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Predictors of Risk for Smoking Relapse in Men and Women: A Prospective Examination

Motohiro Nakajima and

University of Minnesota Medical School, 1035 University Drive Duluth, MN 55812

Mustafa al'Absi

University of Minnesota Medical School, 1035 University Drive Duluth, MN 55812

Abstract

The current study examined whether pre-quit trait negative mood and smoking motives have different predictive patterns of smoking relapse in men and women. Thirty-three female (mean age $\pm$ SEM: 34.9 ± 2.5) and 38 male (mean age $\pm$ SEM: 37.1 ± 2.3) smokers interested in smoking cessation completed forms on smoking history, negative mood (i.e., depression, anxiety, and anger), stress, and smoking motives. Participants also provided samples for measurement of cotinine and carbon monoxide. Then, they set a quit date and were required to abstain from smoking at least for 24 hours. Participants were followed up for 12 months post-cessation to measure their smoking status. Cox proportional hazard models revealed that motivation to reduce craving was a unique predictor of smoking relapse in men, while depressive mood, anxiety, anger, and perceived stress were predictive of time to relapse among women. These findings remained significant after statistically controlling for smoking-related variables, providing preliminary evidence that different factors may be associated with nicotine withdrawal and smoking relapse in men and women.

Keywords

smoking; relapse; negative mood; craving; smoking motives

Introduction

Pre-cessation trait negative mood is associated with increased risk of smoking relapse (al'Absi, Hatsukami, & Davis, 2005; Burgess et al., 2002; Leventhal, Ramsey, Brown, LaChance, & Kahler, 2008), and this may be more pronounced in women than in men (Westmaas & Langsam, 2005). However, compared with research in pre-quit depressive symptoms and smoking relapse, sex differences in predictive patterns of other constructs such as anxiety, anger, and perceived stress have not been fully examined in the context of long term abstinence (al'Absi, Carr, & Bongard, 2007; Patterson, Kerrin, Wileyto, & Lerman, 2008).

Sex may also moderate reasons for tobacco use (Perkins, Jacobs, Sanders, & Caggiula, 2002; Perkins, 1999; Pomerleau, Pomerleau, & Garcia, 1991; Ward, Klesges, Zbikowski, Bliss, & Garvey, 1997; Westmaas & Langsam, 2005). Several studies have reported its role in the link between smoking incentives and subsequent relapse (Allen, Allen, Lunos, &

Address correspondence to: Mustafa al'Absi, Ph.D., Professor, University of Minnesota Medical School, Duluth, Minnesota, USA 55812, Tel: 1-218-726-7144, Fax: 1-218-726-7559, malabsi@umn.edu.

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Pomerleau, 2010; Croghan et al., 2006; Klesges, Meyers, Klesges, & LaVasque, 1989; Linares Scott, Heil, Higgins, Badger, & Bernstein, 2009; Lopez Khoury, Litvin, & Brandon, 2009; Solomon et al., 2007). However, the extent to which expectancies to relieve craving predicts prolonged abstinence in women and men has not been directly examined. One study showed that men reported increased craving during nicotine withdrawal than women (Pomerleau et al., 2005), suggesting the possibility that craving reduction may be associated with one's ability to quit smoking, especially in men.

We examined whether different determinants account for smoking relapse in men and women. It was hypothesized that smoking motives for diminishing craving would predict relapse among male smokers but not in female smokers. Also, the second goal was to replicate and extend previous findings (al'Absi et al., 2005) by examining sex differences in the association between pre-cessation trait negative mood, perceived stress, and smoking relapse within 12 months. Based on previous work (Brandon & Baker, 1991; Westmaas & Langsam, 2005), it was hypothesized that trait negative mood and perceived stress would predict smoking relapse in women but not in men.

Method

Sample and Procedure

The sample consisted of 33 female (mean age $\pm$ SEM: 34.9 ± 2.5) and 38 male (mean age $\pm$ SEM: 37.1 ± 2.3) smokers. Recruitment was completed from the community through newspaper advertisements and flyers. Potential participants completed a phone screening interview that included questions regarding current or recent history of medical or psychiatric disorders and medication intake. Participants were required to meet the smoking criteria (i.e., 10 cigarettes or more per day at least for 2 years) and have a strong motivation to quit smoking. Screened individuals were invited to an on-site screening. Participants were included in the study if they met following criteria: no history of a major illness or psychiatric disorder, weighed within $\pm 30\%$ of Metropolitan Life Insurance norms, 2 or few alcohol drinks a day, and no routine use of prescriptive medications except contraceptives. Participants who qualified read and signed a consent form approved by the Institutional Review Board of the University of Minnesota.

Qualified participants were asked to complete questionnaires regarding demographic information, smoking history, trait mood, perceived stress, and smoking motives (i.e., pre-quit session). Following the measurement of height and weight, the participants provided a saliva sample for cotinine assay and a breath sample for carbon monoxide (CO) assessment. Participants then set a quit date and were required to be abstinent for at least 24 hours, and completed a laboratory session (al'Absi et al., 2005). Smoking status was verified by self-report and biochemical measures (cotinine and CO). Those who did not meet the criteria (e.g., CO levels higher than 8 ppm) were rescheduled. After the laboratory session, the participants attended four weekly follow-up support sessions during which self-report and biochemical measures were collected. They were encouraged to maintain abstinence or reduce the amount of smoking if they had returned to smoking after the quit day. Participants were also contacted by phone at 3, 6, 9, and 12 months after cessation and were asked about their smoking behavior. Participants received a monetary incentive of approximately 15 U.S. dollars per hour during the study.

This study did not include any pharmacotherapeutic aids after the quit day because the primary purpose was to investigate sex differences in psychological determinants associated with smoking relapse in unaided quitters. Ninety-two participants were initially screened for the study, and from those 71 participants went on to complete the whole study. The completers did not differ from those who terminated after the medical screening ($n = 21$) in

demographic variables such as age, BMI, length of education, caffeine consumption, or hours of sleep. The results reported here are derived from data obtained at pre-cessation period and smoking status data collected over the 12 months follow-up period.

Materials

The following measures were collected prior to the start of cessation. Reasons for Smoking scale (RFS; Ikard, Green, & Horn, 1969) consisted of 18 items ranging from 1 (Never) to 5 (Always). Six subscales have been proposed: Stimulation (e.g., use smoking to make oneself more awake), Pleasure (e.g., use smoking to induce or enhance enjoyment), Handling (e.g., fiddling with a cigarette), Negative affect reduction (e.g. use smoking to reduce negative affect), Habit (e.g., use smoking for no specific reason), and Craving reduction (e.g., use smoking to reduce craving). Each subscale consisted of 3 items. Previous studies have replicated the six-factor structure and validity of the scale (Tate, Schmitz, & Stanton, 1991; Tate & Stanton, 1990). Three-year test-retest reliability has been also reported (Costa, McCrae, & Bosse, 1980), suggesting the stability of smoking motives over time. In the present sample, internal consistency for Stimulation subscale was .80, Pleasure was .58, Handling was .72, Negative affect reduction was .82, Habit was .60, and Craving reduction was .69.

The Center for Epidemiologic Studies-Depression scale (CESD; Radloff, 1977) was used to assess depressive symptoms. State-Trait Anxiety Inventory (Trait-Form; STAI; Spielberger, Gorsuch, & Lushene, 1983) was used to measure levels of trait anxiety and Trait Anger Expression Inventory (STAXI; Spielberger, Johnson, Russell, & et al, 1985) was used to evaluate levels of trait anger. The Perceived Stress Scale (PSS; Cohen, Kamarck, & Mermelstein, 1983) was used to measure perceived levels of psychosocial stress. Participants also completed forms on demographic information, smoking behavior, and Fagerström Test of Nicotine Dependence (FTND; Heatherton, Kozlowski, Frecker, & Fagerstrom, 1991).

For the measurement of cotinine concentrations, participants were asked to provide 1–2 ml of saliva using cotton dental rolls held in the mouth until saturated. The saliva was collected into a plastic tube (Salivette® tubes, Sarstedt, Rommelsdorf, Germany). Samples were stored in –70°C until assayed and were measured by enzyme immunoassay (EIA; DRG Diagnostics, Marburg, Germany). Inter- and intra-assay variations were below 12%. Measurement of expired CO was performed using MicroCO™ monitors (Micro Direct Inc., Auburn, Maine).

Data analysis

A series of one-way ANOVA was conducted to examine pre-cessation sex differences in demographic variables, smoking history, levels of nicotine dependence, cotinine concentration and expired CO, trait negative mood, and reasons for smoking. Cox regression models were conducted to test the extent to which trait mood, stress, and smoking motives predicted smoking relapse. Our primary outcome variable was the number of days between the person's quit day and when he or she smoked the first cigarette (Hughes et al., 2003). However, preliminary analysis with Kaplan-Meier plot suggested that our predictor (i.e., sex) did not meet the assumption of proportional hazards (Bruce, Pope, & Stanistreet, 2008). Thus, instead of including sex as a factor, we conducted Cox regressions separately for men and women. Each independent variable was entered as a predictor (i.e., univariate model) to test the likelihood of relapse within a year of abstinence.

Results

Female and male smokers were comparable in demographic information, smoking history, and biochemical measures except that men had higher BMI than women ($F(1, 69) = 4.09, p < .05$; see Table 1). Female smokers reported higher scores on Negative affect reduction of RFS than men ($F(1, 69) = 9.43, p < .01$). Women also tended to show greater depressive symptoms as assessed by CESD ($F(1, 69) = 3.61, p = .06$) and cite more positive affect (i.e., Pleasure) on the RFS compared to men ($F(1, 69) = 3.48, p = .07$). The median of days to relapse was 5.5 in women and 4.9 among men, and the rate of relapse did not differ by sex ($\chi^2 = .29$). Although the majority of participants relapsed within 3 months (79% in women and 76% in men), our analysis strategy was to examine relapse as a continuous measure (i.e., number of days to relapse). Eight participants never relapsed over the course of the study and were therefore censored in the survival analysis.

Results showed that in women, trait depression (HR = 1.05; 95% CI: 1.01 – 1.10; $p < .05$), anxiety (HR = 1.05; 95% CI: 1.01 – 1.10; $p < .05$), anger (HR = 1.12; 95% CI: 1.02 – 1.22; $p < .05$), and perceived stress (HR = 1.09; 95% CI: 1.02 – 1.16; $p < .05$) predicted the risk of smoking relapse (see Table 2). In men, Craving reduction scale of RFS was the only significant predictor of relapse (HR = 1.26; 95% CI: 1.06 – 1.49; $p < .05$). These results indicate that a one-point increase in negative affect or stress measure raised the risk of smoking relapse by 5 to 12% in women, and a unit increase in the measure of craving reduction elevated the probability of relapse by 26% in men. These results remained significant ($p < .05$) except for stress ($p = .06$) when smoking variables (i.e., cigarettes per day, duration, previous quit attempts, longest quit days in the past, motivation to quit, FTND) were included in the model. It should be noted that although observed HR of negative affect measures in men were similar to that of women, 95% confidence intervals for these HR included “1.” This indicates that the relationship may be held in either positive or negative direction, suggesting that the estimated parameters would be less reliable.

Discussion

The current study clearly demonstrated that, although rates of smoking relapse were comparable between women and men, different variables were associated with the risk of smoking relapse in female and male smokers. In women, depression, anxiety, anger, and perceived stress predicted relapse within 12 months of smoking abstinence whereas in men, motives for smoking to relieve craving was predictive of cessation outcome. Furthermore, these results (except for stress) retained after controlling for various smoking variables (i.e., cigarettes per day, duration, previous quit attempts, longest quit days in the past, motivation to quit, FTND), which suggests that trait negative affect and craving reduction may have sex-specific relations to prolonged abstinence. The present findings extend previous work (al'Absi et al., 2005; al'Absi et al., 2007; Burgess et al., 2002; Leventhal et al., 2008; Patterson et al., 2008; Pomerleau et al., 2005; Westmaas & Langsam, 2005).

The finding that women use smoking to manage mood more than men is consistent with previous reports (Brandon & Baker, 1991), further suggesting sex difference in reasons for cigarette smoking. However, motives to reduce negative affect did not predict smoking relapse as previously reported (Copeland et al., 1995; Shiffman, 1984; Wetter et al., 1994). Different methodology, such as sample characteristics, smoking criteria, and assessment of smoking motives may have contributed to the inconsistent results. It is also possible that the role of positive expectancies in predicting relapse may partly depend on the duration of abstinence. Studies showing an association between negative affect reduction and smoking relapse tended to have shorter length of follow-up period (e.g., less than 6 months). It is therefore possible that smoking motives for relieving negative affect are a potent indicator of

relapse early in the cessation attempt, but become less predictive over a longer follow-up period. The extent to which positive expectancies about smoking cigarettes is mediated by trait negative mood should be examined in future research.

The underlying mechanism of sex differences in predictors of smoking relapse should be elucidated. A few studies have shown that men and women may undergo different psychological and physiological processes during nicotine withdrawal. For example, research examining sex differences in nicotine sensitivity has shown that men are more sensitive to pharmacological influences of nicotine, whereas environmental or contextual cues play a greater role in determining perceived effects of nicotine in women (Perkins, 1999; Perkins, Donny, & Caggiula, 1999). In addition, withdrawal severity post-stress was related to smoking relapse in women whereas attenuated adrenocortical responses to stress were associated with relapse in men (al'Absi, 2006). Although preliminary, these studies suggest that men and women may have different psychobiological profile that may mediate factors (e.g., trait mood, smoking motives) related to withdrawal symptomatology and subsequent smoking relapse.

The results of the current study are limited by a number of factors. First, we were not able to directly examine the moderating role of sex in the associations between trait negative mood and smoking motives and relapse. Also, lack of power due to small sample size may have contributed to the findings. Thus, cautions should be exercised in interpreting the results. We note, however, our findings were confirmed even after controlling for various smoking variables, suggesting independent contribution of negative affect and craving reduction in predicting smoking relapse. Second, participants' smoking status was not confirmed chemically during 3, 6, 9, and 12 month follow-up periods. It should be noted however that participants received monetary compensation regardless of their smoking status, and therefore there was no incentive to provide false information. Furthermore, the results of the relapse rate were consistent with existing literature over a similar time frame (Garvey, Bliss, Hitchcock, Heinold, & Rosner, 1992). Third, participants were free from any medical or psychiatric conditions and initially had strong intention to quit smoking, limiting the generalizability of the results to smokers with comorbidity. Fourth, this study did not assess weight concerns, body image dissatisfaction, self-esteem, or hormonal activity that have been suggested as potential mediators of smoking and relapse among female smokers (Allen et al., 2010; Croghan et al., 2006; Klesges et al., 1989; Lopez Khoury et al., 2009). Nonetheless, the current study has strengths including the use of multiple psychological measures (i.e., trait negative mood, perceived stress, and smoking motives) and a careful statistical approach (e.g., controlling for baseline variations) to examine predictors of relapse and the prospective approach used in the analysis over a relatively long period.

In summary, the current study demonstrated that motives for craving reduction predicted smoking relapse in men while trait depression, anxiety, anger, and perceived stress predicted relapse among women within 12 months after smoking cessation. Sex differences in psychological and biological mechanisms associated with smoking motives, withdrawal symptoms, and smoking relapse should be investigated in future research.

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Table 1

Sample characteristics.

	Women	Men	<i>p</i>
Age (years)	34.9 (2.5)	37.1 (2.3)	.52
BMI (kg/m ²)	24.1 (0.7)	26.0 (0.6)	.047
Education (years)	14.5 (0.5)	14.2 (0.4)	.69
Caffeine (drinks/day)	3.8 (0.5)	4.8 (0.5)	.18
Sleep (hours/day)	6.8 (0.2)	7.3 (0.2)	.13
Cigarettes/day	19.1 (1.2)	19.9 (1.2)	.65
Duration (years)	10.1 (2.0)	14.5 (1.8)	.11
Previous quit attempts	8.2 (2.2)	4.4 (2.0)	.22
Longest quit (days)	5.9 (3.6)	11.4 (3.3)	.26
Motivation to quit	6.0 (0.2)	6.1 (0.2)	.82
Nicotine dependence (FTND)	5.4 (0.4)	5.7 (0.3)	.49
Cotinine (ng/mL)	184.3 (21.7)	202.6 (20.8)	.54
Carbon monoxide (ppm)	24.2 (1.7)	23.0 (1.6)	.61
Depression (CESD)	14.4 (1.6)	10.3 (1.5)	.06
Anxiety (STAI)	38.7 (1.6)	36.9 (1.5)	.42
Anger (STAXI)	17.2 (0.9)	17.5 (0.8)	.80
Stress (PSS)	16.2 (1.1)	14.0 (1.0)	.14
Reasons for smoking (RFS)			
Stimulation	7.4 (0.5)	7.7 (0.4)	.71
Pleasure	10.8 (0.3)	9.9 (0.3)	.07
Handling	7.4 (0.5)	7.1 (0.5)	.70
Negative affect reduction	12.3 (0.5)	10.3 (0.4)	.003
Habit	6.4 (0.3)	5.9 (0.3)	.29
Craving reduction	10.3 (0.4)	9.8 (0.4)	.38

Note. Entries show mean (standard error); BMI: body mass index; FTND: Fagerström Test of Nicotine Dependence; ppm: parts per million; CESD: Center for Epidemiologic Studies-Depression scale; STAI: State-Trait Anxiety Inventory; STAXI: Trait Anger Expression Inventory; PSS: Perceived Stress Scale.

Table 2
Results on survival analysis of smoking relapse within 12 months of abstinence.

	Women			Men		
	HR	p	CI (95%)	HR	p	CI (95%)
Unadjusted						
Depression (CESD)	1.05	.03	1.01–1.10	1.03	.15	0.99–1.07
Anxiety (STAI)	1.05	.03	1.01–1.10	1.03	.13	0.99–1.08
Anger (STAI-X)	1.12	.02	1.02–1.22	1.04	.18	0.98–1.10
Stress (PSS)	1.09	.01	1.02–1.16	1.01	.72	0.95–1.07
Reasons for smoking (RFS)						
Stimulation	1.12	.17	0.95–1.31	0.94	.37	0.82–1.08
Pleasure	0.92	.41	0.75–1.13	0.90	.27	0.74–1.09
Handling	0.94	.35	0.82–1.07	1.01	.87	0.89–1.14
Negative affect reduction	0.86	.12	0.72–1.04	1.07	.26	0.95–1.21
Habit	1.03	.81	0.84–1.26	0.99	.94	0.82–1.21
Craving reduction	1.03	.71	0.88–1.20	1.26	.01	1.06–1.49
Adjusted^a						
Depression (CESD)	1.07	.02	1.01–1.12	1.03	.32	0.98–1.08
Anxiety (STAI)	1.05	.04	1.003–1.10	1.04	.15	0.99–1.10
Anger (STAI-X)	1.12	.01	1.02–1.23	1.14	.39	0.84–1.55
Stress (PSS)	1.07	.06	0.99–1.15	0.96	.41	0.88–1.06
Reasons for smoking (RFS)						
Stimulation	1.06	.51	0.89–1.26	0.93	.40	0.79–1.10
Pleasure	0.94	.71	0.70–1.27	0.86	.23	0.67–1.10
Handling	0.85	.10	0.70–1.03	0.94	.45	0.80–1.10
Negative affect reduction	0.90	.40	0.72–1.14	1.00	.97	0.84–1.20
Habit	0.89	.44	0.66–1.20	0.89	.44	0.66–1.20
Craving reduction	1.03	.75	0.85–1.24	1.26	.03	1.03–1.54

Note.

^aResults indicated are controlled for cigarettes per day, duration, previous quit attempts, longest quit days in the past, motivation to quit, and nicotine dependence; CESD: Center for Epidemiologic Studies-Depression scale; STAI: State-Trait Anxiety Inventory; STAI-X: Trait Anger Expression Inventory; PSS: Perceived Stress Scale.