Annals of Epidemiology 40 (2019) 13–20

Contents lists available at ScienceDirect

Annals of Epidemiology

Original article

Associations between child maltreatment, cigarette smoking, and nicotine dependence in young adults with a history of regular smoking

Alison L. Cammack, PhD, MPH [a,*], Regine Haardörfer, PhD [b], Shakira F. Suglia, ScD, MS [a]

[a] Department of Epidemiology, Rollins School of Public Health, Emory University, Atlanta, GA
[b] Department of Behavioral Sciences and Health Education, Rollins School of Public Health, Emory University, Atlanta, GA

ARTICLE INFO

Article history:
Received 25 February 2019
Accepted 14 October 2019
Available online 21 October 2019

Keywords:
Child maltreatment
Child abuse
Child neglect
Smoking
Addiction
Substance use

ABSTRACT

Purpose: The purpose of this study was to evaluate whether childhood maltreatment is associated with smoking behaviors and lifetime nicotine dependence and if associations are moderated by sex. We examined these associations among individuals who ever reported being regular smokers.
Methods: Using data from the National Longitudinal Study of Adolescent to Adult Health, we examined relationships between retrospectively self-reported child maltreatment (parent/caregiver-perpetrated emotional, physical, sexual abuse, and neglect; and non-parent/caregiver-perpetrated sexual abuse) and self-reported smoking behaviors among individuals with a history of regular smoking. Outcomes were any current smoking in early adulthood (mean age = 28 years), current smoking in adolescent study waves only, adulthood only, and adolescence and adulthood ($n = 3581$); and lifetime history of nicotine dependence ($n = 3594$) per the Fagerstrom scale.
Results: Poly-maltreatment (aRR for 2+ vs. 0 exposures = 1.20, 95% CI: 1.08, 1.34) was associated with lifetime nicotine dependence; associations between nicotine dependence and neglect and non-parent/caregiver sexual abuse by force were only present in women. Neglect and non-parent/caregiver sexual abuse by nonphysical threat were associated with continued smoking, and an association between non-parent/caregiver sexual abuse by physical force and continued smoking was also noted in women only. Women who experienced poly-maltreatment were less likely to report current smoking in adolescence but not adulthood.
Conclusions: These data suggest in a nationally representative sample of ever regular smokers, child maltreatment is associated with outcomes that suggest an inability to quit smoking and some associations may vary by sex.

Introduction

Although the prevalence of cigarette smoking has declined steadily in adults since the 1960s and in adolescents since the early 2000s, smoking remains common. According to the CDC, 17.5% of adult males and 13.5% of adult females were current cigarette smokers in 2016 [1]. Moreover, the prevalence of smoking in disadvantaged groups, such as individuals with low socioeconomic status (SES) [2] and severe mental illness [3], has not experienced the same decrease as the overall population. Thus, given that smoking, even intermittent smoking, is a well-established risk factor for several physical health outcomes, including cardiovascular disease and cancer, and is the leading cause of preventable deaths in the United States, it remains a high public health priority [4–6].

Many individuals who smoke report a desire to quit or reduce their smoking [7], but some populations are less successful in cessation. Individuals experiencing psychosocial adversity may be more persistent smokers because smoking helps them cope with distress [8,9]. Forms of mental illness, including depression, anxiety, and post-traumatic stress disorder (PTSD) are also important determinants of smoking and smoking cessation [8,9]. Moreover,

Conflict of interest: The authors have no affiliation with any organization with a direct or indirect financial interest in the subject matter discussed in the manuscript.

* Corresponding author. Department of Epidemiology, Rollins School of Public Health, Emory University, 1518 Clifton Road NE, Atlanta, GA 30322. Tel.: +714-613-2271; fax: 404-727-8871.
E-mail address: acammac@emory.edu (A.L. Cammack).

https://doi.org/10.1016/j.annepidem.2019.10.003
1047-2797/

studies suggest interventions that address mental health symptomatology may be more effective in individuals with psychosocial adversity than interventions that focus on physical health benefits [10,11], highlighting the need to identify psychosocial antecedents of smoking and their upstream root causes. There is also evidence of sex differences in smoking behaviors and motivators. While the prevalence of smoking is higher in adult men [12], women may have more difficulty quitting smoking, particularly in the context of stress [13]. Studies also have shown that women's reasons for smoking may be more closely related to mood and affect [14].

One common upstream psychosocial stressor known to affect risk of smoking is a history of childhood maltreatment (CM). Prevalences of CM range from 11 to 37% for emotional abuse, 11 to 15% for physical abuse, and 6 to 54% for sexual abuse, with more women than men reporting a history of sexual abuse [15–18]. Several studies have linked CM and smoking in adolescence [19–22], early adulthood [19,23], and later adulthood [24]. However, far fewer studies consider smoking cessation [25] or continued smoking among individuals with histories of smoking [26] as outcomes, despite the more direct relevance of these outcomes to smoking cessation interventions. Furthermore, the one study that evaluated sex as a potential effect modifier [25] only assessed emotional and physical abuse. This study found associations between CM and smoking cessation in women only; thus, it is important to further examine sex differences with respect to a wider range of CM exposures.

A limited number of studies have also assessed the relationship between CM and lifetime history of nicotine dependence (ND), or nicotine addiction, an outcome that influences one's ability to quit smoking [27–30], and these studies generally report positive associations. However, they do not consider the temporal sequence between ND and CM. This is an important limitation because adolescent substance use behaviors are linked with negative changes in family dynamics [31] and violence against adolescents [32]; therefore, ND could be a cause rather than a consequence of CM. In addition, with one exception [30], these studies include individuals who had no history of smoking in the ND denominator, making it difficult to disentangle the development of ND from smoking initiation.

Thus, to understand the impact of CM on outcomes related to smoking cessation, the goals of this study were four-fold. We sought to examine whether, among ever regular smokers, 1) CM is associated with lifetime history of ND assessed in early adulthood, 2) CM is associated with continued smoking into early adulthood, 3) CM is associated with trajectories of smoking in adolescence and adulthood, and 4) sex moderates these associations. We carried out these aims within a large, nationally representative longitudinal sample.

Materials and methods

Study population

The National Longitudinal Study of Adolescent to Adult Health ("Add Health") [33] interviewed over 90,000 adolescents in grades 7 through 12 during 1994–95 in schools located in 80 communities throughout the United States. Sampling methods and stratification ensured that the selected schools were representative of U.S. schools with respect to region of country, urbanicity, size, school type, and ethnicity. A subset of participants with sampling weights was followed up at home at ages 12–19, 13–20, 18–26, and 24–32 years (waves I, II, III, and IV, respectively). Our analyses were restricted to the 9421 individuals who participated in all waves. A table further describing timing of variables used in the analysis is shown in Supplemental Table A.1. Permission to conduct secondary analyses was approved by the Emory University Institutional Review Board.

Analytic populations

We considered two distinct but overlapping populations; the base study population consisted of individuals who ever reported being regular smokers at any study wave ("Have you ever smoked cigarettes regularly—that is, at least one cigarette every day for 30 days?"; $n = 4569$) and had complete data on CM ($n = 4294$). For our aims pertaining to continued smoking at wave IV and smoking trajectories (analytic $n = 3581$), our population was derived from individuals who had information on the frequency of smoking in the last 30 days at wave IV (missing $n = 15$), timing of CM relative to smoking initiation (missing $n = 31$), and confounders (missing $n = 75$), and we excluded individuals who were pregnant at the wave IV interview ($n = 146$), or reported regular smoking onset before child maltreatment exposure ($n = 482$). For our aim pertaining to ND (analytic $n = 3594$), our models included participants with information on lifetime history of ND at wave IV (missing $n = 463$), timing of CM relative to dependence (missing $n = 30$), and confounders (missing $n = 117$), and we excluded participants who reported initial symptoms of ND before CM exposure ($n = 193$).

Outcome assessments

Continued smoking was defined as any smoking in the last 30 days at the time of the wave IV interview. Four smoking trajectories were also evaluated: no smoking in the last 30 days at all of the study wave assessments, smoking in adolescence only (any smoking within the last 30 days of the wave I or II interviews), smoking in adulthood only (any smoking within the last 30 days of the wave III or IV interviews), and smoking in childhood and adolescence (any smoking within the last 30 days of the wave I or II interviews and any smoking within the last 30 days of the wave III or IV interviews). To assess lifetime ND, we used the Fagerstrom test for ND [34] measured at the time of the wave IV interview, which was asked with respect to the period when they smoked the most. This measure, which assesses the intensity of ND, includes questions such as "Do you find it difficult to refrain from smoking in places where it is forbidden?" We considered scores of ≥ 4 (vs. <4 symptoms) as indicative of ND [35,36].

CM assessment

Retrospective abuse history was assessed during the wave IV interview. Three questions assessed parental/adult caregiver sexual, physical, and emotional abuse, and two questions assessed non-parental/adult caregiver sexual abuse motivated by physical and nonphysical threats [33,37–39]. Parental/adult caregiver emotional abuse, physical, and sexual abuse was asked as "Before your 18th birthday, how often did a parent or other adult caregiver say things that really hurt your feelings or made you feel like you were not wanted or loved?", "How often did a parent or adult caregiver hit you with a fist, kick you or throw you down on the floor, into a wall, or down stairs?", and "How often did a parent or other adult caregiver touch you in a sexual way, force you to touch him or her in a sexual way, or force you to have sexual relations?", respectively. Questions about non-parental/adult caregiver sexual abuse were phrased as "Have you ever been forced, in a nonphysical way, to have any type of sexual activity against your will? For example, through verbal pressure, threats of harm, or by being given alcohol or drugs? Do not include any experiences with a parent or adult caregiver", and "Have you ever been physically forced to have any type of sexual activity against your will? Do not

include any experiences with a parent or adult caregiver". For an affirmative response to a question, participants were subsequently asked about the age abuse first occurred, and we only considered abuse beginning <18 years old as exposed. Neglect was assessed during wave III from the question "How often had your parents or other adult caregivers not taken care of your basic needs, such as keeping you clean or providing food or clothing?"

Abuse subtypes were considered as dichotomous variables, selecting cut-points that yield prevalence approximating those found in the Adverse Childhood Experiences questionnaire administered to a multistate, nationally representative population-based sample, the Behavioral Risk Factor Surveillance System [18]. For these data, the cut-points were 1 or more total times for sexual abuse (both parental/adult caregiver and non-parental/adult caregiver subtypes), 2 or more times for physical abuse, and 3 or more times for emotional abuse. For neglect, we considered 1 or more total times as exposed, which approximates the prevalence of physical neglect in a meta-analysis [40]. Each individual CM measure was assessed individually and the sum of individual CM measures was examined as a cumulative measure of maltreatment.

Confounders

We included participant age at wave IV, race/ethnicity, childhood SES, parental history of smoking, and other substance use, abuse, and/or dependence as potential confounders. Childhood SES was measured as the highest level of parental education in the household and was reported by a parent if available, and by the participant otherwise. For models examining continued smoking as the outcome and smoking trajectories, we included any cannabis use, high-risk alcohol use (more than 3 drinks per instance of drinking for women and more than 4 drinks per instance of drinking for men), and any other illicit drug use, all with respect to the last 30 days. For models assessing ND, substance use was operationalized as lifetime history of alcohol abuse or dependence, cannabis abuse or dependence, and other illicit drug use or dependence, all per Diagnostic and Statistical Manual version IV criteria. We implemented two sets of models for each outcome; one was adjusted for demographic factors and the other adjusted for demographic factors plus substance use related confounders.

Table 1
Descriptive characteristics of ever lifetime smokers with childhood maltreatment data

Characteristic	Male (n = 2107)	Female (n = 2187)
	Weighted percentage (SD.)	Weighted percentage (SD.)
Smoking behaviors		
Any smoking at wave IV*	70.17 (1.28)	65.75 (1.57)
Daily smoking at wave IV	45.75 (1.46)	43.14 (1.79)
Age of smoking onset <16 years†	43.46 (1.46)	50.37 (1.60)
Household parental smoking	71.03 (1.42)	74.09 (1.30)
Lifetime history of nicotine dependence‡	51.98 (1.80)	45.94 (1.74)
Smoking trajectories‡		
Current smoking in adolescence and adulthood	54.27 (1.96)	58.68 (1.72)
No current smoking in adolescence, smoking in adulthood	30.61 (1.82)	23.58 (1.53)
Current smoking in adolescence but not adulthood	7.41 (0.74)	11.01 (0.89)
No current smoking in adolescence or adulthood	7.72 (0.83)	6.73 (0.70)
Other recent substance use		
Marijuana use‡	32.45 (1.45)	21.65 (1.18)
High risk drinking‡	31.86 (1.64)	23.50 (1.18)
Other illicit drug use	11.36 (0.94)	8.20 (.80)
Lifetime other substance abuse/dependence		
Lifetime history of alcohol abuse or dependence‡	40.78 (1.60)	32.23 (1.47)
Lifetime history of cannabis abuse or dependence‡	26.58 (1.25)	15.09 (1.03)
Lifetime history of drug use/dependence	14.01 (1.00)	11.99 (.94)
Maltreatment exposures		
Parent/adult caregiver maltreatment		
Emotional abuse‡	24.11 (1.37)	35.82 (1.42)
Physical abuse	14.17 (0.93)	15.59 (1.16)
Sexual abuse‡	3.03 (0.50)	8.18 (.91)
Neglect‡	17.34 (1.18)	11.65 (.78)
Non-parent/adult caregiver sexual abuse		
By nonphysical threat‡	2.79 (.49)	16.87 (1.06)
By physical force	1.93 (.46)	12.67 (.86)
0 Total exposures‡	58.10 (1.51)	51.42 (1.84)
1 Exposure‡	28.03 (1.47)	24.12 (1.43)
2+ Exposures‡	13.87 (1.02)	24.45 (1.51)
Age	M = 28.49 y (SD = .12)	M = 28.26 y (SD = .13)
Race/ethnicity‡		
Hispanic	10.54 (1.66)	9.48 (1.27)
Black	12.54 (2.06)	8.70 (1.41)
Other	3.86 (.60)	3.32 (0.50)
Asian	3.80 (0.87)	2.66 (0.76)
White	69.27 (2.87)	75.85 (2.35)
Highest level of household parental education		
Less than high school	10.43 (1.40)	10.63 (1.34)
High school graduate/GED	25.72 (1.85)	30.01 (1.58)
Some college	32.09 (1.46)	30.05 (1.42)
College graduate	31.76 (2.04)	29.31 (2.28)

* χ^2 p-value <.05 for male versus female.
† χ^2 p-value <.01 for male versus female.
‡ χ^2 p-value <.001 for male versus female.

Table 2
Associations (risk ratios, 95% CI) between childhood maltreatment and continued smoking, modeled individually

Maltreatment type	Overall RR*	Male RR*	RR female*	Overall RR†	Male RR†	RR female†
	$n = 3581$	$n = 1917$	$n = 1664$	$n = 3581$	$n = 1917$	$n = 1664$
Parent/caregiver maltreatment						
Emotional abuse	0.96 (0.89, 1.03)	0.90 (0.82, 1.00)	1.04 (0.95, 1.14)	0.95 (0.89, 1.02)	0.89 (0.81, 0.99)	1.03 (0.94, 1.12)
Physical abuse	0.96 (0.87, 1.05)	0.91 (0.80, 1.05)	1.02 (0.91, 1.16)	0.93 (0.85, 1.03)	0.90 (0.78, 1.04)	0.98 (0.86, 1.11)
Sexual abuse	1.07 (0.90, 1.26)	1.06 (0.84, 1.35)	1.07 (0.91, 1.26)	1.03 (0.86, 1.22)	1.03 (0.79, 1.34)	1.03 (0.88, 1.20)
Neglect	1.07 (1.00, 1.16)	1.10 (1.01, 1.19)	1.04 (0.90, 1.21)	1.09 (1.01, 1.17)	1.10 (1.01, 1.20)	1.06 (0.93, 1.21)
Non-parent/caregiver maltreatment						
Sexual abuse by nonphysical threat	1.17 (1.03, 1.32)	1.18 (0.98, 1.41)	1.16 (1.02, 1.32)	1.15 (1.02, 1.30)	1.17 (0.97, 1.40)	1.13 (1.00, 1.28)
Sexual abuse by physical force	1.08 (0.91, 1.27)	0.97 (0.75, 1.26)	1.24 (1.08, 1.41)	1.08 (0.93, 1.26)	0.98 (0.77, 1.24)	1.21 (1.07, 1.37)
Maltreatment sum						
1 Total exposures versus 0	1.02 (0.96, 1.09)	1.00 (0.92, 1.08)	1.05 (0.94, 1.19)	1.01 (0.95, 1.08)	0.99 (0.91, 1.07)	1.05 (0.94, 1.17)
2+ Total exposures versus 0	1.02 (0.94, 1.12)	0.96 (0.84, 1.09)	1.13 (1.01, 1.26)	1.01 (0.93, 1.10)	0.94 (0.83, 1.08)	1.10 (0.98, 1.22)

* Adjusted for sex, age, race, childhood SES.
† Adjusted for sex, age, race, childhood SES, parental smoking, current marijuana use, current binge drinking, current other drug use.

Analyses

To examine relationships between CM, continued smoking, smoking trajectories, and ND, which were common outcomes, we calculated risk ratios with predicted marginal proportions [41], using SAS-callable SUDAAN. Each maltreatment exposure was modeled individually and collectively as a sum (1 exposure vs. 0 exposures and 2 or more exposures vs. 0 exposures). To assess interaction by sex, we also included an interaction term (maltreatment * sex) in each model, and models were computed for the overall sample and stratified by sex. Because maltreatment exposures are correlated, to discern the relative influence of each exposure, we also ran multivariable models that included all individual maltreatment exposure entered simultaneously as independent variables [42]. To assess smoking trajectories, we ran multinomial models to estimate the impact of CM on current smoking in adolescence only, current smoking in adulthood only, and current smoking in adulthood and adolescence (no current smoking in adolescence or adulthood study waves as the referent group). Analyses were conducted with complex sample weighting to account for the Add Health sampling design [43]. The weights account for loss-to-follow-up from the baseline study wave.

Sensitivity/exploratory analyses

Because daily smoking and nondaily smoking may have different behavioral causes [44], we implemented two sets of models examining nondaily smoking in the last 30 days (smoking 1–29 days) and daily smoking (smoking 30 days) as separate outcomes (referent group no smoking for both models). We also implemented models that did not exclude individuals who reported ND or regular smoking before CM to assess if reverse causation influences previously noted associations between childhood maltreatment and lifetime ND. We also conducted sensitivity analyses to help assess nonresponse bias on questions that had highest proportion of missing data. First, participants who did not report any history of smoking in wave IV were not asked about lifetime ND; therefore, all participants reporting histories of regular smoking in waves I, II, or III (but not IV) had missing data on lifetime ND. Because these participants may have not endorsed a history of lifetime regular smoking because they were less nicotine-dependent, we evaluated the impact of imputing missing values for these participants as no ND. Second, because participants missing data for at least one CM exposure were excluded, we examined associations for each individual maltreatment type irrespective of missingness for other CM exposures. Finally, we evaluated whether age of smoking onset modified the relationship between CM and continued smoking by testing CM*age of regular smoking onset (<16 vs. 16+ years) interaction terms and stratifying models by age of onset.

Results

Table 1 shows descriptive characteristics of the base study population for both smoking outcomes: individuals who reported a history of regular smoking and had complete data on childhood maltreatment exposures ($n = 4294$). Any current smoking and currently daily smoking were common at wave IV and a lifetime history of ND was common in this population. About half of participants reported current smoking at both adolescent and adulthood study waves. Also shown in Table 1, current substance use and lifetime histories of other forms of substance use were common in this population. Sexual abuse and emotional abuse were more common in women, and a higher proportion of women experienced poly-maltreatment than men.

Table 3
Associations (risk ratios, 95% CI) between childhood maltreatment exposures and continued smoking, all maltreatment exposures entered simultaneously

Maltreatment type	Overall RR	Male RR	Female RR
	$n = 3581$	$n = 1917$	$n = 1664$
Parent/caregiver maltreatment			
Emotional abuse	0.96 (0.89, 1.03)	0.91 (0.82, 1.01)	1.02 (0.93, 1.12)
Physical abuse	0.93 (0.84, 1.04)	0.94 (0.82, 1.08)	0.92 (0.79, 1.08)
Sexual abuse	1.00 (0.83, 1.21)	1.01 (0.76, 1.34)	1.00 (0.84, 1.18)
Neglect	1.09 (1.01, 1.17)	1.10 (1.01, 1.20)	1.07 (0.94, 1.22)
Non-parent/caregiver maltreatment			
Sexual abuse by nonphysical threat	1.17 (1.03, 1.33)	1.30 (1.07, 1.58)	1.01 (0.82, 1.25)
Sexual abuse by physical force	0.95 (0.70, 1.25)	0.76 (0.44, 1.30)	1.21 (1.03, 1.43)

Adjusted for sex, age, race, childhood SES, parental smoking, current marijuana use, current binge drinking, current other drug use.

Table 4
Associations (risk ratios, 95% CI) between childhood maltreatment and lifetime history of nicotine dependence, modeled individually

Maltreatment type	Overall RR*	Male RR*	RR female*	Overall RR†	Male RR†	RR female†
	$n = 3594$	$n = 1820$	$n = 1774$	$n = 3594$	$n = 1820$	$n = 1774$
Parent/caregiver maltreatment						
Emotional abuse	1.10 (1.01, 1.20)	1.09 (0.97, 1.23)	1.12 (0.99, 1.26)	1.05 (0.96, 1.15)	1.04 (0.92, 1.18)	1.06 (0.94, 1.19)
Physical abuse	1.16 (1.04, 1.29)	1.14 (0.99, 1.31)	1.18 (1.01, 1.39)	1.11 (0.99, 1.25)	1.10 (0.95, 1.27)	1.13 (0.97, 1.33)
Sexual abuse	1.23 (0.99, 1.53)	1.22 (0.89, 1.66)	1.26 (0.96, 1.65)	1.16 (0.92, 1.46)	1.14 (0.82, 1.60)	1.19 (0.90, 1.58)
Neglect	1.14 (1.03, 1.27)	1.08 (0.94, 1.24)	1.23 (1.04, 1.46)	1.13 (1.01, 1.25)	1.06 (0.91, 1.22)	1.22 (1.03, 1.45)
Non-parent/caregiver maltreatment						
Sexual abuse by nonphysical threat	1.14 (0.92, 1.42)	1.08 (0.77, 1.54)	1.23 (1.04, 1.46)	1.09 (0.87, 1.38)	1.04 (0.70, 1.50)	1.15 (0.98, 1.36)
Sexual abuse by physical force	1.23 (1.00, 1.52)	1.13 (0.78, 1.63)	1.39 (1.18, 1.63)	1.19 (0.97, 1.48)	1.10 (0.76, 1.61)	1.32 (1.10, 1.57)
Maltreatment sum						
1 Total exposures versus 0	1.10 (0.97, 1.25)	1.07 (0.93, 1.23)	1.16 (0.94, 1.42)	1.05 (0.93, 1.20)	1.01 (0.88, 1.17)	1.11 (0.91, 1.36)
2+ Total exposures versus 0	1.28 (1.15, 1.42)	1.24 (1.09, 1.42)	1.32 (1.14, 1.54)	1.20 (1.08, 1.34)	1.18 (1.03, 1.35)	1.24 (1.07, 1.45)

* Adjusted for sex, age, race, childhood SES.
† Adjusted for sex, age, race, childhood SES, parental smoking, lifetime history of marijuana, alcohol, other drug abuse/dependence.

Table 2 shows associations between childhood maltreatment and continued smoking at wave IV. In overall models adjusted for demographic factors as well as fully adjusted models, neglect and non-parent/caregiver sexual abuse by nonphysical threat were associated with continued smoking. In women, continued smoking was also associated with non-parent/caregiver sexual abuse by physical force in partially and fully adjusted models. For most maltreatment types, effect sizes were above the null in women, but this was less consistently observed in men. There were also statistically significant sex*maltreatment interactions for emotional abuse and non-parent/caregivers sexual abuse by force (both p = .03), with larger RRs observed for women. In models that adjusted for all forms of childhood maltreatment simultaneously (Table 3), the point estimate for non-parental/caregiver sexual abuse by force in women was similar to the model which did not include other forms of childhood adversity, and the largest RRs in men were observed with respect to non-parent/caregiver sexual abuse by nonphysical threat.

Table 4 shows associations between childhood maltreatment and ND. Overall, emotional abuse, physical abuse, and neglect and non-parent/caregiver perpetrated sexual abuse by physical force were associated with a history of lifetime ND, and individuals experiencing poly-maltreatment were at increased risk of ND. However, in fully adjusted models, associations were somewhat attenuated and only neglect and poly-maltreatment remained associated with ND, although the largest RRs were for non-parent/caregiver sexual abuse by physical force. Although no maltreatment*sex interaction terms were statistically significant, in women, the RRs were generally larger than in men, particularly for non-parent/caregiver abuse by physical force (fully adjusted RR = 1.32, 95% CI: 1.10, 1.57) and neglect (fully adjusted RR = 1.22, 95% CI: 1.03, 1.45). Table 5 shows the results of multivariable models for men and women when all maltreatment exposures were entered simultaneously. In men, similar to models where exposures were individually modeled, the largest point estimate was seen for parental/caregiver sexual abuse, although this estimate was small in magnitude (aRR = 1.12, 95% CI: 0.79, 1.60). In women, non-parental/caregiver sexual abuse by force was most strongly associated with ND.

Table 6 shows associations between CM and smoking trajectories. Women experiencing 2+ types of CM were approximately half as likely to be current smokers in adolescence, but not report current smoking in adulthood (aRR = 0.51, 95% CI: 0.26, 1.01). These inverse associations were not observed with respect to poly-maltreatment in men. However, in both men and women, non-parental/caregiver sexual abuse was inversely associated with current smoking in adolescence, but not adulthood. In men only, poly-maltreatment was positively associated with current smoking in both adolescence and adulthood (aRR = 1.21, 95% CI: 1.06, 1.38) and point estimates for associations with individual maltreatment types were all above 1. Also, in men only, current smoking in adulthood, but not adolescence was inversely associated with poly-maltreatment (aRR = 0.70, 95% CI: 0.52, 0.95) and point estimates for associations with individual maltreatment types were all below 1.

Tables A.2 and A.3 show associations between CM and continued smoking, considering daily and nondaily smoking as separate outcomes. Point estimates for both sets of models were generally similar to models that combined daily and nondaily smoking. In Tables A.4 and A.5, models that did not exclude individuals who reported ND and regular smoking onset before maltreatment exposure yielded point estimates that were similar to models that excluded these individuals. Imputing missing ND data as no ND yielded estimates that were only marginally higher than in models not imputing missing values (Table A.6). Models for individual maltreatment types not excluding participants with

Table 5
Associations (risk ratios, 95% CI) between childhood maltreatment exposures and lifetime history of nicotine dependence, all maltreatment exposures entered simultaneously

Maltreatment type	Overall RR	Male RR	Female RR
	$n = 3594$	$n = 1820$	$n = 1774$
Parent/caregiver maltreatment			
Emotional abuse	1.01 (0.90, 1.13)	1.01 (0.87, 1.17)	1.00 (0.87, 1.15)
Physical abuse	1.07 (0.92, 1.23)	1.08 (0.91, 1.29)	1.05 (0.86, 1.28)
Sexual abuse	1.11 (0.87, 1.43)	1.12 (0.79, 1.60)	1.10 (0.80, 1.53)
Neglect	1.11 (0.99, 1.23)	1.05 (0.91, 1.22)	1.18 (0.99, 1.41)
Non-parent/caregiver maltreatment			
Sexual abuse by nonphysical threat	0.95 (0.68, 1.32)	0.94 (0.56, 1.59)	0.96 (0.76, 1.22)
Sexual abuse by physical force	1.18 (0.89, 1.56)	1.09 (0.64, 1.84)	1.31 (1.07, 1.60)

Adjusted for sex, age, race, childhood SES, parental smoking, lifetime history of marijuana, alcohol, other drug abuse/dependence.

Table 6
Associations (risk ratios, 95% CI) between childhood maltreatment exposures and smoking trajectories (no current smoking in adolescence or adulthood as referent)

Maltreatment type	Male RR*	Female RR*	Male RR*	Female RR*	Male RR*	Female RR*
	Current smoking in adolescence and adulthood $n = 1016$	Current smoking in adolescence and adulthood $n = 923$	Current smoking in adulthood only $n = 594$	Current smoking in adulthood only $n = 430$	Current smoking in adolescence only $n = 170$	Current smoking in adolescence only $n = 188$
Parent/caregiver maltreatment						
Emotional abuse	1.04 (0.92, 1.17)	0.94 (0.84, 1.06)	0.83 (0.67, 1.02)	1.21 (0.99, 1.48)	1.13 (0.71, 1.81)	0.72 (0.47, 1.12)
Physical abuse	1.12 (0.96, 1.31)	0.96 (0.82, 1.13)	0.71 (0.51, 1.03)	1.02 (0.74, 1.43)	1.29 (0.76, 2.19)	0.88 (0.45, 1.71)
Sexual abuse	1.24 (0.94, 1.63)	1.03 (0.83, 1.29)	0.66 (0.33, 1.32)	0.96 (0.61, 1.52)	1.26 (0.40, 3.97)	1.02 (0.44, 2.63)
Neglect	1.21 (1.08, 1.35)	1.04 (0.91, 1.19)	0.78 (0.62, 0.98)	0.97 (0.71, 1.32)	1.06 (0.67, 1.67)	1.06 (0.67, 1.67)
Non-parent/caregiver maltreatment						
Sexual abuse by nonphysical threat	1.24 (0.95, 1.63)	1.08 (0.92, 1.27)	0.86 (0.46, 1.59)	1.01 (0.71, 1.45)	0.02 (0.00, 0.13)	0.60 (0.28, 1.30)
Sexual abuse by physical force	1.36 (1.09, 1.69)	0.99 (0.81, 1.22)	0.60 (0.32, 1.13)	1.39 (0.96, 2.02)	0.28 (0.04, 2.15)	0.07 (0.02, 0.20)
Maltreatment sum						
1 Total exposures versus 0	1.03 (0.91, 1.17)	0.94 (0.83, 1.07)	0.90 (0.75, 1.09)	1.21 (0.95, 1.55)	1.52 (1.04, 2.22)	0.86 (0.56, 1.33)
2+ Total exposures versus 0	1.21 (1.06, 1.38)	1.05 (0.91, 1.21)	0.70 (0.52, 0.95)	1.05 (0.78, 1.41)	0.97 (0.51, 1.86)	0.51 (0.26, 1.01)

* Adjusted for sex, age, race, childhood SES, parental smoking, current marijuana use, current binge drinking, current other drug use.

incomplete CM data yielded estimates similar to our primary models (Tables A.7 and A.8). Finally, CM* age of regular smoking onset interaction terms were not statistically significant and associations for models stratified by age of regular smoking onset were not meaningfully different.

Discussion

These data showed that among ever regular smokers, CM is associated with continued smoking into early adulthood and ND in a well-characterized, nationally representative sample, although most associations were small (RR < 1.3). Associations tended to be more consistently above the null for exposure to neglect and non-parent/caregiver sexual abuse. Associations were generally larger in women, suggesting that CM may be more clearly related to persistent smoking and ND in women; however, given that sex differences were fairly small in magnitude, additional studies should confirm the observed differences. Larger sex differences emerged for smoking trajectories, such that in women, poly-maltreatment was inversely related to endorsing current smoking in childhood but not in adolescent study waves, which suggests that women with CM histories may have difficulty quitting smoking. However, in men, poly-maltreatment was positively associated with endorsing current smoking in both adolescent and adulthood study waves, an outcome which also suggests persistent smoking.

Our results corroborate other findings in the literature, which have reported associations between various forms of CM and smoking outcomes. The magnitude of our associations was relatively smaller, which may be due to our referent groups not including individuals who had never regularly smoked. Although studies examining smoking outcomes have not established relatively stronger associations for sexual abuse and neglect, we note that experiences of sexual violence, particularly in women, have been more clearly linked with developmental outcomes [45,46], as well as other outcomes such as PTSD [47], adding to the plausibly of our observed stronger associations for some types of sexual abuse in women. In addition, we note that most studies have not examined the impact of parent/caregiver perpetrated versus nonparent/caregiver sexual abuse. Given that in the Add Health study population, parent/caregiver sexual abuse had an earlier onset than non-parent/caregiver sexual abuse [48], it is possible that our findings of stronger associations with non-parent/caregiver sexual abuse may be due to it being a more proximal exposure to smoking that typically begins in adolescence. While neglect is relatively understudied compared with other forms of maltreatment [40], studies support its role in substance use disorders and a distinct effect independent of abuse exposures on other outcomes [49]. It is possible that children with parents who did not address their needs may be less likely to address their own behaviors, such as smoking, that increase health risks as adults. Furthermore, some studies suggest that women, relative to men, who have experienced neglect may be more susceptible to substance use [50]. Finally, while studies of sex differences in CM-smoking relationships are limited, as previously noted, there is some evidence for stronger associations in women, consistent with our emotional abuse−sex interaction [25]. This also aligns with other studies that have reported stronger associations between CM and other forms of substance use in women [51,52]. The exact mechanisms contributing to increased vulnerability in women are unclear, but some data suggest mood disorders may serve as a mediator [25].

Our study has several limitations. First, we relied on self-reported data for smoking and maltreatment exposure, which may be subject to underreporting. The ND assessment was limited to the Fagerstrom measure, and our results may differ from studies that rely on other measures of ND (e.g., Diagnostic and Statistical Manual version IV measured dependence). The epidemic of teen smoking in the 1990s, during the adolescence of Add Health participants, may affect the generalizability of our findings [53]; social acceptance of smoking in this period may have yielded more regular smokers whose motivations for smoking were not related to psychosocial adversity. This could bias associations downward and may be another factor in our small point estimates. Our study also has important strengths. We had information on a diverse number of maltreatment exposures and the perpetrator. In addition, the longitudinal nature of Add Health allowed us to capture smoking behaviors at four different time points, allowing for a more valid assessment of lifetime regular smoking.

Conclusions

In summary, this study finds evidence of a relationship between CM and smoking that persists into adulthood, smoking trajectories, and ND, with potentially larger associations in women, and it highlights the role of upstream early-life psychosocial determinants of these smoking behaviors. Future studies should continue to explore sex differences and factors that may explain sex differences in links between childhood maltreatment and smoking behaviors related to cessation (e.g., PTSD). An examination of additional current forms of nicotine exposure, such as e-cigarettes, would also have high public health relevance. Although there is still

a relatively small literature on outcomes relevant to cessation, our study offers additional support that experiences of CM may impede smoking cessation efforts many years later. Trauma informed approaches considering exposures in early life may help guide effective public health prevention strategies.

Acknowledgments

This research uses data from Add Health, a program project directed by Kathleen Mullan Harris and designed by J. Richard Udry, Peter S. Bearman, and Kathleen Mullan Harris at the University of North Carolina at Chapel Hill, and funded by grant P01-HD31921 from the Eunice Kennedy Shriver National Institute of Child Health and Human Development, United States, with cooperative funding from 23 other federal agencies and foundations. Special acknowledgment is due Ronald R. Rindfuss and Barbara Entwisle for assistance in the original design. Information on how to obtain the Add Health data files is available on the Add Health website (http://www.cpc.unc.edu/addhealth). No direct support was received from grant P01-HD31921 for this analysis.

This work was supported by the National Institutes of Health, United States [grant R01HL125761-04S1].

Authors' contributions: All authors have participated in (a) conception and design, or analysis and interpretation of the data; (b) drafting the article or revising it critically for important intellectual content; and (c) approval of the final version.

References

[1] Centers for Disease Control and Prevention. Current Cigarette Smoking Among Adults in the United States. https://www.cdc.gov/tobacco/data_statistics/fact_sheets/adult_data/cig_smoking/index.htm. [Accessed 15 October 2018].
[2] Hiscock R, Bauld L, Amos A, Fidler JA, Munafo M. Socioeconomic status and smoking: a review. Ann N Y Acad Sci 2012;1248:107–23.
[3] Peckham E, Brabyn S, Cook L, Tew G, Gilbody S. Smoking cessation in severe mental ill health: what works? an updated systematic review and meta-analysis. BMC Psychiatry 2017;17(1):252.
[4] Huxley RR, Woodward M. Cigarette smoking as a risk factor for coronary heart disease in women compared with men: a systematic review and meta-analysis of prospective cohort studies. Lancet 2011;378(9799):1297–305.
[5] Shields M, Wilkins K. Smoking, smoking cessation and heart disease risk: a 16-year follow-up study. Health Rep 2013;24(2):12–22.
[6] Torre LA, Siegel RL, Ward EM, Jemal A. Global cancer incidence and mortality rates and trends–an update. Cancer Epidemiol Biomarkers Prev 2016;25(1):16–27.
[7] Siahpush M, McNeill A, Borland R, Fong GT. Socioeconomic variations in nicotine dependence, self-efficacy, and intention to quit across four countries: findings from the International Tobacco Control (ITC) Four Country Survey. Tob Control 2006;15(Suppl 3):iii71–5.
[8] Mahaffey BL, Gonzalez A, Farris SG, Zvolensky MJ, Bromet EJ, Luft BJ, et al. Smoking to regulate negative affect: disentangling the relationship between posttraumatic stress and emotional disorder symptoms, nicotine dependence, and cessation-related problems. Nicotine Tob Res 2016;18(6):1471–8.
[9] Nohlert E, Ohrvik J, Helgason AR. Self-perceived ability to cope with stress and depressive mood without smoking predicts successful smoking cessation 12 months later in a quitline setting: a secondary analysis of a randomized trial. BMC Public Health 2018;18(1):1066.
[10] Audrain-McGovern J, Leventhal AM, Strong DR. The role of depression in the uptake and maintenance of cigarette smoking. Int Rev Neurobiol 2015;124:209–43.
[11] Cinciripini PM, Blalock JA, Minnix JA, Robinson JD, Brown VL, Lam C, et al. Effects of an intensive depression-focused intervention for smoking cessation in pregnancy. J Consult Clin Psychol 2010;78(1):44–54.
[12] Higgins ST, Kurti AN, Redner R, White TJ, Gaalema DE, Roberts ME, et al. A literature review on prevalence of gender differences and intersections with other vulnerabilities to tobacco use in the United States, 2004-2014. Prev Med 2015;80:89–100.
[13] Smith PH, Bessette AJ, Weinberger AH, Sheffer CE, McKee SA. Sex/gender differences in smoking cessation: a review. Prev Med 2016;92:135–40.
[14] D'Angelo ME, Reid RD, Brown KS, Pipe AL. Gender differences in predictors for long-term smoking cessation following physician advice and nicotine replacement therapy. Can J Public Health 2001;92(6):418–22.
[15] Felitti VJ, Anda RF, Nordenberg D, Williamson DF, Spitz AM, Edwards V, et al. Relationship of childhood abuse and household dysfunction to many of the leading causes of death in adults. The Adverse Childhood Experiences (ACE) Study. Am J Prev Med 1998;14(4):245–58.
[16] Finkelhor D. The international epidemiology of child sexual abuse. Child Abuse Negl 1994;18(5):409–17.
[17] Gorey KM, Leslie DR. The prevalence of child sexual abuse: integrative review adjustment for potential response and measurement biases. Child Abuse Negl 1997;21(4):391–8.
[18] Merrick MT, Ford DC, Ports KA, Guinn AS. Prevalence of adverse childhood experiences from the 2011-2014 behavioral risk factor surveillance system in 23 states. JAMA Pediatr 2018;172:1038–44.
[19] Anda RF, Croft JB, Felitti VJ, Nordenberg D, Giles WH, Williamson DF, et al. Adverse childhood experiences and smoking during adolescence and adulthood. JAMA 1999;282(17):1652–8.
[20] Jun HJ, Rich-Edwards JW, Boynton-Jarrett R, Austin SB, Frazier AL, Wright RJ. Child abuse and smoking among young women: the importance of severity, accumulation, and timing. J Adolesc Health 2008;43(1):55–63.
[21] Kaplan SJ, Pelcovitz D, Salzinger S, Weiner M, Mandel FS, Lesser ML, et al. Adolescent physical abuse: risk for adolescent psychiatric disorders. Am J Psychiatry 1998;155(7):954–9.
[22] Mills R, Alati R, Strathearn L, Najman JM. Alcohol and tobacco use among maltreated and non-maltreated adolescents in a birth cohort. Addiction 2014;109(4):672–80.
[23] Topitzes J, Mersky JP, Reynolds AJ. Child maltreatment and adult cigarette smoking: a long-term developmental model. J Pediatr Psychol 2010;35(5):484–98.
[24] Edwards VJ, Anda RF, Gu D, Dube SR, Felitti VJ. Adverse childhood experiences and smoking persistence in adults with smoking-related symptoms and illness. Perm J 2007;11(2):5–13.
[25] Smith PH, Saddleson ML, Homish GG, McKee SA, Kozlowski LT, Giovino GA. The relationship between childhood physical and emotional abuse and smoking cessation among U.S. women and men. Psychol Addict Behav 2015;29(2):338–46.
[26] Taha F, Galea S, Hien D, Goodwin RD. Childhood maltreatment and the persistence of smoking: a longitudinal study among adults in the US. Child Abuse Negl 2014;38(12):1995–2006.
[27] Afifi TO, Henriksen CA, Asmundson GJ, Sareen J. Childhood maltreatment and substance use disorders among men and women in a nationally representative sample. Can J Psychiatry 2012;57(11):677–86.
[28] Al Mamun A, Alati R, O'Callaghan M, Hayatbakhsh MR, O'Callaghan FV, Najman JM, et al. Does childhood sexual abuse have an effect on young adults' nicotine disorder (dependence or withdrawal)? Evidence from a birth cohort study. Addiction 2007;102(4):647–54.
[29] Nelson EC, Heath AC, Madden PA, Cooper ML, Dinwiddie SH, Bucholz KK, et al. Association between self-reported childhood sexual abuse and adverse psychosocial outcomes: results from a twin study. Arch Gen Psychiatry 2002;59(2):139–45.
[30] Xie P, Kranzler HR, Zhang H, Oslin D, Anton RF, Farrer LA, et al. Childhood adversity increases risk for nicotine dependence and interacts with alpha5 nicotinic acetylcholine receptor genotype specifically in males. Neuropsychopharmacology 2012;37(3):669–76.
[31] Jackson D, Usher K, O'Brien L. Fractured families: parental perspectives of the effects of adolescent drug abuse on family life. Contemp Nurse 2006;23(2):321–30.
[32] Silverman JG, Raj A, Mucci LA, Hathaway JE. Dating violence against adolescent girls and associated substance use, unhealthy weight control, sexual risk behavior, pregnancy, and suicidality. JAMA 2001;286(5):572–9.
[33] Harris KM, Halpern CT, Whitsel E, Hussey J, Tabor J, Entzel P, et al. The National Longitudinal Study of Adolescent to Adult Health: Research Design. https://www.cpc.unc.edu/projects/addhealth/design. [Accessed 1 October 2018].
[34] Heatherton TF, Kozlowski LT, Frecker RC, Fagerstrom KO. The fagerstrom test for nicotine dependence: a revision of the fagerstrom tolerance questionnaire. Br J Addict 1991;86(9):1119–27.
[35] Breslau N, Johnson EO. Predicting smoking cessation and major depression in nicotine-dependent smokers. Am J Public Health 2000;90(7):1122–7.
[36] Hu MC, Davies M, Kandel DB. Epidemiology and correlates of daily smoking and nicotine dependence among young adults in the United States. Am J Public Health 2006;96(2):299–308.
[37] Briere J, Elliott DM. Prevalence and psychological sequelae of self-reported childhood physical and sexual abuse in a general population sample of men and women. Child Abuse Negl 2003;27(10):1205–22.
[38] Crowley TJ, Mikulich SK, Ehlers KM, Hall SK, Whitmore EA. Discriminative validity and clinical utility of an abuse-neglect interview for adolescents with conduct and substance use problems. Am J Psychiatry 2003;160(8):1461–9.
[39] Straus MA, Hamby SL, Finkelhor D, Moore DW, Runyan D. Identification of child maltreatment with the Parent-Child Conflict Tactics Scales: development and psychometric data for a national sample of American parents. Child Abuse Negl 1998;22(4):249–70.
[40] Stoltenborgh M, Bakermans-Kranenburg MJ, van Ijzendoorn MH. The neglect of child neglect: a meta-analytic review of the prevalence of neglect. Soc Psychiatry Psychiatr Epidemiol 2013;48(3):345–55.
[41] Bieler GS, Brown GG, Williams RL, Brogan DJ. Estimating model-adjusted risks, risk differences, and risk ratios from complex survey data. Am J Epidemiol 2010;171(5):618–23.
[42] Gilbert R, Kemp A, Thoburn J, Sidebotham P, Radford L, Glaser D, et al. Recognising and responding to child maltreatment. Lancet 2009;373(9658):167–80.
[43] Chen P, Chantala K. Guidelines for Analyzing Add Health Data. https://www.cpc.unc.edu/projects/addhealth/documentation/guides/wt_guidelines_20161213.pdf. [Accessed 1 October 2018].

[44] Shiffman S, Dunbar MS, Scholl SM, Tindle HA. Smoking motives of daily and non-daily smokers: a profile analysis. Drug Alcohol Depend 2012;126(3):362–8.
[45] Lewis T, McElroy E, Harlaar N, Runyan D. Does the impact of child sexual abuse differ from maltreated but non-sexually abused children? A prospective examination of the impact of child sexual abuse on internalizing and externalizing behavior problems. Child Abuse Negl 2016;51:31–40.
[46] Noll JG. Sexual abuse of children–unique in its effects on development? Child Abuse Negl 2008;32(6):603–5.
[47] Kessler RC, Sonnega A, Bromet E, Hughes M, Nelson CB. Posttraumatic stress disorder in the National Comorbidity Survey. Arch Gen Psychiatry 1995;52(12):1048–60.
[48] Cammack AL, Hogue CJ. Retrospectively self-reported age of childhood abuse onset in a United States nationally representative sample. Inj Epidemiol 2017;4(1):7.
[49] Teicher MH, Anderson CM, Ohashi K, Khan A, McGreenery CE, Bolger EA, et al. Differential effects of childhood neglect and abuse during sensitive exposure periods on male and female hippocampus. Neuroimage 2018;169:443–52.
[50] Huang S, Trapido E, Fleming L, Arheart K, Crandall L, French M, et al. The long-term effects of childhood maltreatment experiences on subsequent illicit drug use and drug-related problems in young adulthood. Addict Behav 2011;36(1-2):95–102.
[51] Hyman SM, Garcia M, Sinha R. Gender specific associations between types of childhood maltreatment and the onset, escalation and severity of substance use in cocaine dependent adults. Am J Drug Alcohol Abuse 2006;32(4):655–64.
[52] Widom CS, Marmorstein NR, White HR. Childhood victimization and illicit drug use in middle adulthood. Psychol Addict Behav 2006;20:394–403.
[53] Pampel FC, Aguilar J. Changes in youth smoking, 1976-2002: a time-series analysis. Youth Soc 2008;39(4):453–79.

Appendix A

Table A.1
Timing of assessment for variables used the analysis

Study wave	Variable
Wave I	Childhood socioeconomic status
	Race/ethnicity
	Parental smoking
Wave II	Parent/caregiver-perpetrated physical abuse
	Parent/caregiver-perpetrated sexual abuse
Wave IV	Parent/caregiver-perpetrated emotional abuse
	Parent/caregiver-perpetrated physical abuse
	Parent/caregiver-perpetrated sexual abuse
	Non-parent/caregiver-perpetrated sexual abuse by nonphysical threat
	Non-parent/caregiver-perpetrated sexual abuse by physical force
	Nicotine dependence
	Current cigarette smoking
	Age
	Sex
	Current marijuana use
	Current binge drinking
	Current other illicit drug use
	Age of nicotine dependence symptoms onset
	Lifetime history of marijuana abuse/dependence
	Lifetime history of alcohol abuse/dependence
	Lifetime history of other drug abuse/dependence
Waves I and II	Current smoking in adolescence
Waves III and IV	Current smoking in adulthood
Waves I, II, III, and IV	History of ever being a regular smoker
	Age of regular smoking onset (information used from earliest report)

Table A.2
Associations (risk ratios, 95% CI) between childhood maltreatment exposures and daily continued smoking

Maltreatment type	Overall RR	Male RR	Female RR
	$n = 2671$	$n = 1423$	$n = 1248$
Parent/caregiver maltreatment			
Emotional abuse	0.94 (0.86, 1.03)	0.86 (0.75, 0.98)	1.06 (0.95, 1.19)
Physical abuse	0.92 (0.80, 1.05)	0.86 (0.70, 1.06)	0.99 (0.83, 1.18)
Sexual abuse	1.01 (0.78, 1.30)	0.98 (0.66, 1.44)	1.04 (0.84, 1.30)
Neglect	1.13 (1.01, 1.25)	1.14 (1.01, 1.28)	1.11 (0.92, 1.34)
Non-parent/caregiver maltreatment			
Sexual abuse by nonphysical threat	1.17 (0.97, 1.42)	1.23 (0.92, 1.63)	1.10 (0.92, 1.33)
Sexual abuse by physical force	1.14 (0.93, 1.38)	1.03 (0.77, 1.36)	1.28 (1.06, 1.53)
Maltreatment sum			
1 Total exposures versus 0	1.02 (0.93, 1.11)	0.96 (0.86, 1.07)	1.10 (0.96, 1.26)
2+ Total exposures versus 0	1.02 (0.91, 1.15)	0.95 (0.79, 1.13)	1.13 (0.97, 1.30)

Adjusted for sex, age, race, childhood SES, parental smoking, current marijuana use, current binge drinking, current other drug use.

Table A.3
Associations (risk ratios, 95% CI) between childhood maltreatment exposures and non-daily continued smoking

Maltreatment type	Overall RR	Male RR	Female RR
	$n = 2076$	$n = 1092$	$n = 984$
Parent/caregiver maltreatment			
Emotional abuse	0.90 (0.78, 1.04)	0.83 (0.67, 1.04)	1.00 (0.83, 1.20)
Physical abuse	0.91 (0.76, 1.09)	0.88 (0.67, 1.16)	0.95 (0.72, 1.25)
Sexual abuse	1.11 (0.80, 1.55)	1.15 (0.70, 1.90)	1.06 (0.75, 1.51)
Neglect	1.09 (0.92, 1.29)	1.17 (0.94, 1.46)	0.99 (0.74, 1.33)
Non-parent/caregiver maltreatment			
Sexual abuse by nonphysical threat	1.42 (1.10, 1.84)	1.41 (0.95, 2.09)	1.44 (1.12, 1.85)
Sexual abuse by physical force	1.10 (0.75, 1.61)	0.82 (0.40, 1.70)	1.47 (1.11, 1.94)
Maltreatment sum			
1 Total exposures versus 0	1.01 (0.87, 1.17)	1.04 (0.86, 1.26)	0.97 (0.75, 1.26)
2+ Total exposures versus 0	0.99 (0.82, 1.20)	0.85 (0.62, 1.17)	1.18 (0.93, 1.50)

Adjusted for sex, age, race, childhood SES, parental smoking, current marijuana use, current binge drinking, current other drug use.

Table A.4
Associations (risk ratios, 95% CI) between childhood maltreatment and nicotine dependence, not excluding individuals who reported nicotine dependence occurring before maltreatment exposure

Maltreatment type	Overall RR	Male RR	Female RR
	$n = 3777$	$n = 1865$	$n = 1912$
Parent/caregiver maltreatment			
Emotional abuse	1.05 (0.97, 1.15)	1.06 (0.94, 1.19)	1.05 (0.93, 1.18)
Physical abuse	1.10 (0.99, 1.22)	1.11 (0.96, 1.27)	1.09 (0.92, 1.28)
Sexual abuse	1.18 (0.95, 1.46)	1.15 (0.84, 1.58)	1.21 (0.95, 1.54)
Neglect	1.14 (1.03, 1.27)	1.05 (0.91, 1.22)	1.26 (1.08, 1.48)
Non-parent/caregiver maltreatment			
Sexual abuse by nonphysical threat	1.11 (0.91, 1.35)	1.08 (0.78, 1.50)	1.14 (0.98, 1.32)
Sexual abuse by physical force	1.17 (0.95, 1.43)	1.12 (0.79, 1.60)	1.22 (1.05, 1.42)
Maltreatment sum			
1 Total exposures versus 0	1.06 (0.94, 1.20)	1.03 (0.90, 1.18)	1.12 (0.92, 1.35)
2+ Total exposures versus 0	1.18 (1.07, 1.31)	1.18 (1.04, 1.34)	1.18 (1.01, 1.38)

Adjusted for sex, age, race, childhood SES, parental smoking, lifetime history of marijuana, alcohol, other drug abuse/dependence.

Table A.5
Associations (risk ratios, 95% CI) between childhood maltreatment and continued smoking, not excluding individuals who reported regular smoking onset before maltreatment exposure

Maltreatment type	Overall RR	Male RR	Female RR
	$n = 4021$	$n = 2044$	$n = 1977$
Parent/caregiver maltreatment			
Emotional abuse	0.95 (0.90, 1.02)	0.90 (0.81, 0.99)	1.02 (0.95, 1.10)
Physical abuse	0.96 (0.89, 1.04)	0.92 (0.82, 1.04)	1.00 (0.91, 1.11)
Sexual abuse	1.06 (0.94, 1.20)	1.09 (0.90, 1.31)	1.04 (0.92, 1.17)
Neglect	1.09 (1.02, 1.16)	1.10 (1.01, 1.20)	1.07 (0.95, 1.19)
Non-parent/caregiver maltreatment			
Sexual abuse by nonphysical threat	1.08 (0.96, 1.22)	1.07 (0.86, 1.32)	1.10 (1.01, 1.19)
Sexual abuse by physical force	1.09 (0.96, 1.24)	1.02 (0.82, 1.26)	1.18 (1.07, 1.29)
Maltreatment sum			
1 Total exposures versus 0	1.02 (0.95, 1.08)	0.98 (0.91, 1.06)	1.06 (0.96, 1.17)
2+ Total exposures versus 0	1.02 (0.95, 1.10)	0.96 (0.85, 1.08)	1.10 (1.00, 1.21)

Adjusted for sex, age, race, childhood SES, parental smoking, current marijuana use, current binge drinking, current other drug use.

Table A.6
Associations (risk ratios, 95% CI) between exposure to childhood maltreatment and nicotine dependence, imputing missing values for nicotine dependence as zero

Maltreatment type	Overall RR	Male RR	Female RR
	$n = 4060$	$n = 2042$	$n = 2018$
Parent/caregiver maltreatment			
Emotional abuse	1.08 (0.98, 1.19)	1.08 (0.95, 1.23)	1.09 (0.96, 1.23)
Physical abuse	1.15 (1.02, 1.29)	1.14 (0.97, 1.32)	1.16 (0.99, 1.37)
Sexual abuse	1.22 (0.97, 1.53)	1.21 (0.88, 1.67)	1.22 (0.92, 1.63)
Neglect	1.13 (1.01, 1.26)	1.03 (0.89, 1.20)	1.25 (1.05, 1.49)
Non-parent/caregiver maltreatment			
Sexual abuse by nonphysical threat	1.13 (0.89, 1.44)	1.10 (0.74, 1.62)	1.18 (0.99, 1.40)
Sexual abuse by physical force	1.22 (1.01, 1.47)	1.09 (0.79, 1.53)	1.39 (1.18, 1.64)
Maltreatment sum			
1 Total exposures versus 0	1.07 (0.94, 1.23)	1.02 (0.88, 1.19)	1.15 (0.93, 1.42)
2+ Total exposures versus 0	1.24 (1.12, 1.39)	1.22 (1.06, 1.40)	1.29 (1.11, 1.49)

Adjusted for sex, age, race, childhood SES, parental smoking, lifetime history of marijuana, alcohol, other drug abuse/dependence.

Table A.7
Associations (risk ratios, 95% CI) between childhood maltreatment and continued smoking, not limited to individuals with complete information on all maltreatment exposures

Parent/caregiver maltreatment			
Emotional abuse*	0.94 (0.88, 1.00)	0.87 (0.79, 0.96)	1.03 (0.95, 1.11)
Physical abuse†	0.94 (0.86, 1.02)	0.88 (0.77, 1.00)	1.01 (0.91, 1.11)
Sexual abuse‡	1.07 (0.94, 1.22)	1.09 (0.89, 1.34)	1.05 (0.92, 1.19)
Neglect§	1.10 (1.03, 1.17)	1.11 (1.03, 1.21)	1.07 (0.96, 1.20)
Non-parent/caregiver maltreatment			
Sexual abuse by nonphysical threat‖	1.14 (1.01, 1.28)	1.16 (0.97, 1.37)	1.11 (0.98, 1.27)
Sexual abuse by physical force¶	1.09 (0.95, 1.26)	1.00 (0.80, 1.25)	1.20 (1.07, 1.35)

* $n = 4025$.
† $n = 4106$.
‡ $n = 4209$.
§ $n = 4099$.
‖ $n = 4057$.
¶ $n = 4127$.

Table A.8
Associations (risk ratios, 95% CI) between childhood maltreatment and nicotine dependence, not limited to individuals with complete information on all maltreatment exposures

	Overall RR	Male RR	Female RR
Parent/caregiver maltreatment			
Emotional abuse*	1.05 (0.97, 1.15)	1.06 (0.94, 1.19)	1.05 (0.93, 1.18)
Physical abuse†	1.09 (0.97, 1.22)	1.06 (0.91, 1.22)	1.13 (0.96, 1.33)
Sexual abuse‡	1.13 (0.89, 1.43)	1.11 (0.78, 1.58)	1.16 (0.90, 1.49)
Neglect§	1.14 (1.03, 1.27)	1.05 (0.91, 1.21)	1.26 (1.08, 1.47)
Non-parent/caregiver maltreatment			
Sexual abuse by nonphysical threat‖	1.09 (0.87, 1.36)	1.04 (0.74, 1.47)	1.15 (0.98, 1.37)
Sexual abuse by physical force¶	1.18 (0.96, 1.44)	1.08 (0.75, 1.55)	1.32 (1.13, 1.55)

* $n = 3884$.
† $n = 3921$.
‡ $n = 3955$.
§ $n = 3844$.
‖ $n = 3890$.
¶ $n = 3922$.