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Adverse Childhood Experiences and Cigarette Smoking: Demographic Moderators

Taylor Cosanella
tcosanella@student.llu.edu

LOMA LINDA UNIVERSITY
School of Behavioral Health
in conjunction with the
Department of Psychology

Adverse Childhood Experiences and Cigarette Smoking: Demographic Moderators

by

Taylor Cosanella

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Each person whose signature appears below certifies that this project in his/her opinion is adequate, in scope and quality, as a project for the degree Doctor of Psychology.

Holly E.R. Morrell, Associate Professor of Psychology, Chairperson

Cameron L. Neece, Associate Professor of Psychology

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ABBREVIATIONS

ACE	Adverse Childhood Experiences
BRFSS	Behavioral Risk Factor Surveillance System
CDC	Centers for Disease Control and Prevention
CI	Confidence Interval
DSM	Diagnostic and Statistical Manual for Mental Disorders
GED	General Education Development
HIV	Human Immunodeficiency Virus
HMO	Health Maintenance Organization
HPA	Hypothalamic-Pituitary-Adrenal
OR	Odds Ratio
SES	Socioeconomic Status

ABSTRACT OF THE DOCTORAL PROJECT

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by

Taylor Cosanella

Doctor of Psychology, Graduate Program in Psychology
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Dr. Holly E.R. Morrell, Chairperson

Research suggests that there is a dose-response relationship between ACE score and cigarette smoking, such that as ACE score increases, so does smoking behavior, but little is known about what factors moderate this relationship. Therefore, the goal of this study was to examine demographic characteristics as potential moderators of relationship between Adverse Childhood Experiences (ACEs) and cigarette smoking. A secondary data analysis was conducted using the 2013 California Behavioral Risk Factor Surveillance System data. The sample included 2,604 U.S. adults (54.8% female; Age: *M* = 53.3, *SD* = 8.10; 83.6%; Caucasian, 6.4% Asian, 5.9% Black or African American, 3.1% American Indian or Alaska Native, and 0.6% other, and 0.2% Native Hawaiian or other Pacific Islander). We used multinomial logistic regression to test sex, race, socioeconomic status, and education as moderators of the relationship between ACE score and smoking. Sex, race, education, and income were significantly and independently associated with smoking outcomes. Men, individuals with lower income and education, and certain ethnic/racial groups reported greater odds of smoking. No interactions between ACE score and sex, race, education, or income significantly predicted smoking outcomes. ACEs were not significantly associated with smoking behavior. Results suggest that the relationship between ACEs and smoking later in life

does not depend on basic demographic features. Knowing which populations are more vulnerable to smoking can help clinicians better assess and tailor interventions to meet the needs of their patients by using culturally sensitive interventions and obtaining resources to help improve treatment access, motivation, and success.

CHAPTER ONE

INTRODUCTION

According to the Centers for Disease Control and Prevention, chronic diseases cause seven out of 10 deaths each year. About half of all adults had one or more chronic diseases in 2012 (Ward, Schiller, & Goodman, 2014). Many adults engage in unhealthy lifestyle behaviors that are related to the development and progression of chronic diseases. For example, 15.1% of all adults were current cigarette smokers in 2015, with nearly 2,100 youth and young adults becoming regular cigarette smokers each day (Jamal et al., 2016; U.S. Department of Health and Human Services, 2014). With numbers so large and being pertinent to so many individuals, the epidemic of chronic diseases is a significant public health issue.

Recently, this public health problem has been conceptualized through the framework of Adverse Childhood Experiences (ACEs; for example, child abuse and parental incarceration), as studies show that people who have experienced one or more ACEs are at a higher risk of developing chronic diseases (Campbell, Walker, & Egede, 2016; Felitti et al., 1998; Monnat & Chandler, 2015). Some of the diseases ACEs have been associated with are coronary heart disease, stroke, diabetes, cancer, lung disease, and liver disease (Brown et al., 2010; Brown et al., 2013; Campbell et al., 2016; Dong, Dube, Felitti, Giles, & Anda, 2003).

Similarly, unhealthy lifestyle behaviors put people at risk for developing these same chronic diseases. There is a lot of research that demonstrates the value of healthy lifestyle behaviors and the health benefits people gain from consistent exercise, a healthy diet, and other positive health behaviors (Ford, Bergmann, Boeing, Li, & Capewell, 2012;

Hertzog, Kramer, Wilson, & Lindenberger, 2008). Despite the knowledge of these positive health benefits, people continue to engage in unhealthy behaviors that put their health at risk. The association between ACEs and high risk behaviors, including smoking, substance use, alcoholism, and high risk sexual behavior, is evident throughout research (Allem, Soto, Baezconde-Garbanati, & Unger, 2015; Anda et al., 2002; Bellis et al., 2014; Campbell et al., 2016; Ramiro, Madrid, & Brown, 2010).

When discussing the profound influence of ACEs on physical and mental health outcomes, Anda and colleagues raised an important question about a common risky behavior that is associated with ACEs: smoking. Health outcomes of smoking are very similar to that of ACEs, including heart disease, diabetes, stroke, lung and liver problems, and more (Anda, Butchart, Felitti, & Brown, 2010; Campbell et al., 2016; U.S. Department of Health and Human Services, 2014). Despite well-publicized knowledge about poor health outcomes, people continue to smoke. Some researchers describe why people may continue to engage in risky behavior despite the bad health outcomes, such as to alleviate negative affect. One example of this is with smoking and depression, as they are highly related and researchers argue that smoking possibly functions as a coping mechanism (Anda et al., 2010). With this known association, a new question arises. Who is most vulnerable to developing maladaptive coping strategies, such as smoking? The ACE framework may provide insight to this phenomenon.

ACEs provide a framework that describes "a common pathway to social, emotional, and cognitive impairments that lead to increased risk of unhealthy behaviors, violence or revictimization, disease, disability, and premature mortality" (Anda et al., 2010, p. 95). Understanding which individuals are at the most risk for these outcomes

could help prevention efforts, allowing clinicians to properly assess for risk factors and target intervention towards those who are the most vulnerable. The aim of the current study is to test if the relationship between ACEs and smoking status (whether one is a current, former, or never smoker) is different depending on sex, race, socioeconomic status (SES), and education in order to help clinicians delineate which populations are most at risk to start smoking. It is hypothesized there will be a positive relationship between ACE score and smoking, such that higher ACE scores will be associated with current and former smoking, and that this relationship will be stronger for females, those with low SES, and those with low education levels. The hypothesis determining whether or not the relationship between ACEs and current smoking depends on race will be left exploratory.

Adverse Childhood Experiences

The ACE Study

From 1995 to 1997, a study was conducted through the CDC and Kaiser Permanente where over 17,000 HMO members completed a confidential survey regarding their childhood experiences, current health status, and health behaviors (Felitti et al., 1998). In this study, ACEs were defined as childhood exposure to abuse and household dysfunction. Childhood abuse had three categories: psychological, physical, and sexual abuse. Household dysfunction had four categories, including parental substance abuse, mental illness, domestic violence (against the mother), and parent incarceration (Felitti et al., 1998). Number of ACEs were summed to yield a total score

for each participant, ranging from zero to seven.

The findings of this study revealed strong associations not only between ACE score and chronic disease and risky health behavior, but also in simple prevalence rates. Only 36.1% of participants reported having zero ACEs, meaning that nearly two thirds of the study participants reported experiencing at least one ACE. Of the study sample, 12.5% reported experiencing four or more ACEs. A more recent survey conducted through the CDC's Brief Risk Factor Surveillance System (BRFSS) in 2010 produced similar findings. This survey covered ten states and Washington DC, with over 53,000 participants. Nearly 60% of participants reported at least one ACE, with 14.3% reporting four or more ACEs (Centers for Disease Control and Prevention, 2015). These numbers represent a high incidence rate of these negative childhood experiences.

Outcomes of ACEs

With so many individuals experiencing adverse childhood events, it is important to understand the detrimental effects they can have on the body, and how this can lead to maladaptive coping. Stress is a trademark feature of ACEs. The stress experienced by children living in an unsafe home can be categorized as chronic and unpredictable, where the stress response system is activated for prolonged periods of time and often in the absence of supportive, calming relationships (Nakazawa, 2015; Toxic Stress, n.d.). For example, an abusive, alcoholic parent may lead a child to live in constant stress because that parent's mood may constantly change. A child living in this environment may be on constant alert, living with chronic stress for survival purposes throughout their childhood. This example also illustrates the comorbid nature of ACEs; they often occur together,

which can lead to a higher ACE score (Anda et al., 1999). It is important to understand the implications of toxic stress and how it can lead to negative behavioral patterns and poorer psychological well-being.

Stress Response and Other Brain Changes

There is a large body of literature that outlines the neurobiological effects of adverse events on the brain. Some research suggests that toxic stress leads to changes in neural networks and brain structure that alter brain function (Anda et al., 2006). Researchers have extensively examined the impact of early stress on the developing brain. The hypothalamic-pituitary-adrenal (HPA) axis is a collection of endocrine and neural structures that facilitate the body's adaptive response to stress (Gillespie, Phifer, Bradley, & Ressler, 2009). In childhood, the HPA axis is still developing, and healthy maturation is influenced by the safety children experience in day to day life (Nakazawa, 2015). Exposure to stressful events in childhood has been shown to produce enduring alterations in the HPA axis (Gillespie et al., 2009). These alterations influence a child's perception, as he or she becomes less able to distinguish threatening from nonthreatening environmental stimuli (Gillespie et al., 2009). When a child is in a constant state of anxiety or hyperarousal, the stress axis is stimulated over and over again, becoming continuously flooded with inflammatory stress neurochemicals (Nakazawa, 2015). Dysregulation of this system can lead to increased levels of cortisol and norepinephrine in children, as well as stress-induced cortisol in adults (Anda et al., 2006). The early experience of stress may beget a lifetime of disadvantage, including mood and anxiety disorders, rendering a person sensitized to stress through the altered functioning of the

HPA axis (Gillespie & Nemeroff, 2007).

Research connects this chronic HPA axis dysregulation in childhood to changes in the stress response function and the brain's neural circuits in adulthood (Gillespie et al., 2009). A review was conducted that suggested that childhood trauma is associated with altered dynamics of the HPA axis and persistent sensitization of the stress response, which in turn are related to depression (Heim, Newport, Mletzko, Miller, & Nemeroff, 2008). The authors suggest the damage of childhood trauma is located in the neural system, preventing neural networks from compensating or adapting in response to challenges, leading to exaggerated physiological responses and altered behavior (Heim et al., 2008). These structural and functional changes in the brain as a result of adverse childhood events, in turn, render a person more susceptible to poor mental and behavioral outcomes.

Social, Emotional, and Cognitive Impairment

The impact of ACEs and a dysregulated stress response can lead to a range of adverse outcomes in the social, emotional, and cognitive domains. Anda et al. (2006) found a strong, graded relationship between ACE score and number of affective disturbances, such as panic reactions, depressed affect, anxiety, and hallucinations. Results of this study show that having an ACE score of four or more compared to having an ACE score of zero significantly increases the risk of developing affective disturbances in adulthood, with the odds of depressed affect increasing by 260%, the odds of hallucinations increasing by 170%, the odds of panic reactions increasing by 150%, and the odds of anxiety increasing by 140% (Anda et al., 2006). Anda and colleagues also

observed this same relationship with perceived stress and anger, with the odds of perceived stress increasing by 120%, the odds of difficulty controlling anger increasing by 300%, and the odds of perpetrating intimate partner violence increasing by 450% for individuals with an ACE score of 4 or more compared to individuals with an ACE score of zero (Anda et al., 2006). ACEs are also associated with a number of personality disorders, such as schizotypal, antisocial, borderline, and narcissistic personality disorders (Afifi et al., 2011). These findings present a framework where ACEs change the developing brain and promote disturbed schemas, which can lead to poor functioning in a variety of areas in adulthood.

There is a large body of literature that discusses the implications of childhood emotional maltreatment, abuse, and neglect in adulthood. One study examined the co-occurrence of emotional maltreatment with other types of childhood maltreatment, such as neglect, physical and sexual abuse, and domestic violence (Taillieu, Brownridge, Sareen, & Afifi, 2016). This study found that emotional maltreatment was very often comorbid with these other forms of maltreatment. The questions in the survey used in this study were pulled from the ACE questionnaire, and findings support the comorbid nature of ACEs. Furthermore, research suggests that exposure to adverse events in childhood leads to poorer outcomes in adulthood, with people developing a variety of disorders, such as a mood and anxiety disorders (Edwards, Holden, Felitti, & Anda, 2003; Taillieu et al., 2016). Findings support the ACE framework; that is, childhood adversities are often comorbid, and high numbers of adversities can lead to poorer health in adulthood.

Since the initial ACE study, research has suggested a strong association between ACE score and mental health outcomes. More specifically, as ACE score increases, so

does a person's chance of developing mental illness in adulthood. The association between depression and ACEs is highly researched, with all studies finding a strong, graded relationship between ACEs and depression outcomes, such that with an ACE score of four or more, the odds of developing depression increases two to five times compared to an ACE score of zero (Almuneef et al., 2016, Anda et al., 2002; Anda et al., 2006; Campbell et al., 2016; Chapman et al., 2004; Ramiro et al., 2010; Remigio-Baker, Hayes, & Reyes-Salvail, 2014; Sinnott, Mc Hugh, Fitzgerald, Bradley, & Kearney, 2015). The same is true for anxiety, with the odds of anxiety increasing two to four times with an ACE score of four or more compared to an ACE score of zero, and is true of populations both in the United States and internationally (Almuneef et al., 2016; Anda et al., 2006; Anda et al., 2010; Sinnot et al., 2015). One study found a dose-response increase in prescription rates of antidepressant and anxiolytic drugs as ACE score increased, showing the burden that ACEs have on adult mental illness (Anda et al., 2007).

Research also suggests that higher ACE scores are associated with a greater risk of suicide attempts. Specifically, the odds of making a suicide attempt increase by 2,300% as the number of ACEs reaches four or more (Ramiro et al., 2010). ACEs are also associated with Post-Traumatic Stress Disorder and other stress related symptomatology, with the odds of developing PTSD increasing by 200% to 500% with an ACE score of three or higher compared to lower ACE scores (Anda et al., 2010; Brockie, Dana-Sacco, Wallen, Wilcox, & Campbell, 2015; Schalinski et al., 2016).

Examining ACEs from a cognitive and social standpoint, it is known that trauma and negative experiences can have a huge impact on adult functioning. As discussed, trauma is associated with the development of negative self-schemas, such as shame and

guilt. Children obtain their sense of self-worth from their caregivers, learning rules, standards, and emotion regulation from them as they grow up (Matos, Pinto-Gouveia, & Duarte, 2013). Given that much of what occurs in the home happens behind closed doors, children may not always fully understand or know when they are growing up in an abusive and unsafe environment because they have no way of knowing the difference. Parents are a source of security for children, and the home is supposed to be a safe space, making it easy for children to accept a caregivers' words without questioning them (Nakazawa, 2015). Consider a child who grows up in a home where he or she is constantly criticized and humiliated. Parents can instill detrimental core beliefs in their children that can influence self-concept and later identity development. This can greatly impact the child's cognitive development, as when insecure attachment develops, the critical neural interconnections that help create loving, secure relationships are not formed. Insecurely attached children are also less likely to seek out healthy relationships later in life (Colozino, 2006).

The experience of ACEs and their outcomes may differ depending on an individual's sex and race. For example, based on prevalence numbers, females are more likely to experience certain categories of ACEs than men, such as sexual abuse, possibly leading to higher ACE scores and different adult health outcomes for women (Centers for Disease Control and Prevention, 2015). Culturally, children of some races may be more likely to be born into disadvantaged environments where they experience greater of levels of stress and discrimination, thus exposing them to more ACEs (Drake & Rank, 2009; Drake & Pandey, 1996; Johnson-Reid, Drake, & Zhou, 2012). Similarly, some cultures may be more likely to use corporal punishment with differing severities as a parenting

strategy, a practice that research shows puts children at a higher risk for physical abuse (Fréchette, Zoratti, & Romano, 2015; Lapré & Marsee, 2016).

Socioeconomic status and education can also influence an individual's chances of experiencing ACEs. Research suggests that people of lower SES are more susceptible to ACEs (Halonen et al., 2014; Wade et al., 2016). Low SES can limit resources, possibly influencing other factors such as parenting stress, which in turn may increase the likelihood of ACEs for children (Steele et al., 2016). All of these demographic qualities can influence a person's general functioning, possibly reducing his or her chances of completing higher education. Low education can be a risk factor for other adverse outcomes, as it has been associated with poor health, such as cardiovascular disease (Ose et al., 2014). Suicide attempts, depression and behavioral risk factors such as smoking are also associated with low education levels (Barboza Solís et al., 2015; Kim, Kim, Choi, Lee, & Park, 2016; Kraus & Karaman, 2013). Basic demographic information, as discussed, can influence people in a variety of ways, exposing them to different risk factors that may influence their ACE score and adult functioning. The stressful nature of ACEs puts many individuals in a place where they have poorer social and emotional functioning, and may develop high risk behaviors, such as substance use, as coping mechanisms.

Risky Behavioral Factors

Research suggests that ACEs put people at a higher risk of developing poor lifestyle behaviors. As ACE score increases, the odds of many health-risk behaviors increase, such as suicide attempts, drug use, early smoking initiation, current smoking,

and risky sexual behavior (Bellis, Hughes, Leckenby, Perkins, & Lowey, 2014; Ramiro et al., 2010). Campbell and colleagues (2016) found similar results in regards to smoking and risky HIV behavior, as well as a strong, graded relationship between ACE score and the presence of heavy drinking and binge drinking (Anda et al., 2002; Campbell et al., 2016). Similarly, other research suggests a difference in the number of ACEs, from 0 to 8, was associated with a 31% increased chance of marijuana use, 24% increased chance of binge-drinking, 22% increased chance of cigarette smoking, and 12% increased chance of hard drug use in emerging adults (Allem, Soto, Baezconde-Garbanati, & Unger, 2015). Potential explanations for this increase in risky behavior vary. Many researchers believe that substance use such as smoking is a coping mechanism, as many users report it alleviates stress and negative affect (Anda et al., 1999; Cameron, Reed, & Ninnemann, 2013; Johnson & McLeish, 2016; Leventhal et al., 2013). High risk behaviors such as smoking are important to consider due to the fact that engagement in many of these behaviors increases an individual's chances of developing chronic diseases. Smoking, in particular, is related to many chronic diseases, and is the leading cause of death in the United States (Jamal et al., 2016; U.S. Department of Health and Human Services, 2014).

Smoking

According to the CDC, 37.8 million U.S. adults were cigarette smokers in 2016 (Jamal et al., 2018). Cigarette smoking causes nearly one in five deaths in the United States, which translates to over 480,000 people per year (U.S. Department of Health and Human Services, 2014). With such high prevalence, understanding risk factors for smoking initiation is essential to informing prevention efforts. Sex, race, SES, and

education level can have a differing impact on smoking behavior in adulthood.

Tobacco dependence has historically been viewed as occurring through a natural progression, with the concept that nicotine dependence develops only after a period of heavy or regular smoking. DSM 5 criteria support this model, with criteria for tobacco withdrawal requiring daily tobacco use for several weeks (American Psychiatric Association, 2013; Wellman et al., 2016). However, recent research has demonstrated that dependence can manifest soon after onset in some adolescents, and that early onset may predict long-term smoking behavior (Chassin, Presson, Sherman, & Edwards, 1990; DiFranza et al., 2000; Gervais, O'Loughlin, Meshefedjian, Bancej, & Tremblay, 2006; O'Loughlin et al., 2003). In a literature review that examined the evidence of predictors of smoking onset, it was found across studies that an increased risk of smoking onset was associated with several basic demographic factors, such as increased age, lower SES, and poor academic performance (Chang, Wu, Wu, Cheng, Hurng, & Yen, 2011; Johnson & Novak, 2009; Wellman et al., 2016).

Research also indicates sex differences in tobacco use (Wellman et al., 2016). Prevalence rates of adult smokers in the United States indicate that men tend to smoke more than women, with 17.5% of men and 13.5% of women being smokers in 2016 (Jamal et al., 2018). Sex differences have also been found in regards to smoking initiation. For example, children who engage in rebellious and risk-taking behaviors are more likely engage in smoking behavior and youth who have friends who smoke have greater exposure to smoking behavior, suggesting that boys may be at a higher risk (Burt, Dinh, Peterson, & Sarason, 2000; Robinson & Klesges, 1997; Wellman et al., 2016). Rebelliousness is more common in boys and they are more likely to have friends who

smoke than girls (Robinson & Klesges, 1997), suggesting that boys may be at a higher risk. In a review examining smoking onset, seven out of ten studies found that men are at a greater risk for onset, where only three studies indicated that women are at a higher risk (Wellman et al., 2016). With regard to sex differences in smoking cessation, results are mixed (Smith, Bessette, Weinberger, Sheffer, & McKee, 2016). Treatment studies generally find that women are less likely to quit smoking, but this has been disputed, given that findings from a variety of studies have demonstrated that there are multiple biological, psychological, and social factors that influence smoking cessation outcomes (Smith et al., 2016). In general, women tend to have less dependence and are less likely to be heavy smokers, but have consistently exhibited lower quit rates, less confidence in their ability to quit, and experience more withdrawal symptoms (Perkins & Scott, 2008; Ward, Klesges, Zbikowski, Bliss, & Garvey, 1997). Overall, there are many factors related to sex that can influence smoking behavior, including cessation efforts, perceived discrimination, mental health, SES, and family and peer smoking (Allen, Scheuermann, Nollen,Hatsukami, & Ahluwalia, 2016; Broms, Koskenvuo, Sillanmäki, Mattila, & Koskenvuo, 2012; Lorenzo-Blanco, Unger, Ritt-Olson, Soto, & Baezconde-Garbanati, 2011; Wallace et al., 2009).

Smoking prevalence rates also vary across racial categories. Native Americans have the highest rates at 31.8%, followed by multiracial individuals (25.2%), Caucasians (16.6%), African Americans (16.5%), Hispanic/Latinos (10.7%) and Asian Americans (9.0%; Jamal et al., 2018). In general, studies examining smoking initiation across racial and ethnic groups show mixed results, as not all studies examined the same racial/ethnic groups; however, Caucasians commonly had higher initiation rates compared to other

racial groups (Finkenauer, Pomerleau, Snedecor, & Pomerleau, 2009; Griesler, Kandel, & Davies, 2002; Kandel, Kiros, Schaffran, & Hu, 2004; Mahabee-Gittens, et al., 2011). One study comparing Caucasian and African American children found that Caucasian children were more likely to start smoking than African American children (Harrell, Bangdiwala, Deng, Webb, & Bradley, 1998).

There are many factors associated with race that can influence smoking outcomes. People of different races may have different perceptions of smoking that are influenced by discrimination (Lorenzo-Blanco et al., 2011). Similarly, certain cultural preferences may influence smoking behavior, which can be impacted by characteristics such as race and SES (Wallace et al., 2009). For example, in a study examining acculturation, perceived discrimination, and smoking in Hispanic youth, perceived discrimination (defined as perceived daily unfair and differential treatment) influenced smoking behavior for females (Lorenzo-Blanco et al., 2011). Authors attribute this finding to Hispanic gender role expectations, suggesting that the process of acculturation increases stress and discrimination more for females. For example, females may acculturate more quickly to the less traditional model of gender roles in the United States, but Hispanic families may uphold traditional values where females have less freedom than males. Overall, these results suggest that some cultural phenomena such as gender role expectations may influence discrimination, leading to increases in smoking. In another study, musical tastes corresponded with SES, such that higher income was associated with liking classical-omnivore genres (including musicals, opera, classical, big band, folk, and Latin music). Liking for classical-omnivore genres was associated with less smoking behavior, showing that music preference may be related to smoking through

cultural tastes that differentiate SES-based group membership (Pampel, 2006). These results indicate that smoking behavior can be influenced by sociocultural preferences. All of these factors can influence the likelihood of smoking within different racial groups.

When examining national statistics, prevalence rates show that individuals whose annual income falls below the poverty line smoke far more than those above the poverty line (25.4% and 14.3% respectively; Jamal et al., 2018). Socioeconomic status, when examined by looking at income, reflects access to material resources, including those associated with healthcare and basic survival resources, such as food and housing. A useful conceptual framework linking SES and cigarette smoking describes a relationship where low SES may influence individuals' control over their own lives due to economic disadvantage (Harwood, Salsberry, Ferketich, & Wewers, 2007). In the U.S., minorities tend to come from lower SES backgrounds; for example, Drake and Rank (2009) found that African American children were more than seven times as likely to live in a high childhood poverty neighborhood compared to Caucasians. This phenomenon can lead to high levels of stress, and research suggests that for many people, smoking alleviates negative affect, including stress (Harwood et al., 2007; Wang, Chen, Gong, & Yan, 2016). Low SES is often associated with less access to healthcare and therefore to evidence-based smoking cessation treatments, possibly providing an explanation as to why there are more low SES smokers compared to individuals from a high SES background (Jamal, Does, Penninx, & Cuijpers, 2011). Many studies have also demonstrated that low SES is associated with smoking initiation (Harrell et al., 1998; Stronks, van de Mheen, Looman, & Mackenbach, 1997). State tobacco control policies and implementation, access to cigarettes in the home, parent and sibling smoking

behavior, socioeconomic disadvantage, unpopularity in school, and stress are additional factors that may the explain relationship between smoking initiation and SES (Harrell et al., 1998; Kim & Clark, 2006; Krueger, & Chang, 2008; Novak, Ahlgren, & Hammarstrom, 2007; Tjora, Hetland, Aarø, & Øverland; 2011).

Education is also associated with smoking behavior. In general, those with a lower education level smoke more than those with higher education. Prevalence rates in 2016 show that those with a GED have the highest smoking rates at (40.6%), followed by those with 12 or fewer years of education (24.1%), a high school diploma (19.7%), some college (18.9%), an Associate's degree (16.8%), a Bachelor's degree (7.7%), and a Graduate degree (4.5%; Jamal et al., 2018). In studies that examine smoking cessation, higher education is also associated with successful quit attempts (Breslau & Peterson, 1996; Fernandez et al., 2001; Lee & Kahende, 2007; Osler, Prescitt, Godtfredsen, Hein, & Schnohr, P., 1999). One study examined smoking cessation rate by education through both rate of quit attempts and success, finding that individuals with more than 12 years of education reported a greater number of quit attempts and more success in cessation compared to those with less than 12 years of education (Zhuang, Gamst, Cummins, Wolfson, & Zhu, 2015).

Based on previous literature and prevalence statistics, men; people of lower SES and education; and American Indians, African Americans, and Caucasians have the highest smoking rates. With a conceptual understanding about which populations of people are more likely to initiate smoking and who may be more successful in quitting, clinicians may be able to more accurately target treatment interventions at more vulnerable populations.

ACEs and Smoking

ACEs and smoking have consistently been related across the academic literature. In the initial ACE study, a high ACE score was associated with a higher likelihood of smoking by age 14, chronic adult smoking patterns, and the presence of smoking related disease later in life, with the odds of current smoking in individuals with an ACE score of four or more increasing by 120% compared to individuals with an ACE score of zero (Felitti et al., 1998). Since then, many studies have examined the relationship between ACE score and smoking outcomes, finding that as an individual's ACE score increases, so does his or her chances of smoking cigarettes (Allem et al., 2015; Anda et al., 1999; Anda et al., 2006; Bellis et al., 2014; Campbell et al., 2016; Dube, Felitti, Dong, Giles, & Anda, 2003; Edwards, Anda, Gu, Dube, & Felitti, 2007; Felitti et al., 1998; Ford et al., 2011; Vander Weg, 2011). These studies examined many different types of smoking behavior, from current smoking patterns to having ever smoked. Specifically, with an ACE score of four or more, the odds of smoking in adulthood increase by 80% to over 220% compared to individuals with an ACE score of zero (Anda et al., 2006; Bellis et al., 2014; Campbell et al., 2016; Ford et al., 2011; Vander Weg, 2011).

Reasons for the association between ACEs and smoking vary. Several researchers have hypothesized that adolescents with a ACE history may use nicotine to self-medicate affective disturbances or past childhood traumas (Anda et al., 1999). Not all authors agree with this statement, believing self-medication may only partially explain the relationship. They assert that other environmental and personal factors, such as the quality of parenting, self-esteem, and sadness or depression, better explain the relationship (Parrott, 2000; Reynolds, 2000). Research indicates that psychological distress, as defined by

scores on the Mental Component Summary (measuring physical and social functioning, and emotional mental health), increases as ACE score increases, and also mediates the relationship between ACEs and adult smoking in women (Strine et al., 2012). Depression has also been shown to mediate the relationship between ACE score and smoking (Walsh & Cawthon, 2014). However, given that research on ACEs and smoking is in its infancy, few other factors that may influence this relationship have been studied.

Sex

Some research suggests the relationship between various forms of trauma and smoking may differ according to sex. In a study examining smoking cessation among men and women with a history of physical and emotional abuse and serious psychological distress, it was found that women were 58% less likely to successfully quit (Smith et al., 2015). Another study found that, although negative affect was related to smoking for both men and women with a history of ACEs, the relationship was much stronger for women, putting them at a higher risk for smoking in adulthood (Strine et al., 2012). These results confirm findings from other studies suggesting that the relationship between negative affect and smoking is stronger for women than it is for men (Husky, Mazure, Paliwal, & McKee, 2008; McKee, Maciejewski, Falba, & Mazure, 2003). Research also suggests that stressful childhood life events may disproportionately effect a women's decisions to use substances (Anda et al., 1999; Dube et al., 2003; Edwards et al., 2007).

Race

There is little research that examines whether or not the relationship between ACEs and smoking depends on racial characteristics. Current studies examine racial differences using prevalence numbers based on ACE score, with many of the samples being predominately Caucasian (Bellis et al., 2014; Campbell et al., 2016; Felitti et al., 1998; Ford et al., 2011). Similarly, most studies will control for race as a potential confounding variable, rather than examine it directly (Anda et al., 1999; Campbell et al., 2016; Dube et al., 2003; Felitti et al., 1998; Ford et al., 2011). While basic smoking prevalence estimates can provide some limited insight into how the relationship between ACEs and smoking differs by race (as described above), there are important cultural and social characteristics that should be considered. For example, in a study examining substance use prevention, African Americans were exposed to more contextual risk factors, such as economic deprivation and academic failure, whereas Caucasians were exposed to more personal and interpersonal risk factors, such as sensation seeking and peer use (Wallace & Muroff, 2002). Risk factors associated with smoking initiation differed by race, perhaps due to differences in life experiences resulting from living in a society that is divided along racial lines.

Some races also have a history of discrimination against their racial group and may more likely be of lower SES. Given that discrimination can be indicative of stress and poor life circumstances, that SES statistics reveal those under the poverty line have a higher risk of smoking, and that general prevalence rates indicate that Native Americans, African Americans, and Caucasians have the highest smoking rates, it is difficult to generate consistent, evidence-based hypotheses about the influence of race on the

relationship between ACEs and smoking (Jamal et al., 2016). Therefore, additional research in this area is warranted.

Socioeconomic Status

Socioeconomic status can have a substantial impact on a person's life, as lower SES and income are often associated with having fewer resources and therefore possibly more stress (Gallo, 2009; Gallo, Bogart, Vranceanu, & Matthews, 2005). In regard to ACEs and smoking, not only does low SES possibly increase a child's risk of experiencing ACEs, but as an adult, it may be a predictor of smoking behavior (Halonen et al., 2014; Harrell et al., 1998; Stronks et al., 1997). For the purposes of this study, only current SES will be taken into consideration, as it is a factor relating to adult smoking behavior; prevalence estimates show a strong, graded relationship between low SES and cigarette smoking, as 25.3% of individuals whose income is below the poverty line smoke, compared to 14.3% above the poverty line (Jamal et al., 2018). Similarly, there is research that links childhood and adult SES. For example, individuals from low SES backgrounds often have higher unemployment rates due to substance use or may maintain low SES in adulthood due to the nature of their environment, including a lack of resources and preparedness for adult life (Conroy, Sandel, & Zuckerman, 2010; Haushofer & Fehr, 2014; Lee et al., 2015).

Education

In regard to education, research suggests that men and women with a history of ACEs are more likely to have lower educational attainment and also are more likely to

smoke (Barboza Solís et al., 2015). General prevalence numbers suggest that those with a lower education are more likely to smoke cigarettes as well (Jamal et al., 2018). These findings suggest that the relationship between ACE's and cigarette smoking in adulthood may differ by education level.

The Current Study

The aim of the current study is to test whether the relationship between Adverse Childhood Experiences (ACEs) and current smoking is different depending on sex, race, SES, and education. Past research studies have not examined whether or not demographic characteristics help impact the relationship between ACEs and smoking in adulthood; therefore, the results of this study may provide valuable new information by which to inform assessment and intervention. It is not reasonable to assume that individuals from different backgrounds are exposed and vulnerable to the same risk factors, and this assumption could lead to poorly targeted prevention efforts. Therefore, knowing which factors impact the relationship between ACEs and smoking can inform treatment and intervention by identifying populations that are more vulnerable to developing smoking behaviors after experiencing ACEs. With this information, clinicians can more accurately assess and treat vulnerable populations.

Research posits that women have lower quit rates and a strong relationship between ACEs and smoking; therefore, we hypothesize that (1) there will be a significant interaction between sex and ACE score, such that females with a high ACE score will have greater odds of being current or former smokers than never smokers, compared to men with a high ACE score. Due to strong associations between low SES, stress, and

smoking behavior observed in previous research, we hypothesize that (2) there will be a significant interaction between SES and ACE score, such that individuals with lower SES and a higher ACE score will have greater odds of being current and former smokers than never smokers, compared to individuals with higher SES and a higher ACE score. Given that ACEs are associated with low educational attainment and smoking, we hypothesize that (3) there will be a significant interaction between education and ACE score, such that individuals with a lower education and a higher ACE score will have greater odds of being current or former smokers than never smokers, compared to individuals with a higher education and a higher ACE score. The analysis testing if the relationship between ACEs and current smoking depends on race will be exploratory, given that there is little research examining this relationship directly, with most studies controlling for race instead of examining its impact directly, and that a wide variety of factors can influence the relationship.

CHAPTER TWO

METHODS

Participants and Procedures

Data from the 2013 California Behavioral Risk Factor Surveillance System in conjunction with the CDC were analyzed (BRFSS; Ryan-Ibarra, Induni, Zuniga, & Ewing, 2013; CDC, 2013). The BRFSS is conducted in all 50 states, the District of Columbia, and other U.S. territories. Each state uses the same core questionnaire, with optional modules as determined by each individual state based on public health concerns that are relevant to each territory. In California, the BRFSS collects information on the prevalence of and trends in health-related behaviors in California residents aged 18 and older, including an optional ACE module. Trained interviewers follow the standardized procedures developed by the CDC, taking roughly 30 minutes to complete. A dual-frame sampling design is used with both landline and cell random-digit components, where either a resident of the home or the primary user of the cell phone is identified to participate in the telephone survey.

Participation in the survey was voluntary and anonymous. The full sample included 11,214 participants. The mean age was 52.61 years (*SD* = 18.34), 57.1% were female, and the racial/ethnic distribution was as follows: 82.1% Caucasian, 7.0% Asian, 6.2% Black or African American, 3.5% American Indian or Alaska Native, 0.5% other, and 0.4% Native Hawaiian or other Pacific Islander. After accounting for missing data, the sample used in the final analysis included 2,604 participants. The mean age of the sample was 53.03 years (*SD* = 8.10), and 54.8% were female. The final sample included

83.6% Caucasian, 6.4% Asian, 5.9% Black or African American, 3.1% American Indian/Alaska Native, 0.6% other, and 0.2% Native Hawaiian or Pacific Islander (see Table 1).

Table 1. Demographic Characteristics of Sample (N = 2,604)

	Full Dataset		Analytic Sample	
Variable	*N*	%	*N*	%
Sex				
Female	6,404	57.1	1,593	54.8
Male	4,810	42.9	1,176	45.2
Race/Ethnicity – Four Category				
Caucasian	6,597	58.8	1,575	60.5
African American	553	4.9	124	4.8
Hispanic	3,161	28.2	724	27.8
Other	903	8.1	181	7.0
Race – Expanded Category				
Caucasian	9,207	82.1	2,177	83.6
African American	696	6.2	153	5.9
Asian	788	7.0	167	6.4
Native Hawaiian or Pacific Islander	49	0.4	6	0.2
Native American/Alaska Native	404	3.6	81	3.1
Other	57	0.5	16	0.6
Refused	13	0.1	4	0.2
Education				
Less than High School	1,467	13.4	321	12.3
High School Graduate	2,247	20.6	524	20.1
Some College or technical school	2,770	25.4	646	24.8
Technical School Graduate	154	1.4	43	1.7
College Graduate	2,408	22.1	580	22.3
Postgraduate Graduate	1,868	17.1	490	18.8
Income				
< $25,000	3,398	33.9	844	32.4
$25,000 to $49,999	2,090	20.8	533	20.5
$50,000 to $99,999	2,476	24.7	658	25.3
>$100,000	2,071	20.6	569	21.9

Table 1 (continued)

ACE Score				
0	974	35.1	896	34.4
1	603	21.8	556	21.4
2	407	14.7	390	15.0
3	295	10.6	284	10.9
4	206	7.4	198	7.6
5	124	4.5	122	4.7
6	79	2.9	77	3.0
7	45	1.6	43	1.7
8	26	0.9	26	1.0
9	12	0.4	12	0.5
Smoking Status				
Current Smoker	1,163	11.4	292	11.2
Former Smoker	2,770	27.1	719	27.6
Never Smoked	6,271	61.4	1,593	61.2
	Mean	*SD*	Mean	*SD*
Total ACE Score	1.75	1.94	1.79	1.96

Measures

Demographic Features

Sex was defined using male/female categories. Race was measured by asking with which race participants identify, including Caucasian, Black or African American, Asian, Native Hawaiian or other Pacific Islander, and American Indian or Alaska Native. For the purposes of this study, race was separated into four categories (henceforth referred to as the "Four Category" race/ethnicity variable, in comparison to the "Expanded Category" race variable reported in the Participants section above) due to the small number of

participants in some of the categories. Race categories included Caucasian (60.5%), Hispanic (27.8%), Black or African American (4.8%), and other (7.0%).

Socioeconomic status was measured as annual household income from all sources. Income ranges in the survey include less than $10,000; $10,000 to less than $15,000; $15,000 to less than $20,000; $20,000 to less than $25,000; $25,000 to less than $35,000; $35,000 to less than $50,000; $50,000 to less than $75,000; $75,000 to less than $100,000; $100,000 to less than $125,000; and $125,000 or more. For the purposes of this study, income was separated into four categories in order to preserve statistical power by limiting the number of predictors in the regression model described below. Income categories included less than $25,000; $25,000 to $49,999; $50,000 to $99,999; and $100,000 or more.

Education was measured by highest grade or year of school completed. Categories in the survey include eighth grade or less, some high school, grade 12 or GED certificate, some technical school, technical school graduate, some college, college graduate, and post graduate or professional degree. For the purposes of this study, education was measured using six categories to reduce the number of predictors in the statistical model. Categories included less than high school, high school graduate, some college or technical school, college graduate, technical school graduate, and post graduate.

Adverse Childhood Experiences

Nine ACEs were examined in this 12-item survey as an optional module to the California BRFSS (see appendix). This survey only assesses nine of the 10 ACEs; however, examining fewer than 10 ACEs is common in the literature (Anda et al., 1999;

Ford et al., 2011; Walsh & Cawthon, 2014). These ACEs include caregiver mental illness; substance abuse; incarceration; separation or divorce; domestic violence; physical, emotional, and sexual abuse; and physical neglect. Participants indicated whether or not they experienced each ACE prior to the age of 18. Example items include, "Looking back at your childhood, before age 18…did you live with anyone who was a problem drinker or alcoholic?" or "…how often did a parent or adult in your home ever swear at you, insult you, or put you down?" Responses are summed to yield a total ACE score. The psychometric properties of the ACE questionnaire have been little studied; however, Dube and colleagues (2004) report test-retest reliability kappa values of κ = .41-.86, which are consistent with good (κ = .40-.75) to excellent ($\kappa \geq .75$) reliability, as defined by Fleiss (Dube, Williamson, Thompson, T., Felitti, & Anda, 2004; Fleiss, 1981). In the current study, the ACEs questionnaire demonstrated adequate reliability (α = .73).

Smoking

Based on their self-report, participants were classified according to their cigarette smoking status: current smoker, former smoker, or never smoker.

Statistical Analysis

After reviewing descriptive statistics for the predictor and outcome variables, it was determined that the originally proposed outcome variable of "number of cigarettes smoked per day" did not include participants who do not smoke (responses included participants who smoke one to 100 cigarettes per day), and the resulting small sample size did not provide enough statistical power to test our hypotheses. Therefore, we

decided to use the categorical outcome variable of smoking status, which includes the three categories described above (current smoker, former smoker, never smoker). As a result, we used a multinomial logistic regression analysis to test sex, race, education, and income as moderators of the relationship between ACEs and cigarette smoking. Sex, race, education, and income ranges were dummy-coded so that females were compared to males, Caucasians were compared to the three other race categories, obtaining a postgraduate degree was compared to the five other education levels, and people making greater than $100,000 were compared to the three other income groups. Total ACE score was mean centered.

Descriptive statistics, outliers, and assumptions of logistic regression were assessed prior to conducting the main regression analysis. Based on a simulation study evaluating the minimum sample size required for logistic regression (Peduzzi, Concato, Kemper, Holford, & Feinstein, 1996), we used the following formula to determine the sample size required for our analysis: $N = 10k/p$, where N = sample size; k = number of predictors (20 for our analysis); and p = the proportion of "successful" events, or in our case the proportion of individuals who reported being current or former smokers (.112 and .276 for our analysis, respectively). Results indicated that we would need a sample size of at least 725 for the portion of the analysis predicting current smoking status, and at least 1,786 participants for the portion of the analysis predicting former smoking status. Our final sample size of 2,604 is sufficiently greater than both of these estimates.

CHAPTER THREE

RESULTS

A multinomial logistic regression analysis was performed to predict the odds of former smoking or current smoking versus having never smoked based on ACEs, sex, race, education, income, the interaction between ACEs and sex, the interaction between ACEs and race, the interaction between ACEs and education, and the interaction between ACEs and income.

Assumptions of logistic regression and outliers were tested. There were no outliers and all assumptions were met with the exception of the assumption of linearity in the logit. This assumption was violated when comparing former smokers to never smokers. Attempts to remedy this violation via variable transformation were unsuccessful, and therefore these results should be interpreted with caution.

Current Smoker versus Never Smoker

Sex

Significant sex differences in smoking were found that follow general trends in population prevalence rates. The odds of being a current smoker compared to a never smoker were 60% lower for females than for males, OR = .40, 95% CI [.30, .53], $p < .001$ (see Table 2).

Table 2. Results of Multinomial Logistic Regression Analysis Predicting the Odds of Being a Current Smoker versus a Never Smoker (N = 2,604)

Variable	*b*	SE	*p*-value	OR	95% CI
Male	-.919	.141	.000***	.399	[.303, .525]
Race/Ethnicity					
African American	-.389	.330	.239	.678	[.355, 1.295]
Hispanic	-.851	.184	.000***	.427	[.298, .613]
Other	-.581	.307	.059	.560	[.306, 1.022]
Education					
Less than High School	.908	.338	.007**	2.480	[1.278, 4.809]
High School Graduate	1.121	.279	.000***	3.069	[1.775, 5.306]
Some College or Technical School	1.027	.269	.000***	2.783	[1.648, 4.735]
Technical School Graduate	1.887	.480	.000***	6.603	[2.576, 16.925]
College Graduate	.429	.280	.125	1.536	[.888, 2.659]
Income					
< $25,000	1.191	.242	.000***	3.291	[2.047, 5.291]
$25,000 to $49,999	1.063	.244	.000***	2.894	[1.794, 4.668]
$50,000 to $99,999	.207	.252	.413	1.230	[.750, 2.017]
ACE Score	.242	.125	.052	1.274	[.998, 1.627]
ACE x Male	.010	.066	.884	1.010	[.888, 1.148]
ACE x African American	.123	.153	.424	1.130	[.837, 1.527]
ACE x Hispanic	1.145	.080	.069	.865	[.740, 1.011]
ACE x Other	.130	.152	.393	1.139	[.845, 1.536]
ACE x Less than High School	.181	.148	.220	1.199	[.897, 1.602]
ACE x High School Graduate	.196	.127	.123	1.217	[.948, 1.561]
ACE x Some College or Technical	.136	.124	.272	1.146	[.899, 1.460]
ACE x Technical School Graduate	.038	.214	.858	1.039	[.683, 1.579]
ACE x College Graduate	-.206	.147	.161	.814	[.610, 1.085]
ACE x < $25,000	-.125	.110	.257	.883	[.712, 1.095]
ACE x $25,000 to $49,999	-.228	.116	.050	.796	[.634, 1.000]
ACE x $50,000 to $99,999	-.090	.118	.446	.914	[.726, 1.151]

Note. ACEs = Adverse Childhood Experiences. Total ACE score is centered. Males were

compared to females. All race categories compared to Caucasians. All education categories compared to postgraduates. All income ranges are compared to > $100,000. *$p < .05$. **$p < .01$. ***$p < .001$.

Race/ethnicity

A significant difference was found between Hispanic and Caucasian participants when comparing current smokers to never smokers. The odds of being a current smoker compared to a never smoker were 57% lower for Hispanic participants than for White participants, OR = .43, 95% CI [.30, .61], $p < .001$. The odds of being a current smoker compared to a never smoker were not statistically different for participants who endorsed the Other and Black racial/ethnic categories compared to White participants, *p*s > .05 (see Table 2).

Education

Many significant effects were found in in the lower education levels when comparing smoking status. The odds of being a current smoker compared to a never smoker were 148% higher for individuals who reported completing less than a high school education than for participants who reported completing a postgraduate degree, OR = 2.48, 95% CI [1.28, 4.81], $p < .01$. The odds of being a current smoker compared to a never smoker were 207% higher for individuals who reported completing a high school education than for participants who reported completing a postgraduate degree, OR = 3.07, 95% CI [1.78, 5.31], $p < .001$. The odds of being a current smoker compared to a never smoker were 179% higher for individuals who reported completing some college or technical school than for participants who reported completing a postgraduate degree, OR

= 2.79, 95% CI [1.65, 4.74], $p < .001$. The odds of being a current smoker compared to a never smoker were 560% higher for individuals who reported completing technical school than for participants who reported completing a postgraduate degree, OR = 6.60, 95% CI [2.58, 16.93], $p < .001$. The odds of being a current smoker compared to a never smoker were not statistically different for participants who reported completing a college degree compared to participants who reported completing a postgraduate degree, $p > .05$ (see Table 2).

Income

Significant effects were found among lower income ranges when comparing current smoking to never smoking. The odds of being a current smoker compared to a never smoker were 229% greater for participants who reported an annual income less than $25,000, compared to individuals who reported an annual income of more than $100,000, OR = 3.29, 95% CI [2.05, 5.29], $p < .001$. The odds of being a current smoker compared to a never smoker were 189% greater for participants who reported an annual income between $25,000 and $49,999, compared to individuals who reported an annual income of more than $100,000, OR = 2.89, 95% CI [1.79, 4.67], $p < .001$. The odds of being a current smoker compared to a never smoker were not statistically different for participants who reported an annual income between $50,000 and $99,999, compared to individuals who reported an annual income of more than $100,000, $p > .05$ (see Table 2).

ACE Score and Interaction Effects

ACE score did not significantly predict the odds of being a current versus never

smoker, $p > .05$. There were no statistically significant interactions predicting the odds of being a current versus never smoker, ps > .05 (see Table 2).

Former Smoker versus Never Smoker

Sex

In concordance with general trends of sex differences in cigarette smoking, the odds of being a former smoker compared to a never smoker were 47% lower for females than for males, OR = .53, 95% CI [.44, .64], $p < .001$ (see Table 3).

Table 3. Results of Multinomial Logistic Regression Analysis Predicting the Odds of Being a Former Smoker versus a Never Smoker (N = 2,604)

Variable	*b*	SE	*p*-value	OR	95% CI
Male	-.637	.097	.000***	.529	[.438, .639]
Race/Ethnicity					
African American	-.452	.221	.041*	.636	[.412, .982]
Hispanic	-1.156	.137	.000***	.315	[.241, .412]
Other	-1.047	.226	.000***	.351	[.225, .547]
Education					
Less than High School	.126	.227	.581	1.134	[.726, 1.770]
High School Graduate	.364	.164	.027*	1.438	[1.043, 1.984]
Some College or Technical School	.578	.147	.000***	1.782	[1.335, 2.379]
Technical School Graduate	.590	.406	.146	1.804	[.814, 4.000]
College Graduate	-.008	.149	.955	.992	[.740, 1.328]
Income					
< $25,000	.634	.152	.000***	1.886	[1.400, 2.541]
$25,000 to $49,999	.507	.154	.001***	1.660	[1.228, 2.245]
$50,000 to $99,999	.250	.140	.073	1.284	[.977, 1.688]

Table 3 (continued)

Variable	*b*	SE	*p*-value	OR	95% CI
ACE Score	.002	.077	.983	1.002	[.861, 1.165]
ACE x Male	.051	.053	.329	1.053	[.949, 1.168]
ACE x African American	-.045	.128	.726	.956	[.744, 1.229]
ACE x Hispanic	1.119	.066	.074	.888	[.780, 1.012]
ACE x Other	-.018	.134	.894	.982	[.756, 1.277]
ACE x Less than High School	.064	.113	.572	1.066	[.855, 1.329]
ACE x High School Graduate	.063	.086	.463	1.066	[.900, 1.262]
ACE x Some College or Technical	.082	.077	.293	1.085	[.932, 1.263]
ACE x Technical School Graduate	.182	.181	.315	1.199	[.841, 1.709]
ACE x College Graduate	.134	.081	.097	1.144	[.976, 1.340]
ACE x < $25,000	.023	.081	.775	1.023	[.874, 1.198]
ACE x $25,000 to $49,999	-.153	.086	.075	.858	[.725, 1.016]
ACE x $50,000 to $99,999	.054	.077	.485	1.055	[.907, 1.227]

Note. ACEs = Adverse Childhood Experiences. Total ACE score is centered. Males were compared to females. All race categories compared to Caucasians. All education categories compared to postgraduates. All income ranges are compared to > $100,000. **p* < .05. ***p* < .01. ****p* < .001.

Race/ethnicity

Several significant effects were found when examining the odds of being a former smoker compared to a never smoker in terms of race/ethnicity. The odds of being a former smoker compared to a never smoker were 68% lower for Hispanic participants than for White participants, OR = .32, 95% CI [.24, .41], $p < .001$. The odds of being a former smoker compared to a never smoker were 65% lower for participants who identified as Other than for White participants, OR = .35, 95% CI [.23, .55], $p < .001$. The odds of being a former smoker compared to a never smoker were 36% lower for

Black participants than for White participants, OR = .64, 95% CI [.41, .98], $p < .05$ (see Table 3).

Education

With the exception of participants who completed less than high school, significant effects were found when comparing former smoking to never smoking in lower education levels. The odds of being a former smoker compared to a never smoker were 44% higher for individuals who reported completing a high school education than for participants who reported completing a postgraduate degree, OR = 1.44, 95% CI [1.04, 1.98], $p < .05$. The odds of being a former smoker compared to a never smoker were 78% higher for individuals who reported completing some college or technical school than for participants who reported completing a postgraduate degree, OR = 1.78, 95% CI [1.34, 2.38], $p < .001$. The odds of being a former smoker compared to a never smoker were not statistically different for participants who reported having less than a high school education or who reported completing either a technical school or college degree, compared to participants who reported completing a postgraduate degree, ps > .05 (see Table 3).

Income

Among lower income ranges, significant effects were found when comparing former smoking to never smoking. The odds of being a former smoker compared to a never smoker were 88% greater for participants who reported an annual income less than $25,000, compared to individuals who reported an annual income of more than $100,000,

OR = 1.88, 95% CI [1.40, 2.54], $p < .001$. The odds of being a former smoker compared to a never smoker were 66% greater for participants who reported an annual income between $25,000 and $49,999, compared to individuals who reported an annual income of more than $100,000, OR = 1.66, 95% CI [1.23, 2.25], $p < .01$. The odds of being a former smoker compared to a never smoker were not statistically different for participants who reported an annual income between $50,000 and $99,999, compared to individuals who reported an annual income of more than $100,000, $p > .05$ (see Table 3).

ACE Score and Interaction Effects

ACE score did not significantly predict the odds of being a former versus never smoker, $p > .05$. There were no statistically significant interactions predicting the odds of being a former versus never smoker, $ps > .05$ (see Table 3).

CHAPTER FOUR

DISCUSSION

Overall, the results of the current study suggest that the relationship between ACEs and smoking later in life does not depend on basic demographic features; no interactions between ACE score and sex, race, education, or income significantly predicted smoking outcomes. In addition, despite past research indicating a clear relationship between ACE score and smoking outcomes, ACEs were not significantly associated with whether or not respondents reported being current or former smokers in adulthood. However, sex, race, education, and income were significantly and independently associated with smoking outcomes. These results highlight directions for future research and have implications for clinical work.

The relationship between sex and smoking in adulthood was significant, suggesting that the odds of being a male smoker compared to a female smoker is higher in both analyses ($p < .001$; see Tables 2 and 3). This is consistent with population trends in smoking, which indicate that men tend to smoke more than women, with 17.5% of men and 13.5% of women being smokers in 2016 (Jamal et al., 2018). This finding does not support the original hypothesis for this analysis, which predicted that women would have higher prevalence rates, but this hypothesis was based on the interaction effect between ACEs and sex due to the fact that women tend to have higher ACE scores and lower quit rates (Centers for Disease Control and Prevention, 2015; Smith et al., 2015). The result of this main effect, however, is consistent with past research on smoking prevalence.

In the exploratory analysis examining the effect of race on smoking, significant

effects were found. For current smokers compared to never smokers, Caucasians had significantly greater odds of being current smokers than Hispanics (see Table 2). This result reflects prevalence rates from long-term CDC data, which show that Caucasians tend to have higher smoking rates than Hispanics (Martell, Garrett, & Caraballo, 2016; U.S. Department of Health and Human Services, 2014), and is consistent with the demographic characteristics of the sample we used for the analysis, which show that Hispanics had lower smoking rates than Caucasians (see Table 4).

Table 4. Smoking Prevalence Rates by Race/Ethnicity in Analytic Sample (N = 2,604)

	Current Smoker		Former Smoker		Never Smoker	
Variable	*N*	%	*N*	%	*N*	%
Race/Ethnicity – Four Category						
Caucasian	179	11.4	531	33.7	865	54.9
African American	16	12.9	34	27.4	74	59.7
Hispanic	82	11.3	126	17.4	516	71.3
Other	15	8.3	28	15.5	138	76.2
Race – Expanded Category						
Caucasian	240	11.0	632	29.0	1,305	59.9
African American	21	13.7	39	25.5	93	60.8
Asian	11	6.6	20	12.0	136	81.4
Native Hawaiian or Pacific Islander	1	16.7	2	33.3	3	50.0
Native American/Alaska Native	16	19.8	23	28.4	42	51.9
Other	1	6.3	3	18.8	12	75.0
Refused	2	50.0	0	0.0	2	50.0

Some research suggests that Hispanics are more likely to have a complete home smoking ban than Caucasians, which may reduce smoking rates (Trinidad, Perez-Stable, White, Emery, & Messer, 2011). Additionally, Hispanics are more likely to be intermittent

(nondaily) smokers and overall smoke fewer cigarettes than Caucasians, suggesting differences in smoking patterns across ethnicities (Trinidad, Perez-Stable, Emery, White, Grana, & Messer, 2009).

For former smokers compared to never smokers, Caucasians had greater odds than African Americans, Hispanics, and members of the Other category of being a former smoker than a never smoker (see Table 3). These disparities in cessation by race/ethnicity may be explained by differences in healthcare utilization, access to treatment, knowledge about treatment, and differences in tobacco use behaviors (Babb et al., 2017). Babb and colleagues (2017) suggest it is possible that increasing the number of adults who receive healthcare and requiring better cessation coverage may have contributed to the number of people who attempted to quit, successfully quit, and use proven cessation treatments. Despite this, rates of Hispanics, African Americans, and other races using proven cessation methods remain lower than Caucasians (Babb, et al., 2017; McAfee, Babb, McNabb, & Fiore, 2015). In 2015, more Caucasians received a professional's advice to quit (60.2%) compared to African Americans (55.7%), Hispanics (42.2%), American Indian/Alaska Natives (38.1%), and Asians (34.2%); therefore, people in some minority racial groups may have less knowledge about available treatments and thus be less likely to quit smoking (Babb et al., 2017).

Due to the significant differences in smoking behavior among the groups that are included in the Other category (Native American/Alaska Native, Asian, Native Hawaiian or Pacific Islander, and other), the ability to draw conclusions about this group is limited. Nationally, Native American/Alaskan Indians report the highest rates of smoking in 2016 (31.8%) and Asians report the lowest smoking rates (9.0%; Jamal et al., 2018). Similarly,

in California between 2015-2016, American Indian/Alaska Natives had the highest smoking rates (16.3%), followed by African Americans (15.1%), Caucasians (12.7%), Hispanics (10.7%), and Asian/Pacific Islanders (6.2%; CDC, 2016). The prevalence rates in our sample (both full and analytic) roughly mirror state and national trends by showing significant differences in smoking prevalence rates among the groups included in the Other category (Tables 2 and 3). The primary difference in our sample is that Native Hawaiians and Pacific Islanders reported the highest smoking prevalence rates. However, since there were only six Native Hawaiians and Pacific Islanders in our analytic sample (Table 1), it is unsurprising that their smoking rates do not reflect state or national rates.

It is also important to note that there are many within-group differences in prevalence rates in each category that could not be directly examined in this analysis. For example, among the Hispanic population, Puerto Ricans have the highest smoking rates at 28.5%, whereas Central/South Americans had rates at 15.6% between 2010 and 2013 (Martell, Garrett, & Caraballo, 2016). Although it may be possible to draw general conclusions about Hispanic, African American, and Caucasian populations in our study, within group variability should be considered in future studies.

Education was significantly associated with smoking outcomes. The odds of being a current smoker versus a never smoker were greater for individuals with less than a high school degree ($p < .01$), with a high school education, with some college or technical school, and for technical school graduates, compared to individuals with a graduate degree ($p < .001$; see Table 2). The odds of being a former smoker versus a never smoker were greater for respondents with a high school education ($p < .05$) and

some college or technical school, compared to individuals with a graduate degree ($p <$ .001; see Table 3). These findings are consistent with national smoking prevalence rates; in 2015, smoking rates were highest in individuals with a GED (40.6%), followed by those with 12 or fewer years of education (24.1%), a high school diploma (19.7%), some college (18.9%), an Associate's degree (16.8%), a Bachelor's degree (7.7%), and a Graduate degree (4.5%; Jamal et al., 2018). Similarly, research suggests that higher education is associated with a greater number of quit attempts (Zhuang, Gamst, Cummins, Wolfson, & Zhu, 2015).

The findings described above are consistent with literature about the relationship between education and smoking, suggesting that, overall, lower education is associated with higher smoking rates and lower quit rates. Research suggests many reasons for higher smoking rates among less educated individuals. Among highly educated individuals, smoking is more stigmatized compared to the less educated; this class distinction may motivate higher SES individuals to behave in healthy ways and for lower SES groups to set themselves apart through smoking that can symbolize toughness and independence (Stuber et al., 2008). Additionally, maintaining a healthy lifestyle may be easier for people with a higher education, as higher education can lead to increased personal control, human capital, and effective agency (Barbeau, Krieger, & Soobader, 2004; Mirowsky & Ross, 2007). Similarly, people with less education may have more trouble overcoming obstacles to healthy behavior due to a higher chance of being in a position of powerlessness (Adler et al., 1994).

In examining income, significant effects were found when comparing both current and former smoking to never smoking. Specifically, these effects were found among the

lower income ranges, with individuals earning less than $49,999 having greater odds of being a current smoker than a never smoker, compared to individuals earning over $100,000 ($p < .001$; see Tables 4 and 5). Past research has suggested that lower income may be associated with greater odds of smoking through the effects of stress. Stress associated with lower income often reflects less access to material resources, including those associated with basic survival needs. Lower income may negatively influence the control individuals have over their lives due to economic disadvantage (Harwood et al., 2007). Many individuals believe that smoking helps relieve negative affect and stress, and therefore some people smoke in order to relieve these negative affective states (Harwood et al., 2007; Wang, Chen, Gong, & Yan, 2016). Results generally support the original hypothesis suggesting that lower income would be positively associated with higher smoking rates.

In general, ACE scores were not associated with smoking outcomes in the current study; however, marginally significant results were found in the analysis comparing current smokers to never smokers ($p = .052$; see Table 2). The effect size associated with this finding, in combination with previous research, suggests that the relationship between ACEs and smoking warrants further study: with every one additional ACE, the odds of currently smoking compared to never smoking increased by 27.4%, OR = 1.274, 95% CI [.998, 1.627]. Interestingly, the range of ACE scores found in the present study is similar to that of other population studies examining the relationship between ACEs and smoking (Dube et al., 2003; Felitti et al., 1998; Edwards et al., 2007; Parrot, 2000; Ramiro et a., 2010), and the dataset used for the secondary data analysis is from a common survey (BRFSS) that other studies use to examine this relationship (Alcalá, von

Ehrenstein, & Tomiyama, 2016; Campbell et al., 2016; Ford et al., 2011; Vander Weg, 2011). One potential explanation for the lack of a statistically significant relationship between ACEs and smoking outcomes in the present study is that, compared to other studies examining the same relationship, the current sample had higher education rates. In the current study, 41.1% of the sample had a bachelor's degree or higher, whereas in other studies, participants with a bachelor's degree or higher range from 28.26% to 32.6% (Campbell et al., 2016; Ford et al., 2011; Ramiro et al., 2010; Vander Weg, 2011). Education is known to be a protective factor against smoking, as higher education is associated with higher income, personal control, and effective agency, compared to those with lower education who may not have as much control over the circumstances in their lives, leading to more stress and a higher likelihood smoking (Barbeau et al., 2004; Mirowsky & Ross, 2007; Stuber et al., 2008).

Additionally, CDC data suggests lower smoking rates are present in California compared to the rest of the United States. California had the second lowest smoking rates in 2016 at 11%; only Utah had even lower rates at 8.8% (CDC, 2016). Current smoker rates were also lower in the present study (11.2%) than past studies, some current smoking rates being 17.8% (Campbell et al., 2016), 18.8% (Ford et al., 2011), and 33.3% (Ramiro et al., 2010). Findings suggest that the relationship between ACEs and smoking may be different depending on the sample used and geographical location due to differences in demographic characteristics and smoking rates.

Recommendations and Limitations

Based on the results of this study and others, clinicians may wish to tailor

interventions to demographic groups that have been identified as potentially more vulnerable to smoking, such as men, individuals with low income and education, and some racial/ethnic groups. For example, this analysis corroborated that low income is associated with higher smoking rates. With this knowledge, clinicians can make themselves aware of some of the problems associated with the economic disadvantages of their area in order to best validate a patient's situation, ask the right questions to promote insight and motivation in treatment, and provide appropriate interventions and resources that may help with some of the issues specific to a patient's situation. Similarly, if clinicians are aware that lower education or racial factors may increase a patient's likelihood to smoke, they may be able to provide psychoeducation or culturally relevant interventions to prevent smoking and/or aid in smoking cessation. Given that some of the demographic factors described above may be less amenable to change, it will be useful to test other, potentially more malleable factors (such as depression and social support) that may better explain the relationship between ACEs and smoking, and may give clinicians more opportunity to intervene.

Findings of this study suggest a gap in the current literature examining the relationship between ACEs and smoking. Although this study had similar range of ACE scores to other studies, results contradict the findings of previous research by suggesting that ACE score does not significantly impact smoking in adulthood. Demographic similarities of samples among previous studies include fairly high current smoking rates and lower education, all of which increase the chance of finding significant results due to research findings that suggest low education is a risk factor for smoking that can result in higher smoking rates (Barboza Solís et al., 2015; Jamal et al., 2018). Future research

should further examine other samples that have demographic characteristics and smoking rates that are different than previous studies so as to generate a more comprehensive understanding of this relationship. Doing research in other states with low smoking rates similar to our sample from California, such as Utah, and with populations with higher education and income could provide a better understanding of whether or not ACEs impact future smoking. It is apparent that future research is needed to determine why the relationship between ACEs and smoking may exist for some groups and not others. Given that smoking rates have decreased over the years (U.S. Department of Health and Human Services, 2014), it is possible that this relationship is also become weaker, which may necessitate a shift in our current understanding of this relationship and indicate other important treatment interventions to help prevent the impact of ACEs in adulthood.

It is important to acknowledge that there may also be a genetic component that explains substance use behavior. According to past research, there are several ACEs, including parental mental illness and substance use, that have a strong genetic component that make individuals more susceptible to smoking (Waaktaar, Kan, & Torgersen, 2017). This suggests that there may be family genetics that explain adult smoking use beyond the effects of ACEs, or genetic vulnerabilities that work in tandem with an individual's environment that exacerbate the risk of smoking (Meyers, & Dick, 2010). Future research should examine family history of substance use to determine genetic vulnerability that could additionally explain this relationship.

In the BRFSS survey, the ACE of emotional neglect is missing, and it appears that across literature examining ACE scores, emotional neglect is often left out. One study did examine all ten ACEs and found that 43.6% of the population reported experiencing

emotional neglect (Ramiro et al., 2010). Given the high prevalence of emotional neglect in this study, future research should include questions regarding emotional neglect to better determine the impact this ACE may have on adult smoking, among other risky behaviors.

There are several limitations to this study. Firstly, cross-sectional data were used, which precludes the inference of causality. Due to the sampling source, participants were only from the state of California, posing possible threats to external validity, or the extent to which findings can be generalized to the population. The limited number of respondents in each racial/ethnic category also limits our ability to draw conclusions about external validity. There may be limitations related to the self-report nature of the study, as under or over reporting are always a risk and can threaten construct validity. However, in regards to ACEs, high test-retest reliability has been found for both individual and overall ACE scores, suggesting consistency of reporting (Dube, Williamson, Thompson, Felitti, & Anda, 2004). The use of a secondary analysis of BRFSS data limited the usable variables to ones that were already present in the survey, restricting the definitions and the specificity of variables to analyze. The assumption of linearity of the logit was violated in the analyses that compared former to never smokers; therefore, results from this portion of the analysis should be interpreted with caution. Finally, it is possible that there are other variables not examined in this analysis that could pose a threat to conclusion validity, or the degree to which conclusions made about the relationships between ACEs, smoking, and moderating variables are reasonable.

Summary and Implications

Past research provides evidence to support that higher ACE scores are associated with increased smoking in adulthood. Research also suggests that sex, education, and income may be risk factors to smoking in adulthood. The purpose of this analysis was to test whether or not the relationship between ACEs and smoking depends on these demographic features in order to help researchers and clinicians understand factors that may moderate this relationship so treatment interventions can be targeted more effectively at potentially vulnerable groups. Overall, the current study suggests that the relationship between ACEs and smoking later in life does not depend on basic demographic features. Sex, race, education, or income were significantly and independently associated with smoking outcomes; however, no interactions between ACE score and sex, race, education, or income significantly predicted smoking outcomes. In addition, ACEs were not significantly associated with whether or not respondents reported being current, former, or never smokers in adulthood.

This research has implications for future research and intervention. Future research should examine populations with lower smoking rates and more protective factors (such as higher income and education), and with larger samples of racial and ethnic minority groups so more accurate conclusions can be drawn about the relationship between race, smoking, and ACEs. Despite the fact that many demographic characteristics are unchangeable within the realm of treatment, knowledge about which populations and demographic characteristics are more vulnerable to smoking, such as males, individuals with lower income and education, and certain racial/ethnic groups, can help clinicians better assess and tailor interventions to meet the needs of their patients.

Specifically, clinicians can be culturally sensitive and can help patients obtain resources to help improve treatment access, motivation, and success.

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APPENDIX A

2013 CALIFORNIA BRFSS ACE MODULE

1. Looking back at your childhood, before age 18, did you live with anyone who was depressed, mentally ill, or suicidal?
    1. Yes
    2. No
2. (Looking back at your childhood, before age 18) did you live with anyone who was a problem drinker or alcoholic?
    1. Yes
    2. No
3. (Looking back at your childhood, before age 18) did you live with anyone who used street drugs or who abused prescription medications?
    1. Yes
    2. No
4. (Looking back at your childhood, before age 18) did you live with anyone who served time or was sentenced to serve time in a prison, jail, or other corrections facility?
    1. Yes
    2. No
5. (Looking back at your childhood, before age 18) were your parents ever separated or divorced?
    1. Yes
    2. No
6. (Looking back at your childhood, before age 18) how often did your parents or adults in your home ever slap, hit, kick, punch or beat each other up? Would you say…
    1. Never
    2. Once
    3. More than once
7. Before age 18, 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. Would you say…
    1. Never
    2. Once
    3. More than once
8. (Looking back at your childhood, before age 18) how often did a parent or adult in your home ever swear at you, insult you, or put you down? Would you say…
    1. Never
    2. Once
    3. More than once
9. (Looking back at your childhood, before age 18) how often did anyone at least 5 years older than you or an adult, ever touch you sexually? Would you say…
    1. Never
    2. Once
    3. More than once

10. (Looking back at your childhood, before age 18) how often did anyone at least 5 years older than you or an adult, ever try to make you touch them sexually? Would you say…
    1. Never
    2. Once
    3. More than once
11. (Looking back at your childhood, before age 18) how often did anyone at least 5 years older than you or an adult, force you to have sex? Would you say…
    1. Never
    2. Once
    3. More than once
12. (Looking back at your childhood, before age 18) did a parent or adult caretaker ever fail to provide for your basic needs, such as food, clothing, medical care, hygiene, or fail to protect you from known dangers?
    1. Yes
    2. No