




Short Communication

Adverse childhood experiences and obesity over time

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Abstract

Objective: The effects of adverse childhood experiences (ACE) on children and adolescents' health status such as obesity are understudied. The current study addressed the effect of ACE on obesity status during childhood utilising multiple waves of national panel data.

Design: Longitudinal survey.

Setting: Data were drawn from three waves of the second cohort of the National Survey of Child and Adolescent Well-Being (NSCAW II). NSCAW II study sampled cases from Child Protective Services investigations that were closed between February 2008 and April 2009 nationwide. We measured ACE cumulatively and as separate events and stratified by gender.

Participants: Totally, 3170 youth births to 14 years of age at baseline.

Results: A count measure of ACE is indeed associated with greater odds of obesity during childhood. Differential effects for different types of ACE were also found, most notably neglect. For girls, physical and psychological neglect increased odds of obesity.

Conclusions: Findings support evidence for the importance of using both a count measure of ACE as well as separating out single events by gender.

Keywords

Adverse childhood experiences
Obesity
Childhood abuse
Child neglect
National Survey of Child and Adolescent Well-Being
Longitudinal study
Child Protective Services

The health consequences of adverse childhood experiences (ACE), defined here as multiple forms of negative events experienced during childhood, have primarily been studied in adult populations retrospectively⁽¹⁾. The Center for Disease Control hypothesises that exposure to the toxic stress caused by ACE, which include child abuse and neglect, parental mental health and substance abuse problems, family disruptions such as parental separation or incarceration, can make children susceptible to disease and illness⁽²⁾. This is a dynamic process where experiencing ACE over time and in higher doses prolongs the activation of the body's stress-response system. The litany of negative developmental and psychological consequences of ACE in childhood are well known: depression, anxiety, post-traumatic stress disorder symptoms, risk-taking behaviour, early pregnancy, substance use and suicide attempts⁽³⁾. However, when the relationship between ACE and health outcomes has been examined in childhood, it has been studied mainly through cross-sectional study design⁽⁴⁾.

One important indicator of health is obesity, which has been associated with ACE in studies of adults⁽⁵⁾. For children,

the evidence of a consistent association is less clear. A recent study on the associations between ACE in infancy and obesity at age eleven found positive associations between having 4 + ACE compared with none⁽⁶⁾. In contrast, a longitudinal study⁽⁷⁾ found the accumulation of ACE was associated with adult Type-2 diabetes for women when ACE are measured at age 14, but the relationship was attenuated after controlling for BMI. ACE did not predict type-2 diabetes or obesity for adult men. The differences between these studies suggest that these associations may differ by how ACE are measured, developmental timeframe of subjects sampled and ability to examine important subgroups with differing risk profiles.

Risk for obesity may differ by gender⁽⁸⁾. Physiologically, girls have a higher percentage of body fat, and socially girls are more likely to gain weight when living in high conflict families. In contrast, boys are more physically active, have lower leptin levels and are not as susceptible to gain weight if living with family conflict⁽⁸⁾. These gender differences may explain reverse associations that are sometimes found in ACE studies among adults⁽⁷⁾. A study by Helton and Liechty⁽⁹⁾, using one

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wave of the data set used herein, found decreased odds of obesity for adolescent boys experiencing physical abuse compared with boys experiencing neglect. The inverse was true of younger age girls who experienced sexual abuse.

Studies examining the associations between ACE and health outcomes are usually focused on ACE as either cumulative risk or single adverse events⁽¹⁰⁾. Both types of operationalisations have limitations. Counting ACE can be reductive in nature; it equates chronic and life-threatening experiences like severe physical and sexual abuse with less malicious events like divorce⁽¹¹⁾. Single adverse event measurements on the other hand ignore that ACE co-occur. Thus, any effect found for a specific adversity can be partially explained by the existence of other ACE that were not taken into account⁽¹²⁾. Gender differences in the associations between ACE and obesity may also occur depending on whether single event or accumulative measures are used. A cross-sectional study among Finnish adolescents found that while no associations were found between the accumulative measure of ACE and obesity for both genders, gender differences were found while examining each ACE separately⁽¹³⁾.

The purpose of the current study is to address the above limitations by (1) adding to the knowledge base on the effect of ACE on obesity status during childhood; (2) utilising multiple waves of national panel data to prospectively measure within-subject effects of ACE on childhood obesity; (3) examining the effect of ACE on childhood obesity separately for boys and girls and (4) comparing outcomes for both count and separate event measurements of ACE on obesity by gender.

Methods

Data were obtained from three waves of the second cohort of the National Survey of Child and Adolescent Well-Being (NSCAW II). NSCAW II used a two-stage stratified sampling design, which first selected nine sampling strata consisting of the eight states with the largest child welfare caseloads and the remainder of the United States⁽¹⁴⁾. NSCAW II study sampled cases from Child Protective Services investigations of families that were closed between February 2008 and April 2009 nationwide ($n = 5873$). Data collection includes three waves: 4 months, 18 months and 36 months after the close of an investigation. The final sample of children was representative of the national population of children birth to 17 years of age in families being investigated for allegations of maltreatment⁽¹⁴⁾. Our analysis followed youth birth to 14 years of age at baseline to account for children ageing out. Response rates for waves 2 and 3 ranged from 84% to 94%. We dropped cases without follow-up data and obtained a final sample size of $n = 3170$.

Measures

Obesity

Child obesity was defined as at or above the 95th percentile per the 2000 Centers for Disease Control and Prevention

sex-specific weight-for-age growth charts⁽¹⁵⁾. Height and weight were reported by caregivers at the time of interview. Due to the large number of missing child height data, we assessed obesity using Centers for Disease Control and Prevention's sex-specific weight-for-age growth charts.

ACE

Abusive and neglectful events in the previous year were measured using the Conflict Tactics Scale – Parent-Child version at each wave⁽¹⁶⁾. Hitting with a fist or kicking, beating, choking, burning and threatening with or using a knife or gun were coded as *physical abuse*; leaving a child alone when an adult should be present, not being able to provide food, being too drunk or high, or not being able to get to a doctor when a child needed it were coded as *neglect*; any forced sexual contact was coded as *sexual abuse*; so caught up with problems that parent did not tell child (s)he were not loved were coded as *emotional neglect* and shout/yell/scream, swear or curse, called dumb or lazy or threaten to send away were coded as *psychological abuse*.

Mental health was measured using the standardised Short Form Health Survey⁽¹⁷⁾. Scores under two standard deviations below mean were coded as *mental health problem*. *Alcohol or drug dependence* was assessed using the Alcohol Use Disorders Identification Test⁽¹⁸⁾ and the Drug Abuse Screening Test-20⁽¹⁹⁾. Based on the NSCAW data manual⁽¹⁴⁾, we operationalised parents as meeting criteria for alcohol or drug dependence when Alcohol Use Disorders Identification Test or Drug Abuse Screening Test-20 scores were > 4 . Parents who reported being separated or divorced in the previous year were coded as *separated*. Parents who reported being arrested in the year previous to each wave of data collection were coded as *arrested*.

Controls

Caregivers reported how many children were currently living in the household. This measure was treated as a count variable. Family poverty was measured by calculating the family's income-to-needs ratio, which was estimated by dividing family income by its corresponding poverty threshold in 2009. This measure was divided into two categories by the authors: at or below 100% of the poverty line and above 100% of the poverty line.

Analysis

ACE are analysed in two distinct ways: (1) count measure from 0 to 10 and (2) individual events. STATA survey commands were applied to obtain unbiased estimates of population parameters⁽²⁰⁾. All percentages were weighted for population probabilities. We first examined the association of ACE on obesity over time within children using fixed effects logistic regression controlling for changes in household size and poverty over time and then individual events on obesity over time within children. Fixed effects logistic regression takes the difference of predictor variables across

all three waves using a mean-centering approach, and it is suitable for the current analysis as it controls for the unmeasured stable heterogeneity and multicollinearity of children characteristics.

Results

Table 1 describes the sample characteristics at each wave. More than a quarter of youth were obese at each wave. On average, a mean ACE score of between 1.6 and 2.3 was observed. Very few youth were physically or sexually abused, more experienced psychological abuse. Fewer than a quarter of parents who experienced violence had a mental health problem, or were drug or alcohol dependent. One-third of parents were separated at baseline, and very few cohabiting parents separated at later waves. Very few parents reported being arrested in the previous year.

Table 2 presents the results of a series of logistic regressions predicting obesity by ACE cumulatively (top row) and by event (lower rows) and then stratified by gender. Youth at higher cumulative scores of ACE were at greater odds of obesity (OR = 1.18, $P < 0.05$) compared with youth at lower scores. For all youth, neglect as a single event was associated with greater odds of obesity (OR = 2.54, $P < 0.05$). Once stratified by gender, different associations began to emerge. Girls who experienced physical abuse and those with parents who had a mental health problem were at decreased odds of obesity (OR = 0.40, $P < 0.05$; OR = 0.38, $P < 0.05$). In contrast, girls who experienced neglect or psychological neglect were associated with greater odds of obesity (OR = 4.97, $P < 0.01$; OR = 3.34, $P < 0.05$). Males who experienced sexual abuse were associated with decreased odds of obesity (OR = 0.06, $P < 0.05$).

Discussion

The results of the present study show that the accumulative measure of ACE is indeed associated with greater likelihood of obesity not only among adults⁽⁷⁾, but during childhood as well. However, to only examine ACE as a count measure would miss the differential effects for different types of ACE. Specifically, neglect was most profoundly associated with obesity. Children who experienced neglect were 2.5 more likely to become obese during childhood compared with those who did not experience neglect. Several explanations may be suggested for this finding, such as neglect may be associated with impaired self-regulation capacity. Individuals with low self-regulation use overeating as a mechanism to self-regulate their thought, emotions and behaviour as they lack more adaptive self-regulatory mechanisms⁽²¹⁾. Another interpretation is that a child's neglect is a traumatic event, no less damaging than child's abuse. The overeating resulting in obesity might serve as a compensation mechanism or self-medication

Table 1 Sample characteristics (n 3170)

	Baseline		Wave 2		Wave 3	
	%	SE	%	SE	%	SE
Obesity	29	2.11	28	2.16	26	2.01
ACE (mean)	2.3	0.05	1.6	0.05	1.7	0.05
Physical abuse	5	0.91	3	0.71	3	0.82
Neglect	24	1.29	19	1.37	19	1.41
Sexual abuse	4	0.77	1	0.31	1	0.41
Emotional neglect	13	1.16	11	1.20	12	1.21
Psychological abuse	75	1.54	75	1.61	75	1.76
Domestic violence	25	1.82	16	1.33	21	1.55
Mental health	19	1.56	15	1.32	21	1.66
Alcohol or drug dependence	22	1.15	8	0.98	6	0.99
Separated	34	1.86	5	0.85	3	0.52
Arrest	4	0.92	6	0.81	3	0.52

ACE, adverse childhood experience.

similarly to other addictions⁽²²⁾. These interpretations should be studied in future research studies.

Results show that physical abuse was associated with *lower* likelihood of obesity among girls. Likewise, sexual abuse was associated with *lower* likelihood of obesity among boys. The associations between childhood physical or sexual abuse and eating disorder such as anorexia and bulimia were found among adult girls⁽²³⁾ and is explained by dysregulation of emotions and behaviours which lead to psychopathology and destructive internal (e.g. anorexia) or external (e.g. substance use) behaviour⁽²⁴⁾. Our findings suggest that the same impaired mechanism of self-dysregulation can explain low weight problems not only among girls but also among boys who experienced sexual abuse in childhood. Moreover, our findings imply that the same impaired mechanism of self-dysregulation can lead to obesity when the child experience neglect and to anorexia when the child experience sexual (boys) or physical (girls) abuse. These interpretations should be further examined in future studies.

One limitation of our study was that all variables were based on parental report, which may underestimate both the rates of ACE and their effects on children. Further, NSCAW did not measure specifically for ACE. However, the Conflict Tactics Scale – Parent-Child version and Short Form Health Survey provided almost identically matched wording as typical ACE items. Another limitation is the study population of children at risk for future maltreatment, meaning we cannot generalise to all children in the United States. Further, the wide CI of some OR may reflect a less precise measure of the predictor's effect size. This is most likely due to the lower prevalence of some forms of adverse events, the variability of which generated wider ranges.

Conclusion

Our study points to the importance of assessing each ACE separately, examining differing risk profiles by gender and using longitudinal designs during childhood. It emphasises

Table 2 Obesity and adverse childhood experience (ACE) fixed effects logistic regression

	Total (n 3170)		Female (n 1548)		Male (n 1622)	
	OR	95 % CI	OR	95 % CI	OR	95 % CI
Cumulative ACE	1.18*	1.01, 1.40	1.32	0.92, 1.89	1.10	0.86, 1.43
Separate events						
Physical abuse	0.81	0.32, 2.05	0.40*	0.17, 0.92	1.10	0.32, 3.79
Neglect	2.54*	1.22, 5.28	4.97*	1.51, 16.36	1.46	0.51, 4.25
Sexual abuse	0.16	0.03, 1.08	0.22	0.02, 2.76	0.06*	0.01, 0.49
Emotional neglect	2.15	0.96, 4.78	2.78	0.77, 9.96	1.81	0.52, 6.26
Psychological abuse	1.01	0.52, 2.00	3.34*	1.07, 10.36	0.48	0.21, 1.13
Domestic violence	1.56	0.84, 3.06	0.99	0.25, 3.94	2.11	0.89, 4.98
Mental health	0.58	0.33, 1.01	0.38*	0.19, 0.79	0.75	0.31, 1.84
Alcohol or drug dependence	1.05	0.55, 1.96	1.29	0.43, 3.91	0.91	0.42, 1.93
Separated	0.93	0.51, 1.71	0.79	0.32, 1.98	1.05	0.56, 1.98
Arrest	0.97	0.34, 2.71	0.64	0.14, 2.92	1.15	0.37, 3.58

Sampling weights are applied. Controls household size and poverty not reported in table.

* $P < 0.05$.

the heavy toll of neglect on childhood obesity, particularly for girls, and calls for further research to uncover the potential mechanisms between ACE and obesity among children.

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References

- Petrucelli K, Davis J & Berman T (2019) Adverse childhood experiences and associated health outcomes: a systematic review and meta-analysis. *Child Abuse Neglect* **97**, 104127.
- Centers for Disease Control and Prevention (2019) *Preventing Adverse Childhood Experiences: Leveraging the Best Available Evidence*. Georgia: National Center for Injury Prevention and Control, Centers for Disease Control and Prevention.
- Boynton-Jarrett R, Ryan LM, Berkman LF *et al.* (2008) Cumulative violence exposure and self-rated health: longitudinal study of adolescents in the United States. *Pediatrics* **122**, 961.
- Lynch BA, Agunwamba A, Wilson PM *et al.* (2016) Adverse family experiences and obesity in children and adolescents in the United States. *Prev Med* **90**, 148–154.
- Lynch L, Waite R & Davey MP (2013) Adverse childhood experiences and diabetes in adulthood: support for a collaborative approach to primary care. *Contemp Fam Ther* **35**, 639–655.
- McKelvey LM, Saccente JE & Swindle TM (2019) Adverse childhood experiences in infancy and toddlerhood predict obesity and health outcomes in middle childhood. *Child Obes* **15**, 206–215.
- Lown EA, Lui CK, Karriker-Jaffe K *et al.* (2019) Adverse childhood events and risk of diabetes onset in the 1979 National longitudinal survey of youth cohort. *BMC Public Health* **19**, 1007.
- Wisniewski AB & Chernausk SD (2009) Gender in childhood obesity: family environment, hormones, and genes. *Gender Med* **6**, 76–85.
- Helton JJ & Liechty JM (2014) Obesity prevalence among youth investigated for maltreatment in the United States. *Child Abuse Neglect* **38**, 768–775.
- Merrick MT, Ports KA, Ford DC *et al.* (2017) Unpacking the impact of adverse childhood experiences on adult mental health. *Child Abuse Neglect* **69**, 10–19.
- Anda RF, Felitti VJ, Bremner JD *et al.* (2006) The enduring effects of abuse and related adverse experiences in childhood. *Eur Arch Psychiatr Clin Neurosci* **256**, 174–186.
- Lacey RE & Minnis H (2020) Practitioner review: twenty years of research with adverse childhood experience scores – advantages, disadvantages and applications to practice. *J Child Psychol Psychiatr* **61**, 116–130.
- Isohookana R, Marttunen M, Hakko H *et al.* (2016) The impact of adverse childhood experiences on obesity and unhealthy weight control behaviors among adolescents. *Compr Psychiatr* **71**, 17–24.
- Dolan M, Smith K, Casanueva C *et al.* (2011) *NSCAW II Baseline Report: Introduction to NSCAW II*. Washington, DC: Office of Planning, Research and Evaluation, Administration for Children and Families, US Department of Health and Human Services.
- Ogden CL, Kuczmarski RJ, Flegal KM *et al.* (2002) Centers for Disease Control and Prevention 2000 growth charts for the United States: improvements to the 1977 National Center for Health Statistics Version. *Pediatrics* **109**, 45.
- Straus MA, Hamby SL, Finkelhor D *et al.* (1998) Identification of child maltreatment with the parent-child Conflict Tactics Scales: development and psychometric data for a national sample of American parents. *Child Abuse Neglect* **22**, 249–270.
- Ware JE, Kosinski M & Keller SD (1996) A 12-Item Short-Form Health Survey: construction of scales and preliminary tests of reliability and validity. *Med Care* **220**–233.
- Babor TJ, Higgins-Biddle JC & Saunders JB *et al.* (2001) The alcohol use disorders test. Guidelines for use in primary care. World Health Organization Department of Mental Health and



- Substance Dependence. http://apps.who.int/iris/bitstream/handle/10665/67205/WHO_MSD_MSB_01.6a.pdf;jsessionid=04C207315584D52AAF90DDF4451F9550?sequence=1 (accessed December 2020).
19. Skinner HA & Goldberg AE (1986) Evidence for a drug dependence syndrome among narcotic users. *Br J Addict* **81**, 479–484.
 20. StataCorp (2017) *Stata Statistical Software: Release 15*. College Station, TX: StataCorp LLC.
 21. Hawkins M, Ciciolla L, Colaizzi J *et al.* (2020) Adverse childhood experiences and cognitive function among adults with excess adiposity. *Obes Sci Pract* **6**, 47–56.
 22. Mason SM, Bryn Austin S, Bakalar JL *et al.* (2016) Child maltreatment's heavy toll: the need for trauma-informed obesity prevention. *Am J Prev Med* **50**, 646–649.
 23. Molendijk ML, Hoek HW, Brewerton TD *et al.* (2017) Childhood maltreatment and eating disorder pathology: a systematic review and dose-response meta-analysis. *Psychol Med* **47**, 1402–1416.
 24. Rai T, Mainali P, Raza A *et al.* (2019) Exploring the link between emotional child abuse and anorexia nervosa: a psychopathological correlation. *Cureus* **11**, e5318.