Published in final edited form as:

Addiction. 2016 May ; 111(5): 913–923. doi:10.1111/add.13292.

Childhood maltreatment, personality disorders, and 3-year persistence of adult alcohol and nicotine dependence in a national sample

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Abstract

Background and Aims—Persistent cases of alcohol and nicotine dependence are associated with considerable morbidity and mortality, and are predicted by childhood maltreatment and personality disorders. Our aim was to test whether personality disorders (individually or conjointly) mediate the relationship between childhood maltreatment and the persistence of dependence.

Design—Personality disorders, modeled dimensionally, were tested as mediators of the relationship between childhood maltreatment and the 3-year persistence of alcohol and nicotine dependence in participants in the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) who had current alcohol and nicotine dependence in their baseline interview. Individual personality disorders were assessed in separate models. Then, those that were

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Declaration of interest: No conflict of interest is declared.

significant were examined jointly in multiple mediator models to determine their total and unique effects.

Setting—A large, nationally representative United States survey.

Participants—Participants 18 years who completed baseline and 3-year follow-up NESARC interviews who had baseline alcohol dependence ($n=1,172$; 68% male) or nicotine dependence ($n=4,017$; 52.9% male).

Measurements—Alcohol Use Disorder and Associated Disabilities Interview Schedule (AUDADIS-IV) measures of childhood maltreatment, personality disorders, and alcohol/nicotine dependence.

Findings—Individual models indicated that many personality disorders mediated the relationship between childhood maltreatment and the 3-year persistence of alcohol and nicotine dependence (each explaining 6%–46% of the total effect, $ps<0.05$). In multiple mediator models, borderline and antisocial symptoms remained significant mediators, each explaining 20%–37% of the total effect ($ps<0.01$).

Conclusions—Personality disorder symptoms (especially borderline and antisocial) help explain the association between childhood maltreatment and persistent alcohol and nicotine dependence.

INTRODUCTION

Alcohol and nicotine dependence are common disorders (1, 2) that place a considerable burden on the health and well-being of the general population (3, 4). A disproportionate part of this burden is accounted for by chronic, persistent cases, as persistent alcohol dependence is associated with mental health and relationship problems (5) and medical illnesses, e.g., liver disease, pancreatitis, and cardiomyopathy (6), while persistent nicotine dependence is associated with cancers, cardiovascular and other chronic diseases (7). Much epidemiologic research has focused on risk factors for the occurrence of alcohol and nicotine dependence. However, less is known about risk factors for persistence of these disorders once they have started, representing a gap in knowledge of substantial public health importance. Childhood maltreatment, which affects DNA methylation and brain function (8–10) and disrupts learning of core skills (e.g., interpersonal, affect regulation) (11, 12), is a risk factor for a range of psychopathology (8–10, 12–15). Childhood maltreatment increases the risk for the occurrence of nicotine (16) and alcohol (17) dependence as well as their persistence (18). However, the mechanisms through which these distal childhood experiences predict persistent cases of adult dependence remain unknown.

Personality disorders may be one such mechanism. Consistent with childhood maltreatment's effects on a range of psychopathology (15), childhood maltreatment predicts increased odds for nearly all personality disorders (19). Childhood maltreatment is also associated with the development of enduring maladaptive traits that are seen across personality disorders (20), e.g., emotional reactivity (21), impulsivity (22), and poor coping strategies (23). In addition, most personality disorders predict increased risk for three-year persistence of adult alcohol and/or nicotine dependence (24), consistent with the enduring nature of impairment associated with personality disorders (25, 26). Consequently,

personality disorders may mediate the effect of childhood maltreatment on persistence, potentially providing an explanation for the mechanisms of this effect. In other words, childhood maltreatment may influence persistence of adult dependence through adaptation of maladaptive traits/behaviors characteristic of personality pathology.

Using a large, nationally representative dataset, our goal was to determine whether personality disorders mediated the effect of childhood maltreatment on the 3-year persistence of alcohol and nicotine dependence. This was tested among individuals meeting criteria for alcohol and nicotine dependence at a baseline interview. We aimed to:

1. Determine whether personality disorders mediated the effects of childhood maltreatment on persistent alcohol and nicotine dependence, testing each personality disorder separately.
2. Using combined mediator models, simultaneously test mediation of all personality disorders that were significant in individual models.

Given the comorbidity and overlap in symptomology among personality disorders (27), we tested multiple-mediator models to determine both the total mediating effect of personality disorder symptomology and the unique mediating effects of each personality disorder.

METHODS

Participants, procedures

The National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) sampled residents of households and group quarters aged 18 and older (28, 29), using a multistage cluster sampling procedure (30). Black and Hispanic adults, and adults aged 18–24 years, were oversampled, with data adjusted for oversampling and nonresponse. At Wave 1 (2001–2002), 43,093 participants were interviewed (28). Wave 2 re-interviews (N=34,653) were conducted approximately 3 years later, with 86.7% of Wave 1 participants who were eligible for re-interview (29, 31).

Participants who completed both waves and had Wave 1 current (past 12-month) diagnoses of DSM-IV alcohol dependence (n=1,172) or nicotine dependence (n=4,017) formed our subsamples (18, 24). These participants were chosen in order to assess factors associated with maintaining full criteria for dependence (i.e., chronicity/persistence) throughout the three years between Wave 1 and Wave 2. The majority of participants in the alcohol and nicotine dependent subsamples were male, White, and younger than 40 years; about half were college graduates; marital status differed between alcohol and nicotine dependent subsamples (18, 24) (Table 1).

Measures

All measures are from the Alcohol Use Disorder and Associated Disabilities Interview Schedule (AUDADIS-IV) (32–34).

Persistent DSM-IV alcohol and nicotine dependence—DSM-IV alcohol and nicotine dependence require 3 criteria within a 12-month period. AUDADIS-IV

dependence diagnoses have good-to-excellent test-retest reliability (alcohol: κ s=0.66–0.79; (35) nicotine: κ =0.63 (33)). Wave 1 current dependence required meeting criteria within the last 12 months. At Wave 2, dependence was assessed for the last 12 months, and prior to the last 12 months but since Wave 1. Consistent with prior research (18, 24, 36), persistent dependence occurred when those with baseline current dependence continued to meet full dependence criteria across all three years of the follow-up (queried at Wave 2 for last 12 months, and prior to the last 12 months but since Wave 1).

Childhood maltreatment—Childhood maltreatment experiences prior to age 18 were assessed using a measure, adapted from earlier empirically validated scales (37, 38), that included items assessing physical, sexual, and emotional abuse, as well as physical and emotional neglect (32). For the present analyses, we included physical neglect and physical, sexual, and emotional abuse, as these maltreatment types predict persistent alcohol and nicotine dependence (18) and have excellent test–retest reliability (ICCs=0.79–0.88) and internal consistency (α s=0.78–0.90) (32). Participants responded to items assessing these maltreatment experiences using a five-point scale (never, almost never, sometimes, fairly often, very often).

For a more parsimonious representation, we evaluated childhood maltreatment as a continuous latent construct using a second-order factor structure. Four latent maltreatment factors representing physical neglect, physical abuse, sexual abuse, and emotional abuse were created based on the responses to the items in these scales. Confirmatory factor analysis (MPlus Version 7.1 (39)) indicated that a general factor that accounted for the commonality of the four lower order latent factors had good model fit (40): RMSEA=.049, CFI=0.93, TLI=0.92 (for factor loadings, see Table S1). This latent variable was therefore used in all analyses, standardized to have mean=0 and variance=1. Factor loadings of the latent childhood maltreatment factor were constrained to be the same across subsamples with alcohol and/or nicotine dependence to produce standardization and enhance interpretation across the two groups.

DSM-IV personality disorders—Symptoms of antisocial, avoidant, borderline, dependent, histrionic, narcissistic, obsessive-compulsive, paranoid, schizoid and schizotypal personality disorders were assessed, as described elsewhere (24). As defined in DSM-IV, these diagnoses require evidence of long-term maladaptive patterns of cognition, emotion and functioning. Therefore, symptoms of all personality disorders, except for antisocial, were assessed with an introduction and repeated reminders to answer about how they felt or acted “most of the time, throughout your life, regardless of the situation or whom you were with,” excluding symptoms occurring only when depressed, manic, anxious, drinking heavily, using drugs, recovering from the effects of alcohol/drugs, or physically ill. Antisocial was assessed at Wave 1, with questions about conduct disorder before age 15 and adult antisocial symptoms since age 15; adult symptoms were assessed again at Wave 2. Adult symptoms endorsed at both waves were considered positive in our study. All other disorders were assessed once (Wave 1: avoidant, obsessive-compulsive, paranoid, histrionic, dependent, schizoid (33); Wave 2: borderline, narcissistic, schizotypal (32)).

Items addressing personality disorder symptoms, worded in non-technical language to avoid the need for insight or judgment, were adapted from semi-structured diagnostic interviews (41–43). In this study, we used personality disorder criteria counts, reflecting the dimensional nature of severity (44, 45). Such criteria counts consisted of seven to nine criteria for each personality disorder. The antisocial criteria count consisted of seven adult criteria and an eighth representing conduct disorder. Criteria counts demonstrated good-to-excellent test-retest reliability (ICC: 0.50–0.79) (32, 33) and internal consistency (Table 2). As expected, all personality disorder variables were significantly correlated in both alcohol and nicotine dependent subsamples, with correlations that varied in magnitude (r 0.06–0.60).

Demographic characteristics—Age, sex, race, marital status, and education were used as control covariates.

Analysis plan

Descriptive statistics—Means and standard errors were produced with MPlus, which adjusts for the complex NESARC sampling design using a weighted log-likelihood function and sandwich estimators.

Structural Equation Models—Associations between the latent childhood maltreatment variable, the personality disorder variables, and alcohol or nicotine dependence persistence were tested with structural equation modeling (SEM) (MPlus Version 7.1 (39)), controlling for age, sex, race, marital status, and education. We used multigroup SEM to enable us to simultaneously incorporate the baseline alcohol and nicotine dependent groups into the same models. This was done in order to constrain the latent factor model for childhood maltreatment to be invariant across the alcohol and nicotine dependent subsamples, thus allowing results for the two outcomes to be more directly comparable. The multigroup SEM separately estimated the effects for nicotine and alcohol dependence persistence. Subjects who had both nicotine and alcohol dependence were also included; for these participants the effects on nicotine persistence were constrained to be the same as those with nicotine dependence only, and the effects on alcohol persistence were constrained to be the same as those with alcohol dependence only. A probit link function was used for modeling the relationships of childhood maltreatment and personality disorders with the two dichotomous persistence outcomes; the WLSMV estimation method was used due to its robustness (46).

First, an SEM was fit to estimate the total effect, τ , of childhood maltreatment on persistence of alcohol or nicotine dependence (Figure 1; Model A). Second, a series of SEMs were fit including each personality disorder variable separately as a mediator to obtain the coefficients α , β , and τ' in Model B (Figure 1, Model B). Third, to detect total and unique mediation effects, a multiple-mediator SEM was fit including all personality disorder variables that were significant in individual mediator models for either outcome, that allowed for their correlations with each other (Figure 1, Model C). For interpretability, the probit coefficients (τ , τ' , β) were back-transformed to represent percent change in the risk of persistent alcohol or nicotine dependence associated with a one standard deviation increase in the predictor. Because inverse probit functions are non-linear, back-transformed estimates are not homogeneous across levels of persistence risk. Therefore, we present these results

against a reference: the overall rate of persistent dependence in the alcohol and nicotine dependent subsamples, respectively.

Indirect (mediation) effect—The traditional ‘product of coefficient’ method for estimating indirect effects (47) can be biased when modeling binary outcomes (48), and is therefore inadvisable. A counterfactual definition of indirect causal effects has become widely accepted (48–54), and allows generation of back-transformed estimates on the probability scale (enhancing interpretability), so we use this method. In this model, the indirect causal effect of childhood maltreatment on persistence through each personality disorder is defined as the difference between expected values of the outcome (i.e., the probability of persistence) if one changes the number of PD criteria in the presence of no childhood maltreatment to the expected number of PD criteria if there had been a one standard deviation increase in the childhood maltreatment variable, while not actually changing the value of the childhood maltreatment variable. For this, we used the Mplus estimation method for indirect effects (46). Specifically, after back-transforming the probit effect estimates to the probability scale (MPLUS MODEL CONSTRAINT (46)), this indirect effect was calculated as the difference between τ and τ' (i.e., $\tau - \tau'$). Whether this difference equaled zero was tested using standard errors obtained with the delta method (55). To determine the percent change in risk of persistent dependence that was due to the indirect effect, the indirect effect was divided by the total effect.

Sensitivity analyses: First, to confirm consistency of results and to provide results interpretable to readers unfamiliar with presented methodology, mediation was tested using MPLUS Model Indirect. Second, mediation analyses were repeated using several alternate operationalizations of the antisocial variable. These analyses were conducted because diagnostic criteria are unclear regarding whether full conduct disorder criteria are required for an antisocial diagnosis, and because conduct disorder could be incorporated into the criteria count in several ways. Third, models were conducted including additional control for Axis I mood and anxiety disorders, to ensure that comorbidity did not explain these associations.

RESULTS

3-Year Persistence of Alcohol Dependence

Among participants with Wave 1 alcohol dependence, 30.1% had persistent dependence at Wave 2 (18, 24). The weighted mean number of personality disorder criteria endorsed ranged from 0.55 (s.e. 0.04) for dependent to 2.98 (s.e. 0.08) for narcissistic (Table 2). Childhood maltreatment predicted persistent alcohol dependence ($p < .001$; Model A, Table 3). Compared to the reference level, each one standard deviation increase in maltreatment predicted an 8.7% (95% CI 5.7%–11.7%) increase in the risk of persistent alcohol dependence.

In models testing personality disorders individually, maltreatment predicted the level of each personality disorder variable ($p < .001$; α , Model B, Table 3). The magnitude of increase in mean personality disorder criteria associated with a one standard deviation increase in maltreatment varied from 0.17 (dependent) to .78 (borderline). Five personality disorder

criteria counts predicted alcohol dependence persistence (borderline, schizotypal, antisocial, narcissistic, histrionic; $p < .05$; β , Model B, Table 3). A one-criterion increase in these personality disorder criteria was associated with a 2.5% (histrionic) to 15.2% (antisocial) increase in the risk of alcohol dependence persistence. Tests of the indirect effect of maltreatment through each personality disorder (τ - τ') indicated that the indirect effects were significant for these five personality disorders ($p < .05$; Table 3). These indirect effects ranged in magnitude, from a 0.6% increase in the risk of alcohol dependence persistence for histrionic (representing 7% of the total maltreatment effect) to a 4.0% increase for borderline (representing 46% of the total maltreatment effect).

In the multiple-mediator model that included the eight personality disorders that were significant mediators for either alcohol or nicotine persistence, the overall indirect effect of personality disorders was significant ($p < 0.001$, Table 4), representing 67% of the total effect. However, the magnitude of the indirect effects were generally smaller than in the individual models, and only borderline and antisocial remained significant (Table 4). Of the 8.7% total increase in the risk of alcohol dependence persistence predicted by childhood maltreatment, 3.0% (95% CI 1.2%–4.8%) was indirect through borderline ($p < .01$), and 3.3% (95% CI 1.9%–4.7%) was indirect through antisocial ($p < .001$). When all mediators were accounted for, the direct effect of childhood maltreatment was not significant ($p = .12$).

3-Year Persistence of Nicotine Dependence

Among participants with Wave 1 nicotine dependence, 56.6% had persistent dependence at Wave 2 (18, 24). The weighted mean number of personality disorder criteria endorsed by the nicotine dependent sample ranged from 0.45 (s.e. 0.02) for dependent to 2.27 (s.e. 0.05) for narcissistic (Table 2). Childhood maltreatment predicted persistent nicotine dependence ($p < .001$; Model A, Table 3). Compared to the reference level, each one standard deviation increase in maltreatment predicted a 6.5% (95% CI 4.8%–8.3%) increase in the risk of persistent nicotine dependence.

Maltreatment predicted each personality disorder variable ($p < .001$; α , Model B, Table 3). Eight personality disorders predicted nicotine dependence persistence: borderline, schizotypal, antisocial, narcissistic, histrionic, obsessive-compulsive, avoidant, and dependent ($p < .05$; β , Model B, Table 3). The magnitude of the increase in risk of nicotine dependence persistence associated with a one criterion increase in the personality disorder criteria count ranged from 1.8% (obsessive-compulsive and histrionic) to 6.8% (antisocial). Tests of the indirect effect of maltreatment through each personality disorder (τ - τ') indicated that the indirect effect was significant for all eight of these personality disorders ($p < .05$; Table 3). These indirect effects ranged in magnitude, from a 0.4% increase in the risk of nicotine dependence persistence for histrionic, obsessive-compulsive and dependent (6% of the total maltreatment effect) to a 2.9% increase for borderline (45% of the total maltreatment effect).

In the multiple-mediator model that included these eight personality disorders, the overall indirect effect of personality disorders was significant ($p < 0.001$, Table 4), representing 61% of the total effect. However, the magnitude of each indirect effect was smaller than in the individual models, and only borderline and antisocial remained significant (Table 4). Of the

6.5% total increase in the risk of nicotine persistence predicted by childhood maltreatment, 2.0% (95% CI 1.0%–3.0%)) was indirect through borderline ($p<.001$) and 1.3% (95% CI 0.7%–1.9%) was indirect through antisocial ($p<.001$). The direct effect of childhood maltreatment accounted for the remaining 2.6% increase in the risk of persistent nicotine dependence ($p<.01$).

Sensitivity analyses

Results were generally consistent (with few exceptions) using Model Indirect (Tables S2, S3), using alternate operationalizations of antisocial (Tables S4, S5), and with additional control for Axis I mood and anxiety disorders (Tables S6, S7).

DISCUSSION

Childhood maltreatment prospectively predicts the persistence of adult alcohol and nicotine dependence (18). Yet, why these distal childhood experiences predict persistence of adult disorders has been uncertain. To address this, we investigated whether personality disorder symptoms mediated this association. Results indicated significant mediating effects in both individual- and multiple-mediator models, particularly for borderline and antisocial symptoms.

Borderline demonstrated large indirect effects. This suggests that either collective number of borderline symptoms or perhaps specific important symptoms of this disorder may interfere with remission from substance dependence among individuals maltreated in childhood. Previous research suggested that specific borderline features such as feelings of emptiness and impulsivity are particularly important to persistent drug use disorder (36). Future research could examine whether such symptoms are also responsible for borderline's mediating effects in the current study. Borderline demonstrated mediation in both individual models and in multiple mediator models that included seven other personality disorders, emphasizing the importance and uniqueness of this effect.

Antisocial also evidenced consistent mediating effects, suggesting that antisocial symptoms are also important in predicting persistent alcohol and nicotine dependence among individuals maltreated in childhood. As with borderline, future research is needed to determine whether certain symptoms are primarily responsible for this indirect effect. Potential candidates include those previously found to predict persistence of drug use disorders (e.g., irresponsibility, lack of remorse) (36).

Taken together, borderline and antisocial symptomology, stemming from a difficult childhood, may interfere with ability to remit from adult alcohol or nicotine dependence. Particularly influential symptoms of these disorders should be identified and targeted in therapy to help individuals with a history of childhood maltreatment more effectively manage their affect and behavior. Other personality disorders were significant mediators in individual models, but many explained little variance, and all lost significance in multiple-mediator models, suggesting overlap in effect with more important borderline or antisocial symptoms.

Study limitations are noted. First, the sequence of some elements of our model can be determined with more certainty than others. Childhood maltreatment, defined as occurring prior to age 18, is by definition prior to 3-year persistence of dependence measured prospectively among individuals age 18 and over when first assessed. The models also assume that childhood maltreatment precedes personality disorder onset. Given that childhood maltreatment experiences prior to age 18 were assessed, and personality disorder often begins in adolescence or early adulthood (25), this assumption seems reasonable. It is also consistent with studies that show that maltreated children who subsequently decrease in ego resilience are most at risk for the problems that later constitute personality psychopathology (56). However, our models also assume that personality disorders precede 3-year persistence. The certainty of this assumption is less clear, particularly as some personality disorders were assessed only at Wave 2. However, when personality disorder symptoms were assessed (regardless of the wave), participants were repeatedly reminded to endorse only symptoms present *throughout their entire life* regardless of a list of extenuating circumstances that included substance use. Further, previous research shows that AUDADIS personality disorders assessed at either wave measure ongoing psychopathology (57). However, age and sequence of childhood maltreatment, personality disorder, and dependence should be investigated if appropriate data can be found.

Additional study limitations include the three year duration of follow-up. While a longer timeframe is desirable, three years is longer than most treatment study follow-ups, and reflects a persistent problem that increases risk for health and psychosocial problems. Also, disorders were not clinician-assessed. However, clinician assessments do not necessarily add to the predictive ability of reliable, valid, structured assessments (58). Additionally, all measures were based on self-report. Despite concerns about underreporting of childhood maltreatment, this method is used widely and generally considered valid (59). Finally, the alcohol sample was smaller than the nicotine sample, which may account for some differences between models. However, the alcohol sample was substantial ($N > 1,000$), so any undetected effects are likely to be small.

The study also has strengths. The research question is novel. Results enhance understanding of how childhood maltreatment influences the persistence of alcohol and nicotine dependence, common disorders associated with considerable disability, morbidity and premature mortality. Data were drawn from a large, nationally representative sample. Persistence of alcohol and nicotine dependence was ascertained prospectively. Reliable and valid measures were used. Continuous personality disorder variables maximized variance. Maltreatment was modeled as a latent variable, providing conceptual unity to observed variables. Multiple-mediator models allowed determination of conjoint and unique effects. Sensitivity analyses generally yielded similar results, supporting our conclusions.

This study demonstrates that personality disorder symptomatology explains much of the association between childhood maltreatment and persistent alcohol and nicotine dependence. For maltreated individuals with persistent dependence, extending research attention to symptoms of personality disorders (i.e., impulsivity, irresponsibility), and to their environmental and biological causes, may increase understanding of the reasons for poor

outcomes. Additionally, greater clinical attention to helping patients manage dysfunctional personality traits may mitigate lasting effects of maltreatment.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

Funding: This study was funded by grants U01AA018111, K05AA014223, and K23AA023753 from the National Institute on Alcohol Abuse and Alcoholism (NIAAA) (Drs. Hasin and Elliott); T32DA031099 from the National Institute on Drug Abuse (NIDA) (Dr. Elliott); and the New York State Psychiatric Institute (Drs. Hasin and Wall). The National Epidemiologic Survey on Alcohol and Related Conditions was sponsored by the NIAAA and funded in part by the Intramural Program, NIAAA, National Institutes of Health, with additional support from NIDA.

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Model A:

Model B:

Model C:

Figure 1.

Three models for the effect of childhood maltreatment on persistence of alcohol and nicotine dependence.

Table 1

Demographic characteristics for alcohol and nicotine dependent subsamples.

	Alcohol Dependent Sample (n=1172)	Nicotine Dependent Sample (n=4017)
Gender		
Male	68.0%	52.9%
Ethnicity		
White	69.9%	79.6%
Black	10.8%	8.3%
American Indian/Alaska Native, Not Hispanic	3.3%	4.1%
Asian/Native Hawaiian/ Pacific Islander	2.3%	2.0%
Hispanic or Latino	13.7%	6.0%
Age		
18–29	53.5%	28.4%
30–39	21.6%	23.0%
40–49	17.5%	24.9%
50+	7.4%	23.7%
Education		
College graduate	55.1%	46.8%
Marital Status		
Married	27.7%	49.6%
Living with someone as married	7.3%	5.7%
Widowed/ Divorced/ Separated	16.0%	20.5%
Never been married	49.0%	24.2%

Note. This descriptive information has been published previously (18, 24).

Table 2

Number of possible and endorsed criteria, as well as internal consistency, for all personality disorder criteria counts.

	Alcohol Dependent Sample (n = 1172)			Nicotine Dependent Sample (n = 4017)		
	Possible number of criteria	Weighted mean (S.E) criteria endorsed	α	Weighted mean (S.E) criteria endorsed	α	
Borderline	9	2.47 (0.09)	0.82	2.06 (0.05)	0.81	
Schizotypal	9	2.13 (0.08)	0.76	2.04 (0.04)	0.76	
Antisocial	8	0.94 (0.05)	0.72	0.56 (0.02)	0.70	
Narcissistic	9	2.98 (0.08)	0.74	2.27 (0.05)	0.74	
Schizoid	7	2.17 (0.06)	0.67	2.18 (0.04)	0.67	
Histrionic	8	2.41 (0.06)	0.66	1.77 (0.04)	0.62	
Paranoid	7	1.71 (0.07)	0.80	1.45 (0.04)	0.74	
Obsessive-compulsive	8	2.05 (0.06)	0.65	2.18 (0.04)	0.61	
Avoidant	7	1.03 (0.06)	0.80	0.84 (0.03)	0.77	
Dependent	8	0.55 (0.04)	0.73	0.45 (0.02)	0.72	

Childhood maltreatment, personality disorders and the risk for 3-year persistence of alcohol or nicotine dependence: Separate mediator models for each personality disorder.^a

Table 3

Outcome	Model A Childhood maltreatment, no PDs		Model B Childhood maltreatment: direct effects on persistence, and indirect effects via individual personality disorders			
	Total childhood maltreatment effect on persistence (τ) ^b	Direct childhood maltreatment effect on persistence (τ') ^b	Childhood maltreatment effect on PD (α) ^c	PD effect on persistence (β) ^b	Indirect childhood maltreatment effect on persistence through PD ($\tau - \tau'$)	% of total childhood maltreatment effect explained by PD ($(\tau - \tau')/\tau$)
% increase in persistence risk ^d						
Alcohol dependence persistence (n=1172)						
Change in PD symptom count ^d						
% increase in persistence risk ^e						
% increase in persistence risk ^f						
% increase in persistence risk ^g						
Alcohol dependence persistence (n=1172)						
Borderline	-	4.4 ^h (1.2–7.6)	.78 ^j (.71–.85)	5.2 ^j (3.6–6.9)	4.0 ^j (2.7–5.4)	46
Schizotypal	-	6.5 ^j (3.4–9.7)	.60 ^j (.54–.67)	3.4 ^j (1.9–5.0)	2.0 ^j (1.1–3.0)	23
Antisocial	-	4.5 ^j (1.3–7.8)	.27 ^j (.25–.29)	15.2 ^j (10.0–20.4)	3.9 ^j (2.6–5.3)	45
Narcissistic	-	6.7 ^j (3.7–9.7)	.42 ^j (3.6–4.8)	4.2 ^j (2.7–5.8)	1.7 ^j (1.1–2.4)	20
Schizoid	-	8.7 ^j (5.7–11.8)	.23 ^j (.17–.28)	–0.4 (–2.2–1.4)	–0.1 (–0.5–0.3)	--
Histrionic	-	8.0 ^j (4.9–11.0)	.25 ^j (.20–.30)	2.5 ^h (0.3–4.7)	0.6 ^h (0.1–1.2)	7
Paranoid	-	8.1 ^j (5.0–11.2)	.40 ^j (.34–.46)	1.3 (–1.0–3.6)	0.5 (–0.4–1.4)	6
Obsessive-Compulsive	-	8.5 ^j (5.5–11.5)	.23 ^j (.17–.28)	0.6 (–1.2–2.3)	0.1 (–0.3–0.5)	1
Avoidant	-	8.6 ^j (5.6–11.5)	.30 ^j (.25–.34)	0.4 (–1.9–2.7)	0.1 (–0.6–0.8)	1
Dependent	-	8.4 ^j (5.4–11.5)	.17 ^j (.14–.20)	1.3 (–1.7–4.2)	0.2 (–0.3–0.7)	2
Nicotine dependence persistence (n=4017)						
Borderline	-	3.7 ^j (3.9–11.8)	.78 ^j (.71–.85)	3.7 ^j (2.9–4.5)	2.9 ^j (2.2–3.6)	45
Schizotypal	-	4.7 ^j (2.8–6.6)	.60 ^j (.54–.67)	3.1 ^j (2.1–4.0)	1.9 ^j (1.3–2.4)	29
Antisocial	-	4.7 ^j (2.7–6.7)	.27 ^j (.25–.29)	6.8 ^j (4.8–8.8)	1.9 ^j (1.3–2.4)	29

Outcome	Model A Childhood maltreatment, no PDs		Model B Childhood maltreatment: direct effects on persistence, and indirect effects via individual personality disorders			
	Total childhood maltreatment effect on persistence $(\tau)^b$	Direct childhood maltreatment effect on persistence $(\tau)^b$	Childhood maltreatment effect on PD $(\alpha)^c$	PD effect on persistence $(\beta)^b$	Indirect childhood maltreatment effect on persistence through PD $(\tau - \tau')$	% of total childhood maltreatment effect explained by PD $(\tau - \tau')/\tau$
	% increase in persistence risk ^d	% increase in persistence risk ^e	Change in PD symptom count ^d	% increase in persistence risk ^f	% increase in persistence risk ^g	%
Narcissistic	-	5.5 ^j (3.7–7.3)	.42 ^j (3.6–4.8)	2.6 ^j (1.7–3.4)	1.1 ^j (0.7–1.5)	17
Schizoid	-	6.4 ^j (4.7–8.2)	.23 ^j (.17–.28)	0.3 (-.8–1.4)	0.1 (-0.2–0.3)	2
Histrionic	-	6.1 ^j (4.3–7.8)	.25 ^j (.20–.30)	1.8 ^j (0.6–2.9)	0.4 ^j (0.1–0.7)	6
Paranoid	-	6.2 ^j (4.4–8.0)	.40 ^j (.34–.46)	0.9 (-0.4–2.2)	0.4 (-0.1–0.9)	6
Obsessive-Compulsive	-	6.1 ^j (4.4–7.9)	.23 ^j (.17–.28)	1.8 ^j (0.6–2.9)	0.4 ^j (0.1–0.7)	6
Avoidant	-	5.9 ^j (4.1–7.7)	.30 ^j (.25–.34)	2.1 ^j (0.7–3.6)	0.6 ^j (0.2–1.1)	9
Dependent	-	6.1 ^j (4.4–7.9)	.17 ^j (.14–.20)	2.2 ^h (0.3–4.2)	0.4 ^h (0.1–0.7)	6

^aAll analyses adjusted for gender, marital status, race, education and age. Values representing the percent increase in persistence risk use a baseline reference value of the persistence prevalence in the sample (30.1% for persistence of alcohol dependence and 56.6% for persistence of nicotine dependence). Percent change is computed by calculating the inverse probit of the regression coefficient from the probit models and subtracting the inverse probit of the baseline value.

^bprobit regression.

^clinear regression.

^dfor each unit increase in maltreatment factor.

^efor each unit increase in maltreatment factor, after removing variance accounted for by PD.

^ffor each unit increase in personality disorder criteria count.

^gIndirect effect may not exactly equal difference between total and direct effects due to rounding error.

^hSignificant at $p < .05$.

ⁱSignificant at $p < .01$.

100%
Significant at p < .001

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Childhood maltreatment, personality disorders and the risk for 3-year persistence of alcohol or nicotine dependence: Combined mediator models including all individually significant personality disorders.^a

Table 4

Model C						
Childhood maltreatment: direct effects on persistence, and indirect effects via individual personality disorders						
Outcome	Direct childhood maltreatment effect on persistence (τ) ^b	Childhood maltreatment effect on PD (α) ^c	PD effect on persistence (β) ^b	Indirect childhood maltreatment effect on persistence through PD ($\tau - \tau'$)	% of total childhood maltreatment effect explained by PD ($(\tau - \tau')/\tau$)	
Change in PD symptom count ^d						
	% increase in persistence risk ^e		% increase in persistence risk ^f	% increase in persistence risk ^g		%
Alcohol dependence persistence (n=1172)	2.7(-0.7-6.1)					
Borderline		.79 ^j (.72-.87)	3.8 ^j (1.5-6.0)	3.0 ^j (1.2-4.8)		34
Schizotypal		.62 ^j (.55-.69)	-0.6 (-2.9-1.6)	-0.4 (-1.8-1.0)		-
Antisocial		.28 ^j (.26-.30)	12.6 ^j (7.2-17.9)	3.3 ^j (1.9-4.7)		37
Narcissistic		.43 ^j (.37-.49)	1.6 (-0.3-3.6)	0.7 (-0.1-1.5)		8
Histrionic		.26 ^j (.21-.31)	0.7 (-1.9-3.3)	0.2 (-0.5-0.9)		2
Obsessive-Compulsive		.23 ^j (.18-.29)	-0.9(-2.9-1.2)	-0.2 (-0.7-0.3)		-
Avoidant		.30 ^j (.26-.35)	-1.2 (-3.8-1.4)	-0.4 (-1.2-0.4)		-
Dependent		.17 ^j (.14-.20)	-1.9 (-5.2-1.5)	-0.3 (-0.9-0.3)		-
Sum of All PDs				6.0 ^j (4.2-7.9)		67
Nicotine dependence persistence (n=4017)	2.6 ^j (0.5-4.8)					
Borderline		.79 ^j (.72-.87)	2.5 ^j (1.3-3.7)	2.0 ^j (1.0-3.0)		30
Schizotypal		.62 ^j (.55-.69)	0.8 (-0.6-2.1)	0.5 (-0.3-1.3)		8
Antisocial		.28 ^j (.26-.30)	4.6 ^j (2.5-6.7)	1.3 ^j (0.7-1.9)		20
Narcissistic		.43 ^j (.37-.49)	0.3 (-0.8-1.5)	0.1 (-0.4-0.7)		2

Model C					
Childhood maltreatment: direct effects on persistence, and indirect effects via individual personality disorders					
Outcome	Direct childhood maltreatment effect on persistence (τ) ^b	Childhood maltreatment effect on PD (α) ^c	PD effect on persistence (β) ^b	Indirect childhood maltreatment effect on persistence through PD ($\tau - \tau'$)	% of total childhood maltreatment effect explained by PD ($\tau - \tau'$) / τ
	% increase in persistence risk ^e	Change in PD symptom count ^d	% increase in persistence risk ^f	% increase in persistence risk ^g	%
Histrionic		.26 ^j (.21–.31)	–0.1 (–1.4–1.2)	0.0 (–0.4–0.3)	0
Obsessive-Compulsive		.23 ^j (.18–.29)	0.8 (–0.5–2.0)	0.2 (–0.1–0.5)	3
Avoidant		.30 ^j (.26–.35)	0.7 (–1.1–2.4)	0.2 (–0.3–0.7)	3
Dependent		.17 ^j (.14–.20)	–1.2 (–3.5–1.2)	–0.2 (–0.6–0.2)	–
Sum of All PDs				4.0 ^j (3.2–4.8)	61

^a All analyses adjusted for gender, marital status, race, education and age. Values representing the percent increase in persistence risk use a baseline reference value of the persistence prevalence in the sample (30.1% for persistence of alcohol dependence and 56.6% for persistence of nicotine dependence). Percent change is computed by calculating the inverse probit of the regression coefficient from the probit models and subtracting the inverse probit of the baseline value.

^b probit regression.

^c linear regression.

^d for each unit increase in maltreatment factor.

^e for each unit increase in maltreatment factor, after removing variance accounted for by PD.

^f for each unit increase in personality disorder criteria count.

^g Indirect effect may not exactly equal difference between total and direct effects due to rounding error.

^h Significant at $p < .05$.

ⁱ Significant at $p < .01$.

^j Significant at $p < .001$.