Title

Correction to: Young Adult Mental Health Problem Incidence Varies by Specific Combinations of Adverse Childhood Experiences

Authors

Agrawal, Juhee
Lei, Yvonne
Shah, Vivek
et al.

Publication Date

2025

DOI

10.1007/s42844-025-00165-4

Peer reviewed

Introduction

Adverse Childhood Experiences (ACEs) are stressful, potentially traumatic events occurring before age 18 associated with worse health outcomes across the life course (Bellis et al., 2019; Nelson et al., 2020). They are conventionally defined to include 3 types of abuse (sexual, physical, and emotional), 2 types of neglect (physical and emotional), and 5 types of household challenges (parent with mental illness, parent with substance use disorder, incarcerated parent, domestic violence, and divorced or single parent). The ACEs were defined as a combination of these domains in the CDC-Kaiser study in 1998, showing that as the total number of ACEs an individual has experienced (the "ACE score") increases, the risk for adverse health outcomes in adulthood increases (Felitti et al., 1998). However, the ACE score may mask important variation in health risk conferred by specific types and combinations of ACE exposures.

While the growing body of ACEs research has been instrumental in improving our understanding of how ACEs impact health, the numerical ACE score is an imprecise measure because it assumes without evidence that each ACE carries equal risk. Different ACEs likely convey different risks, as demonstrated in a small number of studies comparing specific ACEs (e.g. sexual abuse and parental separation (Auersperg et al., 2019; Downing et al., 2021)). These differences must be examined to accurately predict health risks that specific ACEs confer, whether to inform clinical risk stratification or to understand how to prioritize interventions to interrupt ACEs' influence on health. Additionally, since individuals with ACEs often have multiple, co-occurring ACEs, it is important to know the different associated risks not only for solitary ACE types but also for specific *combinations* of ACE types.

Besides the ACE score, other methodological approaches have been conceptualized to understand cumulative adversity in childhood and how health outcomes differ based on specific exposures. One approach uses Latent Class Analysis (LCA) to identify subgroups of children who experience the same discrete ACEs and other risk factors together. Several studies have used LCA to study ACE clustering as they pertain to mental health outcomes later in life (Barboza, 2018; Bevilacqua et al., 2021; Björkenstam et al., 2015; Lee et al., 2020). While LCA looks at the most common ways ACEs travel together, it does not systematically examine each combination of ACEs and the health outcome risk associated with each combination.

Another approach to conceptualize specific ACE exposures and their associated health risks is dimensional analysis, which examines the extent to which negative ACE-associated health outcomes vary based on which dimension the ACE is in (for example, as conducted in Sheridan and McLaughlin's study, ACEs are categorized as exposures to threat versus experiences of deprivation), and how frequent and severe the ACE is (McLaughlin & Sheridan, 2016). Both dimensional analysis and LCA attempt to categorize ACEs together and do not provide a comprehensive examination of each ACE combination's risk of different health outcomes. This is an important limitation, because with the increase in ACE screening tools used in the clinical setting, clinicians do not know the outcome risk associated with specific combinations that patients or family members may disclose. While some studies have begun to examine specific ACE combinations and their associated risk with outcomes such as behavior problems (Putnam et al., 2020) or specific mental illnesses like depression (Giano et al., 2021), no study has systematically examined each combination of ACEs and their risk for poor mental health outcome development in the stage of life immediately after childhood.

ACEs are strongly associated with increased risk of developing depression and anxiety, so these mental health outcomes may be well-suited to examine differential longitudinal ACE-health associations for ACEs alone or in combination (De Venter et al., 2013; Hughes et al., 2017). Young adulthood is a time marked by the onset of many mental health disorders. Seventy-five percent of all mental illnesses emerge during or have emerged by young adulthood (Kessler et al., 2005). While cross-sectional studies have linked ACEs and the likelihood of mental illness or chronic disease development in young adulthood (Sonu et al., 2019), no studies have longitudinally assessed the differential risk of developing psychological distress and mental illness in young adults based on specific exposure to an ACE type or ACE type combinations. Further, this has not been studied using a nationally representative sample.

In this study, we examined how types of exposure to ACEs *and* combinations of exposures to ACEs were associated with longitudinal risk of developing mental health problems, measured as either a new mental illness diagnosis or severe psychological distress, in a nationally representative sample of young adults. We hypothesized that different ACE types and combinations of ACEs would be associated with varying risk of mental health problems.

Methods

Sample and Data Sources

We used data from the Transition to Adulthood Supplement (TAS) of the Panel Study of Income Dynamics (PSID) (McGonagle & Sastry, 2015). The PSID is the longest running nationally representative panel survey that conducts surveys biennially from one person per household. Survey topics include employment, income, wealth, and health. In 2005, the TAS was created to follow children surveyed in another supplement called the Child Development Supplement (CDS), which included data about up to two children per household. The TAS

collects information via phone interview about various topics including mental health and sociodemographic information (Dynamics). The 2017 wave includes ACEs information, although few studies have utilized the PSID to study the effects of ACEs. Both the CDS and TAS contain information about mental health. The CDS has information about socioemotional well-being through the behavior problem scale (which asks parents questions about whether the child experiences "sudden changes in mood or feeling, is fearful or anxious, bullies or is cruel or mean, [or] demands a lot of attention") (Sandra Hofferth). The TAS asks respondents about mental illness diagnoses, including the age of diagnosis for common mental health conditions (e.g., depression, anxiety, phobias, obsessive compulsive disorder, post-traumatic stress disorder, bipolar disorder, and schizophrenia) and how these conditions limited their schoolwork and activities. It also has questions about symptoms of depression and anxiety in the participant and diagnoses and symptoms of mental illness in their parents (Noura Insolera, 2019). Because the PSID has information about both parent and child ACE exposures and health outcomes, it has been utilized to study the intergenerational effects of ACEs (Schickedanz et al., 2018).

Our study examined six TAS waves (2007, 2009, 2011, 2013, 2015, 2017), with response rates by wave ranging from 86%-92%. Participants were eligible for TAS 2007-2015 if they were part of a PSID household and had been children in households surveyed for the 1997 PSID Child Development Supplement (CDS), had reached age 18 by the year of a given TAS wave, and were 28 or under. Beginning in 2017, all PSID sample members aged 18 to 28 years were eligible for TAS participation, and this group of young adults was our primary study population. For our study, we excluded individuals who participated in the 2017 TAS but were *not* members of the 1997 CDS cohort, leaving a sample of only those 2017 TAS participants who had been part of the 1997 CDS cohort and one or more 2007-2015 TAS waves (N=1832).

Measures

The ACEs measures were constructed by aggregating more fine-grained survey items from the TAS. Indicators of 9 ACEs were derived from 36 measures of component survey items from the TAS 2017, an approach adapted from prior studies (Schickedanz et al., 2018; Schickedanz et al., 2019). For example, the sexual abuse measure was created by including responses to four questions regarding sexual intercourse history in the 2017 TAS. ACEs variable creations are detailed in Table 1.

We examined 2 mental health outcome measures: mental illness diagnosis and severe psychological distress. We assessed mental illness diagnosis by a binary response item at each wave. Participants responded to the survey item "has a clinician ever told you that you have depression, anxiety, or other mental illness?" Psychological distress was assessed from the Kessler Psychological Distress Scale (K6) score, assessing self-reported psychological distress in the past 30 days. The K6 is well-validated and widely used to identify individuals at high risk of severe mental illness without a clinical diagnosis (Bryant et al., 2020; Liu et al., 2018; Prochaska et al., 2012; Sanchez-Villegas et al., 2008). This scale asks 6 questions regarding frequency in the last month of symptoms of feeling (1) nervous, (2) hopeless, (3) restless, (4) too sad, (5) worthless, and/or (6) that everything is an effort (Prochaska et al., 2012). Each question was asked on a 5-point scale, where 0 was "none of the time" and 4 was "all of the time." The scores were then summed (range of 0-24). The psychological distress outcome was dichotomized based on scoring 13 points or higher, per the previously validated threshold for clinically significant severe psychological distress (Kessler et al., 2003).

The mental illness diagnosis measure was intended to capture clinically diagnosed mental illness, while the K6 psychological distress score was used to measure real-time, self-reported symptom burden without requiring a clinical diagnosis, irrespective of health care utilization.

Our outcome measures included both prevalence and incidence of mental illness diagnoses and severe psychological distress separately using longitudinal data across waves of the TAS. To measure outcome incidence, participants who had the outcome of interest in a survey wave two years prior to any given wave were excluded. Two-year outcome *incidence* was considered positive in a TAS wave if a participant was positive for the outcome in a wave of the TAS after having been negative in prior waves. Outcome *prevalence* was considered positive if a participant was positive for the outcome in any TAS wave included (2007-2017). The purpose of including outcome prevalence was two-fold: first, to highlight differences in adverse mental health outcomes when comparing different ACE exposures, and second, to provide a reference point for interpreting incidence data.

Covariates

Covariates included in all regression models were sex, race or ethnicity, age, marital status, family income as a proportion of Federal Poverty Level (FPL) (<100% FPL, 100-199% FPL, 200-400% FPL, >400% FPL), participant's educational attainment, participant's highest parental educational attainment (less than high school, high school, or any college or higher degree), health insurance (has insurance or does not have insurance), and healthcare utilization ("in the past 12 months, did you go to the doctor for a checkup?"). All covariates were allowed to vary at each wave in the models. We obtain race and ethnicity as covariates as a proxy to control for individuals' experience with racism and other related disparities.

Statistical Analysis

For our analyses, we used a logistic regression with cluster-robust variance estimation to account for correlation within individuals. We first examined covariate-adjusted associations between each of the 9 ACEs and *prevalence* of mental illness diagnosis and then, separately, severe psychological distress. We then performed longitudinal analyses between the 9 individual ACEs and 2-year *incidence* of the same two mental health outcomes. To investigate the impact of combinations of ACEs on mental illness diagnosis, we tested associations between pairwise combinations of ACEs and prevalence and incidence (separately) of each mental health outcome. All ACEs or ACE combinations that were not being analyzed as the primary exposure of interest in a given model were held at their mean levels in the model. All analyses were conducted using all waves of TAS data included in the study (2007-2017).

Outcome risk ratios and 95% confidence intervals (CIs) were calculated for individual ACEs. Absolute outcome incidence risks and 95% CIs were estimated for both individual ACEs and combinations of ACEs. All analyses were adjusted with the 2017 TAS individual longitudinal weight to account for the complex survey design and nonresponse (Noura Insolera, 2019). The UCLA IRB reviewed the study and approved it as exempt. All analyses were performed using STATA version 17.0 (Stata Corp, College Station, TX).

Results

The average response rate was over 90% across all 6 TAS waves. Across all waves, 50% identified as male, 44% of the sample was White, 43% of the sample was Black, 10% was Hispanic or Latino, 21% were from households with low income (under 200% of the Federal Poverty Line), and 77% of participants had experienced at least 1 ACE (Table 2). Across all waves, the most experienced ACE was emotional abuse, experienced by 44% of participants. The least experienced ACE was emotional neglect, experienced by 1% of participants. 12% of

participants reported a mental illness diagnosis. 7.5% of participants reported a new mental illness diagnosis within any given 2-year period in young adulthood. 5% of participants had experienced clinically severe psychological distress in the past 30 days relative to the time they were being interviewed in at least one of the TAS waves. 4.5% of participants experienced severe psychological distress in the past 30 days relative to their interview time for the first time within any 2-year period in young adulthood (meaning, in the prior TAS waves, they had not experienced this outcome, but then experienced it newly in a particular TAS wave).

Variation in Outcome Risk by Individual ACE Type

Investigating the 9 individual ACEs showed that parental mental illness, emotional neglect, and sexual abuse were significantly associated with increased prevalence of mental illness diagnosis. Of these, parental mental illness and sexual abuse were associated with highest risks of increased prevalence of mental illness diagnosis (Fig. 1). For our longitudinal analyses, divorce/single parent, parental interpersonal violence, parental incarceration, parental mental illness, emotional neglect, emotional abuse, and sexual abuse were significantly associated with increased risk of mental illness diagnosis incidence over any given two-year period in the study. Similarly, parental mental illness and sexual abuse were associated with the highest average risks of increased incidence of mental illness diagnosis across any given 2-year interval in the study (Fig. 1).

Analyses of the 9 individual ACEs demonstrated that divorce/single parent, parental incarceration, parental interpersonal violence, parental mental illness, emotional neglect, emotional abuse, physical abuse, and sexual abuse were associated with increased prevalence of severe psychological distress. Individual ACEs that conferred the highest risks of severe psychological distress prevalence were parental mental illness and parental incarceration (Fig. 1).

Longitudinally, we found that parental incarceration, parental mental illness, emotional abuse, physical abuse, and sexual abuse were significantly associated with an increase in newly experiencing severe psychological distress over any given 2-year interval of the study period. Parental mental illness and sexual abuse were associated with the highest risks of increased psychological distress incidence over any given 2-year interval of the study period (Fig. 1).

Variation in Mental Illness Diagnosis Risk by ACE Combination

The absolute outcome risk of prevalence of mental illness diagnosis varied widely across groups defined by different pairwise combinations of ACEs, ranging between 3.2% to 77.3%. Pairwise ACEs combinations associated with highest absolute outcome risk of prevalence of mental illness diagnosis were 1) divorce/single parent plus emotional neglect, 2) parental mental illness plus emotional neglect, and 3) parental mental illness plus sexual abuse (Fig. 2). Pairwise ACEs combinations associated with lowest absolute outcome risk of prevalence of mental illness diagnosis were 1) parental interpersonal violence plus parental incarceration, 2) parental substance use plus emotional abuse, and 3) parental substance use plus parental interpersonal violence (Fig. 2).

For incidence of the new mental illness diagnosis outcome, the absolute outcome risk also varied widely for the pairwise combinations of ACEs, ranging from 0.7% to 32.3% probability of new mental illness diagnosis within any 2-year period studied. Pairwise ACEs combinations associated with highest absolute outcome risk of incidence of mental illness diagnosis over any studied two years period were 1) parental mental illness plus emotional neglect, 2) parental mental illness plus sexual abuse, and 3) divorce/single parent plus sexual abuse (Fig. 2). Pairwise ACEs combinations associated with lowest absolute outcome risk of

incidence of mental illness diagnosis were 1) parental substance use plus physical abuse and 2) parental substance use plus parental interpersonal violence (Fig. 2).

Variation in Psychological Distress Risk by ACE Combination

Across groups with different pairwise combinations of ACEs, the absolute risk for severe psychological distress prevalence varied from 0.4% to 12.7%. The combinations of ACEs associated with the highest absolute outcome risk were 1) parental mental illness plus parental incarceration, 2) parental mental illness plus emotional neglect, and 3) parental mental illness plus sexual abuse (Fig. 3). Pairwise ACE combinations associated with lowest absolute risk of ever experiencing severe psychological distress were 1) parental interpersonal violence plus emotional neglect, 2) parental interpersonal violence plus sexual abuse, and 3) parental interpersonal violence plus parental substance use (Fig. 3).

The absolute 2-year risk of newly experiencing severe psychological distress also varied widely across groups defined by different pairwise combinations of ACEs, ranging from 0.8% to 9.7%. The pairwise combinations conferring highest absolute outcome risk for increased incidence of severe psychological distress were 1) parental mental illness plus sexual abuse and 2) parental mental illness plus parental incarceration (Fig. 3). Pairwise ACEs combinations associated with lowest absolute incidence risk of severe psychological distress were 1) physical abuse plus emotional neglect and 2) parental interpersonal violence plus sexual abuse (Fig. 3).

Discussion

In this longitudinal study across 10 years of a nationally representative sample of young adults, we found different ACEs, and their combinations, were associated with widely differing levels of risk for worsened mental health outcomes.

To our knowledge, this is the first longitudinal, nationally representative study in a young adult population comprehensively examining the link between individual ACEs and pairwise combinations of ACEs and mental health outcomes. The strength of this type of approach as compared to LCA and dimensional analysis is that it empirically, rather than conceptually, analyzes each pairwise ACE combination for its associated mental health outcome risk. Our results suggest that the pattern of relationships between ACE combinations is complex and associated with widely varying mental health risk. Since each individual ACE and ACE combination carries different mental health risks, using the ACE score alone may not be the most precise and useful approach to risk assessment. Our results suggest that it is more informative to examine an individual's specific exposures to ACEs to estimate longitudinal risk more accurately for mental health outcomes. Additionally, this study adds to the limited number of studies using the PSID to study ACEs and their longitudinal effects, demonstrating the potential of this dataset to be used for this purpose.

Our study found that parental mental illness and sexual abuse – whether independently, together, or combined with various other ACEs – were most strongly associated with mental health problem risk. We also saw that the combination of parental mental illness and emotional neglect was associated with some of the highest risks for adverse mental health outcomes. Across individual ACEs and their combinations, parental mental illness consistently had the strongest association with incidence and prevalence of mental illness diagnosis and psychological distress.

The link between parent and child mental illness has been well-established, with evidence that children of parents with mental illness have an up to 50% increased risk of developing a mental illness.(Leijdesdorff et al., 2017) Another study using the PSID found that individuals

whose parents suffered mental health problems experience increased psychological distress throughout adulthood (Kamis, 2021). Evidence suggests several mechanisms mediate this relationship, including increased genetic predisposition and increased prevalence of out-of-household factors, including low socioeconomic status and unemployment (Manning & Gregoire, 2006). Other studies have also shown that childhood sexual abuse has been found to be strongly associated with developing post-traumatic stress disorder or other mental illnesses in adolescence and young adulthood (Boumpa et al., 2022; Burnam et al., 1988). Current hypotheses show that these associations may be mediated by traumatic sexualization, insecure attachment, and avoidance (Noll, 2021).

Across our results, parental substance use, physical abuse, and household violence individually were associated with the least risk of adverse mental health outcomes. Additionally, when considering combinations of ACEs, we found that the individual ACEs conferring the least risk to adverse mental health outcomes (parental substance use and physical abuse) also conferred the least risk when combined with other ACEs.

The finding that parental substance use was least associated with young adult mental health problems was surprising, as much of the literature describes its association with *increased* risk of the studied mental health outcomes. However, it is possible that parental substance use leads to worsened young adult mental health through other ACEs. When other ACEs were included at their population mean levels in our model, the effect of parental substance use on the mental health outcome variables was dampened. Epidemiologic data finds that children of parents with substance use disorders are 3 times more likely to experience physical or sexual abuse, which increases the child's risk for depression and anxiety (Lander et al., 2013). It is also possible that in our models, other comorbid ACEs associated with parental substance use

explained more variance than parental substance use alone, since our logistic regression models included all ACEs.

It was also surprising that physical abuse was less strongly associated with risk of mental illness, as many studies have described the increased risk that physical abuse carries in adult mental health outcomes. It is possible that, like parental substance use, other ACEs included in our model, also associated with physical abuse, explain more variance for the mental illness as an outcome variable. There is evidence for this in the literature; one study found that sexual abuse mediated the relationship between physical abuse and psychiatric disorders in adults (Mulder et al., 1998). However, an alternative explanation might be that the mental health impact of physical abuse was incompletely captured by our outcome variable (diagnosis of mental illness), given that it relies on access to clinical care and diagnosis. This alternative explanation is supported by the fact that in our study physical abuse *was* associated with increased risk of the psychological distress outcome, which suggests that this ACE may be associated with symptoms of mental illness without leading to a diagnosis.

Limitations

Our study had several limitations. The ACEs variables were constructed from self-reports; however, this is convention in the ACEs literature and there is no way to "verify" a participant's reported ACEs. The outcome variables studied were also based on self-report, but mental illness diagnosis was based on a self-report of a diagnosis received from a healthcare professional, and psychological distress was based on answers to a validated scale assessing psychological distress. The constructed variables have been used in a prior published study (Lei et al., 2021). Another limitation is our inability to disaggregate mental illness diagnosis into specific diagnoses, such as depression, anxiety, post-traumatic stress disorder, schizophrenia, and

bipolar disorder, which may be connected to specific combination of ACEs. Similarly, although we were able to examine psychological distress, this study is unable to characterize mental health outcomes in terms of severity of mental illness. Furthermore, even though this was a longitudinal study, we could not determine how timing, duration, and intensity of ACE exposures relate to mental health risk in young adulthood. We had limited power to examine combinations of 3 or more ACEs. Additionally, we did not have information on ages or severity of exposure to ACEs. Our study was not scoped to explore how contextual factors like poverty, community violence, and racism, which have been proposed as ACEs, increase risk for adverse mental health outcomes, nor how resilience factors buffer the health impact of adversity.

Conclusion

This nationally representative study found that different ACEs or pairwise combinations of ACEs were associated with varying degrees of mental health risk. Clinicians should account for specific ACE types and combinations, rather than relying solely on an ACE score, when estimating individual and population mental health risk. This approach should be utilized when tailoring interventions to address the consequences of childhood adversity. Additionally, this study demonstrates the potential that the PSID contains for longitudinal mental health analyses.

Further investigation using other national datasets, such as the CDC's Youth Risk Behavior Surveillance System (YRBSS), should be conducted to identify whether similar results are found when analyzing combinations of ACEs and their associated mental health risks. Additionally, a qualitative component, such as interviews with participants about how and why they perceive their ACEs have affected their mental health, would provide a valuable dimension to our understanding of the mechanisms that mediate ACE combinations and health outcomes.

ACE interventions include the use of ACE screenings in health care settings such as primary care appointments for both children and adults, and identifying trauma-informed resources to either intervene on ACEs themselves or the resulting mental health outcomes that patients may experience (Gilgoff et al., 2020). We hope that clinicians find the results of this study useful in paying particular attention when patients have either a parent with a mental illness, a history of sexual abuse, or both. In time-limited settings or in those where ACE screenings have not been implemented, asking specifically about these ACEs, if possible, can alert clinicians to whether the patient could benefit from more targeted, earlier interventions for their mental health.

References

Auersperg, F., Vlasak, T., Ponocny, I., & Barth, A. (2019, Dec). Long-term effects of parental divorce on mental health - A meta-analysis. *J Psychiatr Res, 119*, 107-115. https://doi.org/10.1016/j.jpsychires.2019.09.011

Barboza, G. E. (2018, May). Latent classes and cumulative impacts of adverse childhood experiences. *Child Maltreat, 23*(2), 111-125. https://doi.org/10.1177/1077559517736628

Bellis, M. A., Hughes, K., Ford, K., Ramos Rodriguez, G., Sethi, D., & Passmore, J. (2019). Life course health consequences and associated annual costs of adverse childhood experiences across Europe and North America: A systematic review and meta-analysis. *The Lancet. Public health, 4*(10), e517-e528. https://doi.org/10.1016/S2468-2667(19)30145-8

Bevilacqua, L., Kelly, Y., Heilmann, A., Priest, N., & Lacey, R. E. (2021, Feb). Adverse childhood experiences and trajectories of internalizing, externalizing, and prosocial behaviors from childhood to adolescence. *Child Abuse Negl, 112*, 104890. https://doi.org/10.1016/j.chiabu.2020.104890

Björkenstam, E., Burström, B., Brännström, L., Vinnerljung, B., Björkenstam, C., & Pebley, A. R. (2015, Oct). Cumulative exposure to childhood stressors and subsequent psychological distress. An analysis of US panel data. *Soc Sci Med, 142*, 109-117. https://doi.org/10.1016/j.socscimed.2015.08.006

Boumpa, V., Papatoukaki, A., Kourti, A., Mintzia, S., Panagouli, E., Bacopoulou, F., Psaltopoulou, T., Spiliopoulou, C., Tsolia, M., Sergentanis, T. N., & Tsitsika, A. (2022, Jun 18). Sexual abuse and post-traumatic stress disorder in childhood, adolescence and young adulthood: A systematic review and meta-analysis. *Eur Child Adolesc Psychiatry*. https://doi.org/10.1007/s00787-022-02015-5

Bryant, D. J., Oo, M., & Damian, A. J. (2020, Aug). The rise of adverse childhood experiences during the COVID-19 pandemic. *Psychol Trauma, 12*(S1), S193-s194. https://doi.org/10.1037/tra0000711

Burnam, M. A., Stein, J. A., Golding, J. M., Siegel, J. M., Sorenson, S. B., Forsythe, A. B., & Telles, C. A. (1988, Dec). Sexual assault and mental disorders in a community population. *J Consult Clin Psychol, 56*(6), 843-850. https://doi.org/10.1037//0022-006x.56.6.843

De Venter, M., Demyttenaere, K., & Bruffaerts, R. (2013). [The relationship between adverse childhood experiences and mental health in adulthood. A systematic literature review]. *Tijdschr Psychiatr, 55*(4), 259-268. (Het verband tussen traumatische gebeurtenissen in de kindertijd en angst, depressie en middelenmisbruik in de volwassenheid; een systematisch literatuuroverzicht.)

Downing, N. R., Akinlotan, M., & Thornhill, C. W. (2021, Oct). The impact of childhood sexual abuse and adverse childhood experiences on adult health related quality of life. *Child Abuse Negl, 120*, 105181. https://doi.org/10.1016/j.chiabu.2021.105181

Dynamics, U. o. M. P. S. o. I. Studies. Retrieved 02/20/2024 from https://psidonline.isr.umich.edu/Studies.aspx

Felitti, V. J., Anda, R. F., Nordenberg, D., Williamson, D. F., Spitz, A. M., Edwards, V., Koss, M. P., & Marks, J. S. (1998, May). Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults. The Adverse Childhood Experiences (ACE) Study. *Am J Prev Med, 14*(4), 245-258. https://doi.org/10.1016/s0749-3797(98)00017-8

Giano, Z., Ernst, C. W., Snider, K., Davis, A., O'Neil, A. M., & Hubach, R. D. (2021, Dec). ACE domains and depression: Investigating which specific domains are associated with depression in adulthood. *Child Abuse Negl, 122*, 105335. https://doi.org/10.1016/j.chiabu.2021.105335

Gilgoff, R., Singh, L., Koita, K., Gentile, B., & Marques, S. S. (2020, 2020/04/01/). Adverse childhood experiences, outcomes, and interventions. *Pediatric Clinics of North America, 67*(2), 259-273. https://doi.org/https://doi.org/10.1016/j.pcl.2019.12.001

Hughes, K., Bellis, M. A., Hardcastle, K. A., Sethi, D., Butchart, A., Mikton, C., Jones, L., & Dunne, M. P. (2017, Aug). The effect of multiple adverse childhood experiences on health: A systematic review and meta-analysis. *The Lancet. Public health, 2*(8), e356-e366. https://doi.org/10.1016/s2468-2667(17)30118-4

Kamis, C. (2021, Mar 1). The long-term impact of parental mental health on children's distress trajectories in adulthood. *Soc Ment Health, 11*(1), 54-68. https://doi.org/10.1177/2156869320912520

Kessler, R. C., Barker, P. R., Colpe, L. J., Epstein, J. F., Gfroerer, J. C., Hiripi, E., Howes, M. J., Normand, S. L., Manderscheid, R. W., Walters, E. E., & Zaslavsky, A. M. (2003, Feb). Screening for serious mental illness in the general population. *Arch Gen Psychiatry, 60*(2), 184-189. https://doi.org/10.1001/archpsyc.60.2.184

Kessler, R. C., Berglund, P., Demler, O., Jin, R., Merikangas, K. R., & Walters, E. E. (2005). Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the national comorbidity survey replication. *Archives of General Psychiatry, 62*(6), 593-602. https://doi.org/10.1001/archpsyc.62.6.593

Lander, L., Howsare, J., & Byrne, M. (2013). The impact of substance use disorders on families and children: From theory to practice. *Soc Work Public Health, 28*(3-4), 194-205. https://doi.org/10.1080/19371918.2013.759005

Lee, H., Kim, Y., & Terry, J. (2020, May). Adverse childhood experiences (ACEs) on mental disorders in young adulthood: Latent classes and community violence exposure. *Prev Med, 134*, 106039. https://doi.org/10.1016/j.ypmed.2020.106039

Lei, Y., Shah, V., Biely, C., Jackson, N., Dudovitz, R., Barnert, E., Hotez, E., Guerrero, A., Bui, A. L., Sastry, N., & Schickedanz, A. (2021, Dec 1). Discrimination and subsequent mental health, substance use, and well-being in young adults. *Pediatrics, 148*(6). https://doi.org/10.1542/peds.2021-051378

Leijdesdorff, S., van Doesum, K., Popma, A., Klaassen, R., & van Amelsvoort, T. (2017). Prevalence of psychopathology in children of parents with mental illness and/or addiction: An up to date narrative review. *Current Opinion in Psychiatry, 30*(4). https://journals.lww.com/co-psychiatry/Fulltext/2017/07000/Prevalence_of_psychopathology_in_children_of.12.aspx

Liu, J., Jiang, N., Fan, A. Z., & Weissman, R. (2018). Alternatives in assessing mental healthcare disparities using the Behavioral Risk Factor Surveillance System. *Health Equity, 2*(1), 199-206. https://doi.org/10.1089/heq.2017.0056

Manning, C., & Gregoire, A. (2006, 2006/01/01/). Effects of parental mental illness on children. *Psychiatry, 5*(1), 10-12. https://doi.org/https://doi.org/10.1383/psyt.2006.5.1.10

McGonagle, K. A., & Sastry, N. (2015, Apr). Cohort profile: The Panel Study of Income Dynamics' Child Development Supplement and Transition into Adulthood study. *Int J Epidemiol, 44*(2), 415-422. https://doi.org/10.1093/ije/dyu076

McLaughlin, K. A., & Sheridan, M. A. (2016, Aug). Beyond cumulative risk: A dimensional approach to childhood adversity. *Curr Dir Psychol Sci, 25*(4), 239-245. https://doi.org/10.1177/0963721416655883

Mulder, R. T., Beautrais, A. L., Joyce, P. R., & Fergusson, D. M. (1998, Jun). Relationship between dissociation, childhood sexual abuse, childhood physical abuse, and mental illness in a general population sample. *Am J Psychiatry, 155*(6), 806-811. https://doi.org/10.1176/ajp.155.6.806

Nelson, C. A., Scott, R. D., Bhutta, Z. A., Harris, N. B., Danese, A., & Samara, M. (2020). Adversity in childhood is linked to mental and physical health throughout life. *BMJ (Clinical research ed.), 371*, m3048-m3048. https://doi.org/10.1136/bmj.m3048

Noll, J. G. (2021, May 7). Child sexual abuse as a unique risk factor for the development of psychopathology: The compounded convergence of mechanisms. *Annu Rev Clin Psychol, 17*, 439-464. https://doi.org/10.1146/annurev-clinpsy-081219-112621

Noura Insolera, K. M., Narayan Sastry, Beth Simmert. (2019). Panel Study of Income Dynamics, Transition into Adulthood Supplement 2017: User guide. [User Guide]. Retrieved 02/20/2024, from https://psidonline.isr.umich.edu/cds/TAS17_UserGuide.pdf

Prochaska, J. J., Sung, H. Y., Max, W., Shi, Y., & Ong, M. (2012, Jun). Validity study of the K6 scale as a measure of moderate mental distress based on mental health treatment need and utilization. *Int J Methods Psychiatr Res, 21*(2), 88-97. https://doi.org/10.1002/mpr.1349

Putnam, F. W., Amaya-Jackson, L., Putnam, K. T., & Briggs, E. C. (2020, Aug). Synergistic adversities and behavioral problems in traumatized children and adolescents. *Child Abuse Negl, 106*, 104492. https://doi.org/10.1016/j.chiabu.2020.104492

Sanchez-Villegas, A., Schlatter, J., Ortuno, F., Lahortiga, F., Pla, J., Benito, S., & Martinez-Gonzalez, M. A. (2008, Jun 17). Validity of a self-reported diagnosis of depression among participants in a cohort study using the Structured Clinical Interview for DSM-IV (SCID-I). *BMC Psychiatry, 8*, 43. https://doi.org/10.1186/1471-244x-8-43

Sandra Hofferth, P. E. D.-K., Jean Davis, Jonathan Finkelstein. The Child Development Supplement to the Panel Study of Income Dynamics: 1997 user guide [User Guide]. Retrieved 05/20/2024, from https://psidonline.isr.umich.edu/CDS/cdsi_userGD.pdf

Schickedanz, A., Halfon, N., Sastry, N., & Chung, P. J. (2018, Aug). Parents' adverse childhood experiences and their children's behavioral health problems. *Pediatrics, 142*(2). https://doi.org/10.1542/peds.2018-0023

Schickedanz, A. B., Escarce, J. J., Halfon, N., Sastry, N., & Chung, P. J. (2019, May). Adverse childhood experiences and household out-of-pocket healthcare costs. *Am J Prev Med, 56*(5), 698-707. https://doi.org/10.1016/j.amepre.2018.11.019

Sonu, S., Post, S., & Feinglass, J. (2019, 2019/06/01/). Adverse childhood experiences and the onset of chronic disease in young adulthood. *Preventive Medicine, 123*, 163-170. https://doi.org/https://doi.org/10.1016/j.ypmed.2019.03.032

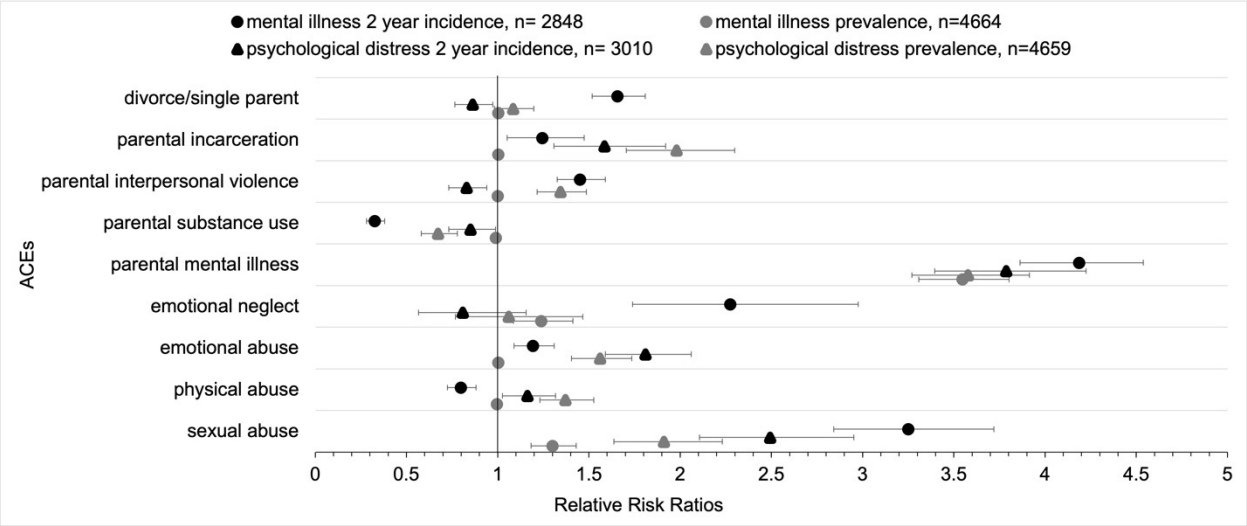
Figure Captions

Fig. 1 Scatter plot comparing the relative risk ratios of outcome incidence and prevalence in young adulthood associated with different ACEs. Risk ratios were obtained through logistic regressions. The control variable for each risk ratio is the incidence or prevalence associated with no exposure to the particular ACE being tested, which would be 1 (see vertical line in figure). The figure was created using Microsoft Excel Version 16.82.

Fig. 2 Heatmap of mental illness outcome risks associated with pairwise ACE combinations. Cells display probabilities and 95% confidence intervals. Left column and bottom row display outcome probabilities in the absence of 1 ACE. Cells diagonally across heatmap display incidence (left of diagonal line) and prevalence (right of diagonal line) of estimates of the probability of mental illness diagnosis estimates for individual ACEs. “na” means models did not converge. The figure was created using Microsoft Excel Version 16.82.

Fig. 3 Heatmap of psychological distress outcome risks associated with pairwise ACE combinations. Cells display probabilities and 95% confidence intervals. Left column and bottom row display outcome probabilities in the absence of 1 ACE. Cells diagonally across heatmap display incidence (left of diagonal line) and prevalence (right of diagonal line) of estimates of the probability of experiencing severe psychological distress for individual ACEs. “na” means models did not converge. The figure was created using Microsoft Excel Version 16.82.

485 **Fig. 1**



487

488

489

490

491

492

493

494

495

496

497

498

499

Fig. 2

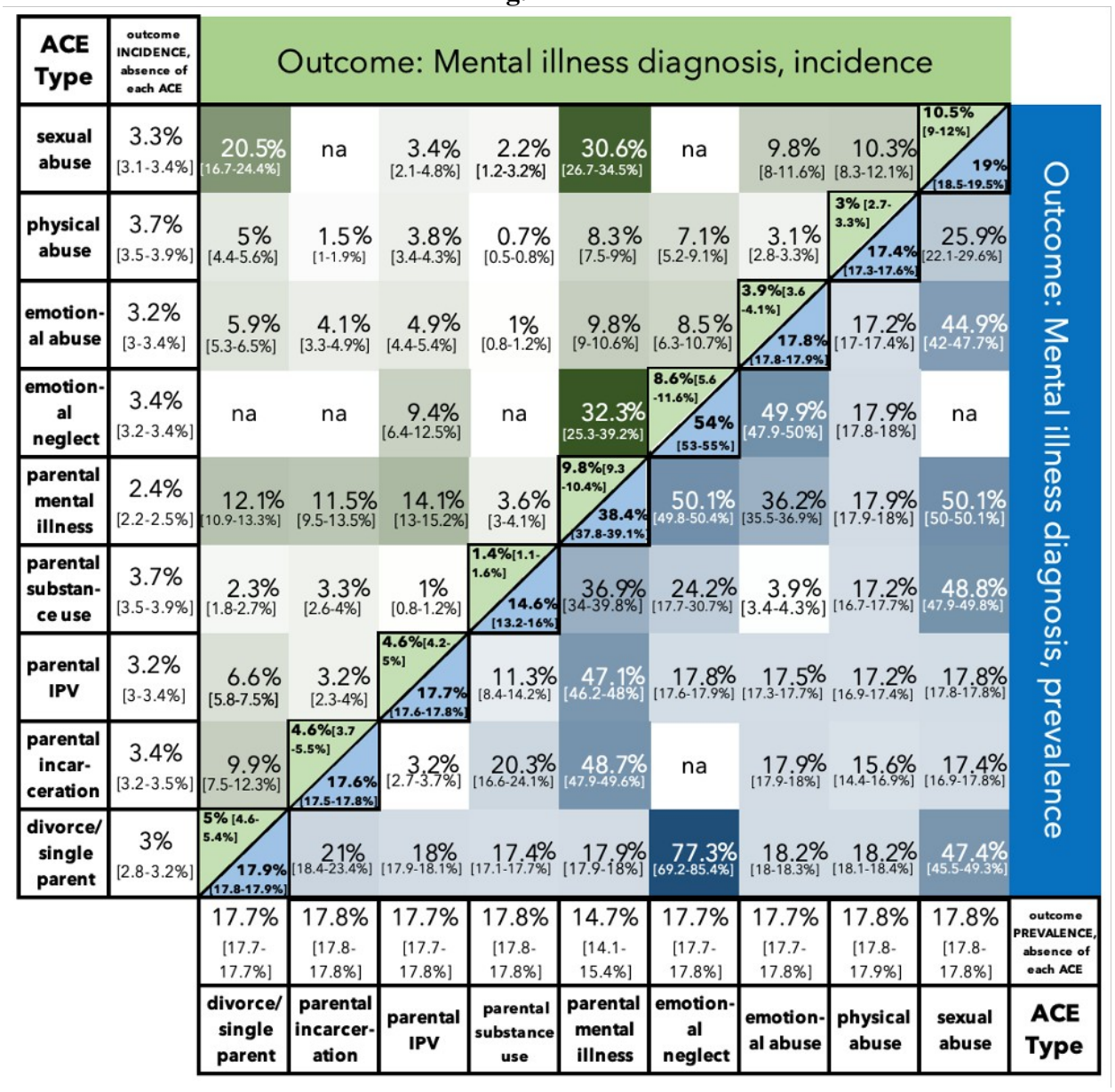
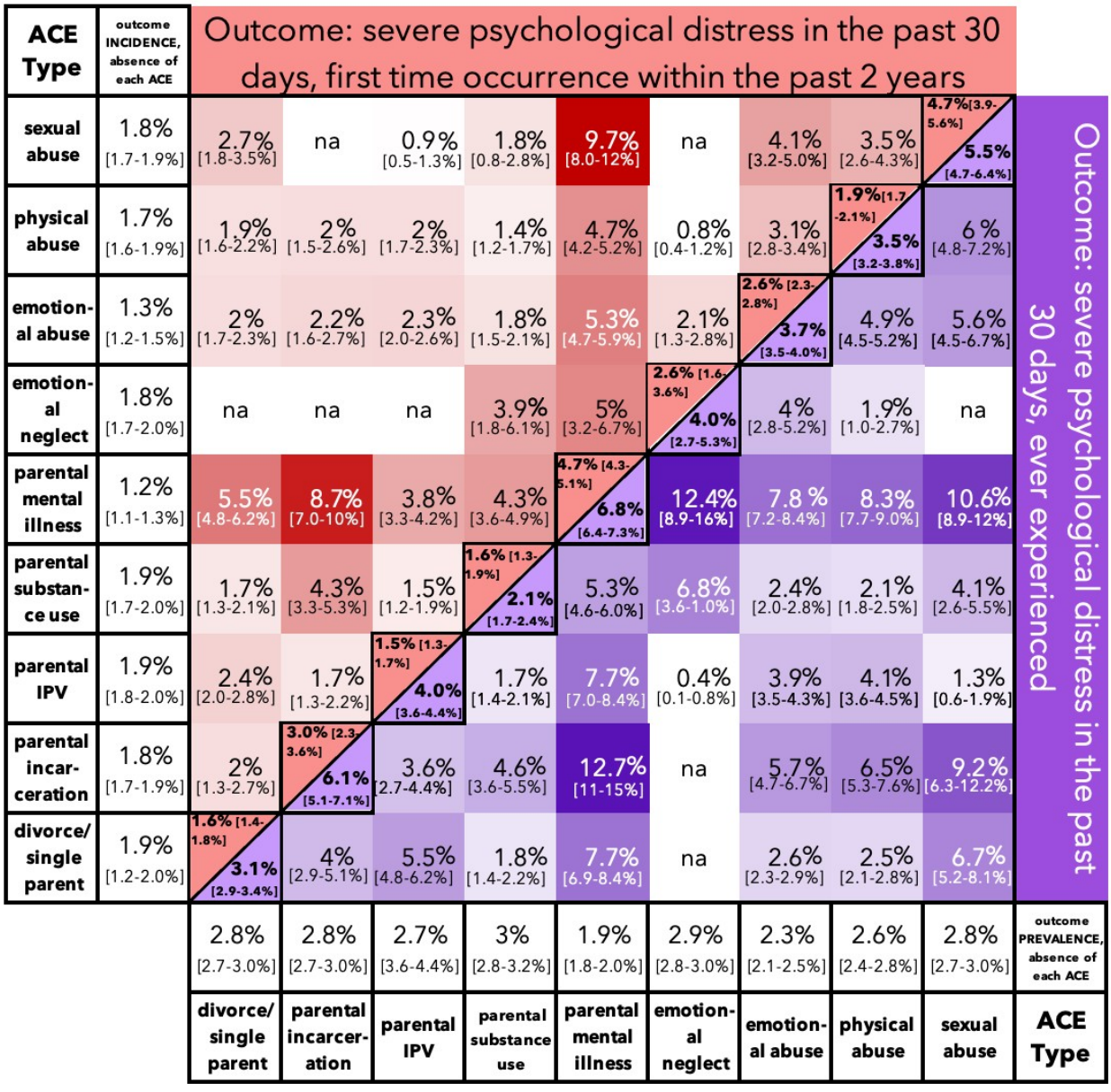

ACE Type
outcome INCIDENCE, absence of each ACE
Outcome: Mental illness diagnosis, incidence
sexual abuse
3.3% [3.1-3.4%]
20.5% [16.7-24.4%]
na
3.4% [2.1-4.8%]
2.2% [1.2-3.2%]
30.6% [26.7-34.5%]
na
9.8% [8-11.6%]
10.3% [8.3-12.1%]
10.5% [9-12%] 19% [18.5-19.5%]
physical abuse
3.7% [3.5-3.9%]
5% [4.4-5.6%]
1.5% [1-1.9%]
3.8% [3.4-4.3%]
0.7% [0.5-0.8%]
8.3% [7.5-9%]
7.1% [5.2-9.1%]
3.1% [2.8-3.3%]
3% [2.7-3.3%] 17.4% [17.3-17.6%]
25.9% [22.1-29.6%]
emotion-al abuse
3.2% [3-3.4%]
5.9% [5.3-6.5%]
4.1% [3.3-4.9%]
4.9% [4.4-5.4%]
1% [0.8-1.2%]
9.8% [9-10.6%]
8.5% [6.3-10.7%]
3.9% [3.6-4.1%] 17.8% [17.8-17.9%]
17.2% [17-17.4%]
44.9% [42-47.7%]
emotion-al neglect
3.4% [3.2-3.4%]
na
na
9.4% [6.4-12.5%]
na
32.3% [25.3-39.2%]
8.6% [5.6-11.6%] 54% [53-55%]
49.9% [47.9-50%]
17.9% [17.8-18%]
na
parental mental illness
2.4% [2.2-2.5%]
12.1% [10.9-13.3%]
11.5% [9.5-13.5%]
14.1% [13-15.2%]
3.6% [3-4.1%]
9.8% [9.3-10.4%] 38.4% [37.8-39.1%]
50.1% [49.8-50.4%]
36.2% [35.5-36.9%]
17.9% [17.9-18%]
50.1% [50-50.1%]
parental substan-ce use
3.7% [3.5-3.9%]
2.3% [1.8-2.7%]
3.3% [2.6-4%]
1% [0.8-1.2%]
1.4% [1.1-1.6%] 14.6% [13.2-16%]
36.9% [34-39.8%]
24.2% [17.7-30.7%]
3.9% [3.4-4.3%]
17.2% [16.7-17.7%]
48.8% [47.9-49.8%]
parental IPV
3.2% [3-3.4%]
6.6% [5.8-7.5%]
3.2% [2.3-4%]
4.6% [4.2-5%] 17.7% [17.6-17.8%]
11.3% [8.4-14.2%]
47.1% [46.2-48%]
17.8% [17.6-17.9%]
17.5% [17.3-17.7%]
17.2% [16.9-17.4%]
17.8% [17.8-17.8%]
parental incar-ceration
3.4% [3.2-3.5%]
9.9% [7.5-12.3%]
4.6% [3.7-5.5%] 17.6% [17.5-17.8%]
3.2% [2.7-3.7%]
20.3% [16.6-24.1%]
48.7% [47.9-49.6%]
na
17.9% [17.9-18%]
15.6% [14.4-16.9%]
17.4% [16.9-17.8%]
divorce/ single parent
3% [2.8-3.2%]
5% [4.6-5.4%] 17.9% [17.8-17.9%]
21% [18.4-23.4%]
18% [17.9-18.1%]
17.4% [17.1-17.7%]
17.9% [17.9-18%]
77.3% [69.2-85.4%]
18.2% [18-18.3%]
18.2% [18.1-18.4%]
47.4% [45.5-49.3%]
Outcome: Mental illness diagnosis, prevalence
17.7% [17.7-17.7%]
17.8% [17.8-17.8%]
17.7% [17.7-17.8%]
17.8% [17.8-17.8%]
14.7% [14.1-15.4%]
17.7% [17.7-17.8%]
17.7% [17.7-17.8%]
17.8% [17.8-17.9%]
17.8% [17.8-17.8%]
outcome PREVALENCE, absence of each ACE
divorce/ single parent
parental incarcer-ation
parental IPV
parental substance use
parental mental illness
emotion-al neglect
emotion-al abuse
physical abuse
sexual abuse
ACE Type

Fig. 3


ACE Type
outcome INCIDENCE, absence of each ACE
Outcome: severe psychological distress in the past 30 days, first time occurrence within the past 2 years
Outcome: severe psychological distress in the past 30 days, ever experienced
sexual abuse
1.8% [1.7-1.9%]
2.7% [1.8-3.5%]
na
0.9% [0.5-1.3%]
1.8% [0.8-2.8%]
9.7% [8.0-12%]
na
4.1% [3.2-5.0%]
3.5% [2.6-4.3%]
4.7% [3.9-5.6%] 5.5% [4.7-6.4%]
physical abuse
1.7% [1.6-1.9%]
1.9% [1.6-2.2%]
2% [1.5-2.6%]
2% [1.7-2.3%]
1.4% [1.2-1.7%]
4.7% [4.2-5.2%]
0.8% [0.4-1.2%]
3.1% [2.8-3.4%]
1.9% [1.7-2.1%] 3.5% [3.2-3.8%]
6 % [4.8-7.2%]
emotional abuse
1.3% [1.2-1.5%]
2% [1.7-2.3%]
2.2% [1.6-2.7%]
2.3% [2.0-2.6%]
1.8% [1.5-2.1%]
5.3% [4.7-5.9%]
2.1% [1.3-2.8%]
2.6% [2.3-2.8%] 3.7% [3.5-4.0%]
4.9% [4.5-5.2%]
5.6% [4.5-6.7%]
emotional neglect
1.8% [1.7-2.0%]
na
na
na
3.9% [1.8-6.1%]
5% [3.2-6.7%]
2.6% [1.6-3.6%] 4.0% [2.7-5.3%]
4% [2.8-5.2%]
1.9% [1.0-2.7%]
na
parental mental illness
1.2% [1.1-1.3%]
5.5% [4.8-6.2%]
8.7% [7.0-10%]
3.8% [3.3-4.2%]
4.3% [3.6-4.9%]
4.7% [4.3-5.1%] 6.8% [6.4-7.3%]
12.4% [8.9-16%]
7.8 % [7.2-8.4%]
8.3% [7.7-9.0%]
10.6% [8.9-12%]
parental substance use
1.9% [1.7-2.0%]
1.7% [1.3-2.1%]
4.3% [3.3-5.3%]
1.5% [1.2-1.9%]
1.6% [1.3-1.9%] 2.1% [1.7-2.4%]
5.3% [4.6-6.0%]
6.8% [3.6-1.0%]
2.4% [2.0-2.8%]
2.1% [1.8-2.5%]
4.1% [2.6-5.5%]
parental IPV
1.9% [1.8-2.0%]
2.4% [2.0-2.8%]
1.7% [1.3-2.2%]
1.5% [1.3-1.7%] 4.0% [3.6-4.4%]
1.7% [1.4-2.1%]
7.7% [7.0-8.4%]
0.4% [0.1-0.8%]
3.9% [3.5-4.3%]
4.1% [3.6-4.5%]
1.3% [0.6-1.9%]
parental incarceration
1.8% [1.7-1.9%]
2% [1.3-2.7%]
3.0% [2.3-3.6%] 6.1% [5.1-7.1%]
3.6% [2.7-4.4%]
4.6% [3.6-5.5%]
12.7% [11-15%]
na
5.7% [4.7-6.7%]
6.5% [5.3-7.6%]
9.2% [6.3-12.2%]
divorce/ single parent
1.9% [1.2-2.0%]
1.6% [1.4-1.8%] 3.1% [2.9-3.4%]
4% [2.9-5.1%]
5.5% [4.8-6.2%]
1.8% [1.4-2.2%]
7.7% [6.9-8.4%]
na
2.6% [2.3-2.9%]
2.5% [2.1-2.8%]
6.7% [5.2-8.1%]
2.8% [2.7-3.0%]
2.8% [2.7-3.0%]
2.7% [3.6-4.4%]
3% [2.8-3.2%]
1.9% [1.8-2.0%]
2.9% [2.8-3.0%]
2.3% [2.1-2.5%]
2.6% [2.4-2.8%]
2.8% [2.7-3.0%]
outcome PREVALENCE, absence of each ACE
divorce/ single parent
parental incarcer-ation
parental IPV
parental substance use
parental mental illness
emotion-al neglect
emotion-al abuse
physical abuse
sexual abuse
ACE Type

576
577
578
579
580
581
582
583