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The impact of adverse childhood experiences on healthcare utilization in children

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ABSTRACT

Background: Adverse childhood experiences (ACEs) are related to long-term negative outcomes. The impact of these experiences on healthcare utilization in children has been understudied.
Objective: To examine the impact of ACEs on children's healthcare utilization, medical diagnoses, and pharmacological treatment.
Participants and setting: Children aged 6 months to 17 years who were screened for ACEs in the Behavioral Health Department or in primary care locations as part of an initial consultation visit and who had at least one subsequent healthcare visit during the study period were included in the study.
Methods: Adverse childhood experiences were measured using the ACE screening questionnaire designed by Felitti et al. (1998). Data from the year following administration of the ACE screening tool were retrospectively extracted from the electronic health record.
Results: Overall, 1,183 children met study inclusion criteria. Children with any reported ACEs were more likely to no show appointments (1−3 ACEs incidence rate ratio (IRR) [95 % confidence interval (CI)]: 1.40 [1.11–1.77]; 4+ ACEs IRR [95 % CI]: 1.41 [1.08–1.84]) and to use emergency services (1−3 ACEs IRR [95 % CI]: 1.24 [1.00–1.53]; 4+ ACEs: IRR [95 % CI]: 1.42 [1.11–1.81]) than children with no ACEs. Those with 4+ ACEs used the telephone nurse advisor less frequently (1−3 ACEs IRR [95 % CI]: 0.67 [0.53–0.84]; 4+ ACEs IRR [95 % CI]: 0.69 [0.53–0.90]). Although ACE scores were associated with healthcare utilization, insurance status was more robustly associated with healthcare utilization than ACE score.
Conclusions: Healthcare systems may employ results from this study to adopt trauma-informed care initiatives. Ensuring that all patients have insurance may be a first step toward improving healthcare utilization.

1. Introduction

Children who experience adversity are at risk of a multitude of long-term developmental, behavioral, psychological, and physical health conditions that affect well-being throughout the lifespan (Balistreri, 2015; Felitti et al., 1998; Hughes et al., 2017). These experiences have been termed "adverse childhood experiences" (ACEs; Felitti et al., 1998) and have been studied in many ways,

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including with the ACE screening tool developed by Felitti et al. (1998)). This 10-item tool broadly examines abuse, neglect, and household dysfunction, addressing (1) physical abuse, (2) emotional abuse, (3) sexual abuse, (4) physical neglect, (5) emotional neglect, (6) parental mental illness, (7) incarcerated relative, (8) mother treated violently, (9) household substance abuse, and (10) not being raised by both biological parents (Center for Youth Wellness, 2017b).

ACEs affect 34.8 million children in the United States. Two thirds of adults have experienced at least one ACE, and one out of eight adults have experienced four or more ACEs (Center for Youth Wellness, 2017a). It is now well understood that a dose-response relationship exists between ACEs and negative outcomes (Hughes et al., 2017). A recent meta-analysis highlights the magnitude of research on ACEs, yielding over 11,000 references and suggesting that individuals with four or more adverse childhood experiences are at increased risk of all poor health outcomes (Hughes et al., 2017). Associations found were weak to modest for physical inactivity, overweight and obesity, and diabetes, strong for risky sexual behaviors, mental illness, and alcohol misuse, and strongest for drug use problems, interpersonal violence, and self-harm (Hughes et al., 2017).

1.1. ACEs and medical and mental health

Although the relationship between ACEs and medical and mental health comorbidities has been well documented in adults (Danese et al., 2009; Edwards, Holden, Felitti, & Anda, 2003; Felitti & Anda, 2010; Kalmakis & Chandler, 2015; Thompson et al., 2015), it has been less explored in children and adolescents. Research has suggested that young children with increased ACE scores are at risk of early childhood mental health concerns and chronic medical conditions, including learning, attention, and behavior problems, and obesity (Burke, Hellman, Scott, Weems, & Carrion, 2011; Jimenez, Wade, Lin, Morrow, & Reichman, 2016; Kerker et al., 2015; McKelvey, Whiteside-Mansell, Conners-Burrow, Swindle, & Fitzgerald, 2016). ACEs have been linked with asthma development and/or illnesses that require immediate childhood medical attention, as well as with increased odds of poor child health and negative psychosocial outcomes—for example, sadness, anger, and sleep problems (Flaherty et al., 2006; Marie-Mitchell, Watkins, Copado., & Distelberg, 2020). Hunt and colleagues found that ACE exposure by age 5 years is predictive of development of externalizing and internalizing behaviors and middle school ADHD diagnosis. They found that children as young as 9 years may start to show behavior problems due to early exposure to ACEs (Hunt, Slack, & Berger, 2017). Further research in this emerging area is warranted.

1.2. ACEs and medication use

ACEs have been associated with more prescription medications, psychotropic medications, and multiple classes of medications prescribed among adults (Anda et al., 2007; Anda, Brown, Felitti, Dube, & Giles, 2008). A large-scale Swedish study of young adults (ages 18–23 years) found that accumulation of ACEs was associated with increased psychotropic medication use: Women and men with >3 ACEs were 2.4 and 3.1 times more likely than those with <3 ACEs to use psychotropic medication, respectively (Bjorkenstam et al., 2013). Also documented is the relationship between ACEs and illicit drug use in adults (Anda et al., 2006; Dube et al., 2003), with some emerging evidence in adolescents specifically related to nonmedical use of prescription medications (Young, Glover, & Havens, 2012). A recent study by Forster and colleagues in a sample of over 100,000 adolescent students indicated that nearly 3% reported engaging in non-medical use of prescription medications, and of those, 70 % experienced at least 1 ACE (Forster, Gower, Borowsky, & McMorris, 2017). For each additional ACE, the number of prescription drugs used increased by 62 % (Forster et al., 2017). Understanding how ACEs related to prescribed medications in younger children has been understudied and has important implications for lifelong medication use and misuse and for potential development of long-term negative side effects.

1.3. ACEs and healthcare utilization

With this vast knowledge base on the effects of adversity on health and wellbeing, researchers have begun to explore the impact of ACEs on healthcare utilization, primarily in adults. A recent study by Koball et al. found that adults with four or more ACEs *make* more but *keep* fewer appointments than those with <3 ACEs and have more late cancelled and no-show healthcare visits (Koball et al., 2019). Moreover, it has been suggested that adults with a history of ACEs have higher healthcare utilizations, use emergency services more often, have more frequent overnight hospital stays, and have more difficulty paying for healthcare (Bonomi et al., 2008; Chartier, Walker, & Naimark, 2010; Corso, Edwards, Fang, & Mercy, 2008; Felitti & Anda, 2010; Hughes et al., 2017; Tang et al., 2006). Regarding children, one recent study suggested that experiencing ACEs was associated with greater odds of receiving specialty care (e.g., a surgeon or allergist) and higher unmet needs when seeing a specialist (Bloom, Alcala, & Delva, 2019). It has been suggested that family adversity may make it difficult for parents to meet their children's healthcare needs and that these families have lower insurance enrollment and lower use of preventive healthcare visits (Alcala, Valdez-Dadia, & von Ehrenstein, 2018; Berg, Shiu, Feinstein, Msall, & Acharya, 2018; Fairbrother, Kenney, Hanson, & Dubay, 2005). Certain children—for example, children with autism spectrum disorders—may be especially at risk of unmet healthcare needs when they have experienced ACEs (Berg et al., 2018).

1.4. ACEs and healthcare costs

Healthcare costs also seem to be affected by ACE exposure (Bonomi et al., 2008; Walker et al., 1999). As the Koball et al. study above indicates, more late cancelled and no-show visits lead to less revenue opportunity for healthcare systems (Koball et al., 2019). Other research has found a significant personal financial burden (Afifi et al., 2008) and higher healthcare costs (Schickedanz, Escarce, Halfon, Sastry, & Chung, 2019) for those who have experienced ACEs. In their recent study, Schickedanz et al. found that out-of-pocket medical costs were $184 higher annually when adults reported one or two ACEs and $311 higher among those with three or more ACEs compared with those with no ACEs. Costs were disproportionately higher among single, childless adults, and for women. Those with three or more ACEs were more likely to have medical costs exceeding 10 % of their household income and to incur medical debt (Schickedanz et al., 2019). Sterling and colleagues recently documented that "high utilizers" of healthcare services (those who were classified in the top 20 % ranked by dollars spent on healthcare cost) could be predicted by ACEs. Additionally, ACEs, psychiatric problems, and financial stress contributed to high medical utilization and cost (Sterling et al., 2018).

1.5. ACEs framework

A framework for understanding how ACEs can affect healthcare utilization can be gleaned from results of the original ACE study by Felitti et al. (1998) and the ACE Pyramid (Centers for Disease Control & Prevention, 2020), which highlight the mechanisms by which trauma influences physical and mental health over the life span. Specifically, accumulation of ACEs without buffering can disrupt neurodevelopment, leading to impaired social, emotional, and/or cognitive functioning, which in turn can lead to risky health behaviors. This can promote disease, disability, and other social problems long term, and finally, can put people at risk of early mortality (Centers for Disease Control & Prevention, 2020; Felitti et al., 1998). Given the myriad of potential negative health outcomes, it is understandable that ACEs would have a significant impact on whether and how individuals utilize healthcare services to treat and manage these resulting conditions.

1.6. ACEs and socioeconomic status

Socioeconomic status (SES) is an important factor to explore, given its likely impact on ACEs and healthcare utilization. Children living in poverty are particularly affected by ACEs (Lieberman, Chu, Van Horn, & Harris, 2011) and are mediated via physical health (Simons et al., 2019) and genetic transmission (Ridout et al., 2018). As a result of its significant risk for childhood adversity, a measure of low SES was included in a revised ACE inventory because it was predictive of physical health problems (Finkelhor, Shattuck, Turner, & Hamby, 2015).

1.7. Study aims

As indicated above, research on ACEs and healthcare utilization has focused primarily on adults with a history of ACEs and has examined these phenomena among children with ACEs minimally. Similarly, the literature on the relationship between ACEs and medical and mental health comorbidities and prescription medication use in children is sparse and emerging. The current study primarily sought to examine the impact of ACEs on children's healthcare utilization during childhood and adolescence (e.g., attendance to appointments, types of healthcare sought), a novel area of study. Based on findings from the study by Koball et al. (2019), it was hypothesized that children with high ACEs would similarly make more but keep fewer appointments and have more late cancelled and no-show visits than children with low ACEs. A secondary aim of the current study was to examine the impact of ACEs on medication use and medical comorbidities among children with low, moderate, and high ACE scores. Given the existing literature, it was hypothesized that children who have high ACE scores would have more medical comorbidities and be prescribed more psychiatric medications than those with low scores.

2. Methods

2.1. Study design

Eligible study participants were children aged 6 months to 17 years whose parents completed a screening questionnaire for ACEs as part of an initial behavioral health consultation visit during the study period (May 2015 to May 2017) and who had at least one healthcare visit subsequent to completion of the ACE questionnaire. Parents were asked to complete the questionnaire about their child to the best of their knowledge. The screening tool was completed in the waiting room or in provider offices during the visit in either the Behavioral Health Department or in other clinic locations (e.g., Pediatrics, Family Medicine) with a Behavioral Health consultant. Of the 3,048 children potentially eligible for study inclusion, 1,286 (42 %) had completed ACE questionnaires, and 1,762 (58 %) did not (parent declined, items were missed, or parents were not asked to complete due to workflow breakdown). Institutional Review Board approved the study.

2.2. Data extraction and measures

Data extracted from the healthcare system's electronic health record included demographic information, ACE screening score, and healthcare visits (within the study healthcare system only) for the year following the initial ACE screening. Information about medical and mental health comorbidities and medication prescriptions were also extracted.

Experiences of childhood adversity were assessed using the 10-item ACE questionnaire (Felitti et al., 1998). This tool includes questions assessing childhood abuse (e.g., Did a parent or other adult in the household often push, grab, slap, or throw something at you?), neglect (e.g., Did you often feel that no one in your family loved you or thought you were important or special?), and household dysfunction (e.g., Did you live with anyone who was a problem drinker or alcoholic or who used street drugs?). The total ACE score equaled the number of "yes" responses to the 10 items. As indicated above, an incremental relationship between ACEs, health outcomes, and health behaviors has been well documented in the literature. Experiencing four or more ACEs greatly increases the risk of being diagnosed with adverse health conditions (Anda et al., 2008; Chartier et al., 2010; Dube et al., 2009; Felitti et al., 1998). Similar to the study by Koball et al. (2019), in the current study, we generally analyzed ACEs at three levels: 0 ACEs, 1−3 ACEs, and 4+ ACEs.

The EHR was queried to capture appointments made in our regional healthcare system (clinics and hospitals covering a 150-square-mile catchment area). Appointments were classified as primary care (i.e., pediatrics and family medicine), specialty care (e.g., pediatric allergy), express care (i.e., local grocery store clinics), use of 24 -h telephone nurse advisor line, and urgent care/emergency department. Appointments were defined as "kept" (patient attended scheduled outpatient appointment) or "missed" (patient cancelled or rescheduled with less than 24 -hs' notice or no showed to visit). To calculate visit attendance, proportions were computed with the number of kept appointments/total appointments scheduled. For missed appointments, a proportion using late cancel or no show/total appointments scheduled was calculated.

Medical and mental health comorbidities were examined and included asthma, depression, anxiety, attention deficit hyperactivity disorder (ADHD), behavior disorders (e.g., oppositional defiance disorder), or mood disorders (e.g., bipolar disorder). Diagnoses were included if the patient had *ever* been diagnosed with the disease or disorder. Psychiatric medications were analyzed by drug class and included antidepressants, benzodiazepines, mood stabilizers, or antipsychotics. Medications were included if a patient was *ever* prescribed a medication of interest.

2.3. Statistical analyses

Descriptive statistics are reported as mean (standard deviation), median [interquartile range], and frequency (percentage). Associations between demographic, clinical factors, utilization, and outcomes were assessed using the chi-square and Fisher exact tests for categorical data and Wilcoxon rank sum and Kruskal Wallis tests for ordinal and continuous data. The association between ACEs scores and outcomes of interest were further assessed via construction of multivariate regression models designed to control for potential confounding effects of age and, gender, as well as insurance status, which is commonly used as proxy for SES (Kachmar, Connolly, Wolf, & Curley, 2019). Multivariate logistic regression models were constructed for binary outcomes of interest (e.g., medical diagnoses or prescription of medication classes), while deviance-scaled multivariate log-linked negative binomial regression models were constructed for outcomes expressed as count data (e.g., proportion of missed appointments). Finally, multivariate logit-linked binomial regression models were constructed for outcomes expressed as proportions (e.g., proportion of kept appointments out of all scheduled appointments) ranging between 0 and 1. To control for Type 1 errors in the primary utilization analysis, the Benjamini-Hochburg procedure was applied to the results of the primary analysis, with an allowed false discovery rate of 5%. All analyses were performed using the SAS software suite, version 9.4 (SAS Foundation, Cary NC).

3. Results

During the study period, 3,048 children were potentially eligible for study inclusion. Of these, 1,286 (42 %) parents completed an ACE questionnaire about their child, and 1,762 (58 %) did not. Children of parents who did not complete an ACEs questionnaire were slightly older than those whose parents did complete one (12.9 [9.1–15.6] vs 11.1 [7.8–14.5] years, respectively, $p < .001$) and were also more likely to be uninsured or utilizing public insurance policies (784 (44.5 %) vs 501 (39.0 %), respectively, $p = .002$). Patient race and gender were not significantly associated with completion or non-completion of ACEs screening.

Participants were 51 % male ($n = 668$), predominantly White (96.5 %, $n = 1241$), and 11 years old ($SD = 4.1$). Most participants had private insurance (53.2 %, $n = 684$), 38.4 % had state insurance (38.4, $n = 494$), and 8.4 % had no insurance ($n = 108$). Average ACE score for all participants across age ranges was 2.3 ($SD = 2.47$); 32.3 % had 0 ACEs ($n = 415$), 41.8 % had 1−3 ACEs ($n = 538$), and 25.9 % had 4+ ACEs ($n = 333$). See Table 1 for rates of each ACE score. The most commonly endorsed ACE screening item by parents about their child was #9 ("Was a household member depressed or mentally ill or did a household member attempt suicide;" 42 % positively endorsed). Girls were more likely to have higher overall ACEs ($M = 2.5$, $SD = 2.5$ vs $M = 2.1$, $SD = 2.4$, $p < .01$) and 4+ ACEs than boys (29.0 % vs 23.1 %, $p < .05$). Children with no insurance ($M = 3.1$, $SD = 2.5$) or state-based insurance ($M = 3.2$, $SD = 2.7$) had

Table 1
Child ACE Score rates (N = 1286).

Child ACE Score	Frequency	%
0	415	32.2
1	230	17.9
2	157	12.2
3	151	11.7
4	103	8.0
5	64	5.0
6	57	4.4
7	45	3.5
8	34	2.6
9	18	1.4
10	12	0.9

higher ACE scores than those with private insurance ($M = 1.5$, $SD = 2.0$; $p < .001$).

Notably, 7% of participants ($n = 89$) did not have any scheduled healthcare visit during the year following completion of the ACE screening tool. These children were more likely to have experienced any ACEs than those who did have scheduled healthcare visits during this period (82 % vs 67 %, respectively $p = .003$), and were more likely to be uninsured (36 % vs 6 %, respectively, $p < .001$). These participants were excluded from subsequent calculations involving the probability of late canceled and/or no-showed scheduled appointments, but were included in calculations involving utilization of non-scheduled medical care (emergency /urgent care, telephone nurse advisor calls) and overall clinic utilization (primary and/or specialty care visits).

3.1. *Kept visits*

3.1.1. *Total primary or specialty visits*

Across all patients, after controlling for age, gender, and insurance status, higher ACEs levels were not significantly associated with overall clinic use. Age 13–17 years and state-sponsored insurance were associated with higher overall clinic use, whereas male gender and lack of health insurance was associated with lower clinic use (Table 2A).

Table 2A
Total Primary or Specialty Care Appointments, All Patients (N = 1,286).

Parameter	IRR [95 % CI]	*p*
Age at ACEs, years		
0–5	Reference	
6–12	1.11 [0.92–1.34]	.27
13–17	1.38 [1.14–1.68]	.001*
ACEs Level		
0	Reference	
1–3	0.96 [0.84–1.11]	.61
4+	1.01 [0.86–1.18]	.93
Gender		
Female	Reference	
Male	0.87 [0.77–0.98]	.02*
Insurance Status		
Private	Reference	
State	1.15 [1.01–1.31]	.03
None	0.44 [0.35–0.55]	<.001*

Multivariate regression models of healthcare resource utilization. Results are presented as Incident Rate Ratios (IRR) and [95 % Confidence Intervals (CI)] or Odds Ratios (OR) and [95 % CI]. * Denotes that parameter remains a significant predictor after correcting for multiple comparisons via the Benjamini-Hochberg procedure with an allowed false discovery rate of 5%.

Table 2B
Total Primary Care Appointments, All Patients (N = 1,286).

Parameter	IRR [95 % CI]	*p*
Age at ACEs, years		
0–5	Reference	
6–12	1.05 [0.87–1.26]	.64
13–17	1.17 [0.96–1.42]	.12
ACEs Level		
0	Reference	
1–3	0.92 [0.80–1.06]	.26
4+	0.91 [0.78–1.08]	.28
Gender		
Female	Reference	
Male	0.82 [0.73–0.93]	.002*
Insurance Status		
Private	Reference	
State	1.16 [1.01–1.32]	.03
None	0.48 [0.38–0.61]	<.001*

3.1.2. Primary care visits

Across all patients, after controlling for age, gender, and insurance status, higher ACEs levels were not significantly associated with overall primary care utilization. State-sponsored insurance was associated with higher overall primary care use, whereas male gender and lack of health insurance was associated with lower primary care use (Table 2B).

3.1.3. Specialty care visits

Across all patients, after controlling for age, gender, and insurance status, higher ACEs levels were not significantly associated with overall specialty care utilization. Age 13−17 years was associated with higher overall clinic utilization, whereas lack of health insurance was associated with lower specialty care utilization (Table 2C). Appointments with the departments of Neurosciences, Ophthalmology, Radiology and Sports Medicine together accounted for approximately 45 % of all kept specialty care appointments.

3.1.4. Urgent care/emergency room visits

In general, ACEs exposure was associated with higher utilization of emergency and urgent care services. After controlling for relevant covariates, participants with ACE scores of 1−3 were marginally more likely to utilize emergency and urgent care than those with 0 ACEs (incidence rate ratio (IRR) [95 % confidence interval (CI)]: 1.24 [1.00–1.53] $p < .05$), whereas participants with ACE scores 4+ have 1.42 [1.11–1.81] times higher incidence rate of emergency and urgent care visits as those with 0 ACEs ($p = .005$). Additionally, state-sponsored insurance was associated with higher emergency and urgent care use, and male sex and lack of health insurance were associated with lower use (Table 2D).

Table 2C
Total Specialty Care Appointments, All Patients (N = 1,286).

Parameter	IRR [95 % CI]	*p*
Age at ACEs, years		
0−5	Reference	
6−12	1.18 [0.90–1.55]	.23
13−17	1.73 [1.30–2.31]	<.001*
ACEs Level		
0	Reference	
1−3	1.00 [0.81–1.22]	.96
4+	1.13 [0.89–1.42]	.32
Gender		
Female	Reference	
Male	0.93 [0.78–1.11]	.42
Insurance Status		
Private	Reference	
State	1.18 [0.98–1.42]	.08
None	0.39 [0.28−0.55]	<.001*

Table 2D
Total Combined Urgent Care and Emergency Department Visits, All Patients (N = 1,286).

Parameter	IRR [95 % CI]	*p*
Age at ACEs, years		
0−5	Reference	
6−12	0.85 [0.65–1.11]	.51
13−17	1.10 [0.83–1.47]	.24
ACEs Level		
0	Reference	
1−3	1.24 [1.00–1.53]	.046
4+	1.42 [1.11–1.81]	.005*
Gender		
Female	Reference	
Male	0.79 [0.66−0.94]	.009*
Insurance Status		
Private	Reference	
State	1.55 [1.28–1.88]	<.001*
None	0.68 [0.48−0.97]	.034

3.2. Missed appointments

3.2.1. Late cancelled appointments

In patients with at least 1 scheduled primary or specialty care appointment, after controlling for other relevant covariates, there were no significant associations between ACEs level and the probability of late cancelled (less than 24-h notice) appointments recorded during the study patients' follow-up period. Male gender, state-sponsored health insurance, and lack of health insurance were associated with increased odds of late cancelled primary or specialty care appointments (Table 2E).

3.2.2. No-show appointments

In patients with at least 1 scheduled primary or specialty care appointment, after controlling for relevant covariates, participants with 1−3 (odds ratio (OR) [95 % CI]: 1.37 [1.16–1.62], p <.001) and 4+ (OR [95 % CI]: 1.40 [1.17–1.68], $p < .001$) ACEs had significantly higher probability of no showed appointments during patients' follow-up period compared to those with 0 ACES. Additionally, patients with state-sponsored or no health insurance were more likely to no-show appointments (Table 2F)

3.3. Telephone nurse advisor calls

After controlling for relevant covariates, participants with any ACEs exposure were less likely to utilize the health system's free telephone nurse advisor resources (1−3 ACEs IRR [95 % CI]: 0.67[0.53−0.84], $p < .001$; 4+ ACEs IRR [95 % CI]: 0.69[0.53−0.90], $p =$

Table 2E
Probability of Late Cancelled (<24 h' notice) Clinic Appointments, Patients with At Least 1 Scheduled Appointment (n = 1,197).

Parameter	OR [95 % CI]	*p*
Age at ACEs, years		
0−5	Reference	
6−12	1.03 [0.84–1.25]	.80
13−17	1.09 [0.90–1.35]	.39
ACEs Level		
0	Reference	
1−3	0.95 [0.82–1.10]	.49
4+	1.00 [0.85–1.17]	.99
Gender		
Female	Reference	
Male	1.22 [1.08–1.37]	.001*
Insurance Status		
Private	Reference	
State	1.25 [1.10–1.41]	<.001*
None	1.76 [1.35–2.28]	<.001*

Table 2F
Probability of No-Show Appointments, Patients with At Least 1 Scheduled Appointment (n = 1,197).

Parameter	OR [95 % CI]	*p*
Age at ACEs, years		
0−5	Reference	
6−12	1.09 [0.88–1.35]	.44
13−17	0.96 [0.77–1.20]	.72
ACEs Level		
0	Reference	
1−3	1.37 [1.16–1.62]	<.001*
4+	1.40 [1.17–1.68]	<.001*
Gender		
Female	Reference	
Male	0.94 [0.83–1.07]	.39
Insurance Status		
Private	Reference	
State	1.80 [1.56–2.07]	<.001*
None	2.64 [2.02–3.42]	<.001*

Table 2G
Total Telephone Nurse Advisor (TNA) Calls, All Patients (N = 1,286).

Parameter	IRR [95 % CI]	*p*
Age at ACEs, years		
0–5	Reference	
6–12	0.50 [0.38–0.67]	<.001*
13–17	0.52 [0.38–0.70]	<.001*
ACEs Level		
0	Reference	
1–3	0.67 [0.53–0.84]	<.001*
4+	0.69 [0.53–0.90]	.007*
Gender		
Female	Reference	
Male	0.80 [0.66–0.97]	.022*
Insurance Status		
Private	Reference	
State	1.34 [1.09–1.66]	.007*
None	0.79 [0.54–1.16]	.23

.03) compared with those with 0 ACEs. Ages 6–12 and 13–17 years, and male gender were also associated with lower telephone nurse advisor utilization, whereas state-sponsored insurance was associated with higher use of this resource (Table 2G).

3.4. Medical and mental health comorbidities

Participants with 1–3 ($p < .01$) and 4+ ($p < .01$) ACEs were more likely to be diagnosed with ADHD than those with 0 ACEs. No relationship emerged between ACE scores and anxiety diagnoses. Participants with 1–3 ($p < .001$) and 4+ ($p < .001$) ACEs were more likely to be diagnosed with depression than those with 0 ACEs. Participants with 1–3 ($p < .01$) and 4+ ($p < .01$) were more likely to be diagnosed with a mood disorder than those with 0 ACEs. Participants with 1–3 ($p = .02$) and 4+ ($p = .01$) ACEs were more likely to be diagnosed with a behavioral disorder (e.g., oppositional defiant disorder) than those with 0 ACEs.

Alcohol and/or substance use disorders were diagnosed rarely (1% of sample), so no multivariate tests were performed to examine differences by groups on variables of interest. Asthma, a common childhood diagnosis, was also examined; no significant relationships emerged with ACEs or other variables of interest except for age. Participants with 4+ ACEs were more likely to have a developmental delay diagnosis than those with 0 ACEs ($p < .05$).

3.5. Medications

The most commonly prescribed psychiatric medications were antidepressants (35 %, $n = 449$). No differences in who was prescribed antidepressants by ACE score emerged ($p = 0.2$). Stimulants were the next most commonly prescribed medication (31 %, $n = 400$). Participants with 1–3 and 4+ ACEs were more likely to be prescribed stimulants than those with 0 ACEs ($p < .001$). Because of the high collinearity between a diagnosis of ADHD and stimulant prescription, the association between ACEs and stimulant prescription is likely influenced by the association between ACEs and ADHD. To examine this, we constructed a logistic regression model of stimulant prescription with ACEs and ADHD diagnosis as covariates, along with an interaction term between ACEs and ADHD. In this model, neither ACEs level nor the ACEs x ADHD interaction term were significant predictors of stimulant prescription. Antipsychotic medications, benzodiazepines, mood stabilizers, opiates, and non-benzodiazepine hypnotics were all prescribed infrequently (in less than 7% of the sample) and only antipsychotic prescription was related to ACEs. Those with 1–3 and 4+ ACEs were more likely to be prescribed antipsychotics than those with 0 ACEs ($p < .001$).

4. Discussion

The primary purpose of this study was to examine the association between ACEs and children's healthcare utilization. Secondarily, we sought to examine the impact of ACEs on medication use and medical comorbidities. As indicated above, age, gender, and insurance (a proxy for SES; Kachmar et al., 2019) were controlled for in all analyses. As may be expected given the literature on the relationship between SES and ACEs (Finkelhor et al., 2015; Font & Maguire-Jack, 2016; Lieberman et al., 2011), insurance status seemed to play an important role in the pattern of results seen in the current study.

Children with private insurance had significantly lower ACE scores than those uninsured or with state insurance. Only a small percentage of children did not have insurance, and these children's ACE scores were similar to those of children with state insurance; however, despite their similar ACE scores, they had significantly different patterns of healthcare use, which has important implications. For example, when examining total primary and specialty care appointments, primary and specialty care appointments separately, and telephone nurse advisor calls, children with state insurance utilized healthcare at rates higher than children with private insurance, and children with no insurance (again, who have similar mean ACE scores) seemed to have a “double hit.” Lack of health insurance also was related to increased odds of late cancelling primary or specialty care appointments. Insurance status seems important, but regardless of insurance status, higher ACE scores appear to be associated with more difficulty accessing care. Children who had higher ACEs had higher rates of emergency and urgent care utilization, more no-show appointments, and were less likely to utilize the telephone nurse advisor as a resource.

Prior research has demonstrated that adults with high (4+) ACEs were more likely to make—yet less likely to keep—medical appointments in both primary and specialty care (Koball et al., 2019); the current study findings did not exactly replicate this pattern of utilization, for which we suggest the following possible explanations. First, it may be that adults are more likely to keep primary care appointments for their children instead of themselves, given that routine healthcare visits are required by many daycares and public schools for child enrollment and attendance (Wisconsin Department of Children and Families, 2016). Additionally, there seems to be some evidence that children have more contact with healthcare providers than do adults (Centers for Disease Control and Prevention, 2017). This was not examined in the current study, so it is unclear whether these explanations fit for the current results. Further, the likely economic and resource cost (e.g., parent may have to miss work, no childcare available, or child may not be permitted to attend school) may drive keeping appointments and utilizing emergency or urgent care services. As is suggested above, another possible explanation for the non-significant association between ACEs and keeping medical appointments is that insurance coverage in our study was a stronger predictor of healthcare visits than ACE history. This may be especially true for this sample of children and adolescents, rather than adults. Although ACE history is likely important in determining how families use healthcare, whether one has insurance seems to be a larger driver of use, which has important implications for public policy and trauma-informed care initiatives. Finally, the type of adversity (sexual abuse vs neglect) and the specific health issues/services (e.g., colorectal cancer vs cervical cancer screening) may affect healthcare utilization differently (Alcala, Keim-Malpass, & Mitchell, 2017; Alcala, Mitchell, & Keim-Malpass, 2017); future research in this area is warranted.

Secondary analyses examined whether children with ACEs were more likely to be diagnosed with a behavioral health condition or prescribed certain classes of psychotropic medications. Children with ACEs were more likely to be diagnosed with ADHD, depression, mood disorders, developmental delays, and other behavioral disorders. This is consistent with prior research that individuals with ACEs, and children who have experienced traumatic events, are more likely to be diagnosed with a behavioral health concern (Brown et al., 2017; Hunt et al., 2017; Jimenez et al., 2016; Jimenez, Wade, Schwartz-Soicher, Lin, & Reichman, 2017; Rogosch, Dackis, & Cicchetti, 2011; Wang & Maguire-Jack, 2018; Whitted, Delavega, & Lennon-Dearing, 2012). Finally, we found that children with ACES were more likely to be prescribed stimulants and antipsychotic medications. Again, prior research in adults has also found this link (Anda et al., 2007), and more recent research has demonstrated this link in children and adolescents (Alcala, Horino, & Delva, 2018).

Limitations of this study include use of a “high risk” sample of children seeking behavioral health care. A recent, large-scale study of children in the United States found that half of the estimated 7.7 million with a treatable mental health condition did not receive treatment (Whitney & Peterson, 2019). Socioeconomic factors and state policy issues that influence access to care appeared to play an important role in these findings. Given that all participants in the current study were being seen for behavioral health care (which is where they were screened for ACEs), it may be that healthcare utilization would be lower in studies with samples having lower SES and/or who lived in a state with more barriers to behavioral health care. These results may not generalize to a population of children seen in primary care who do not have behavioral or mental health concerns. Similarly, this study utilized a US-based, homogenous sample of mostly White children. Previous research has highlighted differing rates of ACEs in low- versus high-income families and healthcare utilization disparities exist among underserved racial and ethnic groups (Chokshi, 2018; Halfon, Larson, Son, Lu, & Bethell, 2017); again, this study may not generalize to populations with more diversity where healthcare utilization may be depressed due to inequality and inequity. These results may be expected to replicate in other hospital systems with predominantly Caucasian samples who are experiencing behavioral health difficulties.

When considering other limitations, unfortunately, 58 % of potentially included participants for this study were not screened for ACEs. Again, this occurred for a variety of reasons (parent declined, items were missed, or parents were not asked to complete due to workflow breakdown that are) yet was in large part because participants were from a convenience sample of clinical patients. Additionally, the ACE questionnaire was completed by parents about their child and/or adolescent. Parents may under-report a history of adversity due to lack of knowledge (i.e., parent does not know that their child experienced sexual abuse) or fear of judgement or retribution if they disclose. Results should be viewed with this limitation in mind, and future research may do well to utilize other child-appropriate measures (e.g., Trauma Events Screening Inventory, Ford et al., 1996; Trauma Symptom Checklist for Children, Briere, 1996); or interviews to ascertain ACEs history from the perspective of the child (i.e., with older children and adolescents). Similarly, no parent involvement measure was utilized; this is particularly important as younger children are not able to attend medical visits alone or transport themselves. This may have impacted healthcare utilization in this study. Finally, healthcare visit results only include appointments to the study healthcare system and not to outside healthcare organizations. It may be that those with high ACEs seek care at a variety of locations; future research in this area is warranted as this has consequences for continuity of care.

Results from this study suggest that continued research examining healthcare utilization patterns of children with ACEs is worthwhile. Specifically, studies that include a diverse sample is warranted. Examining a sample of non-behavioral health seeking participants would also help to clarify how these results may generalize. Studies examining parent/caregiver factors in utilizing healthcare for their child may also help clarify the impact of social determinants of health that could have impacted results (e.g., willingness/interest in utilizing certain types of healthcare, income, or transportation barriers). Finally, examining potential changes in healthcare utilization with the increased availability of virtual care that has come out of the COVID-19 pandemic is an important next step. It is unclear whether virtual care options reduce healthcare disparities, yet they represent an exciting possibility of bringing care into patient’s homes more easily than our existing model of healthcare is able to do.

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Declaration of Competing Interest

The authors report no declarations of interest.

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