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The impact of adverse childhood experiences on an urban pediatric population☆

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ABSTRACT

Objective: The goal of this study was to investigate the adverse childhood experiences (ACEs) in youth in a low-income, urban community.
Study design: Data from a retrospective chart review of 701 subjects from the Bayview Child Health Center in San Francisco are presented. Medical chart documentation of ACEs as defined in previous studies were coded and each ACE criterion endorsed by a traumatic event received a score of 1 (range = 0–9). This study reports on the prevalence of various ACE categories in this population, as well as the association between ACE score and two pediatric problems: learning/behavior problems and body mass index (BMI) ≥ 85% (i.e., overweight or obese).
Results: The majority of subjects (67.2%, $N = 471$) had experienced 1 or more categories of adverse childhood experiences (ACE ≥ 1) and 12.0% ($N = 84$) had experienced 4 or more ACEs (ACE ≥ 4). Increased ACE scores correlated with increased risk of learning/behavior problems and obesity.
Conclusions: There was a significant prevalence of endorsed ACE categories in this urban population. Exposure to 4 or greater ACE categories was associated with increased risk for learning/behavior problems, as well as obesity.
Practice implications: Results from this study demonstrate the need both for screening of ACEs among youth in urban areas and for developing effective primary prevention and intervention models.

Introduction

Adverse childhood experiences (ACEs) including abuse, neglect, and histories of domestic and community violence are significant public health concerns in the United States. More than 3.7 million cases are referred to Child Protective Services (CPSs) every year (US Department of Health and Human Services, 2008). As compared to adults, some young people are at higher risk for negative effects due to ACEs (e.g., chronic disease, posttraumatic stress symptoms) because the experience of community violence augments traumatic experiences on their developing systems (De Bellis, 2001). For example, 30–40% of youth exposed to community violence develop posttraumatic stress symptoms such as re-experience (nightmares, intrusive thoughts, and flashbacks), avoidance of traumatic triggers and emotional numbing (constriction of affect) and physiological hyperarousal (hypervigilance, insomnia, behavioral problems; Berman, Kurtines, Silverman, & Sarafini, 1996). These symp-

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toms impact behavioral and emotional development as well as academic performance (Carrion, Weems, Ray, & Reiss, 2002). Moreover, the physiological consequences of stress affect not only mental health, but have also been shown to correlate with non-psychological medical conditions (Dong et al., 2004; Dube et al., 2009).

Adult studies have demonstrated a dose–response relationship between endorsement of ACE categories and many psychological, as well as non-psychological, medical conditions (Anda et al., 2008; Felitti et al., 1998; Felitti, 2002). The original ACE Study showed that adults endorsing ≥4 ACE categories (ACE score of 4 or more) were much more likely to suffer from various chronic diseases than adults who endorsed 0 ACE categories (ACE score of 0; Felitti et al., 1998). Follow-up studies have shown that adults endorsing ≥4 ACE categories are 2.6 times as likely to have Chronic Obstructive Pulmonary Disease (COPD) when compared with adults who scored 0 (Anda et al., 2008). Similar results were found for other diseases and behaviors such as hepatitis (2.4), sexually transmitted infections (STIs) (2.5), and injection drug use (46.0; Felitti, 2002; Felitti et al., 1998). Psychological conditions such as depression and suicidality also were more prevalent in the first group, with a relative risk of 4.6 and 12.2, respectively (Felitti et al., 1998). However, there currently exists a gap in the literature in terms of examining ACE categories in pediatric samples. Therefore, investigating the prevalence of ACEs in a pediatric population will allow for deeper understanding of onset time and the impact of trauma on development. Moreover, further investigation of ACEs may help identify children who are at risk for chronic diseases and/or psychological problems throughout later adolescence and adulthood and demonstrates the need for effective early identification of ACEs.

In order to study the effects of traumatic experiences on child development, we studied the relationship between the prevalence of ACE categories in a specific urban population and both psychological and physical outcomes: learning and behavior problems as identified by the primary care physician (psychological development) and obesity (physical development). These particular outcomes were chosen because they are risk factors for adult chronic conditions (e.g., Huntington & Bender, 1993; Kopelman, 2000). Specifically, learning/behavior difficulties have been shown to be associated with the development of depression, anxiety, bullying and suicidality among other outcomes (Huntington & Bender, 1993; Maag & Reid, 2006; Margalit & Raviv, 1984; Mishna, 2003; Newcomer, Barenbaum, & Pearson, 1995). Furthermore, studies have demonstrated relationships between obesity and hypertension, COPD, diabetes, sleep problems and other medical problems (Kopelman, 2000; Mokdad et al., 2001). Finally, whereas the prevalence of chronic conditions like hypertension or COPD is relatively low in a pediatric population (e.g., Adrogué & Sinaiko, 2001), obesity and learning/behavior problems have sufficient prevalence for adequate data analysis.

We present data from youth who live in and around Bayview Hunters Point, a community that places them at high risk for exposure to ACEs. The leading cause of years of life lost (YLL) among people living in Bayview Hunters Point is violence (Northern California Council for the Community, 2004). We hypothesized, first, that the majority of youth in this community would endorse 1 or more ACE criteria and, secondly, that an ACE score ≥4 would be associated with higher odds of these children being diagnosed with learning/behavior problems and/or obesity.

Methods

Participants

We conducted a retrospective medical chart review for all pediatric patients seen at the Bayview Child Health Center (BCHC) in its first 2 years of operation (April 2007–April 2009). BCHC is run by California Pacific Medical Center and is a private, not for profit, community based primary care clinic that employs 2 pediatricians, a registered nurse, 2 medical assistants, a case manager, and a psychologist. The study sample included 701 youth between the ages of 0 and 20.9 years. The mean age of patients was 8.13 years and median age 7.33 years (SD 5.47 years). The gender distribution was 54.3% female and 45.7% male. Race distribution was 58% African American, 14.5% Hispanic, 12.5% Pacific Islander, 8.1% Multi-racial, 2.6% White, 2.3% Asian, 0.1% Native American, and 1.8% Unknown or Other.

Measures

In the original ACE Study (Felitti et al., 1998), researchers defined seven categories of trauma, but later tracked the prevalence of two additional categories (one or no parents and neglect) in order to enhance the precision for obtaining statistics on follow-up health events (Felitti & Anda, 2010). The nine total categories used in this study correspond to ACE categories identified and used in previous ACE Studies and include: (1) recurrent physical abuse; (2) recurrent emotional abuse; (3) contact sexual abuse; (4) an alcohol and/or drug abuser in the household; (5) an incarcerated household member; (6) someone who is chronically depressed, mentally ill, institutionalized, or suicidal; (7) mother treated violently; (8) one or no parents; and (9) emotional or physical neglect. A Trauma Screen (Fig. 1) was developed and included in the confidential section of each participant's chart in order to document the ACE categories endorsed by each participant (Costello, Erkanli, Fairbank, & Angold, 2002). Figure 1 presents the 9 ACEs, in addition to other investigational items. In this paper, we only report on the original 9 ACEs.

Procedure

Data collection for this retrospective chart review started in April 2009. Despite limitations of retrospective chart reviews, studies have highlighted their utility in identifying possible etiologies of diseases and issues for further study, particularly

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Name	DOB

Denied	ACE Category	Hx	Date & Initial
	1. Physical Abuse		
	2. Emotional Abuse		
	3. Contact Sexual Abuse		
	4. Alcohol and/or Drug Abuser in the Household		
	5. Incarcerated Household Member		
	6. Someone Chronically Depressed, Mentally Ill, Institutionalized, or Suicidal		
	7. Mother Treated Violently		
	8. One or No Parents, Parental Separation, or Divorce		
	9. Emotional or Physical Neglect		

Denied	+1 Categories	Hx	Date & Initial
	Homelessness (Hx or Current)		
	Traumatic Incident		
	Foster Care System (Hx or Current)		
	Witness to Violence/Abuse		
Denied	**Other/Not Scored**	**Hx**	**Date & Initial**
	Public Housing		
	Intrauterine Drug Exposure		
	Child Protective Services Involvement		

Fig. 1. Trauma Screen.

when the review process follows rigorous standards (Gilbert, Lowenstein, Koziol-McLain, Barta, & Steiner, 1996; Greenspan & Wieder, 1997; Luck, Peabody, Dresselhaus, Lee, & Glassman, 2000; Nagy & Szatmari, 1986; Sartwell, 1974). To minimize errors in this chart review, we adopted the following approach: all chart documentation was completed by one of two pediatricians within the same practice, a standard abstraction form was used, inter rater reliability was calculated, researchers were trained and monitored by experts, and meetings were held to discuss clinical discrepancies between the research team members. Individual charts were reviewed according to published ACEs guidelines (http://www.acestudy.org) and approved by the principal investigators (VC and NB).

The number of experiences endorsed was counted and coded as any of the nine ACE categories. Each category endorsed as a traumatic event received a score of 1, hence potential scores range from 0 to 9. Furthermore, individual participant data was optimized by including relevant supplementary information from siblings' charts. All sibling charts were reviewed by the second author and every fifth chart was reviewed by a research assistant. For each documented case of sibling abuse a note was included on the referenced patient's chart and all uncertainties were resolved via clinical consensus in consultation with the principal investigator (NB).

The medical charts were reviewed in entirety. Most information was taken from the "Progress Notes" section, the "Confidential" section, "Social Services" section, and records from previous providers. Parameters were ascertained either through a medical history form filled out by the patient or by the MD during patient visits. Patient history obtained by a physician was gathered by a single physician (NB) for the first 1 1/2 years (April 2007–November 2008) and then by both NB and another pediatrician trained by NB from November 2008 to April 2009. History of abuse was determined by caregiver report of abuse, CPS report of confirmed child abuse or historical medical record report of abuse. Cases of abuse that were suspected by an MD but unsubstantiated after a CPS investigation were not included.

Documentation of learning/behavior problems and overweight/obesity was taken from the medical charts. Overweight/obesity was defined as having a BMI $\geq$ 85%. Classification of learning/behavior problems was obtained from a clinical

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Table 1
Prevalence of individual categories of adverse childhood experiences in a low income, urban pediatric population in San Francisco.

Original ACE categories	Prevalence (%)
Physical abuse	5.7
Sexual abuse	3.6
Emotional abuse	5.3
Substance user in the household	25.4
Parental incarceration	11.7
Mental illness	11.1
Mother treated violently	11.0
One or no parents, parental separation, or divorce	62.2
Emotional/physical neglect	11.7
At least one ACE	67.2

measure reported by the pediatrician and was based upon both objective learning data (i.e., low academic achievement) and objective behavioral data (i.e., history of violent behavior). Obesity, which may lead to other significant medical morbidity, was noted as categorical data ("Yes" or "No") for analysis. Data were collected and entered on Microsoft Excel and analyzed with SPSS v.17.

Statistical analysis

Inter-rater reliability was established by a second rater reviewing every fifth chart reviewed by a research assistant. The Inter-Class Correlation Coefficient was calculated to be .81.

Demographic information for individual participants was collected from the participant's intake forms included in the medical chart. Demographic data for the study sample were computed with frequency calculations in SPSS. We tested hypothesis 1 using descriptive statistics to find the frequency of an ACE score of 1 or more as well as the prevalence of each ACE type within our population.

To test hypothesis 2 we used separate logistic regressions to calculate the risk (Odds ratio) of having learning/behavior and obesity (BMI $\geq$ 85%) problems in association with an ACE score $\geq$ 1 and $\geq$4 (as compared to ACE score = 0). This procedure allowed us to control for demographic variables that may covary with ACE scores and outcome variables including age, gender, ethnicity, and two different groupings of ACE score (ACE $\geq$ 1 and $\geq$4 as compared to ACE score = 0). Ethnicity was categorized as African American vs. all other ethnicities because the majority of study participants were African American and a correlation was found between African American ethnicity and at least 1 ACE ($\chi^2 = 36.6$, $p < 0.001$). Predictor variables were coded as follows: male (1), female (0), African American (1) and all other ethnicities (0), ACE score = 0 (0), ACE score $\geq$ 1 (1) and then ACE score $\geq$ 4 (1).

Results

Prevalence of ACEs and supplemental ACEs

In this study sample, 67.2% ($n = 471$) of the participants had experienced at least 1 or more of the 9 ACE categories (i.e., an ACE score $\geq$ 1), and 12% ($n = 84$) had experienced at least 4 or more (i.e., an ACE score $\geq$ 4). Specifically, 32.8% had an ACE score = 0, 30.7% had an ACE score of 1, 13.8% had an ACE score = 2, 10.7% had an ACE score = 3, 6% had an ACE score = 4, 3.4% had an ACE score = 5, 2.1% had an ACE score = 6, 0.1% had an ACE score = 7, and finally 0.3% had an ACE score = 8. Within the total population ($N = 701$), the prevalence of different ACE categories varied from 3.6% (sexual abuse) to 62.2% (one or no parents). The prevalence of each ACE category in this study population is summarized in Table 1.

ACE score and medical conditions

As shown in Fig. 2, 3% of participants with an ACE score of 0 had learning/behavior problems, while 51.2% of participants with an ACE score $\geq$ 4 displayed learning/behavior problems. The prevalence of overweight and obesity (BMI $\geq$ 85%) was also greater (45.2%) among the participants with ACE score $\geq$ 4 than it was among participants with a score of 0 (31.3%).

Table 2 summarizes results of the logistic regression analysis when the dependent variable is either learning/behavior problems or a BMI $\geq$ 85%. As shown in Table 2, an ACE score $\geq$ 1 was associated with increased odds of reporting learning/behavior problems as compared to an ACE score of 0 (OR = 10.30, $p < 0.001$). Similarly, an ACE score $\geq$ 4 was associated with significantly increased odds of reporting learning/behavior problems as compared with an ACE score of 0 (OR = 32.60, $p < 0.001$). In terms of having a BMI $\geq$ 85%, age, ethnicity, and an ACE score $\geq$ 4 (OR = 2.0, $p = 0.02$) were associated with an increased likelihood of being overweight or obese as compared to those children with an ACE score of 0. In contrast, an ACE score $\geq$ 1 was not found to be significantly associated with being overweight or obese.

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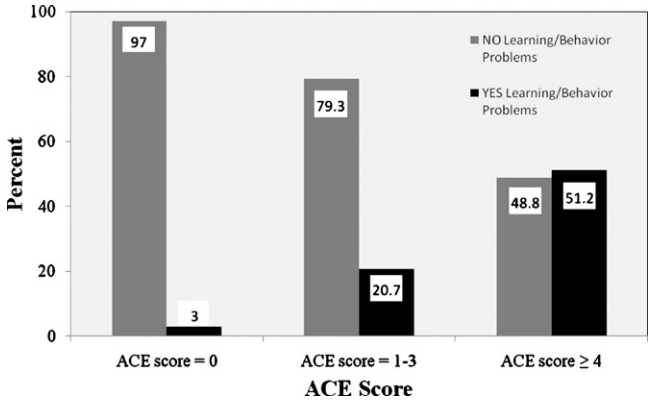

Fig. 2. Learning/behavior problems by ACEs score.

Table 2
Estimates of risk for developing learning/behavior problems and a BMI ≥ 85% based on ACE score.

	ACEs ≥ 1[c,e]					ACEs ≥ 4[d,f]				
	Wald	p[b]	Odds ratio	95%	CI	Wald	p[b]	Odds ratio	95%	CI
Learning/behavior										
Age[a]	22.66	<0.001**	1.10	1.06	1.14	2.63	0.11	1.07	.99	1.16
Ethnicity	4.46	0.04**	1.63	1.04	2.55	2.38	0.12	1.94	.84	4.50
Gender	17.07	<0.001**	2.43	1.59	3.69	6.71	0.01**	2.94	1.30	6.64
ACEs ≥ 1	33.18	<0.001**	10.30	4.66	22.77	–	–	–	–	–
ACEs ≥ 4	–	–	–	–	–	55.14	<0.001**	32.60	13.00	81.78
BMI ≥ 85%										
Age	69.42	<0.001**	1.15	1.11	1.19	40.51	<0.001**	1.17	1.12	1.23
Ethnicity	5.81	<0.001**	.49	.34	.70	9.05	<0.01**	.43	.25	.75
Gender	.13	0.72	.94	.67	1.32	.05	0.82	.94	.56	1.59
ACEs ≥ 1	.21	0.65	1.09	.75	1.59	–	–	–	–	–
ACEs ≥ 4	–	–	–	–	–	5.35	0.02**	1.99	1.11	3.55

[a] Variable(s) entered on step 1: age, ethnicity, gender, ACE ≥ 1 or ACE ≥ 4.
[b] **$p < 0.05$.
[c] Learning/behavior problems: model $\chi^2(4, N = 701) = 112.2$ ($p < 0.001$**); overall classification = 80.9%.
[d] Learning/behavior problems: model $\chi^2(4, N = 314) = 108.9$ ($p < 0.001$**); overall classification = 86.0%.
[e] BMI ≥ 85%: model $\chi^2(4, N = 701) = 90.45$ ($p < 0.001$**); overall classification = 71.3%.
[f] BMI ≥ 85%: model $\chi^2(4, N = 314) = 58.82$ ($p < 0.001$**); overall classification = 68.5%.

Discussion

The results of this study support the main hypotheses. A majority of participants (67.2%) were exposed to 1 or more adverse childhood experiences (ACEs) and an ACE score ≥ 4 was associated with increased risk of learning/behavior disorders (OR = 32.6) and BMI ≥ 85% (OR = 2.0). Furthermore, the prevalence of participants exposed to 1 or more ACEs in this study (67.2%) was significantly higher than the same measurement in the Felitti and Anda (2010) study (52%). This difference may have arisen from different methodology (e.g., sampling bias), as well as different sampling demographics (e.g., middle-class vs. low-income families). For example, participants in Felitti and Anda's (2010) study were recruited from a middle class Kaiser Permanente practice, whereas the participants in this study came from a neighborhood with a median household income of $37,146, where over 36% of the population has less than a high school education and the leading cause of YLLs is violence (Northern California Council for the Community, 2004). Future studies would benefit from screening and directly comparing the prevalence of ACEs among urban low-income and middle-class families to test whether ACEs is truly higher in a poor urban population.

Another alarming finding in this study was the greater prevalence of learning/behavior problems among children who had experienced at least 4 ACEs as compared to those children without such ACEs (51.2% vs. 3%, respectively). The importance of this finding is further exemplified when comparing it to those children with at least 4 ACEs who did and did not have overweight or obesity problems (45.2% vs. 31.3%). Although obesity was greater for those children with at least 4 ACEs, the greater discrepancy between children with and without learning/behavior problems signifies an urgent need to not only screen for ACEs in urban populations but target learning/behavior problems.

A significant limitation of this study is that the history of ACEs was obtained from the caregiver, whereas the original ACE Study used self-report. This creates an almost certain sampling bias because parents may be less likely to report abuse to a primary care provider who is a mandated reporter and may represent an underreporting of ACE categories. In the same

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regard, our pediatrician-reported measure of learning/behavior problems may not truly reflect the child's actual learning abilities (or disabilities), as well as behavioral problems, considering no formal assessment was conducted and only parents reported on the child's learning and behavioral history.

In addition, the cross-sectional design of this study limits the ability to infer causation in regards to the associations between ACES (risks) and both learning/behavior problems and obesity (outcomes) considering both are likely to be occurring at the same point in time. The prospective chart review design of this study also leads to certain limitations, such as possible selection bias (i.e., whose charts were reviewed), the possibility of relevant information being excluded from analyses (e.g., marital discord), and other possible confounding variables (socio-economic status). Nevertheless, this study is the first to examine the prevalence of ACE categories and ACES associations with negative psychological and physical outcomes among a pediatric population and presents significant findings that warrant further exploration in future studies.

The results of this study demonstrate a clear need for universal screening of ACEs in urban medical centers serving youth. Specifically, the alarming prevalence of aversive childhood experiences being endorsed in this urban population supports the dire need for the implementation of ACEs screening procedures across urban health-care settings. Furthermore, due to the association between ACES and both obesity and learning/behavior problems found in this study, the authors advocate for pediatricians and mental-health care providers be aware of the potential influence ACEs may have on preventative and intervention measures for these two more common childhood problems. Future studies should look prospectively to evaluate whether targeted interventions may attenuate the risk of chronic problems, such as learning/behavior problems and obesity, and assess whether universal screening and early intervention can reduce the risk of subsequent adverse events.

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