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Gender Differences in the Association between Adverse Childhood Experiences and Cancer

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A B S T R A C T

Objectives: Adverse childhood experiences (ACEs) have been linked to a variety of diseases in adulthood, including cancer. However, current research has yet to determine if all abuse types are associated with cancer and if women are more adversely impacted by ACEs than men.
Methods: Data from the 2011 Behavioral Risk Factor Surveillance System, a national survey of American adults 18 and older ($N = 111{,}964$) were analyzed. Logistic regression models were fit to estimate odds of ever being diagnosed with cancer after experiencing one or more of eight different ACEs, while adjusting for potential confounders. These analyses were then stratified by gender.
Results: Among women, childhood experiences of physical abuse, sexual abuse, emotional abuse, living with someone who was mentally ill, living with a problem drinker, living with a drug user, and living in a household where adults treated each other violently were associated with higher odds of cancer. Among men, only emotional abuse was associated with higher odds of cancer.
Conclusions: Results suggest that ACEs increase risk of cancer later in life. However, this impact occurs mostly among women. This finding may be because women experience many ACEs at higher rates than men and because women, via sexual abuse, can be exposed to cancer-causing viruses.

Adverse childhood experiences (ACEs) have been linked to a number of negative health consequences in both adults and children (Alcalá, Keim-Malpass, & Mitchell, 2017; Alcalá, von Ehrenstein, & Tomiyama, 2016; Lindert et al., 2014; Maniglio, 2009; Rohde et al., 2008; Springer, Sheridan, Kuo, & Carnes, 2007; U.S. Department of Health & Human Services, 2012). Physical and sexual abuse are particularly problematic because they are associated with short-term outcomes such as bruising, bone fractures, and death (U.S. Department of Health & Human Services, 2012). In addition to short-term consequences, ACEs are detrimental because they have been linked to poor health later in life (Lindert et al., 2014; Maniglio, 2009; Rohde et al., 2008; Springer et al., 2007). Also, ACEs have been associated with precursors of poor health, including substance abuse, tobacco use, risky sexual behaviors, reduced rates of use of preventative health services, and criminality (Alcalá, Mitchell, & Keim-Malpass, 2016; Alcalá, von Ehrenstein, et al., 2016; Gilbert et al., 2009). Overall, available evidence has documented consistent associations between ACEs and, primarily, physical health consequences in the short-term and psychiatric health consequences in the long term (Hughes, Hardcastle, & Bellis, 2016).

Emerging research has suggested associations between ACEs and cancer later in life. The number of ACEs reported is associated with elevated odds of cancer in adulthood (Brown et al., 2010; Felitti et al., 1998; Llabre et al., 2016), and lung cancer mortality (Brown et al., 2010). Because ACEs encompass measures of both child abuse and household dysfunction, some insight into the impact of ACEs can be gleaned from examining specific ACEs. For example, physical abuse as a child is associated

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with increased odds of cancer in adulthood (Fuller-Thomson, Bottoms, & Brennenstuhl, 2009). Similarly, research has suggested child sexual abuse is associated with increased risk of cervical cancer (Coker, Hopenhayn, DeSimone, Bush, & Crofford, 2009). Specifically, women who have been sexually abused as children have double the risk of cervical cancer, when compared with those who have not been abused (Coker et al., 2009).

When researchers have attempted to examine the impact of different ACEs on cancer health in the same population, inconsistent results have been noted. For example, when extracting three factors from ACE items, only the factor with the strongest loading on measures of sexual abuse was associated with elevated odds of cancer (Brown, Thacker, & Cohen, 2013). Conversely, when comparing the impact of child abuse and household dysfunction, a study in the rural United States found that experiencing any child abuse was not associated with odds of cancer, whereas experiencing any household dysfunction was associated with a lower odds of cancer (Iniguez & Stankowski, 2016). In all, available evidence suggests that the impact of individual ACEs is not uniform; given variability, the practice of summing items or creating categorical measures of ACEs may obscure associations (Alcalá, von Ehrenstein, et al., 2016). This is important because, as some have argued, not all ACE items may be linked to cancer by the same mechanisms or to the same degree (Alcalá, 2016).

Limited cross-sectional research has explored the role of gender in the association between ACEs and cancer. In the Behavioral Risk Factor Surveillance System (BRFSS), women experience higher rates of most ACEs, including sexual abuse (Centers for Disease Control and Prevention, 2010). This is of concern in relation to cancer because sexual abuse can involve exposure to the human papilloma virus or human immunodeficiency virus (Lindegren et al., 1998; Rogstad, Wilkinson, & Robinson, 2016); both viruses are associated with an increased risk of cancer (Engels et al., 2008; Walboomers et al., 1999), with human papilloma virus being of particular concern for cervical cancer. In the cancer context, experiencing any child abuse is more strongly associated with cancer among women than men (Afifi et al., 2016). Experiences of physical, but not emotional, abuse increase the risk for cancer for both men and women (Morton, Schafer, & Ferraro, 2012). Overall, the gender-specific impact of ACEs and cancer has received limited attention, but available evidence suggests that women have a greater exposure to ACEs and female survivors of ACEs are more adversely impacted than are males. Consequently, we hypothesize that the association between ACE items and cancer will depend on gender, such that female ACE survivors will have a higher odds of cancer, relative to male survivors.

Materials and Methods

Data Source

The present study used publicly available data from the 2011 BRFSS, thus not requiring institutional review board approval. This multistage, random digit dial telephone survey is designed to be representative of noninstitutionalized adults (ages 18 and over) living in all U.S. states and some territories. The BRFSS is conducted on an annual basis (Centers for Disease Control and Prevention, 2011a). A core set of questions were asked of all participants in all states and territories (Centers for Disease Control and Prevention, 2011a). Optional modules of questions were asked of all or some participants in states electing to administer them (Centers for Disease Control and Prevention, 2011a). Data on core questions were collected using both landlines and cell phones in all states, and optional modules were administered with landlines and/or cellphones (Centers for Disease Control and Prevention, 2011a). For the 2011 BRFSS, 10 states (California, Maine, Minnesota, Montana, Nebraska, Nevada, Oregon, Vermont, Washington, and Wisconsin) administered a module that measured ACEs (Centers for Disease Control and Prevention, 2011b). Among these 10 states, the median weighted American Association for Public Opinion Research response rate (RR4) was almost 50%, which is better than other telephone-based surveys in the U.S. (BRFSS, 2013a).

Among the 10 states that administered the ACEs module, 131,686 respondents participated in the BRFSS. Individuals with missing data (i.e., missing or responses of “don’t know” or “refused”) on any variable used in the present analyses were excluded, resulting in an analytic sample size of 111,964.

Measures

The main independent variables of interest were measures of childhood adversity. These were measured in the BRFSS with the widely used ACE scale, which assesses adversity occurring before age 18. The psychometric properties of the ACEs scale have been examined among both clinical and community-dwelling samples and have shown good internal consistency and strong correlations with other self-reported measures of adversity (Ford et al., 2014; Murphy et al., 2014; Wingenfeld et al., 2011). The 11-item scale includes measures of child abuse as well as household dysfunction (Felitti et al., 1998). These questions were: 1) “How often did a parent or adult in your home ever hit, beat, kick, or physically hurt you in any way? Do not include spanking.”; 2) “How often did a parent or adult in your home ever swear at you, insult you, or put you down?”; 3) “How often did anyone at least 5 years older than you or an adult, ever touch you sexually?”; 4) “How often did anyone at least 5 years older than you or an adult, try to make you touch them sexually?”; 5) “How often did anyone at least 5 years older than you or an adult, force you to have sex?”; 6) “Did you live with anyone who was depressed, mentally ill, or suicidal?”; 7) “Did you live with anyone who was a problem drinker or alcoholic?”; 8) “Did you live with anyone who used illegal street drugs or who abused prescription medications?”; 9) “Did you live with anyone who served time or was sentenced to serve time in a prison, jail, or other correctional facility?”; 10) “Were your parents separated or divorced?”; and 11) “How often did your parents or adults in your home ever slap, hit, kick, punch, or beat each other up?” Because the California BRFSS did not have any data for the item on imprisonment and jail, this item was not included. All items were coded to indicate if the respondent had experienced the specific adversity in question. Based on evidence from prior studies indicating that sexual abuse measures in the ACE scale capture the same underlying construct (Brown et al., 2013; Ford, et al., 2014), the three items measuring sexual abuse were combined to create a singular measure of sexual abuse. This yielded eight ACE measures.

Existing research has treated the ACEs module as a count of experiences or extracted factors, and this greatly limits our understanding of how these experiences impact later health outcomes. Specifically, because these experiences have unique characteristics, treating them as interchangeable does not advance our understanding of how and if each of these experiences impact disease. For example, as noted, sexual abuse is associated with increased risk of infections that are associated with cancer, suggesting that some adversities have biological pathways linking to disease that are likely irrelevant for other adversities. Also, as

others have argued, some ACEs, like parental divorce or separation, are becoming more normative over time (Finkelhor, Shattuck, Turner, & Hamby, 2015). Consequently, not all ACEs may be equally deleterious. Thus, the present analyses do not sum these ACEs into a count.

The dependent variable of interest, lifetime cancer diagnosis, was assessed with a single item. This item indicated if a doctor had ever told the respondent that they had cancer. Because of the frequently benign nature of skin cancer, only non–skin cancer cases were coded as having the disease. This coding scheme is consistent with previous studies (Alcalá, 2014; Alcalá et al., 2017).

Several variables were included as potential confounders, based on existing literature (Alcalá, 2014; Brown et al., 2010; Felitti et al., 1998). Age was included as a continuous variable. Race or ethnicity was measured using a categorical variable representing race and ethnicity category combinations: non-Latino White, non-Latino Black or African American, non-Latino Asian, non-Latino other race, and Latino. Non-Latino Whites served as the reference group. A respondent's state of residence was measured using a categorical variable representing the 10 states included in this study. Years of education completed was computed by recoding educational attainment from the original categories (i.e., kindergarten or less, 1st through 8th grade, 9th through 11th grade, high school graduate, 1–3 years of college, and ≥4 years of college) to continuous values that represented the midpoint of the category in terms of years of education, except for the last category, which was coded to 16 years. Ever smoking (i.e., smoked ≥100 cigarettes in one's lifetime) was included as a potential confounder. Although the BRFSS includes a measure of current smoking status, ever smoking was preferred because cancer diagnoses may lead people to stop smoking, thus obscuring the nature of the association between smoking and cancer. Finally, gender (men or women) was used to stratify analyses.

Statistical Analyses

All analyses were conducted using Stata 14.1 (StataCorp, College Station, Texas). Weights were used to account for survey design (BRFSS, 2013b). Univariate statistics were computed for all variables and stratified by gender. Unadjusted and adjusted (i.e., multivariable) logistic regression models estimating odds ratios and 95% CIs of cancer separately for each of the ACE measures. Each model included an ACE item and confounders were included in multivariable models. These analyses were then repeated, stratifying by gender.

Results

Table 1 shows the weighted means and frequencies of the sample, along with unweighted sample sizes. Six percent of respondents had received a diagnosis of cancer in their lifetime. The most commonly reported ACE was emotional abuse and the least commonly reported adversity was living with a drug user. Respondents were predominantly non-Latino White with around one-half of the sample being women. On average, respondents were in their mid 40s and had completed more than a high school education. Nearly 40% of respondents had ever smoked in their lifetimes.

Table 1 also shows sample characteristics by gender. Women had higher rates of most ACEs relative to men. Women also had higher rates of cancer. Compared with women, men were slightly younger, slightly fewer were White, and slightly more identified as Asian. More men reported being ever smokers than did women.

ACEs and Cancer among All Respondents

Table 2 shows unadjusted odds of cancer estimated for each of the ACE items. Each estimate in the table represents a different logistic regression model. Among the entire sample (model 1) reporting sexual abuse (OR = 1.53; 95% CI = 1.30–1.81) and having parents who were separated or divorced (OR = 0.77; 95% CI = 0.65–0.89) were each associated with odds of cancer.

Table 3 shows the estimated odds of cancer related to each of the ACEs items, while also accounting for potential confounders. Among the entire sample (model 1) reporting physical abuse (AOR = 1.31; 95% CI = 1.11–1.55), sexual abuse (AOR = 1.63; 95% CI = 1.36–1.94), emotional abuse (AOR = 1.34; 95% CI = 1.18–1.53), having lived with someone who was mentally ill (AOR = 1.36; 95% CI = 1.14–1.61), having lived with a problem drinker (AOR = 1.22; 95% CI = 1.07–1.40), having lived with a drug user (AOR = 1.52; 95% CI = 1.21–1.91), and having lived with adults who treated each other violently (AOR = 1.19; 95% CI = 1.02–1.40) were each associated with a higher odds of cancer.

ACEs and Cancer among Women

In unadjusted models, among women (Table 2, model 2), reporting sexual abuse (OR = 1.44; 95% CI = 1.21–1.70) and having lived with a problem drinker (OR = 1.28; 95% CI = 1.09–1.49) were each associated with higher odds of cancer. Having parents who were separated or divorced was associated with lower odds of cancer (OR = 0.82; 95% CI = 0.69–0.79).

In adjusted models, among women (Table 3, model 2), reporting physical abuse (AOR = 1.35; 95% CI = 1.12–1.63), sexual abuse (AOR = 1.49; 95% CI = 1.25–1.78), emotional abuse (AOR = 1.27; 95% CI = 1.09–1.48), having lived with someone who was mentally ill (AOR = 1.26; 95% CI = 1.05–1.51), having lived with a problem drinker (AOR = 1.34; 95% CI = 1.13–1.59), having lived with a drug user (AOR = 1.68; 95% CI = 1.29–2.19), or having lived with adults who treated each other violently (AOR = 1.25; 95% CI = 1.03–1.52) were each associated with higher odds of cancer.

ACEs and Cancer among Men

In unadjusted models, among men (Table 2, model 3), having lived with a problem drinker (OR = 0.76; 95% CI = 0.62–0.94), having lived with a drug user (OR = 0.56; 95% CI = 0.36–0.87), having parents who were separated or divorced (OR = 0.69; 95% CI = 0.51–0.92), and having lived with adults who treated each other violently (OR = 0.75; 95% CI = 0.58–0.97) were each associated with lower odds of cancer. In adjusted models, among men (Table 3, model 3) reporting emotional abuse (AOR = 1.41; 95% CI = 1.13–1.77) was associated with a higher odds of cancer.

Discussion

This study of adults living in 10 U.S. states suggests that most ACEs were associated with cancer risk. In adjusted models among all respondents, only having parents who were separated or divorced was not associated with cancer, which is consistent with arguments made that this specific ACE item may have become more normative over time, and thus less deleterious (Finkelhor et al., 2015). Furthermore, because divorce may, in some cases, result in removing a child from contexts in which other ACEs occur, it is not surprising that this item was not associated with cancer. This study expands on previous research

Table 1
Sample Characteristics, by Gender, BRFSS 2011 ($N = 111,964$)

Variable	All respondents ($N = 111,964$)			Women ($n = 66,752$)		Men ($n = 45,212$)	
	N	% or Mean	SE	% or Mean	SE	% or Mean	SE
Lifetime cancer diagnosis	11,747	6.00%	0.16%	7.30%	0.23%	4.69%	0.22%
Adverse childhood experiences							
Physical abuse	17,358	19.88%	0.42%	19.65%	0.52%	20.12%	0.66%
Sexual abuse	13,892	11.87%	0.29%	16.60%	0.43%	7.10%	0.39%
Emotional abuse	36,792	37.39%	0.49%	37.44%	0.62%	37.33%	0.75%
Lived with someone who was mentally ill	17,336	16.26%	0.37%	19.23%	0.52%	13.27%	0.51%
Lived with problem drinker	26,652	24.06%	0.41%	25.32%	0.53%	22.79%	0.64%
Lived with drug user	8,161	10.38%	0.31%	10.01%	0.38%	10.76%	0.49%
Parents divorced or separated	21,573	25.49%	0.44%	25.71%	0.56%	25.27%	0.68%
Adults in household treated each other violently	16,525	18.39%	0.40%	18.91%	0.50%	17.86%	0.62%
Age	111,964	46.02	0.18	47.05	0.25	44.98	0.27
Women	66,752	50.26%	0.50%	–	–	–	–
Race							
White	99,331	62.74%	0.53%	64.12%	0.68%	61.35%	0.83%
Black	2,033	3.22%	0.16%	3.09%	0.21%	3.35%	0.25%
Latino	4,703	22.56%	0.49%	22.66%	0.63%	22.45%	0.76%
Asian	1,453	8.13%	0.43%	7.27%	0.53%	9.00%	0.68%
Other	4,444	3.35%	0.16%	2.86%	0.17%	3.85%	0.28%
Educational attainment (y)	111,964	13.08	0.03	13.09	0.04	13.07	0.05
Ever smoked cigarettes	51,957	39.96%	0.47%	33.76%	0.54%	46.22%	0.76%
State of residence							
California	9,090	58.10%	0.34%	57.90%	0.49%	58.30%	0.62%
Maine	3,440	1.18%	0.02%	1.19%	0.03%	1.17%	0.05%
Minnesota	21,460	8.84%	0.12%	8.95%	0.17%	8.72%	0.21%
Montana	16,057	1.71%	0.03%	1.73%	0.04%	1.69%	0.05%
Nebraska	9,127	3.15%	0.05%	3.21%	0.08%	3.09%	0.09%
Nevada	3,510	2.09%	0.06%	2.01%	0.08%	2.09%	0.10%
Oregon	4,013	3.12%	0.07%	3.21%	0.10%	3.03%	0.12%
Vermont	11,999	1.14%	0.02%	1.16%	0.03%	1.12%	0.03%
Washington	25,360	11.56%	0.13%	11.61%	0.20%	11.50%	0.20%
Wisconsin	7,908	9.15%	0.17%	9.03%	0.26%	9.28%	0.32%

showing an association between ACEs and cancer, by demonstrating that summing items into a scale or creating categorical measures of ACEs (i.e., some ACEs versus no ACEs) obscures the relative importance of individual experiences.

Importantly, unadjusted models showed that only two ACEs were associated with cancer (i.e., sexual abuse and having parents who were separated or divorced) among all participants. Having parents who were separated or divorced was related to a lower odds of cancer. This seemingly "protective" effect was also seen in unadjusted models for men and women. Also, in unadjusted models for men, four ACE items were associated with a lower odds of cancer (living with a problem drinker, living with a drug user, living with parents who were separated or divorced, and living in a household where adults treated each other violently). However, adjusting for age rendered these "protective" effects null or reversed their direction, suggesting that age may influence recall of adversity or that people who live into later life with a history of ACEs are different than those who do not.

There are several hypothesized behavioral and socioeconomic pathways by which abuse may increase cancer risk. Child abuse has been associated with higher rates of risky health behaviors (Kendall-Tackett, 2002) as a means of self-medicating (Repetti, Taylor, & Seeman, 2002). For example, child abuse has been associated with increased use of cigarette smoking (Alcalá, von Ehrenstein, et al., 2016), a well-established cause of cancer (Sasco, Secretan, & Straif, 2004). Similarly, women who experience sexual or physical abuse have a lower odds of being compliant with cervical cancer screening guidelines (Alcalá, Mitchell, et al., 2016), suggesting that abused individuals eschew services that can detect and treat precancerous lesions. Also, as other investigators have argued, ACEs can also influence risk for cancer by leading to lower socioeconomic status (Alcalá,

Table 2
Unadjusted Odds Ratios for the Association between ACEs and Cancer, by Gender, BRFSS 2011 ($N = 111,964$)

Variable	Model 1: All ($N = 111,964$)	Model 2: Women ($n = 66,752$)	Model 3: Men ($n = 45,212$)
	OR 95% CI	OR 95% CI	OR 95% CI
Physical abuse	0.99 (0.84–1.16)	1.06 (0.89–1.27)	0.89 (0.66–1.21)
Sexual abuse	1.53 (1.30–1.81)	1.44 (1.21–1.70)	1.27 (0.78–2.06)
Emotional abuse	0.95 (0.84–1.07)	0.96 (0.83–1.11)	0.93 (0.74–1.16)
Lived with someone who was mentally ill	0.96 (0.82–1.13)	0.96 (0.81–1.14)	0.83 (0.57–1.20)
Lived with problem drinker	1.08 (0.95–1.23)	1.28 (1.09–1.49)	0.76 (0.62–0.94)
Lived with drug user	0.85 (0.69–1.06)	1.09 (0.85–1.40)	0.56 (0.36–0.87)
Parents divorced or separated	0.77 (0.65–0.89)	0.82 (0.69–0.97)	0.69 (0.51–0.92)
Adults in household treated each other violently	0.91 (0.78–1.06)	1.00 (0.83–1.21)	0.75 (0.58–0.97)

Table 3
Adjusted Odds Ratios for the Association between ACEs and Cancer, by Gender, BRFSS 2011 ($N = 111,964$)

Variable	Model 1: All ($N = 111,964$)	Model 2: Women ($n = 66,752$)	Model 3: Men ($n = 45,212$)
	AOR 95% CI	AOR 95% CI	AOR 95% CI
Physical abuse	1.31 (1.11–1.55)	1.35 (1.12–1.63)	1.22 (0.89–1.67)
Sexual abuse	1.63 (1.36–1.94)	1.49 (1.25–1.78)	1.34 (0.78–2.29)
Emotional abuse	1.34 (1.18–1.53)	1.27 (1.09–1.48)	1.41 (1.13–1.77)
Lived with someone who was mentally ill	1.36 (1.14–1.61)	1.26 (1.05–1.51)	1.26 (0.85–1.88)
Lived with problem drinker	1.22 (1.07–1.40)	1.34 (1.13–1.59)	0.93 (0.74–1.17)
Lived with drug user	1.52 (1.21–1.91)	1.68 (1.29–2.19)	1.19 (0.76–1.88)
Parents divorced or separated	1.08 (0.92–1.27)	1.05 (0.87–1.27)	1.10 (0.81–1.47)
Adults in household treated each other violently	1.19 (1.02–1.40)	1.25 (1.03–1.52)	1.03 (0.78–1.34)

All models additionally control for age, race, educational attainment, lifetime smoking, and state of residence.

2016; Fuller-Thomson et al., 2009). Thus far, ACEs have been associated with lower educational attainment (Boden, Horwood, & Fergusson, 2007), higher unemployment, and lower earnings (Currie & Spatz Widom, 2010). Lower socioeconomic status has been associated with an increased incidence of certain types of cancers (Clegg et al., 2009) and may lead to delayed detection and clinical resolution (Rodday et al., 2015). Moreover, socioeconomic disadvantage relates to occupations with higher levels of carcinogens such as asbestos, silica, ultraviolet radiation from the sun, and diesel exhaust (Rushton et al., 2012).

There are also potential biological pathways by which ACEs can increase risk for cancer. Experiences of adversity can lead to altered biological stress response, suppressed immune function, exaggerated inflammatory responses, and epigenetic changes (Kelly-Irving, Mabile, Grosclaude, Lang, & Delpierre, 2013). At the cellular level, available evidence suggest that exposure to violence during childhood is associated with increased rates of cellular aging (as measured by erosion of telomeres; Shalev et al., 2013), which may reduce a cell's ability to repair damage that can lead to cancer initiation and progression. More broadly, exposure to chronic stressors like ACEs have been related to abnormal levels of stress hormones (i.e., norepinephrine and epinephrine), which stimulate the growth of blood vessels and promote both cell migration and invasion (Moreno-Smith, Lutgendorf, & Sood, 2010). These processes are critical for the growth of cancerous cells. Also, as noted, sexual abuse may involve exposure to viruses that are linked to cancers. Although we had no data to examine the potentially underlying biological mechanisms in the present study, only sexual abuse is likely to trigger all of the suggested pathways, which may explain the relative strength of this association compared with all other ACE items.

In addition, the present study suggests gender differences in the impact of ACEs. All but one ACE item (having parents who were separated or divorced) was associated with increased odds of cancer among women. Among men, only emotional abuse was associated with an increased odds of cancer. Two different hypothesized reasons explaining the observed gender differences exist: differential exposure and differential vulnerability (Denton, Prus, & Walters, 2004). In the context of sexual abuse, both mechanisms are likely involved. First, because women report equal or higher rates of childhood sexual abuse relative to men, women are at greater risk of exposure. Also, women report greater intensity of sexual abuse than men (Ullman & Filipas, 2005). Second, because women are at risk for one of the most common virally associated cancers (i.e., cervical cancer) women are also more susceptible to the potentially carcinogenic impacts of sexual abuse than men. This vulnerability can be amplified by gender-specific patterns of responses and reactions to sexual abuse. Namely, female survivors of sexual abuse report greater rates of distress, self-blame, intrusive thoughts, hyperarousal, sexual anxiety, personal vulnerability, and perceiving the world as a dangerous place after abuse than do men (Feiring, Taska, & Lewis, 1999; Ullman & Filipas, 2005). However, additional research is needed to examine the gender-specific burden and impact of other ACEs, in order to understand why ACEs seem to be more harmful for women than men.

This study has several limitations to consider when interpreting results. Owing to the cross-sectional nature of the study, the timing of events is based on recall. However, reverse causality is unlikely because ACEs will typically precede cancer, a disease frequently manifesting later in life. However, the data did not allow us to determine when a respondent was diagnosed with cancer, which limits our ability to exclude cases in which cancer preceded adversity. We cannot exclude the possibility of recall bias, such that cancer cases overreport ACEs; however, owing to the long latency and relative rarity of cancer, large-scale prospective studies that would prevent such bias have not been conducted to date. The BRFSS is designed to be representative of the underlying population, but nonresponse bias has been a reported problem (Schneider, Clark, Rakowski, & Lapane, 2012). In addition, ACEs measures included in the BRFSS are limited. More detailed information about the context of ACEs would have been useful, including who the abuser was and the age at which the ACE experienced occurred. Relatedly, information about the greater childhood context (i.e., childhood socioeconomic status) is important, but unavailable in the BRFSS. Also, given the nature of the BRFSS data, no site-specific analyses of cancer can be undertaken, outside of skin cancer. As such, all non–skin cancer conditions were treated as identical and interchangeable. This is certainly not the case. Cancer is a very heterogeneous disease (Tu, 2010) that has a variety of causes, courses, and treatment options.

Implications for Practice and/or Policy

Limitations notwithstanding, this large study representing a diverse selection of U.S. states suggests that ACEs may not be equally detrimental for both genders. Efforts to mitigate the impact of ACEs should keep these disparities in mind. For example, recent research has shown that women who are victims of sexual abuse as children are less likely to be currently compliant with cervical cancer screening recommendations (Alcalá, Mitchell, et al., 2016). As a result, women who are survivors of sexual abuse may be targeted with interventions aimed to increase compliance with screening recommendations. Because cervical cancer screening may be invasive and traumatizing for women, clinicians may offer women who are refusing

Pap smears the option to self-collect human papilloma virus specimens (Garcia, Lothamer, & Mitchell, 2016). Also, because women seem to be more negatively impacted by the consequences of ACEs, agencies that deal with populations with a high-risk for ACEs, like Child Protective Services, should consider providing targeted services for girls that both help them deal with trauma and alter patterns of risky health behaviors.

References

Afifi, T. O., MacMillan, H. L., Boyle, M., Cheung, K., Taillieu, T., Turner, S., & Sareen, J. (2016). Child abuse and physical health in adulthood. *Health Reports*, 27(3), 10.

Alcalá, H. E. (2014). Differential mental health impact of cancer across racial/ethnic groups: Findings from a population-based study in California. *BMC Public Health*, 14, 930.

Alcalá, H. E. (2016). Making the connection between child abuse and cancer: Definitional, methodological, and theoretical issues. *Social Theory & Health*, 14(4), 458–474.

Alcalá, H. E., Keim-Malpass, J., & Mitchell, E. (2017). Colorectal cancer screening and adverse childhood experiences: Which adversities matter? *Child Abuse & Neglect*, 69, 145–150.

Alcalá, H. E., Mitchell, E., & Keim-Malpass, J. (2016a). Adverse childhood experiences and cervical cancer screening. *Journal of Women's Health*, 26, 58–63.

Alcalá, H. E., von Ehrenstein, O. S., & Tomiyama, A. J. (2016b). Adverse childhood experiences and use of cigarettes and smokeless tobacco products. *Journal of Community Health*, 41, 1–8.

Behavioral Risk Factor Surveillance System (BRFSS). (2013a). *2011 Summary Data Quality Report* (5th ed.) Bethesda: Centers for Disease Control and Prevention.

Behavioral Risk Factor Surveillance System (BRFSS). (2013b). *Weighting the data (2011 weighting formula)*. Available: http://www.cdc.gov/brfss/annual_data/2011/2011_weighting.htm. Accessed: May 9, 2016.

Boden, J. M., Horwood, L. J., & Fergusson, D. M. (2007). Exposure to childhood sexual and physical abuse and subsequent educational achievement outcomes. *Child Abuse & Neglect*, 31(10), 1101–1114.

Brown, D. W., Anda, R. F., Felitti, V. J., Edwards, V. J., Malarcher, A. M., Croft, J. B., & Giles, W. H. (2010). Adverse childhood experiences are associated with the risk of lung cancer: A prospective cohort study. *BMC Public Health*, 10, 20.

Brown, M. J., Thacker, L. R., & Cohen, S. A. (2013). Association between adverse childhood experiences and diagnosis of cancer. *PLoS One*, 8(6), e65524.

Centers for Disease Control and Prevention. (2010). Adverse childhood experiences reported by adults –- five states, 2009. *MMWR Morbidity and Mortality Weekly Reports*, 59(49), 1609–1613.

Centers for Disease Control and Prevention. (2011a). *Overview: BRFSS 2011*. Available: http://www.cdc.gov/brfss/annual_data/2011/overview_11.pdf. Accessed: May 14, 2016.

Centers for Disease Control and Prevention. (2011b). *Preparing 2011 BRFSS module data for analysis*. Available: http://www.cdc.gov/brfss/annual_data/2011/BRFSS2011_Analysis.pdf. Accessed: May 9, 2016.

Clegg, L. X., Reichman, M. E., Miller, B. A., Hankey, B. F., Singh, G. K., Lin, Y. D., … Edwards, B. K. (2009). Impact of socioeconomic status on cancer incidence and stage at diagnosis: Selected findings from the surveillance, epidemiology, and end results: National Longitudinal Mortality Study. *Cancer Causes & Control*, 20(4), 417–435.

Coker, A. L., Hopenhayn, C., DeSimone, C. P., Bush, H. M., & Crofford, L. (2009). Violence against women raises risk of cervical cancer. *Journal of Womens Health (Larchmont)*, 18(8), 1179–1185.

Currie, J., & Spatz Widom, C. (2010). Long-Term consequences of child abuse and neglect on adult economic well-being. *Child Maltreatment*, 15(2), 111–120.

Denton, M., Prus, S., & Walters, V. (2004). Gender differences in health: A Canadian study of the psychosocial, structural and behavioural determinants of health. *Social Science & Medicine*, 58(12), 2585–2600.

Engels, E. A., Biggar, R. J., Hall, H. I., Cross, H., Crutchfield, A., Finch, J. L., … Goedert, J. J. (2008). Cancer risk in people infected with human immunodeficiency virus in the United States. *International Journal of Cancer*, 123(1), 187–194.

Feiring, C., Taska, L., & Lewis, M. (1999). Age and gender differences in children's and adolescents' adaptation to sexual abuse. *Child Abuse & Neglect*, 23(2), 115–128.

Felitti, V. J., Anda, R. F., Nordenberg, D., Williamson, D. F., Spitz, A. M., Edwards, V., … Marks, J. S. (1998). Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults. The Adverse Childhood Experiences (ACE) Study. *American Journal of Preventive Medicine*, 14(4), 245–258.

Finkelhor, D., Shattuck, A., Turner, H., & Hamby, S. (2015). A revised inventory of Adverse Childhood Experiences. *Child Abuse and Neglect*, 48, 13–21.

Ford, D. C., Merrick, M. T., Parks, S. E., Breiding, M. J., Gilbert, L. K., Edwards, V. J., … Thompson, W. W. (2014). Examination of the factorial structure of adverse childhood experiences and recommendations for three subscale scores. *Psychology of Violence*, 4(4), 432–444.

Fuller-Thomson, E., Bottoms, J., & Brennenstuhl, S. (2009). Making a link between childhood physical abuse and cancer: Results from a regional representative survey. *Cancer*, 115(14), 3341–3350.

Garcia, C., Lothamer, H., & Mitchell, E. M. (2016). Provider-identified barriers to cervical cancer screening and perceptions toward self-collection of human papillomavirus in southwest Virginia. *Public Health Nursing*, 33(6), 539–546.

Gilbert, R., Widom, C. S., Browne, K., Fergusson, D., Webb, E., & Janson, S. (2009). Burden and consequences of child maltreatment in high-income countries. *Lancet*, 373(9657), 68–81.

Hughes, K., Hardcastle, K., & Bellis, M. A. (2016). 286 The impact of adverse childhood experiences on health: A systematic review and meta-analysis. *Injury Prevention*, 22(Suppl 2), A105.

Iniguez, K. C., & Stankowski, R. V. (2016). Adverse child experiences and health in adulthood in a rural population-based sample. *Clinical Medicine & Research*, 14, 126–137.

Kelly-Irving, M., Mabile, L., Grosclaude, P., Lang, T., & Delpierre, C. (2013). The embodiment of adverse childhood experiences and cancer development: Potential biological mechanisms and pathways across the life course. *International Journal of Public Health*, 58(1), 3–11.

Kendall-Tackett, K. (2002). The health effects of childhood abuse: Four pathways by which abuse can influence health. *Child Abuse and Neglect*, 26(6-7), 715–729.

Lindegren, M. L., Hanson, I. C., Hammett, T. A., Beil, J., Fleming, P. L., & Ward, J. W. (1998). Sexual abuse of children: Intersection with the HIV epidemic. *Pediatrics*, 102(4), E46.

Lindert, J., von Ehrenstein, O. S., Grashow, R., Gal, G., Braehler, E., & Weisskopf, M. G. (2014). Sexual and physical abuse in childhood is associated with depression and anxiety over the life course: Systematic review and meta-analysis. *International Journal of Public Health*, 59(2), 359–372.

Llabre, M. M., Scneiderman, N., Gallo, L. C., Arguelles, W., Daviglus, M. L., Gonzalez, F., 2nd, … Penedo, F. J. (2017). Childhood trauma and adult risk factors and disease in Hispanics/Latinos in the US: Results from the Hispanic Community Health Study/Study of Latinos (HCHS/SOL) Sociocultural Ancillary Study. *Psychosomatic Medicine*, 79(2), 172–180.

Maniglio, R. (2009). The impact of child sexual abuse on health: A systematic review of reviews. *Clinical Psychology Review*, 29(7), 647–657.

Moreno-Smith, M., Lutgendorf, S. K., & Sood, A. K. (2010). Impact of stress on cancer metastasis. *Future Oncology (London, England)*, 6(12), 1863–1881.

Morton, P. M., Schafer, M. H., & Ferraro, K. F. (2012). Does childhood misfortune increase cancer risk in adulthood? *Journal of Aging and Health*, 24(6), 948–984.

Murphy, A., Steele, M., Dube, S. R., Bate, J., Bonuck, K., Meissner, P., … Steele, H. (2014). Adverse childhood experiences (ACEs) questionnaire and adult attachment interview (AAI): Implications for parent child relationships. *Child Abuse & Neglect*, 38(2), 224–233.

Repetti, R. L., Taylor, S. E., & Seeman, T. E. (2002). Risky families: Family social environments and the mental and physical health of offspring. *Psychological Bulletin*, 128(2), 330–366.

Rodday, A. M., Parsons, S. K., Snyder, F., Simon, M. A., Llanos, A. A., Warren-Mears, V., … Freund, K. M. (2015). Impact of patient navigation in eliminating economic disparities in cancer care. *Cancer*, 121(22), 4025–4034.

Rogstad, K. E., Wilkinson, D., & Robinson, A. (2016). Sexually transmitted infections in children as a marker of child sexual abuse and direction of future research. *Current Opinion in Infectious Diseases*, 29(1), 41–44.

Rohde, P., Ichikawa, L., Simon, G. E., Ludman, E. J., Linde, J. A., Jeffery, R. W., & Operskalski, B. H. (2008). Associations of child sexual and physical abuse with obesity and depression in middle-aged women. *Child Abuse & Neglect*, 32(9), 878–887.

Rushton, L., Hutchings, S. J., Fortunato, L., Young, C., Evans, G. S., Brown, T., … Van Tongeren, M. (2012). Occupational cancer burden in Great Britain. *British Journal of Cancer*, 107(Suppl 1), S3–7.

Sasco, A. J., Secretan, M. B., & Straif, K. (2004). Tobacco smoking and cancer: A brief review of recent epidemiological evidence. *Lung Cancer*, 45(Suppl 2), S3–S9.

Schneider, K. L., Clark, M. A., Rakowski, W., & Lapane, K. L. (2012). Evaluating the impact of non-response bias in the Behavioral Risk Factor Surveillance System (BRFSS). *Journal of Epidemiology and Community Health*, 66(4), 290–295.

Shalev, I., Moffitt, T. E., Sugden, K., Williams, B., Houts, R. M., Danese, A., … Caspi, A. (2013). Exposure to violence during childhood is associated with telomere erosion from 5 to 10 years of age: A longitudinal study. *Molecular Psychiatry*, 18(5), 576–581.

Springer, K. W., Sheridan, J., Kuo, D., & Carnes, M. (2007). Long-term physical and mental health consequences of childhood physical abuse: Results from a large population-based sample of men and women. *Child Abuse & Neglect*, 31(5), 517–530.

Tu, S.-M. (2010). *Heterogeneity of cancer. In: Origin of cancers*. New York: Springer, 129–136.

U.S. Department of Health & Human Services. (2012). *Child maltreatment 2012*. Available: http://www.acf.hhs.gov/sites/default/files/cb/cm2012.pdf. Accessed: May 10, 2016.

Ullman, S. E., & Filipas, H. H. (2005). Gender differences in social reactions to abuse disclosures, post-abuse coping, and PTSD of child sexual abuse survivors. *Child Abuse & Neglect*, 29(7), 767–782.

Walboomers, J. M. M., Jacobs, M. V., Manos, M. M., Bosch, F. X., Kummer, J. A., Shah, K. V., … Muñoz, N. (1999). Human papillomavirus is a necessary cause of invasive cervical cancer worldwide. *Journal of Pathology*, 189(1), 12–19.

Wingenfeld, K., Schafer, I., Terfehr, K., Grabski, H., Driessen, M., Grabe, H., … Spitzer, C. (2011). The reliable, valid and economic assessment of early traumatization: first psychometric characteristics of the German version of the Adverse Childhood Experiences Questionnaire (ACE). *Psychotherapie, Psychosomatik, medizinische Psychologie*, 61(1), e10–14.

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