



Stress that Endures: Influence of Adverse Childhood Experiences on Daily Life Stress and Physical Health in Adulthood.

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ABSTRACT

Background: Understanding the influence of ACEs on reported daily stress is needed to further address the role of ACEs on adult health and well-being.

Methods: Data from 3,235 adults in the Midlife in the US (MIDUS) (Wave 1 (1995–1996) and Wave II (2004–2006)) were used. ACEs included emotional and physical abuse, household dysfunction, and financial strain. Daily stress was assessed using the National Study of Daily Experiences survey. Generalized Estimating Equations were used to examine the relationship between ACEs and Daily Stress.

Results: ACE exposure was associated with higher number of reported stressors per day ($p < .05$), stressor severity ($p < .05$), number of physical symptoms reported ($p < .05$), and negative affect ($p < .05$). ACE count was significantly associated with multiple stressor types ($OR = 1.73$, 95% 1.05 – 2.82) and number of days reported with stressor ($RR = 1.14$, 95% 1.00 – 1.30). Abuse specifically was associated with a higher number of days reported with a stressor ($RR = 1.23$, 95% CI 1.16 – 1.30).

Limitations: Assessment of ACEs is retrospective and self-reported. Secondly, this data is limited by ACE category. Specifically, sexual abuse and other forms of family dysfunction were not included in this dataset.

Conclusions: ACEs are associated with increased report of daily stress as an adult, reported physical symptoms as a result of stress, and reports of poor negative affect in adulthood. These findings highlight the role that ACEs play in the occurrence of reported daily stress during adulthood. Further investigation is needed to establish treatment and interventions for individuals who have experienced ACEs to avoid worsening health conditions and promote positive coping skills.

Introduction

Adverse Childhood Experiences (ACEs) have been defined as moderate to severe stressful experiences that occur when a child is exposed to varying types of abuse, neglect, or a traumatic living environment within the first 18 years of life (Felitti et al. 1998; Hughes et al. 2017). ACEs are prevalent in the general population with over a third of adults reporting at least 2 or more ACEs (Kessler et al., 1997; Anda et al. 2006; Green et al. 2010). A large and growing body of evidence indicates that people who report a history of ACEs are more likely to have chronic disease and suffer from depression and poor mental health later in life (Felitti et al. 1998; Thomas et al. 2008; Afifi et al. 2011; Miller et al. 2011; Campbell et al. 2016; Huffhines et al. 2016). Additionally, individuals who experience ACEs have a greater risk of premature

mortality compared to those who have not experienced ACEs (Hughes et al. 2017; Anda et al. 2006; Brown et al. 2009; Bellis et al. 2015).

The relationship between ACEs and persistent poor mental and physical health throughout adulthood is hypothesized to be related to higher levels of stress over time (Nurius et al., 2016, 2019). Evidence shows that among individuals who have experienced ACEs, higher ACE scores are associated with higher reports of stressors (McElroy and Hevey, 2014). The reason for this relationship is unclear, however, evidence shows both chronic and acute forms of stress can have a biological influence (Pearlin et al. 2005; Pearlin, 2010; Epel et al. 2018), with multiple layers of stress, for example, ACEs, daily stressors, or a cluster of stressful events, differentially impacting health due to vulnerabilities formed from early chronic stress exposure (Pearlin et al. 2005; Pearlin, 2010). Therefore, it is important to understand if ACEs

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are associated with stressors later in life that negatively impact psychological well-being or health in adulthood (Thoits, 2010).

Daily stressors are defined as the difficulties that arise from day to day activities across domains of work, home, and social experiences such as familial relationships and the responsibilities that intersect across each of these domains (Almeida, 2005), for example child care, work tasks and hours etc. The body of literature on daily stress suggests that experiences of daily stress are related to higher levels of psychological distress, depression, and poor physical health (Almeida et al. 2002). Additionally, evidence suggests that stress reactivity, the emotional or physical reaction to any given stressor, is a critical factor to consider when examining the impact of daily stress on physical health (Almeida, 2005). Factors that influence reactivity to stress include vulnerability at the biological, environmental, or psychosocial level, which may create stress exposure that influences health differentially (Almeida, 2005; Bolger and Schilling, 1991; Walker et al. 2019) and may be largely informed by the diathesis stress model that purports vulnerabilities are created through exposure to early chronic stress, lowering the threshold for stress reactivity (Hammen et al., 2000; Slavik and Croake, 2006). However, a gap remains in understanding the role of ACEs on the adult experience of daily stressors. Understanding the relationship between ACEs and daily stress may provide new information to develop interventions that address the impact of multiple layers of stress on health in adulthood. This study aims to examine the relationship between ACEs and adulthood daily stress using data from the national longitudinal cohort of adults as part of the Midlife in the United States (MIDUS) study.

Methods

Sample and Study Population

Midlife in the United States (MIDUS), is a public, de-identified data set, and a national longitudinal study of health and well-being, which was first conducted in 1995-1996 (Wave 1) by the MacArthur Foundation Research Network on Successful Midlife Development (MIDUS, 2011). The aim was to investigate the role of behavioral, psychological, and social factors in accounting for age-related variations in health and well-being in a national sample of Americans. The second phase of MIDUS (Wave 2, conducted in 2004-2006) largely repeated the comprehensive assessments obtained in all of the original content areas, plus launched new areas of biological and neurological assessment.

This cross-sectional analysis used the first two waves of the longitudinal MIDUS study and includes data from the main project (telephone and the self-administered questionnaire (SAQ) survey) as well as the national study of daily experiences (NSDE) project. We included participants who answered both telephone and mail questionnaire, as well as participated in the NSDE project for this study. There were 1,497 unique participants who completed the phone, SAQ, and NSDE at wave 1, and 1,775 unique participants who completed the three aspects of wave 2. A total of 726 participants completed both waves 1 and 2 and data from both waves was included for those individuals. Anyone who did not report age or answer both ACE and NSDE questions were excluded, resulting in a total cohort size of 3,234 individuals.

Adverse Childhood Experiences (ACEs)

We used the ACE Study Questionnaire (Felitti et al. 1998) and the MIDUS questionnaire data documentation (ICPSR 2760: National Survey of Midlife Development in the United States (MIDUS) 1995-1996; ICPSR 2009) to identify measures of adverse events experienced during childhood. Items were derived from childhood family background questions and childhood background questions. Household dysfunction and financial strain definitions are based on (Ferraro et al., 2016; Turiano et al. 2017; Schafer et al. 2011). Five measures for ACE were created:

- a) Abuse (emotional abuse or physical abuse) that occurred prior to the age of 18.
- b) Household dysfunction (parental divorce, death of a parent, adopted, lack of male head in the household, parental alcohol or drug use, or parental mental illness) that occurred prior to the age of 18.
- c) Financial strain (receipt of welfare; report of being 'worse off' than other families; less than a high school education for father, or mother where father was not present) that occur prior to the age of 18.
- d) Any ACE where 'yes' to abuse, household dysfunction, or financial strain were coded as 'yes' to any ACE.
- e) ACE count where each individual could have 0 to 3 based on whether they indicated they experienced abuse, household dysfunction, and/or financial strain.

Daily Stress Measurements

Data collection for the NSDE project occurred across a 12-month period with individual participants being asked to recall daily experiences using the Daily Inventory of Stressful Events (DISE) over the past week via a short telephone interview. The DISE inventory assesses whether certain types of events occurred in the past 24 hours based on 7 stem questions: 1) "Did you have an argument or disagreement with anyone since yesterday?"; 2) "Since yesterday, did anything happen that you could have argued about but you decided to let pass in order to avoid a disagreement?"; 3) "Since yesterday, did anything happen at work or school (other than what you already mentioned) that most people would consider stressful?"; 4) "Since yesterday, did anything happen at home (other than what you already mentioned) that most people would consider stressful?"; 5) "Many people experience discrimination on the basis of such things as race, sex, or age. Did anything like this happen to you since yesterday?"; 6) "Since yesterday, did anything happen to a close friend or relative (other than what you've already mentioned) that turned out to be stressful for you?"; 7) "Did anything else happen to you since yesterday that people would consider stressful?". The dataset is organized by person-day, we summarized the stress-related measurement by person.

A number of variables were used to investigate the relationship with daily stress, including:

- a) Number of days with stressor: count of reported days with stressor (range 0 -7).
- b) Average number of stressors per day: mean of reported number of stressors each day.
- c) Number of stressor types over reported days: count of reported stressor types over all days reported.
- d) Individuals with any stressor: any stressor reported.
- e) Individuals with multiple stressor types: more than two stressor types reported over all days reported.
- f) Average stressor severity: mean of the stressor severity per reported day.
- g) Average number of physical symptoms: mean of number of physical symptoms per reported day. Physical symptoms included respondents being asked questions such as "how much of the time of today did you have headache, backache, muscle soreness?"
- h) Average negative affect: mean of negative affect per reported day. Example questions included "Did you feel depressed? Did you feel hopeless? Were you in good spirits?"

Demographic variables

Covariates included gender, age (grouped as 20-39 years; 40-54 years; 55-74 years; 75+ years), race/ethnicity (grouped as Non-Hispanic White; Non-Hispanic Black; and other Minority), education (dichotomized as high school diploma or less vs. higher education), marital status (dichotomized as married vs. not married), household total income (grouped as less than 25k; 25k - < 75k; and 75k +).

Statistical Analysis

Statistical analysis was performed with SAS version 9.4 (SAS Institute). Generalized estimating equations (GEE) was used to account for repeated measures over waves. Descriptive statistics were first used to describe the sample. Characteristics of the sample by the waves were compared and presented separately since a wider age range was included by design for wave 2.

Each daily stress measurement was assessed separately for their relationship with ACEs. First, each measure of daily stress was compared with individual ACE categories (abuse, household dysfunction, or financial strain). Second each measure of daily stress was compared against the dichotomous ‘any ACE’ category. And finally, each measure of daily stress was compared against the count of ACEs for an individual.

As some individuals had stress measured multiple times, repeated measures models were developed to test the unadjusted and adjusted associations for ACEs and each daily stress measurement. As in initial comparisons, first unadjusted GEE models were run with individual ACE categories as the primary independent variable. Second, unadjusted GEE models were run with the dichotomous any ACE variable as the primary independent variable. And finally, unadjusted GEE models were run with count of ACE as the primary independent variable with 0 as the reference. Each GEE model was then adjusted for demographic covariates. Adjustments for covariates allow for controlling for any variability in order to have a more precise measure between the predictor and outcome variables and determine if the relationship is independent of the influence of demographics on the outcome. The type of GEE model was based on the characteristics of each daily stress measurements. Logistic regression was used for dichotomous daily stress variables (any stressor and multiple stressor types); Poisson regression was used for count daily stress variables (number of days with stressor and number of stressor types over reported days); Linear regression was used for continuous daily stress variables (average number of stressors per day, average stressor severity, average number of physical symptom types, and average negative affect).

Results

Demographics during each wave for this longitudinal study are displayed in Table 1. Table 2 shows information on daily stress measurements overall and by different ACEs categories. Overall, presence of any stressor was reported by 89% of participants, while 68% reported presence of multiple stressors. The mean number of days with a stressor was 2.81 (s.d.=1.92), and there were on average 2.41 (s.d.=1.54) stressor types over the reporting time frame.

Those reporting an ACE had statistically significantly higher average stressor severity (1.75±0.69 with ACE vs. 1.67±0.63 no ACE, $p<0.01$), average number of physical symptom types (1.13±0.92 with ACE vs. 0.92±0.76 no ACE, $p<0.0001$), and average negative affect (0.21±0.30 with ACE vs. 0.15±0.20 no ACE, $p<0.0001$) compared to not having an ACE. Those reporting abuse as a specific ACE had statistically significantly higher percentage across all daily stress measures (all $p<0.0001$).

Table 3 provides the results of multivariable repeated measure model estimates for each daily stress measurement adjusted by demographic variables. For the logistic model, having an ACE count of 2 or 3 was statistically significantly related to greater odds of reporting multiple stressor types compared to those reporting no ACE (OR=1.51, 95% CI 1.15 - 1.99; OR=1.73, 95% CI 1.05 - 2.82), respectively. Those reporting experiences of abuse during childhood were statistically significantly more likely to report any stressor (OR=2.25, 95% CI 1.50 - 3.37) and more likely to report multiple stressor types (OR=1.76, 95% CI 1.40 - 2.21), compared to those who did not report abuse during childhood.

Results from the Poisson model showed that those reporting an ACE had statistically significantly higher number of days with stressor (RR=1.07, 95% CI 1.01 - 1.12) and number of stressor types over reported days (RR=1.09, 95% CI 1.04 - 1.15). Those reporting an ACE

Table 1
Sample characteristics over survey wave

	Wave 1	Wave 2
	n=1496	n=1738
Gender		
Male	694(46.39%)	753(43.33%)
Female	802(53.61%)	985(56.67%)
Age group		
20-39	536(35.83%)	130(7.48%)
40-54	538(35.96%)	645(37.11%)
55-74	422(28.21%)	799(45.97%)
75 +		164(9.44%)
Race		
White	1354(91.06%)	1615(92.92%)
Black	86(5.78%)	61(3.51%)
Other Race	47(3.16%)	62(3.57%)
Education level		
High school diploma or less	548(36.68%)	510(29.41%)
Higher education	946(63.32%)	1224(70.59%)
Marital status		
Married	1028(68.72%)	1258(72.38%)
Not Married	468(31.28%)	480(27.62%)
Household total income category		
Less than \$25k	281(19.17%)	331(19.54%)
\$25k - <\$75k	704(48.02%)	746(44.04%)
\$75k +	481(32.81%)	617(36.42%)
ACEs		
Any ACE	832(55.61%)	946(54.43%)
Abuse (Emotional or Physical)		
No	1188(79.41%)	1386(79.75%)
Yes	294(19.65%)	342(19.68%)
Household dysfunction		
No	1155(77.21%)	1397(80.38%)
Yes	341(22.79%)	340(19.56%)
Financial strain		
No	983(65.71%)	1147(66.00%)
Yes	513(34.29%)	591(34.00%)

count of 2 or 3 had statistically significantly higher number of days with stressor (RR=1.15, 95% CI 1.07 - 1.24; RR=1.14, 95% CI 1.00 - 1.30), respectively, and number of stressor types over reported days (RR=1.16, 95% CI 1.08 - 1.24; RR=1.18 95% CI 1.05 - 1.33). Those reporting abuse during childhood were statistically significantly more likely to report number of days with stressor (RR=1.23, 95% CI 1.16 - 1.30) and number of stressor types over reported days (RR=1.25, 95% CI 1.19-1.32). Those reporting financial strain had a statistically lower reported number of days with a stressor.

Results from the GLM model showed that reporting any ACE was statistically significantly related to average number of stressors per day ($\beta=0.07$, 95% CI 0.04 - 0.11), average stressor severity ($\beta=0.07$, 95% CI 0.02 - 0.12), average number of physical symptom types ($\beta=0.17$, 95% CI 0.11 - 0.23), and average negative affect ($\beta=0.06$, 95% CI 0.04 - 0.08). Those reporting higher ACE count had statistically significantly higher average number of stressors per day ($\beta=0.12$, 95% CI 0.02 - 0.22 for count of 3), higher average stressor severity ($\beta=0.28$, 95% CI 0.16 - 0.40 for count of 3), higher average number of physical symptom types ($\beta=0.49$, 95% CI 0.26 - 0.71 for count of 3), and higher average negative affect ($\beta=0.15$, 95% CI 0.07 - 0.22 for count of 3). For ACE categories, those reporting abuse during childhood had statistically significantly higher average number of stressors per day ($\beta=0.18$, 95% CI 0.13 - 0.22), higher average stressor severity ($\beta=0.11$, 95% CI 0.04 - 0.17), higher average number of physical symptom types ($\beta=0.30$, 95% CI 0.21 - 0.39), and higher average negative affect ($\beta=0.11$, 95% CI 0.08 - 0.14). Those reporting household dysfunction in childhood had statistically significantly higher average stressor severity ($\beta=0.11$, 95% CI 0.04 - 0.17), average number of physical symptom types ($\beta=0.11$, 95% CI 0.02 - 0.19), and average negative affect ($\beta=0.03$, 95% CI 0.00 - 0.06).

Table 2
Daily Stress measurements (Frequency % and Mean (SD))

	ScaleRange	Overall	Childhood adversity		Childhood adversity count				Abuse		Household dysfunction		Financial strain	
			no ACE	with ACE	0	1	2	3	No	Yes	No	Yes	No	Yes
Any stressor (%)		89.83	90.45	89.31	90.45	88.76	90.26	91.89	88.77	94.50***	89.85	89.87	91.36	86.87**
Multiple stressor types (%)		68.34	69.02	67.77	69.02	65.65	71.02	79.28*	66.08	77.67***	67.79	70.48	70.61	63.95**
Number of days with stressor	0-8	2.81 (1.92)	2.83 (1.90)	2.79 (1.93)	2.83 (1.90)	2.71 (1.94)	2.93 (1.91)	3.18 (1.94)	2.69 (1.90)	3.30*** (1.93)	2.79 (1.91)	2.87 (1.94)	2.92 (1.92)	2.58*** (1.88)
Average number of stressors per day	0-4	0.54 (0.47)	0.52 (0.43)	0.55 (0.49)	0.52 (0.43)	0.52 (0.49)	0.58* (0.50)	0.66** (0.49)	0.50 (0.44)	0.69*** (0.54)	0.53 (0.46)	0.57 (0.49)	0.56 (0.47)	0.49*** (0.46)
Number of stressor types over reported days	0-7	2.41 (1.54)	2.39 (1.50)	2.43 (1.58)	2.39 (1.50)	2.37 (1.58)	2.50 (1.53)	2.87** (1.65)	2.29 (1.50)	2.91*** (1.61)	2.39 (1.54)	2.49 (1.55)	2.51 (1.54)	2.23*** (1.52)
Average stressor severity	0-3	1.71 (0.66)	1.67 (0.63)	1.75** (0.69)	1.67 (0.63)	1.70 (0.68)	1.81** (0.70)	2.06*** (0.58)	1.68 (0.66)	1.84*** (0.64)	1.68 (0.66)	1.84*** (0.65)	1.71 (0.63)	1.72 (0.72)
Average number of physical symptom types	0-6	1.03 (0.86)	0.92 (0.76)	1.13*** (0.92)	0.92 (0.76)	1.07*** (0.90)	1.20*** (0.91)	1.47*** (1.09)	0.97 (0.81)	1.29*** (0.99)	1.00 (0.84)	1.16** (0.93)	0.99 (0.82)	1.11** (0.92)
Average negative affect	0-4	0.18 (0.26)	0.15 (0.20)	0.21*** (0.30)	0.15 (0.20)	0.19*** (0.28)	0.24*** (0.33)	0.32*** (0.37)	0.16 (0.23)	0.28*** (0.35)	0.17 (0.24)	0.22** (0.32)	0.18 (0.25)	0.20 (0.29)

Bold*p<0.05; **p<0.01; ***p<0.001

Table 3
Multivariable GEE Regression model estimates

	Childhood adversity with ACE	Childhood adversity count			Abuse Yes	Household dysfunction Yes	Financial strain Yes
		1	2	3			
Logistic model							
with any stressor	1.26(0.97 - 1.63)	1.17(0.89 - 1.54)	1.64(1.05 - 2.57)	1.15(0.53 - 2.53)	2.25(1.50 - 3.37)	1.04(0.75 - 1.45)	0.85(0.65 - 1.12)
with multiple stressor types	1.18(1.00 - 1.40)	1.07(0.89 - 1.28)	1.51(1.15 - 1.99)	1.73(1.05 - 2.82)	1.76(1.40 - 2.21)	1.13(0.92 - 1.40)	0.91(0.76 - 1.09)
Poisson model							
Number of days with stressor	1.07(1.01 - 1.12)	1.03(0.98 - 1.09)	1.15(1.07 - 1.24)	1.14(1.00 - 1.30)	1.23(1.16 - 1.30)	1.03(0.97 - 1.09)	0.94(0.89 - 1.00)
Number of stressor types over reported days	1.09(1.04 - 1.15)	1.07(1.01 - 1.12)	1.16(1.08 - 1.24)	1.18(1.05 - 1.33)	1.25(1.19 - 1.32)	1.03(0.97 - 1.08)	0.95(0.90 - 1.00)
GLM model							
Average number of stressors per day	0.07(0.04 - 0.11)	0.05(0.01 - 0.09)	0.12(0.06 - 0.18)	0.12(0.02 - 0.22)	0.18(0.13 - 0.22)	0.03(-0.02 - 0.07)	-0.03(-0.07 - 0.01)
Average stressor severity	0.07(0.02 - 0.12)	0.03(-0.02 - 0.09)	0.12(0.04 - 0.20)	0.28(0.16 - 0.40)	0.11(0.04 - 0.17)	0.11(0.04 - 0.17)	0.01(-0.05 - 0.06)
Average number of physical symptom types	0.17(0.11 - 0.23)	0.12(0.05 - 0.19)	0.25(0.15 - 0.35)	0.49(0.26 - 0.71)	0.30(0.21 - 0.39)	0.11(0.02 - 0.19)	0.03(-0.04 - 0.10)
Average negative affect	0.06(0.04 - 0.08)	0.04(0.02 - 0.06)	0.09(0.05 - 0.12)	0.15(0.07 - 0.22)	0.11(0.08 - 0.14)	0.03(0.00 - 0.06)	0.00(-0.02 - 0.03)

Note: adjusted by sex, age, race, education level, marital status, household total income.

Reference for childhood adversity is no ACE, for childhood adversity count is 0, for abuse is No, for household dysfunction is No, for financial strain is No.

Estimate for Logistic model is Odds Ratio, for Poisson model is Rate Ratio, for GLM model is Beta (β).

Bold= $p < 0.05$.

Discussion

Overall, this study found in a national cohort of adults, that those

reporting ACEs, reported significantly increased number of days with a stressor, significantly worse stressor severity, reported worse physical symptoms, and had significantly increased negative affect, compared to

those who did not report any ACEs. ACEs and daily stress had a dose response relationship, with the likelihood of multiple stressors increasing as the type of ACEs increased. Those with at least 2 ACEs were 51% more likely to report having multiple stressor types, and those with at least 3 ACEs were 73% more likely to report having multiple stressor types. When looking at ACE type, adults who experienced abuse during childhood had a two-fold increased likelihood of reporting any daily stressor. Additionally, those experiencing abuse during childhood were 76% more likely to report multiple stressor types compared to those who did not experience abuse. Individuals with experiences of abuse were also significantly more likely to report an increased number of days with a stressor, increased number of stressor type as well as have a higher number of stressors per day and higher physical symptoms and negative affect. Reporting household dysfunction was significantly associated with stressor severity, number of physical symptom types, and negative affect.

This is the first study to our knowledge to examine the relationship between ACEs and reports of daily stress in a national cohort of adults. These findings add to the ACE literature by providing evidence for the impact that history and type of ACE have on frequency of daily stress, type of daily stress reported, and reported physical health symptoms. These findings also lend support for the diathesis stress model through stress sensitization (Hammen et al., 2000; Slavik and Croake, 2006). Specifically, diathesis stress models purport that experiences of chronic stress or trauma early in life result in vulnerability to stress being established, this vulnerability then impacts the ability of individuals to navigate and manage stressful triggers as an individual matures into adulthood (Slavik and Croake, 2006). This diathesis stress model has been demonstrated in studies of depression where individuals with a history of ACEs were found to have a lower threshold to stress exposure, leading to depression over a two year period, compared to their counterparts with no history of ACEs (Hammen et al., 2000). More recently, using the diathesis stress model as a framework, a small study of approximately 141 adults examined the relationship between history of ACEs and type of ACE experienced with reported stressors in the past 12 months (McElroy and Hevey, 2014). Findings demonstrated that having a history of ACEs was significantly related to report of a stressor in the last year with reports of neglect, emotional abuse, and sexual abuse being significantly related to higher reports of a stressor compared to those who did not experience any ACE (McElroy and Hevey, 2014).

In the current study, from a diathesis stress standpoint, these results showing that history of abuse, household dysfunction, and financial strain during childhood are associated with different reports of daily stress measures, suggest that ACE type and score may differentially impact vulnerability to stress. For example, in this sample, reporting abuse during childhood was related to higher odds of experiencing daily stress and greater reports of daily stress for each measure across three regression models. However, reporting household dysfunction was related only to reports of increased stressor severity, physical symptoms, and negative affect. Whereas, reporting financial strain as an ACE was significantly related to lower reports of days with a stressor in the poisson model and not related to likelihood or increased number of stressors across the logistic or regression model. This differential relationship is consistent with evidence showing that the level of resultant stress from a given exposure may yield greater vulnerability and thus lower thresholds to stress exposure (Monroe and Simons, 1991), for example abuse may exert more significant stress compared to experiences of financial hardship. However these findings represent preliminary evidence that necessitates further investigation to include more diverse ACEs as well as more sophisticated analyses to examine the mechanisms driving these relationships.

Taken together, the findings presented here have important implications for clinical practice, research, and policy. Specifically, evidence suggests chronic, daily stress may lead to maladaptive coping strategies and experiencing ACEs may further compound maladaptive coping strategies (Amnie, 2018). From a clinical standpoint, evidence-based

interventions that can enhance life skills or self-efficacy while considering the adverse experiences from one's childhood that are influencing their coping mechanisms are needed (Amnie, 2018). For example, enhancing individual resources such as social support and physical activity have been shown to buffer the negative effects of acute and chronic stress (Puterman et al. 2011; Cohen and Wills, 1985; Uchino, 2006; Gottlieb and Bergen, 2010; Southwick et al. 2016; Widom et al. 2007). Tailoring existing interventions to account for the presence of ACEs and daily stress may allow for a new evidence base for addressing the co-occurrence of ACEs and daily stress. Additionally, screening for ACEs in patients with mental health disorders can improve treatment efficacy and efficiency when they are followed up by targeted and evidence-based interventions to address the individual's response to daily stressors. From a research standpoint, understanding the mechanisms driving the relationship between ACE exposure, type of ACE, and daily stress is greatly needed, particularly to mitigate the development of pathology and or chronic illness. The evidence base is very strong showing the association between ACEs and adult mental and physical health conditions. These results offer important evidence in showing the relationship between ACEs and daily stress in adulthood such that further research is needed to understand both the mechanisms underlying this relationship and associated mental and physical health conditions. Finally, evidence from the current findings and existing body of literature can be used for policy development across primary, secondary, and tertiary levels of ACE prevention to effectively prevent ACE from occurring, develop programs to buffer the effects of ACEs when they have occurred, and to finally provide effective interventions for individuals who have experienced ACEs and the deleterious effects of those exposures become manifest.

Limitations

While this study is strengthened by its large sample size and assessment of multiple ACEs and daily stress measures over time, there are some limitations that should be considered. First, while this data is longitudinal, assessment of ACEs is retrospective and self-reported. The literature suggests that assessment of ACEs has relatively low recall bias (Widom et al. 2007), however, there may be some underreporting. Secondly, self-report methods that assess stressor severity may be impacted by participant's mood at the time of recall, however, the DISE used in the MIDUS study is a valid assessment that has an advantage over other self-report scales because it is delivered by an investigator who interviews, probes and rates the participant's self-reported stressors based on objective criteria for what constitutes a stressor and its severity. Affective states and mood at the time the participant is interviewed do not meet objective criteria measures and each stressor must be independent from other stressors. Therefore, a participant with a high ACE score would have their self-reported stressors appraised using the same criteria as a participant with low or no-ACE score to reduce the potential for confounding stressors or appraisal of those stressors. Research on the DISE has shown it is a useful for investigating daily stressors because it has the ability to investigate how daily stressors are associated with health outcomes, under what conditions, and to discriminate between stressor types (Almeida et al. 2002).

Additionally, this data is limited by ACE category. Specifically, sexual abuse and other forms of family dysfunction were not included in this dataset. Finally, these findings show a strong graded relationship between ACE and daily stress, however we cannot speak to causality between ACEs and daily stress as we only have two time points for stress and ACEs were measured at the same time as the first stress survey. Future work should consider mechanisms and pathways between ACEs and daily stress.

Conclusions

The current findings show that individuals reporting ACEs are more

likely to report increased daily stress in adulthood, physical symptoms resulting from stress, and reports of poor negative affect in adulthood. While the literature has established the impact of ACEs and stress in adulthood on health, these findings further explicate this relationship by examining the relationship between ACEs and daily stress. Further investigation is needed to establish treatment and interventions for individuals who have experienced ACEs and who are at risk for experiencing daily stress, in order to avoid worsening health conditions, as well as to promote positive coping skills.

Declaration of Competing Interest

None.

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Compliance with Ethical Standards:

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Author contribution: LEE, RJW, JAC designed this analysis. EG and RWJ acquired and analyzed the data. EMJ, JAC, EG drafted this manuscript. EMJ, JAC, RJW, EG, and LEE critically revised the manuscript for intellectual content. All authors approved the final manuscript.

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