	-0.133	-0.229	
Treatment intensity							
Duration	8	75	0.896	4.533***	0.004	0.464	<i>F</i> (1,73) = 0.216
Number of sessions	8	75	0.940	4.722***	0.009	0.801	<i>F</i> (1,73) = 0.641
Group component							<i>F</i> (1,73) = 0.441
Yes	3	16	1.100	3.255**			
No	5	59	0.863	3.510***	-0.275	-0.664	
Parental involvement							<i>F</i> (1,73) = 2.156
Yes	5	43	0.719	3.477***			
No	3	32	1.230	4.400***	0.511	1.468	
Adolescent characteristics							
Age	8	75	0.741	4.981***	0.213	2.528*	<i>F</i> (1,73) = 6.390*
Sex (% boys)	8	75	0.886	4.886***	0.007	0.942	<i>F</i> (1,73) = 0.887
Methodological characteristics							
Follow-up							<i>F</i> (1,73) = 0.074
Yes	6	39	0.889	4.673***			
No	8	36	0.922	4.947***	0.034	0.272	
Type control group							<i>F</i> (1,73) = 44.871***
No treatment	6	50	1.694	4.799***			
TAU	3	25	-0.006	-0.018	-1.700	-6.699***	
Informant							<i>F</i> (2,72) = 1.858
Adolescent	6	32	0.932	5.140***			
Parent	4	17	0.683	3.170**	-0.249	-1.384	
Therapeutic	3	26	0.990	4.590***	0.059	0.316	
Inclusion drop-outs							<i>F</i> (1,73) = 0.051
Yes	4	46	0.874	3.164**			
No (completer)	4	29	0.962	3.443**	0.089	0.225	
Publication characteristics							
Publication year	8	75	0.860	4.096***	0.023	0.671	<i>F</i> (1,73) = 0.450
Impact factor	8	75	0.904	4.700***	-0.024	-0.529	<i>F</i> (1,73) = 0.280

Note. *k* = number of independent studies; #*ES* = number of effect sizes; *B₀/d* = intercept/mean effect size; *t₀* = *t*-value for mean *d*; *B₁* = regression coefficient or difference from reference category; *t₁* = *t*-value for regression coefficient; *F*(*df₁*, *df₂*) = omnibus test.

p* < .05. *p* < .01. ****p* < .001.

effects on both trauma symptoms and externalizing behavior. As expected, trauma treatment had more effect on trauma symptoms (*d* = 1.123; large effect) than on externalizing behavior problems (*d* = 0.666; medium effect). The other intervention characteristics: treatment intensity, group component, and parental involvement, did not moderate the overall treatment effect on trauma symptoms and externalizing behavior. There was too little information available to analyze possible moderator effects of additional treatment offers.

Regarding adolescent characteristics, age was a significant moderator for overall treatment effect: consistent with expectations, the effect for older adolescents was larger than for younger adolescents ($d=0.741$; medium-large effect). Gender did not moderate treatment effects. The effect of trauma type (I or II) and of mild intellectual disabilities could not be analyzed due to a lack of data and/or variation.

Regarding methodological characteristics, follow-up measurements, type of informant, and inclusion of drop-outs, did not moderate treatment effects. Type of control group was a significant moderator: TF-CBT and EMDR were more effective compared to no treatment ($d=1.694$, large effect). However, if compared to treatment as usual (TAU), TF-CBT and EMDR were not significantly better ($d=-0.006$).

Finally, publication year and impact factor did not moderate overall treatment effects.

Discussion

This multi-level meta-analysis (eight independent samples and 75 effect sizes) examined whether evidence-based trauma treatment (TF-CBT or EMDR) effectively reduced trauma symptoms and externalizing behavior problems in adolescents, accounting for moderator effects of intervention, adolescent, methodological, and publication characteristics. Results showed that trauma treatment for adolescents with externalizing behavior problems significantly decreased trauma symptoms (large effect) and externalizing behavior problems (medium effect). TF-CBT and EMDR were equally effective, although this finding must be interpreted with caution, as seven TF-CBT studies were compared to only one EMDR study. Both TF-CBT and EMDR were more effective than no treatment, but not more effective than treatment as usual. Furthermore, trauma treatment was more effective for older adolescents than younger adolescents in reducing either trauma symptoms or externalizing behavior problems. Other moderator variables, including treatment intensity, group component, parental involvement, gender, type of informant, follow-up measurement, inclusion of drop-outs, publication year, and impact factor of the journal, were unrelated to overall treatment effects (trauma symptoms or externalizing behavior).

It is remarkable that no significant difference could be found between the experimental treatment (TF-CBT or EMDR) and treatment as usual (TAU). Possibly, some treatment types other than TF-CBT and EMDR are equally effective in reducing trauma symptoms and externalizing behavior problems (John-Baptiste Bastien et al., 2020). This corresponds with previous findings in which trauma treatment effects were larger compared to controls receiving no treatment than controls receiving TAU (Cary & McMillen, 2012; Frost et al., 2014; Gutermann et al., 2016; Watts et al., 2013). Another possible explanation may be found in the nature of the four included studies with a TAU control group. Two of these studies found TF-CBT/EMDR to be significantly more effective than TAU, with medium to large effects (Farkas et al., 2010; McMullen et al., 2013). Both studies added TF-CBT or EMDR to a pre-existing treatment offer aimed at reducing various problems in adolescents, including

externalizing behavior problems. This indicates that trauma treatment has a large added value beyond treatment of other risk factors.

In the third study (Cohen et al., 2005), TF-CBT was offered as an isolated treatment offer and was much less effective in reducing externalizing behavior problems than a control group receiving active treatment (non-directive supportive therapy). This finding confirms our hypothesis that sole treatment of trauma symptoms may be insufficient. It is plausible to suggest that adolescents with severe externalizing behavior problems, besides trauma treatment, need additional treatment to address risk factors that maintain or even reinforce the adolescent's problem behavior (Bonta & Andrews, 2017; Greenwald et al., 2012). To reduce all problems, a transdiagnostic approach may be needed (Becker et al., 2011), which means that treatment of adolescents with externalizing behavior problems and trauma-related complaints also needs to focus on stress reduction, motivation, anger management, impulse control, self-esteem, and involvement of the family system (Hoogsteder et al., 2014).

The fourth study (O'Callaghan et al., 2015) compared TF-CBT with the intervention Child Friendly Spaces (CFS; Tol et al., 2011). This study found that both interventions were equally effective in reducing trauma symptoms and externalizing behavior problems. TF-CBT was offered in a group according to the format of Cohen et al. (2006), and was adapted to make it more culturally sensitive. Both TF-CBT and CFS were culturally sensitive and focused on stabilization, skill acquisition and empowerment. CFS concentrated on traumatic experiences; processing was not done through exposure, but mainly through increasing self-esteem. Looking at these four studies, it seems that the finding that TF-CBT and EMDR did not differ from TAU can be explained by a broader therapeutic approach in the TAU groups, targeting additional relevant risk factors.

A final possible explanation for the lack of difference between TF-CBT/EMDR and TAU lies in the importance of a good therapeutic relationship. Research shows that a therapeutic alliance is a critical component of effective trauma treatment in adolescents (Ovenstad et al., 2020; Yasinski et al., 2018). It is possible that trauma treatment that meets this condition may be more important for recovery than receiving a specific intervention. One prior study showed that the therapeutic alliance affected TF-CBT outcome more positively than TAU outcome (Ormhaug et al., 2014). However, therapeutic alliance may also have had a positive influence on the TAU groups of this meta-analysis (there were no data available to examine this further).

Previous research (Gutermann et al., 2016; Newman et al., 2014; Trask et al., 2011) found that trauma treatment was more effective in older adolescents than younger adolescents. Trask et al. (2011) suggest that this is because treatment is based on cognitive functions, which are better developed in older adolescents. Another possible explanation is that, based on DSM-IV (the criteria changed in DSM-5), trauma symptoms are often under-reported in younger adolescents compared to older adolescents (Jonkman et al., 2013; Mikolajewski et al., 2017). This could imply that younger adolescents had more severe symptoms than older adolescents, and therefore showed less recovery.

Notably, there was no significant difference in effect between treatment with and without parental involvement. Several studies have pointed out that involvement of the adolescent's social system positively affected treatment of trauma symptoms and externalizing behavior problems (Gutermann et al., 2016). An involved social system provides social support for the adolescent (Cohen & Mannarino, 2015) and often reduces parental stress (Pollio & Deblinger, 2017). It is possible that no effect was found because parental involvement is only possible when parents are motivated or able to participate in treatment. Given that in some treatment contexts parents were not alive anymore or lived too far from the treatment site, it may be assumed that not all parents could be involved in treatment (hereto, insufficient data was provided in the studies). Another explanation could lie in the presence of psychiatric problems in the parents. Research shows that psychopathology or trauma in parents is a contra-indication for parental involvement in treatment, because parents cannot provide enough support for their child during treatment (Scheeringa & Zeanah, 2001; Stallard, 2006; Tutus & Goldbeck, 2016). The included studies in this meta-analysis did not report upon this. These explanations indicate that we should interpret the finding of no effect from parental involvement cautiously. Future studies should consider reporting the psychiatric state of the parents.

There was no significant difference between post-treatment and follow-up measurements. This is important because several studies (not included in this meta-analysis) showed that adolescents with severe externalizing behavior problems tended to relapse with a new offense, as defined by an official re-arrest or reconviction (Deković et al., 2011; James et al., 2013; Van der Put et al., 2013). A review found a positive effect of trauma treatment only directly after treatment, but not at follow-up (Cary & McMillen, 2012). It is important to take this into account in future studies.

An important limitation of this multi-level meta-analysis is the relatively small number of included studies and effect sizes. Even though the minimum number of studies for a meta-analysis is only three (Treadwell et al., 2006), and most published meta-analyses include less than nine studies (Lau et al., 2006), this impacts generalizability and interpretation of our findings. Still, the findings are large and robust, since only RCTs with a sufficient degree of program integrity were included (i.e., Kraemer & Kupfer, 2006; Weisz et al., 2017). Also, the included studies were all carried out under clinically representative conditions, which increases the generalizability of the results (Weisz et al., 2013).

Another limitation of this meta-analysis is that certain variables did not have enough variation or that not enough information was reported in the included studies, which made it impossible to investigate possible moderating effects of these variables. It was not possible to investigate the effects of additional treatment offer, trauma type, and mild intellectual disabilities. We could therefore not test the hypothesis that trauma informed treatment is more effective than isolated treatment. Furthermore, due to large heterogeneity in variables and relatively small samples, in some cases there was insufficient statistical power to test differences or specify outcomes. This was the case for treatment intensity and sex, where no large differences existed between included studies. Also, in order to preserve sufficient statistical power, we only tested moderators of

the combined treatment effect on trauma symptoms and externalizing behavior. Therefore, results must be interpreted with caution.

Finally, it is not possible to perfectly control for publication bias in any meta-analysis (Carter et al., 2019). The presence of publication bias can therefore never be ruled out, even if formal tests indicate that publication bias is unlikely. In fact, it is imperative that all clinical trials be preregistered in effectiveness research, including publication of the research protocols. In the present study, we chose to conduct a funnel-plot-based trim and fill method, which is commonly used in three-level meta-analyses (e.g., Assink et al., 2019; Zeegers et al., 2017), and seems a sufficiently sensitive method to detect publication bias in (three-level) meta-analyses (Assink & Wibbelink, 2016; Idris, 2012).

In sum, it can be concluded that the trauma interventions TF-CBT and EMDR were only more effective than no treatment in reducing trauma symptoms and externalizing behavior problems in adolescents. This means that some treatment types other than TF-CBT and EMDR were equally effective in reducing trauma symptoms and externalizing behavior problems. It seems important to provide a broad treatment offer for adolescents with severe externalizing behavior problems, in which, besides trauma treatment, attention is paid to reducing relevant individual risk factors, such as impulsivity and anger (Greenwald et al., 2012; Hoogsteder et al., 2014). Further research is needed to ground this claim, as this meta-analysis could not include additional treatment offers due to lack of data. Both clinicians and researchers should pay special attention to young adolescents with externalizing behavior problems and trauma, since trauma treatment in this study was more effective in older adolescents than in younger adolescents. Furthermore, it is important that researchers report more information on parent, adolescent and intervention characteristics to provide clarity about which factors are relevant in effective treatment of adolescents with trauma and externalizing behavior.

Appendix I. Characteristics Included Studies.

Study	N	Age (M)	Study and sample characteristics	Assessment externalizing behavior	Assessment trauma symptoms	Experimental condition	Control condition
Cohen et al. (2005)	82	11.40	USA, RCT, clinical sample, completer analysis, 68% girls	CBCL-PRF TSCC (anger)	TSCC (PTS total symptoms)	TF-CBT (n=41)	NST (TAU) (n=41)
Farkas et al. (2010)	40	14.3	USA, RCT, clinical sample, completer analysis, 62.5% girls	DISC, CBCL-PRF, TSCC (anger)	DISC, TSCC (PTS total symptoms)	EMDR + MASTR (n=19)	WL with routine care (TAU) (n=21)
Goldbeck et al. (2016)	159	13.03	Europe, RCT, clinical sample (exp) and community sample (ctrl), intention-to-treat analysis, 71% girls	CBCL-PRF	CAPS-CA, UCLA-PTSD RI, CPTCI	TF-CBT (n=76)	WL (NT) (n=83)
King et al. (2000)	24	11.40	USA, RCT, clinical sample, intention-to-treat analysis, 69% girls	CBCL-PRF	ADIS-C, CBCL-PTSD schaal	TF-CBT + parents (n=12) TF-CBT (indiv) (n=12)	WL (NT) (n=12)
McMullen et al. (2013)	48	15.80	Africa, RCT, clinical sample, completer analysis, 100% boys	AYPAs (conduct scale)	UCLA-PTSD RI (revised)	TF-CBT (n=24)	WL with routine care (TAU) (n=24)
O'Callaghan et al. (2015)	50	14.88	Africa, RCT, community sample, intention-to-treat analysis, 42% girls	AYPAs (conduct scale)	UCLA PTSD-RI (revised)	TF-CBT (n=26)	CFS (TAU) (n=24)
O'Callaghan et al. (2013)	52	16.02	Africa, RCT, community sample, intention-to-treat analysis, 100% girls	AYPAs—conduct scale	UCLA-PTSD RI (revised)	TF-CBT (n=24)	WL (NT) (n=22) WL (NT) (n=28)
Shein-Szydlo et al. (2016)	99	14.89	USA, RCT, clinical sample, completer analysis, 64% girls	STAXI	CPTS-Ri, CPSS	TF-CBT (n=50)	WL (NT) (n=49)

Note. RCT = Randomized Controlled Trial; TF-CBT = Trauma-Focused Cognitive Behavioral Therapy; NST = Non-directive Supportive Therapy; EMDR = Eye Movement Desensitization and Reprocessing; MASTR = Motivation-Adaptive Skills-Trauma Resolution; TAU = Treatment as Usual; WL = waiting list; NT = No treatment; CFS = Child Friendly Spaces; a non trauma based psychosocial intervention; CBCL-PRF = Child Behavior Checklist Parent Report Form; ADIS-C = Anxiety Disorder Interview Schedule Children; CAPS-CA = Clinician-Administered PTSD Scale for Children and Adolescents; TSCC = Trauma Symptom Checklist for Children; UCLA-PTSD RI = University of California at Los Angeles PTSD Reaction Index; SDQ = Strength and difficulties questionnaire; CPTCI = Child Post-Traumatic Cognitions Inventory; CPTS-RI = Child Posttraumatic Stress Reaction Index; CPSS = Child PTSD Symptom Scale; AYPAs = African Youth Psychosocial Assessment; STAXI = State Trait Anger Expression Inventory; DISC = Diagnostic Interview Schedule for Children.

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