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Life adversity is associated with smoking relapse after a quit attempt

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Abstract

Multiple cross-sectional studies have linked adverse childhood events and adult adversities to current smoking, lifetime smoking, and former smoking. To date, however, there have been no direct observation studies assessing the influence of adversities on smoking relapse. We prospectively followed 123 participants, 86 of whom were habitual smokers, from pre-quit ad libitum smoking to four weeks post quit. Thirty-seven non-smokers were also tested in parallel as a comparison group. Subjects provided biological samples for confirmation of abstinence status and self-report history of adversities such as abuse, neglect, family dysfunction, incarceration, and child-parent separation. They also completed mood and smoking withdrawal symptom measures. The results indicated that within non-smokers and smokers who relapsed within the first month of a quit attempt, but not abstainers, females had significantly higher adversity scores than males. Cigarette craving, which was independent from depressive affect, increased for low adversity participants, but not those with no adversity or high adversity. These results demonstrate that sex and relapse status interact to predict adversity and that craving for nicotine may be an important additional mediator of relapse. These results add further support to the previous cross-sectional evidence of an adversity and smoking relationship. Further studies to clarify how adversity complicates smoking cessation and impacts smoking behaviors are warranted.

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Keywords

Adverse childhood events; tobacco; smoking; cessation; relapse; depression

Introduction

Despite significant strides in tobacco control policies over the past 20 years, approximately 18% of young persons will begin smoking (Aldrich et al., 2014). Depression and anxiety have been linked with the initiation and maintenance of smoking (Kassel et al., 2007; Killen et al., 1996). It is important to note that the relationship between depression, anxiety, and smoking is complex and, at times, bidirectional, and there is some emphasize that smoking itself is a risk factor for subsequent development of depressive affect (Kassel, Stroud, & Paronis, 2003). In addition to depression, individual differences in anxiety also interact with environmental circumstances, including stress, in determining who will experience increases in anxiety with smoking (Evatt & Kassel, 2010). Research has consistently linked negative emotions and depression to other important smoking variables that complicate quit attempts. For example, negative emotions related to stress decrease an individual's ability to resist smoking and increase the number and velocity of puffs taken while smoking a cigarette (McKee et al., 2011).

For the chronic smoker who attempts to quit, depression, anxiety, craving, and anger have been linked to relapse following a quit attempt (al'Absi, Carr, & Bongard, 2007; al'Absi, Nakajima, Allen, Lemieux, & Hatsukami, 2015; Nakajima & al'Absi, 2012; Roche et al., 2014; Tsaur, Strasser, Souprontchouk, Evans, & Ashare, 2015). Both trauma exposure and the experience of adverse childhood experiences, including loss, abuse, and neglect, are strong predictors of depression (Kendler, Kessler, Neale, Heath, & Eaves, 1993; Kim et al., 2013; Sen, Exworthy, & Forrester, 2014; Tang, Liu, Liu, Xue, & Zhang, 2014; Young, Harford, Kinder, & Savell, 2007). Interpersonal traumas or adult adversities contribute to increased depression and other mental health problems, including the adult adversities or trauma of intimate partner violence (Devries et al., 2013; Farris, Zvolensky, Beckham, Vujanovic, & Schmidt, 2014; Lagdon, Armour, & Stringer, 2014) and the chronic stress of caregiving for family members with mental illness or substance abuse problems (Jiang, Callinan, Laslett, & Room, 2015; Kate, Grover, Kulhara, & Nehra, 2013; Priestley & McPherson, 2015; Vella & Pai, 2013). There are complex and interdependent relationships between adversities and trauma across the developmental lifespan. Mental illness such as PTSD, depression, and comorbid substance use heightens the risk of further trauma, thereby perpetuating the cycle of trauma, poor mental health, and substance abuse (Ullman, Najdowski, & Filipas, 2009). Given this, it is important to consider how life adversity and trauma influence nicotine dependence and relapse.

Adverse childhood experiences and trauma have long been linked to substance use and related physical illnesses. Early work demonstrated that adversity, particularly at high levels, was capable of tripling an individual's risk of early smoking initiation (Anda et al., 1999; Felitti et al., 1998). As the burden of adversity increases, so does the likelihood of being a current heavy smoker (Anda et al., 1999). Likewise, a well-developed literature on

interpersonal partner violence (IPV) during adulthood also shows that victims, as well as their perpetrators, are more likely to smoke than non-victims regardless of relationship type or socioeconomic status (Crane, Hawes, & Weinberger, 2013; Crane, Pilver, & Weinberger, 2014). Trauma exposure also has direct and indirect effects on nicotine dependence and smoking behaviors (Farris et al., 2014). Since the early work linking childhood adversity to smoking, there has continued to be strong support for the adversity, trauma, and smoking relationship from large epidemiological, cross-sectional studies, and, more recently, prospective studies (Bellis, Hughes, Leckenby, Perkins, & Lowey, 2014; Crane et al., 2013; Crane et al., 2014; Edwards, Anda, Gu, Dube, & Felitti, 2007; Elliott et al., 2014; Ford et al., 2011; Taha, Galea, Hien, & Goodwin, 2014; Xie et al., 2012). More specifically, depression and adversity independently predict smoking persistence in patients experiencing serious smoking-related illnesses and increased health risks directly mediated by smoking (Edwards et al., 2007). Some studies addressing adverse childhood experiences have further suggested that anxiety, especially in women, is a stronger predictor than depression of when someone classifies him or herself as a former smoker (Fuller-Thomson, Filippelli, & Lue-Crisostomo, 2013). It has also been suggested that the effect of adversity on smoking persistence is independent of either depression or anxiety (Taha et al., 2014) though with IPV other substance use (alcohol) severity and mental health, including PTSD-related symptoms, predict daily smoking (Jessup, Dibble, & Cooper, 2012; Sullivan et al., 2015).

The above review suggests that adversity and trauma predict a variety of smoking behaviors including early smoking initiation, habitual smoking, and persistence in smoking despite increased health risks, highlighting the role of life adversity as a potential mediator of smoking addiction. Although readiness to quit has been investigated relative to IPV perpetration (Stuart et al., 2006), to the authors' knowledge, no study to date has explored by direct observation prospectively the role of adversity in smoking relapse following a quit attempt. We therefore examined the association of adversity with smoking relapse by assessing whether a group of smokers who relapsed within the first month of a quit attempt reported higher lifetime adversity than those who remained abstinent. Although a variety of adult trauma exposures such as natural disasters, war, and terrorism may impact various aspects of smoking (Calhoun, Levin, Dedert, Johnson, & Beckham, 2011; Dorahy et al., 2015; Geiling, Rosen, & Edwards, 2012; Harville, Xiong, & Buekens, 2009), in this study we focus only on childhood adverse experiences and interpersonal adult adversities or trauma such as abuse, neglect, IPV, and substance abuse or mental illness in the family. As both the adversity and smoking literatures point to important sex differences, the potential for a sex by relapse status interaction on adversity scores will also be examined. Furthermore, we examined whether characteristics of the withdrawal experience, baseline mood, or biological smoking indicators were related to adversity. We hypothesized that smokers with early smoking relapse would report higher adversity in comparison to those who were able to successfully abstain from smoking, and female relapsers would have higher adversity scores than any other subgroup. We also hypothesized that negative affect, craving, and higher level of nicotine exposure would be related to higher adverse life experiences.

Methods

Participants

This study was a secondary analysis of a larger scale project which investigated predictors of smoking relapse (al'Absi et al., 2015). Participants were recruited through advertisements and flyers posted in the local community. Interested participants called the laboratory and completed a telephone screening. They were then invited to an on-site medical screening during which eligibility was determined. Participants must have had: (a) no current major physical or psychiatric conditions; (b) two or fewer alcoholic drinks per day; and (c) no routine prescribed medication use, except for contraceptives. Smokers must have smoked 10 or more cigarettes per day. Although it is well known that both childhood and adult adversities predict increased risk of physical and psychiatric dysfunction, the parent study protocol required the exclusion of current major physical or psychiatric conditions as potential confounders of neuroendocrine and psychophysiological function. The participants also needed to claim a strong motivation to quit smoking. Qualified candidates read and signed a consent form approved by the University of Minnesota IRB, and were monetarily compensated for their participation. A total of 123 individuals (37 non-smokers and 86 smokers) were included in the current report.

Measures

Psychological—Participants completed an adversity questionnaire based on the Adverse Childhood Experiences questionnaire (Felitti et al., 1998; Ford et al., 2011). Adversity was queried through questions about psychological abuse, physical abuse, sexual abuse, household member substance abuse, household member mental illness, household member suicide attempt, mother treated violently, and household member incarceration. The adversity questionnaire had 14 items. Due to an error in printing, the instructions did not explicitly state “prior to age 18” as in the original ACE questionnaire, therefore this version should more broadly be considered to be a lifetime adversity due to the potential for reporting events in both childhood or adulthood (see Supplemental Table S1). Baseline mood differences were assessed using the Patient Health Questionnaire-9 (PHQ-9) (Kroenke, Spitzer, & Williams, 2001) and State-Trait Anxiety Inventory (STAI) (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983). The STAI is a 40 item inventory that includes state anxiety and trait anxiety subscales. The trait anxiety measure subscale was used in this analysis (STAI-T). Possible STAI scores for the trait anxiety measure range from 20 to 80. The PHQ-9 is a 9-item scale (0 “not at all” to 3 “nearly every day”) with an overall score range of 0 to 27.

Demographic & Smoking measures—Demographic variables (e.g., age, years of education), smoking history (e.g., average cigarettes per day), and nicotine dependence levels using the Fagerström Test of Nicotine Dependence (FTND) (Heatherton, Kozlowski, Frecker, & Fagerstrom, 1991) were collected at baseline. In addition to tobacco use, alcohol use was quantified as self-report of never, rarely, approximately two drinks per day, or greater than two drinks per day. A modified version of the Minnesota Nicotine Withdrawal Scale (MNWS) was used to measure the severity of withdrawal symptoms (J. Hughes & Hatsukami, 1998; J. R. Hughes & Hatsukami, 1986). The item “desire to smoke” was

analyzed separately to examine craving, since studies have reported that withdrawal symptoms and craving have different patterns of change (J. Hughes & Hatsukami, 1998). In addition, subjective distress during withdrawal was assessed by items of anxiety, irritability, impatience, and restlessness. Positive affect during withdrawal was evaluated by items such as cheerfulness, content, calmness, controllability, and interest. Physical symptoms were assessed by items of headache, sweating, tremor, stomach ache, drowsiness, fatigue, and coughing. Each item was marked on a seven-point scale with the endpoints, *Not at All* and *Very Strong* (al'Absi et al., 1997; al'Absi, Hatsukami, Davis, & Wittmers, 2004). Levels of smoking urges were measured by the abbreviated version of the Questionnaire of Smoking Urges (QSU-B) (Cox, Tiffany, & Christen, 2001; Tiffany & Drobes, 1991), which consists of two components: appetitive urges (factor 1) and aversive urges (factor 2).

MicroCO™ monitors (Micro Direct Inc., Auburn, Maine) were used to measure exhaled carbon monoxide (CO) levels. Saliva samples were collected for the measurement of cotinine concentration. The participant was instructed to place a cotton dental roll in his or her mouth until it was saturated, and the roll was collected in a plastic tube (Salivette® tubes, Sarstedt, Rommelsdorf, Germany). We used EIA (DRG Diagnostics, Marburg, Germany) with inter- and intra-assay variations of < 12% to measure cotinine levels.

Procedure

After the consent process, participants were given a battery of questionnaires including the demographic questionnaire, smoking history, mood and withdrawal symptoms measures, and the adversity measure. They also provided an expired breath CO sample and saliva sample for quantification of cotinine. Participants then set a quit day and subsequent laboratory sessions were scheduled. After the quit day, participants attended post-cessation assessments each week for four weeks to assess smoking behavior (e.g., returned to smoking or not returned to smoking) through self-report and biochemical measures (i.e., CO and cotinine). Questionnaires on mood and withdrawal symptoms were also collected. These post-quit visits included a brief counseling session with a cessation counselor, and participants were encouraged to maintain abstinence or to reduce cigarette consumption if they had relapsed. Since the primary purpose was to identify biomarkers of smoking abstinence, this study did not include any pharmaceutical smoking cessation aids. Nonsmoking controls participated in the same sequence and time-line of sessions to further assess the effect of repeated measures on the biological variables reported elsewhere (al'Absi et al., 2015).

Data analysis

Relapse was defined as any smoking during each day of any 7 consecutive days during the 4 week period. The adversity scores were calculated both as total number of subcategories endorsed as well as tertile categories of none (0), low (1-3), and high (4) total adversity scores. While there is no standard convention for grouping adversity scores, the original paper published on adversity and smoking used 4 and above as the cut-off for high adversity (Felitti et al., 1998). This publication, as well as other recent epidemiological studies (Strine et al., 2012), also compared separately scores of 0, 1, 2, and 3 to the 4 or more categories, but the sample size in the current study does not allow for this luxury. The scores of 1 – 3

were grouped together to limit the risk of reducing the sample size and power per cell in the analysis and to preserve the comparison of no adversity to high adversity (4). First, an analysis of variance (ANOVA) was used to assess differences in smoking groups on total adversity score. Sex was also included, resulting in a 2 (sex: women, men) X 3 (smoking and relapse group: non-smokers, abstainers, relapsers) ANOVA model. Following this analysis, the three adversity categories (none, low, and high) were further characterized based on the continuous demographic variables (age, education, body mass index (BMI)), factors known to affect biomarkers of stress (average sleep, caffeine per day), mood variables (depressive affect and trait anxiety), and smoking variables (use patterns, nicotine dependence, biological markers of smoking) collected at baseline. Significant main effects of adversity category were followed up with Bonferonni corrected post hoc analysis. Significant interactions were followed up with univariate ANOVA and Bonferonni corrected post hoc analysis as appropriate.

We also conducted a repeated measure ANOVA to characterize how both smoking relapse and adversity might be associated with subjective distress, biological indicators of smoking, and withdrawal measures during abstinence. A 2 (relapse group: abstainers, relapsers) X 3 (adversity category: none, low, high) X 2 (time: pre-quit and 28 days post-quit) ANOVA was used to compare changes in withdrawal symptoms assessed both at baseline prior to the quit attempt and at the 4-week follow-up. Due to limits in sample size, sex was not included as a main effect in this analysis but it was initially included along with age as covariates. As neither of these factors were significant in these models, they were not retained as covariates. Correlations were used to examine the relationship between total adversity scores, smoking variables, withdrawal, and mood variables. Due to occasional missing values, the sample size varies slightly by analysis.

Results

Demographics

One hundred and twenty-three individuals (61 females, 62 males) completed baseline and 4-week post-quit sessions. Non-smokers were most often found within the no adversity (40.5%) or low adversity (43.2%) categories, while a higher proportion of abstainers were within the low adversity category (66.7%) relative to relapsers (46.7%). Within the high ACE category, both abstainers (24.2%) and relapsers (26.7%) outnumbered non-smokers (16.2%). There was an association between sex and adversity categories ($\chi^2(2) = 7.54$, $p < .05$). Females were over-represented in the highest adversity category where 70% were female and 30% were male. ($\chi^2(1) = 4.80$, $p < .05$). The pattern was the opposite in the category with no adversity where 38% were female and 62% were male. Within the low adversity category the genders were more equally split with 44% female and 56% male. Due to smaller number of males within relapse groups, further analysis of sex within both adversity and relapse groups was not possible.

The demographics of the sample broken down by adversity categories can be seen in Table 1. The three adversity categories were significantly different in age ($F(2,124) = 5.30$, $p < .01$). The highest adversity category was significantly older than the low ($p < .001$) and no adversity categories ($p < .001$) and the low adversity category was older than the no

adversity category ($p < .01$). Males had marginally higher BMI than women ($F(1, 120) = 3.78, p = .054$), but BMI was unrelated to adversity. Average sleep differed by adversity category ($F(2, 124) = 3.76, p < .05$). The highest adversity category reportedly slept on average one half hour less than the no adversity category ($p < .05$). None of the adversity categories differed on years of education, coffee or caffeine consumption, depressive affect, or anxiety. Differences between the relapse groups (non-smokers, abstainers, and relapsers) on these demographic variables have been published elsewhere (al'Absi et al., 2015; al'Absi, Nakajima, & Grabowski, 2013).

Adversity and relapse

Using the three smoking groups (non-smokers, abstainers, and relapsers) and sex as predictors of adversity total score, the two-way ANOVA revealed a significant main effect of relapse group ($F(2, 124) = 3.26, p < .05$) which was further qualified by a marginal significant sex by relapse group interaction ($F(2, 124) = 3.01, p = .053$). However, as shown in Figure 1, females had higher adversity scores than males within both the non-smokers and relapser groups ($ps < .05$), but there were no sex differences within the abstainers. Furthermore, male abstainers had higher adversity scores than the male non-smokers ($p < .05$). There was no difference between the male relapsers and either the non-smokers or abstainers. To determine whether or not withdrawal symptoms and biological indicators of smoking might differ based on adversity, these variables were assessed just within the smokers (classified as abstainers and relapsers). In the total smoking group, cotinine declined across time ($F(1, 65) = 26.83, p < .001$), but there was no effect of adversity, relapse status, or adversity by relapse interaction ($ps > .10$). CO declined across the sessions in a manner consistent with 24 hours of abstinence ($F(1, 88) = 260.34, p < .001$), but there was no effect of adversity, relapse or adversity by relapse interactions ($ps > .10$). There was no correlation between adversity, salivary cotinine, CO, and depressive affect or anxiety ($ps > .10$).

Withdrawal symptoms and mood measures

Craving changed differentially based on adversity category as evident by a significant adversity by time interaction ($F(2, 89) = 3.35, p < .05$). As seen in Figure 2, only the low adversity category showed a significant increase in craving ($F(1, 49) = 5.63, p < .05$). There was also non-significant increase in craving for high adversity participants. At the same time, there was a non-significant decrease in craving for those with no adversity. Withdrawal symptoms (MNWS), smoking urges based on the QSU-B, positive affect, and distress measures all failed to produce a significant main effect of adversity, adversity by relapse group interaction or adversity by time interactions (all $ps > .10$). The main effects of smoking relapse on these measures have been reported elsewhere (al'Absi et al., 2015).

Discussion

The current study demonstrates for the first time a link between adversities and prospectively assessed smoking cessation outcomes, and we further demonstrate that sex interacts with adversity and smoking outcome. Consistent with the childhood adversity literature, our non-smokers revealed that females had higher adversity than males. However,

within the smoking groups, female smokers who relapsed within the first 28 days of abstinence reported higher levels of adversity than their male counterparts. Abstainers, on the other hand, did not show a sex difference in adversity scores, though male abstainers had higher adversity than non-smokers. Furthermore, nicotine craving with abstinence was increased significantly for only those smokers with a low number of adverse events. Although non-significant, those with no ACE experiences appeared to show declining craving while both the low and high ACE categories increased.

These results support and extend the previous findings that adversity increases an individual's risk of early smoking initiation or lifetime smoking (Anda et al., 1999; Edwards et al., 2007; Ford et al., 2011). While others have shown that depressive affect partially mediates the relationship between adverse childhood experiences and smoking (Edwards et al., 2007; Topitzes, Mersky, & Reynolds, 2010; Walsh & Cawthon, 2014), in this study neither depressive affect nor anxiety were related to the severity of adverse lifetime experiences. This discrepancy between our results and those of others may be related to the use of cross-sectional analysis in the existing literature as opposed to the prospective design tracking smoking cessation utilized here. Also, it is important to emphasize that the current study excluded those with active psychiatric disorders. Only one other study has investigated how adversity was related to smoking relapse. That study demonstrated that adversity was related to smoking initiation, but not smoking cessation, as assessed by survey and self-identification as an ex-smoker (van Loon, Tijhuis, Surtees, & Ormel, 2005). The results here support their findings, but we add additional strengths gained from being a carefully controlled and biologically monitored prospective cessation study.

The careful selection of study participants and the lack of significant differences in withdrawal symptoms and general mood between the groups in this study argue that these effects are specific to the impact of adversity on smoking behaviors. The data shows that this effect is not only specific to adversity, but also specific to abstinence-related craving for nicotine. The craving measure used in this study has been extensively used in other smoking cessation studies and has repeatedly shown to be related to relapse (al'Absi, Hatsukami, & Davis, 2005; al'Absi et al., 2004; al'Absi et al., 2013; Nakajima & al'Absi, 2011), and we now show that adversity may be an important mediator of craving. Secondly, the lack of an association between adversity scores and other measures of distress or general mood, such as depressive affect (PHQ-9) and trait anxiety (STAI), argue that this effect is not due to heightened general negative affect, but instead is specific to adversity and craving in the context of smoking.

It has been proposed that smokers use nicotine as a way to manage negative affect and that fluctuating cravings, especially with abstinence, are an expression of this relationship (Langdon, Farris, Overup, & Zvolensky, 2015; Tsaur et al., 2015; Wu et al., 2015). Heightened negative affect, psychopathology, and related glucocorticoid dysregulation have been well documented in those with high adversity and traumatic backgrounds (Dunn et al., 2011; Hostinar, Lachman, Mroczek, Seeman, & Miller, 2015; Lagdon et al., 2014; Schalinski, Elbert, Steudte-Schmiedgen, & Kirschbaum, 2015). Within the smoking literature, it has also been found frequently, though not exclusively (Ceballos & al'Absi, 2006), that glucocorticoid dysregulation increases the likelihood of smoking during stress,

changes the pattern of smoking, or increases the risk of relapse (al'Absi et al., 2005; al'Absi et al., 2015; McKee et al., 2011; Rasmusson, Wu, Paliwal, Anderson, & Krishnan-Sarin, 2006). Thus, the current results provide further support of the stress and smoking literature and provide the additional evidence that craving in conjunction with adversity may be a critical subjective experience worthy of further investigation. It will be important in future studies to examine in greater detail the potential relationships between adversity, glucocorticoids, and craving within the context of prospectively tracked abstinence.

This study does, however, have its limitations. Because this study was focused on smoking and smoking relapse, this study is both limited and strengthened in that it purposefully oversampled for smokers. If adversity indeed raises the risk of smoking (Anda et al., 1999; Ford et al., 2011), it is possible that we inadvertently also selected for individuals with adverse backgrounds. Furthermore, this sample of smokers excluded subjects who were actively receiving psychiatric treatment. To this end, this sample might be non-representative of the average smoker with high adversity experiences. Another limitation is that the current study also contained a relatively small number of males with high adversity scores. This limited any analysis by sex, particularly when stratified by smoking status. Our inability to examine this further is unfortunate given the well-documented sex differences in stress and relapse (al'Absi et al., 2015; Bohadana, Nilsson, Rasmussen, & Martinet, 2003; Cepeda-Benito, Reynoso, & Erath, 2004; Torchalla et al., 2012; van Loon et al., 2005), though this has recently been challenged (Jarvis, Cohen, Delnevo, & Giovino, 2013). More specific to adversity and smoking, for females, but not males, adversity has an indirect effect on current smoking via psychological distress (Strine et al., 2012). It is unknown whether adversity directly predicts smoking relapse or if additional factors, such as sex, glucocorticoid reactivity, psychological distress, or a combination of all three mediates the link between adversity and smoking relapse. In addition, it would be helpful to include a sample of ex-smokers to further examine the relationship between adversity and the full range of smoking history. Further longitudinal assessment incorporating more high adversity males is warranted. Finally, due to the format of instructions on our adversity survey, our work cannot begin to disentangle the relative effects of childhood adversity versus adult trauma or chronic stress. Thus, it will be imperative that future work carefully assess each to allow for more complex modeling of these predictors on relapse.

In summary, our preliminary results demonstrate that smokers who relapse within the first 28 days of quitting have experienced more adversity than smokers who are able to maintain their abstinence. This is, to our knowledge, the first prospective study of smoking relapse in individuals with high adversity. This study highlights the complexity of adversity and the need for careful quantification and analysis of both adversity and trauma in future prospective studies of smoking relapse. Our use of a simple total number of adversity categories is common, but not unchallenged. Dunn has demonstrated that adversities cluster in unique and meaningful ways (Dunn et al., 2011), and following a similar approach in the future with regards to smoking and relapse might provide important, clinically relevant information. Childhood adversity has been proposed to set the foundation for social, emotional, and cognitive impairment leading to the adoption of health risk behaviors that interact with adult adversities to increase morbidity and mortality, particularly in conjunction with economic deprivation during adulthood (Felitti et al., 1998; Levine, Cole, Weir, &

Crimmins, 2015). Since the majority of the U.S. population report one or more categories of exposure to adverse experiences (Dong et al., 2004; Felitti et al., 1998; Ford et al., 2011), consequential public health implications are potentially far-reaching.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Highlights

1. Females who relapse following a cessation attempt have higher adversity than men who relapse.
2. Cigarette craving is independent of depressive affect.
3. Cigarette craving is increased for those with low adversity during abstinence.

Figure 1.

The total adversity was evaluated using a two-way ANOVA with sex and relapse group as predictors. The interaction between sex and relapse group was significant ($p < .05$). Follow-up Bonferonni post hoc analysis indicates that the female relapsers and non-smokers had higher adversity scores than the male relapsers and non-smokers ($p < .05$) but the abstainers were not significantly different from either group. Further, the male abstainers had higher adversity scores than the male non-smokers ($p < .05$).

Figure 2.

Bonferonni post hoc analysis indicates that the low adversity group demonstrated an increase in craving across sessions ($p < .05$). The high adversity group showed a similar, but non-significant, pattern while the group with no adversities reported showed a non-significant decrease in craving.

Table 1

Demographics and baseline characteristics by adversity group.

	Adversity Level						Sample		Results
	None		Low		High		Total		
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	
Age	28.73	1.95	35.20	1.47	38.37	2.02	34.28	1.06	ACE p < .01
BMI ^a	24.77	0.56	25.74	0.52	25.53	0.89	25.43	0.36	SEX p = .054
Education	15.00	0.53	14.75	0.38	14.67	0.32	14.79	0.25	
Sleep	7.45	0.13	7.08	0.11	6.78	0.15	7.10	0.08	ACE p < .05
Coffee/day	2.35	0.55	2.48	0.42	2.38	0.45	2.43	0.27	
PHQ-9	1.61	0.57	0.88	0.28	0.97	0.47	1.09	0.23	
STAI-T	35.91	1.58	35.98	1.16	35.83	1.68	35.93	0.81	

^a Acronyms used here include BMI = Body Mass Index, PHQ-9 = Physicians Health Questionnaire – 9, STAI-T = State-Trait Anxiety Inventory Trait Scale