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ORIGINAL ARTICLE

Examining the Effects of Adverse Childhood Experiences and Gender on Trauma-Informed Intervention Outcomes

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Abstract

Purpose The prevalence of Adverse Childhood Experiences (ACEs) and their link to negative behavioral and health outcomes is well documented, but very few studies have empirically examined the effect of ACEs on intervention outcomes. There is also emerging evidence of gender differences in vulnerability to developing traumatic symptoms, which relates to intervention outcomes. The current study examined the effects of ACEs and gender on trauma-informed intervention outcomes in a community-based clinical setting.

Methods The study includes data from children who were treated with trauma-informed intervention services grounded in the Attachment, Self-Regulation, and Competency (ARC) framework from 2017 to 2019. ACE scores are measured as a total across 10 items and different types, maltreatment versus family dysfunction, at intake. Children's trauma-related symptoms are assessed at intake and every 90 days under the ARC framework. In order to examine the changes of traumatic symptoms over time, a total of 362 children with three time points are included for the current analyses using Multilevel modeling with SAS PROC MIXED.

Results The study found that a trauma-informed intervention based on the ARC framework was effective in reducing children's trauma related symptoms until they experienced 6 or more ACEs. The intervention effect, however, did not hold when children's ACEs were cumulated to 7 or more. The study also revealed gender differences in intervention outcomes.

Conclusions The finding has significant implications for early detection and preventative intervention efforts with children's ACEs before their ACEs further cumulate to a higher number. Gender difference should be considered in intervention planning and monitored during the intervention process.

Keywords Adverse childhood experiences · Trauma-informed intervention · ARC · Gender

Introduction

Adverse Childhood Experiences (ACEs) are traumatic events that happen during childhood including emotional abuse, sexual abuse, physical abuse, neglect, domestic violence, parental divorce, household substance abuse, mental illness, and criminal activity (Felitti et al. 1998). Studies based on national surveys found that nearly 65 to 80% of children experienced at least one ACE (Copeland et al., 2007; Finkelhor et al., 2009), and more than one-third reported exposure to multiple ACEs (Copeland et al., 2007). Since the seminal ACE study (Felitti et al., 1998), a large body of research has reported the high prevalence of childhood exposure to trauma and its link to negative behavioral and health outcomes. The impact of ACEs on risk development can vary depending on the total number and types of ACEs that children experience. However, most work addressing treatment of childhood trauma has focused on a general reduction of traumatic symptoms, and very few studies have examined the effect of types or number of ACEs on intervention outcomes. There is also emerging evidence of gender differences in vulnerability to developing traumatic symptoms, which may impact intervention outcomes. The current study examined the effects of ACEs on a trauma-informed treatment intervention and the gender differences in the intervention outcomes.

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Effect of adverse childhood experiences (ACEs) on Child Development

Studies have found that ACEs are related to increased risk of mental health Cicchetti, 2016; Taillieu et al., 2016; Trauelsen et al., 2015), substance use Anda et al., 2008; DeBellis, 2002; Ducci et al., 2009; O'Connell et al., 2007; Mills et al., 2005), physical health Bellis et al., 2014; Danese & Tan, 2014; Suglia et al., 2018), sexual risk taking (Hillis et al., 2001), and youth violence (Fox et al., 2015). A dose-response effect has been consistently demonstrated, with the greater number of ACEs associated with more serious outcomes (Flaherty et al., 2013; Greeson at al. 2014). For example, a study examining the relationship between ACEs and substance use illustrates that each ACE increased the likelihood for early initiation of drug use by two to four-fold (Dube et al., 2003). Moreover, studies reported that persons with a total ACEs score of 4 or higher are at significantly greater risk of suicide attempt (Hughes et al., 2017), and those with a total ACEs score of 6 or higher are at risk of shortening their lifespan by 20 years (Felitti et al., 1998). Another study of a diverse sample of over 14,000 children found that the greater the number of trauma events experienced in childhood, the greater the severity of child behavior problems (Greeson et al., 2014). It is also important to consider the unique contributions that different types of ACEs may have on risk development. There is growing evidence on ACEs' relative predictive strengths compared with different types of adversity, especially childhood maltreatment versus family dysfunction (Atzl et al., 2019; Negriff, 2020). Different types of ACEs may involve unique pathways to adaptation or maladaptation and have different effects on negative behavioral and health outcomes. Drawing from a developmental psychopathology perspective, research indicates that there are multiple contributors to developmental outcomes, each contributor's influence on the developmental outcomes varies, and myriad pathways exist to any particular manifestation of adaptive or maladaptive behavior (Cicchetti & Cohen, 1995; Cicchetti & Rogosch, 1996). This suggests a multisystem, contextual approach to development where a different type of adversity can have its relative predictive power compared with other types of adversity (Atzl et al., 2019; Cicchetti & Toth, 1995). For example, a study found that exposure to childhood maltreatment showed significantly stronger power to predict child socioemotional problems than family dysfunction (Narayan et al., 2017). Several studies indicated that maltreatment experiences are strongly associated to poor self-regulation, which predicts emotional problems (Kim & Cicchetti, 2010; Maughan & Cicchetti, 2002; Shipman et al., 2007). Another study reported that childhood maltreatment is more strongly associated with subsequent internalizing problems, whereas family dysfunction is more strongly associated with externalizing problems (Ryan et al., 2000).

The attachment, Self-Regulation, competency (ARC) Framework

Early development takes place largely within the context of the caregiving relationship within the family, and trauma experienced in childhood can be especially damaging in its impact on the primary caregiving system (Scheeringa & Zeanah, 2001). The primary attachment system provides the security necessary for children to master an array of competencies including the ability to self-regulate (Arvidson et al., 2011), which is also connected to the foundation for self and identity formation (McCathy, 1998). Traumatic experiences can potentially impair the development of these core processes, and the use of a trauma-informed intervention that focuses on the attachment system as a foundation is critical in treatment with children who are exposed to trauma (Arvidson et al., 2011; Osofsky, 2004). The Attachment, Self-Regulation, and Competency (ARC) Framework is one promising evidence-based intervention model being developed in partnership with the National Child Traumatic Stress Network (NCTSN) for children and adolescents impacted by trauma (Cook et al., 2005). The ARC framework provides a flexible structure to guide providers in trauma-informed intervention with children. The model is applicable for work with children from early childhood to young adulthood and their caregiving support systems. The flexibility of ARC allows for adaptation to various settings, including outpatient clinics, schools, and residential treatment centers (Hodgdon et al., 2013). The ARC framework centers on three core domains that are impacted by exposure to trauma (See Fig. 1). Within these three domains of attachment, self-regulation, and competency, there are 10 building blocks of intervention. The attachment domain addresses how building a safe environment and safe relationship can buffer the impact of traumatic stressors and support children in meeting developmental needs. The self-regulation domain addresses supporting a child's ability to safely and effectively manage traumatic experience by building an awareness and understanding of his or her internal experience. The competency domain addresses how to build the foundational skills needed for healthy and ongoing development and resiliency including the ability to set goals and make active choices and form a developmentally appropriate sense of self (Arvidson et al., 2011; Blaustein & Kinniburgh, 2010). The individual building blocks represent specific intervention targets and, as a whole, provide an organizational framework to guide the development and

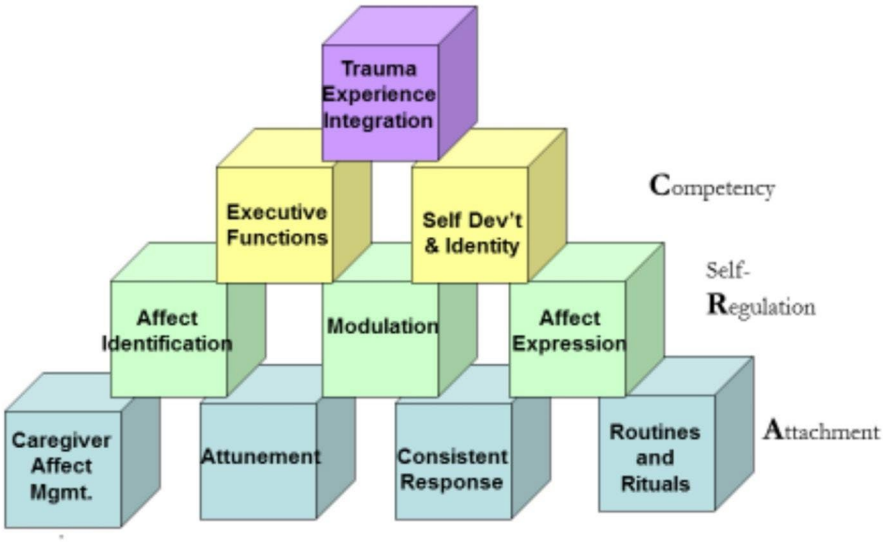

Fig. 1 Attachment, Self-Regulation, Competency (ARC). (Blaustein & Kinniburgh 2010; Kinniburgh & Blaustein, 2005, Reprinted with permission)

implementation of intervention approaches that address the comprehensive nature of trauma (Rishel et al., 2019).

Studies have reported that the ARC framework is effective in improving outcomes for children and youth exposed to trauma (Bartlett et al., 2018; Holmes et al., 2014; Tabone et al., 2020). A preschool intervention model that used the ARC framework found that children who received intervention demonstrated significant improvement in attention span and behavior (Holmes, et al., 2014). Another study of children and youth who received intervention using the ARC model showed significant reductions in PTSD symptoms and internalizing and externalizing behavior problems (Bartlett et al., 2018). Moreover, Hodgdon et al., (2013) reported that the ARC model was effective in reducing PTSD symptoms and externalizing and internalizing behavior problems in a youth sample. Studies have shown that intervention based on the ARC framework are effective at individual, classroom, and organizational levels (Bartlett et al., 2018; Rishel et al., 2019) and also in community, child welfare, and residential samples (Arvidson et al., 2011; Hodgdon et al., 2013). Although there is considerable evidence of the negative impact of ACEs on children's development and positive effects of the ARC framework on children's trauma related symptoms, there are no studies to our knowledge that have empirically examined the effect of ACEs on intervention outcomes. Studies have, instead, focused on the general reduction of trauma related symptoms. As the evidence indicates the impact of ACEs on risk development can vary depending on the total number and types of ACEs that children experience, these factors may influence intervention outcomes and need to be considered as part of the intervention planning process.

Gender differences and contemporaneous ACEs in intervention outcomes

The impact on intervention outcomes may also differ by gender. Gender is often included as a control variable in ACEs studies, or studies have examined gender differences in rates of trauma exposure or the subsequent development of posttraumatic stress disorder (PTSD), particularly in adult samples (Wamser-Nanny & Cherry, 2018). Few studies have examined gender difference in symptom expression following trauma exposure (Wamser-Nanny & Cheery, 2018) and in the intervention outcomes (Ascienzo et al., 2021) in a child sample. Examination of gender-based difference in intervention outcomes have typically involved PTSD symptom reduction using Trauma-Focused Cognitive Behavioral Therapy (TF-CBT) (Cohen et al., 2004; Kane et al., 2016; Murray et al., 2013), and the findings are inconsistent (Wamser-Nanney & Cherry, 2018; Craig & Sprang, 2014) found that boys exhibited lower levels of PTSD symptoms than girls after receiving TF-CBT treatment, while Tol et

al., (2008) indicated girls reported having larger treatment gains compared to boys. Moreover, multiple studies have shown that interventions based on the ARC framework are effective in reducing trauma related symptoms (Bartlett et al., 2018; Rishel et al., 2019), but no studies have examined gender differences in the intervention outcomes among children treated with the ARC framework.

Based on initial evidence of potential gender differences in developing traumatic symptoms, gender differences should be further examined in intervention outcome research. In addition to gender, contemporaneous measure of ACEs is important to consider in examining the effect of ACEs on the intervention outcomes. Many studies measure ACEs retrospectively as adults. The retrospective measure of ACEs can be appropriate to examine their long-term effects on behavioral and health outcomes such as chronic health risks as adults. However, the identification of ACEs contemporaneously among children will have significant preventative intervention implications in mitigating potential negative ACEs' effects through early detection and intervention efforts before they reach adulthood (Crouch et al., 2019).

The current study

Collectively previous studies demonstrate that ACEs are a risk factor for later behavioral and health outcomes, and their impact on risk development can vary depending on the total number and types of ACEs that children experienced. Individuals with high ACEs scores are at increased risk, and different types of ACEs have unique contributions to risk development. Moreover, there is an initial evidence of gender differences in trauma symptom expression and intervention outcomes. The current study examines the effects of ACEs on trauma-informed intervention outcomes based on the ARC framework in a large community-based clinical setting where the state was reported to have 27% of children with two or more ACEs as compared to the national average of 21.7% (ACEs Crittenton of WV, 2018). This sample with high exposure to ACEs allows us to examine ACEs' effects based on different numbers and types of ACEs measured contemporaneously among children on their intervention outcomes. Potential gender differences are also explored in the intervention outcomes.

Methods

Procedure and Sample

The study conducted in a major mental health clinic, Crittenton, in the Northern "panhandle" of WV. Crittenton Services has been serving WV for more than a century across 23 counties, providing both residential and community-based outpatient mental health services. Crittenton, a member of the ACEs Coalition of WV, began to engage with national leaders in ACEs research and trauma-informed treatment in 2012. The National Crittenton Foundation (TNCF), a national advocacy group that supports 28 independent Crittenton organizations across the country, partnered with Dr. Felitti (the author of the original ACE study) to participate in a study of ACEs within treatment populations. WV respondents to this study scored substantially higher as compared to the national Crittenton population, indicating greater trauma exposure. In response to the high prevalence of trauma in the state, Crittenton Services of WV, has participated in a number of state and national initiatives focused on trauma-informed services. Crittenton integrated a trauma-informed treatment framework, the ARC model, into agency practice and environment in 2015 and then participated in the state's efforts on developing a comprehensive trauma-focused assessment tool. WV developed a WV Child and Adolescent Needs and Strengths (CANS) tool that recognizes WV's unique situation and rural culture. WV CANS adapted the language of original CANS items to be culturally specific to WV culture in consultation with the original CANS developer, Dr. Lyons. Although WV CANS adapted the language of the original CANS to be culturally specific to WV, the majority of CANS language remained the same. Crittenton connected WV CANS items to the ARC building blocks based on their relevance to the block. In this model, assessment information measured by the WV CANS can be easily translated into the ARC framework in order for clinicians to identify areas that need further improvement and to integrate their assessment and treatment processes. Clinicians can translate WV CANS assessment scores into ARC competencies using the WV CANS-ARC mapping template and create graphs and reports based on assessment and treatment building blocks to promote clients' understanding and progress. All clinical staff attend a formal mapping training as well as complete a testing and certification process to assure fidelity and consistency in the administration and scoring of the assessment. Staff continue subsequent trainings on an individual basis during the course of formal supervision with their clinical supervisor, and Crittenton also holds yearly formal re-training sessions for all clinical staff. Children are usually referred to Crittenton for behavioral issues from family or friends, schools, the

Table 1 Descriptive Data on the Sample

	% (N) or M (SD)
Gender	
Girls	53% (192)
Race	
White	95% (318)
Age (years)	12.0 (3.8)
Program	
Outpatients	85.4% (309)
Residential	11.3% (41)
School-based	3.3% (12)

state Department of Health and Human Resources (DHHR), pediatricians, or juvenile court. All children who came to Crittenton were treated using trauma-informed therapeutic intervention services under WV CANS-ARC mapping since 2016. Children's ACEs were assessed at intake and the WV CANS was used to monitor children's progress in their trauma related symptoms over time, at intake and every 90 days under the ARC framework. Children who were treated with trauma-informed therapeutic intervention services under the WV CANS-ARC mapping and have at least three time points from 2017 to 2019 were included for this study in order to examine the changes of traumatic symptoms over time. Thus, a total of 362 children were used for the current analysis.

In the study sample, most children (86%) received services in an outpatient facility, with 11% receiving services in a residential facility, and 3% in school-based settings. Slightly more than half of the children were girls (53%), and majority of the sample were White (95%). Those who reported as non-white (5%) included African-American, Multi-race, and other. The average age of the children in the sample was 12 years (SD = 3.8).

Measures

ACEs. The ACE Questionnaire is a 10-item measure that is most commonly reported in the ACEs research (Felitti et al., 1998). The measure includes five items of maltreatment type (physical, sexual or emotional abuse, physical or emotional neglect) and five items of family dysfunction (parental separation or divorce, witnessing domestic violence, and incarceration, substance abuse, or mental illness of a household member). The ACE questionnaire has been reported to have satisfactory test and retest reliability for each category of abuse and family dysfunction (Dube et al., 2004). A total ACE score was calculated by summing the 10 binary item responses (mean = 4.25, sd = 2.64, $\alpha = 0.76$). A total maltreatment score was created by summing the first five items (mean = 1.63, sd = 1.56), and a total family dysfunction score was created by summing the second five items (mean = 2.62, sd = 1.48).

Gender. Children's gender was dichotomized: Female were coded as 1 (male as 0).

ARC Outcome Domains. The WV CANS was used to measure children's trauma related symptoms at the beginning of services, 90 days, and 180 days after the first assessment. The original CANS were rated on a 0 to 3 scale. A score of 0 indicates no evidence of any trauma of this type; a 1 indicates a single incident of trauma occurred or suspicious exists of this trauma type; a 2 indicates multiple incidents or a moderate degree of this trauma type; and a 3 indicates repeated and severe incidents of trauma with medical/physical consequences (Lyons et al., 2002; Lyons et al., 2009). WV CANS has the same rating scale, 0 to 3. *Attachment.* This ARC domain targets the child's caregiving system and includes four sub-domains: caregiver affect management, attunement, consistent response, and routine and rituals. Each sub-domain was created by summing the relevant multiple items, and then these sub-domains were combined to measure the attachment domain ($\alpha = 0.70$). *Self-Regulation.* This ARC domain targets a child's ability to identify, modulate, and express his or her internal experience and includes three sub-domains: affect identification, modulation, and affect expression. Each sub-domain was created by summing the relevant multiple items, and then these sub-domains were combined to measure the self-regulation domain ($\alpha = 0.60$). *Competency.* The third ARC domain focuses on a child's ability to acquire the foundational skills for ongoing development and includes three sub-domains: Developmental tasks, executive functions, and self & identity. Each sub-domain was created by summing the relevant multiple items as described above, and then these sub-domains were combined to measure the competency domain ($\alpha = 0.57$). For a description of each sub-domain, see Blaustein & Kinniburgh 2010. The corresponding WV CANS items to each ARC sub-domains are presented in Table 2.

Controls. Basic demographic characteristics (e.g., age, race, and program settings) were used as controls. Because 95% of the sample were white, race was dichotomized (white vs. other groups). Age was measured at the initial assessment as a continuous variable (years). Program settings where children received the services were categorized into three groups, outpatient, residential, and school-based settings.

Analyses

Multilevel modeling using SAS PROC MIXED is used to examine the effects of total number and types of ACEs and gender on intervention outcomes over time. In longitudinal data, the multilevel model has two levels in which repeated observations (between-subject level) are nested within

Table 2 WV CANS-ARC Map describing ARC domain blocks and corresponding WV CANS items

ARC Attachment Domain	
ARC Sub-domains	*Corresponding WV CANS items*
Caregiver Affect Management	Parent/caregiver understanding of impact of own behavior on child; ability to communicate; mental health; family stress, substance use; posttraumatic reactions
Attunement	Attachment difficulties; knowledge of child's needs; empathy with children
Consistent Response	Discipline
Routines and Rituals	Spiritual/religious; cultural stress; living situation; sleep, learning environment; organization; educational setting; school behavior; school attendance
ARC Self-Regulation Domain	
ARC Sub-domains	*Corresponding WV CANS items*
Affect Identification	Avoidance; numbing; dissociation; somatization
Modulation	Coping and savoring; attention/concentration; impulsivity; affective and/or physiological dysregulation; anger control; suicide risk; non-suicidal self-injury; other self-harm; substance use; eating disturbance; Danger to others; cruelty towards animals; fire setting; sexually abusive; sexualized behaviors; bullying runaway; intentional misbehavior
Affect Expression	Family; interpersonal; social functioning; attachment difficulties
ARC Competency Domain	
ARC Sub-domains	*Corresponding WV CANS items*
Developmental Tasks	Social functioning; daily functioning; recreational; school behavior; school achievement
Executive Functions	Attention/concentration; impulsivity
Self & Identity	Optimism; talent/interest; spiritual/religious; resilience; sexual development; identity

Tabone et al., 2021, Reprinted with permission

individuals (within-subject level). Trajectories are defined by intercept (level of trauma-related symptoms at the first data point) and slope (increasing or decreasing trends over time), and each individual's trajectory is then characterized by its own intercept and slope parameters. Given that there are multiple trajectories, one can consider a mean trajectory (fixed effects) by pooling overall individuals with the individual variability (random effects) around the mean values. This allows an examination of how the mean trajectory of trauma related outcome changes over time in each domain after adjusting for basic demographic variables. Because the effects of number and types of ACEs and the role of gender on intervention outcomes are largely unknow, the multilevel modeling analyses were stratified according to number of ACEs, type of ACEs, and gender in order to explore their potential effects on the outcomes. First, total ACE score was grouped into four or more (4+) vs. three or less and then grouped into 5+, 6+, 7 + and 8+. The group of 9+ (n = 29) and 10 (n = 10) were not included in the analysis because the sample sizes in both groups were too small to conduct analyses. While the grouping total ACE score is somewhat arbitrary, it is used in a number of studies to divide groups into a "High ACE" category (Felitti et al., 1998; Lodhia et al., 2014; Steinke & Derrick 2018). With controls, the multilevel model analysis was conducted by these different groups of total ACE score first, then by different ACE type (maltreatment and family dysfunction) and lastly by gender in order to address the study purpose.

Results

The effects of total ACE scores on the intervention outcomes

As seen in Model 1 of Table 3, after adjusting for children's age, gender, race, and service settings, the initial values of trauma related symptoms across different number of ACE scores are all significantly different from zero. On average, these trauma symptoms were significantly decreased in all three outcome domains over time until the total ACE score was 6 or more. When the total ACE score became 7 or more, however, trauma symptoms showed a significant decrease in the attachment domain, but not in self-regulation and competency domains. Moreover, when the total ACE score reached 8 or more, trauma symptoms did not show any significant decreases over time in all three outcome domains. The random effects revealed that there was significant individual variability in intercepts and slopes of three outcome domains across different number of ACE groups.

The effects of gender on the intervention outcomes

After adjusting for children's age, gender, race, and service settings, the initial values of trauma related symptoms are all significantly different from zero in both female and male groups. Over time, these trauma symptoms showed significant decreases in attachment and competency domains, but not in self-regulation, among females, while the trauma symptoms showed significant decreases in self-regulation and competency domains, but not in attachment, among males. This suggests that both boys and girls showed significant beneficial effects from the intervention in their competency development. However, for girls the intervention had significant effect on building a safe and secure attachment while for boys the intervention had significant effect on developing self-regulative ability to safely and effectively manage traumatic experience. The random effects revealed that there was significant individual variability in intercepts and slopes of three outcome domains in both gender groups.

Table 3 Results of Multilevel models of change for Traumatic Symptoms in ARC Outcome Domains by Total ACE score, ACE type, and Gender

	Attachment Estimates (SE)	Self-Regulation Estimates (SE)	Competency Estimates (SE)
After controlling for age, race, gender, and program:			
Fixed effects on *Time*			
Model1: Total ACE score			
ACEs 4+	-0.81 (0.19)***	-0.54 (0.19)**	-0.48 (0.12)**
ACEs 5+	-0.75 (0.23)**	-0.43 (0.23)*	-0.43 (0.15)**
ACEs 6+	-0.78 (0.31)*	-0.53 (0.29)*	-0.42 (0.21)*
ACEs 7+	-1.10 (0.42)*	*n.s.*	*n.s.*
ACEs 8+	*n.s.*	*n.s.*	*n.s.*
Model 2: Gender			
Female	-0.54 (0.19)**	*n.s.*	-0.33 (0.14)*
Male	*n.s.*	-0.37 (0.18)*	-0.38 (0.11)**

** p < 0.05 ** p < 0.01 *** p < 0.001 n.s.= non significance*

The results of changes over time by gender are presented in Model 2 of Table 3.

The effects of ACE types on the intervention outcomes

The initial values of trauma related symptoms are all significantly different from zero in both maltreatment and family dysfunction types after adjusting for children's age, gender, race, and service settings. However, no significant decreases in trauma symptoms were detected over time in both maltreatment and family dysfunction types. The random effects revealed that there was significant individual variability around intercepts and slopes of three outcome domains in both ACE types.

Discussion

This study examined the effects of ACEs and gender on trauma-informed intervention outcomes based on the ARC framework in a community-based clinical setting. Existing evidence indicates the effect of ACEs on negative behavioral and health outcomes and the effectiveness of trauma-informed interventions on reducing trauma symptoms. These factors, however, are rarely assessed together in ACE research. This study found that, on average, children's trauma related symptoms significantly decreased over time when treated using the ARC framework, and this finding is consistent with previous studies using the ARC or other intervention models (Ascienzo et al., 2021; Bartlett et al., 2018; Holmes et al., 2014; Rishel et al., 2019). The study further found that the intervention was effective at reducing trauma symptoms until children experienced 6 or more ACEs, but the significant intervention effects did not hold when the number of ACEs exceeded more than 7. Studies have reported that children who experienced multiple traumas have higher risk for additional trauma, which leads to complex or chronic trauma (Finkelhor et al., 2007, 2009). This chronic trauma is also associated with severe developmental impairments (Spinazzola et al., 2013). Moreover, Flaherty et al. (2013) reported that children who experienced recent adversity appeared to have poorer developmental outcomes compared with distant adversity experience. It is possible that children who experienced more than 7 ACEs are highly likely to have persistent trauma leading up to the recent event and develop chronic traumatic symptoms. These children may not achieve the same intervention benefit as those with lower numbers or more distant experiences of adversity and may require a long-term intensive intervention. Although no studies have examined different numbers of ACEs on intervention effects, a previous study reported that youth with four or more ACEs showed significantly high levels of positive treatment engagement including readiness to change and bond with staff in residential facilities (Steinke & Derrick, 2018). Despite the high number of ACEs, children are still able to exhibit strong engagement in treatment and showed significant decrease in trauma related symptoms with a trauma-informed intervention service. These findings suggest the importance of early detection and intervention efforts with children who have experienced ACEs. Early intervention with children's trauma can not only reduce their symptoms but also prevent further deleterious effects on behavioral health outcomes before their ACEs cumulate further until or throughout adulthood. In addition, measuring ACEs contemporaneously, rather than retrospectively, is important to initiating preventative intervention efforts. By identifying exposure to ACEs early, trauma informed intervention services can be better targeted toward specific trauma exposure and symptoms as appropriate and are therefore more likely to prevent negative adolescent and adult outcomes.

The study did not detect significant effects of ACEs types, child maltreatment and family dysfunction, on intervention outcome. This finding may be because different types of childhood adversities often co-occur (Ascienzo et al., 2021; Turner et al., 2006). The sample of the current study includes high rates and prevalence of ACEs compared with the national average. It suggests there may be a high co-occurrence across different types of ACEs, and it is difficult to differentiate the impact of child maltreatment and family dysfunction to assess their relative power associated

to intervention outcomes. Future studies should continue to examine different types of ACEs with large and diverse sample of children and to assess independent predictive power of intervention outcomes.

The current study revealed that there are differences in the intervention outcomes of boys and girls. Over time, trauma symptoms showed significant decreases in attachment, but not in self-regulation, among girls, while the trauma symptoms showed significant decreases in self-regulation, but not in attachment, among boys. The trauma symptoms in the competency domain were significantly decreased in both girls and boys. Children's development largely takes place within their immediate or extended caregiving system, and traumatic experiences especially damage the primary attachment system. An impaired attachment system does not provide the trust or security needed for children to develop their ability to self-regulate. Studies demonstrate that girls display an easier access to emotions related to attachment experiences and expressed and developed more secure internal working models compared to boys (Choi et al., 2012; Shomaker & Furman, 2009). Girls may build a safe attachment system more easily through the intervention, which provides the foundation on which other developmental competencies are built. On the other hand, boys may achieve their development competencies by restoring their impaired self-regulation. A recent study reported a gender difference in a trauma related symptom fluctuation during TF-CBT intervention sessions (Ascienzo et al., 2021). In general, both girls and boys showed a significant decrease in their PTSD symptoms from baseline to termination of the intervention. However, there were significant gender differences during phases of treatment (Ascienzo et al., 2021). Future studies should include more assessments to investigate symptom fluctuation by gender during intervention, which may explain different paths to attain developmental competencies from baseline.

There are some limitations that must be noted in this study. First, the study did not use an experimental design or a comparison group, and this limits any causal inference. Second, the study used the ACE index derived from Felitti et al.'s (1998) operationalization. Although many studies have used this measure, emerging literature suggests to expanding the measure into more broad contextual domains (Leban & Gibson, 2020) including peer victimization, witnessing violence, low socioeconomic status, foster care, and experiencing discrimination (Cronholm et al., 2015; DeLisi et al., 2019; Finkelhor et al., 2015; Wade et al., 2016). There is still a lack of consistency in operationalization of ACEs, but future studies should consider a more expanded measure of ACEs in relation to the context of the study. Third, the study grouped total ACE score into 4+, 5+, 6+, 7 + and 8 + to examine the effects of different numbers of ACEs with an effort to find a potential threshold where a typical treatment intervention does not hold the effect. We acknowledge, however, that different ways of categorizing the total number of ACEs including groups of non-overlapping number of ACEs should be considered using a larger sample with high prevalence of multiple ACEs in future research. Also, this study did not distinguish different combinations of total number of ACEs. For example, the effect of an ACE score of 7 with 5 maltreatment and 2 family dysfunction events on risk behaviors or intervention outcomes could be different from the same score of 7 with 3 maltreatment and 4 family dysfunction events. Each type of ACE may be an equally important contributor to an individual's total ACE score, but some types of ACEs may be more closely related to specific behavioral health problems and its intervention outcomes. Future studies should examine whether different combinations or types of ACEs are more powerful at predicting certain outcomes than others, which may lead to weighting the importance of these experiences differently depending on study outcomes. Fourth, it may be natural that children's trauma symptoms fluctuate depending on age, and intervention effects may differ by age groups. Also, age is a proxy for years of exposure (Crouch et al., 2019) suggesting that the older the child, the greater the opportunity to experiences the events. For the purpose of the current study, age was controlled in the analyses, but future studies should consider including age in the analyses and examining the effects of different age groups on the study outcomes.

Implications and conclusion

Using the contemporaneous measure of ACEs, the current study examined the effects of ACEs on intervention outcomes. The study found that a trauma-informed intervention based on the ARC framework was effective in reducing children's trauma related symptoms until they experienced 6 or more ACEs. The intervention effect, however, did not hold when children's ACE were cumulated to 7 or more. The finding has significant implications for early detection and preventative intervention efforts on children's ACEs before their ACEs are further cumulated to higher number. It suggests that clinicians working with children with trauma exposure would have benefit from assessing ACEs not only at intake but also repeatedly over the course of intervention to monitor potential changes across children's systems, and special attention should be paid to those with high ACEs. The study also revealed that there were gender differences in intervention outcomes, which needs to be considered in intervention planning and monitored during the intervention process. Identifying sub-groups of children by considering numbers of ACEs and gender would have potential benefit

to formulating tailored intervention plans targeted toward those most likely to benefit.

Declarations

Conflict of interest The authors declare that they have no conflicts of interest.

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