



Familial Childhood Adversity is Associated with Chronic Disease Among Women: Data from the Geographic Research on Wellbeing (GROW) Study

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Abstract

Objectives Few population-based studies on the relationship between childhood adversity and health in adulthood for women exist. Little is known about whether some social groups are more vulnerable to childhood adversity than other groups. **Methods** Using data from the Geographic Research on Wellbeing survey (GROW) conducted in California during 2012–2013, we examine associations between familial childhood adversities (FCAs) and a set of important chronic diseases and related conditions among women with young children, employing logistic regression models (N = 2409). Specifically, we test two measures of FCAs on the odds of reporting one or more chronic diseases or related-conditions (diabetes, hypertension, high cholesterol, heart disease). We also examine whether the associations between the two measures and the dependent variables vary by social factors (race/ethnicity, marital status, education, income). **Results** Both FCA measures were associated with reporting one or more chronic diseases after controlling for a set of important sociodemographic factors. Each unit increase in the number of FCAs corresponded to about a 10% increase in the odds of reporting one or more chronic disease(s). Moderating effects were also observed, with greater impacts among more socially vulnerable groups. Furthermore, ancillary analyses demonstrated that diabetes and high cholesterol were the drivers of the relationship between FCAs and chronic disease. **Conclusions for Practice** The social ecological model framework suggests that childhood adversity can be considered at multiple levels; that is, a sustainable reduction in the adverse health impacts of childhood adversity requires a concerted effort among policymakers and practitioners that includes both “upstream” and “downstream” approaches.

Keywords Adverse childhood experiences · Diabetes · Hypertension · Cholesterol · Heart disease

Significance Statement

What is already known on this subject? Large-scale epidemiological studies have linked familial childhood adversities to chronic illness in adults in the general population. Few studies have examined whether some social groups of women are more vulnerable to chronic illnesses associated with familial childhood adversities than other groups.

What this study adds? A history of familial childhood adversity among women was associated with greater odds of developing chronic illness in adulthood, and this relationship

was moderated by social vulnerability. These findings suggest that social vulnerability exacerbates the relationship between familial childhood adversity and adult chronic illnesses in women.

Introduction

The adverse childhood experiences (ACEs) study (Felitti et al. 1998), an epidemiological study conducted by the U. S. Centers for Disease Control and Prevention (CDC) in partnership with Kaiser Permanente, recruited more than 17,000 participants across two waves (1995–1996, 1997) and found a dose–response relationship between a history of childhood trauma—such as maltreatment or household dysfunction—and health risk behaviors, mental health conditions, and chronic illnesses in adults. Subsequent data from ten states and Washington D.C. demonstrated

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that 22.4% of women had experienced at least one ACE and that 16.2% had an ACE score of 4 or more (CDC 2015).

Since the original publication of the ACE study, investigators have sought to explore the mechanisms linking ACEs and health. In theory, children who face traumatic family events—such as parental divorce or death of a family member—could have high and variable cortisol levels in order to allow the body to respond to unpredictable, uncontrollable, environmental conditions, and persistent exposure to family stressors is associated with risk of having unusual cortisol profiles, immunosuppression, and energy depletion later in life (Flinn and England 1995; Gunnar and Quevedo 2007).

Prior literature has found a relationship between ACEs and an increased risk of cardiovascular disease and related conditions such as hypertension. In a longitudinal study conducted by Su et al. (2015), participants had their blood pressure trajectories measured over a 23-year period (age range of 5–38 years) with subsequent assessments taken of their socioeconomic status and experiences of childhood trauma. Participants who had experienced multiple types of ACEs had a greater likelihood of experiencing a more rapid increase in blood pressure as they aged, as opposed to their counterparts without a history of ACEs. Building upon these results, altered blood pressure during the night, a strong indicator of adverse consequences to organs and cardiovascular health (Pickering 1990) was also found to be associated with ACEs among participants from the same sample (Su et al. 2016). Women were not examined separately.

Regarding high cholesterol, only one relevant study was found: a recent longitudinal analysis (Lee et al. 2013) found an association between lifetime history of parental incarceration and high cholesterol among adults aged 24–35. However, this study did not examine the relationship among women separately.

Several studies have analyzed the relationship between ACEs and heart disease by looking at differences among participants, by type and severity of adversity. The results in this area have been mixed. The relationship between ACE scores and cardiovascular risk among 119 females between the ages of 10–14 years old was examined by Klassen et al. (2016). When comparing female youth with 4 or more ACEs to those who had 0–3 ACEs, no elevated risk profile for heart disease was found. In contrast, a retrospective study of adults who had been evacuated to temporary foster care placements as young children during World War II were more likely than their non-evacuated peers to suffer from hypertension, type 2 diabetes, and to have a higher

likelihood of dying from cardiovascular illness (Alastalo et al. 2009).

A systematic review of 11 studies by Huffhines et al. (2016) found that more child adversity corresponded to greater risk of diabetes. A meta-analysis of four longitudinal and three cross-sectional designs also found that participants with more childhood adversity had a greater risk of diabetes (Huang et al. 2015).

The original ACE study (Felitti et al. 1998) drew its conclusions from a sample of primarily White, middle class adults with health insurance residing in Southern California. In contrast, Gilbert et al. (2015) analyzed more representative data obtained from the ACE module included in the 2010 BRFSS for ten states and the District of Columbia. They found that the odds of developing diabetes were greater for individuals with 1–3 and 4–6 ACEs, compared to those with no ACEs. This is congruent with the work of Lynch et al. (2013) who studied the relationship between ACEs and diabetes among 647 low-income, minority females in community-based healthcare settings. Their results demonstrated a positive association between the amount of childhood adversity reported and diabetes. These authors also reported that ACE scores in the sample were higher than those reported in the original study.

Other research has also demonstrated a higher prevalence of ACEs among minority individuals and those of low socioeconomic status (Cronholm et al. 2015; Finkelhor et al. 2013) compared to more socially advantaged groups. A qualitative study of young adults from low-income neighborhoods indicated a need to consider an expanded definition of adverse childhood experiences that included situations such as exposure to poverty, bullying, criminal behavior, and growing up in a single-parent household (Wade et al. 2014). Young adults in this study also experienced a lower prevalence of certain items included in the original ACE survey, such as parental mental illness and separation, which may be due to a social class bias. The need to expand the conceptualization of ACEs was echoed by Cronholm et al. (2015), in their results of a study that explored the relationships between the conventional ACEs that were used in the original study, and an expanded version of ACEs involving community-level factors. The authors found that, among a diverse sample of 1784 adults ages 18 or older, the use of a conventional ACE-only survey would have resulted in 14% of participants who experienced expanded ACEs being unrecognized.

Other researchers have developed measures of ACEs examining forms of adversity that were not included in the original survey. In 2013, Finkelhor et al. developed an updated version of the ACE survey that replaced some

of the original items with questions about other forms of adversities, including bullying, poverty, and community violence. Currently, the World Health Organization is working to validate their ACE International Questionnaire which, in addition to conventional items, includes items that ask about experiences of peer violence, witnessing community violence, and exposure to collective violence (World Health Organization n.d.). Finally, the Philadelphia Urban ACE Survey, developed by the city's Institute for Safe Families, addresses adverse experiences such as feeling unsafe in one's community, witnessing violence, racial and/or ethnic discrimination, bullying, and involvement in the child welfare system (Institute for Safe Families 2013).

The purpose of the current study is to contribute to the empirical literature on ACEs among women in the following ways: (1) develop two measures of ACEs, one we refer to as familial childhood adversities (FCAs) and an 'expanded' FCAs measure that also includes two additional items, most notably racial/ethnic discrimination; (2) examine the association between each of the two measures and a set of important chronic diseases and related conditions (hereafter, chronic diseases); and (3) examine whether the associations between the two measures and the dependent variables vary by social factors (race/ethnicity, marital status, education, income).

Methods

Data Sources

The Geographic Research on Wellbeing (GROW) study (2012–2013) is a follow-up survey of women who completed California's Maternal and Infant Health Assessment (MIHA) survey (2003–2007). MIHA is an annual, statewide-representative survey of women delivering live infants in California during February through May, linked with birth certificate data. Women were eligible for MIHA if they were English- or Spanish-speaking CA residents, were aged 15 years or older, had singleton, twin, or triplet births, and had their address recorded on the birth certificate. MIHA collected data from approximately 3500 women representing approximately 500,000 women delivering live infants during the same year using self-administered mail or telephone questionnaires in English or Spanish. Response rates exceeded 70%. Additional details about MIHA survey have been reported elsewhere (Cubbin et al. 2002; Rinki et al. 2012).

The GROW study followed up MIHA respondents who had agreed to be re-contacted for potential future research and lived in one of six largely urbanized counties with a high number of respondents (Alameda, Los Angeles, Orange, Sacramento, San Diego, and Santa Clara). Data collection for GROW occurred between February 2012 and September 2013. Mail or telephone surveys were conducted in English or Spanish. Of all MIHA respondents during 2003–2007, 51% (N = 9256) were initially eligible for GROW. Of the 9256 eligible women, 3016 women responded (33% of all eligible women; 75% of women who could be located). The questionnaire included approximately 80 items regarding demographic, socioeconomic, psychosocial, and health-related characteristics, pertaining to themselves and their child (i.e., their infant from the MIHA study). Comparing the weighted GROW sample to the weighted MIHA sample and the target population of all women in California who gave birth during the relevant time period, the GROW study is highly representative in terms of important sociodemographic characteristics. The GROW study was approved by the Institutional Review Boards at The University of Texas at Austin, The University of California, San Francisco, and the California Department of Public Health. All participants gave informed consent. Further information about the GROW study is available elsewhere (Cubbin 2015).

The analytic data set excluded women aged 20–29 years (n = 441) because chronic diseases, the interest of the present study, are rarely observed in young adults. We also excluded women whose data were missing for chronic diseases (n = 51), race/ethnicity (n = 51), marital status (n = 9), education level (n = 5), household income (n = 20), and adverse childhood experiences (n = 22). Women whose race/ethnicity was reported as American Indian/Alaska Native or 'other' were excluded because of its small sample size (n = 8). The final sample in the analytic data included 2409 respondents.

Variables

The dependent variable was the occurrence of one or more chronic disease (yes/no). A respondent was coded as 'yes' if she was told by a doctor, nurse, or other health care worker that she had any of the following health problems: diabetes (not during pregnancy), hypertension (not during pregnancy), high cholesterol, or any kind of heart condition or heart disease. If not, she was coded as 'no'.

The independent variables were (1) familial childhood adversities (FCAs); and (2) expanded FCAs. The FCAs measure consists of 7 items about adversities from birth through age

13 that were included on the 2011 Maternal and Infant Health Assessment survey, and originally derived from the National Survey of Children's Health (CDC 2014). The respondents answered "yes" or "no" to the following questions: (i) most of the time I had an adult who believed in me and who I could count on to help me; (ii) a parent or guardian I lived with got divorced or separated; (iii) we had to move because of problems paying the rent or mortgage; (iv) someone in my family or I went hungry because we could not afford enough food; (v) a parent or guardian got in trouble with the law or went to jail; (vi) a parent or guardian I lived with had a serious drinking or drug problem; (vii) I was in foster care (removed from my home by the court or child welfare agency). These seven items were then summated to a scale of 0–7 with a higher score indicating experiencing more childhood adversities. For the expanded FCAs, in addition to the seven FCA items, two more questions were added to the scale referring to the time from birth through age 13: (1) how often a respondent's family faced difficulties paying for basic needs like food or housing; and (2) how often a respondent was treated or judged unfairly because of her race or ethnic group (somewhat or very often = yes). The expanded FCAs was measured as a sum, ranging from 0 to 9 based on the number of "yes" responses. The correlation between FCAs and expanded FCAs is 0.85.

Other variables included age (30–57 years), race/ethnicity (Asian/Pacific Islander; non-Hispanic Black; Immigrant Latina; US-born Latina; non-Hispanic White), marital status (married or cohabiting; separate/divorced/widowed; never married), education level (less than high school; high school/GED; some college; college graduate or more), and annual family income (in increments of the federal poverty level: ≤ 100%; 101–200%; 201–300%; 301–400%; > 400%).

Analytic Plan

We first examined the distribution of all variables and the prevalence of chronic diseases. Next, we compared means of FCAs and expanded FCAs by sociodemographic characteristics. We then constructed a series of logistic regression models with the occurrence of one or more chronic diseases as the dependent variable: (A) unadjusted models; (B) a sociodemographic model including age, race/ethnicity, marital status, education level, and family income; (C) a model with FCAs and sociodemographic variables; and (D) a model with expanded FCAs and sociodemographic variables. We also conducted the same series of logistic regression models with each chronic disease (i.e., diabetes, hypertension, high cholesterol, heart disease) as the dichotomized dependent variable (see "Appendix" Tables).

Finally, we tested for moderation effects by adding interaction terms between sociodemographic characteristics (i.e., race/ethnicity, marital status, education level, and family income) and the FCAs measures one at a time to Models

C and D. In computing interaction terms, centering and contrast coding were used to minimize the multicollinearity between the direct effects and interaction terms (Aiken and West 1991). When significant interaction was found, the sample was stratified by the sociodemographic characteristic, and the odds ratios of the occurrence of chronic disease were compared across the stratified samples. All analyses were conducted using the statistical software package SAS and incorporated weighting and the complex sample design. Statistical significance was inferred if *p* values were < 0.05.

Table 1 Descriptive statistics, Geographic Research on Wellbeing (GROW) Study, California, U.S., 2012–2013, N = 2409

Characteristics	Total sample		Prevalence of chronic diseases ^a (%)
	n	Weighted %	
Total sample			20.0
Age (years)			
30–39	1331	60.4	16.7
40 or above	1078	39.6	24.9
Race/ethnicity			
Asian/Pacific Islander	270	17.3	17.9
Black, non-Hispanic	257	5.9	23.3
Latina, immigrant	662	35.1	21.8
Latina, US-born	303	12.3	20.5
White, non-Hispanic	917	29.4	18.0
Marital status			
Married or cohabiting	2049	85.6	19.9
Separated/divorced/widowed	172	6.9	26.6
Never married	188	7.5	14.7
Education level			
Less than high school	362	19.1	22.7
High school/GED	374	19.1	20.9
Some college	555	21.5	18.8
College graduate or more	1118	40.4	18.8
Family income (% of federal poverty level)			
≤ 100%	538	26.9	19.9
101–200%	419	18.9	23.0
201–300%	254	10.9	17.9
301–400%	233	8.5	16.2
> 400%	965	34.8	19.9
Number of adverse childhood experiences			
0	1345	55.4	17.3
1	548	23.4	25.1
2 or more	516	21.3	21.2
Number of expanded adverse childhood experiences			
0	1151	46.8	16.9
1	564	23.4	22.5
2 or more	694	29.8	22.7

^aDiabetes, hypertension, high cholesterol, heart condition/disease

Results

Descriptive Characteristics

Table 1 presents the distribution of the sample characteristics and the prevalence of chronic disease (1 or more) by sociodemographic characteristics. Nearly half were Latina, followed by non-Hispanic White (29%), Asian/Pacific Islander (17%), and non-Hispanic Black (6%). A majority were married to or cohabitating with a partner, and two-fifths were college graduates. Nearly half the women had family incomes at or below 200% of poverty. About one-fifth reported at least two FCAs, and nearly 30% reported at least two expanded FCAs.

The prevalences of chronic diseases varied: 11% of women had high cholesterol, 6% had hypertension, 5% had diabetes, and 2% had heart disease (data not shown). The prevalence of chronic disease was high among older, non-Hispanic Black or Latina women, and separated/divorced/widowed women. While the socioeconomic gradients in chronic diseases were not strong, those who reported FCAs showed higher prevalences of chronic diseases compared with those reporting no FCAs.

Sociodemographic Variations in FCAs

Figure 1 presents mean values of the FCA and expanded FCA scores stratified by sociodemographic characteristics. Patterns demonstrate that for both FCA measures, non-Hispanic Black and Latina women, and previously or never married women appeared to have higher mean values of FCAs compared with Asian/non-Hispanic White or married women. Socioeconomic gradients in mean FCAs were apparent for both education and income. Comparing mean values of the FCAs versus expanded FCAs measure, more pronounced differences in the patterns were observed with the expanded measure.

Direct Effects of FCAs on Chronic Diseases

The number of FCAs and expanded FCAs were each significantly associated with the occurrence of one or more chronic diseases in the unadjusted models (Table 2). These associations remained stable and significant in the fully adjusted models. Each unit increase in FCAs was associated with an 11% increased odds of reporting one or more chronic disease, after controlling for age, race/ethnicity, marital status, education and income. The corresponding increased odds for expanded FCAs was 8%. We also examined the association between the FCAs measures and each chronic disease. Both FCAs measures were significantly associated with increased

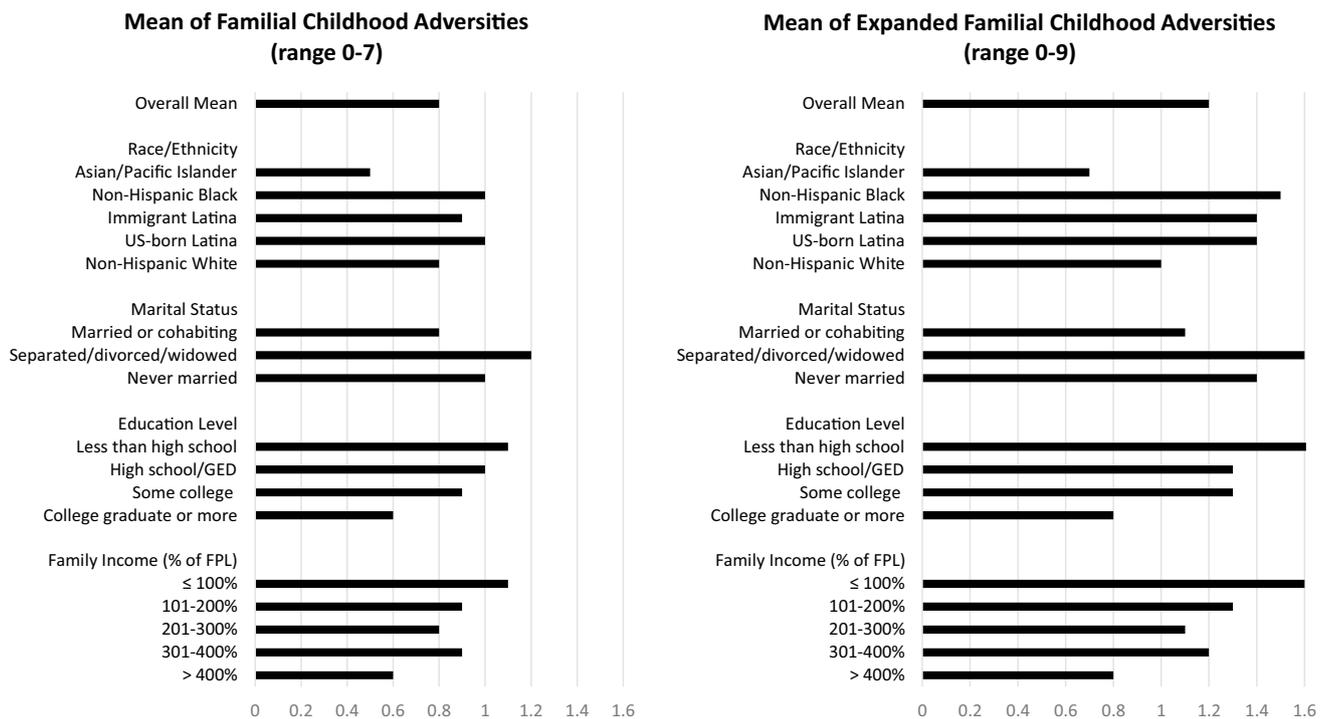


Fig. 1 Mean familial childhood adversities (FCAs) and expanded FCAs by individual characteristics, Geographic Research on Wellbeing (GROW) Study, California, U.S., 2012–2013, N=2409

Table 2 Logistic regression analysis assessing associations between familial childhood adversities (FCAs) and chronic diseases (one or more), Geographic Research on Wellbeing (GROW) Study, California, U.S., 2012–2013, N=2409

Characteristic	Unadjusted model		Sociodemographic model		FCAs model		Expanded FCAs model	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Age	1.07***	1.05–1.09	1.08***	1.06–1.11	1.08***	1.06–1.11	1.08***	1.06–1.11
Race/ethnicity								
Asian/Pacific Islander	0.99	0.68–1.44	1.05	0.72–1.52	1.08	0.74–1.58	1.06	0.73–1.55
Black, non-Hispanic	1.38	0.94–2.01	1.86**	1.22–2.84	1.85**	1.21–2.82	1.81**	1.18–2.76
Latina, immigrant	1.27	0.97–1.66	1.33	0.88–2.01	1.37	0.92–2.04	1.34	0.90–2.00
Latina, US-born	1.17	0.84–1.65	1.56*	1.08–2.26	1.55*	1.06–2.24	1.52*	1.05–2.21
White, non-Hispanic	1.00		1.00		1.00		1.00	
Marital status								
Married or cohabiting	1.00		1.00		1.00		1.00	
Separated/divorced/widowed	1.46	0.96–2.21	1.38	0.90–2.12	1.35	0.89–2.05	1.36	0.89–2.07
Never married	0.69	0.45–1.08	0.66	0.41–1.07	0.66	0.41–1.08	0.66	0.41–1.08
Education level								
Less than high school	1.27	0.94–1.72	1.31	0.84–2.05	1.25	0.79–1.95	1.25	0.80–1.95
High school/GED	1.14	0.82–1.57	1.32	0.87–2.01	1.29	0.85–1.95	1.30	0.86–1.96
Some college	1.00	0.75–1.33	1.10	0.80–1.51	1.07	0.78–1.48	1.08	0.78–1.48
College graduate or more	1.00		1.00		1.00		1.00	
Family income								
≤ 100%	1.00	0.75–1.34	0.88	0.57–1.38	0.86	0.55–1.35	0.86	0.55–1.34
101–200%	1.21	0.88–1.66	1.11	0.74–1.66	1.10	0.73–1.64	1.09	0.73–1.64
201–300%	0.88	0.60–1.30	0.93	0.61–1.43	0.93	0.61–1.42	0.93	0.61–1.42
301–400%	0.78	0.52–1.16	0.88	0.58–1.33	0.87	0.57–1.31	0.86	0.57–1.31
> 400%	1.00		1.00		1.00		1.00	
Number of familial childhood adversities (range 0–7)	1.10*	1.01–1.20			1.11*	1.01–1.21		
Number of expanded familial childhood adversities (range 0–9)	1.08*	1.02–1.16					1.08*	1.01–1.16

OR odds ratio, CI confidence interval

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

odds of diabetes and high cholesterol, but not with hypertension or heart disease (“Appendix” Tables 5, 6, 7 and 8); however, odds were all in the same direction.

Moderating Effects of Sociodemographic Characteristics in the FCAs–Chronic Disease Relationship

We found statistically significant interactions in the relationship between FCAs and chronic disease by race/ethnicity, marital status, and family income (data not shown). For the

interpretation of interaction effects, the sample was stratified by race/ethnicity, marital status, or family income, and the associations between FCAs and the odds of chronic disease were assessed in an unadjusted model and adjusted model. As shown in Table 3, the number of FCAs was associated with increased odds of chronic disease among immigrant Latinas (OR 1.19, 95% CI 1.02–1.39), however, it was associated with decreased odds of chronic disease among US-born Latinas (OR 0.78, 95% CI 0.63–0.98). The number of FCAs was significantly associated with increased odds of chronic disease among separated/divorced/widowed women (OR 1.64,

Table 3 Weighted odds ratios and confidence intervals for the interaction effects between sociodemographic characteristics and familial childhood adversities (FCAs) in chronic diseases (one or more), Geographic Research on Wellbeing (GROW) Study, California, U.S., 2012–2013, N = 2409

Characteristic	Unadjusted model		Adjusted model ^a	
	OR	95% CI	OR	95% CI
Number of FCAs by race/ethnicity				
Asian/Pacific Islander	1.05	0.78–1.41	1.12	0.77–1.63
Black, non-Hispanic	1.10	0.88–1.38	1.08	0.85–1.38
Latina, immigrant	1.18*	1.01–1.38	1.19*	1.02–1.39
Latina, US-born	0.83	0.67–1.02	0.78*	0.63–0.98
White, non-Hispanic	1.13	0.98–1.31	1.14	0.98–1.32
Number of FCAs by marital status				
Married or cohabiting	1.06	0.96–1.16	1.06	0.96–1.17
Separated/divorced/widowed	1.36*	1.04–1.78	1.64**	1.16–2.34
Never married	1.19	0.87–1.63	1.13	0.82–1.57
Number of FCAs by family poverty				
≤ 200%	1.17*	1.04–1.32	1.11*	1.01–1.21
> 200%	1.00	0.89–1.13	1.00	0.88–1.14

OR odds ratio, CI confidence interval

p* < .05; *p* < .01; ****p* < .001

^aAdjusted for other sociodemographic characteristics in Table 2

Table 4 Weighted odds ratios and confidence intervals for the interaction effects between sociodemographic characteristics and expanded familial childhood adversities (FCAs) in chronic diseases (one or more), Geographic Research on Wellbeing (GROW) Study, California, U.S., 2012–2013, N = 2409

Characteristic	Using expanded ACEs			
	Unadjusted model		Adjusted model ^a	
	OR	95% CI	OR	95% CI
Number of expanded FCAs by race/ethnicity				
Asian/Pacific Islander	1.09	0.87–1.37	1.17	0.90–1.52
Black, non-Hispanic	1.09	0.91–1.31	1.08	0.89–1.30
Latina, immigrant	1.14*	1.01–1.28	1.14*	1.02–1.29
Latina, US-born	0.86	0.73–1.01	0.81*	0.68–0.96
White, non-Hispanic	1.09	0.96–1.23	1.09	0.96–1.24
Number of expanded FCAs by education level				
Less than high school	1.14	0.99–1.30	1.15	0.98–1.34
High school/GED	1.13	0.96–1.32	1.19	0.99–1.42
Some college	0.97	0.84–1.12	0.95	0.83–1.10
College graduate or more	1.07	0.96–1.19	1.08	0.96–1.22
Number of expanded FCAs by family poverty				
≤ 200%	1.13**	1.03–1.24	1.14**	1.04–1.25
> 200%	1.01	0.92–1.11	1.00	0.90–1.11

OR odds ratio, CI confidence interval

p* < .05; *p* < .01; ****p* < .001

^aAdjusted for other sociodemographic characteristics in Table 2

95% CI 1.16–2.34) and among women with family incomes at or below 200% of poverty (OR 1.11, 95% CI 1.01–1.21). Similar patterns were observed with the expanded FCAs measure except that instead of marital status, education attainment had a significant interaction with the expanded FCAs measure (Table 4). However, in the stratified models, no level of educational attainment had a significantly different odds ratio from 1.00.

Discussion

Familial childhood adversities were associated with reporting one or more chronic diseases, even after controlling for a set of important sociodemographic factors. Each unit increase in the number of FCAs (including expanded FCAs) corresponded to about a 10% increase in the odds of reporting one or more chronic disease(s), which is consistent with other studies (Alastalo et al. 2009; Huang et al. 2015; Huffhines et al. 2016; Su et al. 2015, 2016). Moderating effects were also observed, with greater impacts among more socially vulnerable groups. Furthermore, ancillary analyses demonstrated that diabetes and high cholesterol were the drivers of the relationship, in line with other studies (Gilbert et al. 2015; Huang et al. 2015; Huffhines et al. 2016; Lynch et al. 2013), suggesting that perhaps dietary habits may be an important mediating factor between FCAs and chronic disease. Some evidence suggests this may be the case. For example, when we examined mean differences in FCAs by dietary habits, we found that FCAs were higher among those reporting daily sweetened beverage consumption compared with those who consumed less. However, there appeared to be no differences by daily fruit or daily vegetable consumption.

Traumatic experiences during childhood can have long-lasting impacts. Research has found that mental health is a mediator in the relationship between childhood trauma and chronic disease and that adult socioeconomic status is a potential buffer of the adverse chronic disease impacts of childhood trauma (Mock and Arai 2011). While we did not test mental health formally as a mediating factor, we know that FCAs are twofold higher among women in GROW reporting depressive symptoms (mean = 1.52 FCAs) compared with those not reporting depressive symptoms (mean = 0.72 FCAs) and among those reporting one or more stressors in the past year (mean = 1.11 FCAs) compared with none (mean = 0.63 FCAs). We also found evidence of a buffering effect for higher SES individuals: only those with incomes at or below 200% of the federal poverty level were adversely impacted by FCAs, suggesting that higher resources among those with more income may have been able to overcome the harmful effects of childhood adversity.

Although stronger social gradients were observed with the expanded FCAs measure compared with the regular measure (Fig. 1), and a clearer pattern in prevalence of one or more chronic diseases was observed with the expanded FCAs measure (Table 1), the results from the multivariate models demonstrated no difference in conclusions. Future research ought to determine whether self-reported experiences of racial/ethnic discrimination (included in the expanded measure) is important to consider in studies of FCAs and chronic diseases before recommending their inclusion.

Strengths of the study include external validity (generalizability), little missing data, and a racially/ethnically and socioeconomically diverse sample of women with young children. A number of limitations also deserve mention. All data were based on self-report, and the dependent variable was based on a health professional diagnosis, possibly introducing a health care access bias since those without access to care may not be aware of all their chronic disease conditions. The dependent variable was also designed to represent a global measure of chronic disease with many of the same risk factors; thus, relationships between FCAs and each condition separately are obscured. For instance, we do not know of different risks associated with having heart disease and hypertension versus having heart disease and diabetes. We also did not have information on family history for each chronic condition. Finally, given reporting requirements and the survey administration, abuse-related items were not included and thus, we were unable to include them in our analyses.

Our results provide further evidence of the health-damaging impact of experiencing adversity during childhood, in our case, economic and family-related adversity. The social ecological model framework suggests that childhood adversity can be considered at the micro-, meso-, exo-, and macro levels. For example, evidence-based, trauma-informed

interventions can be delivered to affected children and families. Policies that support living wages, paid family leave, and affordable housing can strengthen families' economic wellbeing and stability. Because stable and supportive caregivers buffer or prevent elevations in cortisol to distress-eliciting events (Gunnar and Quevedo 2007), family support services to reduce parental stress and to improve parenting skills for socioeconomically disadvantaged families would offset the deteriorating impacts of FCAs on child's later health. Addressing institutional discrimination can increase equity and inclusion and provide more opportunities to vulnerable groups. A future area of research, given the findings on diabetes, might be to examine factors such as dietary habits, mental health, and access to comprehensive care as mediators of the FCA-diabetes (or pre-diabetes) relationship among young adults in their twenties (who were not included in the current study). A sustainable reduction in the adverse health impacts of childhood adversity requires a concerted effort among policymakers and practitioners that acknowledges the necessity of incorporating both "upstream" and "downstream" approaches.

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflict of interest.

Appendix

See Tables 5, 6, 7 and 8.

Table 5 Logistic regression analysis assessing associations between familial childhood adversities (FCAs) and diabetes, Geographic Research on Wellbeing (GROW) Study, California, U.S., 2012–2013, N = 2409

Characteristic	Unadjusted model		Sociodemographic model		FCAs model		Expanded FCAs model	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Age	1.02	0.98–1.07	1.05*	1.01–1.09	1.05*	1.00–1.09	1.05*	1.00–1.09
Race/ethnicity								
Asian/Pacific Islander	1.39	0.56–3.45	1.41	0.56–3.54	1.53	0.60–3.90	1.46	0.58–3.68
Black, non-Hispanic	2.41*	1.13–5.17	2.42*	1.01–5.81	2.39	1.00–5.73	2.29	0.96–5.47
Latina, immigrant	3.80***	2.16–6.69	2.12*	1.09–4.11	2.28*	1.18–4.40	2.18*	1.14–4.15
Latina, US-born	2.33*	1.12–4.86	2.38*	1.07–5.28	2.32*	1.05–5.14	2.26*	1.02–5.02
White, non-Hispanic	1.00		1.00		1.00		1.00	
Marital status								
Married or cohabiting	1.00		1.00		1.00		1.00	
Separated/divorced/widowed	0.98	0.38–2.52	0.74	0.29–1.94	0.69	0.27–1.76	0.70	0.27–1.80
Never married	0.84	0.40–1.76	0.59	0.26–1.34	0.61	0.27–1.38	0.61	0.27–1.39
Education level								
Less than high school	3.54***	2.00–6.27	1.44	0.73–2.81	1.33	0.69–2.57	1.34	0.70–2.58
High school/GED	1.68	0.83–3.38	0.84	0.40–1.75	0.81	0.39–1.69	0.82	0.40–1.71
Some college	1.22	0.65–2.30	0.85	0.48–1.52	0.84	0.47–1.49	0.84	0.47–1.49
College graduate or more	1.00		1.00		1.00		1.00	
Family income								
≤ 100%	3.53***	1.90–6.57	2.52**	1.26–5.01	2.37*	1.18–4.75	2.33*	1.16–4.69
101–200%	2.43*	1.20–4.93	1.91	0.97–3.77	1.85	0.94–3.62	1.84	0.93–3.62
201–300%	1.38	0.56–3.42	1.34	0.57–3.14	1.30	0.55–3.07	1.30	0.55–3.07
301–400%	1.45	0.56–3.74	1.57	0.58–4.23	1.52	0.56–4.10	1.50	0.55–4.08
> 400%	1.00		1.00		1.00		1.00	
Number of FCAs (range 0–7)	1.24**	1.07–1.43			1.20*	1.03–1.39		
Number of expanded FCAs (range 0–9)	1.20**	1.07–1.35					1.14*	1.01–1.29
Interaction tests (separate models)								
Race/ethnicity × FCAs								
Asian/Pacific Islander × FCAs					1.16	0.86–1.57	1.02	0.77–1.35
Black, non-Hispanic × FCAs					1.27	0.98–1.64	1.20	0.98–1.48
Latina, immigrant × FCAs					1.17	0.94–1.46	1.09	0.91–1.30
Latina, US-born × FCAs					1.03	0.81–1.30	1.01	0.85–1.20
Marital status × FCAs								
Separated/divorced/widowed × FCAs					1.12	0.90–1.41	1.08	0.90–1.31
Never married × FCAs					1.19	0.90–1.57	1.15	0.92–1.44
Some college or more × FCAs					0.96	0.83–1.12	0.98	0.87–1.10
Family poverty (≤ 200% FPL) × FCAs					1.09	0.93–1.28	1.07	0.94–1.22

OR odds ratio, CI confidence interval

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

Table 6 Logistic regression analysis assessing associations between familial childhood adversities (FCAs) and hypertension, Geographic Research on Wellbeing (GROW) Study, California, U.S., 2012–2013, N=2409

Characteristic	Unadjusted model		Sociodemographic model		FCAs model		Expanded FCAs model	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Age	1.07***	1.03–1.11	1.09***	1.05–1.14	1.09***	1.05–1.14	1.09***	1.05–1.14
Race/ethnicity								
Asian/Pacific Islander	1.24	0.65–2.36	1.36	0.71–2.62	1.40	0.73–2.69	1.39	0.73–2.66
Black, non-Hispanic	4.27***	2.57–7.10	5.02***	2.78–9.06	5.02***	2.79–9.00	4.90***	2.72–8.80
Latina, immigrant	1.20	0.73–1.98	0.83	0.40–1.74	0.86	0.42–1.74	0.85	0.42–1.72
Latina, US-born	1.77*	1.01–3.12	2.16*	1.16–4.01	2.15*	1.16–3.97	2.11*	1.14–3.91
White, non-Hispanic	1.00		1.00		1.00		1.00	
Marital status								
Married or cohabiting	1.00		1.00		1.00		1.00	
Separated/divorced/widowed	2.74***	1.58–4.76	2.29***	1.26–4.14	2.25**	1.25–4.05	2.25***	1.25–4.05
Never married	1.08	0.58–2.00	0.60	0.32–1.15	0.61	0.32–1.15	0.61	0.32–1.16
Education level								
Less than high school	1.42	0.83–2.41	1.80	0.89–3.64	1.73	0.87–3.43	1.69	0.86–3.33
High school/GED	1.12	0.65–1.92	1.46	0.81–2.63	1.43	0.79–2.57	1.42	0.79–2.56
Some college	1.43	0.91–2.26	1.34	0.87–2.05	1.32	0.86–2.03	1.31	0.86–2.02
College graduate or more	1.00		1.00		1.00		1.00	
Family income								
≤ 100%	1.25	0.77–2.01	1.32	0.74–2.39	1.30	0.72–2.33	1.27	0.71–2.29
101–200%	1.42	0.85–2.37	1.44	0.83–2.50	1.43	0.83–2.48	1.43	0.82–2.47
201–300%	0.92	0.47–1.79	0.94	0.48–1.85	0.94	0.48–1.83	0.93	0.47–1.82
301–400%	0.86	0.43–1.74	0.85	0.42–1.74	0.85	0.42–1.72	0.84	0.41–1.71
> 400%	1.00		1.00		1.00		1.00	
Number of FCAs (range 0–7)	1.11	0.96–1.29			1.08	0.93–1.24		
Number of expanded FCAs (range 0–9)	1.12*	1.01–1.25					1.08	0.97–1.21
Interaction Tests (separate models)								
Race/ethnicity × FCAs								
Asian/Pacific Islander × FCAs					0.89	0.62–1.28	0.95	0.76–1.20
Black, non-Hispanic × FCAs					0.95	0.79–1.15	0.99	0.85–1.15
Latina, immigrant × FCAs					0.92	0.75–1.11	0.95	0.81–1.11
Latina, US-born × FCAs					0.90	0.75–1.09	0.93	0.80–1.08
Marital status × FCAs								
Separated/divorced/widowed × FCAs					1.08	0.87–1.34	1.01	0.84–1.12
Never married × FCAs					1.09	0.87–1.38	1.08	0.91–1.28
Some college or more × FCAs					0.95	0.82–1.10	0.96	0.85–1.07
Family poverty (≤ 200% FPL) × FCAs					1.10	0.95–1.27	1.05	0.94–1.18

OR odds ratio, CI confidence interval

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

Table 7 Logistic regression analysis assessing associations between familial childhood adversities (FCAs) and high cholesterol, Geographic Research on Wellbeing (GROW) Study, California, U.S., 2012–2013, N=2409

Characteristic	Unadjusted model		Sociodemographic model		FCAs model		Expanded FCAs model	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Age	1.07***	1.04–1.10	1.08***	1.05–1.17	1.08***	1.05–1.11	1.08***	1.05–1.11
Race/ethnicity								
Asian/Pacific Islander	0.91	0.56–1.48	0.96	0.59–1.57	1.00	0.61–1.63	0.97	0.60–1.59
Black, non-Hispanic	0.63	0.35–1.15	0.89	0.48–1.66	0.87	0.47–1.63	0.85	0.46–1.60
Latina, immigrant	1.21	0.87–1.68	1.72*	1.02–2.91	1.77*	1.06–2.96	1.72*	1.03–2.88
Latina, US-born	1.17	0.77–1.78	1.73*	1.10–2.72	1.70*	1.08–2.68	1.67*	1.06–2.65
White, non-Hispanic	1.00		1.00		1.00		1.00	
Marital status								
Married or cohabiting	1.00		1.00		1.00		1.00	
Separated/divorced/widowed	1.46	0.87–2.45	1.51	0.90–2.54	1.47	0.88–2.45	1.48	0.88–2.47
Never married	0.67	0.36–1.26	0.86	0.44–1.69	0.87	0.45–1.71	0.87	0.45–1.71
Education level								
Less than high school	1.13	0.77–1.66	1.09	0.60–1.97	1.03	0.57–1.86	1.03	0.57–1.86
High school/GED	0.93	0.62–1.40	1.04	0.57–1.88	1.00	0.56–1.81	1.01	0.56–1.83
Some college	0.78	0.54–1.12	0.87	0.58–1.32	0.85	0.56–1.28	0.85	0.57–1.29
College graduate or more	1.00		1.00		1.00		1.00	
Family income								
≤ 100%	0.87	0.60–1.25	0.68	0.36–1.29	0.66	0.35–1.25	0.66	0.35–1.24
101–200%	0.99	0.65–1.50	0.87	0.48–1.58	0.86	0.47–1.56	0.86	0.47–1.55
201–300%	0.85	0.51–1.40	0.91	0.53–1.57	0.90	0.52–1.56	0.90	0.52–1.56
301–400%	0.91	0.56–1.49	1.06	0.64–1.76	1.05	0.64–1.73	1.05	0.63–1.73
> 400%	1.00		1.00		1.00		1.00	
Number of FCAs (range 0–7)	1.11*	1.00–1.22			1.13*	1.01–1.25		
Number of expanded FCAs (range 0–9)	1.08	1.00–1.17					1.09*	1.00–1.19
Interaction Tests (separate models)								
Race/ethnicity × FCAs								
Asian/Pacific Islander × FCAs					1.00	0.84–1.20	1.00	0.86–1.15
Black, non-Hispanic × FCAs					0.99	0.80–1.21	0.97	0.81–1.15
Latina, immigrant × FCAs					1.01	0.89–1.14	1.02	0.93–1.13
Latina, US-born × FCAs					0.77**	0.65–0.92	0.81**	0.70–0.94
Marital status × FCAs								
Separated/divorced/widowed × FCAs					1.14	0.97–1.34	1.09	0.96–1.23
Never married × FCAs					1.02	0.82–1.27	1.02	0.85–1.23
Some college or more × FCAs					0.97	0.87–1.08	0.95	0.88–1.04
Family poverty (≤ 200% FPL) × FCAs					1.05	0.94–1.16	1.05	0.97–1.14

OR odds ratio, CI confidence interval

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

Table 8 Logistic regression analysis assessing associations between familial childhood adversities (FCAs) and heart disease, Geographic Research on Wellbeing (GROW) Study, California, U.S., 2012–2013, N = 2409

Characteristic	Unadjusted model		Sociodemographic model		FCAs model		Expanded FCAs model	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Age	1.09*	1.02–1.16	1.07	1.00–1.15	1.07	1.00–1.15	1.07	1.00–1.15
Race/ethnicity								
Asian/Pacific Islander	0.76	0.30–1.94	0.76	0.30–1.97	0.80	0.31–2.06	0.78	0.30–2.00
Black, non-Hispanic	0.10*	0.01–0.70	0.17	0.02–1.25	0.16	0.02–1.23	0.16	0.02–1.17
Latina, immigrant	0.58	0.27–1.22	1.23	0.65–2.34	1.25	0.66–2.36	1.21	0.65–2.25
Latina, US-born	0.26*	0.07–0.96	0.36	0.10–1.33	0.35	0.10–1.30	0.35	0.09–1.29
White, non-Hispanic	1.00		1.00		1.00		1.00	
Marital status								
Married or cohabiting	1.00		1.00		1.00		1.00	
Previously or never married	0.28*	0.08–0.92	0.42	0.12–1.44	0.42	0.12–1.41	0.42	0.12–1.42
Education level								
Less than high school	0.54	0.19–1.51	0.92	0.26–3.27	0.86	0.25–2.90	0.86	0.26–2.91
High school/GED	0.69	0.25–1.91	1.26	0.50–3.16	1.19	0.47–2.99	1.20	0.48–3.00
Some college	0.95	0.44–2.09	1.59	0.64–3.97	1.52	0.60–3.89	1.53	0.60–3.91
College graduate or more	1.00		1.00		1.00		1.00	
Family income								
≤ 100%	0.32*	0.13–0.80	0.34	0.11–1.07	0.34	0.11–1.07	0.33	0.10–1.07
101–200%	0.59	0.21–1.65	0.60	0.26–1.38	0.61	0.26–1.38	0.60	0.26–1.37
201–300%	0.91	0.40–2.06	1.05	0.40–2.76	1.05	0.40–2.78	1.05	0.40–2.77
301–400%	0.10*	0.01–0.76	0.13*	0.02–0.95	0.13*	0.02–0.94	0.13*	0.02–0.93
> 400%	1.00		1.00		1.00		1.00	
Number of FCAs (range 0–7)	1.06	0.81–1.38			1.16	0.87–1.53		
Number of expanded FCAs (range 0–9)	1.03	0.81–1.32					1.12	0.87–1.44
Interaction tests (separate models)								
Race/ethnicity × FCAs								
Asian/Pacific Islander × FCAs					0.98	0.54–1.79	0.94	0.61–1.44
Black, non-Hispanic × FCAs					1.53***	1.24–1.89	1.43***	1.19–1.74
Latina, immigrant × FCAs					1.29	0.96–1.74	1.28	0.99–1.66
Latina, US-born × FCAs					0.92	0.58–1.45	0.94	0.61–1.44
Marital status × FCAs								
Previously or never married × FCAs					1.40*	1.03–1.91	1.26	0.96–1.66
Some college or more × FCAs					0.79	0.60–1.03	0.77*	0.61–0.98
Family poverty (≤ 200% FPL) × FCAs					1.27	0.97–1.64	1.27*	1.01–1.61

OR odds ratio, CI confidence interval

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

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