Journal of Crime and Criminal Behavior
Vol. 5, No. 2, 2025, pp. 181-209

URL: www.arfjournals.com
https://doi.org/10.47509/JCCB.2025.v05i02.03

A Multilevel Meta-Analysis of the Effectiveness of Evidence-Based Trauma Interventions in Reducing Trauma Symptoms and Externalizing Behavior Problems in Adolescents and Adults

Vriend, M [1], Hoogsteder, L.M.[12] & Stams, G.J.J.M[2]
[1]De Waag, Forensic outpatient treatment center de Waag, Forensic Care Specialists, Utrecht, The Netherlands. E-mail: MVriend@dewaagnederland.nl
[2]University of Amsterdam, Program Group: Forensic Child and Youth Care, The Netherlands

TO CITE THIS ARTICLE

Vriend, M., Hoogsteder, L.M. & Stams, G.J.J.M. (2025). A Multilevel Meta-Analysis of the Effectiveness of Evidence-Based Trauma Interventions in Reducing Trauma Symptoms and Externalizing Behavior Problems in Adolescents and Adults. *Journal of Crime and Criminal Behavior,* 5: 2, pp. 181-209. *https://doi.org/10.47509/JCCB.2025.v05i02.03*

Abstract: In adolescents and adults with persistent and severe externalizing behavior problems, such as aggression and other forms of delinquent behavior, trauma-related symptoms and/or PTSD are often present. Trauma treatment appears to be a valuable addition to interventions for adolescents with trauma symptoms and aggression or other externalizing behavior problems. However, it remains unclear whether similar outcomes are achieved in adults. Therefore, this multilevel meta-analysis examined whether standard trauma treatments reduce trauma symptoms and externalizing behaviors in both adolescents and adults. Based on 15 independent samples and 92 effect sizes, the results showed that trauma treatment had a medium to large, statistically significant overall effect on reducing trauma symptoms and externalizing behavior problems in both adolescents and adults. No significant differences were found between types of externalizing behavior, although better outcomes were observed in reducing anger and aggressive behavior (medium effect) compared to other externalizing behavior problems (small effect). Age was found to moderate the effects: a small effect was observed in adolescents, while a large effect was observed in adults. Session duration also moderated the effects, with sessions longer than 120 minutes being less effective. A trend was noted concerning the type of intervention: Trauma-Focused Cognitive Behavioral Therapy (TF-CBT) had a large effect, Eye Movement Desensitization

Received : 10 June 2025 • **Revised :** 12 July 2025 • **Accepted :** 16 July 2025 • **Published :** 17 November 2025

and Reprocessing (EMDR) had a medium effect, and other interventions had a small effect. The assessment of treatment integrity showed a trend: when treatment integrity was assessed, a large effect was observed compared to a small effect when it was not assessed. This study underscores the importance of assessing treatment integrity to accurately evaluate treatment effectiveness. The findings indicate that established trauma interventions are valuable for clients with externalizing behavior problems.

Approximately 70% of individuals experience a traumatic event at some point in their lives (Benjet et al., 2016; Kessler et al., 2017). Such events include neglect, emotional and physical abuse, sexual abuse, natural disasters, and structural bullying. In about 5.6% of cases, these events lead to the development of post-traumatic stress disorder (PTSD) (Koenen et al., 2017). PTSD symptoms include intrusive experiences (such as intrusive memories and distressing dreams), persistent avoidance, negative changes in cognition and mood, and alterations in arousal, vigilance, and reactivity. In complex PTSD, an additional symptom cluster involves difficulties with emotion regulation, which may manifest as impulsive and self-destructive behaviors (Resick et al., 2012). Consequently, some adolescents and adults with PTSD experience intense feelings of anger and/or difficulties with aggression regulation. These difficulties can lead to violent behavior and other types of delinquency.

Research indicates that individuals with trauma-related symptoms resulting from childhood abuse are more likely to engage in violent behavior compared to those without such experiences (Fitton et al., 2020). Therefore, it is not surprising that a high percentage of individuals within forensic populations have been diagnosed with PTSD. For instance, meta-analyses by Baranyi et al. (2018) found that PTSD was five times more prevalent among incarcerated males and eight times more prevalent among incarcerated females compared to the general population. Additionally, PTSD is well-established to increase the likelihood of recidivism (Facer-Irwin et al., 2019; Olatunji et al., 2010).

For this reason, it is important to gain a clearer understanding of treatment strategies that address both PTSD symptoms and forensic behavior problems. Trauma treatment appears to be a sensible addition to interventions for adolescents with trauma symptoms and aggression or other externalizing behavior problems (Hoogsteder et al., 2020). However, it remains unclear whether similar results are achieved in adults. Therefore, a multilevel meta-analysis is necessary to investigate whether regular trauma treatments are also effective for both adolescents and adults with externalizing behavior problems, and to determine whether such treatments lead to reductions in persistent feelings of anger, aggression, or other externalizing behaviors.

Relationship Trauma, Aggression and Other Externalizing Behavior

Various studies have established an association between traumatic experiences, post-traumatic stress disorder (PTSD), and externalizing behaviors, particularly in adolescents and adults with a history of abuse, neglect, or violence. Interpersonal traumatic events, such as abuse and violence, are more likely to result in PTSD than

non-interpersonal events like natural disasters (Alisic et al., 2014; Kerig et al., 2009). Research by Orth and Wieland (2006) identified high levels of anger and hostility among adults with PTSD. Similarly, Gillikan et al. (2016) found that interpersonal violence is linked to trauma history and PTSD. Baglivio et al. (2015) demonstrated that juveniles with numerous adverse childhood experiences had higher arrest rates. Facer-Irwin et al. (2019) further showed that incarcerated individuals with PTSD exhibit more aggressive behavior compared to those without PTSD. Sadeh and McNeil (2014) reported that PTSD increases recidivism risk, while Wolff et al. (2017) found that negative childhood experiences shorten the time to recidivism. In summary, there is a strong association between traumatic experiences, PTSD, and various forms of externalizing behavior, including aggression and criminal activity. This highlights the importance of addressing trauma and PTSD in interventions aimed at reducing such behaviors.

Relationship Executive Functioning

Relationship Executive Functioning and Externalizing Behavior

Executive functions encompass cognitive processes essential for adaptive functioning, such as planning and organization, impulse control, and emotional regulation (e.g., Girotti et al., 2018; Reef et al., 2020). These skills play a crucial role in an individual's cognitive, social, and psychological development (Diamond, 2013). It is therefore unsurprising that various studies have confirmed the relationship between executive dysfunction and externalizing behavior. For example, a meta-analysis by Schoemaker et al. (2013) demonstrated that poorly developed executive functions, particularly inhibition, working memory, and cognitive flexibility, are strongly associated with ADHD and externalizing behavioral problems even in preschool-aged children. This implies that children with weaker executive functions are at a higher risk of behavioral issues such as aggression and antisocial behavior. Similarly, research by Morgan and Lilienfeld (2000) confirmed that antisocial groups performed worse on executive function tests compared to control groups, with a medium effect size.

Blairs framework

Blair (2013) showed a framework for understanding conduct disorders that is characterized by persistent aggressive or antisocial behavior and were traumatic experiences play a crucial role (see Figure 1). Blair highlights that specific genetic

polymorphisms and exposure to trauma, violence, and neglect can lead to increased amygdala reactivity. The amygdala, a brain region involved in processing emotions, particularly fear and threat, can become hyperactive, resulting in heightened sensitivity to threats and contributing to reactive aggression. Stress also plays a significant role in Blair's theory by affecting overall brain function and emotional responses. Stress can further enhance amygdala reactivity and impact other brain areas involved in regulating emotional reactions. Chronic stress can overwhelm the neurobiological systems responsible for stress responses and emotional regulation, thereby increasing the likelihood of aggressive behavior. Additionally, it can impair executive function (Reynolds & Pedersen, 2022). These factors interact to elevate the risk of persistent aggressive or antisocial behavior.

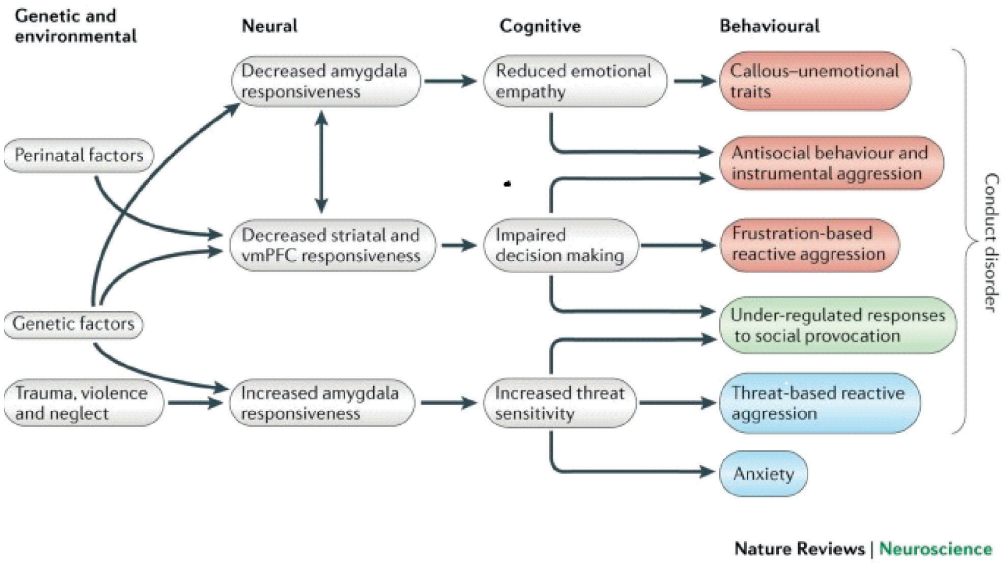

Figure 1: Blairs (2013) framework for understanding conduct disorder

Relationship Executive Function, Stress, PTSD and Externalizing Behaviors

Several literature and research demonstrate the relationship between PTSD, chronic stress and executive disfunctioning. A review article of De Haart et al. (2020) mentioned that PTSD is associated with cognitive problems that occur primarily in learning verbal information, attention, working memory and executive functioning. Hyperactivity of the amygdala and hypoactivity of the medial prefrontal cortex play a role in attentional bias in which there appears to be increased attention to danger

and decreased attention to neutral information. Peripheral system disruption is also mentioned, which is related to the perceived stress and impaired emotion regulation of people with PTSD.

Meta-analyses indicate that children and adolescents exposed to trauma score lower on executive function tasks compared to control groups, with deficits being more pronounced in those with PTSD (Malarbi et al., 2016; Op den Kelder et al., 2018). Dileo et al. (2017) found that child maltreatment affects connections within the prefrontal limbic system, leading to affective dysregulation and impaired executive functions. These impaired executive functions, associated with PTSD, can result in difficulties with aggression regulation and other externalizing problem behaviors (Dileo et al., 2017; Diamond, 2013).

In summary, deficits in executive function, chronic stress, and trauma-related symptoms are linked to the development and maintenance of externalizing behaviors. Concurrently, individuals exhibiting externalizing problem behaviors are more likely to experience traumatic events, which further exacerbates stress and impairs executive function. A better understanding of these interrelationships could enhance the effectiveness of interventions for behavioral and trauma-related disorders.

Treatment Reducing Trauma-Related Symptoms in Externalizing Behavior Problems

In the treatment of externalizing behavior problems, whether mandated by the judiciary or voluntary, the Risk-Need-Responsivity (RNR) model (Bonta & Andrews, 2023) can be a valuable framework. This influential model is used in forensic settings for assessing and treating offenders. Adhering to RNR principles has been shown to reduce recidivism in externalizing behavior. The model focuses on three core principles: risk (matching the intensity and duration of treatment to the offender's risk of reoffending), need (addressing criminogenic risk factors), and responsivity (maximizing the offender's ability to learn through evidence-based methods). According to RNR principles, trauma treatment aligns with the need and responsivity principles and should be integrated with the treatment of other present risk factors.

The meta-analysis and systematic review by Karakurt et al. (2019) examined the effectiveness of various batterer intervention programs in reducing violence among male perpetrators of intimate partner violence. They discovered that treatment strategies addressing highly comorbid issues such as substance abuse and trauma are

potentially more effective in preventing violence compared to programs that focus solely on violent behavior. This underscores the importance of an integrated approach in intervention programs for male perpetrators of intimate partner violence. In 2020, a multi-level meta-analysis by Hoogsteder et al. assessed the effectiveness of evidence-based trauma treatments in reducing trauma symptoms and externalizing behavior problems in children and adolescents. The analysis revealed that trauma treatment significantly reduced trauma symptoms (large effect) and externalizing behavior problems (medium effect). The effects were better in treatments that also addressed additional risk factors.

Types of Trauma Treatment Recommended

According to the American Psychological Association (APA), four interventions are strongly recommended for treating post-traumatic stress disorder (PTSD): Trauma-Focused Cognitive Behavioral Therapy (TF-CBT), Cognitive Processing Therapy (CPT), Trauma-Focused Cognitive Therapy (TF-CT), and Prolonged Exposure (PE) (APA, 2023). Additionally, three other psychotherapies are conditionally recommended: Brief Eclectic Psychotherapy for PTSD (BEPP), Eye Movement Desensitization and Reprocessing Therapy (EMDR), and Narrative Exposure Therapy (NET) (APA, 2023).

In the context of veterans, who often experience both PTSD and anger issues (Macmanus et al., 2013; Taylor et al., 2020), the guidelines for this population were also reviewed. These guidelines offer similar recommendations but are more favorable toward BEPP, EMDR, and NET, and they also include written narrative exposure as a recommended approach. These findings are consistent with a meta-analysis conducted by Yunitry et al. (2023).

Current Study

This study employed a multilevel meta-analysis to evaluate the effectiveness of evidence-based trauma treatments in adolescents and adults with trauma-related symptoms combined with persistent feelings of anger, aggression problems, or other forms of externalizing behavior. Specifically, we investigated whether the presence of stress negatively moderates the reduction of anger, aggression, and externalizing behaviors. To enhance our understanding of the effective components of these treatments, we explored various potential moderators, including client

characteristics, treatment characteristics, methodological factors, and publication characteristics (details on these moderators are provided in the Method section). We hypothesize that trauma treatment will reduce trauma-related symptoms in clients with forensic issues and aggressive behavior or other externalizing problems (Hoogsteder et al., 2020). Additionally, we expect that high levels of stress will have a moderating effect, such that greater stress will be associated with smaller reductions in aggression and persistent anger (Reynolds & Petersen, 2022).

Method

Inclusion Criteria and Search Strategy

Prior to conducting a systematic review, the Populations, Interventions, Comparisons, Outcomes, Time, and Settings (PICOTS) of the studies that were going to be included in the meta-analysis were decided according to The *Cochrane Handbook for Systematic Reviews of Interventions* (Higgins et al., 2023). Therefore, the inclusion and exclusion criteria developed by using the PICOTS framework includes P: Youth and adults from 12 years old, with persistent feelings of anger and/or antisocial behavior and PTSD diagnosis or trauma-related symptoms, I: Evidence- based trauma treatment (here defined as: two or more control group studies where the where the effectiveness of the trauma treatment emerged) C: pre-post test comparisons, O: reduction in, T: any time period, S: No setting limitations were applied. So, the six criteria used to include studies in this meta-analysis were as follows: First, the experimental group received an evidence based trauma focused treatment. For selection, at first all forms of trauma treatment were allowed. When inspected, these were selected if two or more control group studies where the effectiveness of the trauma treatment emerged. Second, the average age from the experimental research group was from 12 years old. Third, the study included a control group, either a randomized controlled trial (RCT) or quasi-experimental in order to reliably prove treatment was effective and results could not be ascribed to alternative factors. Fourth, participants had increased and persistent feelings of anger and/or antisocial behavior at the start of treatment. This was diagnosed and monitored with valid measures, with a valid outcome measure focused on anger or antisocial behavior as baseline and final measurements. Also, and as fifth, the participants had trauma symptoms or (partial) PTSD, which were also diagnoses and monitored with valid measures, also a baseline and final measurement. Finally,

studies included at least one pretreatment and posttreatment measurement, so that effect sizes could be calculated for this multilevel meta-analysis.

We conducted a systematic search strategy in the electronic databases, PsychINFO, ERIC, and Medline in December 2021. 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: aggression, antisocial, problem behavior, anger, externalizing, delinquent, recidivism, delict, trauma, PTSD, intervention, therapy, treatment, EMDR, TF-CBT, CBT, exposure, rescripting. All abstracts resulting from the search were reviewed for appropriateness. Full-text screening was then performed on the studies that potentially met the inclusion criteria. Finally, systematic reviews and meta-analyses

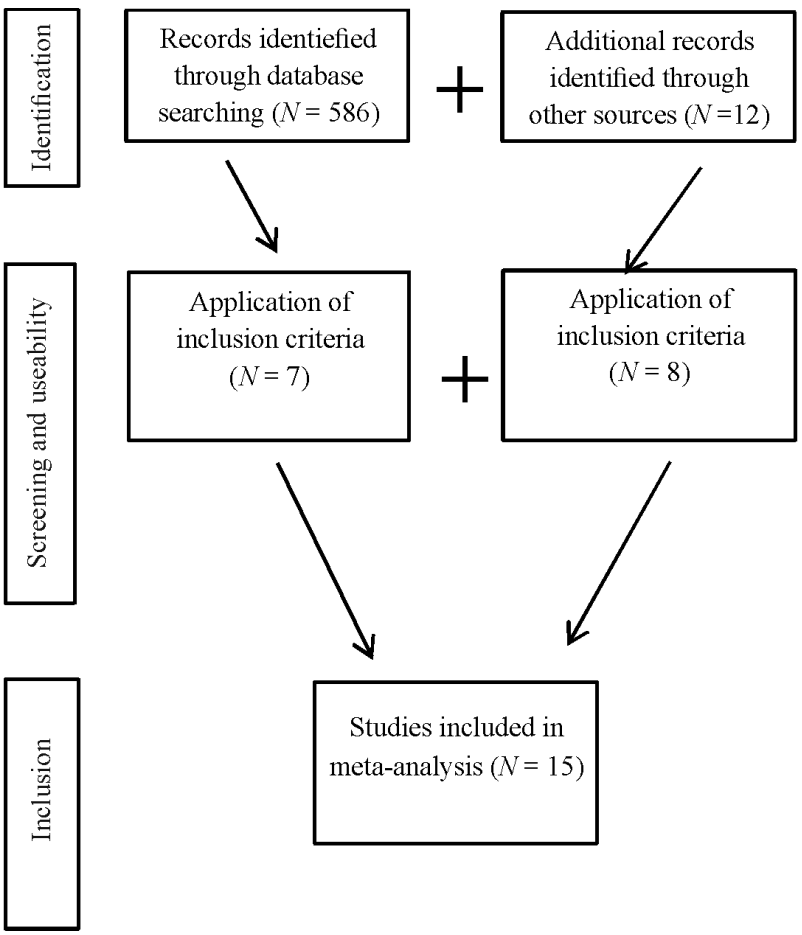

Figure 2: Screening and selection process of the included studies

of related research were run through to examine whether there were additional studies that met the inclusion criteria.

Selection was performed by two investigators, when in doubt the entire article was read and inclusion or exclusion followed based on consensus of all three investigators.

The search strategy resulted in seven individual studies meeting the inclusion criteria. Besides the systematic search strategy, we manually searched references, reviews and meta-analyses regarding the target group, this resulted in eight additional studies. Figure 2 shows the screening and selection process of this multilevel meta-analysis.

Coding

Various factors can influence the effect of trauma treatment. These moderator variables were categorized as client characteristics, treatment characteristics, methodological characteristics, and publication characteristics. The following intervention factors were coded: treatment outcome (trauma symptoms and externalizing behavior problems), focus of intervention (trauma only and trauma & externalizing), setting (outpatient or inpatient), type of intervention (TF-CBT, EMDR or other: FORNET and Beyond Violence, treatment intensity (duration of treatment and number of sessions), presence of a group therapy component (yes/no), and system involvement (yes/no). Age, sex, trauma type (type I or II), degree of stress and mild intellectual disabilities were coded as client 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 (client, family, or therapist), type of assessment (clinical judgment of questionnaire), study design (RCT of quasi experimental) and inclusion of drop-outs (intention to treat or completer analysis). We coded year of publication, the continent where the research took place and the impact factor of the publishing journal as publication factors. Studies were double-coded by the first and second author.

Data Analysis

We utilized Cohen's d as the measure of effect size, as per the formula established by Lipsey and Wilson (2001), separately for each study. Following Cohen's benchmarks (1992), an effect size of d = .20 is deemed small, d = .50 reflects a medium effect, and d = .80 represents a large effect. We calculated effect sizes for the pre-measurement,

post-measurement, and follow-up measurements. Next, we subtracted the post-measurement effect sizes from the pre-measurement effect sizes, and the follow-up measurements were subtracted from the pre-measurement effect sizes. In order to standardize the analysis, categorical variables were converted into dummy variables, while continuous variables were adjusted to have a mean centered.

We conducted a three-level meta-analysis to accommodate for statistical dependency (Houben et al., 2015; Wibbelink & Assink, 2015) and to include multiple effect sizes per study. Level 1 represents the sampling variance, which is the variance of the observed effect size around the population effect size. Level 2 is the within-study variance, and level 3 is the between-study variance. All calculations were performed in the statistical software program R (www.r-project.org) using the syntaxes from Wibbelink & Assink (2015). To test for heterogeneity, two log-likelihood-ratio-tests were employed. Heterogeneity is considered to be present when there is significant variance among effect sizes within studies (level 2) or between studies (level 3). In such cases, more variance is found than could be expected based on sampling variance, in which case a moderator analysis is recommended to investigate potential factors that could account for this variance.

To examine the possibility of missing date resulting from publication bias, a funnel plot was conducted (Egger et al., 1997). A funnel diagram plots effect sizes against standard measurement error. In the presence of bias, the funnel plot is asymmetrical and the Egger's test is significant. A left-skewed funnel plot indicates publication bias (the tendency for research studies with statistically significant or positive results to be more likely to be published and studies with negative or non-significant results left out), while a right-skewed funnel plot indicates other forms of selection bias (participants of the study were not representative for the larger population, apparently certain groups were left out). If bias is detected, a trim and fill procedure is performed to evaluate the extent of the (Duval & Tweedie, 2000). During this procedure, missing effect sizes are filled by estimated values. As a result, a new overall effect size is calculated taking into consideration the presence of bias.

Results

Overall effect

This study consists of 15 independent samples and 92 effect sizes. A total of 1,170 participants were included in this multi-level meta-analysis (experimental

groups: N_{exp} = 436, control groups N_{ctrl} = 478), of whom 59% were women and 41% were men. The mean age of the total sample was 22.9 years (SD = 10.59). Trauma treatment had a medium to large effect on reducing trauma symptoms and externalizing behavioral problems in adolescents and adults with forensic problems (*d* = 0.690, 95% CI = [0.45, 0.93], p < .001; see Table 1).

Table 1: Overall Treatment Effect

	k	*#ES*	*M d*	*95% CI*	*p*	$\sigma^2_{level\ 2}$	$\sigma^2_{level\ 3}$	*% Var. Level 1*	*% Var. Level 2*	*% Var. Level 3*
Overall Effect	15	92	0.69	[0.45, 0.93]	<.001	0.132***	0.167***	18.19	36.06	45.75

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

*p < .05; **p < .01; ***p < .0

The results of the funnel plot analysis (Figure 3) show that there was no publication bias. However, it appears that there was selection bias, indicating that

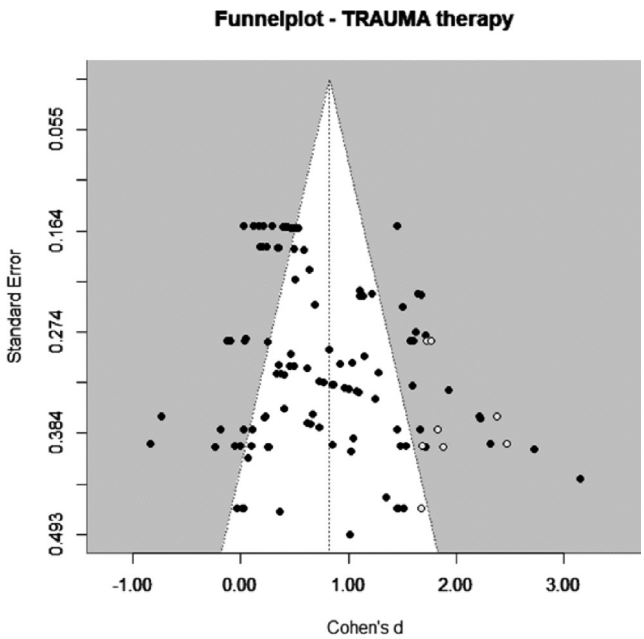

Figure 3: Funnel Plot

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

part of the target population was not included. To correct for selection bias, the missing effect sizes (8 of them) were imputed, after which the overall effect was recalculated. This resulted in a larger positive effect (d = 0.86, 95% CI = [0.60, 1.12], p < .001). This suggests that the observed effect size may be a slight underestimate of the true effect.

Moderator Analyses

Results of the likelihood-ratio test showed significant variance of the effect sizes within studies (level 2), $\chi^2(1) = \chi2(1) = 37.09$, p < .0001, and significant variance of the effect sizes between studies (level 3), $\chi2(1) = 19.85$, p < .0001 . This justifies the use of moderator analyses to explain the heterogeneity on level 2 and level 3.

Table 2 presents the results of moderator analyses examining the impact of client characteristics, treatment characteristics, methodological characteristics, and publication characteristics on trauma symptoms and externalizing behavior. As expected, trauma treatment had a larger effect on trauma symptoms (d = 0.91; large effect) compared to anger and other externalizing behavior problems (d = 0.50; medium effect). While no significant differences were found between types of externalizing behavior, reductions in anger and aggressive behavior (d = 0.62; medium effect) were more pronounced than in other externalizing behavior problems (d = 0.41; small effect).

The duration of treatment sessions moderated the overall treatment effect on trauma symptoms and externalizing behavior (d = 0.69; medium effect), with longer session durations associated with diminished outcomes. A trend emerged regarding the type of intervention: Trauma-Focused Cognitive Behavioral Therapy (TF-CBT) had a large effect (d = 0.99), Eye Movement Desensitization and Reprocessing (EMDR) had a medium effect (d = 0.66), and other interventions (FORNET and Beyond Violence) had a small effect (d = 0.45) on trauma symptoms and anger/externalizing behavior problems. Other treatment characteristics—such as the type of externalizing behavior (anger/aggression or other), intervention focus (trauma only or trauma & externalizing), setting, session duration, individual versus group treatment, and system involvement—did not moderate the overall treatment effect on trauma symptoms and externalizing behavior problems.

Regarding client characteristics, age moderated the overall treatment effect: a small effect was observed in adolescents (d = 0.39), while a large effect was found

in adults (d = 0.92). Gender did not moderate treatment effects. Although trauma type (Type I or II), degree of stress, and mild intellectual disabilities were coded as client characteristics, none of the analyzed studies included measurements of these factors.

In terms of methodological characteristics, a trend was observed for assessment of treatment integrity: when treatment integrity was assessed, a large effect was found (d = 0.86), compared to a small effect when it was not assessed (d = 0.42). Other methodological characteristics—such as follow-up measurement, type of control group, informant, assessment type, study design, and intention-to-treat analysis—did not moderate treatment effects. Finally, publication characteristics such as publication year, impact factor, and continent did not moderate treatment effects.

Table 2: Moderator Analyses of Treatment Effects

Moderator Variables	*k*	*#ES*	B_0/d	t_0	B_1	t_1	$F(df_1, df_2)$
Intervention Characteristics							
Treatment Outcome							$F(1,90) = 18.688^{***}$
Trauma symptoms	15	43	0.91	7.032^{***}			
Externalizing	15	49	0.50	3.990^{***}	-0.41	-4.321^{***}	
Outcome Externalizing behavior							$F(1,49) = 1.132$
Anger/Aggression			0.62	3.724^{***}			
Other externalizing			0.41	3.786^{***}	-0.19	-1.06	
Focus intervention							$F(1,90) = 0.130$
Trauma only	7	41	0.74	3.977^{***}			
Trauma & Externalizing	8	51	0.65	3.794^{***}	-0.09	-0.361	
Setting							$F(1,90) = 0.423$
Residential	10	58	0.63	4.112^{***}			
Outpatient	5	34	0.80	3.755^{***}	0.17	0.635	
Intervention Type							$F(2,89) = 2.422^{+}$
TF-CBT	6	33	0.99	5.388^{***}			
EMDR	2	16	0.66	2.192^{*}	-0.33	-0.939	
Other	7	43	0.45	2.799^{**}	-0.54	-2.119^{*}	
Treatment Intensity							
Duration treatment	14	88	0.69	6.438^{***}	-0.01	-2.363^{*}	$F(1,86) = 5.584^{*}$
Duration sessions	14	88	0.70	5.204^{***}	-0.00	-0.019	$F(1,86) = 0.000$
Individual/group treatment							$F(2,89) = 1.318$

Moderator Variables	*k*	*#ES*	B_0/d	t_0	B_1	t_1	$F(df_1, df_2)$
Both	6	32	0.90	4.609***			
Individual	6	45	0.64	3.419**	-0.26	-0.967	
Group	3	15	0.36	1.318	-0.54	-1.589	
System involvement							$F(1,90)$ =0.374
Yes	3	22	0.84	3.031**			
No	12	70	0.65	4.622***	-0.19	-0.612	
Client Characteristics							
Age							$F(1,90)$ = 7.052**
Adolescents (12-18 year)			0.39	2.660**			
Adults			0.92	6.779***	0.53	2.656	
Sex (% boys)	15	92	0.69	5.580***	-0.00	-0.593	$F(1,90)$ = 0.352
Methodological Characteristics							
Follow-Up							$F(1,90)$ = 0.074
No	10	48	0.70	5.173***			
Yes	11	44	0.67	4.947***	-0.03	-0.272	
Follow up in months	10	48	0.65	4.996***	0.00	0.017	$F(1,46)$ = 0.000
Type Control Group							$F(1,90)$ = 2.740
No Treatment	9	48	0.82	5.331***			
Treatment	8	44	0.53	3.297***	- 0.29	-0.900	
Informant							$F(2,89)$ = 0.000
Client report	15	74	0.69	5.603***			
Family system report	2	10	0.68	3.079**	-0.01	-0.024	
Therapist report	3	8	0.69	3.148**	-0.00	-0.003	
Assessment type							$F(1,90)$ = 0926
Questionnaire	13	67	0.65	5.189***			
Clinical judgment	6	25	0.79	4.910**	0.14	0.962	
Assessment treatment integrity							$F(1,90)$ = 3.699+
Yes	9	55	0.86	5.933***			
No	6	37	0.42	2.399*	-0.44	-1.923	
Study design							$F(1,90)$ = 1.822
RCT	12	70	0.77	5.835***			
Quasi Experimental	3	22	0.38	1.495	-0.39	-1.350	
Intention to treat							$F(1,90)$ = 0.374
Yes	3	22	0.84	3.031**			
No (Completer)	12	70	0.65	4.622***	-0.19	-0.612	
Publication Characteristics							
Publication Year	15	92	0.69	5.443***	0.00	0.036	$F(1,90)$ = 0.001
Impact Factor	15	92	0.69	5.441***	-0.00	-0.058	$F(1,90)$ = 0.003

Moderator Variables	*k*	*#ES*	B_0/d	t_0	B_1	t_1	$F(df_1, df_2)$
Continent							$F(2,89) = 0.492$
America	6	37	0.63	3.166^{**}			
Europe	1	12	0.34	0.738	-0.30	-0.599	
Africa	8	43	0.78	4.417^{***}	0.15	0.574	

Note: *k* = number of independent studies; *#ES* = number of effect sizes; B_0/d = intercept/mean effect size; t_0 = *t*-value for mean *d* ; B_1 = regression coefficient or difference from reference category; t_1 = t-value for regression coefficient; $F(df_1, df_2)$ = omnibus test.

$^{+}p < .10$ $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$

Discussion

This study, based on 15 independent samples and 92 effect sizes, employed a multilevel meta-analytic approach to assess the effectiveness of evidence-based trauma treatments in clients (adolescents and adults) with trauma-related symptoms and persistent anger, aggression, or other forms of externalizing behavior problems, compared to a control group. Specifically, it examined whether the presence of stress has a negative moderating effect on the efficacy of trauma treatments in reducing anger, aggression, and externalizing behaviors. Additionally, the study investigated potential moderating variables, including client demographics, treatment modalities, methodological aspects, and publication features.

Results indicated that trauma treatment had a medium to large, statistically significant overall effect on trauma symptoms and externalizing behavior problems in adolescents and adults (d = 0.69). This overall effect was found to be even greater after correcting for selection bias (d = 0.86). Trauma treatment had a large effect on reducing trauma symptoms and a medium effect on diminishing externalizing behavior problems. While no significant differences were observed between types of externalizing behavior, better outcomes were found in reducing anger and aggressive behavior (medium effect) compared to other externalizing behavior problems (small effect). These findings suggest that established trauma interventions are applicable for clients with externalizing behavior problems, consistent with previous research by Hoogsteder et al. (2020) and Karakurt et al. (2019).

No conclusions could be drawn about the moderating effect of stress levels, as the selected studies did not include measurements of stress. Other moderator analyses revealed that the effect size for adults was significantly larger than for adolescents. Session duration also moderated the overall treatment effect on trauma

symptoms and externalizing behaviors: sessions longer than 120 minutes were less effective. The average session length was 103 minutes. A trend was observed in the effectiveness of different intervention types: TF-CBT had a large effect, EMDR had a medium effect, and other interventions had a small effect on reducing trauma symptoms and externalizing behavior problems. The assessment of treatment integrity showed a trend: a large effect was observed when treatment integrity was assessed, compared to a small effect when it was not.

Other moderator variables were not significantly related to overall treatment effects (trauma symptoms, anger, and other externalizing behaviors. It is regrettable that the selected studies did not include measurements of chronic stress levels, as stress presence can influence treatment outcomes. Understanding whether perceived stress diminishes alongside reductions in PTSD symptoms and aggression is crucial, as it may exacerbate externalizing behavioral issues.

The duration of sessions showed a notable result: the longer the sessions, the less impact. So, extending the session does not always seem to have an effect on the outcome. This was also found in a study of Minnen & Foa (2006), where imaginal exposure (prolonged exposure) of 30 minutes were as effective as sessions of 60 minutes in improvement of the PTSD-symptoms. One possible explanation is that longer sessions are exclusively offered to clients with severe symptoms. Consequently, when assessing the overall treatment efficacy, same of less effects may be observed due to the complex nature of their issues. Another explanation may lie in that a longer session makes too great a demand on concentration ability and has no added value. After all, concentration problems are one of the criteria of potential changes in arousal and reactivity belonging to PTSD (American Psychiatric Association, 2022). Lastly, it's important to note that in this meta-analysis, only group-based therapies featured longer sessions. Although group intervention wasn't identified as a moderator in this study, it's evident that group interventions yield less outcomes (a small effect size) in reducing trauma and externalizing problem behavior compared to individual treatment (which demonstrates a medium to large effect).

Also, the moderator analyses showed that effect for adults was significantly larger than for adolescents. Adults were more likely to benefit from the evidence based trauma treatments. Earlier studies (Gutermann et al., 2016; Newman et al., 2014; Trask et al., 2011) have demonstrated that trauma intervention yields greater efficacy in older adolescents compared younger adolescents/children. Trask

et al. (2011) proposed that trauma treatment is more effective for adults due to their advanced cognitive and emotional development. Adults generally possess more developed cognitive abilities and emotional regulation skills compared to adolescents. This allows them to better understand and apply the complex concepts and techniques used in trauma therapy. This effectiveness could be attributed to the reliance of treatment on cognitive faculties, which are more mature in adults compared to older adolescents.

In the meta-analysis of Hoogsteder et al. (2020) trauma treatment significantly decreased trauma symptoms (large effect) and externalizing behavior problems (medium effect) in children and adolescents. Possibly, in this study stronger effects were found because the inclusion criteria on program integrity were more stricter (the treatment had to be sufficiently implemented as intended). In this study, assessment treatment integrity was found as a trend. Program integrity is crucial for accurately evaluating treatment effectiveness (Goense et al., 2014). Studies demonstrate that the efficacy of a treatment decreases with a decline in program integrity (Duwe & Clark, 2015; Durlak & DuPre, 2008; Hoogsteder et al., 2016). When assessing program integrity, it is essential to evaluate whether therapists participate in supervision, meet competency requirements, and adhere to education standards. Moreover, it is vital to determine if the intended content and working components have been adequately delivered, and if the intensity and duration align with the treatment approach guidelines (Duerden & Witt, 2012; Miller & Miller, 2015). Expanding on this, it's crucial to attain the utmost level of program integrity during both treatment and research endeavors to accurately determine effectiveness. This aligns with Barber et al.'s recommendation (2007), advocating for comprehensive characterization of trauma treatments, adherence, and competency measurements. Such an approach fosters a deeper understanding of successful therapies and ensures effective assessment of treatment integrity.

Differences in effectiveness were found in the type of interventions (trend). TF-CGT demonstrated a large effect, EMDR showed a moderate effect, and other treatments (such as FORNET and Beyond Violence) resulted in small to medium effects. These discrepancies are consistent with findings from Lewey et al. (2018) meta-analysis, which indicated that TF-CBT yielded marginally better outcomes than EMDR in children and adolescents with PTSD. Similarly, Kline et al. (2018) meta-analysis reported the effectiveness of all evidence-based trauma

interventions, highlighting exposure-based treatments (a component of TF-CGT) as particularly impactful in long-term follow-ups. An possible explanation could be that TF-CGT involves a structured cognitive-behavioral therapeutic approach specifically designed to address trauma-related cognitions, emotions, and behaviors. This focused approach allows individuals to modify unhelpful beliefs and behaviors associated with their traumatic experiences, potentially leading to more enduring therapeutic effects. Additionally, TF-CGT often includes skill-building elements such as relaxation training, affect regulation, and coping skills development. These skills provide individuals with practical tools to manage stressful emotions and situations related to their trauma, aiding in long-term coping. According to the general responsiveness principle, these effective elements are well-suited for clients with externalizing behavior problems and/or forensic issues. This is a component that aligns with the RNR principles (Bonta &Andrews, 2023). Another explanation for the observed results is that TF-CBT and EMDR primarily target reducing PTSD symptoms, whereas Beyond Violence and FORNET are tailored for forensic populations with a dual focus on trauma and recidivism reduction. This meta-analysis did not permit conclusions regarding the effect on recidivism.

Restrictions

One limitation of this study is the relatively small number of studies included in the meta-analysis (N = 15). A limited number of studies can potentially undermine the validity of statistical conclusions due to insufficient statistical power to detect effects (Farrington, 2003). Nonetheless, the number of studies included in this analysis exceeds that of many meta-analyses, which typically include fewer than nine studies (Lau et al., 2006). Moreover, the use of a multilevel approach allowed for the incorporation of multiple effect sizes from the same study, thereby enhancing statistical power and enabling meaningful moderator analyses. This issue also pertains to the measurement of mild intellectual disabilities, which were not assessed in any of the included studies.

Another significant limitation is the presence of selection bias, indicating that parts of the target population were not represented. Selection bias occurs when certain groups within a population are systematically excluded from a study, leading to an inaccurate representation of the true population characteristics. In this meta-analysis, selection bias likely resulted from non-response bias, where individuals either refused

to participate or dropped out, potentially causing overestimation or underestimation of outcomes. Efforts were made to address the identified selection bias.

Conclusion

The multilevel approach of this meta-analysis revealed that trauma treatment had a large effect on reducing trauma symptoms and a medium effect on decreasing persistent feelings of anger and aggression (medium effect) and other externalizing behaviors (small effect). Adults generally benefit more from evidence-based trauma treatments compared to adolescents, potentially due to a higher prevalence of early childhood trauma among adolescents. Previous research suggests that trauma interventions are more effective in older adolescents, possibly due to their more advanced cognitive abilities.

TF-CBT demonstrated the best results, likely due to its structured approach addressing trauma-related cognitions, emotions, and behaviors, along with its incorporation of skill-building elements like relaxation training and coping skills. Notably, none of the studies measured stress as an outcome, which should be included in future research to explore its relationship with trauma symptoms and its potential moderating effect on treatment outcomes. This study highlights the critical importance of assessing treatment integrity to accurately evaluate effectiveness. Program integrity, encompassing therapist supervision, competency, and adherence to educational standards, significantly impacts treatment outcomes and should be a focus for both clinical practice and research.

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Appendix 1: Characteristics Included Studies

Study	*N*	*Age (M)*	*Study and Sample Characteristics*	*Assessment Externalizing Behavior*	*Assessment Trauma Symptoms*	*Experimental Condition*	*Control Condition*
Bradley& Follinstad (2003)	31	36,67	USA, DBT/writing	TSI anger	TSI PTSD symptoms	DBT/writing	No treatment
Crombach & Elbert (2015)	32	17,0	Africa, FORNET/TAU	Offenses, AAS	PTSD SYMPTOMS	FORNET	TAU
Farkas, Cyr, Lebeau, & Lemay (2010)	40	14.3	USA, RCT, clinical sample, completer analysis, 62,5% girls	DISC, CBCL-PRF, TSCC (anger)	DISC, TSCC (PTSD total symptoms)	EMDR + MASTR (*n* = 19)	WL with routine care (TAU) (*n* = 21)
Goldbeck, Muche, Sachser, Tutus, & Rosner (2016)	159	13.03	Europe, RCT, clinical sample (exp) and community sample (ctrl), intention-to-treat analysis, 71% girl	CBCL-PRF	CAPS-CA, UCLA-PTSD RI, CPTCI	TF-CBT (*n* = 76)	WL (NT) (*n* = 83)
Hinsberger, Holtzhausen, Sommer Kaminer, Elbert, Seedat, Wilker, Crombach & Weierstall (2017)	39	22,95	South Africa, mixed: clinical community	AAS bewerkte vorm	Foa and Tolin's P	CBT (n =11) en FORNET (*n* =15)	WL (*n* = 13)
Köbach, Schaal, Hecker & Elbert (2017)	98	23,48	Congo, completed analysis, men	AAS en AFAA	Foa and Tolin's P	FORNET (*n* = 21/28)	TAU (*n*=26/23)
Kubiak, Kim, Fedock,& Bybee (2015)	22	34,18	North America, clinical, intention-to-treat, 100% women	The revised Expagg, STAXI-2	short screening scale of DSM of PTSD	Beyond Violence (*n* = 19)	WL (*n* = 8)

Study	*N*	*Age (M)*	*Study and Sample Characteristics*	*Assessment Externalizing Behavior*	*Assessment Trauma Symptoms*	*Experimental Condition*	*Control Condition*
Messina, & Calhoun (2022)	143	38,6	North America, clinical, completer, 100% women	The revised Expagg, Buss-Warren Aggression Questionnaire	short screening scale of DSM of PTSD	Beyond Violence (*n*=77)	WL (*n* = 66)
McMullen, O'Callaghan, Shannon, Black, & Eakin (2013)	48	15.80	Africa, RCT, clinical sample, completer analysis, 100% boys	AYPA (conduct scale)	UCLA-PTSD RI (revised)	TF-CBT (*n* = 24)	WL with routine care (TAU) (*n* = 24)
O'Callaghan, McMullen, Shannon & Rafferty (2015)	50	14.88	Africa, RCT, community sample, intention-to-treat analysis, 42% girls	AYPA (conduct scale)	UCLA PTSD-RI (revised)	TF-CBT (*n* = 26)	CFS (TAU) (*n* = 24) WL (NT) (*n* = 22)
O'Callaghan, McMullen, Shannon, Rafferty, & Black (2013)	52	16.02	Africa, RCT, community sample, intention-to-treat analysis, 100% girls	AYPA – conduct scale	UCLA-PTSD RI (revised)	TF-CBT (*n* = 24)	WL (NT) (*n* = 28)
Silver, Brooks, & Obenchain (1995)	68	46	USA, veteranen, mannen, completers	Problem Report Form	Problem Report Form	EMDR (*n* =13), biofeedback, relaxation	TAU (*n*=55)
Shein-Szydlo, Sukhodolsky, Kon, Tejeda, Ramirez, & Ruchkin (2016)	99	14.89	USA, RCT, clinical sample, completer analysis, 64% girls	STAXI	CPTS-RI, CPSS	TF-CBT (*n* = 50)	WL (NT) (*n* = 49)
Robjant, Koebach, Schmitt, Chibashimb Carleial, & Elbert (2019)	92	18.0	Congo, completers, female	AAS, current violent behavior	PTSD symptom scale interview	FORNET (*n* = 43)	TAU (*n* = 41)

Study	*N*	*Age (M)*	*Study and Sample Characteristics*	*Assessment Externalizing Behavior*	*Assessment Trauma Symptoms*	*Experimental Condition*	*Control Condition*
Hermenau, Hecker, Schaal, Maedl, Elbert	36	19,00	Congo	AAS	PSS-I	FORNET (*n* = 17)	TAU (*n* = 19)

Note: RCT = Randomized Controlled Trail; 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; AYPA = African Youth Psychosocial Assessment; STAXI= State Trait Anger Expression Inventory; DISC= Diagnostic Interview Schedule for Children