Causes of smoking relapse in the 12 months after smoking cessation treatment: affective and cigarette dependence–related factors

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Conflict of interest

The authors report no conflicts of interest.

Authors' contributions

Conceptualization, RRC, ALD, and EB.; methodology, RRC, ALD, and EB; validation, ALD and EB; formal analysis, RRC; investigation, RRC, ALD, and EB; data curation, CMV and RRC; writing—original draft preparation, RRC and ALD; writing—review and editing, ALD, CMV, and EB; visualization, RRC, ALD, CMV, and EB; project administration, EB; funding acquisition, EB.

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Highlights

- Experiencing positive or negative affect was the most frequent causes of relapse.
- Cigarette dependence-related causes accounted for 20% of relapses.
- Being men, higher-educated, and not on psychopharm predicted positive-affect relapse situations.
- First smoking at an older age predicted negative-affect relapse situations.
- Less-motivated and younger smokers relapsed in cigarette-dependence–related situations.

Abstract

Despite advances in smoking cessation treatments, smoking relapse remains common. Experiencing positive or negative affect and cigarette dependence are the most common causes of relapse; however, little is known about the characteristics that increase the risk of relapse from these causes among current treatment-seeking smokers. Thus, this study aimed to identify the most frequent causes of relapse and the individual characteristics that increase the risk of relapse from these causes during a 12-month period after smoking cessation. Participants included 121 treatment-seeking smokers who quit smoking at the end of treatment and relapsed during a 12-month follow-up period (60.3% female; M_{age} = 42.57, *SD* = 11.07). Results indicated that the most frequent smoking relapse situations occurred when smokers experienced positive (e.g., being relaxed; 43.0%) or negative (e.g., being angry; 37.2%) affect or cigarette dependence–related situations (e.g., craving; 19.8%). At an individual level, males with a higher level of education and without a psychopharmaceutical prescription had a higher risk of relapsing in positive-affect situations. Smoking the first cigarette at an older age increased the risk of relapse in negative-affect situations. Finally, being younger and less motivated to quit at pretreatment increased the likelihood of relapse in cigarette dependence–related situations. These findings provide detailed information about smoking relapse situations and identify a set of characteristics that might help to improve current relapse-prevention interventions.

Keywords: relapse causes, positive and negative affect, cigarette dependence, smoking cessation treatment

1. INTRODUCTION

The cigarette smoking prevalence has declined during the last several decades (U.S. Department of Health and Human Services, 2020); however, over 1.1 million people continue to smoke globally (World Health Organization, 2015). Although the prevalence of smoking has also declined in Spain, one in four people are still current smokers (Spanish National Statistics Institute, 2020), and smoking causes almost 60,000 deaths per year (Pérez-Ríos et al., 2020). Quitting smoking and maintaining abstinence reduces the burden of smoking-related diseases (U.S. Department of Health and Human Services, 2014); thus, a better understanding of smoking cessation and maintenance processes is essential to reduce the incidence of smoking-related health impairments.

Despite the availability of effective smoking cessation treatment options (Prochaska & Benowitz, 2019), more than 50% of smokers who use a smoking cessation treatment relapse during the first year after quitting (Robinson et al., 2019), a percentage that is even higher (95%) among non–treatment-seeking smokers (Hughes et al., 2004). Understanding the characteristics of smokers who relapse is fundamental to reducing these high rates. For example, in non–treatment-seeking smokers, being a woman, older, single, and having a lower level of education predict relapse (Elfeddali et al., 2010; García-Rodríguez et al., 2013). Also, higher nicotine dependence at baseline (Zhou et al., 2009), lower abstinence self-efficacy, and higher frequency of urges to smoke all increase the risk of relapse (Herd et al., 2009). The characteristics of treatment-seeking smokers have also been widely studied. For example, demographic variables, such as being a woman, older, single, and having a lower level of education increase the likelihood of smoking relapse (Garey et al., 2019; Japuntich et al., 2011). Higher levels of nicotine dependence (Japuntich et al., 2011), more intense nicotine withdrawal symptoms (Berlin et al., 2013), experiencing cravings (Garey et al., 2019), and having a lower motivation to quit (Piñeiro et al., 2016) also increase the risk of relapse.

Mental health also affects smokers' risk of relapse after quitting. A positive history of psychological disorder (Gutiérrez et al., 2016), greater depressive and anxiety symptoms (Heffner et al., 2018; Zvolensky et al., 2009), and a higher level of negative affect (NA) and lower level of positive affect (PA) (Ameringer & Leventhal, 2010; Vasilenko et al., 2014) are related to a higher likelihood of relapse. Finally, the consumption of other psychoactive substances (e.g., alcohol use) increases the risk of smoking relapse (Rodriguez-Cano et al., 2016). The study of individual-level predictors of the relapse is capital to understand the characteristics of smokers who are more likely to relapse in order to inform better smoking relapse prevention strategies. However, the majority of the literature in this areahas considered smoking relapse as a dicothomous event (i.e., smokers vs. abstinent), not taking into account specific information concerning when, why and under which circumstances smokers relapse.

In addition to the study of individual-level predictors of smoking relapse, other studies have analyzed the effects of situational factors associated with smoking relapse. For example, in a community-based study, Piñeiro et al. (2017) found that 70% of smoking relapses occurred when smokers experienced PA or NA. Among treatment-seeking smokers, smoking relapse was associated with negative emotional states, smoking urges, and perceived social pressure to smoke (Piñeiro & Becoña, 2013). Other studies showed that relapse occurred when participants experienced momentary intense NA (Shiffman, 2005), intense positive mood and smoking cravings (Holt et al., 2012), or recent alcohol use and high momentary distress (Bold et al., 2016). Despite the great value of understanding the situational causes of smoking relapse (Marlatt & Donovan, 2005), few studies have examined the association between current treatment-seeking smokers' pretreatment characteristics and the situational causes of relapse. The analysis of such association would help to inform and tailor better

smoking relapse prevention efforts for current treatment-seeking smokers, providing a broader approach in the explanation of the smoking relapse situation.

Thus, this study sought to examine situational causes of smoking relapse among smokers who quit while using a cognitive-behavioral smoking cessation treatment. First, we analyze the most common situational causes for the first smoking relapse in the 12-month period after quitting smoking. Second, we analyze the relation between the most common causes of relapse and 30 theoretically and clinically relevant baseline variables predicting smoking relapse. Increasing our understanding of the relation of smokers' baseline characteristics with the situational causes of smoking relapse will enhance our knowledge of the smoking relapse process among treatment-seeking smokers and help us to develop tailored smoking relapse prevention strategies that could reduce the current high rates of smoking relapse.

2. Methods

2.1. Participants

Participants included 121 treatment-seeking smokers who quit smoking after receiving smoking cessation treatment (M_{age} = 42.57 years, *SD* = 11.07; 60.3% female). Inclusion criteria were being older than 18 years of age, smoked more than 10 cigarettes per day at baseline, achieved 24-hour point-prevalence abstinence at the end of treatment (i.e., expired-air carbon monoxide [CO] level < 5 ppm), relapsed during the 12 months after the end of treatment (smoking within 7 days before a follow-up, as indicated by CO ≥ 5 ppm), and completed the smoking relapse questionnaire at some point during the 12-month follow-up period. Participants were excluded if they had severe mental disorder symptoms (e.g., psychosis or mania), had substance use disorder other than nicotine (e.g., alcohol use disorder), received pharmacological treatment to quit smoking (e.g., nicotine replacement

therapy, varenicline and/or bupropion), participated in the same treatment program during the past year, and/or presented with a high-risk physical disease (e.g., recent cancer diagnosis).

2.2. Measures

All measures were administered using the Spanish versions.

Demographics. Smoking Habit Questionnaire (SHQ; Becoña, 1994) (e.g.., sex, age, marital status).

Smoking variables. SHQ (Becoña, 1994) (e.g., age of smoking onset); Motivation of Change Questionnaire (Prochaska et al., 1992); Fagerström Test for Cigarette Dependence (FTCD; Becoña & Vazquez, 1998; Fagerstrom, 2012); and Minnesota Nicotine Withdrawal Scale (MNWS; Hughes & Hatsukami, 1986) to assess nicotine withdrawal and cravings.

Psychopathology variables. Major Depressive Episode Screening (MDES; Muñoz, 1998) and clinical interview (i.e., for previous mental disorder).

Substance use. SHQ (e.g., psychopharmacology) (Becoña, 1994), Alcohol Use Disorder Identification Test (AUDIT; Contel et al., 1999) for hazardous alcohol drinking.

Smoking relapse status. MicroC Smokerlyzer (Bedfont Scientific Ltd, Sittingbourne, UK) to assess CO levels.

Smoking situational relapse causes. *Ad hoc* questionnaire for assessing the smoking relapse context, including questions about the place, people around, co-substance use, and cue affect (e.g., stress). This questionnaire was based on classic and relevant models of relapse in smoking (Marlatt & Donovan, 2005; Shiffman, 2005) and was used in previous smoking relapse studies (e.g., Piñeiro et al., 2017).

2.3. Procedure

Participants were adult daily smokers seeking treatment at the Smoking Cessation and

Addictive Disorder Unit at the University of Santiago de Compostela, Spain, who quit smoking at the end of treatment. After completing a 1-hour baseline assessment, they were enrolled in a six-session group-format cognitive-behavioral treatment for smoking cessation (Becoña, 2007) during 2010-2015. The treatment included psychoeducation regarding health and tobacco use, physiological feedback of smoking status with CO measures in each session, nicotine fading, stimulus control (e.g., effects of alcohol consumption with regard to smoking), training in skills for reducing craving and nicotine withdrawal (e.g., increasing physical activity), and relapse prevention strategies (e.g., reduce or eliminate the alcohol drink level to help with the abstinence). After treatment, participants were followed up at 1, 3, 6, and 12 months. Participants who had quit smoking at the end of treatment and relapsed in the 7 days prior to a follow-up completed the *smoking situational relapse causes* questionnaire. In order to determine the situational causes of relapse, we only included the first relapse for each participant (during the 12-month period after quitting). Similarly to previous studies that analyzed smoking relapse situational causes (i.e., Piñeiro et al., 2017), we identified and categorized the most frequent situational relapse causes using the *Smoking situational relapse causes* questionnaire. First, two psychologists specialized in smoking cessation interventions analyzed the most common relapse causes. Second, a clinical psychologist, also specialized in smoking cessation intervention, validated the created categories. Next, the three psychologists discussed whether there were any discrepancies in the participant's responses and the determined/identified categories. Finally, three categories were created: PA (e.g., being relaxed, happy, or at a party consuming alcohol, coffee, or cannabis), NA (e.g., being stressed, angry, anxious, or depressed), and *Cigarette dependence-related causes* (*CD-related causes*; e.g., lack of control, smoking habit, craving or nicotine withdrawal syndrome, smoking with others without consuming any other substance).

2.4. Analytic strategy

We calculated descriptive statistics for the total sample. First, according to the most common situational smoking relapse causes, we created three binary dependent variables: 1. PA (coded as 1) vs NA + *CD-related causes* (coded as 0); 2. NA (coded as 1) vs PA + *CD-related causes* (coded as 0); and 3. *CD-related causes* (coded as 1) vs. NA + PA situations (coded as 0). Second, we analyzed differences in 30 baseline predictors (demographic, smoking-related, substance use, and psychopathologic variables) for each of these three groups (Table 1). We used $\chi 2$ tests for binary variables and *t* and Mann-Whitney *U* tests for continuous variables. Lastly, we calculated the effect size for each test.

Next, we ran a set of logistic regressions including the smoking relapse situation as the dependent variable (PA, NA, and *CD-related causes*) to identify potential baseline predictors (Table 2). We selected the predictive variables, including the relation with the criterion variable, at *p* levels of 0.05 and 0.10. Although the most common approach for regression sets the significant *p* level at 0.05, Bursac et al. (2008) recommended including related variables at a *p* level of 0.10 in order to reduce the misidentification of relevant variables for the regression models. In addition, we ran a bootstrap analysis for logistic regression with the bias-corrected and accelerated (BCa) method in 1,000 random resamples to reduce the predictive error to standard intervals (DiCiccio & Efron, 1996). This robust method corrects a wide variety of problems found in the traditional estimation of parameters (e.g., skewness) (Efron, 1987). We calculated the unstandardized parameter (B), standard error, odds ratio (OR), and 95% confidence interval (CI) for the models with and without bootstrapped analyses. We considered as significant predictors those ORs with intervals that did not contain the number 1.

Finally, we compared the overall fitness of each model (selection of variables at $p < 0.05$ vs. $p < 0.10$) (Table 2). We included the overall variance explained by the predictors

(Nagelkerke's R^2), the model calibration (Hosmer-Lemeshow goodness-of-fit test [$\chi^2_{H\text{-}L}$]; $p >$ 0.05 indicates good calibration of the model), and the discrimination of the model (receiver operating characteristic curve analysis); the higher the value of the area under the curve (AUC) above 0.50, the better the ability of the model to discriminate between those who relapsed due to a particular cause (e.g., NA situations) and those who did not relapse due to this cause (e.g., PA + *CD-related causes*) (Anderson et al., 2003).

3. RESULTS

3.1. Descriptive analyses

The main characteristics of the sample (N = 121) are presented in Table 1. The majority of participants were single (52.9%), employed (62.8%), and had less than a high-school education (56.2%). Regarding smoking-related variables, 67.8% were in Prochaska's contemplation state of change; the most popular reason for quitting was health concerns (52.9%), and most participants had been advised by their doctor to quit smoking (73.6%). On average, participants had smoked their first cigarette at 15.81 (*SD* = 2.80) years old and started smoking continuously at 18 (*SD* = 3.07) years old. Participants had been smoking for a mean of 24.15 (*SD* = 10.57) years and smoked on average 19.69 (*SD* = 7.20) cigarettes per day. At baseline, participants presented low scores for cigarette dependence (mean FTCD = 4.62; *SD* = 2.11) and withdrawal symptoms (MNWS = 6.35; *SD* = 5.69). Regarding the consumption of non-nicotine substances, the mean score on AUDIT was 3.93 (*SD* = 3.87); 14.9% reported current consumption of illegal psychoactive drugs (e.g., cannabis), and 23.1% had at least one psychopharmaceutical prescription. Finally, regarding psychopathology variables, 43% had a history of major depressive episode(s) and 34.7 % reported having been treated for depression in the past (assessed by MDES). Finally, 33.1% reported having had a

mental disorder in the past, and 14.9% reported having a current mental disorder (assessed by clinical interview).

3.2. Smoking relapse causes

The most frequent situational causes of relapse were related to PA (43.0%) (e.g., being relaxed, happy, or at a party consuming alcohol, coffee, or cannabis). NA situations (e.g., being stressed, angry, anxious, or depressed) caused relapse in 37.2% of participants, and 19.8% relapsed as a consequence of *CD-related causes* (e.g., lack of control, smoking habit, craving or nicotine withdrawal syndrome, smoking with others). Of those relapsing in PA situations, 76.9% reported alcohol consumption when relapsing. In the NA group, the most commonly consumed substance in the relapse situation was coffee (22.2%). *CD-related causes* did not include any substance consumption except cigarette use. The baseline predictors' bivariate differences are shown in Table 1.

3.2.1. Positive-affect situational causes of relapse

The model with significant baseline-characteristic differences set at $p < 0.05$ (Table 2) indicated that being male (OR = 0.23, $CI_{95\%}$ = 0.08, 0.66) and having education beyond high school (OR = 4.01, $CI_{95\%}$ = 1.57, 10.24) significantly increased the likelihood of relapse in PA situations. In addition to these variables, bootstrap analysis showed that not having a psychopharmaceutical prescription increased the likelihood of relapse in PA situations (OR = 0.35; OR_{BCa} $CI_{95\%}$ = 0.11, 0.71). The model with significant differences at $p < 0.10$ (Table 2) showed similar results for the solutions with and without bootstrapping. Regarding their overall fitness, both models explained similar variance of the criterion variable ($R^2_{p<0.05model}$ = 0.30 vs $R^2_{p<0.10model}$ = 0.31). They also indicated good calibration (both $\chi^2_{H\text{-}L,}$ $p > 0.05$) and similar discrimination ($AUC_{p<0.05model}$ = 0.76 vs $AUC_{p<0.10model}$ = 0.77).

3.2.2. Negative-affect situational causes of relapse

The $p < 0.05$ model indicated that those who had previously received treatment for depression, compared to those who had not, had approximately double the likelihood of relapse in NA situations (OR = 2.29, $CI_{95\%}$ = 1.06, 4.96). This effect remained significant after bootstrapping (OR_{BCa} $CI_{95\%}$ = 1.08, 5.23). In the model that set significant baseline differences at p < 0.10, participants who were older when they smoked their first cigarette, compared with those who were younger, had a 20% higher likelihood of relapsing in an NA situation (OR = 1.20, $CI_{95\%}$ = 1.03, 1.39). Bootstrapping indicated that this variable was a robust predictor in this model (OR_{BCa} $CI_{95\%}$ = 1.01, 1.50). The overall models' fitness indicated that the $p < 0.05$ model explained 10% less variance ($R^2_{p<0.05model}$ = 0.05 vs $R^2_{p<0.10model}$ = .15), presented worse calibration ($\chi^2_{H\text{-}L\ p<0.05model} = 0, p < .05$ vs $\chi^2_{H\text{-}L\ p<0.10model}$ = 6.31, $p > 0.05$), and was 8% less discriminant ($AUC_{p<0.05model}$ = 0.60 vs $AUC_{p<0.10model}$ = 0.68) than the model that selected baseline predictors at $p < 0.10$.

3.2.3. *Cigarette dependence-related situational causes*

The $p < 0.05$ model indicated that being a smoker for longer (OR = 1.17, $CI_{95\%}$ = 1.01, 1.35) and being less motivated to quit at pretreatment (i.e., contemplation vs preparation; OR = 0.25, $CI_{95\%}$ = 0.06, 0.96) increased the likelihood of smoking relapse in *CD-related situational causes*. This effect was confirmed by bootstrapping (Table 2). The $p < 0.10$ model did not include any significant predictors. However, in the bootstrap solution, being younger (OR_{BCa} $CI_{95\%}$ = 0.72, 0.98) and less motivated to quit smoking at pretreatment (OR_{BCa} $CI_{95\%}$ = 0.07, 0.55) increased the likelihood of smoking relapse in *CD-related causes*. The models' overall fitness showed that the $p < 0.05$ model, compared to the $p < 0.10$ model, explained less variance ($R^2_{p<0.05model}$ = .26 vs $R^2_{p<0.10model}$ = .32), displayed similar calibration (both $\chi^2_{H\text{-}}$

$_{L,}$ $p > 0.05$), and had 4% worse discrimination ($AUC_{p<0.05model} = 0.78$ vs $AUC_{p<0.10model} = 0.82$).

4. Discussion

Our findings indicated that affective experiences were the most frequent situational relapse causes support the positive (Glautier, 2004) and negative reinforcement (Baker et al., 2004) conceptualizations of cigarette dependence, suggesting that smoking relapse risk increases as a consequence of the experienced relationship between smoking and affect. However, almost 20% of participants relapsed due to *CD-related causes*, which comprised causes related to cigarette withdrawal and craving and smoking as a psychological habit. Thus, smoking cessation treatments should address not only PA and NA states, but also situations where cigarette withdrawal and craving lead to the likelihood of relapse (Robinson et al., 2019; Shiffman et al., 2002). Additionally, our study helps improve the understanding of the nuances of smoking relapse by identifying relevant variables that might help to improve the effectiveness of smoking relapse prevention interventions (Livingstone-Banks et al., 2019).

The predictors of PA situational causes of relapse were being male, having a higher educational level, and not having a psychopharmaceutical prescription at pretreatment. Notably, more than three-quarters of participants in this category (76.9%) relapsed when they were consuming alcohol, indicating that consuming alcohol, compared with non-consuming, was significantly related with PA situational causes ($\chi^2 = 82.29$, Cramer's $V = 0.83$, $p < 0.001$). Like other studies, our current results indicate that alcohol use might augment the positive reinforcement of smoking (Kirchner & Sayette, 2007; Piasecki et al., 2008), which might be explained by the shared pharmacological effects of nicotine and alcohol on the brain regions related to reinforcement (Funk et al., 2006) and the conditional learning effect of the repetitive co-use of both substances (Verplaetse & McKee, 2017). Likewise, greater alcohol

use has been related to positive expectations of smoking (McCarthy & Thompsen, 2006). This relation might be explained by the potentiating effect that alcohol use has on the rewarding effects of nicotine (Rose et al., 2002). Thus, we could partially explain the relation of baseline variables with PA situations in light of the effect alcohol use has on these variables. For example, the higher likelihood of relapse in PA situations among men, compared to women, might be explained by men's overall higher consumption of alcohol (WHO, 2018) and their tendency to use alcohol less as a coping strategy for NA than women do (Peltier et al., 2019).

Regarding the results related to educational level, higher education is related to higher socioeconomic status (SES) (EUROSTAT, 2016), a variable that might account for the increased likelihood of alcohol consumption and smoking relapse among our participants. Indeed, among people with higher SES, alcohol use may be more commonly associated with socializing (e.g., being at a party with friends) than among people with lower SES. Future work should further explore the effects of SES and alcohol use in smoking relapse situations.

Finally, smokers who did not have a psychopharmaceutical prescription, compared to those who did have one, had a higher likelihood of relapse caused by PA situations. People who have emotion-related problems such as anxiety and depression are more likely to have a psychopharmaceutical prescription and also may be less likely to be exposed to PA–related situations such as parties. However, we did not assess whether smokers had a prescription at the moment when the relapse occurred, so future studies should explore this concurrent relation.

Regarding NA situational causes of smoking relapse, the age at which the participant first smoked a cigarette was the only variable that arose as a significant predictor. In particular, participants who were older when they smoked their first cigarette were more likely to relapse in NA situations. Previous studies indicated that smokers who had experience with tobacco at an early age were more prone to be daily smokers as adults (Everett et al., 1999), had higher

levels of nicotine dependence (Kendler et al., 2013), and had a higher risk of relapse after quitting (Kerr et al., 2011). Despite the relation between earlier smoking onset and smoking relapse, NA relapse situations seems to be prompted by different age-related smoking initiation processes. Indeed, our results showed the importance of assessing the age of the first cigarette smoked along with the role of NA in smoking relapse, even more than the smoker's history of depression treatment (a variable that was not included in the final models).

Regarding relapses from *CD-related situational causes*, being younger and less motivated to quit at pretreatment explained the likelihood of relapse. The *CD-related causes* category included mainly nicotine dependence–related variables, such as cravings. Although previous studies found that older smokers had higher levels of nicotine dependence (Hall et al., 2008), our results suggest that younger smokers could be more sensitive to smoking cues that elicit cravings. Along these lines, previous experimental studies have found that early onset of smoking predicts higher craving reactivity (Mashoon et al., 2018). This relationship might explain the effect we observed in the present study. Future studies should explore the relation of age with craving-cue reactivity and smoking relapse processes among treatment-seeking smokers. Moreover, participants in Prochaska's contemplation stage of change, compared to those in the preparation stage, were more likely to relapse because of *CD-related* causes. According to previous literature, a lower motivation to quit is related to higher nicotine dependence (Leem et al., 2017) and smoking relapse likelihood (Piñeiro et al., 2016). Similarly, our results expand on those of previous studies that found that the lower motivational stages of quitting are associated with a greater likelihood of relapse due to smoking habits (a component of the *CD-related* causes of relapse) (Gokbayrak et al., 2015).

Our study's limitations include its retrospective assessment of the situational causes of smoking relapse, which is subject to the typical recall problems of self-report questionnaires. Our aim was to focus on the participant's first smoking relapse, a moment highly relevant in

the maintenance of abstinence after smoking cessation. Thus, self-report questionnaires were the most appropriate tool to assess participants' concrete experiences (Mehl & Conner, 2014). Our study thus complements previous research that used repetitive momentary assessments to study smoking relapse (i.e., Shiffman, 2005). Our results were based on three three categories according to previous smoking relapse literature (i.e., Piñeiro et al., 2017). Because of the small number of participants indicating some of the reasons comprised under the category *CD-related causes* (i.e., *craving, n = 7),* we could not perform analyses for each of the variables included in this group. Future studies might divide this category into different subcategories (i.e., craving, withdrawal symptoms, or smoking habit) in the case they have bigger sample size or higher likelihood of relapsing for these reasons. Next, our results are applicable to and should be interpreted only in the context of treatment-seeking cigarette smokers who quit at the end of treatment and relapse. Future studies should be extended to other nicotine product users. Finally, although the aim of the current study was to analyze the situational causes of the first smoking relapse, future smoking relapse prevention studies might benefit from analyzing which specific treatment components are related to smoking abstinence maintenance during the follow-ups.

In conclusion, the current study, which expands upon a previous analysis indicating that affectivity was the most important cause of smoking relapse in a community-recruited study of non–treatment-seeking smokers (Piñeiro et al., 2017), provides useful information for smoking cessation and relapse prevention efforts among treatment-seeking smokers (Livingstone-Banks et al., 2019). For instance, a specific functional analysis of the common high-risk smoking relapse situations (i.e., Marlatt & Donovan, 2005) would help the design of specific strategies for relapse prevention, acknowledging the most common situations among treatment-seeking smokers (i.e., positive and negative affectivity). Indeed, similarly to other studies (Buchkremer et al., 1991; Emmons et al., 1988), smokers who are more likely to

relapse at PA situations might benefit from the use of role-playing in groups, where they would be able to learn how to cope with high-risk smoking situations (e.g., being in a party drinking alcohol) and use strategies previously planned (e.g., go to the restroom to wash their hands instead of smoking). In addition, tailoring problem-solving strategies for smoking relapse prevention (Becoña & Vázquez, 1997) might also help to prevent smoking relapse in NA situations (e.g., when a former smoker feels frustration or anger related to a social event, instead of smoking, s/he might use an alternative plan such as calling a friend or leaving the trigger situation for the moment). Finally, for *CD-related causes,* particularly for relapse because of smoking habit (e.g., I smoked when I arrived home), people might prevent the smoking relapse by changing the usual order of events (e.g., having a shower just after arriving home instead of lighting up a cigarette). Including these strategies in the smoking cessation treatment along with additional support and strategies reminders during the follow-ups might improve smoking relapse prevention efforts.

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Table 1.
Demographic, smoking, and psychopathologic variables by smoking relapse situations (N = 121)

	Total sample n (%)	PA (n = 52) n (%)	NA (n = 45) n (%)	CD [a] (n = 24) n (%)	PA vs NA+ CD [a]			NA vs PA+CD [a]			CD [a] vs. NA+PA		
					$\chi2$	p	ES V	$\chi2$	p	ES V	$\chi2$	p	ES V
Sex					9.876	0.002	0.286	3.479	0.062	0.170	2.692	0.101	0.149
Male	48 (39.7)	29 (60.4)	13 (27.1)	6 (12.5)									
Female	73 (60.3)	23 (31.5)	32 (43.8)	18 (24.7)									
Marital status					0.843	0.359	0.083	0.204	0.652	0.041	2.847	0.092	0.153
Single/living alone	64 (52.9)	30 (46.9)	25 (39.1)	9 (14.1)									
Married/living with a partner	57 (47.1)	22 (38.6)	20 (35.1)	15 (26.3)									
Employment					2.718	0.099	0.150	0.011	0.918	0.009	3.694	0.055	0.175
No	45 (37.2)	15 (33.3)	17 (37.8)	13 (28.9)									
Yes	76 (62.8)	37 (48.7)	28 (36.8)	11 (14.5)									
Education					7.148	0.008	0.243	1.056	0.304	0.093	4.299	0.038	0.188
Lower than high school	68 (56.2)	22 (32.4)	28 (41.2)	18 (26.5)									
Higher than high school	53 (43.8)	30 (56.6)	17 (32.1)	6 (11.3)									
Stages of change					1.620	0.203	0.116	0.362	0.547	0.055	5.336	0.021	0.210
Contemplation	82 (67.8)	32 (39.0)	29 (35.4)	21 (25.6)									
Preparation	39 (32.2)	20 (51.3)	16 (41.0)	3 (7.7)									
Follow a procedure for quitting smoking previously					0.056	0.814	0.021	0.107	0.743	0.030	0.475	0.451	0.063
No	73 (60.3)	32 (43.8)	28 (38.4)	13 (17.8)									
Yes	48 (39.7)	20 (41.7)	17 (35.4)	11 (22.9)									
Reasons to quit smoking													
Health					0.033	0.855	0.017	0.204	0.652	0.041	0.599	0.439	0.070
No	57 (47.1)	24 (42.1)	20 (35.1)	13 (54.2)									
Yes	64 (52.9)	28 (43.8)	25 (39.1)	11 (17.2)									
Fear of illness related to smoking					1.114	0.291	0.096	0.344	0.557	0.053	4.088	0.043	0.184
No	74 (61.2)	29 (39.2)	26 (35.1)	19 (25.7)									
Yes	47 (38.8)	23 (48.9)	19 (40.4)	5 (10.6)									
Save money					0.047	0.829	0.020	1.889	0.169	0.125	1.952	0.162	0.127
No	99 (81.8)	43 (43.4)	34 (75.6)	22 (22.2)									
Yes	22 (18.2)	9 (40.9)	11 (24.4)	2 (9.1)									
Give good example to others					0.545	0.460	0.067	2.532	0.112	0.145	1.024	0.312	0.092
No	117 (96.7)	51 (43.6)	42 (35.9)	24 (20.5)									
Yes	4 (3.3)	1 (25.0)	3 (75.0)	0 (0.0)									
Family pressure to quit smoking					1.340	0.247	0.105	2.698	0.100	0.149	0.307	0.580	0.050
No	107 (88.4)	48 (44.9)	37 (34.6)	22 (20.6)									
Yes	14 (11.6)	4 (28.6)	8 (57.1)	2 (14.3)									
Self-discipline					2.047	0.152	0.130	0.001	0.973	0.003	3.010	0.083	0.158
No	102 (84.3)	41 (40.2)	38 (37.3)	23 (22.5)									
Yes	19 (15.7)	11 (57.9)	7 (36.8)	1 (5.3)									
Avoid fire risk					-	-	-	-	-	-	-	-	-
No	121 (100)	52 (43.0)	45 (37.2)	24 (19.8)									
Pressure at work					-	-	-	-	-	-	-	-	-

	Total sample	PA (n = 52)	NA (n = 45)	CD [a] (n = 24)	PA vs NA+ CD [a]			NA vs PA+CD [a]			CD [a] vs. NA+PA		
	n (%)	n (%)	n (%)	n (%)	$\chi2$	*p*	ES *V*	$\chi2$	*p*	ES *V*	$\chi2$	*p*	ES *V*
No	121 (100)	52 (43.0)	45 (37.2)	24 (19.8)									
Respect non-smokers' rights					0.041	0.840	0.018	0.143	0.705	0.034	0.503	0.478	0.064
No	119 (98.3)	51 (42.9)	44 (37.0)	24 (20.2)									
Yes	2 (1.7)	1 (50.0)	1 (50.0)	0 (0)									
Medical recommendation to quit					0.888	0.641	0.086	2.066	0.356	0.131	2.509	0.285	0.144
No	32 (26.4)	16 (50.0)	10 (31.3)	6 (18.8)									
Yes	89 (73.6)	36 (40.4)	35 (39.3)	18 (20.2)									
History of major depressive episode					0.250	0.617	0.045	0.398	0.528	0.057	0.021	0.885	0.013
No	69 (57.0)	31 (44.9)	24 (20.3)	14 (20.3)									
Yes	52 (43.0)	21 (40.4)	21 (40.4)	10 (19.2)									
Treated for depression in the past					1.384	0.239	0.239	4.519	0.034	0.193	1.246	0.264	0.101
No	79 (65.3)	37 (46.8)	24 (30.4)	18 (22.8)									
Yes	42 (34.7)	15 (35.7)	21(46.7)	6 (14.3)									
Past mental disorder					2.675	0.102	0.149	2.719	0.099	0.150	0.001	0.974	0.003
No	81 (66.9)	39 (75.0)	26 (32.1)	16 (19.8)									
Yes	40 (33.1)	13 (32.5)	19 (47.5)	8 (20.0)									
Current mental disorder					0.802	0.370	0.081	0.476	0.490	0.063	0.076	0.783	0.025
No	103 (85.1)	46 (44.7)	37 (35.9)	20 (19.4)									
Yes	18 (14.9)	6 (33.3)	8 (44.4)	4 (22.2)									
Current use psychopharmaceuticals					4.803	0.028	0.199	0.501	0.479	0.064	3.471	0.062	0.169
No	93 (76.9)	45(48.4)	33 (35.5)	15 (16.1)									
Yes	28 (23.1)	7 (13.5)	12 (42.9)	9 (32.1)									
Current use of psychoactive drugs					7.381	0.007	0.247	2.028	0.154	0.129	2.712	0.100	0.150
No	103 (85.1)	39 (37.9)	41 (39.8)	23 (22.3)									
Yes	18 (14.9)	4 (22.2)	4 (22.2)	1 (4.2)									
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	*t/U*	*p*	ES *d*	*t/U*	*p*	ES *d*	*t*	*p*	ES *d*
Age	42.57 (11.07)	40.63 (9.7)	42.16 (12.0)	47.07 (10.7)	1.731	.086	0.318	0.316	0.753	0.067	-2.512	0.013	0.461
Age: First cigarette	15.81 (2.80)	15.58 (2.05)	16.49 (3.21)	15.04 (3.21)	1703.5	0.632	0.002	1383.5	0.077	0.026	928.0	0.121	0.020
Age: Start continuous smoking	18 (3.07)	17.81 (2.30)	18.42 (3.68)	17.63 (3.32)	1788.0	0.975	0	1586.0	0.502	0.004	1034.0	0.394	0.006
Years of continuous smoking	24.15 (10.57)	22.62 (9.20)	22.64 (11.58)	30.29 (9.48)	1.433	0.155	0.263	1.206	0.230	0.221	-3.308	0.001	0.606
Cigarettes per day	19.69 (7.20)	19.40 (7.02)	19.51 (8.08)	20.63 (5.96)	1746.5	0.796	0.001	1582.5	0.478	0.004	989.0	0.238	0.012
FTCD	4.62 (2.11)	4.35 (2.13)	4.69 (2.13)	5.08 (2.08)	1590.5	0.281	0.010	1691.5	0.920	0	979.0	0.224	0.012
MNWS	6.35 (5.69)	6.12 (5.53)	7.09 (5.99)	5.46 (5.54)	1725.0	0.716	0.001	1532.5	0.338	0.008	1055.5	0.478	0.004
AUDIT	3.93 (3.87)	5.00 (4.55)	3.27 (3.27)	2.83 (2.67)	1294.5	0.008	0.058	1433.0	0.134	0.019	941.5	0.145	0.018

Note. PA = positive affect; NA = negative affect; CD = cigarette dependence-related causes. Variables with $p < .20$ were included. ES *V*= effect size, Cramer's V, ES *d* = effect size, Cohen's *d*; FTCD = Fagerström Test of Cigarette Dependence; MNWS = Minnesota Nicotine Withdrawal Scale; AUDIT = Alcohol Use Disorders Identification Test.

[a] lack of control; smoking habit; craving or nicotine withdrawal syndrome; social pressure.

Table 2.
Logistic regression analysis of smoking relapse causes during the 12 months after quitting

				OR 95% CI		*Bootstrap 1000 samples* OR_{BCa} 95% CI		*Model fitness*		
	B	*SE*	*OR*	Lower	Upper	Lower	Upper	R^2	$\chi^2_{H\text{-}L}$	AUC
Positive Affect[a]										
Based on differences p <.05[a.1]								0.30	3.80 [ns]	0.76
Sex (Female)	-1.479	0.538	0.23**	0.08	0.66	0.06	0.56			
Education (Higher than HS)	1.388	0.479	4.01**	1.57	10.24	1.32	22.78			
Current psycho-pharmaceuticals (Yes)	-1.046	0.572	0.35 [ns]	0.11	1.08	0.11	0.71			
Based on differences p <.10[a.2]								0.31	4.07 [ns]	0.77
Sex (Female)	-1.396	0.546	0.25*	0.09	0.72	0.08	0.56			
Education (Higher than HS)	1.228	0.501	3.41*	1.28	9.12	1.03	19.63			
Current psycho-pharmaceuticals (Yes)	-1.002	0.584	0.37 [ns]	0.12	1.15	0.10	0.95			
Negative Affect[b]								0.05	0.00	0.60
Based on differences p <.05[b.1]										
Treated for depression in the past (yes)	0.829	0.393	2.29*	1.06	4.96	1.08	5.23			
Based on differences p <.10[b.2]								0.15	6.31 [ns]	0.68
Age: First cigarette	0.179	0.383	1.20*	1.03	1.39	1.01	1.50			
Cigarette Dependence related causes[c]										
Based on differences p <.05[c.1]								0.26	3.99 [ns]	0.78
Years of continuous smoking	0.154	0.075	1.17*	1.01	1.35	1.02	1.63			
Stages of change (preparation)	-1.396	0.693	0.25*	0.06	0.96	0.03	0.66			
Based on differences p <.10 [c.2]								0.32	5.42 [ns]	0.82
Age	-0.113	0.081	0.89 [ns]	0.76	1.05	0.72	0.98			
Stages of change (preparation)	-1.230	0.706	0.29 [ns]	0.07	1.17	0.07	0.55			

***Notes*:** OR = odds ratio; OR_{BCa} = odds ratio, bias corrected and accelerated method; CI = confidence interval; AUC = area under the curve; SE = standard error; HS = high school.

[ns] p > 0.05, *p < 0.05, **p < 0.01, ***p < 0.001.

[a]Relapse situations with positive affect coded as 1; relapse situations with negative affect and Cigarette Dependence-related situations coded as 0.

[a.1]Variables in the model: Sex, education, current psychopharmaceuticals, current psychoactive drugs, Alcohol Use Disorder Identification Test (AUDIT).

[a.2]Variables in the model: Sex, education, age, employment, current psychopharmaceuticals, current psychoactive drugs, AUDIT.

[b]Relapse situations with negative affect coded as 1; relapse situations with positive affect and Cigarette Dependence-related situations coded as 0.

[b.1]Variables in the model: Treated for depression in the past (yes)

[b.2]Variables in the model: Treated for depression in the past (yes), sex, age: first cigarette, current mental disorder.

[c]Relapse Cigarette Dependence-related situations coded as 1; relapse situations with negative and positive affect coded as 0.

[c.1]Variables in the model: Education, age, years of continuous smoking, stage of change, reason to quit smoking: fear of illness related to smoking.

[c.2]Variables in the model: Education, marital status, employment, age, years of continuous smoking, stage of change, reasons to quit smoking: fear of illness related to smoking, and self-discipline, current psychopharmaceuticals.