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Adverse Childhood Circumstances and Functional Status throughout Adult Life

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Abstract

Objective: We studied the association of childhood adversity with adult functional status.

Methods: With data from the Panel Study of Income Dynamics (PSID) and the 2014 Childhood Retrospective Circumstances Study (1992–2013; n=6,705; 62,885 person-years), we estimated functional status transition probabilities associated with childhood adversity, with multinomial logistic Markov models adjusted for age, sex, race/ethnicity, and education. Microsimulation then estimated functional status outcomes throughout adulthood for African American, Hispanic, and non-Hispanic white women and men.

Results: Adversity was significantly associated with functional status. Of white women without adversities, 2.3% had difficulty doing activities of daily living at age 30, compared to 8.2% with high adversity; comparable results were 3.7% and 8.7% for African Americans, 0.9% and 11.5% for Hispanics (all $p<0.01$). Patterns were similar at other ages, for men, and when adjusted for midlife health conditions and health behavior.

Discussion: Childhood adversity may substantially increase functional impairment throughout adult life.

Keywords

African Americans; demography; epidemiology; Hispanics; physical function

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Introduction

There is evidence that adverse circumstances during childhood (childhood adversity) are associated with poorer adult health (Blackwell, Hayward, & Crimmins, 2001; Bowen & González, 2010; Davey Smith, Hart, Blane, & Hole, 1998; Galobardes, Lynch, & Davey Smith, 2004; Guralnik, Butterworth, Wadsworth, & Kuh, 2006; Haas, 2008; Hayward, & Gorman, 2004; Luo, & Waite, 2005; Miller, Chen, & Parker, 2011; Montez, & Hayward, 2014; O'Rand, & Hamil-Luker, 2005; Pudrovska, 2014; Pudrovska, & Anikputa, 2014; Smith et al., 2016; Turner, Thomas, & Brown, 2016; Warner, & Hayward, 2006; Willson, Shuey, & Elder, 2007). Childhood adversity may also affect health-related behaviors, physiological and psychological health, adult socioeconomic status, and relationships, all of which have been linked to functional status and disability (Ben-Shlomo, & Kuh, 2002; Blackwell, et al., 2001; Montez, & Hayward, 2014; O'Rand, & Hamil-Luker, 2005; Pudrovska, 2014; Pudrovska, & Anikputa, 2014; Schafer, Ferraro, & Mustillo, 2011; Warner, & Hayward, 2006; Willson, et al., 2007). Yet, little is known about the association of childhood adversity with functional status throughout adult life.

Researchers who study the association of childhood adversity with adult health typically focus on one or more of four life course health trajectories: (1) risk that accumulates throughout life to affect adult health, including risks to health from experiences of adversity during childhood (e.g., Cohen, Janicki-Deverts, Chen, & Matthews, 2010; Willson, et al., 2007); (2) adversity during limited periods of particular susceptibility, especially *in utero* and in early childhood (e.g., Cohen et al., 2010; Miller et al., 2011); (3) changes in socioeconomic status during childhood, adolescence, or early adult life that may affect the association of childhood adversity with adult health (e.g., Ben-Shlomo, & Kuh, 2002; Galobardes, et al., 2004); and (4) harmful exposures or behaviors established through the experience of adversity in childhood that continue in adulthood, even if childhood adversity by itself may have limited direct impact on adult health (Pudrovska & Anikputa, 2014). Researchers refer to these trajectories as models of accumulation, timing, change, and pathways. More than one may apply to individuals or populations (e.g., Cohen, et al., 2010; Galobardes, et al., 2004; Pudrovska, & Anikputa, 2014). Childhood adversity may also be linked to adult functional status indirectly. For example, low socioeconomic status is associated with poorer childhood health, which is linked with adult chronic disease and more rapid loss of functional abilities (Blackwell et al., 2001; Guralnik et al., 2006; Haas, 2008).

Many studies have been limited to cross-sectional data, short time durations (Blackwell et al., 2001; Haas, 2006, 2007; Luo & Waite, 2005), or groups least likely to experience childhood adversity such as non-Hispanic whites or men (e.g., Davey Smith et al., 1998; Guralnik et al., 2006; Hayward & Gorman, 2004; Pudrovska, 2014; Pudrovska, & Anikputa, 2014; Warner & Hayward, 2006). A few studies have included African Americans and Hispanics. Luo and Waite (2005) found little evidence of differences in associations of childhood adversity with adult health among African Americans, Hispanics, and non-Hispanic whites. Another study found a significant association of childhood circumstances with adult lung function and gait speed; however, effects of childhood circumstances were averaged across groups, providing limited information about variation by race/ethnicity

(Haas, Krueger, & Rohlfsen, 2012). Smith et al. (2016) found no differences among African Americans, Hispanics, and non-Hispanic whites in the association of childhood adversity with adults' handgrip strength.

A better understanding of associations of childhood adversity with adult health is especially needed for Hispanics. Their number ages 65 and older in the United States may quintuple by 2050 (Hummer & Hayward, 2015), when Hispanics will be about 20% of the population age 65 and over. Although Hispanics live longer than whites, they may have more functional impairment (e.g., Angel, Angel, & Hill, 2014; Hayward, Hummer, Chiu, González-González, & Wong, 2014; Hummer & Hayward, 2015; Markides, & Eschbach, 2005, 2011). High disability rates among Hispanics may result from occupations with high risks such as construction, farming, meat processing, cleaning, and domestic service, and also from childhood poverty and limited education (Hummer & Hayward, 2015; Markides, & Eschbach, 2005, 2011). Researchers have found that Mexican Americans may especially rely on family, including extended family, sharing resources, expenses, and social support in part to deal with social disadvantages; this finding may particularly apply to Mexican American immigrants, who often have low socioeconomic status and face stresses of poverty, discrimination, and family who live separately in the United States and Mexico (e.g., Almeida, Molnar, Kawachi, & Subramanian, 2009; Landale & Oropesa, 2007). Although the importance of kinship, extended family, churches, and other social networks is also well-established and has been found to mediate effects of stress on health for African Americans (Kim & McKenry, 1998), Almeida et al. (2009) found evidence that disadvantaged Hispanics may rely on family support to a greater degree than disadvantaged non-Hispanic African Americans. Thus, when adverse childhood circumstances indicate strained family relationships, Hispanics may be especially vulnerable to life course health risks.

Study Contributions and Hypotheses

Most related research has focused on the association of childhood adversity with health at older ages, providing no information about that association in earlier adult years. Much related research has been limited to cross-sectional data. We examined the association of childhood adversity with adult functional status using a longitudinal analysis of data that were nationally representative of African Americans, Hispanics, and non-Hispanic whites (hereafter whites) ages 20 and over living in the community. We hypothesized that people reporting high levels of childhood adversity would have significantly more functional impairment throughout adult life than people reporting no childhood adversity.

A question that has received little attention is whether the experience of childhood adversity creates direct risks of adult functional impairment, separate from the pathway linking childhood adversity to adult diseases and health behavior. Our second hypothesis was that childhood adversity would be associated with adult functional impairment even after controlling for adult diseases and health behavior.

Few researchers have studied variation by race or ethnicity in the association of childhood adversity with adult health, although researchers have shown that African Americans (e.g., J.N. Laditka & Laditka, 2014, 2016a,b; S.B. Laditka & Laditka, 2009) and Hispanics (e.g.,

Angel et al., 2014; Hayward et al., 2014; Hummer & Hayward, 2015; Markides, & Eschbach, 2005, 2011) have more functional impairment than whites. In light of research suggesting that family support may be especially important for the health of Hispanics (Almeida et al., 2009; Landale & Oropesa, 2007), combined with the fact that adverse childhood experiences often imply problems with family support, our third hypothesis was that the greater prevalence of adult functional impairment associated with childhood adversity would be especially large for Hispanics.

Methods

Data

We used data from the Panel Study of Income Dynamics (PSID) and its 2014 Childhood Retrospective Circumstances Study (CRCS), following adults ages 55 and older beginning with 1992, and ages 20 and older beginning with 2003, both through 2014. PSID surveys were conducted annually through 1997, then every two years. Among its survey waves, PSID response rates range between 96% and 98% (Schoeni, Stafford, McGonagle, & Andreski, 2013). The CRCS, conducted by Internet and paper questionnaire, depending on participants' access to the Internet, attempted to interview all PSID household heads and their partners or spouses, who represent adults living in the community in the United States. We excluded participants in groups other than African Americans, Hispanics, and whites due to their small sample sizes. Participants included in the analysis were those who responded to the CRCS in 2014 and also provided information about their functional status in at least two PSID survey waves, the minimum data requirement for our method.

Dependent Variable

The dependent variable measured four functional status levels: no limitation, difficulty doing one or more of six instrumental activities of daily living (IADLs: preparing meals, shopping for personal items, managing money, using a telephone, doing light housework, or doing heavy housework), difficulty doing one or more of seven activities of daily living (ADLs: bathing, eating, dressing, getting into or out of a bed or chair, walking, getting around outside, and getting to and using the toilet) but not usually having help (ADL difficulty), and usually having help to do one or more of the ADLs (ADL dependency), where the limitations were due to health or physical problems. We coded the outcome variable with mutually exclusive categories based on the highest level of reported impairment (e.g., Crimmins, Hayward, Hagedorn, Saito, & Brouard, 2009; Jagger et al., 2007). For example, participants with an IADL limitation and ADL difficulty were classified as having ADL difficulty without IADL limitation. To obtain adequate statistical power to examine whether the association of childhood adversity with adult functional impairment persisted after adjusting for adult health conditions, the outcome measure for that analysis combined IADL impairment, ADL difficulty, and ADL dependency into a single collective outcome indicating any impairment.

Measuring Childhood Adversity

We focused on four groups of childhood adversity: socioeconomic adversities, including the well-being of the child's caregivers and qualities of the community (e.g., Montez &

Hayward, 2014); family adversities (e.g., Haas, 2007); adverse childhood health (e.g., Turner et al., 2016); and victimization during childhood (e.g., Nansel et al., 2001; Wolke, Copeland, Angold, & Costello, 2013). Consistent with previous research (e.g., Montez & Hayward, 2014), we created an index of childhood adversity focused on variables representing those groups. The index may better represent lifetime health risks than a single adversity measure and may help to avoid overemphasizing effects of a single risk; an index may be especially useful if health is associated with the quantity of risk exposures (e.g., Smith et al., 2016; Turner et al., 2016).

The index summed each participant's measured childhood adversities, with values zero through nine. Socioeconomic adversities were: (1) one or both parents with education grade 8 or less; (2) periods of parental unemployment; (3) parents "struggled financially"; (4) neighborhood unsafe at night; and (5) neighbors not "close knit," or could not be relied on for help. Family adversities were: (6) parents divorced when the participant was less than age 17; and (7) the participant was raised by a single parent; these family adversities also often increase socioeconomic adversity. Adverse childhood health was represented by (8) self-reports of fair or poor childhood health, compared with good, very good, or excellent childhood health. Victimization during childhood was represented by (9) participant reports of having been bullied "a lot" or "sometimes," either in or out of school. Preliminary analyses indicated that each of these circumstances was separately associated with more functional impairment throughout life. Few participants reported having more than four of these adverse circumstances. Thus, we categorized individuals as having 0, 1, 2, 3, or 4 or more adversities, all represented in the model with a single categorical variable with those five levels. We refer to those reporting 4 or more as having high childhood adversity.

Controls for Potential Confounding Variables

We measured three levels of education, a control for adult health and socioeconomic status (J.N. Laditka & Laditka, 2016a; Montez & Hayward, 2014): less than high school graduation, high school graduation (including the General Educational Development credential, GED; J.N. Laditka & Laditka, 2016a), or postsecondary education, all represented in the model as a three-level categorical variable. We controlled for age in years, age-squared, and sex. Separate covariates identified African Americans and Hispanics, with white as the reference group due to the relatively large number of participants in that group. Interaction terms provided separate probabilities for each combination of childhood adversity, sex, and race/ethnicity.

Analytical Approach

We used t-tests and logistic regression to compare PSID participants who completed the CRCS and those who did not. Our principal method was a well-established multinomial logistic Markov chain regression model, estimated by maximum likelihood (e.g., Crimmins et al., 2009; Jagger et al., 2007; J.N. Laditka & Laditka, 2016a,b,c; S.B. Laditka & Laditka, 2014, 2015, 2016; S.B. Laditka & Wolf, 1998). The model estimated functional status transition probabilities specific to each age beginning at 20, adjusting the probability of each transition type for the time between interviews and accommodating any pattern of unrecorded transitions between interviews (S.B. Laditka & Hayward, 2003; S.B. Laditka &

Laditka, 2009; S.B. Laditka & Wolf, 1998). The probability of a given transition at a given age was conditional on the value of the adversity index, current functional status, age, education, sex, and race/ethnicity. A second model estimated transition probabilities beginning at age 40, when adult chronic diseases become prevalent, separately adjusting for diabetes, heart disease, sedentary behavior, and obesity (S.B. Laditka & Laditka, 2015). In both models we used data representing all participants to estimate the functional status transition probabilities, including participants who reported 0, 1, 2, 3, or 4 or more childhood adversities.

We used the probabilities to conduct microsimulations, creating large populations of simulated individuals, each with a complete annual functional status history from age 20 through death. Details of the method are published (S.B. Laditka, 1998; S.B. Laditka & Hayward, 2003; S.B. Laditka & Laditka, 2009, 2014; S.B. Laditka & Wolf, 1998). Each year, the individual had no IADL or ADL limitations, or an IADL limitation, or ADL difficulty, or ADL dependency. In the next year the individual could be in any of those states, or dead. All participants survived to the last year of the study, when the CRCS was conducted, so we could not estimate death risks for childhood adversity levels. We simulated each life to the average age of death, conditional on survival to age 20, for each sex and race/ethnicity, using National Center for Health Statistics life expectancy estimates. In a microsimulation for each population, such as Hispanic women with high school education and high childhood adversity, we simulated 100,000 lives and calculated the population prevalence of each functional impairment level at each age. We compared results for people reporting 4+ measured adversities to those for people reporting none, and also provide comparable results for those reporting 1, 2, or 3 childhood adversities.

Bootstrapping estimated variation in the results, accounting for parameter uncertainty (confidence intervals) and Monte Carlo variation by repeating the microsimulation for each population 1,000 times; additional repetitions did not change results at the reported precision. For each repetition we made a random selection for each parameter from its 95% confidence interval (CI). The point estimates for the microsimulation outcomes were the means of the results; the CIs ranged from the 2.5 to the 97.5 percentiles. We used software that we created for this research using SAS IML (Cary, North Carolina). The Institutional Review Board (IRB) at the University of North Carolina at Charlotte determined that this research did not require IRB review.

Results

Characteristics of the Sample

Of participants who completed the CRCS, 75% used the Internet version; others completed the paper version (results not shown). The CRCS response rate was 67%. The ages of those who completed the CRCS did not differ significantly from those who did not do so (respective means 48.1, 47.7). Adjusted for sex, race/ethnicity, and functional status reported in the year preceding the CRCS, the likelihood of participating in the CRCS did not differ between women and men, or African Americans and whites. Hispanics were more likely to participate than whites (odds ratio, OR 2.05, CI 1.06–3.90). Participants were more likely

than non-participants to report difficulty walking (OR 1.75, CI 1.05–2.91) but did not differ in reporting impairments in IADLs or other ADLs.

CRCS participants who met the inclusion criteria (n=6,705) had 30,949 measured functional status transitions through 62,885 person-years. The mean baseline age, defined by the year of each participant's first functional status measurement, was 40.6 years (standard deviation 12.9); adjusted for national representativeness and the survey design, the mean baseline age was 42.5 (CI 41.9–43.0, results not shown). Women were 57.1% of the sample (53.8% weighted, CI 51.0–56.7). The PSID oversampled African Americans, who were 27.1% of the sample (8.2% weighted, CI 6.1–10.4). Hispanics were 8.4% (8.8% weighted, CI 6.9–10.7). As for childhood adversities, 30.1% of the sample reported having none, 29.3% one, 21.3% two, 11.9% three, and 7.4% four or more. The data used for the analysis that controlled for adult health conditions (n=4,173) represented 18,416 functional status transitions through 37,121 person-years, with mean baseline age 49.5; 56.3% of the sample represented women, 25.6% African Americans, 3.5% Hispanics. Individuals with diabetes, heart disease, sedentary behavior, or obesity were, respectively: 23.3%, 14.1%, 13.7%, and 28.5% of the analytic sample; about 2% of participants reported having all 4 of the conditions, representing 2.1 million Americans.

Table 1 shows descriptive information by sex and race/ethnicity for participants ages 20 and over. The distributions of the adversity index levels varied significantly by race/ethnicity ($p<0.0001$ for both women and men). White women and men had the smallest percentages with high adversity, respectively 7.6% and 6.5%; comparable results were 15.5% and 11.3% for African Americans, 14.7% and 17.2% for Hispanics. Also notable are the summed percentages of individuals who reported having either 3 or 4+ adversities (not shown), an indicator of groups with higher than average risk of experiencing considerable childhood adversity; Hispanics were much more likely than others to have those high adversity levels: 35.1% of Hispanic men (17.2% with an index value of 4 or more, plus 17.9% with an index value of 3) compared with 26.9% of African American men and 17.2% of white men; comparable results for women were 38.0%, 32.1%, and 19.2%.

The Markov Model

Results of the multinomial logistic Markov models were consistent with higher risks of becoming functionally impaired with each additional childhood adversity, and lower probabilities of improving functional status (results not shown). For example, in the model that examined whether the association of childhood adversity with adult functional impairment persisted after adjusting for adult health conditions, the adjusted odds of becoming functionally impaired were 20% higher with each additional adversity (odds ratio, OR 1.20; 95% confidence interval, CI 1.14–1.26). In the same model each additional adversity was associated with 9% lower adjusted odds of recovering from functional impairment (OR 0.91; CI 0.85–0.97). The microsimulation results, described in the following section, were based on the transition probabilities.

Functional Status throughout Adult Life—Results of the Microsimulations

Table 2 shows microsimulation results for ages 20 and older, the population prevalence of levels of functional status at ages 30, 50, and 70 for women and men, focusing on individuals with high school education. At all ages, the population prevalence of IADL impairment, ADL difficulty, and ADL dependency was significantly higher for women reporting 4+ adversities than for those reporting none; except for ADL difficulty at age 70 for African Americans. For example, at age 30 among Hispanic women with 4+ adversities 16.0% reported IADL impairment, 11.5% ADL difficulty, and 14.6% ADL dependency. Comparable results with none of the adversities were 2.0%, 0.9%, and 1.6% (all $p<0.01$).

The results for women also suggest that the differences in the prevalence of all three impairment types that were associated with 4+ childhood adversities compared with no adversity were substantially greater for Hispanics than for African Americans or whites. For example, among white women at age 30 the prevalence of IADL impairment was 207% greater for participants with 4+ adversities than for those with none (comparing the 2.8% prevalence with no adversities to the 8.6% prevalence with 4+ adversities). Analogous comparisons of white women indicated 257% higher prevalence of ADL difficulty for those with 4+ adversities compared to those with none, and 536% higher prevalence of ADL dependency (percentage differences not shown). In the analogous comparisons for African American women the prevalence of IADL impairment, ADL difficulty, and ADL dependency was, respectively, 226%, 135%, and 171% greater for those with 4+ adversities than for those with none. Among Hispanic women, on the other hand, the respective prevalence rates were 700%, 1,178%, and 813% greater with 4+ adversities than with none ($p<0.01$).

The lower portion of Table 2 shows comparable results for men, which also show that childhood adversity was associated with adult functional impairment. For example, at age 30 among Hispanic men with 4+ adversities 8.8% reported IADL impairment, 9.2% ADL difficulty, and 8.5% ADL dependency. Comparable results with none of the adversities were 0.8%, 0.9%, and 1.2% (all $p<0.01$). As in the results for women, for men the higher prevalence of all three impairment types that was associated with higher levels of childhood adversity was substantially larger for Hispanics than for African Americans or whites. For both women and men, the results representing participants reporting 0, 1, 2, 3, or 4+ childhood adversities indicate a trend of greater functional impairment with increasing levels of childhood adversity.

Table 3 shows results for ages 40 and older, comparing participants with and without adult diabetes, heart disease, obesity, and sedentary behavior, where the outcome was the population prevalence of any impairment. For example, for individuals at age 50, among African American women who reported none of the 4 health conditions 8.3% of those reporting no childhood adversity had any impairment, compared with 20.3% of those with 4+ adversities ($p<0.01$). Among African American women who reported all 4 of the health conditions, 58.1% of those reporting no childhood adversity had any impairment, compared with 66.3% of those with 4+ adversities ($p<0.05$). Results for other groups including men also suggested that childhood adversity continued to be associated with a higher prevalence of any impairment after controlling for the 4 health conditions, although these results were

not statistically significant at age 70 for those with the 4 health conditions among Hispanic or African American women and Hispanic men.

Discussion

We examined associations of multiple dimensions of childhood adversity with functional status throughout adult life. Consistent with our first hypothesis, with the accumulation model (e.g., Cohen et al., 2010; Willson, et al., 2007), and with relevant studies (e.g., Blackwell et al., 2001; Bowen & González, 2009; Guralnik et al., 2006; Haas, 2008; Luo & Waite, 2005; Montez & Hayward, 2014), results indicated a trend of increasing functional impairment in adulthood with increasing levels of childhood adversity. For all groups studied, people reporting high childhood adversity had significantly more functional impairment throughout adult life than those reporting little or no adversity.

Consistent with our second hypothesis, the results also suggested that adverse conditions during childhood continue to be associated with more adult impairment even after controlling for health conditions and behaviors that are well-established causes of functional impairment throughout adult life: diabetes, heart disease, obesity, and sedentary behavior. In contrast, Schafer et al. (2011) found that when midlife mediators were controlled, childhood adversity accounted for little of the variance in how favorably people assessed their lives, while without those controls childhood adversity was a substantial risk for negative assessments. The analysis by Schafer et al. (2011) was limited to cross-sectional data; our analysis offered the substantial statistical power of following individuals for nearly 63 thousand person-years, with nearly 31 thousand measured functional status transitions. In contrast to the pathway model, which suggests that childhood adversity is likely to affect adult functional status primarily by increasing chronic diseases and reducing adherence to healthy behaviors (Pudrovska & Anikputa, 2014), the present study provided evidence that the negative effect of childhood adversity on health may also persist throughout adult life as an independent contributor to functional impairment, a risk that is separate from the effects of diabetes, heart disease, obesity, and sedentary behavior. Further research is needed to examine whether that association may be due to other effects of childhood adversity, such as changes in socioeconomic status during childhood, adolescence, or early adult life (e.g., Ben-Shlomo, & Kuh, 2002; Galobardes, et al., 2004).

The results were also consistent with our third hypothesis, that the association of childhood adversity with adult functional impairment would be greater for Hispanics than for African Americans and whites. Some researchers have presented evidence that strong family networks may be especially important for maintaining the health of Hispanics, particularly those with low socioeconomic status (Almeida et al., 2009; Landale & Oropesa, 2007). If that suggestion is accurate, and if childhood adversity affects those family networks or indicates that they are stressed, that may add an extra health burden from childhood adversity to relatively high health challenges for Hispanics that include occupational risks and limited education (Hummer & Hayward, 2015; Markides, & Eschbach, 2011). Hispanics also reported relatively high levels of childhood adversity. Thus, compared to other groups, a larger proportion of Hispanics had the risks of functional impairment that were associated with childhood adversity, and those risks were larger for Hispanics than for other groups;

Hispanic Americans may face a double disparity of health risks associated with childhood adversity. More research is needed in this area.

Limitations and Strengths

Consistent with related studies, participants reported childhood adversities retrospectively (e.g., Blackwell et al., 2001; Bowen & González, 2010; Haas, 2008; Haas et al., 2012; Luo, & Waite, 2005; Montez, & Hayward, 2014; Pudrovska, 2014; Willson et al., 2007). Recall bias may have affected the results, and recall of childhood circumstances related to health may be further biased among adults with functional impairments. However, retrospective reports of childhood socioeconomic status and health are typically accurate and reliable (Batty, Lawlor, Macintyre, Clark, & Leon, 2005; Haas, 2007; Krieger, Okamoto, & Selby, 1998; Smith 2009).

We categorized individuals as having 0, 1, 2, 3, or 4+ childhood adversities, represented in the model with a single categorical variable with those five levels. The index approach assumed an additive association of childhood adversities with the outcomes, and that the measured adversities were each equally associated with adult functional status. Thus, the model did not account for the possibility that childhood adversities may interact to increase or decrease their combined association with functional status. For example, individuals raised by single parents who are poor may face risks to adult health that exceed the sum of the separate effects of growing up poor or with a single parent. It would be useful to test such interactions.

This study was limited to common childhood adversities. It did not examine exposure to emotional or physical abuse of the participant by a parent or another adult, parental mental illness, crime, violence, smoking or other environmental risks, parental substance abuse, serious problems in school, or involvement with the criminal justice system. Expanding the set of adversities and organizing them by domains may usefully extend this research (Felitti et al., 1998; O'Rand, & Hamil-Luker, 2005; Smith et al., 2016; Turner et al., 2016); different domains may be differently associated with adult functional status. The model also did not address the possibility that thresholds of adversity may exist, above which adult health risks may increase greatly, or that the association of adversity with adult functional status may be non-linear, or that the timing of adversities or the order in which they affect the individual may matter, or that some exposure to adversity in childhood may usefully support the development of problem-solving, coping, and resilience (Schafer et al., 2011). From the perspective of the accumulation model, it would be useful to test an index accounting for the frequency, duration, and intensity of adverse experiences. Including all of those factors would improve the measurement of the total health risk of childhood adversity. It would also be useful to examine whether results vary by birth cohort. Different birth cohorts' varying exposures to economic opportunities, medical care, military service and combat, pathogens and environmental risks, public support programs, and other experiences may affect the link between childhood adversity and adult health.

Adult psychosocial and relational variables may mediate the association of childhood adversity with functional impairment. Such mediators may offer opportunities for adult interventions to reduce effects of childhood adversity on adult health (O'Rand & Hamil-

Luker, 2005; Smith et al., 2016). From the perspective of the change model (e.g., Ben-Shlomo, & Kuh, 2002; Galobardes, et al., 2004), individuals with high childhood adversity who have improved adult circumstances may have lower adult health risks than others (Pudrovska & Anikputa, 2014). Our model did not examine these possibilities. Regarding the control for education, if childhood adversity reduces both educational attainment and adult health then controlling for education may under-estimate the association of childhood adversity with adult functional status. Results represented people with high school education, about one-quarter of the adult population.

We did not specifically test the accumulation, timing, change, or pathways models. As researchers have noted, although the mechanisms of the models are conceptually distinct they are so substantially interrelated that it may not be possible to separate them statistically (Pudrovska & Anikputa, 2014). Nonetheless, it would be useful to further examine the mechanisms linking childhood adversity with adult health.

Childhood circumstances were measured at the end of the study, so we could not model the association of childhood adversity with life expectancy. Research suggests that childhood adversity may reduce life expectancy (Davey Smith et al., 1998; Galobardes et al., 2004; Hayward & Gorman, 2004; Montez & Hayward, 2014; Pudrovska & Anikputa, 2013; Warner & Hayward, 2006). This factor may have biased the results. However, bias should be limited given that a majority of adults survive to the ages we reported.

Although IADL limitations can be due to cognitive impairment, researchers often assume that ADL limitations are more severe than IADL limitations. That assumption is reasonable given that ADL impairment, particularly needing help to do ADLs, is among the factors used to diagnose the severity of cognitive impairment (Alzheimer's Association, 2016). Thus, although cognitive impairment may cause or contribute to IADL difficulty, cognitively impaired individuals who have difficulty doing an IADL but do not have ADL impairments are likely to have relatively mild cognitive impairment. Those whose cognitive problems cause IADL and ADL limitations are likely to have more severe cognitive problems. Those who require help with ADLs are more likely to have dementia, although ADL dependency may be due to physical limitations. It is therefore reasonable to consider IADL impairment, ADL difficulty, and ADL dependency as levels of impairment rather than categories. However, this approach may under-estimate IADL impairment.

Study strengths included longitudinal analysis, ages 20 and over. Many related studies have been limited to cross-sectional analyses, ages 65 and over. We also provided results for Hispanics. Few studies have done so. It would be useful to extend this research to distinguish among Hispanic subgroups, with separate analyses for immigrants and individuals born in the United States. We also reported results of an analysis that controlled for four major causes of functional impairment in adulthood, finding that the association of childhood adversity persisted in those results.

Conclusion and Implications

Childhood adversity was associated with significantly more adult functional impairment, with a particularly large association for Hispanics. Our results suggest that reducing

socioeconomic, family, and health adversities in childhood and increasing neighborhood safety and social cohesion may help to address adult health disparities.

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Table 1.

Associations of childhood adversity with adult impairments in activities of daily living (ADLs) and instrumental ADLs (IADLs), characteristics of the sample ages 20 and over, by sex and race/ethnicity.[a]

	Women			Men		
	African American	Hispanic	White	African American	Hispanic	White
Sample size, n[b]	1,185	245	2,401	678	147	2,049
Functional status transitions, n[b]	5,262	975	11,286	3,003	606	9,817
Person-years, n[b]	10,691	1,987	22,958	6,129	1,241	19,879
Age at baseline, mean[c]	38.9	34.2	42.2	42.5	36.3	43.4
(95% CI)	(37.2–40.5)	(31.6–36.8)	(42.3–44.1)	(40.3–44.7)	(32.9–39.7)	(42.6–44.2)
Education years, mean[c]	12.8	11.9	13.6	12.7	11.3	13.5
(95% CI)	(12.0–13.6)	(10.8–13.1)	(13.3–13.9)	(12.3–13.1)	(10.1–12.6)	(13.2–13.8)
Adversity index (0–4), mean[c]	1.8	2.0	1.4	1.7	1.9	1.3
(95% CI)	(1.4–2.0)	(1.5–2.3)	(1.2–1.6)	(1.4–1.9)	(1.8–2.2)	(1.1–1.4)
Index=0, %[d]	19.5	16.4	31.1	21.0	18.7	33.0
Index=1, %[d]	26.3	23.6	28.6	27.3	22.9	29.1
Index=2, %[d]	22.1	22.0	21.1	24.8	23.3	20.7
Index=3, %[d]	16.6	23.3	11.6	15.6	17.9	10.7
Index=4+, %[d]	15.5	14.7	7.6	11.3	17.2	6.5

[a] Data source: 1992–2013 Panel Study of Income Dynamics with 2014 Childhood Retrospective Circumstances Study, n=6,705.

[b] Unweighted sample characteristics.

[c] Results accounting for the survey design, weighted to be nationally representative; CI=95% confidence interval.

[d] Childhoood adversity index level comparisons across race/ethnicity, p<0.0001 for both women and men.

Table 2.

Microsimulation Results: Childhood adversity and adult impairments in activities of daily living (ADLs) and instrumental ADLs (IADLs), ages 20 and over.[a]

	African American					Hispanic					White				
Childhood Adversities, n:	0	1	2	3	4+	0	1	2	3	4+	0	1	2	3	4+
Women															
% of population at age 30:															
IADL	3.4	5.7	7.1	9.0	11.1*	2.0	4.4	7.0	11.1	16.0*	2.8	4.5	5.5	6.8	8.6*
ADL difficulty	3.7	6.0	6.6	7.5	8.7*	0.9	2.5	4.4	7.5	11.5*	2.3	4.2	5.2	6.6	8.2*
ADL dependency	4.5	7.9	8.7	10.2	12.2*	1.6	4.3	6.9	10.6	14.6*	1.1	2.6	3.5	4.9	7.0*
% of population at age 50:															
IADL	6.8	10.2	12.1	14.3	16.4*	4.3	8.5	12.0	16.6	21.1*	6.1	9.3	10.8	12.6	14.6*
ADL difficulty	9.2	13.1	13.5	14.0	14.7+	2.4	5.9	9.0	12.9	17.2*	5.9	10.2	12.2	14.6	17.0*
ADL dependency	10.1	15.8	16.7	18.2	20.0*	3.4	8.2	11.9	15.8	19.0*	2.9	6.1	7.6	9.8	12.5*
% of population at age 70:															
IADL	11.1	14.4	16.7	18.8	20.5*	8.7	14.4	17.9	21.7	24.8*	11.8	15.8	17.1	18.5	19.9*
ADL difficulty	18.9	21.2	21.7	22.4	23.1	5.8	12.0	15.7	19.6	23.2*	13.8	20.9	23.6	26.2	28.3*
ADL dependency	19.2	25.8	26.1	26.7	27.6+	7.2	14.5	17.8	20.6	22.4*	6.9	12.1	14.0	16.2	18.4*
Men															
% of population at age 30:															
IADL	1.3	2.2	2.8	3.8	5.1*	0.8	1.9	3.2	5.4	8.8*	1.2	1.9	2.2	2.7	3.2*
ADL difficulty	3.7	4.0	4.8	6.0	6.3*	0.9	2.0	3.2	5.6	9.2*	2.1	3.3	3.5	3.7	4.1*
ADL dependency	2.9	5.3	6.9	8.3	10.1*	1.2	2.7	3.8	5.8	8.5*	0.6	1.3	1.5	1.9	2.3*
% of population at age 50:															
IADL	2.6	4.0	5.1	6.6	8.4*	1.8	4.0	6.1	9.2	13.3*	2.5	3.9	4.6	5.5	6.6*
ADL difficulty	10.1	11.8	12.8	13.1	12.8	2.4	5.0	7.2	10.4	14.5*	5.7	8.7	9.0	9.3	9.6*
ADL dependency	6.4	11.6	14.0	16.2	18.6*	2.5	5.5	7.7	10.5	13.4*	1.5	3.3	4.0	4.8	5.9*
% of population at age 70:															

	African American					Hispanic					White				
IADL	4.5	6.1	7.5	9.3	11.3*	3.9	7.4	10.1	13.6	17.6*	5.1	7.2	8.3	9.7	11.5*
ADL difficulty	21.3	23.3	23.4	23.8	24.0	6.0	11.1	13.9	17.2	20.6*	14.8	15.0	15.2	15.5	15.6+
ADL dependency	12.6	20.7	23.5	26.3	29.0*	5.3	10.5	13.0	15.7	18.3*	3.5	7.5	9.3	11.2	13.2*

[a]Data source: Panel Study of Income Dynamics with 2014 Childhood Retrospective Circumstances Study, n=6,705; ADL=activities of daily living; IADL= instrumental ADL

[+]p<0.05

[*]p<0.01, comparing participants reporting 4+ childhood adversities to those reporting none.

Table 3.

Microsimulation Results: Childhood adversity, adult health conditions, and adult impairments in activities of daily living (ADLs) or instrumental ADLs (IADLs), ages 40 and over.[a]

	African American					Hispanic					White				
Childhood Adversities, n:	0	1	2	3	4+	0	1	2	3	4+	0	1	2	3	4+
Women															
Without conditions															
% of population, age 50:	8.3	9.5	11.2	17.5	20.3*	6.4	8.5	15.2	20.1	25.7*	6.5	9.7	18.1	24.7	25.3*
% of population, age 70:	17.0	19.2	21.9	31.9	35.3*	13.0	16.6	27.0	32.9	38.7*	13.8	20.2	35.0	43.3	44.6*
With 4 health conditions															
% of population, age 50:	58.1	60.9	63.2	65.0	66.3+	46.0	52.0	57.2	61.4	64.5+	52.8	65.2	73.4	78.4	79.4*
% of population, age 70:	74.9	76.6	77.7	78.4	78.8	63.1	67.6	71.0	73.5	75.2	71.7	81.0	85.9	89.9	88.4*
Men															
Without conditions															
% of population, age 50:	4.6	5.6	8.2	11.7	14.3*	3.6	4.5	7.6	9.8	12.6+	3.5	4.2	7.0	8.4	10.0*
% of population, age 70:	9.9	12.0	16.0	22.8	26.7*	7.6	9.3	14.8	18.0	21.5+	7.7	9.2	14.8	17.3	20.1*
With 4 health conditions															
% of population, age 50:	42.8	47.5	51.9	56.0	59.6*	32.4	36.2	39.0	42.1	44.7+	36.9	41.1	45.5	49.7	53.8*
% of population, age 70:	63.1	66.6	69.7	72.2	74.2+	50.1	53.2	54.6	56.3	57.6	57.9	61.7	65.2	68.3	71.0*

[a]Data source: Panel Study of Income Dynamics with 2014 Childhood Retrospective Circumstances Study, n=4,173; ADL=activity of daily living; IADL= instrumental ADL; measured outcome is % of population reporting any IADL impairment, ADL difficulty, or ADL dependency; the 4 adult health conditions are diabetes, heart disease, obesity, and sedentary behavior.

+p<0.05

*p<0.01, comparing participants reporting 4+ childhood adversities to those reporting none.