An Exploration of Adverse Childhood Experiences and Post-Traumatic Stress Disorder in College Students

ACCEPTANCE

This dissertation, AN EXPLORATION OF ADVERSE CHILDHOOD EXPERIENCES AND POST-TRAUMATIC STRESS DISORDER IN COLLEGE STUDENTS , by BARBARA DURÁN, was prepared under the direction of the candidate's Dissertation Advisory Committee. It is accepted by the committee members in partial fulfillment of the requirements for the degree, Doctor of Philosophy, in the College of Education & Human Development, Georgia State University.

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AN EXPLORATION OF ADVERSE CHILDHOOD EXPERIENCES AND POST-TRAUMATIC STRESS DISORDER IN COLLEGE STUDENTS

by

Barbara Durán

Under the Direction of Dr. Kenneth Rice

ABSTRACT

The Center for Disease Control and Prevention (CDC) previously released a statement calling for researchers to undertake research initiatives that shed light on the effects of adverse childhood experiences (ACEs) on health and mental health outcomes and to work towards ACE prevention and treatment (Center for Disease Control and Prevention, 2020). ACEs have also been documented to predict symptoms of Post-Traumatic Stress Disorder (PTSD; Ferrara & Panlilio, 2020). One potential important implication of ACEs and PTSD is cognitive impairment. Extant literature suggests that experiencing ACEs predicts cognitive struggle. Aglan et al. (2010) demonstrated that individuals with a history of childhood sexual abuse displayed marked memory issues, and Malarbi et al. (2017) found that people with ACEs history had worse cognition than people who did not have a history of ACEs. Certainly, psychologists need to understand the effect of ACEs on college student experiences. In the present study, a meta-analysis was conducted to evaluate the association between ACEs and PTSD in undergraduate students. Further, this study investigates the measurement invariance of an extended ACEs measure, whether relational ACEs are more strongly associated with PTSD than non-relational ACEs, and relations between ACES, PTSD, grade point average (GPA), and working memory.

INDEX WORDS: ACEs, PTSD, college students, meta-analysis, measurement

AN EXPLORATION OF ADVERSE CHILDHOOD EXPERIENCES AND POST-TRAUMATIC STRESS DISORDER IN COLLEGE STUDENTS

by

Barbara Durán

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DEDICATION

For my sisters, Wynona, Janice, Karly, Kimmy, and Holly, with whom I lived these experiences. Your love, kindness, and resilience led me to this work, and your continued support and friendship sustain me. I am thankful to God for the blessing he gave me in my sisters. And to all my tiny clients and their families, past, present, and future – I am humbled by your vulnerability and honored by your trust. Thank you for allowing me to walk with you on your journeys. I dedicate my work to each of you.

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CHAPTER 1: ADVERSE CHILDHOOD EXPERIENCES PREDICT PTSD IN COLLEGE STUDENTS: A META-ANALYSIS

The Center for Disease Control and Prevention (CDC) previously released a statement calling for researchers to shed light on the effects of adverse childhood experiences (ACEs) on health and mental health outcomes and to work towards ACE prevention and treatment (CDC, 2020). ACEs are defined by the CDC as “potentially traumatic events that occur in childhood (0-17 years)” and include physical, emotional, and sexual abuse, physical and emotional neglect, and the following areas of household dysfunction: mental illness, domestic violence, divorce, incarceration of relatives, and substance abuse (Center for Disease Control and Prevention, 2020, para. 2). In the present study, we attempted to synthesize the existing ACEs literature and used meta-analysis to further understand the relation between ACEs and PTSD in college students.

Adverse Childhood Experiences

The study of ACEs can be traced back to at least 1995, when the CDC and Kaiser-Permanente (Felitti et al.,1998) began a longitudinal study of the relation between adverse childhood experiences and major health outcomes, including adult risk behavior, health status, and disease. Researchers defined ACEs as psychological, physical, or sexual abuse; violence against a child’s mother; or living with household members who abused substances, had mental illness, experienced suicidality, or were imprisoned. More than half of participants reported experiencing at least one ACE, and 25% of participants experienced two or more ACEs (Felitti et al., 1998). Analyses revealed a graded relationship between the number of ACEs and measured outcomes, such that experiencing a higher number of ACEs predicted worse health outcomes. Importantly, the study identified that for participants who experienced four or more ACEs, outcomes were four to 12 times worse (Felitti et al., 1998). Researchers suggested a model in which ACEs can lead to social, emotional, and cognitive impairment; these impairments may lead to the adoption of health-risk behaviors; risky behaviors can lead to disease, disability, and social problems; and these problems may lead to early death (Felitti et al., 1998). The CDC and Kaiser-Permanente's study illuminated the grave risk that early adversity presents and catalyzed an enormous effort to investigate the effects of ACEs across psychology, medicine, and public health.

Measurement Concerns

Although many researchers use the measure developed by the CDC and Kaiser-Permanente to measure ACEs (Felitti et al., 1998), ACEs research is littered with various measures of ACEs, which operationalize ACEs differently. For example, Kubany and colleagues (2000) developed the Traumatic Life Events Questionnaire (TLEQ) to assess prior trauma exposure. The TLEQ assesses both adult and childhood trauma, including childhood physical abuse, witness to family violence, childhood sexual abuse by someone at least 5 years older, childhood sexual abuse by someone close in age, and adolescent sexual abuse. The TLEQ is intended to capture traumatic events that align with the DSM-IV criteria for trauma (Kubany et al., 2000). Similarly, the Childhood Trauma Questionnaire (CTQ; Bernstein et al., 1994) captures emotional, physical, and sexual abuse in childhood, which aligns conceptually with the TLEQ's content. However, the CTQ additionally measures emotional and physical neglect in childhood (Bernstein et al., 1994). The Juvenile Victimization Questionnaire- Adult Retrospective – Short Form (JVQ – R2; Finkelhor et al., 2005; Hamby et al., 2004) asks adults to retrospectively report abuse victimizations from birth to age 17. In addition to abuses captured by the TLEQ and CTQ, the JVQ-R2 also captures property crime and peer/sibling victimization (Finkelhor et al., 2005;

Hamby et al., 2004). Whereas measures like the TLEQ, CTQ, and JVQ-R2 measure a wide array of adverse childhood experiences, measures like the Sexual Life Experiences Questionnaire (SLEQ; Finkelhor, 1993) assess for the presence of only one specific ACE, in this case, sexual abuse. These measures capture distinct adversities across different developmental timepoints, making them difficult to compare.

In addition to using different measures to conceptualize ACEs, the ACEs literature reveals several manners by which to calculate ACEs scores. For example, the CTQ (Bernstein et al., 1994) can be used to provide a sum score of all ACEs experienced by individuals, or subscales can be calculated to determine an individual's experiences with particular types of adversity (e.g., sexual abuse). Measures like the Life Experiences Questionnaire (LEQ; Sarason et al., 1978), however, can be used to evaluate the type, frequency, duration, and age of onset of the abuse, as well as whether the abuse was intra- or extrafamilial. These disparate manners of measuring ACEs-related concepts map onto conceptually different aspects of the ACEs construct (i.e., main effect versus moderators of ACEs) and introduce difficulty in interpreting ACEs literature.

Differences in ACEs Base Rates due to Systemic Racism

In addition to measurement concerns, the ACEs literature is riddled with contradictions, including the available evidence regarding who experiences more ACEs and the implications of those experiences for mental health outcomes. Turner and Lloyd (2003) found that a White sample reported more ACEs experiences than BIPOC samples, whereas other studies indicate that Black and Latinx communities (Dorvil et al., 2020; Forster et al., 2019; Sheats et al., 2018) experience more ACEs than White and Asian populations. To our knowledge, no research studies have examined a sample representing individuals from all major racial/ethnic groups in the United States, making it difficult to determine which groups may be at most risk for experiencing higher numbers of ACEs. Further potential factors that may affect one's likelihood of experiencing ACEs, include sex, socioeconomic status, and number and type of ACEs experienced (Dorvil et al., 2020; Petrucelli et al., 2019).

In addition to difficulty determining who is most at risk for experiencing ACEs, there are also conflicting findings regarding mental health outcomes associated with ACEs across racial/ethnic groups (i.e., are ACEs more harmful for certain groups). For example, Sheats et al. (2018) suggested that ACEs lead to similar negative mental health effects in Black and White samples, but that Black samples were more likely to experience more symptoms of physical illness. However, Dorvil et al. (2020) reported that Black people report lower levels of depression in association with ACEs when compared to White groups. We could not locate any study that did a comprehensive comparison of mental health effects of ACEs across racial/ethnic groups.

Importantly, Forster and colleagues (2019) noted that for racial/ethnic minoritized groups, low trust in institutions/systems stemming from a history of discrimination, poor quality care, and rising health care costs may prevent members of these communities from seeking help from providers, both while experiencing ACEs, as well as the consequences of ACEs (i.e., substance use). This may also lead to communities of color underreporting their experiences of ACEs and related mental health symptoms in some of the previously mentioned studies (e.g., Dorvil et al., 2020). A review of the ACEs literature may help to determine differences in ACEs experiences in racial/ethnic groups due to implications of systemic oppression and associated mental health disparities. It will also be useful to explore whether these studies have been done longitudinally and whether outcomes from cross-sectional studies versus longitudinal studies produce similar evidence, providing greater confidence in these findings. Further understanding differences in the experiences of ACEs across various demographic characteristics and their effect on mental health outcomes, especially Post-Traumatic Stress Disorder (PTSD), would be additive to the literature.

ACEs and PTSD

Despite potential issues with and varied approaches to ACEs measurement, ACEs have been demonstrated to predict important mental health and behavioral outcomes, including the development of PTSD. According to the DSM-5 (APA, 2013), PTSD is a potential response to actual or threatened death, serious injury, or sexual violence. The event, or Criterion A of the diagnosis, can be experienced directly, through witnessing the event, learned about later as having happened to a close friend or family member, or through repeated exposure. For PTSD to be present, an individual must experience a set of symptoms characterized by the following categories and must last more than one month after the event: intrusion, avoidance, negative alterations in cognition or mood, hyperarousal (APA, 2013).

This narrow definition of experiences that constitute a trauma required for a PTSD diagnosis is widely debated in the field of psychology, and prominent researchers suggest that non-life-threatening adversities, such as ACEs, can lead to the development of PTSD symptoms. We fall into this camp of belief, which is well-supported by PTSD experts. For example, Anders et al. (2012a) investigated both lifetime and recent exposure to Criterion A1 and non-Criterion A1 directly and indirectly experienced events in a sample of 1,084 college students. Findings suggest that 89% of the sample had experienced a Criterion A1 event, a staggering figure which aligns with the base rate of 90% of the population experiencing a trauma, according to the DSM-V (APA, 2013). Individuals who experienced a greater number of events had worse outcomes than individuals who experienced fewer events, with those directly experiencing events having even worse outcomes than people to whose close family members had these experiences (Anders et al., 2012a). Findings also revealed that community college students were at greater risk for psychopathology than students at a more traditional, and elite, Midwestern university. Perhaps the most surprising finding was that experiencing non-Criterion A events was associated with worse outcomes than experiencing Criterion A events, suggesting that, under certain conditions and doses, adversities may lead to greater levels of PTSD than DSM-aligned traumatic experiences (Anders et al., 2012a). Given the work of researchers like Anders and colleagues (2012), psychologists have learned in recent years that non-life-threatening events can, indeed, lead to PTSD symptoms, especially if the events are relationally laden (e.g., betrayal, breakups). Ferrara and Panlilio (2020) also document the strong positive relation between ACEs and PTSD. These studies, along with previous literature documenting the effect of adversity, not DSM-5 criterion traumatic events, shed light on the relationship between early adversity and the potential development of PTSD across the lifespan.

Psychologists have taken interest in the effect of ACEs on PTSD in college students for several reasons. First, evidence suggests that most college students have experienced at least one ACE, and specific subgroups of students (e.g., students of color) may experience even more ACEs (Dorvil et al., 2020). Second, when experiencing ACEs leads to PTSD, the symptoms of PTSD can interfere with cognition and negatively affect academic achievement. One group of researchers explored the relationship between exposure to ACES and academic barriers while controlling for physical health status, family difficulties, substance use, and depressive symptoms (Hinojosa et al., 2019). For students with higher ACEs, they were more likely to have academic barriers related to health and caregiving. Students with more ACEs were more likely to struggle with time management and reported not being compatible with their instructors current teaching style. Students with ACEs who met the criteria for depression were 49% more likely to have academic barriers (Hinojosa et al., 2019).

Indeed, an important starting point to understand the effect of ACEs on college student PTSD symptoms would be a thorough, systematic review. However, relatively few efforts have been made to synthesize this extensive literature, especially as it relates to college students of color, a group for whom inconsistencies in the frequency and effects of ACEs have been reported (Forster et al., 2019). Sahle and colleagues (2021) reviewed the evidence on key ACEs that contribute to increased risk of anxiety disorders, internalizing disorders, depression, and suicidality. Findings revealed that ACEs were associated with increased risk of anxiety, internalizing disorders, depression, and suicidality. Gender differences did not emerge (Sahle et al., 2021), despite previous studies (Schonfelder et al., 2019) finding sex differences in the experience of specific ACEs (e.g., childhood sexual abuse). Although Sahle and colleagues (2021) reviewed the literature on ACEs and depression in college students, no reviews, to our knowledge, have been conducted to map more extensive mental health outcomes in college samples as they relate to ACEs. Especially surprising is the lack of review on the relation between ACEs and PTSD for college students, given that trauma symptoms (Ferrara & Panlilio, 2020) and ACEs (Hinojosa et al., 2019) predict academic struggles. It is vital to study the effects of mental illness in college students to mitigate their potentially harmful effects on academic success. Missing, too, is an intersectional approach to understanding the complex interaction between race and socioeconomic status and their association with ACEs and ACE-related outcomes, as indicated by Sheats et al. (2018)

The Present Study

Thus, the present study addresses this gap in the literature by conducting a meta-analysis of the relation between ACEs and PTSD in undergraduate samples. Given previous research, we examined potential moderating factors of the relation between ACEs and PTSD, including race, sex, measures of SES, and manners of measuring ACEs. We worked to include longitudinal research studies in the analysis. Research questions include: 1) What is the association between ACEs and PTSD in undergraduate students? 2) Is this association moderated by race, sex, markers of SES, type, duration, severity, and/or frequency of ACE? This study has the potential to inform university policies and college counseling centers by helping to identify the potentially harmful effects of ACEs on college students and which college students may be at most risk. The present research is particularly additive to the literature in its exploration of race, sex, and SES as potentially moderating factors of the association between ACEs and mental health outcomes, given that Black individuals (Forster et al., 2019), women (Sheats et al., 2018), and people with lower socioeconomic status (Sheats et al., 2018) may be at greater risk for ACEs and, therefore, potentially at risk for greater mental illness in a stressful college setting.

We hypothesized that there would be a strong relation between ACEs and PTSD in college students. Further, we hypothesized that the relation between ACEs and PTSD would be stronger for women (Schonfelder et al., 2019), communities of color (Forster et al., 2019), people from low socioeconomic backgrounds (Sheats et al., 2019), and individuals who experienced relational abuse (e.g., sexual abuse, emotional abuse) (Anders et al., 2012b). Additionally, we hypothesized that the relation between ACEs and PTSD would be stronger for college students who experienced more frequent, more severe ACEs (Frazier et al., 2009).

Problem, Intervention, Comparison or Control, and Outcome (PICOS) Framework

To refine our research aims, we utilized the PICOS framework. Our review focused on examining articles that collected data from college students. We excluded other groups who may experience PTSD (e.g., veterans, first responders) because previous meta-analyses have been conducted for those groups (e.g., Kyron et al., 2021) and because college students are likely to have experienced a high number of ACEs (Forster et al., 2019), especially students of color (Dorvil et al., 2020). ACEs was chosen as the independent variable of interest due to their enormous importance across many outcomes (Felitti et al., 1998). We chose PTSD as an outcome measure because, although there appears to be a relation between ACEs and PTSD, extant literature reveals several discrepant beliefs regarding who experiences the most ACEs and worst outcomes in relation to ACEs. Given that PTSD interferes with cognition (APA, 2013; Ferrara & Panlilio, 2020) and, therefore, cognitive abilities, it is vital that research examines the relationship between ACEs and PTSD in college students and provide recommendations to prevent students with ACEs histories from struggling in university settings.

METHOD

Eligibility Criteria

To be included in the review, studies must have a) used quantitative research methods to collect and analyze empirical data, b) conducted research with undergraduate students, c) administered a measure of ACEs or an ACE-related concept (e.g., child sexual abuse instead of the sum of all ACEs), and d) included a measure of PTSD, as defined by the DSM-4 or DSM-5.

Literature Search Procedure

ACEs have been studied across various fields, including psychology and medicine. Thus, the APA *Psyc*INFO and MedLine database was used to find eligible studies to include in this review. Given the importance of including gray, or unpublished, materials in meta-analysis to avoid publication bias (Cooper, 2017), we also searched the ERIC and ProQuest dissertation database for dissertations that met the present search criteria. We used the following search terms for APA *Psyc*INFO: (“childhood adversity” or aces or “adverse childhood experience*” or “childhood trauma” or “child* abuse” or “child* neglect”) AND (ptsd or posttraumatic stress or post-traumatic stress disorder or posttraumatic stress disorder or post-traumatic stress disorder) AND (college students or university students or undergraduates or “post-secondary student*”). For MedLine, the following terms were used: (adverse childhood experiences or aces or child abuse or child neglect, or childhood trauma) AND (stress disorders, post-traumatic or ptsd) AND students. Finally, we used the following search terms for ERIC: (adverse childhood experience OR ACE OR early experience OR child neglect OR child abuse) AND (posttraumatic stress disorder OR trauma) AND (college students OR undergraduate students). After accounting for duplicate articles that appeared across multiple searches, this search revealed 281 relevant research studies to be included in the present meta-analysis. To further our attempt to include gray materials, we emailed every author who appeared at least twice as a lead author in our overall literature search (n = 12) and requested unpublished research studies that would meet study criteria. Although we received five replies, no authors were able to provide further materials for the present study, and we did not receive a reply from seven of the authors.

Screening Process

We used Abstrakr (Wallace et al., 2012), which uploads publication titles and abstracts, to screen the titles and abstracts of the literature that emerged from the initial search. Titles and abstracts were double-screened by the lead author and the fifth and sixth authors using a four-item screening questionnaire assessing the eligibility of the study for the meta-analysis (Appendix A). Quantitative studies conducted with undergraduate students that measured ACEs or a related concept and measured PTSD were included for full-text review. Using Abstrakr, we coded eligible studies as “1” and ineligible studies as “-1.” When we were unsure about a study’s eligibility, we coded the study as “0.” After completing the initial abstract screening, the lead author met with research assistants to discuss inconsistencies in our codes until we reached a consensus about the article's eligibility. A total of 160 studies were excluded after the initial screening, leaving 121 studies eligible for full-text review.

Next, we downloaded electronic copies of all works eligible for the present meta-analysis. One article could not be included due to unavailability. After retrieving full-text copies of each document, we developed and utilized a spreadsheet to complete a full-text screening of potentially eligible studies. The lead author gathered information across the following categories: First author name, the year the study was published, the title of the report, whether the study was quantitative (0 = No; 1 = Yes), whether the study was conducted with college students (0 = No; 1 = Yes), whether the study included an ACEs measure (0 = No; 1 = Yes), whether the study included a PTSD measure (0 = No; 1 = Yes), and whether the study provided the correlation coefficient of the relation between ACEs and PTSD (0 = No; 1 = Yes). Studies that met all eligibility criteria received a code of “1” and studies that did not meet criteria were coded “0”. A total of 82 studies were excluded based on the full-text screening, leaving 34 studies to be included in the final meta-analysis.

Coding Strategy

We developed and utilized a coding sheet to extract relevant data and information from each eligible study. The coding sheet included items that aimed to capture report characteristics, population and study characteristics, information about ACEs and PTSD (see Appendix B). For report characteristics, we documented the name of the first author, publication year, report type, whether the study was peer-reviewed, whether the study was funded, whether the study reported a power analysis, whether the study was cross-sectional or longitudinal, descriptive or experimental, and whether the study reported reliability statistics (i.e., Cronbach's alpha) for study variables of interest. These data were used to examine whether the findings were influenced by publication bias. For population and settings, we documented information on the country in which the study was conducted and demographic information about the participants in the study (e.g., sample size, percentage of women, percentage of minoritized racial/ethnic groups, whether the study collected SES information, and mean age). This information was used to contextualize the results of the meta-analysis and to assess the generalizability of findings.

Further, we collected information about the ACEs construct in each report. We documented the name, authors, and internal consistency of the measure used to examine ACEs. Similarly, we extracted the same information for PTSD-related measures. Finally, we recorded the correlation coefficient between ACEs and PTSD with the associated sample size.

Proposed Analysis Strategy

This study explores the association between ACEs and PTSD in college students. Our review revealed that many of the studies included in the full-text review analyzed the relationship between these two constructs using measures or items that correspond to a rating scale, including the Child Abuse Trauma Scale (CAT; Barlow, 2017), the Traumatic Life Events Questionnaire (TLEQ; Berenz et al., 2018), and the Childhood Trauma Questionnaire (CTQ; Carroll, 2014; Jeter & Brannon, 2014). The correlation coefficient was determined to be the appropriate statistic to calculate an effect size index to examine the relationship between ACEs and PTSD in college students.

The correlation coefficient collected from articles was transformed to Fisher's Z using the Metafor package in R (RStudio Team, 2020). We used a random effects model (REML) to account for the expected variation in effect sizes that may be influenced by sampling, measurement, and study design differences (Cooper, 2017). Robust variance estimation (RVE) methods was used because RVE provides a way to include all dependent effect sizes in a single meta-regression model, even when the exact form of the dependence is unknown, which is relevant in the current study because we included multiple effects from the same studies (Pustejovsky & Tipton, 2021). Thus, RVE inflates the standard error of the model to account for not knowing the true correlation of the effect sizes from the same study. Additionally, RVE was determined to be appropriate because we included studies that used various measures of ACEs and various measures of PTSD. After calculating the mean effect size, we transformed Fisher's Z back to the correlation metric to interpret study results.

Heterogeneity

To explore variance in effect sizes, we used a random effects model and tested whether tau-squared was significantly different from zero. Heterogeneity between our effect sizes may likely be influenced by population characteristics. For example, the country in which the study was conducted, the measure used to capture either ACEs or PTSD, or the mean age of the sample could contribute to variation across study effect sizes. To address our secondary research aim, we explored several moderators (e.g., sex, race, markers of SES, type, duration, severity, and/or frequency of ACE) using meta-regression. Given that numerous studies from the literature review measured a specific type of ACE, a separate meta-analysis was conducted using a random effects model to test the relation between ACEs as measured in these studies and their respective PTSD measures. We explored the type of ACE, whether the ACE was relational, sex, and race as potential moderators of this relation.

Publication Bias

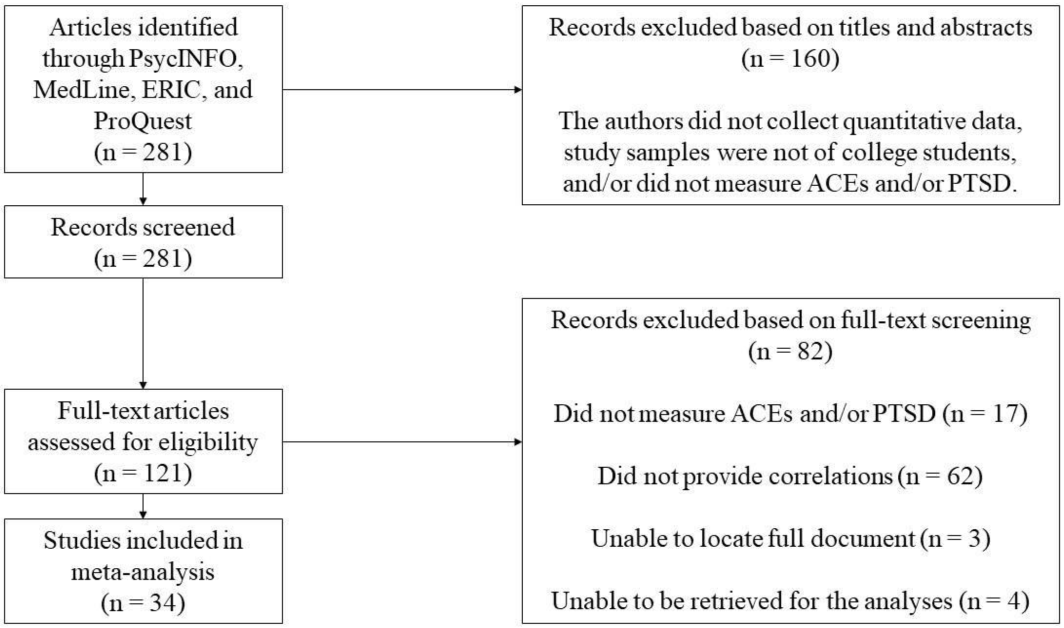
To assess for publication bias, we generated a funnel plot of the study effect estimate (Cooper, 2017). In the absence of publication bias, we would expect the plot to look like an inverted, symmetrical funnel, whereas an asymmetrical plot would indicate publication bias.

RESULTS

A literature review identified 281 potential studies for the present analysis. After removing duplicates, screening abstracts, and conducting a full-text review, we identified a total of 34 studies that are presented in the following sets of meta-analyses. Figure 1 provides a visual depiction of the literature review and screening process.

Figure 1.

PRISMA chart of screening process for meta-analysis



Study Characteristics

Figure 2.

Qualitative description of studies included in meta-analysis. N = 39

ACEs

Studies measured ACEs in several ways:

- Total sum of various kinds of ACEs (n = 12)
- Specific kind of ACE (e.g., sexual abuse) (n =19)
- Duration, severity, frequency, age of onset (n = 4)

PTSD

Studies measured PTSD in several ways:

- Overall PTSD measure (n = 28)
- Hypervigilance/hyperarousal (n = 5)
- Reexperiencing (n = 5)
- Avoidance (n = 5)
- Negative mood and cognition (n = 2)

Sample

Studies were conducted in the following countries:

- United States (n = 28)
- Spain (n = 1)
- South Africa (n = 1)
- Israel (n = 2)
- Italy (n = 2)

Figure 2 provides a brief description of the sample and study constructs, as measured across articles included in the meta-analysis. For an extensive description of the articles, please see Appendix C. The average study sample size was large (*n* = 632), a seemingly robust number to run a Pearson's correlation, according to G*power (Faul et al., 2007), which indicated *n* = 115 as a reasonable sample size by which to detect a Pearson's correlation of 0.3 (a moderate correlation). Study years ranged from 2005-2021, indicating that the study results reflect recently collected data. A total of 15 self-report measures were used to capture ACEs, whereas a total of 13 self-report measures were used to capture PTSD. Studies varied in the type of measure used to assess ACEs. Specifically, 12 studies assessed for a variety of ACEs and created an ACEs sum score. Further, 19 studies assessed a specific type of ACE, and four studies examined the duration, severity, frequency, or age of onset/end of experienced ACEs. For PTSD, 28 studies calculated a PTSD score capturing at least two criteria from the DSM-4 or DSM-5, five studies reported hypervigilance scores, five studies reported avoidance scores, and two studies reported negative mood and cognition scores. Of the studies included in the meta-analysis, 33 were published in peer-reviewed journals, and one of the studies was part of a doctoral dissertation (i.e., gray material).

Importantly, none of the studies included examined demographic characteristics using an intersectional framework, and the number of studies included did not allow for sufficient power to create interaction terms to examine the intersection of race and sex variables. All studies were correlational, cross-sectional, and descriptive, except for two studies, one of which was experimental, and the other was experimental and longitudinal. Only three studies reported results from power analyses. Surprisingly, only 14 studies reported a measure of SES. Due to limited data and highly variable approaches to measuring SES across studies with an SES measure, SES was not included as a moderating variable in the present study.

Table 1 represents descriptive statistics for demographic study variables across the three types of ACEs studies: studies that measured an ACE sum score, studies that measured a specific type of ACE, and studies that measured frequency, duration, severity, age of onset, and/or age of the end of the abuse. Means for this table represent the average percentage of a particular demographic category reported for the type of study. For example, on average, 7.43% of individuals that participated in studies that utilized an ACEs sum score identified as Black.

Table 1.

Descriptive Statistics of Demographic Variables across Studies Measuring ACEs Sum, Type of ACE, and Duration, Severity, Frequency, and Age of Onset of ACE.

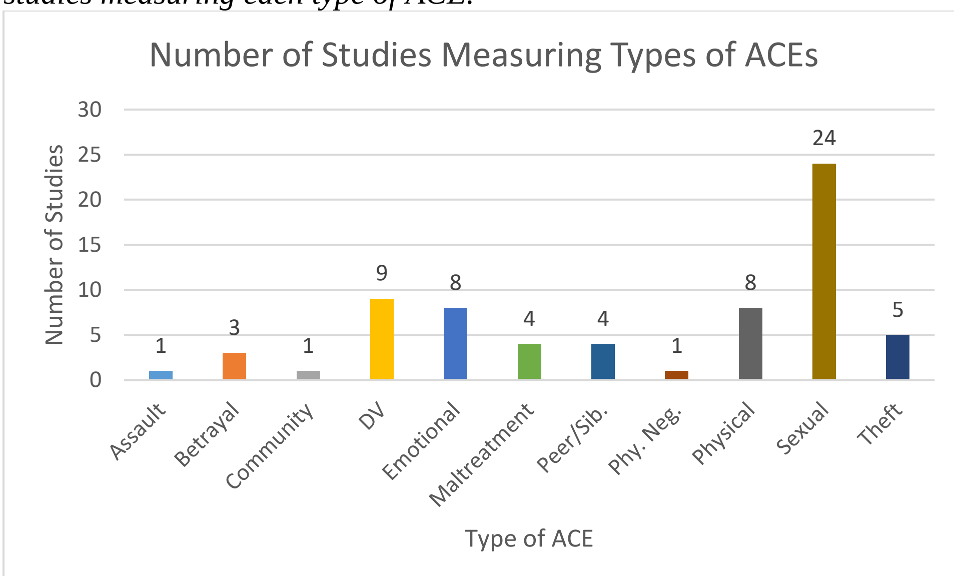
Variable	ACEs Sum		Type of ACE		Duration, Severity, Frequency, Intensity, Age of Onset	
	M	SD	M	SD	M	SD
% Black	7.43	8.98	13.04	12.35	19.81	6.46
% Birac	3.00	2.65	4.21	3.38	2.83	4.83
% Latinx	6.35	5.50	10.72	22.84	8.83	4.07
% Asian	4.72	5.16	5.90	5.59	9.64	7.14
% Native	1.57	1.35	0.17	0.44	0.00	0.00
% Other	13.68	32.50	8.11	19.86	2.55	1.23
% White	64.22	27.62	66.80	24.18	60.14	11.69
% Women	75.25	15.96	76.96	21.21	98.41	6.64
Age	19.78	1.24	20.24	1.56	19.14	0.25
Sample Size	347.47	182.59	471.16	302.36	1095.33	11.69

Of the effect sizes extracted from studies that measured a specific type of ACE, 39 effect sizes were coded as “Relational” ACEs. We also examined the type of ACEs studied across 19 studies that examined specific types of ACEs (e.g., measured sexual abuse, not sum of ACEs). Of the 68 available effect sizes extracted from these studies, 24 (35%) of the studies measured childhood sexual abuse, 9 (13.2%) measured exposure to domestic violence, 8 (12.5%) measured emotional abuse, and 8 (12.5%) measured physical abuse. The remaining 26 (76%) studies measured experiences of assault, betrayal, community violence, maltreatment, peer/sibling victimization, physical neglect, and exposure to theft and other crimes. It appears that there is limited variability in the types of ACEs studied, such that sexual abuse is studied almost three times more frequently than the next most studied ACE, exposure to domestic violence. Given the present research question (do ACEs predict PTSD in college students?) and the methods by which studies in the present sample measured ACEs, we conducted three separate meta-analyses:

an analysis of the *Sum of ACEs on PTSD*, an analysis on the *Type of ACE on PTSD*, and an analysis on *Sexual Abuse ACEs on PTSD*. To determine whether studies measuring PTSD as a sum score or merely specific symptoms of PTSD (e.g., reexperiencing) yielded different mean effect sizes, we ran each meta-analysis separately for samples with PTSD sum scores and samples with PTSD specific symptoms scores. Findings suggested very similar mean effect sizes across ACEs Sum studies, Type of ACE studies, and Sexual Abuse ACE studies; therefore, we reported the results with all studies measuring PTSD sum scores.

Figure 3.

Number of studies measuring each type of ACE.



Distribution of Effect Sizes for ACEs Sum Studies

The first meta-analysis examined the relation between ACEs sum scores and PTSD symptoms in college students. Using an RVE model, analyses revealed a mean effect size estimate of 0.36 for Pearson's r (p < 0.0001; SE = 0.04; CI: [0.34, 0.46]; PI: [0.21, 0.59], df = 9.74). Tau^2 was statistically different from zero, (I^2 = 76.09%; Tau^2 = 0.0094; Q = 60.28, p < 0.0001).

Figure 4.

Forest plot of effect sizes included in meta-analysis of ACEs Sum and PTSD. N = 15

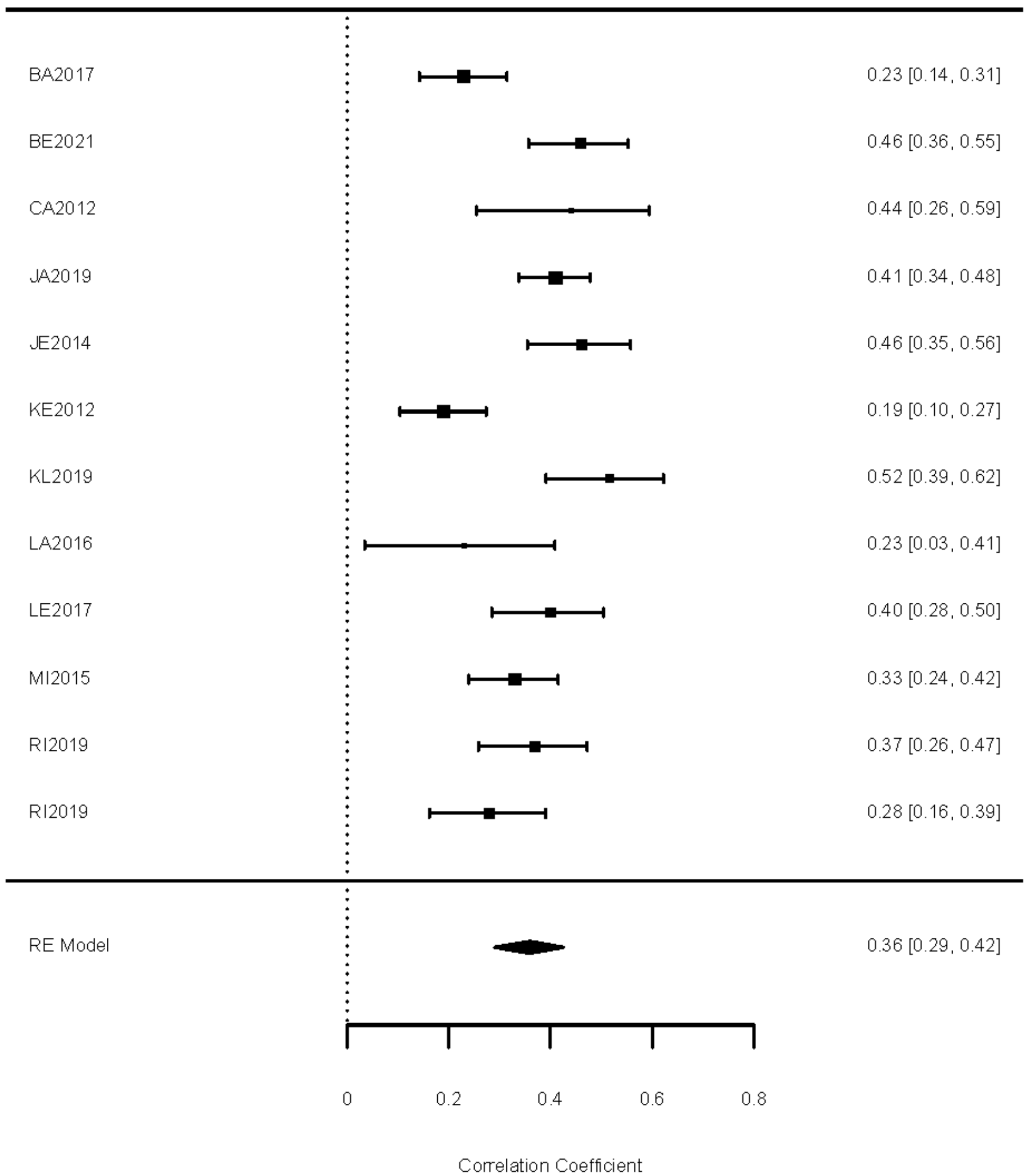


Figure 4 provides a forest plot to aid in visualizing the distribution of effect sizes included in the meta-analysis, which reflects Pearson's rs for each study using the RVE model. All effect sizes included in the analyses were significant (i.e., all studies fall to the right of the dotted line). Upon visual inspection, effect sizes appear to cluster around the 0.4 marking. The forest plot points to a large effect size (0.40) (Funder & Ozer, 2019). No evident outliers emerged via visual inspection of the forest plot for this meta-analysis.

Meta-Regression for ACEs Sum Studies

We used meta-regression to determine whether sex or race moderated the relation between ACEs sum scores and PTSD symptoms. Using a series of correlated effects models, analyses revealed that % White and % non-White, for the studies included in the meta-analysis, did not provide sufficient variability (i.e., variables were highly homogenous) and therefore could not be included as moderators. The percentage of female participants was sufficiently heterogeneous to include as a moderator, but it did not significantly moderate the relation between ACEs Sum score and PTSD.

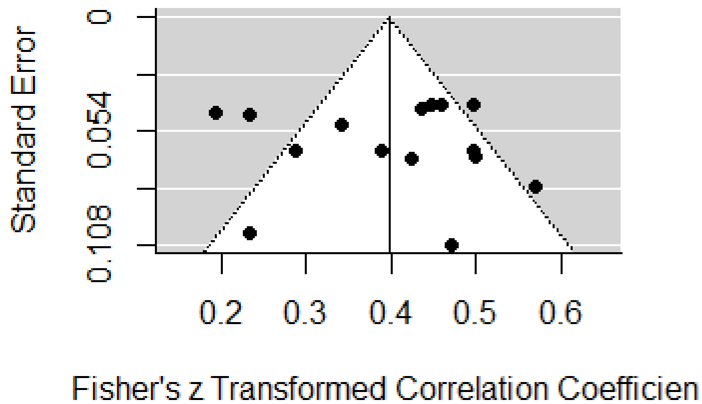
Publication and Reporting Bias for ACEs Sum Studies

Given that most of ACEs Sum studies were published journal articles (two were dissertations) and the forest plot revealed that all effect sizes were statistically significant, we generated a funnel plot (Figure 5) to explore potential publication bias. Large gaps are visible in the funnel plot, indicating that publication bias is likely present (Cooper, 2017).

Figure 5.

Figure 5.

Funnel plot of study effect sizes included in meta-analysis of ACE Sum Scores and PTSD symptoms



Distribution of Effect Sizes for Type of ACEs Studies

A second meta-analysis examined the relation between Type of ACEs scores and PTSD symptoms in college students. Using a Robust Variance Estimation (RVE) model, analyses revealed a mean effect size estimate of 0.25 for Pearson's r ($p < 0.0001$; SE = 0.03; CI: [0.21, 0.27]; PI: [0.00, 0.48]; df = 14.9). Tau^2 was statistically different from zero, ($I^2 = 87.34\%$; $Tau^2 = 0.01$; Q = 525.03, $p < 0.0001$).

Figure 6.

Forest plot of effect sizes included in meta-analysis of Type of ACEs and PTSD. N = 68

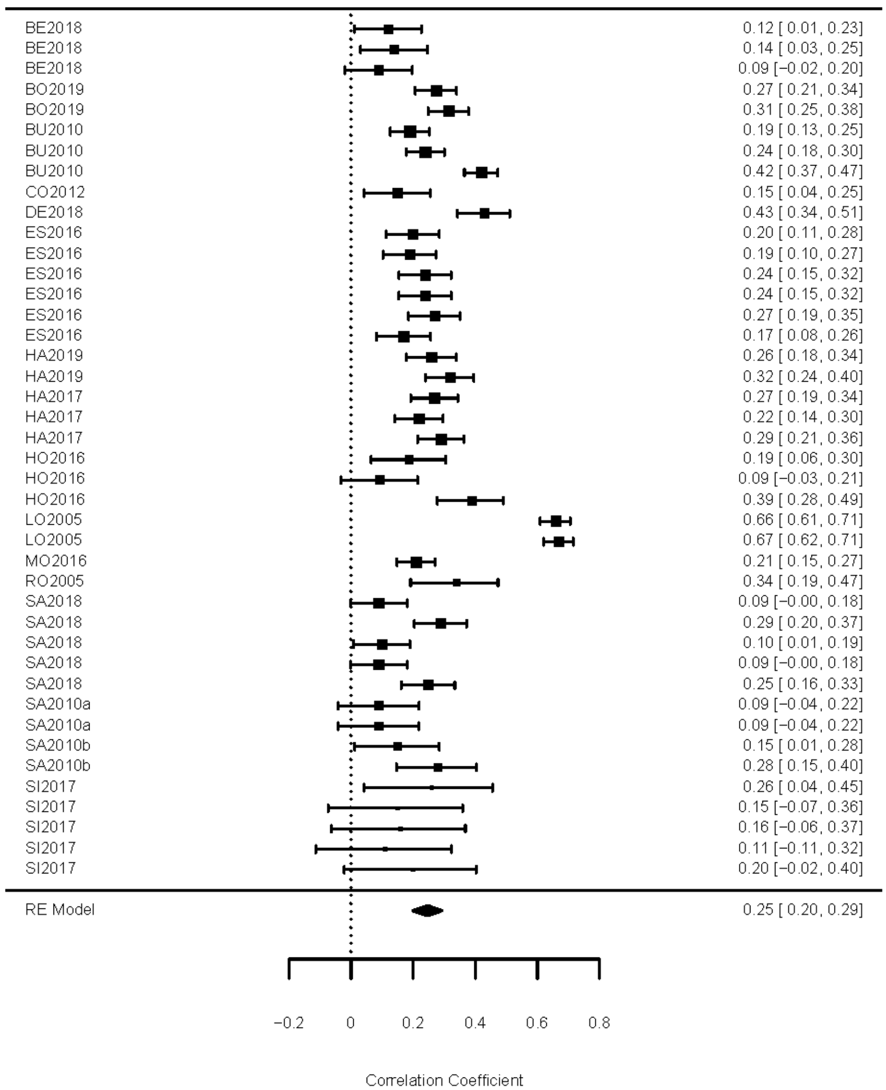


Figure 6 provides a forest plot to aid in visualizing the distribution of effect sizes included in the meta-analysis, which reflects Pearson's rs for each study using the RVE model. All effect sizes included in the analyses appear to be significant (i.e., all studies fall to the right of the dotted line). Upon visual inspection, effect sizes appear to cluster around the 0.2 marking. The forest plot points to a medium effect size (0.24) (Funder & Ozer, 2019). However, the study by Lock yielded two effect sizes of .79 and .81, which may indicate this study as an outlier.

When the Lock study is excluded, meta-analysis yields a mean effect size of 0.23 ($p < 0.0001$; PI: [.09, .36]; CI: [0.21, 0.25]). Thus, the mean effect size only changes slightly when excluding the Lock study and was included for the remainder of the analyses.

Meta-Regression for Type of ACEs Studies

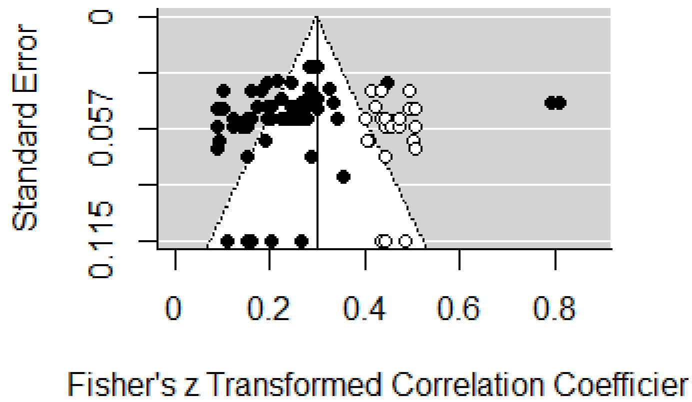
We used meta-regression to determine whether sex or race moderated the relation between type of ACEs and PTSD symptoms. Additionally, we explored whether relational ACEs (e.g., emotional abuse) served as a moderator in the model. Using a series of correlated effects models, analyses revealed that for the % White and % non-White variables, the studies included in the meta-analysis did not provide sufficient variability and therefore could not be included as moderators. Sex did not moderate the relation between type of ACE and PTSD. Interestingly, meta-regression revealed a possible trend effect for the relation between type of ACEs and PTSD ($df = 16.8$, $p = 0.08$), such that there was possibly a stronger association between relational ACEs and PTSD than for non-relational ACEs.

Publication and Reporting Bias for Type of ACEs Studies

Given that all the Type of ACEs studies were published journal articles and the forest plot revealed that all effect sizes were statistically significant, we generated a funnel plot (Figure 7) to explore potential publication bias. Large gaps are visible in the funnel plot, indicating that publication bias is likely present (Cooper, 2017), in the positive direction (e.g., the average effect size of studies of ACEs and PTSD may have overinflated, overly positive effect sizes). The funnel plot also makes easily visible two studies that may be outliers, located at the 0.8 correlational mark.

Figure 7.

Funnel plot of study effect sizes included in meta-analysis of Type of ACEs Scores and PTSD symptoms



Distribution of Effect Sizes for Sexual Abuse ACEs Studies

A third meta-analysis examined the relation between Sexual Abuse ACEs scores and PTSD symptoms in college students. Using a Robust Variance Estimation (RVE) model, analyses revealed a mean effect size estimate of .27 ($p < 0.0001$; SE = 0.06; CI: [0.18, 0.33]; PI: [-0.09, 0.60]; df = 11.9). Tau^2 was statistically different from zero, ($I^2 = 94.79\%$; $Tau^2 = 0.03$; Q = 382.32, $p < 0.0001$).

Figure 8.

Forest plot of effect sizes included in meta-analysis of Sexual Abuse ACEs and PTSD symptoms. N = 24

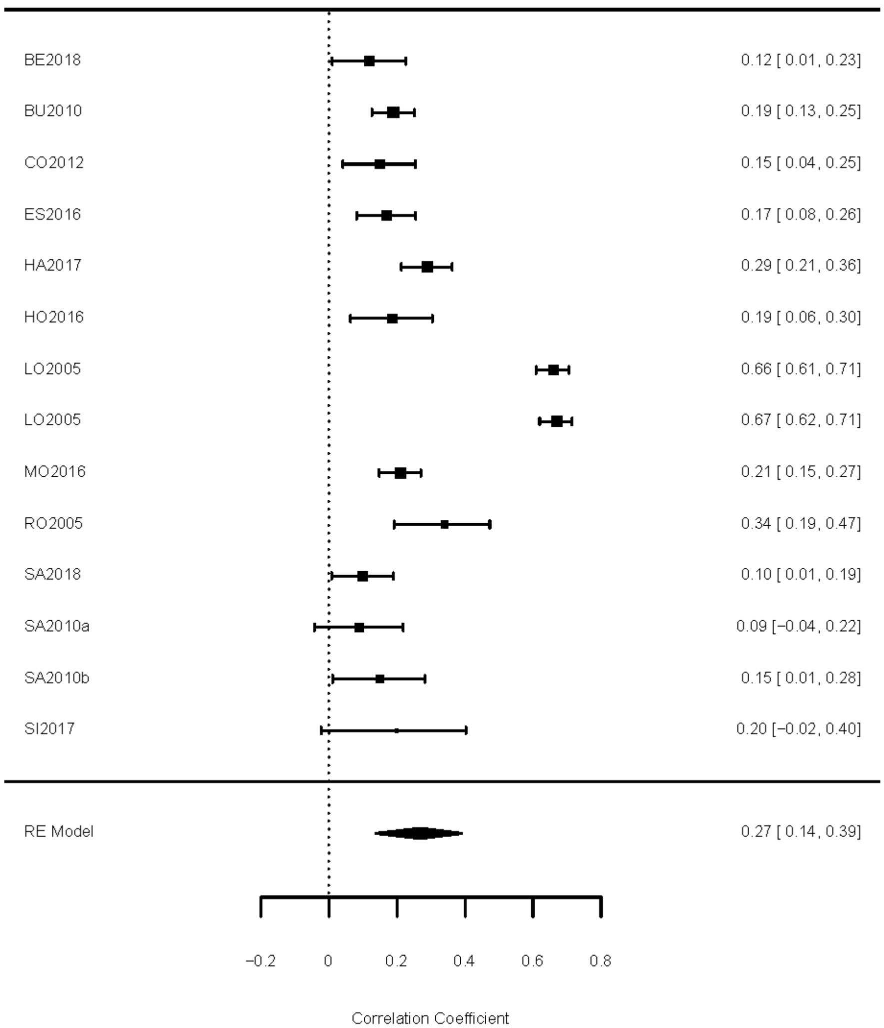


Figure 8 provides a forest plot to aid in visualizing the distribution of effect sizes included in the meta-analysis, which reflects Pearson's rs for each study using the RVE model. All effect sizes included in the analyses appear to be significant (i.e., all studies fall to the right of the dotted line). Upon visual inspection, effect sizes appear to cluster around the 0.2 marking. The forest plot points to a medium effect size (0.26) (Funder & Ozer, 2019). However, the study by Lock yielded two effect sizes of .79 and .81, which may indicate this study as an outlier.

When the Lock study is excluded, meta-analysis yields a mean effect size of 0.21 ($p < 0.0001$; PI: [.10, .32]; CI: [0.18, 0.24]. Thus, the mean effect size drops only slightly without the Lock study and is included in the remainder of the analyses.

Meta-Regression for Sexual Abuse ACEs Studies

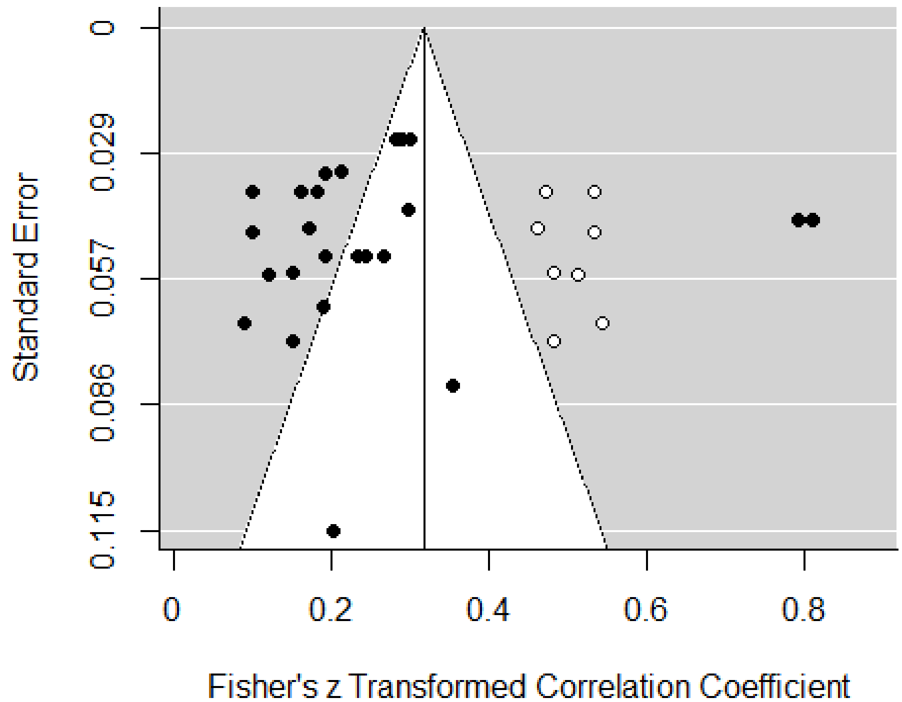
We used meta-regression to determine whether sex or race moderated the relation between Sexual Abuse ACEs and PTSD symptoms. Using a series of correlated effects models, analyses revealed that for the % White and % non-White variables, the studies included in the meta-analysis did not provide sufficient variability (i.e., this variable was too homogenous) and therefore could not be included as a moderator. The sex variable was sufficiently heterogenous to include as moderators but did not moderate the relation between type of ACE and PTSD.

Publication and Reporting Bias for Sexual Abuse ACEs Studies

Given that all the Sexual Abuse ACEs studies were published journal articles and the forest plot revealed that all effect sizes were statistically significant, we generated a funnel plot (Figure 9) to explore potential publication bias. Large gaps are visible in the funnel plot, indicating that publication bias is likely present (Duval & Tweedie, 2000a, 2000b). The funnel plot also makes easily visible two studies that may be outliers, located at the 0.8 correlational mark.

Figure 9.

Funnel plot of study effect sizes included in meta-analysis of Sexual Abuse ACEs Scores and PTSD symptoms



DISCUSSION

The present set of meta-analyses revealed several important characteristics about the college students with whom ACEs studies have been conducted. First, ACEs studies are measured in one of three ways: Authors assess for and calculate an ACEs sum score; authors assess for and calculate a score for a specific type of ACE; or, authors assess severity, duration, frequency, age of onset, or the age of ending of the ACE. These methods of measuring ACEs assess seemingly different constructs (e.g., complex adversity, specific adversity, or moderators of adversities experienced). However, authors of these articles often frame their findings as a reflection of the effect of ACEs on PTSD in college students. Further, the present study revealed that this literature is conducted with predominantly White women. Such little variability existed in study samples that meta-regression was unable to be conducted and, therefore, we could not examine potential moderating effects of sex or race on the model. Given that evidence suggesting people of color experience the highest number of ACEs (Forster et al., 2019) and significant mental illness due to the effects of systemic oppression (Goldstein et al., 2019), researchers must take these results as a call to action to shed light on the effects of ACEs on communities of color, persons who have low-income/ are economically marginalized, and persons who identify as women or potentially neglect those for whom the association between ACEs and PTSD is strongest and most negatively impactful. The present study also revealed that none of the samples of studies used an intersectional approach to studying demographics, very few studied any measure of SES, and most are cross-sectional and correlational, making it difficult to make causal claims.

Three meta-analyses were conducted in the present study. A stronger association was found between ACE sum scores and PTSD ($ES = 0.38$, $p < 0.0001$) than for type of ACE and PTSD ($ES = 0.28$, $p < 0.0001$). When translated back to an average correlation coefficient, a correlation of 0.36, PI: 0.17, 0.58 emerges for ACEs sum score and PTSD. An average correlation coefficient of 0.27, PI: -0.05, 0.55 emerges for the type of ACE and PTSD. These findings suggest that, although both relationships with PTSD are significant and positive, the relation between collective ACEs and PTSD is stronger than the same relation for the type of ACE. More simply, accounting for a broad range of ACEs experiences better explains PTSD symptoms in college students than does measuring one type of ACE, such as sexual abuse. This finding appeared to replicate results from when sexual abuse studies were isolated and analyzed, finding a similar correlational effect between sexual abuse and PTSD ($r = 0.25$) as found for specific types of ACEs and PTSD ($r = 0.27$). The similar and lower correlation coefficient found for the type of ACEs and sexual abuse ACEs compared to the sum of ACEs studies and PTSD seems to further suggest we miss an important part of the adversity story when we only measure specific, not collective ACEs. Practically speaking, studies that measure only sexual abuse simply do not capture important parts of an individual's adversity experiences, such as parental divorce, peer victimization, and so forth.

Due to the design of the studies included in the meta-analyses, these findings are correlational, not causal, such that experiencing more ACEs does not necessarily cause more symptoms of PTSD. Similarly, these results are not directional in that sum and type of ACEs do not necessarily predict PTSD. Notably, studies included in the meta-analyses indicated that they believed that ACEs predict PTSD, and not that PTSD predicts ACEs. The present study is additive to the literature in that it provides evidence to suggest a strong, positive correlation between the sum of ACEs and PTSD in college students, which is stronger than the positive relation between type of ACEs and PTSD and sexual abuse and PTSD. Recall that ACEs sum scores were calculated by summing the number of total ACEs experienced, whereas other studies only measured specific types of ACEs, and an overwhelming number of these studies only measured sexual abuse. Therefore, the present meta-analysis reveals the importance of measuring all types of ACEs to fully understand an individual's potential for the development of PTSD.

These findings may be understood in several ways. First, the stronger association between the sum of ACEs and PTSD in college students may indicate that in measuring specific types of ACEs, researchers do not sufficiently capture the full risk of potential complex trauma and, therefore, an individual's true risk for experiencing PTSD. This finding aligns with work by

Frazier and colleagues (2009), which found that experiencing a higher number of traumas leads to greater levels of distress. However, it is also possible that further analyzing each type of ACE, not just sexual abuse, may have yielded higher mean effect sizes than sexual abuse, and that some types of ACEs may have stronger associations with PTSD than others. For example, the present study found that relational ACEs, or ACEs with a seemingly stronger relational component, may have a stronger association with PTSD than non-relational ACEs. Although this finding was not significant, it did suggest a possible trend effect. The notion that relational ACEs may be more strongly associated with PTSD than non-relational ACEs aligns with the work of Anders et al. (2012b), which found that college students who experienced relationship-related stressors led to high levels of PTSD, over and above Criterion A traumas from the DSM-5. Further, studies of betrayal trauma have found that high betrayal traumas have a stronger association with symptoms of PTSD than do low betrayal traumas (Boyraz et al., 2019). Although the present study did not identify relational ACEs as significantly more associated with PTSD than non-relational ACEs, a possible trend effect and extant literature suggest that further studies should be conducted to examine the effect of relational ACEs on PTSD in college students.

In exploring heterogeneity, we found the effect sizes of the present studies to be quite heterogeneous, as evidenced by the significant I^2 statistic. Specifically, for ACEs sum studies, type of ACEs studies, and sexual abuse studies, 76.09%, 87.34%, and 94.79% of the variation across studies is due to heterogeneity, rather than chance. These high levels of heterogeneity may be explained by moderating factors or publication bias. However, due to the demographic homogeneity of the samples included, SES was unable to be included as a moderator, and sex and race were not significant in the meta-regressions. Due to the high level of heterogeneity, the mean effect size is not an appropriate description of the overall effect size. This evidence suggests that further moderators may be important to explore, which may explain why outliers appear across the forest plots for the type of ACEs and sexual abuse on PTSD.

One study emerged as an outlier across two of the meta-analyses. Lock et al. (2005) conducted a measurement study on the Sexual Abuse Questionnaire (SAQ). Correlations between the SAQ and a measure of PTSD were 0.66 and 0.67, which appeared as outliers in the forest plots generated for ACEs type and sexual abuse ACEs. There are several reasons why the Lock study may be an outlier in measuring the relation between ACEs and PTSD in college students. Intended to be used as a screener for sexual abuse in clinical work, items for the SAQ were developed from authors' clinical experience and reportedly were not always face-valid. Therefore, questions on the SAQ may be difficult to understand, potentially causing individuals to respond overly positively (i.e., I should just say yes, I do not want to ask what this means and appear uninformed). Many of the questions are reverse-coded, again potentially causing confusion. Further, not all the questions appear to be about sexual abuse, which may indicate that the SAQ captures something other than sexual abuse. Thus, the results from the SAQ may overinflate the effect size between ACEs and PTSD. Conversely, it is also possible that the SAQ is especially well-designed to capture sexual abuse, and therefore does a better job detecting a stronger effect between ACEs and PTSD. Further studies should examine reasons why the SAQ detects a stronger effect between ACEs and PTSD.

Limitations

Publication bias

Based on the results of the funnel plots, publication bias is likely present. Note that we found a rather large effect size for the sum of ACEs, as well as high heterogeneity of variance across all three types of ACEs studies. Further, gaps in each of the funnel plots are observable. However, the average sample size for the research studies was large, and, therefore, should reflect more accurate results, a strength of the present study. Still, all studies had significant effect sizes, few gray materials were included, and therefore, the present study may not represent all available literature in the field.

Therefore, we wish to acknowledge several limitations of the present study. First, we were unable to assess potential threats to the internal validity of studies, including examining the type of study (e.g., experimental versus correlational), due to most studies being cross-sectional and correlational. Thus, we have no method by which to identify whether studies controlled for confounding variables. Next, although we made efforts to include gray materials by searching dissertation databases and emailing experts in the field, we were unable to obtain unpublished research materials, likely contributing to publication bias. Further, although we attempted a comprehensive literature review across psychological and medical databases, the present study likely does not address the full body of literature assessing the relation between ACEs and PTSD in college students. In addition, the studies included in the meta-analysis did not all adhere to the same measures of ACEs and PTSD. Thus, it is difficult to determine whether these studies measured ACEs and PTSD or related but different constructs. Finally, there are currently no existing methods by which to assess power in meta-analysis. Therefore, it is difficult to examine whether the present meta-analysis is properly powered to detect the true relationship between ACEs and PTSD.

Conclusion and Future Directions

Despite the limitations present, the present study serves as evidence of a potentially strong relation between total ACEs and PTSD, and a moderate relation between type of ACEs and sexual abuse and PTSD, in college students. This study serves as the first meta-analysis, to our knowledge, of this relation in college students. Researchers interested in the effect of ACEs on college student outcomes should consider several future directions. First, future studies should conduct a wider literature search, including searching further databases, to ensure that all available published studies are included. To further understand for whom this relationship may be most salient, future research should investigate potential moderators, namely sex, race, SES, and their intersections. Specifically, studies of ACEs and PTSD in college students should be conducted with students of color, individuals who do not identify as women (in addition to women), and measure total ACEs experienced, type of ACEs experienced, and whether ACEs were relational, to gain a clearer picture of college students' experiences in the context of historical adversity. Experiences of racism should also be included as a potential ACE category. Importantly, we revealed a great amount of heterogeneity amongst ACEs studies in college students, with a total of 15 different ACEs measures to capture these experiences. Clearly, the field has yet to agree on the best measure to capture ACEs, much less for diverse groups of college students. Psychologists must make a concerted effort to agree upon a standardized psychometric approach to measuring ACEs. This work can be guided by the C-ACE framework (Culturally-Informed Adverse Childhood Experiences Framework; Bernard et al., 2020), which highlights the effect of racism on mental health and advocates for its inclusion in the measurement of ACEs in non-White populations. The C-ACE framework may indicate measures such as the Pediatric ACEs and Related Life Events Screener (PEARLS; Koita et al., 2018), which captures events from the original ACEs study, as well as an expanded set of adversities considered to predict toxic stress (e.g., discrimination, community violence, housing instability).

Results from the present meta-analysis have important implications for college campuses. We found a strong, positive effect between ACEs and PTSD in college students. College campuses and university counseling centers, then, must be aware that students with a history of adversity may be at increased risk for developing psychopathology and may come to college with higher rates of PTSD than students with no history of adversity. It is easy to imagine that these same students may not have the same resources to draw upon as students without adversity histories, including family support, financial assistance, sense of community, or access to knowledge about educational systems (e.g., parents who went to a four-year university). Therefore, identifying students with ACEs early in their college career (e.g., asking students to take the CDC ACEs questionnaire at orientation) could help universities identify students in need of increased mental health, financial, and educational support.

The present meta-analysis found a strong association between ACEs and symptoms of PTSD in college students. These findings may have important implications related to student outcomes. Specifically, students who experience more ACEs and ACEs that have a relational component may be more likely to experience symptoms of PTSD in college. To further understand the implications of PTSD in college students, future investigators should examine the relation between PTSD and academic achievement and retention rates in college students.

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CHAPTER 2: MEASUREMENT AND IMPLICATIONS OF ACES FOR PTSD, ACHIEVEMENT, AND COGNITION IN COLLEGE STUDENTS

Adverse childhood experiences (ACEs) have been a significant area of research in recent years. ACEs are defined by the Center for Disease Control and Prevention (CDC) as "potentially traumatic events that occur in childhood (0-17 years)" and include physical, emotional, and sexual abuse, physical and emotional neglect, and the following areas of household dysfunction: mental illness, domestic violence, divorce, incarceration of relatives, and substance abuse (Center for Disease Control and Prevention, 2020). Research suggests that ACEs occur at a high prevalence rate, with a recent study suggesting that 60% of adults have experienced at least one ACE (Merrick et al., 2018). Below, we discuss the initial ACEs study, implications for mental health and academic outcomes, and present the current study, which examines the effects of ACEs on college student symptomatology.

The original ACEs study, conducted by the Center for Disease Control (CDC) and Kaiser-Permanente (Felitti et al., 1998), examined the relationship between childhood experiences and important medical and public health problems. Conducted in a primary care setting, the study developed a questionnaire to retrospectively assess categories of abuse experienced in childhood. Specifically, the survey assessed childhood abuse (psychological abuse, physical abuse, and contact sexual abuse) and exposure to household dysfunction (substance abuse, mental illness, violent treatment of maternal figure, and criminal behavior). Respondents answered whether they did or did not experience the ACE, and a sum score was calculated for each participant (Felitti et al., 1998). The study team also assessed risk factors and disease conditions, including smoking, severe obesity, physical inactivity, depressed mood, suicide attempts, and more. Data analyses from 8,056 participants revealed the most prevalent childhood exposure was substance abuse (25.6%), 52% of participants had experienced at least one ACE, and 6.2% of participants had experienced four or more ACEs. A graded relationship was found between ACEs and most outcomes, such that people who experienced more ACEs reported higher levels of alcoholism, drug use, sexually transmitted diseases, cancer, suicidality, and more. Older people, White and Asian people, and college graduates experienced fewer ACEs and better health outcomes relative to other participants (Felitti et al., 1998). Thus, the original ACEs study shed light on the importance of early childhood adversity for future health outcomes.

ACEs and Post-Traumatic Stress Disorder

Perhaps most relevant for psychological researchers is the effect of ACEs on mental health outcomes, including the development of post-traumatic stress symptoms. Trauma, as defined by Criterion A for the PTSD diagnosis in the DSM-5, entails exposure to actual or threatened death, serious injury, or sexual violence. The event can be directly experienced, witnessed in person, learned about having happened to a close family member or friend, or experienced repeatedly, typically in a work role (e.g., firefighter, police officer) (American Psychiatric Association, 2013). However, given that non-Criterion A events can also lead to the development of PTSD symptoms (Anders et al., 2012a), we prefer to define trauma as an event that overwhelms the central nervous system, altering the ways we process and recall memories (van der Kolk, 2015).

A growing body of literature suggests that experiencing adversity in childhood increases the likelihood of Post-Traumatic Stress Disorder (PTSD) in college students (Cougle et al., 2010; Gilbert et al., 2009; Lagdon et al., 2018) and other populations (Chang et al., 2018; Dvir et al., 2014; Ehring and Quack, 2010; Vranceanu et al., 2007), as does experiencing maltreatment

(Bremner, 2002; De Bellis & Thomas, 2003; Kessler et al., 1995). In a study of 1,695 college students, 36.1% of participants who reported experiencing abuse also reported symptoms consistent with PTSD (An et al., 2021). These findings align with the work of Kessler and colleagues (2005), who found that 30-40% of people who experience trauma will develop symptoms of PTSD. Given that 70% of the population will experience trauma in their lifetime (Kessler et al., 2005), it is important to understand the conditions under which PTSD symptoms develop. Spinazzola et al. (2005) highlighted that individuals who experienced childhood abuse are underrepresented in PTSD literature, which has historically focused on adult traumas. Therefore, ACEs are an important area of research if we are to more fully understand the experiences of PTSD symptoms in the population.

Evidence suggests that experiencing adversity in childhood versus adulthood may differentially affect individuals across the lifespan. For example, Woon and Hedges (2008) found reduced bilateral hippocampal volume in adults with childhood maltreatment-related PTSD. However, the same was not true for children who had experienced maltreatment and had PTSD symptoms, indicating that early adversity may lead to significant brain changes across the lifespan. Further, a history of early adversity may predict future reactions to and experiences of PTSD symptoms. Gould and colleagues (2020) found that histories of child abuse and pre-existing trauma symptoms predicted immediate responses to stress, and history of prior trauma predicted the course of PTSD symptoms. Thus, understanding who is at risk for the development of PTSD symptoms as a result of ACEs experiences, as well as implications of PTSD in adult samples, should be an area of focus for psychologists.

The Role of Marginalization in the Experiences of ACEs

Individual characteristics also may play an important role in explaining who is at risk in the context of adversity. Studies suggest that ACEs and PTSD may be experienced differentially across race, sex, and socioeconomic status (SES). According to the ecological-transactional model, context affects behavior such that under-resourced environments create conditions likely to result in traumatic experiences, which places individuals in those environments at increased risk for post-traumatic stress (Cicchetti & Lynch, 1993; Lynch & Cicchetti, 1998). This model provides a framework by which to understand the experiences of communities who have been historically marginalized in the United States, namely, people who identify as non-White, women, and individuals from low-socioeconomic backgrounds. Using an intersectionality framework (Crenshaw, 1989), people who hold multiple marginalized identities may be most at risk for experiencing ACEs and may have the fewest resources to draw upon during and after experiencing adversity.

Despite the ecological-transactional model and intersectionality pointing to individuals with racially/ethnically marginalized identities being at potentially highest risk for ACEs, LaBrenz et al. (2020) suggested that research working to illuminate the racial/ethnic disparities of ACEs experiences is lacking. In fact, in one meta-analysis of 1100 studies, less than 7% of studies focused on ethnicity as a construct of interest. Although systemic racism has led to significantly more experiences of adverse health outcomes in communities of color (Wheeler et al., 2018), people of color are less likely to access mental health services (Substance Abuse and Mental Health Services Administration, 2015), potentially due to low confidence in the medical system, insufficient economic resources, and lack of diversity in the helping field (Forster et al., 2019). Thus, researchers must work to include underrepresented communities in studies of ACEs so as not to perpetuate the erasure of marginalized communities in the study of ACEs.

Fortunately, some ACE researchers have answered this call to action, some of which find that communities of color experience more ACEs than White communities. Evidence suggests that Black (Labrenz et al., 2020; Slack et al., 2017), Native American (Brockie et al., 2013; Labrenz et al., 2020), and Latinx (Labrenz et al., 2020) samples experienced ACEs at significantly higher rates than did White participants, who reported the lowest prevalence of ACEs (Forster et al., 2019; Strompolis et al., 2019). Asians, too, have been documented to report experiencing fewer ACEs than their White or Latinx counterparts (Dorvil et al., 2020), as well as other minoritized groups (Forster et al., 2019). Conversely, Gould et al. (2020), demonstrated that people who identified as Hispanic experienced fewer traumas than other racial/ethnic groups, and Turner and Lloyd (2003) found that White people in their sample experienced the highest number of ACEs. Thus, the evidence is mixed on which racial/ethnic groups experience the greatest number of ACEs. It is also possible that different racial/ethnic groups experience different ACEs at different rates. In one study, Latinx participants reported the highest rates of physical abuse, Black participants reported the highest rates of household separation/divorce, and White participants reported the highest rates of emotional abuse (Strompolis et al., 2019). Despite these findings, a recent meta-analysis of ACEs and PTSD in college students revealed that study samples consisted mostly of White women, making it impossible to examine the effect of on the experiences of ACEs across studies Durán, 2021). Further evidence is needed to determine whether and which ACEs are experienced at different rates across racial/ethnic communities.

There is also contention as to whether ACEs lead to higher rates of PTSD symptoms across different racial/ethnic groups. Although some studies (Hatcher et al., 2009; Wilson et al., 2007) have found no racial/ethnic differences in the development of PTSD in people with ACEs histories, a separate set of studies has found more posttraumatic stress responses for those who are racially/ethnically minoritized (La Greca et al., 1996; Shannon et al., 1994). Specifically, non-Hispanic Black (Gould et al., 2020; Labrenz et al., 2020) and Native American (Labrenz et al., 2020) people have been found to display the highest levels of posttraumatic stress symptoms, whereas Latinx individuals may experience the lowest levels of PTSD despite a history of ACEs (Suárez et al., 2009). Other groups who may be at higher risk for the development of PTSD include women and people living in low socioeconomic environments. A meta-analysis by Martinez and colleagues (2014) found that ACEs studies with higher percentages of women demonstrated greater posttraumatic stress symptoms, whereas Gould et al. (2020) found no sex differences on child trauma scores.

Lower SES has been associated with higher ACE exposure and more kinds of ACEs experienced (Slack et al., 2017; Youssef et al., 2017). More specifically, people with incomes of less than 25,000 have been shown to have the highest percent of exposure to each ACEs type compared to respondents in higher-income categories (Strompolis et al., 2019). However, in their review, Martinez et al. (2014) found that less than half of the 74 articles about ACEs measured SES. One potential reason is that SES is difficult to measure. First, multiple related constructs exist and there is contention around whether objective indicators (e.g., income) or subjective social status (SSS) ones should be used to measure SES (Adler et al., 2000). Second, measuring SES in college samples is uniquely difficult due to developmental timing. College students have not yet finished their education and often do not yet have a salary, making traditional markers like educational attainment, occupational prestige, and income unhelpful for describing a college student's social positioning. Although some researchers may choose to measure students' parental SES markers, some students do not receive support from their parents and these markers may be even more inappropriate for nontraditional college students. For these reasons, SES has been understudied in the ACEs literature and warrants a closer look in future ACEs studies.

Relational ACEs

Apart from race/ethnicity, sex, and SES, the type of ACEs may play an important role in the development of PTSD symptoms across the lifespan. Martinez et al. (2014) found that specific types of abuse more strongly predict posttraumatic stress (e.g., sexual abuse), whereas other types had weaker associations with PTSD (e.g., neglect). PTSD is highly prevalent in adult survivors of childhood sexual abuse (Kessler et al., 1995; Ullman & Brecklin, 2002). Promisingly, research supports that strong relationships, or relational resilience, buffers the negative effect of ACEs on mental health outcomes (Brinker & Cheruvu, 2017; Sheffler et al., 2020). Howell and colleagues (2020) found that relational resilience mediation the relation between ACEs and depression, such that more ACEs predicted lower relational resilience and lower relational resilience led to higher depression. It is possible, then, that ACEs strain relationships or lead to decreased social functioning. Further, some ACEs, such as emotional abuse (presumably by a family member or familiar person), appear to be more relational from a conceptual standpoint, whereas other ACEs, such as exposure to theft (presumably by a stranger) do not share that same relational salience. In other words, if relationships act as a resource in the presence of ACEs, then individuals experiencing relational ACEs may not have that same resource to draw upon and may be more likely to develop symptoms of PTSD. This theory is supported by the work of van der Kolk (2015), who suggested that not having relational support in the context of trauma may lead to PTSD, and the interpersonal theories of depression (Hames et al., 2013; Joiner Jr., 1999) and suicide (Van Orden et al., 2010), which highlight the role of interpersonal relationships in the development of these symptomatology.

A recent set of articles (Pollak & Smith, 2021; Smith & Pollak, 2020; McLaughlin et al., 2021) reviewed methods of measuring ACEs and their comparative utility. Consistent with findings from Durán (2021), both groups highlighted ACEs studies that measure cumulative effects of ACEs, effects of specific types of ACEs, and characteristics of ACEs (frequency, duration, intensity, onset). They examined limitations of each method, including how measuring specific ACEs does not account for high comorbidity of ACEs experiences and that cumulative ACE measures do not typically explore the experience of ACEs, only whether they were present. Notably, they explore the utility of dimensional ACE models, a more recent method for measuring ACEs. Although McLaughlin et al. (2021) and Smith and Pollack (2021; 2021) disagree about what constitutes a dimensional model, both groups appear to agree on an important concept, viz. simply assessing for the presence of ACEs does not adequately assess for individual experiences of ACEs. Thus, both groups recommend measuring contextual factors and characteristics of ACEs, namely, how ACEs are experienced or perceived by individuals. Smith and Pollack termed this approach as an atopological model and McLaughlin et al. referred to this as a dimensional ACE model. Whether ACEs involve a relational component may extend our current understanding of how and when ACEs lead to adverse health outcomes and aligns with the dimensional/topological models outlined by McLaughlin et al. (2021) and Smith and Pollack (2021; 2021).

Further supporting the potential influence of relational ACEs on PTSD, Anders et al. (2012b) found that college students who experienced relationship-related stressors led to high levels of PTSD, over and above Criterion A traumas from the DSM-5. Indeed, high betrayal traumas have a stronger association with symptoms of PTSD than low betrayal traumas (Boyraz et al., 2019). In a study of Iranian undergraduate students, Pournaghash-Tehrani (2019) examined whether relational ACEs predicted suicide. Relational ACEs were operationalized as caregivers' maltreatment, household relational dysfunction, family loss events, school events, and sexual abuse, all of which were assessed at home and school. Findings suggested that rates of relational ACEs were higher and associated outcomes were worse for female students compared to male students. However, this study did not capture non-relational ACEs, making it impossible to assess whether relational ACEs predicted PTSD over and above non-relational ACEs. Given the importance of social relationships in college and that different ACEs may be especially detrimental across the developmental timeline (Turner et al., 2020), more extensive investigations should be conducted to understand whether relational ACEs may uniquely predict PTSD symptoms in college students.

Implications for Cognition and Achievement

One potential important implication of ACEs and PTSD symptoms is cognitive impairment. Research suggests that experiencing ACEs predicts cognitive struggle. Aglan et al. (2010) demonstrated that individuals with a history of childhood sexual abuse displayed marked memory issues, and Malarbi et al. (2017) found that people with ACEs history had worse overall cognition than people who did not have a history of ACEs. However, a developing body of literature suggests that having an ACEs history does not necessarily serve as an indicator of future cognitive impairment, but instead, may lead to the development of PTSD symptoms, which can affect cognition. Malarbi et al. (2017) found that children who developed PTSD after experiencing adversity were more likely to demonstrate cognitive deficits than children who did not develop PTSD after adversity (Malarbi et al., 2017). In a separate study, PTSD had a stronger effect on memory than did trauma or child sexual abuse (CSA) (Ono et al., 2016), which indicates that ACEs and PTSD may make unique and differentially predictive contributions to cognitive function. Interestingly, PTSD symptoms appear to affect aspects of cognition differently. For example, some studies reported no differences in attention between individuals with PTSD and those without PTSD (Samuelson et al., 2010), and others found that children with PTSD had worse memory than children without PTSD (Yang et al., 2017; Shoeman et al., 2009; Yasik et al., 2007), Various factors may explain inconsistencies in findings across studies, including variations in samples differences in resources and access (i.e., SES), and different measures used to capture similar, but distinct, constructs (e.g., ACEs versus only sexual abuse, cognition versus memory, diagnosis of PTSD versus symptoms of PTSD). Taken together, these studies suggest that PTSD symptoms may have a robust effect on memory, though further research is warranted.

Further research is required to determine the effect of ACEs and PTSD symptoms on cognitive functioning, which may be of particular importance for college students, who are contextually exposed to high cognitive demands. College students are also subject to trauma at high rates and can display high rates of PTSD (Anders et al., 2012), which may be uniquely problematic for academic performance given the association between PTSD, sleep problems, and difficulty concentrating (An et al., 2021). Given that college is a uniquely stressful period both developmentally and academically, it is vital to understand how early adversity, PTSD symptoms, and cognition may affect performance in college.

Summary

We defined and reviewed ACEs and the original ACE study and its findings. The effects of ACEs may not be immediate, but instead may stretch the lifespan and can predict current stress reactivity. There is a strong relationship between ACEs and PTSD symptoms, such that experiencing more ACEs is associated with higher levels of PTSD symptoms. ACEs have been captured using a variety of measures that may not all map onto the same "ACEs" construct, and insufficient psychometric work has been done to examine whether these measures work the same across various racial/ethnic or sex groups. Historically, ACEs studies have excluded people with marginalized identities, especially those with racially/ethnically marginalized identities, despite there being evidence to suggest that these groups may be at the highest risk for experiencing more ACEs and developing more symptoms of PTSD symptoms than White and Asian people. Further, some ACEs may be more strongly and negatively associated with PTSD symptoms than others, including ACEs that have a relational component. However, further work is needed to understand whether relational ACEs have a stronger association with PTSD symptoms than non-relational ACEs. Finally, ACEs have important implications for PTSD symptoms, cognition, and academic achievement, but the literature is mixed about whether ACEs history, PTSD, or both lead to decreased cognition and decreased achievement.

Research Questions and Hypotheses

Thus, the present study aimed to address several major gaps in psychological literature by addressing four research questions.

Research Question 1

Is the measurement structure of a popular ACEs scale equivalent across sex and race groups in college students?

Research Question 2
Is it possible to distinguish ACEs as being relational or not?

Research Question 3

Is the association between ACEs and PTSD symptoms stronger for relational ACEs than non-relational ACEs in college students?

Research Question 4

What are the associations between ACEs, PTSD symptoms, cognition, and GPA in college students?

Hypothesis 1

Given that the original ACEs study sample (Felitti et al., 1998) and the samples identified by Durán (2021) were mostly White, we hypothesized that ACEs will not function the same across racial groups and that a conventional ACE measure will demonstrate the best model fit for White female-identifying college students. Choi et al. (2020) conducted a confirmatory factor analysis (CFA) with an expanded ACEs measure and found four factors: direct victimization/household dysfunction, neglect, poverty, and family separation/loss. We expected to find the same factor structure for the White sample.

Hypothesis 2

We hypothesized that relational ACEs and traditional ACEs will share variance based on the conceptual overlap but will emerge as distinct constructs in bifactor analysis.

Hypothesis 3

Due to findings that suggest a strong, positive association and medium effect size between relational resilience and depression (Howell et al., 2020), we hypothesized that relational ACEs would have a strong, positive association with PTSD symptoms with a medium effect size for college students. We also hypothesized that the association between relational

ACEs and PTSD symptoms will be stronger than the link between non-relational ACEs and PTSD symptoms.

Hypothesis 4

a) ACEs factors will have a strong, positive association with PTSD symptoms for college students. ACEs will have weak negative associations with cognition and GPA in our sample (Malarbi et al., 2017; Ono et al., 2016). We expect similar strengths of associations between factors of ACEs and PTSD symptoms and GPA, given that there is no basis for expecting the factors to relate differently across these outcomes.

b) PTSD symptoms will have a medium, negative association with working memory for college students (Schoeman et al., 2009; Yasik et al., 2007).

METHOD

Participants

A total of 842 participants were recruited for this study, 794 using the George State University Department of Counseling and Psychological Services' Research Participation System (SONA) and 48 via social media recruiting. Participants read a general description of the study and provided informed consent. Next, they responded to an online survey for course credit for research requirements in undergraduate coursework. Students were also asked to report how many semesters of college they had completed at the time they filled out the survey. Students in their first semester of college were excluded from the study because they were unable to provide a college GPA. To gauge acceptability in a more quantitative manner, we followed recommendations to evaluate the quality of the data (e.g., Curran, 2016). We conducted long-string analyses on questionnaires containing 10 or more items. These analyses helped to locate unlikely identical response sequences for items on those questionnaires. If a participant failed longstring analysis on a single questionnaire, that participant's data were set to missing for that questionnaire. Participants who failed at least one of two validity items were excluded from the study. 635 participants' data were included in the analyses after preliminary data cleaning.

The final sample included 378 females (59.5%) and 249 male (39.2%) participants (1.3% missing data). The ages of participants ranged from 18 to 67, with a mean age of 22.81 years old (SD = 4.95). 282 participants identified as Black/African American (44.4%), 116 as Asian/Asian American (18.3%), 109 as White (17.2%), 52 as Latin American/Hispanic (8.2%), and the remaining categories were represented by less than 8% of the sample (i.e., less than 52 participants). Students reported growing up in families whose median household income was between $50,000 and $74,999, with the greatest number of students (N = 126; 19.8%) reporting between $35,000 and $49,999.

Measures

ACEs

The Childhood Experiences Survey (CES; Mersky et al., 2017) is an expanded version of the CDC-Kaiser Permanente ACEs questionnaire (Felitti et al., 1998) and is designed to capture the presence of adverse childhood experiences. Consisting of 17-items, the CES questionnaire has been modified to assess for adversity experiences before the age of 18 across the following categories: physical abuse, sexual abuse, emotional abuse, physical neglect, emotional neglect, parent alcohol/drug problem, parental mental illness, domestic violence, parent incarceration/jail, parent divorce/separation, frequent financial problems, food insecurity, homelessness, parental absence, death of parent or sibling, peer victimization, violent crime victimization. Eight items measure direct victimization, two items measure neglect, three items measure poverty, and four items measure family separation. These categories align with types of abuse that emerged in a recent meta-analysis by Durán (2021). In addition, recent work by Choi et al. (2020) demonstrated how the CES expanded the understanding of ACEs structure from two (child maltreatment and household dysfunction) to four (direct victimization/household dysfunction, neglect, poverty, and family separation/loss) factors. The CES is especially well-suited for ACEs research in that it captures important elements of SES that may explain individual experiences of ACEs that have not been historically assessed in the ACEs literature (e.g., poverty). Respondents indicated whether and how often they experienced an event (e.g., 1 = Never, 2 = Rarely, 3 = Often). The CES demonstrated adequate internal consistency ($\alpha = .81$) with scores from a previous sample (Mersky et al., 2017), which was replicated in the present study ($\Omega = .78$).

Additionally, if participants endorsed having experienced an ACE (e.g., Rarely, Often) on the CES, we asked them to write a detailed description of the ACE that they experienced. Specifically, participants responded to the following prompt: Describe this experience in as great a detail as you feel comfortable sharing. What happened, and how did the experience make you feel? This prompt was adapted from a similar survey conducted by Anders et al. (2012).

PTSD

The Post-Traumatic Stress Disorder Checklist for DSM-5 (PCL-5; Weathers et al., 1993) is a 20-item self-report measure that maps onto the DSM-5 PTSD criteria. In the present study, we excluded the Criterion A component and instead focused on symptomatology. Scores are rated on a 5-point scale (0 = Not at all, 1 = A little bit, 2 = Moderately, 3 = Quite a bit, 4 = Extremely), which reflects the severity of symptoms in the past month. Evidence suggests strong internal consistency (Cronbach's $\alpha = 0.97$) and construct validity (Wilkins, 2011) in scores from samples of college students (Jamison-Eddinger & McDevitt-Murphy, 2017). In the present study, the PCL-5 demonstrated strong internal consistency (Ω = .956).

Academic achievement

Given a strong, positive correlation between self-reported grades with actual grades in similarly aged students (Sticca et al., 2017), participants were asked to self-report their cumulative college GPA.

Working Memory

The Symmetry Span Task (Foster et al., 2015; Unsworth et al., 2005)) is intended to capture participants' working memory capacity. Participants were shown a series of grid locations one-by-one forming a 4 x 4 location grid in the center of the screen. Before each location grid was shown, the participant was shown a distractor in the form of an 8 x 8 symmetry grid, which was either symmetric or asymmetrical along its vertical axis. Participants were then instructed to judge whether the image was symmetrical before the next grid was shown. At the end of the symmetry-location block, participants were prompted to recall as many grid locations as possible in order of appearance. 10 total blocks were administered. Each participant was assigned a score by the partial credit unit score, in which the number of correctly recalled grids was divided by the total number of grids presented for each set, with scores ranging from 0 to 1 for each block. This task began with an example to familiarize participants with the task (i.e., to avoid confusion about the purpose of the task). Internal consistency was calculated using the partial credit unit scores from each of the 10 blocks administered. Scores from the Symmetry Span Task have been shown to be reliable (Cronbach's α = 0.85; Quek et al., 2021). Internal consistency proved to be strong for scores from the present sample (Ω = .86).

Demographics

A demographic questionnaire was administered to collect information about participants' race, sex, SES, and education level. Race/ethnicity categories were taken from the United States Census 2020 Survey. SES was assessed via subjective socioeconomic status, as well as an objective measure of SES. The MacArthur Scale of Subjective Social Status (Adler et al., 2000) is used to assess perceived social status. The scale is presented as a ladder with ten rungs. Participants are asked to mark where they would place themselves on the ladder by considering the ladder to reflect where people stand in society regarding money, education, and respected jobs. The top rung represents people with the highest social status level, and the bottom rung corresponds to the lowest level of status. Rung placement was converted to a number ranging from 1 (lowest) to 10 (highest). Criterion-related validity is supported by subjective social status ratings explaining significant variation in various health and stress-related indicators even after controlling for objective indicators (e.g., Adler et al., 2000; Garza et al., 2017). Status rankings have been strongly consistent in a national sample over a 6-month, test-retest period (Operario et al., 2004). Perceived SES has been documented to strongly correlate with household income growing up in adolescent samples (Rivenbark et al., 2020). We assessed objective SES by asking students to self-report the average annual income for the household they grew up in. Students could choose from the following categories: Under $15,000; $15,000 - $24,999; $25,000 - $34,999; $35,000 - $49,999; $50,000 - $74,999; $75,000 - $99,999; $100,000 - $149,999; $150,000 - $199,999; $200,000 and over.

Procedure

Analyses were conducted with IBM SPSS Version 23 (2015), and M*plus* Version 8 (Muthén & Muthén, 1998-2017). The robust weighted least squares maximum likelihood estimator (WLSMV) in M*plus* was used in analyses.

Power analyses

Monte Carlo simulations were used to identify a sample size with adequate statistical power for measurement invariance (Cohen, 1992) and structural regression. Monte Carlo simulation constructs a model to the exact specifications and then tests the model on thousands of random datasets with varying conditions (e.g., sample sizes, complications of the model). This procedure helps determine the appropriate sample size for the model we hypothesize by estimating parameter estimate bias, standard error bias, confidence intervals, and the power. The following four criteria are used to determine sample size: parameter and standard error biases do not exceed 10% for any parameter in standard error bias for the parameter for which power is being assessed does not exceed 5 percent; coverage (i.e., the proportion of replications for which the 95% confidence interval contains the true parameter value) remains between 0.91 and 0.98; the sample size is chosen to keep power close to 0.80, which is a commonly used as an accepted value for sufficient power (Muthen & Muthen, 2002).

Monte Carlo simulations were conducted in M*plus* and performed using 1,000 replications with four groups. Data for the latent variables in each model were drawn from a multivariate normal distribution. A four-factor model for ACEs was estimated based on the work of Choi et al. (2020), and the model included three dependent variables, representing GPA, working memory, and PTSD symptoms. One covariate was included in the model (self-reported sex). Parameters estimated in the simulation and the procedures were derived from previous studies (Choi et al., 2020; Ford et al., 2014). The result of the Monte Carlo simulation suggested 800 participants to achieve 80% power to detect significant parameters and the smallest effect size across the four major racial/ethnic groups.

Data Analytic Strategy

Hypothesis 1. We hypothesized that the CES model will have the best model fit for participants who identify as White and as women. We compared the factor structure of the ACEs measure for a binary sex variable. Separately, we compared the factor structure of the ACEs measure four racial/ethnic groups: White, Black, Asian, and consider model modifications to improve score compatibility.

Measurement invariance testing was conducted using a nested model comparison approach, with increasingly demanding constraints, as follows: configural model (no constraints), metric model (constrained factor loadings to be invariant), scalar model (constrained loadings and item thresholds to be invariant). Comparisons help determine if imposing invariance constraints significantly worsen model fit over, allowing parameters to be freely estimated between groups. Metric invariance allows for the relations between the latent factor and external variables to be compared across groups because a one-unit change in one group would be equal to a one-unit change in the other group. Scalar invariance requires equal factor loadings and equal indicator thresholds across groups. When both metric and scalar invariance are present, the comparison of factor means across groups is permissible. We evaluated factor mean differences across racial/ethnic groups to detect differences between the groups before conducting regression analyses. The lack of invariant thresholds indicates the presence of differential item functioning or item bias.

Global fit indices were used to evaluate measurement model hypotheses. Global fit was evaluated via the following indices and typical ranges suggested for each index: chi-square, Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA), standardized root mean square residual (SRMR), and McDonald's noncentrality index (MNCI; McDonald & Marsh, 1990). A non-significant chi-square indicates the sample data and the theoretical model are similar (Schumacker & Lomax, 2010). CFI values in the .90-range would indicate acceptable fit (Byrne, 2013), with values of .95 or greater considered a good fit (Hu & Bentler, 1999; Schumacker & Lomax, 2010). Values less than .08 for RMSEA would indicate an acceptable fit (Browne & Cudeck, 1993), whereas .05 or lower would demonstrate a good fit (Kenny et al., 2015). SRMR values of less than .08 would indicate an acceptable fit (Hu & Bentler, 1999).

Hypothesis 2. We reviewed students' detailed responses to part B of each CES item to determine whether an ACE was relational or traditional. Relational ACEs were coded as 1, and Traditional ACEs were coded as 0. We then compared the percentage of participants who reported an ACE to be Traditional versus Relational. If more participants' responses to an item were coded as Relational, the ACE was then considered to be part of the Relational ACEs in analyses in Hypotheses 2 and 3. If more participants' responses to an item were coded as Traditional, the ACE was then considered to be a Traditional ACE and was treated as such for the purpose of Hypotheses 2 and 3.

To test the hypothesis that relational and traditional ACEs are conceptually distinct constructs, we examined four-factor relational ACEs and four-factor traditional ACEs using a bifactor model to account for likely shared variance between relational and traditional ACEs. A bifactor model allowed us to assess whether relational ACEs and traditional ACEs map onto a global construct (in this case, global ACEs) (Howard et al., 2018; Reise, 2012). We expected that both the traditional and relational ACEs items will load onto four factors each (Choi et al., 2020). Items were allowed to load onto their a priori ACEs factors and all cross-loadings were constrained to zero. This model was specified as orthogonal, or uncorrelated, with each item specified as loading onto both its ACEs factor and the global ACE factor (shared variance).

Hypothesis 3. Our third hypothesis was that relational ACEs are more strongly associated with PTSD symptoms than are traditional ACEs. Using path analysis in structural equation modeling, we assessed the path coefficients between the traditional ACEs and relational ACEs factors to determine whether relational ACEs more strongly predicted PTSD symptoms over and above traditional ACEs. To do this, we regressed PTSD symptoms onto traditional and relational ACEs and allowed for free estimation. We then ran a second model, constrained the paths to be equal, and used the DIFFTEST function in M*plus* to determine whether there was a difference in fit between models (i.e., do relational and traditional ACEs have different effects on PTSD symptoms?).

Hypothesis 4. Finally, we hypothesized that ACEs would have a medium, positive association with PTSD symptoms and a medium, negative association with cognition and GPA in college students. We also hypothesized that PTSD symptoms would have a medium, negative association with cognition and working memory for college students. Structural equation modeling (SEM) was used to investigate associations between ACEs, PTSD symptoms, GPA, and Working Memory. SEM allows the researcher to test relationships between latent variables. For hypothesis 4, we tested the relations between factors of ACEs, PTSD symptoms, working memory, and GPA. We included the number of college semesters students had completed in the model. We used results from the measurement invariance analyses to determine the number of factors to represent ACEs in the SEM model.

RESULTS

Means, standard deviations, and correlations appear in Table 2 below. For comparisons with other studies (Choi et al., 2020; Mersky et al., 2017), a total ACEs scale score was calculated. The average scores and correlations for the sample were generally consistent with other studies using the same scales (e.g., Foster et al., 2015; Mersky et al., 2017). Mean score on the PCL appeared higher than in previous studies with racially diverse college students (Blevins et al., 2015; Pieterse et al., 2010). Correlations between the scales were in expected directions. For example, PTSD symptoms were negatively correlated with GPA, whereas Adverse Childhood Experiences were positively correlated with PTSD symptoms.

Table 2.

Correlations, Means, Standard Deviations, and Omega's alpha for Variables

Variable	1	2	3	4	5
1. CES	-				
2. PCL	.45**	-			
3. GPA	-.01	-.07	-		
4. SymSpan	-.07	-.15*	.23**	-	
5. Semester	.05	.12**	.09*	-.01	
Mean	26.03	47.43	3.19	8.07	3.09
SD	5.90	18.88	.55	1.24	1.18
Omega	.78	.96	--	.86	--

Note. CES = Childhood Experiences Survey; PCL = PTSD Checklist for DSM-5; GPA = Grade Point Average; SymSpan = Symmetry Span; SD = Standard Deviation.

Hypothesis 1a: Measurement invariance between sex groups

The initial measurement model involved the original four-factor structure of the CES with 8 items measuring Direct Victimization, 2 items measuring Neglect, 3 items measuring Poverty, and 4 items measuring Family Separation. Multigroup CFAs were conducted to evaluate configural, metric, and scalar invariance.

The four-factor structure of the CES failed to converge for both the male and female sex groups. Notably, when the Neglect factor items were included in the model, their standardized item loadings appeared implausible (e.g., greater than 1.0), and so this factor was removed from the model. For items 2, 11, 12, and 13, categories were too sparse to be included in the model, and so these items were removed from the model. After these steps, a two-factor solution appeared to be the best solution across sex groups. Fit results supported configural invariance for the two-factor structure of the CES. For the male group, standardized factor loadings ranged from .43 to .94 for Direct Victimization, and .28 to .79 for Family Separation, and all factor loadings were statistically significant. For the female group, standardized factor loadings ranged from .26 to .78 for Direct Victimization, .10 to .98 for Family Separation, and all factor loadings were statistically significant, except for item 16 (Before age 18, did you experience the death of a parent, caregiver, or sibling?). Metric invariance was not met, with DIFFTEST χ^2 difference testing, ΔCFI, and ΔMNCI suggesting significant worsening between metric and configural invariance models.

Table 3.

Summary of Goodness of Fit Indices and Model Comparisons for Sex Groups

Model	χ^2	df	$\Delta\chi^2$	Δdf	*p*	CFI	ΔCFI	RMSEA	90% CI	SRMR	MNCI
Configural	194.31	86				0.899		0.063	0.052, 0.075	.115	.804
Metric	205.34	97	21.62	11	.0275	0.899	0	0.060	0.048, 0.071	.124	.804
Scalar	220.57	104	7.98	7	.3342	0.891	.008	0.060	0.049, 0.071	.124	.791

Note. CFI = Comparative Fit Index. RMSEA = Root Mean Square Error of Approximation. 90% CI = confidence interval for RMSEA. SRMR = Standardized Root Mean Square Residual. MNCI = McDonald's noncentrality index. $\Delta\chi^2$ based on the Yuan-Bentler scaling correction

Hypothesis 1b: Measurement invariance between race groups

Due to sample size (i.e., insufficient number of participants in other racial/ethnic groups to detect effects), only the Asian, Black, and White groups were included in the measurement invariance model. Measurement invariance was conducted to test the four-factor, 17-item model across Asian, Black, and White racial groups to test for configural invariance. This four-factor model failed to converge in separate factor analyses for each racial/ethnic group. Given that the four-factor model was not met, invariance could not be tested across race groups for the CES, and so alternatives models were considered.   Using factor loadings and fit indices as guides for deleting items to determine the best model fit for these data for each racial/ethnic group, a two-factor model was determined to provide acceptable fit (Direct Victimization – items 2, 6, 8, 15; Family Separation – items 10, 14, 16) for the Asian group, with model results as follows: χ^2 (13, N = 116) = 24.87 $p < .05$, CFI = 0.89, RMSEA = 0.09 [90% CI: 0.03, 0.14], SRMR = 0.17). For the Black group, a three-factor model was determined to provide the acceptable fit (Direct Victimization – items 1, 2, 3, 6, 7, 8, 15, 17; Poverty – items 11, 12, 13; Family Separation – items 9, 10, 14, 16), with the following model results: χ^2 (87, N = 282) = 112.49, $p < .05$, CFI = 0.96, RMSEA = 0.032 [90% CI: 0.01, 0.05], SRMR = 0.103). Finally, for the White group, a two-factor model was determined to provide the best fit (Direct Victimization – items 1,2, 6, 8, 15, 17; Family Separation – items 10, 14, 16): χ^2 (139, N = 109) = 28.47, $p = .34$, CFI = 0.99, RMSEA = 0.03 [90% CI: 0.00, 0.08], SRMR = 0.102). Thus, different factor solutions and different item-to-factor designations emerged for the White, Black, and Asian groups. Given that results suggested that the CES does not work the same across race groups, it is not possible to compare ACEs experiences across racial/ethnic groups, nor to compare associations between

ACEs and other study variables. Simply put, measurement invariance testing could not be accomplished. Therefore, all proceeding analyses were conducted with the Black participant group for two reasons. First, this group had the highest number of participants, which is important to be at power for bifactor analysis and structural regression. Second, this group tends to be underrepresented in previous ACEs studies (Durán, 2021), and because less is known about this group, we elected to conduct the remaining analyses with the Black student data to increase representation in the ACEs literature. Third, compared to other groups, the data for the Black group came closest to reflecting the original hypothesized structure for the CES. Therefore, for all further results, the data used were from the Black participant group.

Hypothesis 2: Relational and Traditional vs Global ACEs in bifactor analysis

CES item-level qualitative responses provided by participants were coded to determine whether an ACE was relational or traditional (see Appendix G for the coding sheet used). After coding was completed, item response frequencies were calculated to determine whether each CES item was majority relational or traditional (see Table 4). Only four items emerged as relational ACEs from this method: Item 2, Item 14, Item 16, and Item 17. These items captured experiences of sexual abuse, a parent being absent, the death of a parent or close loved one, or being the victim of a violent crime, respectively. All other CES items were treated as traditional ACEs items.

Table 4.
Relational and Traditional ACE Coding Breakdown – Black Group

Item	% Relational	% Traditional	% Missing
1	21.5	66.3	12.2
2	35.0	34.0	31.0
3	35.8	54.5	9.6
4	18.9	52.2	28.9
5	27.6	54.1	18.3
6	32.4	58.1	9.5
7	30.1	58.8	11.1
8	36.2	52.1	11.7
9	26.7	58.4	14.9
10	23.6	67.5	8.9
11	7.9	79.4	12.7
12	5.3	72.8	21.9
13	16.4	50.8	32.8
14	57.5	31.9	10.6
15	38.4	50.9	10.7
16	74.8	15.0	10.3
17	42.9	35.7	21.4

Note. Percentages are based on only participants for whom a particular ACE was applicable (i.e., participants who reported having experienced an ACE, even rarely).

Bifactor analysis revealed strong overall model fit: χ^2 (102, N = 282) = 161.00, $p < .0001$, CFI = 0.921, RMSEA = 0.045 [90% CI: 0.031, 0.058], SRMR = 0.100. Item loadings for the Global factor were all significant, except for item 16, whereas only 5 of 13 items were significant for the Traditional factor, and no item loadings were significant for the Relational factor. These results suggest that a global factor best represents the CES items, over and above a two-factor model (Relational, Traditional).

Hypothesis 3: PTSD Symptoms on Relational vs. Traditional ACEs

Path analysis was conducted to determine whether traditional or relational ACEs factors were more strongly associated with PTSD symptoms. First, the PTSD factor was regressed onto the Relational and Traditional ACEs factors, allowing those paths to be freely estimated. Using the DIFFTEST function in M*plus*, a second path analysis was conducted with the paths between

Traditional ACEs and PTSD symptoms and Relational ACEs and PTSD symptoms constrained to be equal. Results indicated that there was no difference in fit between the two models, χ^2 (1, N = 282) = .39, p = .531, suggesting no difference between the associations between Relational and Traditional ACEs and PTSD. However, given that our analyses for Hypothesis 2 suggested that ACEs is better captured by a global factor, we created a sum score in SPSS for ACEs using the items from the measurement model for the Black student group and regressed PTSD symptoms onto a global ACEs factor. The overall regression was statistically significant, R^2 = .02, F (1, 264) = 4.66, $p < .05$.

Hypothesis 4: Associations between ACEs, PTSD, GPA, and Working Memory

We attempted to use structural regression in M*plus* to test the relations between subscales of ACEs and PTSD symptoms, ACEs and GPA, ACEs and working memory, PTSD symptoms and GPA, and PTSD symptoms and working memory. We encountered estimation problems in the structural equation modeling framework when adding the dependent variables, even individually, to the model, and therefore switched to using measured variables in SPSS. Subscales were created by summing the scores of the dichotomous ACEs items for Direct Victimization, Poverty, and Family Separation that proved to have good fit in the measurement model for the Black student group. We included self-reported sex, semester in college, and subjective socioeconomic status as covariates in the model. Per recommendations by Becker et al. (2016), we compared the model with sex, semester in college, and subjective socioeconomic status as covariates with a model without covariates. Results were similar, and reported results are those without as covariates. Multiple linear regression was used to test if Direct Victimization, Poverty, and Family Separation significantly predict PTSD symptoms in the Black participant group, with a .05 significance level. The overall regression was statistically significant, $R^2 = .038$, F (3, 262) = 3.43, $p = .018$. None of the subscales significantly predicted PTSD symptoms, although the poverty factor revealed a trend effect, ($\beta = .120$, $p = .059$). Regression results are captured in Table 5.

Table 5.
Regression Model Results for PCL-5, O-Span, and GPA on CES

Variable	***Standardized B***	***SE***	**Unstandardized *B***	***p***
PCL-5				
Direct Victimization	.10	.13	.20	.106
Poverty	.12	1.45	2.75	.059
Family Separation	.08	1.06	1.38	.195
O-Span				
Direct Victimization	-.03	.01	-.00	.802
Poverty	-.09	.22	-.16	.453
Family Separation	.11	.16	.15	.358
GPA				
Direct Victimization	-.06	.00	-.00	.327
Poverty	.00	.05	.00	.973
Family Separation	-.12	.03	-.06	.072

N = 282

Multiple linear regression was used to test if Direct Victimization, Poverty, and Family Separation significantly predicted Working Memory in the Black participant group. The overall regression was not statistically significant, $R^2 = .01$, F (3, 85) = .40, $p = .756$). Finally, Multiple linear regression was also used to test if Direct Victimization, Poverty, and Family Separation significantly predicted GPA in the Black participant group. The overall regression was not statistically significant, $R^2 = .02$, F (3, 255) = 1.45, $p = .229$). Regression results are captured in Table 5.

DISCUSSION

The literature on the effects of ACEs in college student outcomes disproportionately represents White women college students. However, previous ACEs studies reported potentially higher rates of ACEs in college students of color (Labrenz et al., 2020). Recent ACEs studies also use ACEs measures to capture these adverse experiences, without doing group comparisons via measurement invariance to confirm that the measure works similarly across different groups of students. Some ACEs may also be more predictive of PTSD symptoms than others, including relational ACEs (Anders et al., 2012a), and the relations between ACEs, PTSD symptoms, GPA, and cognition in college students remain largely understudied, especially for students of color. Therefore, the present study examined the psychometric properties of an ACEs measure across race and sex groups, whether ACEs are better explained by one (global) or two (relational and traditional) factors, whether relational ACEs are more strongly associated with PTSD symptoms than are traditional ACEs, and the relations between ACEs, GPA, working memory, and PTSD symptoms in a sample of college students.

Psychometric Implications

For Hypothesis 1, several modifications had to be made to the original four-factor CES model with 17 items to obtain a good model fit for both sex groups. A two-factor model appeared to be the best solution across sex groups, limited to 11 of the original 17 items representing direct victimization and family separation. Analyses did not support metric invariance without adjusting the measurement model. This result provided low confidence that the same factors were being measured for women and men, Scalar invariance was also not met. For researchers or clinicians wishing to measure direct victimization or family separation in college students, we discourage the assumption that the CES measures these constructs similarly across sex groups and may encourage scholars interested in making comparisons between male and female college students to seek another measure.

To our knowledge, we are the first group to examine CES psychometric properties across sex groups in a sample of college students, and only two other studies have examined the properties of this ACEs measure (Mersky et al., 2017; Choi et al., 2020). Findings from both previous studies supported a four-factor (direct victimization, neglect, poverty, family separation) model with 16-items. The current study found that a four-factor model did not fit for either the male or female sex groups. Instead, configural invariance was met for a two-factor model across sex groups. Differences between the present study and previous studies can be explained in several ways. The Mersky/Choi research group described that they dichotomized participant responses due to complications that can arise in Mplus when analyzing both categorical and continuous variables. We also dichotomized participant responses for each item, and took a different approach than Mersky and Choi.. For example, for items on a 5-point scale (1 = Never, 5 = Always), we coded all 1s as 0s (i.e., did not have that experience), and all other responses as 1 (i.e., they experienced that ACE to some extent). Mersky and Choi coded 0s (i.e., did not have that experience) for Rarely and Sometimes. Further investigation would be helpful to determine how the difference in dichotomization led to different study findings. A second explanation may be related to differences in sample and procedure across ours and Mersky et al.'s (2017) study. Our sample consisted of college students in the Southeast, and the Mersky sample consisted of low-income women in the Midwest. Further, we collected our data via online survey, whereas the Mersky sample data were collected via surveys administered in participants' homes.

We also tested measurement models across race groups, including Asian/Asian American, Black/African American, and White groups of college students, with the intention of conducting measurement invariance. We found that several modifications had to be made to the original four-factor model with 17 items to obtain a good model fit for all three groups. For the Asian group, we found that a two-factor, seven item model best captured direct victimization and family separation. For the Black group, we fit a three-factor, 15 item model (direct victimization, poverty, family separation). For the White group, a two factor, 9 item model fit best (direct victimization and family separation). Direct victimization and family separation appear to fit most robustly across groups, although not the same, and therefore, metric and scalar invariance were not met. Examining the mean factor scores across race groups, Asian participants reported the highest levels of neglect, followed by White, followed by Black participants, whereas Black participants reported the highest levels of poverty, followed by White, followed by Asian participants. Our results regarding poverty are aligned with national-level income data, whereas our neglect findings stand in contradiction to data suggesting that Black children experience higher rates of neglect than White children (Kim & Drake, 2018). Importantly, that same study suggests that, at higher poverty rates, White children experience higher levels of neglect than do Black children. It is possible that the sample we collected these data with may oversample lower income/socioeconomically marginalized White college students in comparison to the sample studied by Kim and Drake (2018).

It is important to note that, again, the four-factor model did not fit for any race nor sex group, and again, that these results may be due to sampling and procedural differences. Namely, our sample consisted of college students and included males in the sample. Mersky et al.'s (2017) sample was comprised of women who were part of the Family Foundations Home

Visiting Program, a program that promotes maternal and child health, parenting practices, and child development in at-risk families. Not only were the Mersky et al. Black and White participants sampled at different rates than the present study (present study: 17.24% White, 44.4% Black; Mersky study: 33.2% White, 27.4% Black), they did not include Asian women in their sample, which may also explain the difference in study findings.

Implications for Relational ACEs

Previous literature suggests that ACEs that are more relationally salient may have a stronger association with PTSD symptoms than less relationally laden ACEs (Anders et al., 2012a). To our knowledge, no research has been conducted to determine whether relational and traditional (or less/non-relational) ACEs are, in fact, separate constructs, despite a growing body of literature and measures that claim to capture “relational” ACEs. Therefore, in the current study, we tested a bifactor model and examined fit indices to determine whether ACEs are best represented by a global factor, or by two factors: traditional and relational ACEs. Although the overall model fit well, only global ACEs item loadings were significant. This finding can be understood in various ways. First, it is possible that the coding system we devised to determine whether an ACE is relational or traditional does not accurately reflect these potential constructs, and another coding system may lead to different results Our procedure, too, may have affected findings. We single-coded the data, and double coding/checking interrater reliability may change study results. Second, we asked college students to write about their ACEs experiences via an online survey to help determine whether they experienced an ACE as relational or traditional, and it is possible that this method of data collection resulted in poor data quality (e.g., low effort, validity issues, confusion). Third, we dichotomized the items differently than Choi et al. (2020) and Mersky et al. (2017), potentially contributing to the lack of significant findings (i.e., we may have included data in our analyses that do not best capture the construct). Finally, it is possible that ACEs are best represented by a global factor, and, in fact, relational and traditional ACEs are not separate constructs. Further inspection of the ACEs construct(s) is warranted, and researchers and clinicians should take caution when using measures that claim to measure "relational" ACEs (Amini-Tehrani et al., 2021) without further evidence of this constructs' existence.

Despite these limitations, we set out to test our third hypothesis: whether the relation between relational ACEs and PTSD symptoms was stronger than the relation between traditional ACEs and PTSD symptoms, as had been found in previous studies (Anders et al., 2012a). Our findings indicated that there was no difference in strength of association between relational and traditional ACEs and PTSD symptoms. We also found a strong, positive association between total ACEs score and PTSD symptoms, which is aligned with findings from previous studies conducted with Black college students (Labrenz et al., 2020; Slack et al., 2017). Further, the ways in which we conceptualized relational ACEs differed from how Anders et al. (2012a) determined which ACEs were relational. Anders et al. determined a priori whether an ACE was relational via two independent coders who agreed 100% of the time, whereas a single coder empirically coded participant descriptions of their subjective experience of an ACE to determine whether an ACE was relational in the present study. Future studies can help determine how to accurately capture relational ACEs by comparing our method with that of Anders et al. (2012a).

Associations between ACEs, GPA, Working Memory and PTSD Symptoms in College Students

Finally, we set out to examine the associations between ACEs, GPA, working memory, and PTSD using structural equation modeling in a diverse sample of college students. We encountered model estimation issues using M*plus* and instead switched to SPSS, and thus moved from a latent variable framework to working with measured indicators. We found that, overall, the association between ACEs and PTSD was significant for Black college students, but no single factor predicted PTSD. We also found that the relations between ACEs and GPA, working memory were not significant. No ACEs factors were associated with working memory, contrary to findings by Aylan et al. (2010) and Malarbi et al. (2017), which suggested that college students with higher ACEs experiences had lower cognitive functioning than students with lower ACEs. Our findings may shed light on the unique experiences of Black college students, which were not examined in either of these two studies. It is possible that, for Black college students, cognitions are less affected than for other groups of students with similar levels of ACEs. Our study replicated recent findings suggesting little to no association between ACEs exposure and academic performance (Merians et al., 2019). However, our study also used different measures than Merians et al. (2019), Aylan et al. (2010), and Malarbi et al. (2017), and the concerns raised around measurement invariance across sex and racial/ethnic groups in the present study raise caution around the robustness of the CES measure. The findings of the present study warrant further research with Black college students to more fully understand their unique experiences and the effects of early adversity on their outcomes during college, especially in relation to sex and SES.

Limitations

The findings of the present study should be interpreted in light of its limitations. First, our study was cross-sectional, and therefore, we could not speak to whether ACEs are predictive of college student outcomes. However, our selected study measures contribute to our current understanding of directions of effects between study variables. We asked about adverse events that occurred before the age of 18 (CES), trauma symptoms in the past month (PCL-5), tested students' present working memory (Symmetry Span), and collected participants' cumulative GPA. Longitudinal study design can contribute to the present study's findings by further helping to establish change over time. Second, the CES proved problematic in several measurement analyses, possibly owing to its mix of dichotomous and ordered-categorical response options. To obtain model convergence and reasonable estimations, we dichotomized items which reduced potential nuance that the continuous variables would otherwise be able to speak to. This directly contradicts recommendations by McLaughlin et al. (2021) and Smith and Pollack (2021), who call for more complex ways of measuring ACEs than are historically represented to more fully capture the human experience. Both research groups encourage fellow scientists to consider features of an event (e.g., intensity) and the experience of the adversity, stressing their importance in shaping negative outcomes. Although the CES seems to speak to the experiences of adversity in a more refined way than previous measures that simply assessed for whether the event occurred (e.g., includes 5-point scale for participants to report how frequently this happened), we were limited in our ability to maintain the richness of these data In order to due to the need to dichotomize and, essentially, move back to a "Yes/No" model. Third, we asked students to self-report their ACEs experiences, PTSD symptoms, and GPA. Skilled clinical interviewers may be able to glean different results and richer data via clinical interview. Although recent literature suggests that the PCL-5 has high concurrent validity with a structured PTSD diagnostic interview (Hansen et al., 2021), it is possible that some participants may feel more comfortable sharing about these sensitive experiences in the presence of a trained professional. Fourth, data were collected from a large, urban university in the US southeast. Our sample was 44.4% Black, whereas in the United States, Black or African American students make up 12.5% of all postsecondary enrollment (US Department of Education, 2021). It is possible that our data are not representative of student populations at other college campuses across the United States (i.e., low external validity). Therefore, this measure may work better/differently with groups of students from other college campuses. Finally, our coding scheme may not yet reflect a potential relational ACEs construct, especially across racial/ethnic groups with notable cultural differences. It is possible that cultural shame in endorsing particular ACEs items may have contributed to the present findings, including lack of measurement invariance and inability to distinguish relational versus traditional ACEs. Further work must be done to continue to parse out the importance of an ACE's relational salience, whether that is conceptually distinct from the experienced event or from less salient ACEs, and the potential effects on college student mental health.

Future Directions

Results from our study implicate several future directions for ACEs researchers. First, we recommend that researchers compare the way in which our team dichotomized CES item responses and compare it to Mersky et al. (2017) and Choi et al.'s (2020) approach. Further research is needed to explain the important differences in measurement findings across studies. Next, relational ACEs researchers should further explore relational ACEs as a construct before conducting further measurement work to ensure construct validity. Specifically, we would view the Inclusion of interviewing to gather information to determine whether an ACE is relational or traditional to be a valuable procedural change to what we did in the present study. Qualitative data analyses of open-ended, semi-structured interviews may help to better capture relational ACEs as a construct, especially given the cultural salience that these events entail. A randomized control trial where one group is clinically interviewed and one group receives the CES, with a control group receiving another ACEs measure, could help to assess for method effects. This work should guide the ways in which relational ACEs are measured and guide further data collection and analysis to determine the strength of association between ACEs and PTSD symptoms, working memory, and GPA in college students. Further, longitudinal research could be conducted to further map these effects over time, especially related to GPA in college students, and to increase reliability of the present findings. We encourage researchers to consider whether relational and traditional ACEs may share conceptual overlap. For example, each item may instead require three ratings: 1) Was the ACE experienced? 2) Was the ACE relational (perhaps on a scale)? and 3) Was the ACE traditional? Further work could be done to determine whether and how an ACE may be more traditional than relational, or whether it may share components of both. Finally, future research should test the CES on similar and different samples to continue to understand its psychometric properties, and to determine for whom this measure may work best. Research is also needed to understand the potential moderating effects of race and sex on the associations between ACE, PTSD symptoms, GPA, and working memory in college students.

Conclusion

The present study examined the psychometric properties of a refined ACEs measure that appeared to meet the call to action to understand ACEs more fully. We found the measure to be noninvariant across sex and race groups of college student participants. Our findings suggest that ACEs are best represented by a global factor, as opposed to two sub-factors, relational and traditional ACEs. We found that relational ACEs are not more strongly associated with PTSD symptoms than are traditional ACEs, though we did find a strong, positive association between cumulative ACEs and PTSD symptoms. Finally, ACEs were not associated with working memory and GPA in a sample of Black college students.

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APPENDICES

Appendix A

Abstract Screening Form

1. Does the title or the abstract indicate this is a quantitative study?
    a. Yes
    b. No
    c. Unsure
2. Does the title or abstract indicate that they gathered data from college students?
    a. Yes
    b. No
    c. Unsure
3. Does the title or abstract indicate that the authors measured ACEs (or a related concept)?
    a. Yes
    b. No
    c. Unsure
4. Does the title or abstract indicate that PTSD was measured in the study?
    a. Yes
    b. No
    c. Unsure

If NO to any of these questions, the abstract should be rejected.

Appendix B

Full-Text Screening Form

1) What is the name of the first author?
2) What was the year of publication?
3) What is the title of the report?
4) Was this a quantitative study?
5) Does the study sample include college/university students?
6) Does the study measure ACEs?
7) Does the study measure PTSD?
8) Does the study report the correlation coefficient between ACEs and PTSD?

If you answered “No” to 4, 5, 6, and/or 7, please code as 0 (do not include).

If you answered “Yes” to all questions, please code as 1.

If you answered “Yes” to questions 4-7, and no to question 8, please search supplemental materials for the correlation coefficient. If available, please code “1”. If unavailable, please code “0”.

Appendix C

Codebook

Please include this information on every sheet!

Coder	Initials	
Date	Date of coding	
ID	First two letters of the author's last name followed by the publication year If the article includes multiple effect sizes for different groups, please enter as separate entries. At the end of the ID please enter a letter to specify the difference between the code.	Example: AI2021 Example: AI2021A AI2021B AI2021C
ES_ID	Effect size ID. Each entry needs an individual ID. Start with number 1 and continue counting.	
ES_Descript	Describe the population or grouping of the effect size you will list for that specific entry	Example: overall, women, men, USA, Taiwan, Black, Latinx, Undergraduate, Graduate

Report Characteristics (1st tab on excel)

Author	What is the first author's last name?
NumAuthor	Number of authors.
Year	Publication year.
ReportType	What type of report is this? 1 – Journal Article 2 – Dissertation or Master Thesis 3 – Unpublished Study 4 – Conference Paper/Poster 5 – Other (specify) 6 – Unclear -99 – Missing
PeerReview	Is this a peer-reviewed document? 1 – Yes 2 – No 3 – Unclear

	-99 – Missing
Funded	Was this research funded? 0 – No 1 – Yes 2 – Unclear -99 – Missing
Power Analysis	Did they conduct a power analysis? 0 – No 1 – Yes
Study Type	What kind of study was it? 1 – Correlational 2 – Longitudinal 3 – Experimental 4 – Experimental and longitudinal
Analysis Used	1 - Correlation 2 - Regression
Cronbach's Alpha	Did authors report Cronbach's alpha for both measures? 0 – No 1 – Yes

Population and Setting Characteristics (2nd tab)

Country	Was the study conducted in the United States 1 – Yes 2 – No 3 – Unclear -99 – Missing
SampTotal	What was the final sample size for the effect size you are describing?
Per_Women	What was the total percentage of girls/women in the study?
Per_Black	What was the percentage of Black/African American participants in the study?
Per_Latinx	What was the percentage of Hispanic/Latinx participants in the study?
Per_Native	What was the percentage of Native or Indigenous people in the study?
SES	Does the study report data on SES (e.g., household income, maternal education)?

	0 = No 1 = Yes
Mean_Age	What is the mean age of the participants in the study?

ACEs Variable (3rd Tab)

ACEs Definition	How do authors define ACEs?
ACEs_Measure	Name of the ACEs measure? (e.g., CDC ACES Questionnaire)
Type.Spec	What type of ACE does the study measure? 0 = Sum 1 = Sexual Abuse 2 = Punishment 3 = Physical Abuse 4 = Emotional Abuse 5 = Community Violence Exposure 6 = Domestic Violence Exposure 7 = Theft and Property Damage 8 = Assault Victimization 9 = Maltreatment 10 = Peer/sibling Victimization 11 = Physical Neglect 12 = Emotional Neglect 13 = Household Dysfunction 14 = Betrayal
ACEs_Relational	Did the ACE measured have a relational component? (i.e., sexual abuse, emotional abuse, domestic violence exposure, peer/sibling victimization, emotional neglect, or betrayal) 0 = No 1 = yes -999 = does not apply
ACEs_Mean	What was the mean of the ACEs measure for the sample/effect size you are describing?
ACEs_SD	What was the standard deviation of the ACEs measure for the sample/effect size you are describing?

ACEs_Alpha	What was the internal consistency of the ACEs measure for the sample/effect size you are describing? If they do not provide specific internal consistency, please list the overall internal consistency reported.

PTSD Variable (4th Tab)

PTSD_Measure	What is the name of the persistence measure used? (e.g., Commitment to a Science Career (Chemers et al., 2010))
PTSD_Mean	What was the PTSD mean score for the sample/effect size you are describing?
PTSD_SD	What was the PTSD standard deviation score for the sample/effect size you are describing?
PTSD_Alpha	What was the internal consistency of the PTSD measure for the sample/effect size you are describing? If they do not provide specific internal consistency, please list the overall internal consistency reported.
PTSD_Corr	What was the correlation between the PTSD measure and the ACEs measure for the sample/effect size you are describing?

Appendix D

Characteristics of ACEs Studies Included in the Meta-Analysis

Study	*N*	*Mean Age*	*Sample*	*Measure*	*Type*
Barlow et al. (2017)	466	21.21	US college students	Child Abuse Trauma Scale (CAT; Sanders & Becker-Lausen, 1995)	Sum, S.A., Pun. Emot. Neg. Emot. Ab.
Berenz et al. (2018)	320	18.5	US college students	Traumatic Life Events Questionnaire (TLEQ; Kubany et al., 2000)	S. A., Phys. Ab., DVE
Berman et al. (2021)	252	19.2	US women college students	Felitti et al. ACEs Questionnaire (1998)	Sum, Mal., HD
Boyraz et al. (2019)	747	20.18	US college students	Brief Betrayal Trauma Survey (BBTS, Goldberg & Freyd, 2006)	Betrayal
Burns et al. (2010)	912	19	US women college students	Childhood Trauma Questionnaire (CTQ; Bernstein & Fink, 1998)	S.A., Phys. Ab., Emot. Ab.
Cantón-Cortés et al. (2011)	1529	19.43	Spanish women college students	Childhood Sexual Abuse Questionnaire (Cantón-Cortés et al., 2011)	S.A.
Carroll (2011)	89	19.19	US college students	Childhood Trauma Questionnaire (CTQ; Bernstein & Fink, 1998)	Sum
Collings (2012)	323	20.14	South African college students	Brief Betrayal Trauma Survey (BBTS; Goldberg & Freyd, 2006)	Sum
Delker et al. (2018)	361	19.63	US college students	Adult Retrospective Version of the Juvenile Victimization	Betrayal

				Questionnaire (JVQ); (Finkelhor et al. 2005)	
Espelage et al. (2016)	482	19.98	US college students	Banyard, Arnold, and Smith's (2000) CSA questionnaire adapted from Finkelhor (1979)	CV, DVE, TPD, Ass. Vic., Emot. Ab., S.A.
Filipas & Ullman (2006)	577	19.6	US college students	Conflict Tactics Scale (CTS; Straus, 1979)	Age O./E., Freq., Dur., Sev.
Haj-Yahia et al. (2019)	516	24.9	Israeli social work college students	Traumatic Life Events Questionnaire (TLEQ) ; (Kubany, Haynes, et al., 2000)	Sum
Hannan et al. (2017)	579	18.8	US women college students	Sum	Sum
Hong & Lishner (2016)	248	19.7	US college students	2017 CDC Behavioral Risk Factor Surveillance System Questionnaire ACE module and Kaiser Permanente ACE Study (Felitti et al., 1998)	S. A., Emot. Neg., Emot. Ab.
Jakubowski (2014)	540	18.76	US college students	Childhood Trauma Questionnaire–Short Form (Bernstein et al., 2003)	Sum
Jeter & Brannon (2014)	232	18.32	US women college students	Conflict Tactics Scale (CTS-PC form R; Straus 1979; 1990); Finkelhor's Survey of Childhood Sexual Experiences (1979)	Sum
Kendra et al. (2012)	496	18.81	US women college students	Early Trauma Inventory—Self Report—Short Form (ETISR-SF; Bremner, Bolus, & Mayer, 2007)	Sum
Klanecky et al. (2019)	157	18.94	US college students	Childhood Trauma Questionnaire (CTQ; Bernstein et al., 1994)	Sum

Lassri et al. (2016)	99	23.32	Israeli college students	Childhood Trauma Questionnaire – Short Form (CTQ-SF)	Sum
Lewis & Naugle (2017)	226	20	US college students	Sexual Abuse Questionnaire (SAQ) (Lock et al., 2005)	Sum
Lock et al. (2005)	519	18.6	US college students	Juvenile Victimization Questionnaire–Adult Retrospective (JVQR2)	S.A.
Miller-Graff et al. (2015)	395	19.21	US college students	Juvenile Victimization Questionnaire—Adult Retrospective—Short Form (JVQ-R2)	Sum
Miller-Graff et al. (2019)	369	19.57	US college students	Life Experience Questionnaire (LEQ; Long, 1999)	Mal., P/S Vic., S.A., TPD, DVE
Mokma et al. (2016)	929	18.89	US women college students	ETI (ETI-SR; Bremner, Vermetten, & Mazure, 2000)	Sum
Richardson & Jost (2019)	251	20.51	US college students	self-report adaptation of Finkelhor’s Survey of Childhood Sexual Experiences (CSEQ; 1979)	Sum
Risser et al. (2006)	1464	19	US women college students	Wyatt Sexual History Questionnaire (WSHQ; Wyatt, 1988; Wyatt, Lawrence, Vodounon, & Mickey, 1992)	Sev., Dur., Type., For.
Rosenthal et al. (2005)	153	21	US women college students	Childhood Trauma Questionnaire—Short Form (CTQ–SF; Bernstein et al., 2003)	S. A.
Sacchi et al. (2018)	458	23.06	Italian graduate and undergraduate students	Traumatic Life Events Questionnaire (TLEQ); (Kubany et al., 2000)	Phys. Ab., Emot. Ab., S. A., Phys. Neg.,

					Emot. Neg.
Sandberg et al. (2010)	224	21.73	US women college students	Childhood Sexual Victimization questions from Finkelhor (1979)	Phys. Ab., S. A.
Sandberg (2010)	199	-999	US women college students	Childhood Trauma Questionnaire-Short form; (Bernstein et al., 2003)	S. A., Phys. Ab.
Simonelli et al. (2017)	79	22.67	Italian college students	Childhood Trauma Questionnaire-Short form; (Bernstein et al., 2003)	Emot. Ab., Phys. Ab., S. A.
Sistad et al. (2021)	586	19.58	US college students	Child Abuse and Trauma Scale (CATS; Sanders & Becker-Lausen, 1995)	Sum
Walsh et al. (2013)	714	19.7	US women college students	Childhood Trauma Questionnaire (CTQ; Bernstein & Fink, 1998)	Sum
Zinzow et al. (2010)	183	19.1	US women college students	Life Experiences Questionnaire (LEQ); (Ray, 1993)	Typ., Freq., Dur., Age O., Intra.

Appendix E

Demographics Questionnaire

1. What is your sex?
    a. Female
    b. Male
2. What is your gender?
    a. Female
    b. Male
    c. Transgender
    d. Other, please specify
    e. Decline to answer
3. What is your age? (write the number)
4. Please indicate your race, the ethnic group(s) that you identify with the most (you can select more than one):
    a. American Indian/Alaska Native
    b. Asian/ Asian American
    c. Black/ African American
    d. Latinx/ Hispanic
    e. Multiracial
    f. Native Hawaiian/ Pacific Islander
    g. White/ European American
    h. Other, please specify

5. What is your cumulative college GPA? (Example: 2.45)

6. What was the average annual income for your household growing up?

    a. Under $15,000

    b. $15,000 - $24,999

    c. $25,000 – 34,999

    d. $35,000 to $49,999

    e. $50,000 to $74,999

    f. $75,000 to $99,999

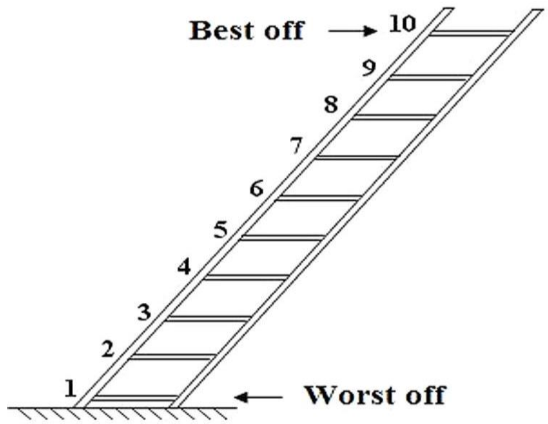
    g. $100,000 to $149,999

    h. $150,000 to $199,999

    i. $200,000 and over

7. Think of this ladder as representing where people stand in the United States. At the top of the ladder are the people who are the best off – those who have the most money, the most education, and the most respected jobs. At the bottom are the people who are the worst off – those who have the least money, the least education, the least respected jobs, or no job. The higher up you are on the ladder, the closer you are to the people at the very top;

the lower you are, the closer you are to the people at the very bottom.



Where would you place yourself on this ladder? Please click a number below that matches the rung where you think you stand at this time in your life relative to other people in the United States.

○ 10 (10)

○ 9 (9)

○ 8 (8)

○ 7 (7)

○ 6 (6)

○ 5 (5)

○ 4 (4)

○ 3 (3)

○ 2 (2)

○ 1 (1)

Appendix F

Questionnaires

CES

While you were growing up, during your first 18 years of life:

1. How often did a parent or other adult in your home ever hit, beat, kick, or physically hurt you in any way?

Never	Once	More than once

a) Describe this experience in as great a detail as you feel comfortable sharing. What happened, and how did the experience make you feel?

2. How often did an adult or person at least 5 years older than you touch you sexually, try to make you touch them sexually, or force you to have sex?

Never	Once	More than Once

a) Describe this experience in as great a detail as you feel comfortable sharing. What happened, and how did the experience make you feel?

3. How often did a parent or other adult in the household swear at you, insult you, or put you down?

Yes	No

a) Describe this experience in as great a detail as you feel comfortable sharing. What happened, and how did the experience make you feel?

4. How often was there an adult in your household who tried hard to make sure your basic needs were met?

Never	Rarely	Sometimes	Most of the Time	Always

a) Describe this experience in as great a detail as you feel comfortable sharing. What happened, and how did the experience make you feel?

5. How often was there an adult in your household who made you feel safe and protected?

Never	Rarely	Sometimes	Most of the Time	Always

a) Describe this experience in as great a detail as you feel comfortable sharing. What happened, and how did the experience make you feel?

6. Did you live with anyone who…

   a) Was a problem drinker or alcoholic?

   b) Used illegal street drugs or who abused prescription medications?

Yes	No

a) Describe this experience in as great a detail as you feel comfortable sharing. What happened, and how did the experience make you feel?

7. Did you live with anyone who was depressed, mentally ill, or suicidal?

Yes	No

a) Describe this experience in as great a detail as you feel comfortable sharing. What happened, and how did the experience make you feel?

8. How often did your parents or adults in your home ever slap, hit, beat, kick, or physically hurt each other?

Never	Once	More than Once

a) Describe this experience in as great a detail as you feel comfortable sharing. What happened, and how did the experience make you feel?

9. Did you live with anyone who served time or was sentenced to serve time in a prison, jail, or other correctional facilities?

Yes	No

a) Describe this experience in as great a detail as you feel comfortable sharing. What happened, and how did the experience make you feel?

10. Were your parents separated or divorced?

Yes	No

a) Describe this experience in as great a detail as you feel comfortable sharing. What happened, and how did the experience make you feel?

11. As a child, how often did your family experience financial problems?

Never	Rarely	Sometimes	Often	Very Often

a) Describe this experience in as great a detail as you feel comfortable sharing. What happened, and how did the experience make you feel?

12. How often were you hungry because your family could not afford food?

Never	Rarely	Sometimes	Often	Very Often

a) Describe this experience in as great a detail as you feel comfortable sharing. What happened, and how did the experience make you feel?

13. How often were you homeless when you were growing up?

Never	Rarely	Sometimes	Often	Very Often

a) Describe this experience in as great a detail as you feel comfortable sharing. What happened, and how did the experience make you feel?

14. Was either one of your parents absent from your life for a long period of time?

Yes	No

a) Describe this experience in as great a detail as you feel comfortable sharing. What happened, and how did the experience make you feel?

15. How often were you bullied or severely teased by other children or adolescents?

Never	Rarely	Sometimes	Often	Very Often

a) Describe this experience in as great a detail as you feel comfortable sharing. What happened, and how did the experience make you feel?

16. Before age 18, did you experience the death of a parent, caregiver, or sibling?

Yes	No

a) Describe this experience in as great a detail as you feel comfortable sharing. What happened, and how did the experience make you feel?

17. Before age 18, were you ever the victim of a violent crime?

Yes	No

a) Describe this experience in as great a detail as you feel comfortable sharing. What happened, and how did the experience make you feel?

PCL-5

Instructions: Below is a list of problems that people sometimes have in response to a very stressful experience. Please read each problem carefully and then circle one of the numbers to the right to indicate how much you have been bothered by that problem in the past month.

Not at all	A little bit	Moderately	Quite a bit	Extremely

1) Repeated, disturbing, and unwanted memories of the stressful experience?
2) Repeated, disturbing dreams of the stressful experience?
3) Suddenly feeling or acting as if the stressful experience were actually happening again (as if you were actually back there reliving it)?
4) Feeling very upset when something reminded you of the stressful experience?
5) Having strong physical reactions when something reminded you of the stressful experience (for example, heart pounding, trouble breathing, sweating)?
6) Avoiding memories, thoughts, or feelings related to the stressful experience?
7) Avoiding external reminders of the stressful experience (for example, people, places, conversations, activities, objects, or situations)?
8) Trouble remembering important parts of the stressful experience?
9) Having strong negative beliefs about yourself, other people, or the world (for example, having thoughts such as: I am bad, there is something seriously wrong with me, no one can be trusted, the world is completely dangerous)?
10) Blaming yourself or someone else for the stressful experience or what happened after it?
11) Having strong negative feelings such as fear, horror, anger, guilt, or shame?
12) Loss of interest in activities that you used to enjoy?

13) Feeling distant or cut off from other people?

14) Trouble experiencing positive feelings (for example, being unable to feel happiness or have loving feelings for people close to you)?

15) Irritable behavior, angry outbursts, or acting aggressively?

16) Taking too many risks or doing things that could cause you harm?

17) Being “superalert” or watchful or on guard?

18) Feeling jumpy or easily startled?

19) Having difficulty concentrating?

20) Trouble falling or staying asleep?

Operation Span Task

Now, in this task, we would like you to identify whether a figure is symmetrical along its vertical axis and memorize the positions of red squares.

Symmetry component

A black and white figure will first appear on the screen, like this:

Identify whether the figure is SYMMETRICAL along the vertical axis or NON-SYMMETRICAL. Since the figure above is not symmetrical along the vertical axis, you should select NON-SYMMETRICAL. Once you have selected the answer, you will be automatically directed to the red square component. It is important that you get these problems correct, but also solve them as quickly as possible.

Red square component

Once you make your decision about the symmetry problem, a 4 by 4 grid with one red square will appear on the next screen for 1 second. Try and remember the position of the red square. After 1 second, another symmetry problem will automatically appear. Similarly, once you solve the symmetry problem, another 4 by 4 grid with one red square will appear. At the end of each round, you will be asked to recall and list down all the positions of the red squares which appeared, in their order of appearances.

Q3 On the next page, we would like for you to test the fit of the page on your screen. Please use the "zoom-out" function on your browser to shrink the page to zoom if you cannot see the whole page without doing any scrolling.

Click the proceed button to start testing the page fit. It is recommended to use 80% zoom if you are on a device with a 13-inch display and 100% zoom if the device has a 15-inch display.

Q4 (sample)

Q5 This is a sample for you to test the fit of the page on your device. Please feel free to move on from this question without answering once you have adjusted the page to fit the screen.

Q6 On the next page, we will begin with a trial run. This is to allow you to get used to the task. Your performance during this practice run will not be recorded, so please feel free to get familiarized with the task. There will be a total of 3 symmetry-red square pairs in this round. You will need to recall and list down the 3 positions of the red squares in order of their appearances at the end of the round. Click the proceed button when you are ready to start.

Appendix G

Instructions for Coding Detailed CES Responses

Thoroughly read each response and use the following questions to determine whether the participant is reporting a relational ACE:

1) They experienced a relationship loss.
2) They experienced interpersonal rejection.
3) They felt like they did not belonged in a relationship.
4) They did not feel safe in a relationship.
5) They did not feel secure in a relationship.

If the participant’s response indicates that they experienced any of the above items, code their response as Relational (1) or Traditional (0).

Definitions

Relational ACE: Relationship loss, interpersonal rejection, or any event that represents a threat to one of the central functions of interpersonal relationships; threatens human need to belong

Traditional ACE: anything that does not meet the criteria for relational ACE (e.g., natural disaster; felt physically threatened, but a relationship was not threatened)