

Adverse Childhood Event Subtypes and Routine Diabetes Care Utilization Among U.S. Adults With Type 2 Diabetes

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Objective: Adverse childhood events (ACEs) have significant impacts on adulthood health, including greater risk of Type 2 diabetes (T2D). While there is a known connection to increased use of outpatient and emergency healthcare services, the potential role of ACEs in routine diabetes care utilization remains unclear. This study uses ACE subtypes to explain pathways to routine diabetes care utilization among adults with T2D.

Method: Cross-sectional data were obtained from the 2019 Behavioral Risk Factor Surveillance System, a survey of a representative sample of U.S. adults. Eligible participants resided in a state that completed both the Adverse Childhood Experiences (ACEs) and Diabetes modules and were diagnosed with non-gestational diabetes ($N = 9,904$), of whom the majority were presumed to have T2D. Confirmatory factor analysis was used to test the measurement model for three ACE factors: household dysfunction, physical and emotional abuse, and sexual abuse. Structural equation modeling was used to relate factors to four routine diabetes care utilization outcomes. **Results:** Factor loadings were strong, and fit indices indicated good measurement model and full structural model fits. In the full structural equation model, household dysfunction was associated with decreased likelihood of meeting frequency recommendations for A1C testing ($\beta = -0.22, p < .05$) and foot exams ($\beta = -0.29, p < .01$). Physical and emotional abuse were associated with greater likelihood of meeting A1C testing frequency recommendations ($\beta = 0.21, p < .05$). **Conclusion:** Specific types of ACEs may differentially relate to routine diabetes care utilization in adulthood.

Clinical Impact Statement

Adverse childhood experience types related differently to whether recommendations for four different types of routine diabetes care were met among U.S. adults with type 2 diabetes (T2D). Specifically, people with a history of childhood household dysfunction were less likely to meet ADA recommendations for A1C testing and foot exams from a medical provider. Findings highlight the potential significance of trauma-informed diabetes care to address disparities in diabetes self-management and engagement with routine diabetes care. However, future studies should discover why and how adverse childhood experiences relate to routine diabetes care use in adulthood to further optimize intervention strategies.

Keywords: adverse childhood experiences, trauma, diabetes, care utilization

More than 34 million adults in the United States (13%) had diabetes in 2018, the vast majority of whom had Type 2 diabetes (T2D; Centers for Disease Control and Prevention [CDC], 2020). Characterized by insulin resistance and high blood glucose levels that can damage many vital organs (CDC, 2020), the prevalence of T2D has been increasing and is expected to continue to increase in the coming decades. By 2060, the prevalence of T2D is estimated to increase to

17.9% among U.S. adults, which translates to almost 61 million people (Lin et al., 2018). Existing disparities and inequities in diabetes prevalence and diabetes-related care are also expected to worsen (Lin et al., 2018; Lundeen et al., 2019), exacerbating the existing gaps of lower quality of life, premature mortality, comorbid health conditions, and greater healthcare expenditures in minority and low-resource populations (Dall et al., 2010; Scully, 2012). For example,

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while T2D prevalence is expected to increase across U.S. adults from all racial groups, Black men and women are expected to have the highest prevalence of all race-sex groups by 2060 at 25.2% and 21.2%, respectively (Lin et al., 2018). The increasing prevalence of diabetes necessitates comprehensive care planning that thoughtfully addresses the needs of individuals at greatest risk for developing T2D.

Adults with a history of adverse childhood experiences (ACEs), including household dysfunction, physical abuse, and sexual abuse occurring before age 18, are at greater risk of developing T2D than the general population (Campbell et al., 2018; Chu & Chu, 2021; Roberts et al., 2015; Rose et al., 2022; Vaccarino et al., 2014). The negative impact of ACEs and repeated exposure to toxic stress on adulthood health and well-being is well established (Bonomi et al., 2008; D. W. Brown et al., 2009; M. J. Brown et al., 2013; Campbell et al., 2016; Chapman et al., 2004; Felitti et al., 1998). In addition to negative effects on physical and mental health (Felitti et al., 1998; Skarupski et al., 2016), ACEs have been linked to increased risk of developing specific chronic conditions, such as T2D. For example, a 2015 meta-analysis found that greater risk of developing T2D in adulthood was associated not only with a history of ACEs (pooled $OR = 1.32$; 95% CI [1.16, 1.51]) but also with specific types of ACEs, such as neglect (pooled $OR = 1.92$; [1.43, 2.57]), physical abuse (pooled $OR = 1.30$; [1.19, 1.42]), and sexual abuse (pooled $OR = 1.39$; [1.28, 1.52]; Huang et al., 2015). In a recent prospective cohort study, researchers found that the odds of developing adulthood diabetes significantly increased by 11% for each additional ACE experienced (Deschênes et al., 2018).

ACEs exposure is also associated with frequency of adult preventative and routine healthcare visits. In an analysis of 2011 Behavioral Risk Factor Surveillance System (BRFSS) data, researchers found that U.S. adults with ACEs exposure had lower adjusted odds of having a primary care provider and a physician checkup in the past year (Alcalá et al., 2018). A recent study also found that childhood trauma was associated with healthcare avoidance in adulthood (Selwyn et al., 2021). Among adults with diabetes, routine diabetes check-ups, visits with a diabetes provider, eye exams, foot exams, and A1C tests are essential components of diabetes self-management and comprehensive care (American Diabetes Association [ADA], 2021; An et al., 2018). However, many U.S. adults do not meet frequency recommendations for routine diabetes care exams and tests. For example, only 54.1% of Medicare Part B fee-for-service beneficiaries with diabetes had a dilated eye exam in 2017 (Lundeen et al., 2019). The association of lack of adherence to recommended routine diabetes care with specific types of ACEs is not known.

Given that adults with T2D underutilize routine healthcare and have experienced more ACEs than adults without T2D, it is important to better understand the potential relationship between ACEs and routine diabetes care engagement among adults diagnosed with T2D. While there is consensus that ACEs are associated with increased risk for adverse health in adulthood, the relative importance of cumulative ACEs versus specific subtypes is less clear. Researchers have proposed disaggregating ACEs into their components so results can be more readily interpreted (Lacey & Minnis, 2020). Thus, the objective of this study was to explore whether three types of ACEs are associated with routine diabetes care utilization among adults with T2D. Because childhood trauma has been linked to healthcare avoidance and underutilization of preventive healthcare (Alcalá et al., 2018;

Selwyn et al., 2021), the study hypothesis was that ACE subtype exposure would be negatively associated with engagement across all four types of routine diabetes care.

Method

Sample

Data were extracted from the 2019 national BRFSS, a publicly available, nationally representative, cross-sectional survey collected via landline and mobile phones. The ACEs and Diabetes modules were only asked to selected states' survey respondents (Centers for Disease Control and Prevention [CDC], 2019). The analytical sample included non-institutionalized U.S. adults who resided in the 11 states that completed the ACEs and Diabetes care common modules and who were ever diagnosed with non-gestational diabetes ($N = 9,904$), of whom an estimated 90%–95% would be diagnosed with T2D (CDC, 2020).

Measures

Participant Characteristics

Sociodemographic characteristics included sex (male and female), race and ethnicity (non-Hispanic White, non-Hispanic Black, non-Hispanic another race, multiple races, and Hispanic/Latinx), age (18–44, 45–54, 55–64, and 65 years and older), and educational attainment (less than high school, high school graduate or GED, some college, and college graduate or more). Other participant characteristics included age first diagnosed with diabetes (under 18, 18–39, and 40 years or more) and binary variables reflecting social support (living alone or with children only, yes/no) and healthcare access, that is, currently had health insurance (yes/no), needed to see a doctor but could not because of cost in the past year (yes/no), and had a primary care provider or other source of usual healthcare (yes/no).

Diabetes Care Utilization

Diabetes care utilization was conceptualized as four, binary (yes/no) observed variables. Each care utilization outcome was dichotomized for whether minimum recommendations by the American Diabetes Association (ADA) were met for the frequency of eye exams, A1C tests, foot exams by a healthcare provider, and diabetes healthcare provider visits (ADA, 2021). Respondents meeting eye exam recommendations reported an eye exam within the past 2 years. Meeting the recommended frequency of A1C measurements meant having their A1C measured at least twice in the past year. Respondents whose feet were checked at least once in the past year by a healthcare provider or other professional were coded as having met recommendations, and meeting recommendations for frequency of annual diabetes healthcare provider visits was operationalized as at least one visit in the past year.

Adverse Childhood Experiences

ACE subtypes were operationalized as three latent variables (household dysfunction, physical and emotional abuse, and sexual abuse) with binary (yes/no) indicators. ACE indicators were dichotomized for whether the experience had ever occurred before age 18. Factors and observed indicators were selected from previous

literature that used exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) to confirm a three-factor structure of ACEs using 2011 BRFSS data (Ford et al., 2014). The 2019 BRFSS contained the same ACE survey items and were grouped accordingly. Table 1 displays indicators and corresponding factors.

Statistical Analysis

To provide nationally and regionally representative estimates, all analyses used the final, person-level weighting variable developed from the complex sampling structure. To adjust for non-independence of observations resulting from stratified and clustered sampling, data were stratified on geographic and density sampling design stratum and clustered on the primary sampling unit (CDC, 2019). Weighted percentages were calculated for sociodemographic characteristics. Chi-square tests of independence were used to examine associations between characteristics of the study sample by whether participants reported at least one experience of the ACE subtype.

Confirmatory factor analysis was used to evaluate acceptable measurement model fit. Factor 1 (household dysfunction) had five

indicators, Factor 2 (physical/sexual abuse) had three indicators, and Factor 3 (sexual abuse) had three indicators. To account for dichotomous indicator variables, a robust, weighted least squares estimator (WLSMV) was used. The reliability of latent constructs was assessed using McDonald's ω coefficient (McDonald, 1985), a more optimal measure of reliability than Cronbach's α for binary indicators (Hayes & Coutts, 2020). McDonald's ω was calculated by adding parameter constraints and setting factors' variances equal to 1. Acceptable reliability of a factor was defined as having a McDonald's ω coefficient of greater or equal to 0.7 (Bagozzi & Yi, 2012). After evaluating the measurement model, latent constructs were used in a full structural equation model (SEM) to explain variation in whether participants met routine diabetes care recommendations.

Chi-square tests of model fit and degrees of freedom were calculated. Given this study's large sample size ($N = 9,904$) and chi-square sensitivity, evaluation of good model fit was instead determined from the following fit indices and cutoff values: root mean square error of approximation (RMSEA) and the upper limit of its 90% confidence interval less than or equal to 0.06, comparative fit index (CFI) greater than 0.95,

Table 1
Frequency and Weighted Percentages of Observed Indicators and Corresponding Adverse Childhood Event (ACE) Subtypes Among U.S. Adults with T2D, BRFSS 2019 ($N = 9,904$)

Factor	Indicator	Response	Weighted (%)	Frequency
Household dysfunction	a1 = Mental health; "Did you live with anyone who was depressed, mentally ill, or suicidal?"	Yes	14.9	1,295
		No	84.3	8,527
		Missing	0.8	82
	a2 = Alcohol; "Did you live with anyone who was a problem drinker or an alcoholic?"	Yes	25.3	2,329
		No	74.0	7,517
		Missing	0.7	58
	a3 = Prison; "Did you live with anyone who served time or was sentenced to serve time in a prison, jail, or other correctional facility?"	Yes	6.9	544
		No	92.8	9,332
		Missing	0.3	28
	a4 = Drugs; "Did you live with anyone who used illegal street drugs or who abused prescription medications?"	Yes	9.2	674
Physical and/or emotional abuse		No	90.1	9,165
		Missing	0.7	65
	a5 = Divorce; "Were your parents separated or divorced?"	Yes	24.4	2,009
		No	73.3	7,694
		Missing	2.3	201
	a6 = Punch; "Did your parents or adults in your home ever slap, hit, kick, punch, or beat each other up?"	Yes	16.6	1,538
		No	80.7	8,119
		Missing	2.7	247
	a7 = Hurt; "Did a parent or adult in your home ever hit, beat, kick, or physically hurt you in any way?"	Yes	26.2	2,442
		No	71.9	7,295
Sexual abuse		Missing	1.9	167
	a8 = Swear; "Did a parent or adult in your home ever swear at you, insult you, or put you down?"	Yes	31.9	2,958
		No	66.0	6,723
		Missing	2.1	223
	a9 = Touch; "Did anyone at least 5 years older than you or an adult ever touch you sexually?"	Yes	11.9	1,141
		No	85.8	8,565
		Missing	2.3	198
	a10 = Touch them; "Did anyone at least 5 years older than you or an adult try to make you touch them sexually?"	Yes	2.1	843
		No	88.9	8,871
		Missing	2.1	190
	a11 = Force sex; "How often did anyone at least 5 years older than you or an adult force you to have sex?"	Yes	6.2	549
		No	91.6	9,172
		Missing	2.2	183

Note. Percentages were estimated using complex survey weighting, and n 's were unweighted. HCP = healthcare provider; BRFSS = behavioral risk factor surveillance system.

and a Tucker–Lewis Index (TLI) greater than or equal to 0.95 (Hu & Bentler, 1999).

Among all eligible participants ($N = 9,904$), 1,037 (10.5%) had missing data for any of the 11 ACE indicators or the 4, observed diabetes care utilization outcomes. Missing data were considered missing at random (MAR), and full information maximum likelihood (FIML) was used in all analyses. Weighted frequencies were calculated in Stata SE Version 16.1, College Station, TX, United States, and CFA and SEM were run in MPlus Version 8.6, Los Angeles, CA, United States.

Results

The study sample included $N = 9,904$ U.S. non-institutionalized adults with non-gestational diabetes. Men and women were represented relatively equally in the sample at 49.7% and 50.3%, respectively. Most participants identified as non-Hispanic White (73.1%), followed by non-Hispanic Black (16.4%), Hispanic/Latinx (5.8%), another race (3.6%), and multiple races (1.1%). Almost half (46.2%) were 65 years or older, 27.1% were 55–64, 15.6% were 45–54, and 11.1% were 18–44 years old. For educational attainment, 13.9% did not finish high school or a GED, 34.8% were high school graduates or had obtained a GED, 31.7% had started but not completed college, and almost one-fifth (19.6%) had a college degree or more. Table 1 contains the unweighted counts and weighted frequencies of responses for each of the ACE indicators, grouped by subtype of ACE.

Characteristics of the study sample are presented as unweighted counts and weighted frequencies by the presence of one or more of each ACE subtype versus none with chi-squared analysis results in Table 2. Significant differences were observed between household dysfunction groups where a greater percentage of respondents who had experienced one or more indicators of household dysfunction were female, younger, diagnosed with diabetes earlier, lived alone or only with children, were not covered by health insurance, and could not afford healthcare compared to adults who experienced no household dysfunction indicators. A greater percentage of those who indicated one or more indicators of physical or emotional abuse were younger, diagnosed with diabetes earlier, and could not afford healthcare compared to those reporting no physical or emotional abuse. Finally, respondents who experienced sexual abuse were more often female, younger, diagnosed with diabetes earlier, and could not afford healthcare relative to adults not who did not report a childhood history of sexual abuse.

Measurement Model

While Chi-square test of model fit was significant, $\chi^2(41) = 235.62$, $p < .001$, RMSEA was 0.022 (90% CI [0.019, 0.025]), CFI was 0.993, and TLI was 0.991. Each of the fit indices and the 90% CI of RMSEA were well within the suggested cutoff values, indicating good model fit.

Factor loadings were also strong, with all significance levels at less than 0.001. All standardized factor loadings were also greater than 0.5, with the lowest loading at 0.535 (a5: divorce ["Were your parents separated or divorced?"]) and the next lowest loading at 0.720 (a3: prison ["Before you were 18 years of age, did you live with anyone who served time or was sentenced to serve time in prison, jail, or a correctional facility?"]). McDonald's ω

coefficient assessed reliability for each of the three latent variables: 0.838 for Household Dysfunction, 0.836 for Physical/Emotional Abuse, and 0.971 for Sexual Abuse. Figure 1 displays standardized factor loadings for the ACEs subscale factors.

Full Structural Equation Model

The Chi-square test of model fit was significant, $\chi^2(73) = 284.32$, $p < .0001$, and RMSEA (0.017; 90% CI [0.015, 0.019]), CFI (0.993), and TLI (0.990) all were well within suggested cutoff values, indicating good model fit. However, this model only accounted for 3.6%, 1.8%, 3.3%, and 0.1% of the variation in whether adults with T2D met recommendations for dilated eye exams, A1C checks, foot exams, and diabetes care provider visits, respectively.

The full structural equation model between the ACE subtypes and routine diabetes care outcomes indicated that childhood household dysfunction was associated with decreased likelihood of meeting recommended thresholds for frequency of A1C tests ($\beta = -0.22$, $p < .05$) and foot exams by a healthcare provider ($\beta = -0.29$, $p < .01$), supporting the hypothesis. Contrary to the hypothesized effect direction, however, childhood exposure to physical and emotional abuse was associated with increased likelihood of meeting A1C test frequency threshold ($\beta = 0.21$, $p < .05$). In the tested model, sexual abuse was not significantly associated with routine diabetes care use. Figure 2 displays standardized parameter estimates for the full structural equation model.

Discussion

To our knowledge, this study is the first to examine the direct relationship between ACE subtypes and routine diabetes care engagement in adulthood using a nationally representative sample of U.S. adults with T2D. These data partially support direct relationships between ACE subtypes and routine diabetes care engagement among adults with T2D: childhood household dysfunction was negatively related to meeting recommendations for frequency of A1C testing and foot exams, physical and emotional abuse were positively associated with meeting A1C testing recommendations, and childhood sexual abuse was not directly related with any of the diabetes care engagement outcomes.

These inconsistencies highlight that other factors might help account for the impacts of types of childhood trauma on adulthood diabetes self-management outcomes. For example, given that almost half (46%) of U.S. adults with T2D were older adults (65 years and older) in this study, consideration of theories that conceptualize trauma exposure throughout the lifespan, such as life course theory (Elder, 1994), might be of use to both clinicians and researchers. Additionally, biological, psychological, social, and environmental processes linking childhood experiences to adulthood routine diabetes care and self-management should be tested. For example, recent studies have identified adulthood mental health (Dixon et al., 2020), psychological distress (Strenth et al., 2022), and delay discounting (Shain et al., 2022) as potential mechanisms for explaining how childhood trauma relates to diabetes self-management in adulthood.

This study does, however, provide preliminary evidence that specific types of ACEs may help to explain differences in patients' adherence to recommended frequency of routine diabetes care in adulthood. Considering these results, diabetes healthcare providers

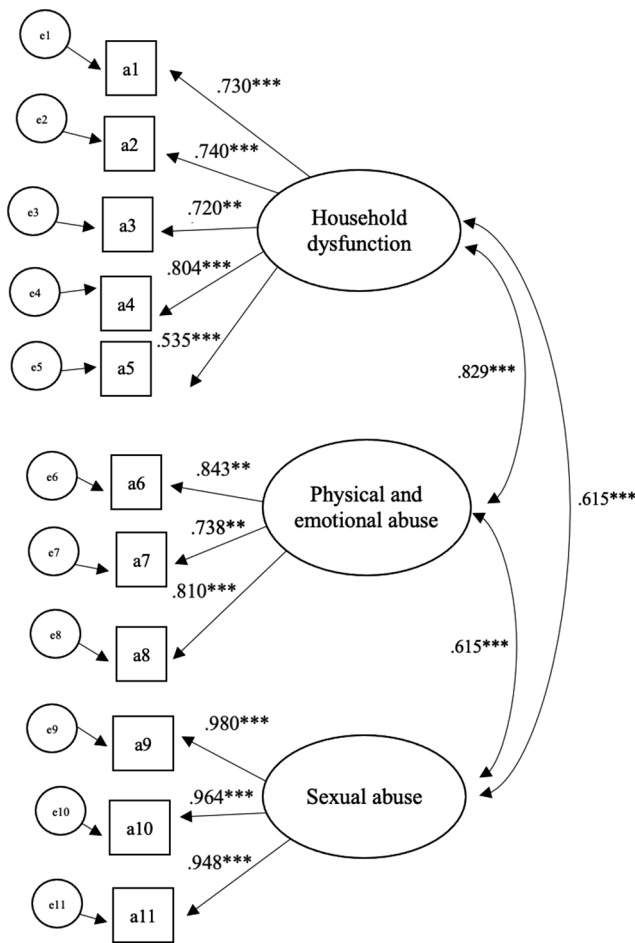
Table 2
Characteristics of Study Sample by Presence of Three Types of Adverse Childhood Experiences, BRFSS 2019 (N = 9,904)

Characteristics	Types of adverse childhood experiences					
	Household dysfunction		Physical and emotional abuse		Sexual abuse	
	None % (n)	1 or more % (n)	None % (n)	1 or more % (n)	None % (n)	1 or more % (n)
Sex						
Male	53.0% (2,819)	45.8% (1,814)	49.6% (2,632)	49.6% (1,966)	53.6% (4,275)	26.0% (310)
Female	47.0% (2,901)	54.2% (2,370)	50.4% (3,037)	50.4% (2,213)	46.4% (4,189)	74.0% (1,016)
Age category						
18–44 years	9.9% (436)	17.4% (134)	8.7% (253)	14.0% (327)	9.9% (436)	17.4% (134)
45–54 years	14.9% (890)	20.3% (218)	12.8% (515)	19.1% (599)	14.9% (890)	20.3% (218)
55–64 years	26.5% (2,040)	30.2% (400)	26.5% (1,313)	27.7% (1,138)	26.5% (2,040)	30.2% (400)
65+ years	48.7% (5,090)	32.0% (574)	52.0% (3,588)	39.2% (2,115)	48.7% (5,098)	32.0% (574)
Age of diabetes diagnosis						
Under 18	2.7% (112)	5.7% (144)	3.16% (127)	5.12% (127)	3.9% (209)	5.1% (42)
18–39	14.8% (645)	24.2% (779)	16.5% (692)	22.5% (722)	17.8% (1,118)	27.5% (291)
40 or older	82.5% (4,599)	70.1% (3,034)	80.4% (4,478)	72.4% (3,119)	78.4% (6,624)	67.4% (927)
Live alone or only children						
Yes	59.2% (3,060)	51.8% (1,975)	57.0% (2,944)	54.2% (2,066)	56.3% (4,349)	52.4% (632)
No	40.8% (2,654)	48.2% (2,201)	43.0% (2,718)	45.8% (2,109)	43.7% (4,103)	47.6% (694)
Has healthcare insurance						
Yes	96.0% (5,511)	94.0% (3,999)	95.7% (5,463)	94.4% (3,994)	95.3% (8,138)	93.8% (1,263)
No	4.0% (199)	6.0% (180)	4.3% (196)	5.6% (180)	4.7% (313)	6.2% (61)
Could afford healthcare						
Yes	91.8% (5,287)	84.0% (3,582)	91.2% (5,208)	84.3% (3,612)	89.6% (7,689)	79.8% (1,085)
No	8.2% (417)	16.0% (591)	8.8% (446)	15.7% (556)	10.4% (754)	20.2% (236)
Has PCP or regular HCPs						
Yes	95.5% (5,464)	94.9% (3,962)	95.5% (5,412)	94.9% (3,961)	95.2% (8,049)	95.5% (1,268)
No	4.5% (247)	5.1% (216)	4.5% (251)	5.1% (209)	4.8% (402)	4.5% (56)

Note. BRFSS = behavioral risk factor surveillance system.

Figure 1

Measurement Model With Standardized Factor Loadings for Adverse Childhood Experience (ACE) Subtypes Among U.S. Adults With T2D, BRFSS 2019 (N = 9,904)



Note. Model fit indices: RMSEA = 0.022; 90% CI [0.019, 0.025], CFI = 0.993, TLI = 0.991. BRFSS = behavioral risk factor surveillance system; RMSEA = root-mean-square error of approximation; CFI = Comparative Fit Index; TLI = Tucker-Lewis Index.

* $p < .05$. ** $p < .01$. *** $p < .001$.

should be mindful of the potential relationship between ACE subtypes, particularly childhood household dysfunction and physical and emotional abuse, and routine diabetes care utilization. Past studies have highlighted how social support from friends and family is associated with reductions in diabetes-related distress and improvements in diabetes management and glycemic control (Lee et al., 2018; Powers et al., 2020). Incorporating family members in care plans, however, may have limited success when there is a history of household dysfunction. For these patients and other patients with T2D and low social support, peer support interventions have been effective in improving glycemic control (Peimani et al., 2018; Piette et al., 2013; Warshaw et al., 2019). However, additional research is needed to evaluate the effectiveness of peer support interventions for increasing diabetes-related support among adult patients with T2D and histories of household dysfunction and other adversities.

More frequent A1C testing is recommended when patients are not meeting glycemic control goals and/or are undergoing medication changes (ADA, 2021). Future research may produce more clinically meaningful information using person-specific diabetes care outcomes, including meeting the frequency of A1C testing as recommended by their provider and/or by their current level of glycemic control. For example, person-specific diabetes care outcomes may help to explain the positive association observed in the present study between physical and emotional abuse and meeting A1C testing frequency recommendations. Similarly, person-specific diabetes care outcomes may help to explain this study's non-significant association between sexual abuse and diabetes care engagement outcomes. This could be because impacts on engagement were accounted for by household dysfunction—which was highly correlated with childhood physical, emotional, and sexual abuse.

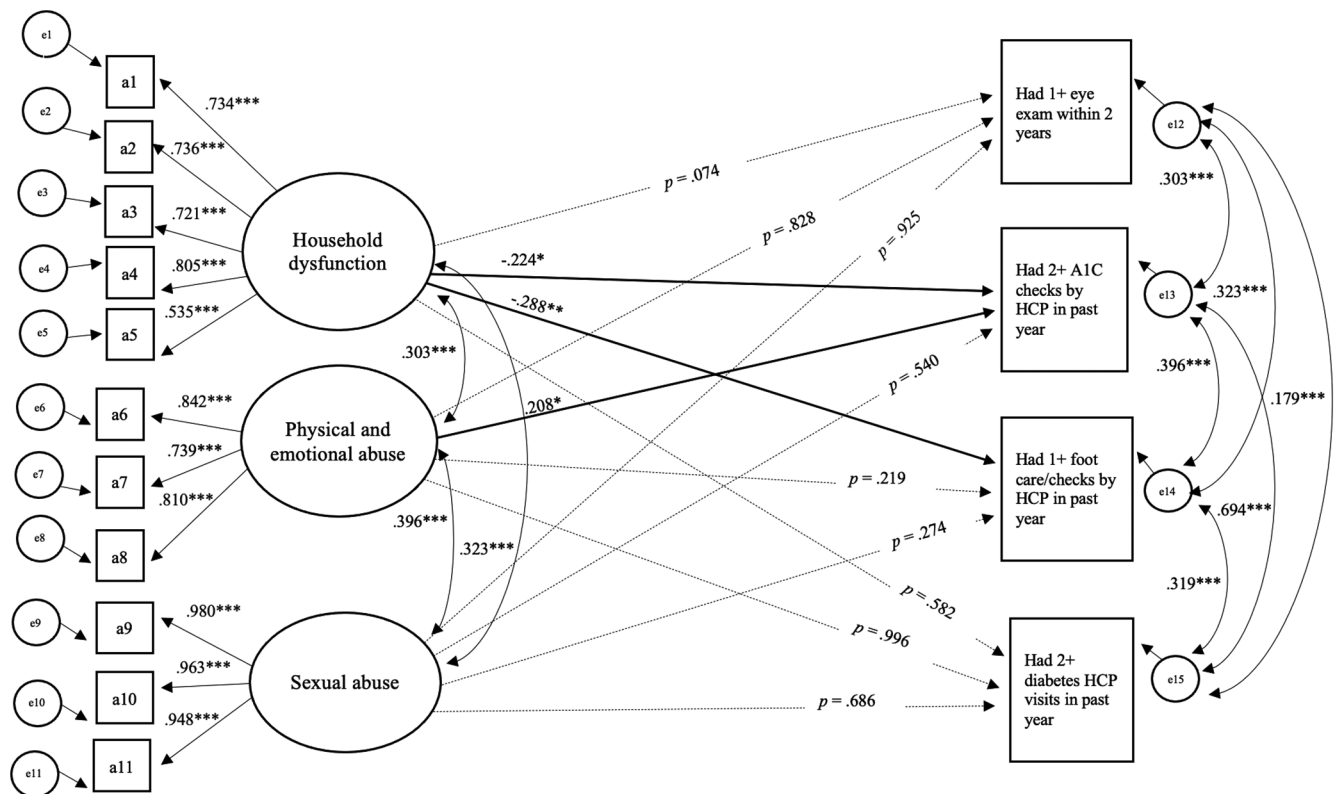
As likely indicated by the low percentage of variation explained in each of the diabetes care outcomes by the model, patient engagement in diabetes self-management and routine diabetes care is multifaceted and complex. Of note, ACEs only represent a proportion of the stressors facing individuals throughout a lifetime. Other known stressors specific to adults with diabetes include diabetes-related stress (e.g., emotional burden of receiving diabetes diagnosis or powerlessness), diabetes treatment-related distress, acute stress (e.g., short-term work-related stress), and chronic stress (e.g., food insecurity, housing instability, community violence, discrimination; Hilliard et al., 2016). Attending routine diabetes appointments is only a small component of diabetes self-care (e.g., glucose testing, diet, hydration, exercise, medication adherence, foot care), each component of which can be negatively impacted by stress (Walker et al., 2014).

In addition to stressors, a prior study found that trust in medical providers partially mediated the relationship between childhood trauma and healthcare avoidance in adulthood (Selwyn et al., 2021). On a broader scale, a history of trauma is also associated with distrust in healthcare systems (Klest et al., 2019). Given that negative interpersonal interactions with healthcare personnel are associated with non-attendance at diabetes outpatient appointments (Sun et al., 2021), improving the quality of interactions between patients, providers, medical staff, and healthcare administrators should remain a priority. Moreover, the quality of patients' routine care experiences beyond the exam room warrants attention, including checking of vital signs and current medication list review, check-in and interactions with office reception, appointment reminders, waiting room signage, verbiage on pre-visit screening questionnaires, website and social media messaging, referral process, and prescription refill reminders. In a qualitative study examining the healthcare experiences of Hispanic adults with T2D, patients wanted more friendly, attentive, and respectful communication from not only their doctors but also from the nurses and front desk receptionists (Amirehsani et al., 2017). The clinical role of medical office staff and receptionists in retaining and engaging patients is not new (Arber & Sawyer, 1985) but has been studied more often in primary care settings (Litchfield et al., 2017; Neuwelt et al., 2015).

Interestingly, one common mechanism for improving treatment engagement and health outcomes among both patients with trauma histories and patients with diabetes is autonomy support, including empowerment approaches to care (Funnell et al., 2007; Selwyn et al., 2021). While no data were available for the present study on participants' diabetes care coordination or treatment experiences, the

Figure 2

Full Structural Equation Model With Standardized Path Coefficients and Factor Loadings Among U.S. Adults With T2D, BRFSS 2019 (N = 9,904)



Note. Model fit indices: RMSEA = 0.017; 90% CI [0.015, 0.019], CFI = 0.993, TLI = 0.990. BRFSS = behavioral risk factor surveillance system; RMSEA = root-mean-square error of approximation; CFI = Comparative Fit Index; TLI = Tucker–Lewis Index.

* $p < .05$. ** $p < .01$. *** $p < .001$.

combined feelings of fear, guilt, and shame originating from the dual stigma of diabetes and trauma may play a role in patients' treatment decision-making processes (de Wit et al., 2020). In a clinical context, providers might consider using trauma-informed approaches to develop messaging around missed appointment and overdue appointment reminders to limit feelings of shame and guilt while simultaneously maintaining transparency and patient autonomy. At the structural level, a recent article by Ostrem (2022) suggests additional steps for increasing providers' ACE awareness and capacity for providing trauma-informed diabetes care, such as addressing ACEs explicitly within the Mental Health Provider Diabetes Education Program developed by American Diabetes Association (ADA) and the American Psychological Association (APA, 2017; Ostrem 2022).

As some clinics and primary care providers screen their patients for ACE histories (Bryant & VanGraafeiland, 2020; Kalmakis et al., 2018), data on patients' past trauma and childhood adversities may become more prevalent and accessible in electronic medical records and patient histories. In interpreting these data, the potential significance of ACE subtypes should not be ignored in favor of cumulative ACE scores. In addition, ACE subtypes should be further investigated when differences in health, health behaviors, or care use are discovered. For example, future studies should seek to better

understand the mechanisms by which household dysfunction may lead to a decreased likelihood of regularly getting foot exams and A1C tests. In addition, potential confounders of the association between ACEs and routine diabetes care engagement should be considered, such as comorbidities and glycemic control.

Underutilization of comprehensive foot care is somewhat more challenging to interpret, as this could be a result of patient preferences, provider practices, access to care, and/or a history of foot problems (Williams et al., 2018). Given that past research has established that depression and mental health comorbidities are more common among patients with trauma histories (Skarupski et al., 2016) and that depression is linked to poorer adherence to diabetes foot care (Pereira et al., 2018), more attention is warranted on the combined impact of ACEs and mental health symptoms on adults' engagement in routine diabetes care. In a recent systematic review, researchers found that depression was the most common co-occurring condition associated with worse diabetes self-care and treatment adherence (Aga et al., 2019). Therefore, future research might explore if depression mediates the association between household dysfunction and routine diabetes care engagement.

Another potential explanation for care underutilization is structural inequities that underlie racial disparities in healthcare access and engagement. For example, distrust in providers and healthcare

system perpetuates disproportionately lower rates of routine health-care use and treatment adherence, particularly by racial and ethnic minority groups (Kang et al., 2016). Past research has found that Asian and Latinx adults with diabetes in the United States were less likely to have received a foot exam by a healthcare provider in the past year than non-Hispanic white adults (Peraj et al., 2019). Therefore, macro-level factors and the role of structural inequities and social disadvantage cannot be ruled out as potential confounders of the relationships between childhood trauma and diabetes care engagement in adults. Future research might consider using multi-level modeling to better account for the influence of these macro-level determinants on routine diabetes care engagement.

Limitations

The results of this study should be interpreted in consideration of several limitations. First, the BRFSS is a cross-sectional survey which limits the ability to make inferences to causality. In addition, these data are self-reported by survey respondents to a phone interviewer, which may have impacted participant responses. For example, asking adults about childhood trauma may have been influenced by recall bias and/or social desirability bias, potentially leading to underreporting of ACEs. Conversely, social desirability bias could lead to increased reporting of routine diabetes care utilization by respondents to phone interviewers. However, the extent and the impact of these biases are unknown. While this study used FIML to calculate parameter estimates despite missing data, it may have been an unfair assumption to make that adverse childhood experience indicators and diabetes care use outcomes were missing at random, which would result in more biased parameter estimates (Enders & Bandalos, 2001).

In addition, the BRFSS data did not distinguish between Type 1 and T2D. However, a 2016 study found that over 90% of all adults diagnosed with diabetes in the United States are diagnosed with T2D (Bullard et al., 2018). This is consistent with ADA estimates that 90%–95% of U.S. adults diagnosed with diabetes have T2D (CDC, 2020). While the age of diagnosis is not indicative of diabetes diagnosis type, the weighted proportion of adults who were diagnosed with diabetes before age 18 in this sample was 4.1%. Therefore, it seems reasonable to assume that a significant proportion of the adults reporting non-gestational diabetes in the BRFSS sample had T2D. However, the true prevalence of T2D in this sample is unknown.

Another limitation is the relatively low threshold for meeting diabetes care recommendations. Past research has used higher thresholds for recommended diabetes care utilization (Yamashita et al., 2012), and the present study used cut-points on the lower end of the recommended range (ADA, 2021). A low threshold may overestimate the percentage of individuals meeting the recommended clinical guidelines. Thus, these data may not generalize to individuals with worse glycemic control or additional risk factors, as these individuals would likely receive exams and/or testing more frequently. Given that these data were limited to adult respondents from 11 U.S. states, it is unknown if these findings can be generalized to the entire United States. Finally, this model does not account for cumulative childhood adversity, timing of ACEs, chronic and acute stressors (Hilliard et al., 2016), adulthood trauma and adversity (Mersky et al., 2021; Nurius et al., 2019), or community-level trauma exposure (Rittenberg, 2020). Cumulatively, these limitations pose some challenges to interpreting these data.

Conclusion

Developing best practices for providing comprehensive diabetes care and facilitating patient and provider adherence to routine care recommendations is a priority. If histories of household dysfunction have the potential for residual influences on reduced engagement in routine care, practitioners should use integrated and trauma-informed approaches that consider patients' broader social context, resources, and mental health. Providers and organizations might consider incorporating trauma-informed care and associated values, such as transparency and autonomy support, into all domains of clinical care, including not only the clinical encounter with a provider, but also interactions with support staff, appointment reminders, waiting room signage, and all communications with patients. Improving these domains of clinical care may not only benefit patients with trauma histories but also patient–provider communication and experiences overall.

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