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Childhood maltreatment and the persistence of smoking: A longitudinal study among adults in the US

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ABSTRACT

The current study examined the relationship between childhood maltreatment—emotional, physical, and severe physical maltreatment—and the initiation and persistence of smoking. Data were drawn from the Midlife Development in the United States (MIDUS) Survey Waves 1 and 2. Frequency of childhood emotional, physical, and severe physical maltreatment (never, rare, intermittent, frequent) reported at Wave 1 was examined in relation to ever smoking, smoking daily, and persistent daily smoking at Waves 1 and 2. Logistic regression analyses were used to calculate odds ratios (with 95% confidence intervals), which were then adjusted for potential confounders. Childhood emotional, physical, and severe physical maltreatment were associated with increased odds of ever smoking, smoking daily, and persistent smoking at Waves 1 and 2. The majority of these associations remained significant after adjusting for confounding variables. These results suggest a history of trauma may play a prominent role in recalcitrant cigarette smoking and suggest that the success rates of treatments for smoking cessation may be improved by integrating trauma treatment where appropriate.

Introduction

Cigarette smoking remains common, nearly one in five (18.1%) of adults in the United States (Centers for Disease Control and Prevention, 2012) and one in five adult deaths (Nelson et al., 2002) is attributable to cigarette smoking. The majority of smokers would like to quit, and have made a quit attempt in the past year. Yet, the majority of quit attempts do not result in sustained abstinence. Moreover, data on the prevalence of tobacco use among adults in the US have shown a nearly 7% decrease from 1994 to 2012 while the decline in the prevalence rate from 2004 to 2012 has been more modest at nearly 3% (Centers for Disease Control and Prevention, 2011, 2012). At the current rate of decline, it is predicted that in 2020, the adult smoking rates in the US will reach approximately 17%, which is substantially higher than the Healthy People 2020 target goal of $\leq 12\%$ (Healthy People 2020, 2014). Therefore, efforts to reduce smoking in the population must be informed by an understanding of both proximal and distal factors that may contribute to persistence of smoking and failure to quit.

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Identifying risk factors for the initiation and persistence of smoking will enable the development more targeted clinical cessation interventions that can help further reduce the prevalence of cigarette smoking among adults in the US.

In recent years, a growing number of studies have documented a relationship between exposure to childhood physical maltreatment and cigarette use in adolescence and adulthood (Green et al., 2010; Huang et al., 2011; Keyes et al., 2012; Lin, Li, Fan, & Fang, 2011; Moran, Vuchinich, & Hall, 2004; Walton et al., 2011). Specifically, studies have linked childhood maltreatment with earlier smoking initiation (Anda et al., 1999), prenatal smoking (Grimstad & Schei, 1999), heavier smoking (Anda et al., 1999), current smoking (Anda et al., 1999; Spratt et al., 2009), and nicotine dependence (Nelson et al., 2002). A dose–response relationship between number of adverse childhood maltreatment experiences and likelihood of various smoking behaviors in adulthood (Anda et al., 1999) has been documented. Yet, two important aspects of the link between childhood maltreatment and subsequent adult smoking remain unclear. First, it is not known whether childhood maltreatment is associated with persistence of smoking through adulthood in the general population. Previous prospective studies have been limited to selected or clinical samples and/or fairly short follow-ups. Second, the mechanisms that link childhood maltreatment to adult smoking remain unclear. It is conceivable, for instance, that this relationship is mediated by depression and anxiety disorders—for which childhood maltreatment is a risk factor (Dunn, McLaughlin, Slopen, Rosand, & Smoller, 2013; Scott, McLaughlin, Smith, & Ellis, 2012b; Teicher & Samson, 2013) and which are also associated with vulnerability to smoking initiation (Allen & Lauterbach, 2007; Roy, 2002). Specific personality traits, such as neuroticism, have also been linked with smoking and substance use problems (Anderson, Tapert, Moadab, Crowley, & Brown, 2007; Kotov, Gamez, Schmidt, & Watson, 2010; Turiano, Whiteman, Hampson, Roberts, & Mroczek, 2012). As such, it is conceivable that either of these factors may mediate the relationship between childhood maltreatment and smoking onset and persistence. Furthermore, findings from previous studies indicate a disproportionately high prevalence of childhood maltreatment histories in populations of treatment-seeking individuals with other addictive disorders (e.g., substance and alcohol use disorders) (Bernstein, Stein, & Handelsman, 1998; Triffleman, Marmar, Delucchi, & Ronfeldt, 1995). Yet, to our knowledge, the potential role of childhood maltreatment in the persistence of smoking has not been examined prospectively in the general population. A more complete understanding of the factors that may contribute to the intractability of smoking in the general population is needed to develop better prevention and treatment strategies that can improve success in smoking cessation and move the prevalence lower (Fenton et al., 2012). Finally, there is limited information on frequency and specific forms of maltreatment (e.g., emotional vs. physical) in relation to smoking persistence.

Against this background, the present study will begin to fill these gaps. First, the current study investigated the relationship between childhood emotional, physical, and severe physical maltreatment and the persistence of cigarette smoking over a ten-year period. Specifically, we examined whether varying frequencies of each type of reported maltreatment (emotional, physical, severe physical) were associated with ever smoking, daily smoking at Wave 1 or Wave 2, and persistent daily smoking over a ten year period, compared with those without a history of maltreatment. Second, the study examined whether and to what degree sociodemographic characteristics (i.e., age, gender, and education) confound the relationship between childhood maltreatment and the aforementioned smoking outcomes. We also explored the potentially confounding role of depression, anxiety, and personality traits in these relationships.

Methods

Participants

Data were drawn from the two waves of the Midlife Development in the United States Survey (MIDUS) (Brim et al., 1996). The MacArthur Midlife Research Network collected Wave 1 data from 1994 to 1995 and Wave 2 data from 2004 to 2006; a national survey of Americans in adulthood that investigated behavioral, psychological, and social factors related to physical and mental health. Wave 1 consisted of a nationally representative multistage probability sample (main sample) of community-dwelling English speakers in the continental United States ($n = 3{,}032$). Participants completed a telephone interview and were mailed a self-administered questionnaire. Approximately 70% of Wave 1 participants took part in the Wave 2 survey collected by the Institute on Aging at the University of Wisconsin–Madison and supported by the National Institute on Aging (2004–2006). Wave 2 participants completed a 30-min telephone interview and a self-administered questionnaire was mailed to them. Of the 3,032 participants from Wave 1, 2,101 completed the Wave 2 telephone and mail-in surveys. For this study, we analyzed only data from those who participated in the Wave 1 main sample who completed both the phone and mail-in surveys, participated in the Wave 2 survey, and had complete information for Wave 2 outcome variables.

Measures

Childhood Maltreatment

Emotional, physical and severe physical childhood maltreatment categories were modeled after the Conflict Tactics Scale (Straus, 1979) using 15 different item measures from the MIDUS self-administered questionnaire. To assess emotional maltreatment, respondents indicated how frequently members of their family including their mother, father, sister, brother,

or anyone else insulted or swore at them; sulked or refused to talk to them; stomped out of the room; did or said something to spite them; threatened to hit them; and smashed or kicked something in anger. To examine childhood physical maltreatment, respondents were asked how frequently their mother, father, sister, brother or anyone else pushed, grabbed, or shoved them; slapped them; or threw something at them. Severe physical maltreatment was assessed by asking participants how frequently their mother, father, sister, brother, or anyone else burned or scalded them; choked them; kicked, bit, or hit them with a fist; hit or tried to hit them with something; or beat them up. Response categories were each rated on a 4-point scale ranging from 0 (*never*), 1 (*rarely*), 2 (*intermittently*), to 3 (*often*). Variables for each of the four levels of maltreatment—*never, rarely, intermittently, and often*—were created such that affirmative responses, regardless of the family member that was said to inflict such maltreatment, was included for each of the three categories. Thus, for each of the three maltreatment categories, variables were coded as 0, 1, 2, or 3, commensurate with the varying frequencies of maltreatment.

Smoking

At Waves 1 and 2 of the MIDUS, all participants were asked whether they had ever smoked a cigarette. Those who responded in the affirmative were classified as having 'ever smoked' in the current analyses and coded as 1. Participants who reported ever smoking at either Wave 1 or Wave 2 were further asked whether they currently "smoked regularly—that is at least a few cigarettes a day." Participants who responded in the affirmative at either wave were categorized as a 'daily smoker at Wave 1 or Wave 2′ and coded as 1. Participants who reported current smoking daily at *both* Waves 1 and 2 were included as 'persistent daily smokers at Wave 1 and Wave 2′ and coded as 1.

Neuroticism

Assessment of personality traits in the Midlife Development Inventory Personality Scales (MIDI), based on the 'big five' factor model (Costa & McCrae, 1988), was developed based on the results of a pilot study conducted in 1994 with a probability sample of 1,000 men and women, aged 30–70 (574 valid cases were usable for item analysis). Items with the highest item to total correlations and factor loadings were selected for MIDI (Bem, 1981; Costa & McCrae, 1988; Kessler et al., 1994; Lachman & Weaver, 1997; Markush, Karp, Heyman, & O'Fallon, 1975; Trapnell & Wiggins, 1990; Wittchen, 1994). Forward regressions were also run to determine the smallest number of items needed to account for over 90% of the total scale variance. Many of the negatively worded items (unemotional, unreliable, unsophisticated, unsympathetic, shy, unsociable) were dropped due to low variance. New items were added to increase reliabilities on some scales. Neuroticism measured at Wave 1 was used in the current analyses. Neuroticism (moody, worrying, nervous, (not) calm) ($\alpha = 0.74$) was comprised of a 4-item scale in which responses were on a Likert scale ranging from 1 to 4. Respondents were asked to describe how much of the time the particular word described them: 'all the time', 'most of the time', 'sometimes' or 'a little'. The score was computed by finding the mean of the items for cases that had valid values for at least half of the items for the trait. The alphas are based on the MIDUS national sample.

Depression and Anxiety Disorders. The MIDUS psychiatric diagnoses were based on the Composite International Diagnostic Interview Short Form scales, a series of diagnostic-specific scales that were developed from item level analyses of the Composite International Diagnostic Interview questions in the National Comorbidity Survey (Costa & McCrae, 1988; Kessler et al., 1994). The Composite International Diagnostic Interview Short Form scales were designed to reproduce the full Composite International Diagnoses as exactly as possible, with only a small subset of the original questions. Composite International Diagnostic Interview Short Form diagnoses at 12 months included in the MIDUS were major depression, panic attacks, and generalized anxiety disorder. These measures were used in Wave 1 past-12 month disorders.

Alcohol/Substance Use Problems. At Wave 1, participants were also asked whether they had experienced or been treated for any alcohol or drug problems within the past 12 months.

Statistical Analyses. The data were weighted and all analyses were run with weights applied. Details of the weighting procedures are reported elsewhere in the technical report on the methodology of the MIDUS survey (http://midmac.med.harvard.edu/tech.html). Descriptive statistics for sociodemographic characteristics were generated and cross-tabulation was conducted to determine their distribution according to type of child abuse (e.g., no emotional maltreatment vs. any emotional maltreatment; no physical maltreatment vs. any physical maltreatment; no severe physical maltreatment vs. any severe physical maltreatment). For categories in which more than 20% of the expected cell frequencies were less than 5 or expected counts were less than 1, the maximum likelihood ratio test was used. Binomial logistic regression analyses with 95% confidence intervals were then used to calculate odds ratios estimating the associations between rare emotional maltreatment as the predictor variable and odds of ever smoking, daily smoking at Wave 1 or Wave 2, and persistent daily smoking at Wave 1 and Wave 2 as the outcome variables. The same procedure was then repeated for the following predictor variables: intermittent and frequent emotional maltreatment (see Table 2), rare, intermittent, and frequent physical maltreatment (see Table 3), and rare, intermittent, and frequent severe physical maltreatment (see Table 4). Statistical significance was set at $p < .05$. All analyses were adjusted for demographics, neuroticism, alcohol/substance use disorder, major depression, generalized anxiety disorder and panic attack at Wave 1.

Results

Sociodemographic characteristics and emotional, physical, and severe physical maltreatment

Sociodemographic characteristics associated with emotional, physical, and severe physical maltreatment are presented in Table 1. Emotional maltreatment was significantly more common among younger persons, males, and individuals who had completed more years of formal education, compared with those without emotional maltreatment. There were no statistically significant differences in marital status or race between individuals with and without emotional maltreatment. Physical maltreatment was significantly more common among younger persons, males, individuals who had completed more years of formal education, and those who were separated or divorced, compared with those without physical maltreatment. There were no statistically significant differences in race between individuals with and without physical maltreatment, compared with those without severe physical maltreatment. Severe physical maltreatment was significantly more common among younger persons, males, and divorced individuals. There were no statistically significant differences in education or race between those with and without severe physical maltreatment (see Table 1).

Rare, Intermittent, and Frequent Emotional Maltreatment and Persistence of Smoking

The results suggest that participants who reported being rarely exposed to emotional maltreatment were more likely to have ever smoked cigarettes in their lifetime (OR = 2.07, 95% CI = 1.42–3.00), become a daily smoker at Wave 1 or Wave 2, (OR = 1.82, 95% CI = 1.25–2.32), and to become a persistent daily smoker at Wave 1 and Wave 2 (OR = 3.28, 95% CI = 1.63–6.60) than those who reported no emotional maltreatment (see Table 2). These associations persisted after controlling for demographics, neuroticism, alcohol/substance use disorder, major depression, generalized anxiety disorder and panic attack at Wave 1. Those who reported having experienced emotional maltreatment intermittently were more likely to have ever smoked cigarettes (OR = 2.73, 95% CI = 1.78–4.21), become a daily smoker at Wave 1 or Wave 2 (OR = 1.84, 95% CI = 1.21–2.79), and to become a persistent daily smoker at Wave 1 and Wave 2 (OR = 3.36, 95% CI = 1.56–7.24) than those who reported no emotional maltreatment. Associations remained after adjusting for possible confounders. Participants who reported frequent emotional maltreatment were more likely to become daily smokers at Wave 1 or Wave 2 (OR = 2.65, 95% CI = 1.21–5.78) and persistent daily smokers at Wave 1 and Wave 2 (OR = 5.80, 95% CI = 1.91–17.65) compared to those who reported no emotional maltreatment and these associations, too, remained significant after controlling for confounders. After adjusting for neuroticism, and generalized anxiety disorder or panic attack at Wave 1, respondents who reported frequent emotional maltreatment were also more likely to have ever smoked cigarettes (see Table 2).

Rare, Intermittent, and Frequent Physical Maltreatment and Persistence of Smoking

Having experienced rare physical maltreatment was associated with increased odds of ever smoking cigarettes (OR = 1.99, 95% CI = 1.39–2.86), becoming a daily smoker at Wave 1 or Wave 2 (OR = 1.59, 95% CI = 1.11–2.28), and becoming a persistent daily smoker at Wave 1 and Wave 2 (OR = 1.93, 95% CI = 1.07–3.49) than those who reported no physical maltreatment. Similarly, participants who reported intermittent physical maltreatment were more likely than those who reported no physical maltreatment to ever smoke cigarettes (OR = 2.23, 95% CI = 1.56–3.20), become daily smokers at Wave 1 or Wave 2 (OR = 1.76, 95% CI + 1.23–2.53), and to become persistent daily smokers at Wave 1 and Wave 2 (OR = 2.68, 95% CI = 1.45–4.84). Those who reported frequent physical maltreatment were more likely to ever smoke cigarettes (OR = 2.82, 95% CI = 1.81–4.39), become a daily smoker at Wave 1 or Wave 2 (OR = 2.97, 95% CI = 1.94–4.53), and become a persistent daily smoker at Wave 1 and Wave 2 (OR = 4.44, 95% CI = 2.29–8.63) than those who reported no physical maltreatment. All significant associations found between rare, intermittent, and frequent physical maltreatment and categories of smoking remained significant after adjusting for demographics, neuroticism, alcohol/substance use disorder, major depression, generalized anxiety disorder and panic attack at Wave 1 (see Table 3).

Rare, Intermittent, and Frequent Severe Physical Maltreatment and Persistence of Smoking

The results suggest that participants who reported rare severe physical maltreatment were more likely to ever smoke cigarettes (OR = 2.15, 95% CI = 1.70–2.72), become a daily smoker at Wave 1 or Wave 2 (OR = 1.79, 95% CI = 1.44–2.24), and become a persistent daily smoker at Wave 1 and Wave 2 (OR = 3.29, 95% CI = 2.26–4.78) than those who reported no severe physical maltreatment. These associations remained significant after adjusting for confounders. Participants who reported intermittent severe physical maltreatment were similarly more likely to ever smoke (OR = 1.53, 95% CI = 1.05–2.22). This association persisted after adjusting for alcohol/substance use disorder, major depression, generalized anxiety disorder, and panic attack at Wave 1. Respondents who reported intermittent severe physical maltreatment were also at increased odds of becoming a daily smoker at Wave 1 or Wave 2 (OR = 1.45, 95% CI = 1.03–2.06), however this association was not significant after adjusting for neuroticism and alcohol/substance use disorder at Wave 1. Additionally, those who reported intermittent severe physical maltreatment were at increased odds of becoming persistent daily smokers at Wave 1 and 2 (OR = 1.90, 95% CI = 1.07–3.40) compared to those who reported no such maltreatment. These associations did not, however, remain significant after controlling for demographics, neuroticism, alcohol/substance use disorder, or generalized anxiety disorder and panic attack at Wave 1. Finally, those who reported severe physical maltreatment were more likely to become daily

Table 1
Demographic characteristics associated with emotional, physical, and severe physical childhood maltreatment reported at Wave 1.

	No emotional maltreatment (124)	Any emotional maltreatment (1809)	*p*-value	No physical maltreatment (148)	Any physical maltreatment (1822)	*p*-value	No severe physical maltreatment (490)	Any severe physical maltreatment (1135)	*p*-value
Age (*M*, *SD*)	50.44 (13.38)	43.93 (12.46)	<.0001	46.72 (13.09)	44.34 (12.66)	.028	46.67 (12.97)	43.37 (12.27)	<.0001
Gender			<.0001			<.0001			<.0001
Male	38 (30.6%)	882 (48.8%)		36 (24.3%)	902 (49.5%)		149 (30.4%)	657 (57.9%)	
Female	86 (69.4%)	927 (51.2%)		112 (75.7%)	920 (50.5%)		341 (69.6%)	478 (42.1%)	
Education			<.0001			.015			.110
Grade school up to GED	27 (21.8%)	248 (13.7%)		30 (20.3%)	249 (13.7%)		67 (13.7%)	165 (14.5%)	
High school graduate	52 (41.9%)	553 (30.6%)		54 (36.5%)	559 (30.7%)		183 (37.4%)	349 (30.7%)	
Some college	25 (20.2%)	516 (28.5%)		34 (23.0%)	519 (28.5%)		126 (25.8%)	326 (28.7%)	
Bachelor's degree	9 (7.3%)	287 (15.9%)		15 (10.1%)	289 (15.9%)		60 (12.3%)	178 (15.7%)	
Any graduate school	11 (8.9%)	206 (11.4%)		15 (10.1%)	205 (11.3%)		53 (10.8%)	117 (10.3%)	
Marital status			.069			.004			<.0001
Married	86 (69.4%)	1250 (69.1%)		105 (70.5%)	1258 (69.1%)		356 (72.5%)	783 (69.0%)	
Separated	1 (0.8%)	44 (2.4%)		0 (0%)	45 (2.5%)		10 (2.0%)	17 (1.5%)	
Divorced	13 (10.5%)	278 (15.4%)		15 (10.1%)	278 (15.3%)		55 (11.2%)	184 (16.2%)	
Widowed	15 (12.1%)	113 (6.2%)		18 (12.1%)	116 (6.4%)		51 (10.4%)	63 (5.6%)	
Never married	9 (7.3%)	123 (6.8%)		11 (7.4%)	124 (6.8%)		19 (1.2%)	88 (7.8%)	
Race			.543			.075			.692
White	108 (90.8%)	1584 (88.9%)		122 (84.7%)	1603 (89.4%)		429 (88.6%)	986 (88.4%)	
Black/African American	9 (7.6%)	122 (6.9%)		17 (11.8%)	115 (6.4%)		37 (7.6%)	76 (6.8%)	
Native American/Alaskan	0 (0%)	13 (.7%)		0 (0%)	13 (.7%)		4 (.8%)	8 (.7%)	
Asian	1 (.8%)	18 (1.0%)		3 (2.1%)	17 (.9%)		6 (1.2%)	12 (1.1%)	
Native Hawaiian/Pacific Islander	1 (.8%)	33 (1.9%)		2 (1.4%)	33 (1.8%)		7 (1.4%)	27 (2.4%)	
Other	0 (0%)	11 (.6%)		0 (0%)	12 (.7%)		1 (.2%)	6 (.5%)	

M = mean; *SD* = standard deviation.

Table 2
Rare, intermittent, and frequent emotional maltreatment and smoking from 1994 to 2005.

	Rare, $N = 1421$						Intermittent, $N = 354$						Frequent, $N = 34$					
	OR (95% CI)	AOR[a] (95% CI)	AOR[b] (95% CI)	AOR[c] (95% CI)	AOR[d] (95% CI)	AOR[e] (95% CI)	OR (95% CI)	AOR[a] (95% CI)	AOR[b] (95% CI)	AOR[c] (95% CI)	AOR[d] (95% CI)	AOR[e] (95% CI)	OR (95% CI)	AOR[a] (95% CI)	AOR[b] (95%)	AOR[c] (95% CI)	AOR[d] (95% CI)	AOR[e] (95% CI)
Ever smoked	**2.07 (1.42, 3.00)**	**2.23 (1.51, 3.30)**	**1.98 (1.36, 2.89)**	**2.02 (1.39, 2.93)**	**1.98 (1.36, 2.87)**	**2.12 (1.44, 3.11)**	**2.73 (1.78, 4.21)**	**2.81 (1.78, 4.43)**	**2.44 (1.58, 3.77)**	**2.67 (1.73, 4.12)**	**2.75 (1.78, 4.25)**	**2.89 (1.84, 4.54)**	2.29 (.99, 5.30)	**2.68 (1.12, 6.44)**	1.92 (.82, 4.52)	2.23 (.96, 5.15)	2.08 (.89, 4.87)	**2.97 (1.16, 7.63)**
Daily smoker at W1 or W2	**1.82 (1.25, 2.32)**	**2.23 (1.50, 3.32)**	**1.79 (1.22, 2.61)**	**1.82 (1.25, 2.66)**	**1.78 (1.22, 2.61)**	**1.77 (1.19, 2.62)**	**1.84 (1.21, 2.79)**	**2.20 (1.41, 3.42)**	**1.90 (1.24, 2.91)**	**1.81 (1.19, 2.76)**	**1.82 (1.20, 2.78)**	**1.86 (1.20, 2.89)**	**2.65 (1.21, 5.78)**	**3.82 (1.61, 9.07)**	**2.34 (1.05, 5.22)**	**2.70 (1.23, 5.90)**	**2.43 (1.09, 5.42)**	**2.99 (1.28, 6.99)**
Persistent daily smoker at W1 and W2	**3.28 (1.63, 6.60)**	**3.97 (1.90, 8.31)**	**2.99 (1.48, 6.06)**	**3.28 (1.61, 6.66)**	**3.15 (1.56, 6.37)**	**3.09 (1.50, 6.37)**	**3.36 (1.56, 7.24)**	**3.42 (1.53, 7.63)**	**3.07 (1.41, 6.70)**	**3.37 (1.55, 7.29)**	**3.07 (1.41, 6.71)**	**3.07 (1.37, 6.90)**	**5.80 (1.91, 17.65)**	**7.00 (1.93, 25.32)**	**4.78 (1.50, 15.29)**	**5.62 (1.85, 17.12)**	**5.71 (1.87, 17.42)**	**7.61 (2.32, 25.01)**

W1: Wave 1; W2: Wave 2.
Bold = $p < .05$.

[a] Adjusted for age, gender, education.
[b] Adjusted for neuroticism at Wave 1.
[c] Adjusted for alcohol/substance use disorder at Wave 1.
[d] Adjusted for major depression at Wave 1.
[e] Adjusted for anxiety disorder (GAD or PA) at Wave 1.

Table 3
Rare, intermittent, and frequent physical maltreatment and smoking from 1994 to 2005.

	Rare, $N = 730$						Intermittent, $N = 780$						Frequent, $N = 242$					
	OR (95% CI)	AOR[a] (95% CI)	AOR[b] (95% CI)	AOR[c] (95% CI)	AOR[d] (95% CI)	AOR[e] (95% CI)	OR (95% CI)	AOR[a] (95% CI)	AOR[b] (95% CI)	AOR[c] (95% CI)	AOR[d] (95% CI)	AOR[e] (95% CI)	OR (95% CI)	AOR[a] (95% CI)	AOR[b] (95%)	AOR[c] (95% CI)	AOR[d] (95% CI)	AOR[e] (95% CI)
Ever smoked	**1.99 (1.39, 2.86)**	**1.96 (1.34, 2.87)**	**1.93 (1.35, 2.78)**	**1.96 (1.36, 2.82)**	**1.97 (1.37, 2.82)**	**1.98 (1.36, 2.87)**	**2.23 (1.56, 3.20)**	**1.99 (1.36, 2.89)**	**2.11 (1.47, 3.04)**	**2.17 (1.51, 3.12)**	**2.16 (1.51, 3.11)**	**1.98 (1.36, 2.87)**	**2.82 (1.81, 4.39)**	**2.67 (1.66, 4.29)**	**2.65 (1.67, 4.20)**	**2.72 (1.74, 4.26)**	**2.53 (1.60, 4.00)**	**1.98 (1.36, 2.87)**
Daily smoker at W1 or W2	**1.59 (1.11, 2.28)**	**1.73 (1.18, 2.54)**	**1.57 (1.09, 2.26)**	**1.56 (1.09, 2.24)**	**1.58 (1.10, 2.27)**	**1.78 (1.22, 2.61)**	**1.76 (1.23, 2.53)**	**1.77 (1.22, 2.58)**	**1.78 (1.24, 2.55)**	**1.70 (1.18, 2.44)**	**1.72 (1.20, 2.47)**	**1.78 (1.22, 2.61)**	**2.97 (1.94, 4.53)**	**2.79 (1.78, 4.38)**	**2.75 (1.78, 4.27)**	**2.83 (1.85, 4.34)**	**2.69 (1.74, 4.16)**	**1.78 (1.22, 2.61)**
Persistent daily smoker at W1 and W2	**1.93 (1.07, 3.49)**	**2.44 (1.26, 4.73)**	**1.90 (1.04, 3.45)**	**1.84 (1.01, 3.33)**	**1.93 (1.07, 3.50)**	**2.20 (1.17, 4.15)**	**2.68 (1.45, 4.84)**	**2.50 (1.35, 4.64)**	**2.61 (1.44, 4.71)**	**2.46 (1.36, 4.44)**	**2.53 (1.40, 4.58)**	**2.77 (1.47, 5.25)**	**4.44 (2.29, 8.63)**	**4.34 (1.78, 4.38)**	**3.88 (1.95, 7.74)**	**4.09 (2.09, 8.00)**	**3.78 (1.91, 7.47)**	**4.15 (2.01, 8.56)**

W1: Wave 1; W2: Wave 2.
Bold = $p < .05$.

[a] Age, gender, education, marital status.
[b] Neuroticism at Wave 1.
[c] Alcohol/substance use disorder at Wave 1.
[d] Major depression at Wave 1.
[e] Anxiety disorder (GAD or PA) at Wave 1.

smokers at Wave 1 or Wave 2 (OR = 2.96, 95% CI = 1.20–7.32) and persistent daily smokers at Wave 1 and Wave 2 (OR = 5.70, 95% CI = 1.74–18.63) than participants who reported no severe physical maltreatment. These associations persisted even after adjusting for confounders (see Table 4).

Discussion

Our analyses reveal several key findings. First, childhood emotional maltreatment, physical maltreatment, and severe physical maltreatment were all associated with lifetime smoking, daily smoking, and persistent daily smoking over a 10-year period in adulthood. Second, rare, intermittent, and frequent emotional, physical, and severe physical childhood maltreatment were relatively consistently linked with persistent smoking; the associations however were not limited to those exposed to frequent childhood maltreatment. Third, with few exceptions, relatively few of the associations between childhood maltreatment and smoking persistence were attributable to the confounding factors we examined here. The implications of these findings will be discussed below in the context of existing knowledge.

To our knowledge, this is the first investigation to document relationships between exposure to various forms of childhood maltreatment and persistence of cigarette smoking dependence over two time points spanning a 10-year period of adulthood in a nationally representative sample. One prior article (Anda et al., 1999) investigated the effects of multiple adverse childhood experiences, which included physical maltreatment, on smoking behavior during adolescence and adulthood and found strong correlations between physical maltreatment and smoking. However, the aforementioned study did not examine the role of potential confounders in the relationship between childhood maltreatment and smoking beyond sex, age, race, and education. Furthermore, data on persistence of cigarette smoking was unavailable.

Identifying factors that contribute to the persistence of cigarette smoking is essential to developing more effective treatment strategies. Childhood maltreatment is closely linked with neuroticism (DeYoung, Cicchetti, & Rogosch, 2011; Gamble et al., 2006), suboptimal coping skills (Anda et al., 2006; Cicchetti & Rogosch, 2001) and increased vulnerability to mental and substance use disorders (Afifi, Henriksen, Asmundson, & Sareen, 2012; Kessler et al., 2010; Scott, McLaughlin, Smith, & Ellis, 2012a). Mood and substance use disorders are associated with increased risk of cigarette smoking onset and persistence (Grant, Hasin, Chou, Stinson, & Dawson, 2004; Hughes, 1999, 2011; Japuntich et al., 2007; Leventhal et al., 2012; Leventhal, Ramsey, Brown, LaChance, & Kahler, 2008; Piper et al., 2010; Zvolensky et al., 2008; Zvolensky, Stewart, Vujanovic, Gavric, & Steeves, 2009). Recent studies have documented robust relationships between mood/anxiety disorders and cigarette smoking including persistence of nicotine dependence (Goodwin, Pagura, Spiwak, Lemeshow, & Sareen, 2011). A recent study even suggests that susceptibility to developing depressive and substance use disorders following childhood maltreatment may be attributed to changes in the brain such as white matter disruptions and reduced volume of brain regions involved in emotion regulation (Carballedo et al., 2012; Huang, Gundapuneedi, & Rao, 2012). According to the negative affect model of tobacco use disorder, engaging in cigarette smoking is in large part attributable to alleviating emotional distress (Carmody, Vieten, & Astin, 2007). It is therefore possible that mood/anxiety disorders could mediate the relationship between childhood maltreatment and smoking.

Another potential explanation for the association between childhood maltreatment and smoking initiation and persistence is provided by a cognitive-behavioral theory: the stress coping model of addiction (Wills & Hirky, 1996; Wills & Shiffman, 1985). According to this model, substance use is a coping mechanism that serves to decrease negative affect, or conversely increase positive affect, in response to encountered stress. The cyclical nature of this model is such that in reducing negative affect and enhancing positive affect, substance use is reinforced in response to any perceived stressor. Previous studies have indeed shown that individuals with histories of childhood maltreatment, including physical and emotional maltreatment, evidence impairment in the hypothalamic–pituitary–adrenal axis; the physiological pathway implicated in mood disorders and the stress response (Glaser, 2000; McGowan et al., 2009). While it remains unclear in the literature to what extent the hypothalamic–pituitary–adrenal axis is affected and what, specifically, the effects of its dysregulation are in individuals with histories of childhood maltreatment, it is plausible that these documented changes may predispose those to engage in substance use in an effort to cope with stress. Thus, although the mechanism of the relationship between childhood maltreatment and persistence of smoking cannot be determined from these data, the association may be partially attributed to neurobiological changes in the brain, which developed following early exposure to childhood maltreatment.

A number of limitations should be considered when interpreting our results. First, assessment of childhood maltreatment is by retrospective report. Retrospective reports of childhood maltreatment play an important role in research, (Rutter, Pickles, Murray, & Eaves, 2001) but are vulnerable to recall bias. However, sibling verification of adult reports of childhood maltreatment (Bifulco, Brown, Lillie, & Jarvis, 1997) and good retrospective recall of maltreatment in prospective studies (Johnson, Cohen, Brown, Smailes, & Bernstein, 1999; Nelson, Lynskey, Heath, Madden, & Martin, 2010; Robins et al., 1985) support the validity of such measures. Also, requiring official records to verify maltreatment is not feasible in a study this size, and could produce false negatives for moderate maltreatments that are never officially reported. Second, information regarding the onset of childhood emotional, physical, or severe physical maltreatment was not available. Thus, it was impossible to determine the chronological sequence of the variables in the current study. Moreover, formal mediation testing of third variables (e.g., anxiety or depression) was precluded by the indetermination of the temporal order. Future studies that can determine the chronological succession of variables and conduct mediation testing are needed to clarify the mechanisms that underlie the relationship between childhood maltreatment and smoking. Third, persistence of cigarette smoking was assessed only at two time points; future studies that can examine how childhood maltreatment affects persistence of

Table 4
Rare, intermittent, and frequent severe physical maltreatment and smoking from 1994 to 2005.

	Rare, $N = 940$						Intermittent, $N = 171$						Frequent, $N = 23$					
	OR (95% CI)	AOR[a] (95% CI)	AOR[b] (95% CI)	AOR[c] (95% CI)	AOR[d] (95% CI)	AOR[e] (95% CI)	OR (95% CI)	AOR[a] (95% CI)	AOR[b] (95% CI)	AOR[c] (95% CI)	AOR[d] (95% CI)	AOR[e] (95% CI)	OR (95% CI)	AOR[a] (95% CI)	AOR[b] (95%)	AOR[c] (95% CI)	AOR[d] (95% CI)	AOR[e] (95% CI)
Ever smoked	**2.15 (1.70, 2.72)**	**1.86 (1.45, 2.40)**	**2.13 (1.68, 2.70)**	**2.08 (1.64, 2.64)**	**2.13 (1.68, 2.70)**	**1.98 (1.36, 2.87)**	**1.53 (1.05, 2.22)**	1.42 (.96, 2.08)	1.44 (.98, 2.10)	**1.51 (1.03, 2.20)**	**1.51 (1.04, 2.20)**	**1.98 (1.36, 2.87)**	2.32 (.85, 6.35)	2.36 (.84, 6.62)	2.10 (.76, 5.80)	2.33 (.85, 6.41)	2.30 (.84, 6.33)	**1.98 (1.36, 2.87)**
Daily smoker at W1 or W2	**1.79 (1.44, 2.24)**	**1.73 (1.37, 2.19)**	**1.79 (1.43, 2.23)**	**1.73 (1.39, 2.16)**	**1.78 (1.42, 2.22)**	**1.78 (1.22, 2.61)**	**1.4 (1.03, 2.06)**	**1.42 (1.00, 2.03)**	1.36 (.95, 1.94)	1.40 (.98, 1.99)	**1.43 (1.01, 2.03)**	**1.78 (1.22, 2.61)**	**2.96 (1.20, 7.32)**	**3.36 (1.34, 8.47)**	**2.71 (1.08, 6.76)**	**2.97 (1.20, 7.36)**	**2.90 (1.17, 7.18)**	**1.78 (1.22, 2.61)**
Persistent daily smoker at W1 and W2	**3.29 (2.26, 4.78)**	**2.68 (1.81, 3.99)**	**3.23 (2.21, 4.71)**	**3.09 (2.12, 4.50)**	**3.25 (2.23, 4.75)**	**3.08 (2.08, 4.56)**	**1.90 (1.07, 3.40)**	1.79 (.99, 3.24)	1.69 (.93, 3.06)	1.72 (.95, 3.13)	**1.84 (1.03, 3.31)**	1.69 (.90, 3.17)	**5.70 (1.74, 18.63)**	**4.08 (1.18, 14.16)**	**4.42 (1.31, 14.96)**	**5.65 (1.73, 18.47)**	**5.68 (1.73, 18.60)**	**6.02 (1.82, 19.87)**

W1: Wave 1; W2: Wave 2.
Bold = $p < .05$.

[a] Age, gender, marital status.
[b] Neuroticism at Wave 1.
[c] Alcohol/substance use disorder at Wave 1.
[d] Major depression at Wave 1.
[e] Anxiety disorder (GAD or PA) at Wave 1.

Table 5
Pearson correlations between any emotional, any physical, and any severe physical maltreatment.

	Any emotional maltreatment	Any physical maltreatment	Any severe physical maltreatment
Any emotional maltreatment	–	.419**	.359**
Any physical maltreatment	–	–	.469**
Any severe physical maltreatment	–	–	–

** Differences are significant at $p < .01$.

substance dependence with multiple, detailed assessments and over a longer span of time could be informative for assessing the level of risk associated with childhood maltreatment and planning interventions for critical periods. Fourth, there are also a number of potential confounders (e.g., childhood socioeconomic status) that we were unable to control, which have been associated with both childhood maltreatment (Hussey, Chang, & Kotch, 2006; Sidebotham & Heron, 2006) and substance dependence (Melchior, Moffitt, Milne, Poulton, & Caspi, 2007). Fifth, we found that emotional, physical, and severe physical maltreatment were highly correlated (see Table 5) and it is likely that some of the associations with smoking may be explained by their correlation. Unfortunately, we were unable to adjust for multicollinearity due to small cell sizes. Finally, we did not have information on PTSD or social phobia, both of which have been linked with cigarette smoking (Beckham, Gehrman, McClernon, Collie, & Feldman, 2004; Sonntag, Wittchen, Höfler, Kessler, & Stein, 2000; Thorndike, Wernicke, Pearlman, & Haaga, 2006) and therefore could be confounders of the relationship between childhood maltreatment and persistent smoking. Future studies are needed to examine these variables.

In sum, emotional, physical, and severe physical childhood maltreatment are associated with persistence of cigarette smoking over time, highlighting the potential importance of trauma assessment and treatment as an integral part of treatment for smoking cessation including nicotine dependence. Importantly, the effect of emotional, physical, or severe physical maltreatment on persistence of cigarette smoking does not appear to be largely mediated by demographics, personality, mood, anxiety, or other substance use disorders. This should also inform the development of novel smoking cessation strategies that integrate treatment of trauma as our results suggest that trauma history is common among persistent smokers. Findings could guide intervention development, especially those aimed at early intervention with high-risk youth who have been exposed to trauma.

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