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Adverse Childhood Experiences and Use of Cigarettes and Smokeless Tobacco Products

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Abstract Adverse childhood experiences (ACEs) have been linked to increased use of tobacco products later in life. However, studies to date have ignored smokeless tobacco products. To address this, data from the 2011 Behavioral Risk Factor Surveillance System, which interviewed adults 18 years and over (N = 102,716) were analyzed. Logistic regression models were fit to estimate odds ratios of ever smoking, current smoking and current smokeless tobacco use in relation to ACEs. Results showed that less than 4 % of respondents currently used smokeless tobacco products, while 44.95 and 18.57 % reported ever and current smoking, respectively. Physical abuse (OR 1.40; 95 % CI 1.14, 1.72), emotional abuse (OR 1.41; 95 % CI 1.19, 1.67), sexual abuse (OR 0.70; 95 % CI 0.51, 0.95), living with a drug user (OR 1.50; 95 % CI 1.17, 1.93), living with someone who was jailed (OR 1.50; 95 % CI 1.11, 2.02) and having parents who were separated or divorced (OR 1.31; 95 % CI 1.09, 1.57) were associated with smokeless tobacco use in unadjusted models. After accounting for confounders, physical abuse (OR 1.43; 95 % CI 1.16, 1.78), emotional abuse (OR 1.32; 95 % CI 1.10, 1.57), living with a problem drinker (OR 1.30; 95 % CI 1.08, 1.58), living with a drug user (OR 1.31; 95 % CI

1.00, 1.72) and living with adults who treated each other violently (OR 1.30; 95 % CI 1.05, 1.62) were associated with smokeless tobacco use. Living with someone who was mentally ill (OR 0.70; 95 % CI 0.53, 0.92) was associated with smokeless tobacco use after accounting for confounders and all ACEs. Results indicated that some childhood adversities are associated with use of smokeless tobacco products. Special attention is needed to prevent tobacco use of different types among those experiencing ACEs.

Keywords Adverse childhood experiences · Smokeless tobacco · Cigarettes · Adversity · Child abuse

Introduction

Cigarette smoking rates have been on the decline in the United States and currently remain at 18.1 % [1, 2]. While these declines are positive, this trend has been accompanied by increases in use of other tobacco products. In particular, the use and sales of smokeless tobacco products (i.e. chewing tobacco, snuff, or snus) have been on the rise [3–5]. Increasing use of these products is troubling because they have been linked to elevated risk of head and neck cancers and dental caries [6]. Given the rising use of smokeless tobacco products, it is important to understand if established psychosocial risk factors for smoking extend to smokeless tobacco.

One risk factor for tobacco use that has received considerable attention is childhood adversity. Generally speaking, adverse childhood experiences (ACEs), encompassing child abuse and household dysfunction, have been associated with use of tobacco products overall (i.e. cigarettes and chewing tobacco) among adults and adolescents [7, 8]. Certain ACEs have been positively associated with lifetime smoking [9, 10],

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current smoking [9–12], early smoking initiation [11] and smoking initiation overall [13]. Similarly, various categorical or count measures of childhood adversity related to increased odds of ever [14] or current smoking [15]. Among individuals with conditions that contraindicate smoking (i.e. heart disease, lung disease etc.), experiencing a greater number of ACEs has been associated with increased odds for smoking [16], suggesting developing a smoking-related illness does not influence associations between ACEs and current smoking behaviors. While research has linked ACEs to tobacco use, available studies do not specifically examine the relationship between ACEs and smokeless tobacco use. This is important because previous research has shown that different tobacco use behaviors have unique correlates [17].

Current tobacco and ACEs research also tends to combine or treat distinct ACEs as interchangeable [18, 19]. This includes experiences such as child abuse, domestic violence and substance use or abuse among adults, along with increasingly common adversities like parental divorce or separation. Previous studies compared individuals who have experienced some adversity to no-adversity or reported associations between a sum of childhood adversities and the health outcome of interest. This approach limits the ability to disentangle associations between specific types of adversities and tobacco use. Also, as argued by Finkhor et al. [20], some adversities, like parental divorce or separation, have become more common in the United States and less potentially damaging over time. Overall, research would benefit by examining ACEs as distinct events because it would help understand whether any or specific types of childhood experiences are important in shaping tobacco use behavior, which would then inform intervention efforts.

The goal of the present study is to examine associations between ACEs and smoking behaviors. Of specific interest is whether or not ACEs are associated with ever smoking, current smoking and current smokeless tobacco use. While ever and current smoking behaviors have been studied, smokeless tobacco use remains poorly examined; it is infrequently the focus of analyses or it is combined with smoking to create a global measure of tobacco use. Both smokeless tobacco and cigarette use are included to examine if ACEs impact tobacco use behaviors.

Methods

Data Source

Data from the 2011 Behavioral Risk Factor Surveillance System (BRFSS) was used. This multistage, random digit dial telephone survey is designed to be representative of

non-institutionalized adults (ages 18 and over) living in all U.S. states, Guam, Washington D.C., Puerto Rico and the U.S. Virgin Islands. Because data was publically available, ethical approval was not required.

The BRFSS is conducted annually, with a core set of questions asked of all participants in all states and optional questions asked of all or some participants in states electing to administer them. Data on core questions were collected using both landlines and cell phones in all states, while optional questions were administered with landlines and/or cellphones [21]. In the 2011 BRFSS cycle, all states administered questions about tobacco use. Only 10 states (California, Maine, Minnesota, Montana, Nebraska, Nevada, Oregon, Vermont, Washington and Wisconsin) administered a module of questions measuring ACEs [22]. The median weighted American Association for Public Opinion Research response rate (RR4) for these regions was 49.85 %, which is better than other telephone-based surveys in the United States [23].

A total of 131,686 respondents participated in the 10 states that administered questions about child abuse and childhood adversities. However, the California administration of the BRFSS omitted the item asking respondents about living with an adult who had been jailed. Consequently, the California sample was not considered for analyses, leaving 120,586 respondents. Individuals with missing values (i.e. missing or responses of “don’t know” or “refused”) on any variable used in the present study were excluded, yielding an analytic sample size of 102,716.

Measures

The main independent variables for these analyses were ACEs. These were measured in the BRFSS using the ACE scale. This widely used 11-item scale measures the following events prior to age 18: (1) physical abuse; (2) being touched sexually; (3) attempted to be made to touch someone sexually; (4) being forced to have sex; (5) psychological/emotional abuse; (6) living with an adult who was depressed, mentally ill or suicidal; (7) living with anyone who was a problem drinker or alcoholic; (8) living with a drug user or abuser; (9) living with someone who was incarcerated or jailed; (10) having parents who were separated or divorced and (11) living in a home where adults or parents physically harmed each other [18]. Items about mental illness, problem drinking, drug use, incarceration and separation or divorce asked whether or not the respondent had been exposed to specific adversity. The remaining items allowed respondents to specify the frequency of occurrence of a specific adversity (i.e. never, once or more than once). For the purpose of the current

analyses, all items were dichotomized to indicate if the experience had ever happened. This coding scheme is consistent with previous studies but refrains from summing these items into a scale [24]. Because three items measured facets of sexual abuse, individuals responding affirmatively to any item were coded as having experienced sexual abuse. This resulted in nine ACE measures.

Dependent variables of interest measured tobacco use behaviors. First, lifetime/ever smoking was assessed as whether or not a person ever smoked one hundred cigarettes in their lifetimes. Individuals who responded affirmatively to this item were coded as “ever smokers”. Second, “current smokers” were those who had smoked one hundred cigarettes in their lifetimes and who reported currently smoking every day or some days. Third, “current smokeless tobacco users” were those who reported using chewing tobacco, snuff, or snus every day or some days.

Several variables were selected a priori and included as potential confounders based on previous publications [17, 25–27]. Age was included as a continuous variable. Gender was measured as a dichotomous variable. Race/ethnicity was measured using a categorical variable representing race and ethnicity category combinations (i.e. non-Latino white, non-Latino Black/African American, non-Latino Asian, non-Latino other race, and Latino). State of residence was measured using a categorical variable for the nine states represented in the sample. Educational attainment was recoded from its 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 or more 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. Cancer status was measured using a dichotomous indicator of lifetime cancer, excluding skin cancer. This variable was included as a proxy for smoking related disease. While other smoking related diseases are included in the BRFSS, only cancer has been associated with both smoking and smokeless tobacco use.

Analyses

All analyses were conducted using Stata 14.1, using appropriate weights to account for survey design. Distributions of outcome and explanatory variables were examined. Correlations of ACEs items were calculated. Logistic regression models were fit to estimate odds ratios and 95 % confidence intervals for each of the smoking behaviors. First, bivariate associations between each of the 9 ACE measures and the respective smoking behavior were modeled. In the next step, confounders were added to these models. The final model includes all ACE measures in the same model, while also including confounders.

Results

Sample Characteristics

Table 1 shows the sample characteristics. Almost 45 % of respondents were ever smokers, 18.57 % were current smokers and 3.96 % were current smokeless tobacco users. Emotional abuse was the most commonly experienced ACE measure (36.89 %) and living with someone who was jailed (6.85 %) was the least commonly experienced. All ACE measures were weakly to moderately correlated with each other (not shown). Most respondents were female. A large majority of respondents were non-Latino white. On average, respondents had completed some college. Less than 7 % of respondents had ever been diagnosed with cancer.

Ever Smoking

Table 2 shows estimated odds of ever smoking from the nine different ACE items. In unadjusted models (Model 1) all ACE items were associated with increased odds of ever smoking. In models that introduced confounders (Model 2) all ACE items were associated with increased odds of ever smoking. Finally, when all ACEs and confounders were entered into the same model (Model 3), most ACEs were associated with increased odds of ever smoking. The only ACE that was no longer associated with ever smoking was living with someone who was mentally ill.

Current Smoking

Table 3 shows the estimated odds of current smoking from the nine different ACE items. In unadjusted models (Model 1) all ACE items were associated with increased odds of current smoking. In the adjusted models (Model 2) all ACE items were associated with increased odds of current smoking similarly as for ever smoking. When adjusting mutually for the different ACEs (Model 3), all ACEs were associated with odds of current smoking, except living with someone who was mentally ill. In this model, each ACE was associated with between roughly 20–30 % higher odds of current smoking.

Current Smokeless Tobacco Use

Table 4 shows the results of logistic regression models estimating odds of current smokeless tobacco use from the nine different ACE items. In unadjusted models (Model 1) physical abuse (OR 1.40; 95 % CI 1.14, 1.72), emotional abuse (OR 1.41; 95 % CI 1.19, 1.67), living with a drug

Table 1 Sample characteristics BRFSS 2011 (N = 102,716)

Variable	N	% or Mean	SE
<i>Smoking behaviors</i>			
Ever smoker	48,139	44.95 %	0.40 %
Current cigarette smoker	14,962	18.57 %	0.34 %
Current smokeless tobacco user	3120	3.96 %	0.16 %
<i>Adverse childhood experiences</i>			
Physical abuse	15,583	17.04 %	0.31 %
Sexual abuse	12,614	11.60 %	0.24 %
Emotional abuse	33,471	36.89 %	0.40 %
Lived with some one who was mentally ill	15,884	17.26 %	0.32 %
Lived with problem drinker	24,513	25.04 %	0.35 %
Lived with drug user	7381	10.44 %	0.26 %
Lived with some one who was jailed	4165	6.85 %	0.24 %
Parents divorced or separated	19,411	24.57 %	0.37 %
Adults in household treated each other violently	14,938	16.68 %	0.31 %
Age	102,716	47.11	0.15
Female	61,235	50.53 %	0.41 %
<i>Race/ethnicity</i>			
White	92,986	84.46 %	0.33 %
Black	1730	2.98 %	0.16 %
Hispanic	2761	6.08 %	0.24 %
Asian	1064	2.63 %	0.15 %
Other	4175	3.85 %	0.17 %
<i>Educational attainment (years)</i>	102,716	13.41	0.2
<i>Lifetime cancer diagnosis</i>	10,857	6.97 %	0.17 %
<i>State of residence</i>			
Maine	3431	2.80 %	0.06 %
Minnesota	21,430	21.07 %	0.23 %
Montana	16,030	4.08 %	0.06 %
Nebraska	9116	7.52 %	0.11 %
Nevada	3499	4.88 %	0.13 %
Oregon	4010	7.46 %	0.16 %
Vermont	11,976	2.73 %	0.04 %
Washington	25,318	27.58 %	0.24 %
Wisconsin	7906	21.88 %	0.33 %

Ns are unweighted, while means, frequencies and SEs are weighted

user (OR 1.50; 95 % CI 1.17, 1.93), living with someone who was jailed (OR 1.50; 95 % CI 1.11, 2.02) and having parents who were separated or divorced (OR 1.31; 95 % CI 1.09, 1.57) were associated with currently using smokeless tobacco. Sexual abuse was associated with lower odds of currently using smokeless tobacco (OR 0.70; 95 % CI 0.51, 0.95). However, this association changed in direction with the introduction of gender as a covariate. In models that introduced confounders (Model 2) physical abuse (OR 1.43; 95 % CI 1.16, 1.78), emotional abuse (OR 1.32; 95 %

CI 1.10, 1.57), living with a problem drinker (OR 1.30; 95 % CI 1.08, 1.58), living with a drug user (OR 1.31; 95 % CI 1.00, 1.72) and living with adults who treated each other violently (OR 1.30; 95 % CI 1.05, 1.62) were associated with currently using smokeless tobacco. Finally, including all ACEs into the same adjusted model (Model 3), living with someone who was mentally ill was associated with lower odds of currently using smokeless tobacco (OR 0.70; 95 % CI 0.53, 0.92). No other ACE item was associated with current use of smokeless tobacco.

Table 2 Estimated odds ratios for ever smoking by ACE measures, BRFSS 2011 (N = 102,716)

Variable	Model 1: unadjusted		Model 2: confounders		Model 3: all ACE measures and confounders	
	OR	95 % CI	AOR	95 % CI	AOR	95 % CI
Physical abuse	2.05	(1.87, 2.23)	2.08	(1.90, 2.28)	1.26	(1.13, 1.40)
Sexual abuse	2.08	(1.91, 2.28)	2.30	(1.01, 1.02)	1.59	(1.43, 1.77)
Emotional abuse	1.59	(1.48, 1.70)	1.77	(1.65, 1.90)	1.22	(1.12, 1.32)
Lived with some one who was mentally ill	1.42	(1.30, 1.55)	1.68	(1.53, 1.84)	0.97	(0.87, 1.07)
Lived with problem drinker	2.02	(1.88, 2.18)	2.09	(1.93, 2.25)	1.38	(1.27, 1.51)
Lived with drug user	2.25	(2.01, 2.53)	2.61	(2.32, 2.95)	1.52	(1.32, 1.74)
Lived with some one who was jailed	2.40	(2.06, 2.80)	2.67	(2.28, 3.12)	1.41	(1.19, 1.68)
Parents divorced or separated	1.79	(1.65, 1.94)	2.06	(1.90, 2.25)	1.52	(1.39, 1.67)
Adults in household treated each other violently	2.03	(1.85, 2.22)	2.09	(1.91, 2.29)	1.13	(1.01, 1.25)

Significant associations ($p < 0.05$) denoted in bold. Model 1 includes unadjusted bivariate associations. Model 2 additionally includes age, gender, race, years of education, state of residence and cancer status. Model 3 introduces all ACEs simultaneously while also controlling for age, gender, race, years of education, state of residence and cancer status

Table 3 Estimated odds ratios for current smoking by ACE measures, BRFSS 2011 (N = 102,716)

Variable	Model 1: unadjusted		Model 2: confounders		Model 3: all ACE measures and confounders	
	OR	95 % CI	AOR	95 % CI	AOR	95 % CI
Physical abuse	2.08	(1.88, 2.30)	1.95	(1.75, 2.18)	1.18	(1.03, 1.35)
Sexual abuse	1.94	(1.74, 2.18)	2.01	(1.78, 2.26)	1.37	(1.19, 1.57)
Emotional abuse	1.89	(1.73, 2.06)	1.76	(1.60, 1.93)	1.21	(1.09, 1.35)
Lived with some one who was mentally ill	1.73	(1.55, 1.93)	1.64	(1.46, 1.84)	0.96	(0.84, 1.10)
Lived with problem drinker	2.09	(1.90, 2.29)	2.01	(1.82, 2.21)	1.32	(1.18, 1.48)
Lived with drug user	2.71	(2.39, 3.07)	2.27	(1.99, 2.59)	1.34	(1.15, 1.57)
Lived with some one who was jailed	3.19	(2.72, 3.75)	2.34	(1.98, 2.77)	1.33	(1.11, 1.60)
Parents divorced or separated	2.46	(2.23, 2, 70)	2.07	(1.87, 2.30)	1.55	(1.38, 1.74)
Adults in household treated each other violently	2.24	(2.01, 2.49)	2.06	(1.85, 2.30)	1.17	(1.03, 1.34)

Significant associations ($p < 0.05$) denoted in bold. Model 1 includes unadjusted bivariate associations. Model 2 additionally includes age, gender, race, years of education, state of residence and cancer status. Model 3 introduces all ACEs simultaneously while also controlling for age, gender, race, years of education, state of residence and cancer status

Table 4 Estimated odds ratios for current smokeless tobacco use by ACE measures, BRFSS 2011 (N = 102,716)

Variable	Model 1: unadjusted		Model 2: confounders		Model 3: all ACE measures and confounders	
	OR	95 % CI	AOR	95 % CI	AOR	95 % CI
Physical abuse	1.40	(1.14, 1.72)	1.43	(1.16, 1.78)	1.26	(0.97, 1.65)
Sexual abuse	0.70	(0.51, 0.95)	1.33	(0.96, 1.82)	1.18	(0.85, 1.65)
Emotional abuse	1.41	(1.19, 1.67)	1.32	(1.10, 1.57)	1.19	(0.97, 1.46)
Lived with some one who was mentally ill	0.86	(0.69, 1.09)	0.91	(0.91, 1.17)	0.70	(0.53, 0.92)
Lived with problem drinker	1.18	(0.98, 1.41)	1.30	(1.08, 1.58)	1.16	(0.92, 1.45)
Lived with drug user	1.50	(1.17, 1.93)	1.31	(1.00, 1.72)	1.18	(0.86, 1.62)
Lived with some one who was jailed	1.50	(1.11, 2.02)	1.24	(0.90, 1.72)	1.02	(0.72, 1.45)
Parents divorced or separated	1.31	(1.09, 1.57)	1.17	(0.96, 1.42)	1.04	(0.84, 1.29)
Adults in household treated each other violently	1.18	(0.96, 1.45)	1.30	(1.05, 1.62)	1.02	(0.79, 1.32)

Significant associations ($p < 0.05$) denoted in bold. Model 1 includes unadjusted bivariate associations. Model 2 additionally includes age, gender, race, years of education, state of residence and cancer status. Model 3 introduces all ACEs simultaneously while also controlling for age, gender, race, years of education, state of residence and cancer status

Discussion

This study uses a large national sample to expand previous work by showing that ACEs are associated with use of smokeless tobacco products in addition to more well-studied smoking behaviors. In our analyses, the different ACEs were associated with increased odds for current smokeless tobacco use after adjusting for confounders. When including all ACEs into the same model, no single item was associated with increased odds of current smokeless tobacco use. This, does not mean that individual ACEs are unimportant, but instead suggests that ACEs are co-occurring and interrelated phenomena. For comparison, almost all ACE measures were associated with increased odds ratios for current and lifetime cigarette smoking in the present study corroborating previous findings [9–12]. Overall, our results suggest associations between ACEs and smokeless tobacco use, whereby potentially not all ACEs are equally harmful. This is important for future research attempting to understand the mechanisms that link adversity to tobacco use and to tobacco-related disease.

One explanation for the observed associations between ACEs and tobacco use is that ACEs correlate with childhood exposure to tobacco use by adults. For example, about a third of adults who suffer from alcohol use disorders are also nicotine dependent [28] and about a third of adults with a lifetime diagnosis of mental illness currently smoke [29]. As a result, children with multiple ACEs may also have a greater likelihood of being exposed to individuals who use tobacco, which itself has been associated with tobacco use [30, 31]. Following this logic, it would be unsurprising that smokeless tobacco is less consistently and less strongly associated with ACEs, given that it is less commonly used and thus less likely to be modeled by caretakers. Also, because substance use by adults measures were among those associated with smokeless tobacco use, it is possible that modeling of drug use in general is particularly important for smokeless tobacco uptake.

Similarly, children confronted by adversity may also be genetically susceptible to engaging in risky behaviors, like smoking. Traits, behaviors and conditions that characterize or shape ACEs (i.e. like impulsivity, substance abuse and mental illness) are heritable [32–34]. Thus, if the adult referred to in the ACE item is biologically related to the respondent, his or her genetic predispositions may be shared with the respondent. As a result, genes that make tobacco use and ACEs more likely could govern the uptake of tobacco products.

Additionally, several authors have argued that experiences of abuse and household dysfunction lead children and adolescents to engage in risky behaviors, like smoking,

as a means of self-medicating [35, 36] or as an avoidant coping strategy [37]. Thus, tobacco use would allow the person experiencing adversity a means of directly dealing with the emotions stemming from abuse. However, this approach would not necessarily explain adversity specific-associations for smokeless tobacco use.

Finally, existing evidence has shown that experiencing child abuse is associated with more severe nicotine withdrawal and with nicotine dependence [38], suggesting that some ACEs make it harder to cease tobacco use. This is an important consideration when comparing smokeless tobacco to cigarettes because the former releases more nicotine into the blood over time while the latter provides a sharper spike in nicotine immediately after use [39]. That is, abused individuals may find that their withdrawal symptoms are more readily quelled by the quick release that cigarettes provide, thus reinforcing this type of tobacco use.

This study, however, is not without its shortcomings. First, because the data are cross-sectional, directionality of relationships cannot be ascertained and recall bias cannot be ruled out. Second, while the ACE scale includes a variety of experiences, it does not include items assessing peer victimization, peer isolation or rejection, community violence and low childhood socioeconomic status, which may also impact health and have been suggested for inclusion in an expanded ACE scale [20]. Third, this study is not representative of the entire United States. The states that could be included for analyses do not adequately capture the sociodemographic and tobacco use variability that exists in the United States. Consequently, generalizations must be made with caution. Fourth, while weight and adjustments created by BRFSS attempt to make the survey representative of the underlying population, non-response bias has still been a documented problem [40] thus the present analyses may not be fully representative. In addition, our ability to pinpoint associations between specific adversities and smoking behavior is limited due to the co-occurrence of many ACE items. Finally, because the frequency of reporting current use of smokeless tobacco products is relatively low, the present study may not be adequately powered to detect all associations between ACEs and smokeless tobacco use. As such, future work should consider using larger samples or lifetime use of smokeless tobacco products. Lastly, given the increasing popularity of e-cigarettes, future researchers should explore this as a potential outcome.

Limitations notwithstanding, this study underscores the importance of identifying vulnerable populations for tobacco use prevention and tobacco cessation interventions. While not all adversities are associated with all smokeless tobacco use, most are associated with cigarette

smoking. Consequently, interventions to prevent adversities in childhood, potentially targeting vulnerable population groups, or providing additional coping resources and increasing resilience to those facing them, may help further curb tobacco use. Furthermore, because individuals with a history of ACEs may have stressful or traumatic origins for their tobacco use, interventions among these populations may benefit from addressing these underlying stressors and trauma.

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Compliance with Ethical Standards

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

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