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## Anxiety Sensitivity and Tobacco Use: A Transdiagnostic Approach

Gema Aonso-Diego<sup>a</sup>, Miriam Ruz<sup>b</sup>, Sergio Fernández-Artamendi<sup>b</sup>, Manuel J. Ruiz<sup>c</sup>, and Carla López-Núñez<sup>d</sup>

<sup>a</sup>University of Oviedo, Spain; <sup>b</sup>Universidad Loyola Andalucía, Dos Hermanas, Seville, Spain; <sup>c</sup>University of Extremadura, Badajoz, Spain; <sup>d</sup>University of Seville, Spain

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### A B S T R A C T

**Background:** In recent years, several studies have found a relationship between transdiagnostic variables, such as anxiety sensitivity (AS) and tobacco use and smoking cessation. **Method:** In this line, the aim was twofold: 1) to analyze sex differences in variables related to tobacco and AS and 2) to examine the mediating effect of AS. For this purpose, the sample consisted of 340 smokers ( $M_{\text{age}} = 33.59$  years,  $SD = 11.98$ , 68.5% women). **Results:** The results showed that men smoked more cigarettes per day and women had higher levels of total, physical, and cognitive AS. The structural equation model confirmed that AS is a mediator variable between the number of cigarettes per day and nicotine dependence, and the number of previous cessation attempts. **Conclusions:** These findings suggest that transdiagnostic variables, such as AS, and sex differences, must be taken into account in smoking cessation interventions.

### La sensibilidad a la ansiedad y el consumo de tabaco: un enfoque transdiagnóstico

### R E S U M E N

**Antecedentes:** En los últimos años, diversos estudios han encontrado relación entre variables transdiagnósticas, como la sensibilidad a la ansiedad (SA) y el consumo de tabaco y dejar de fumar. **Método:** En esta línea, el objetivo ha sido doble: 1) analizar las diferencias de género en variables relacionadas con el tabaco y la SA y 2) examinar el efecto mediador de la SA. Para ello, la muestra consistió en 340 fumadores ( $M_{\text{edad}} = 33.59$  años,  $DT = 11.98$ , 68.5% mujeres). **Resultados:** Los resultados mostraron que los hombres fumaban más cigarrillos al día y las mujeres presentaban mayores niveles de SA total, física y cognitiva. El modelo de ecuaciones estructurales confirma que la SA es una variable mediadora entre el número de cigarrillos al día y la dependencia a la nicotina y el número de intentos previos de dejar de fumar. **Conclusiones:** Estos resultados sugieren que hay que tener en cuenta variables transdiagnósticas como la SA y las diferencias de género en las intervenciones para dejar de fumar.

Tobacco use is the main preventable cause of morbimortality in the world (Organización Mundial de la Salud, 2021). The prevalence of cigarette use in Spain is above the European mean (22.2% vs. 18.4%), and has remained stable in recent years (EUROSTAT, 2019). In view of the negative effects of tobacco addiction on physical and mental health (Martín-Ríos et al., 2021; Sánchez-Villegas et al., 2021), research focused on progress and improvement of its treatment is crucial to public health. Nevertheless, and despite such progress, long-term abstinence rates are still moderate (~ 20-30%) and relapse rates are high (Stead et al., 2017).

One of the limitations of the existent treatments for smoking cessation is the lack of individualized approaches tailored to the particular characteristics of the smoker, including their mental health status (Leventhal & Zvolensky, 2015; Martínez-Vispo et al., 2020). Multiple studies have shown the relationship between tobacco use

and the presence of psychological problems (Zvolensky et al., 2017), of which anxiety and depression are the most closely related to tobacco abstinence and relapse (Pérez-Pareja et al., 2010; Piper et al., 2011). In particular, depressive and anxious symptomatology have been related to greater levels of nicotine dependence (Zvolensky, Farris, et al., 2014), more perceived barriers to smoking cessation (Leventhal & Zvolensky, 2015), lower treatment adherence (Pérez-Pareja et al., 2020), and higher long-term tobacco relapse rates (Zvolensky, Farris, et al., 2014).

Studies analyzing individual factors affecting the onset and maintenance of substance use (see e.g., Ontaneda-Aguilar et al., 2021), including tobacco, as well as long-term relapse, agree on the importance of including techniques specific to such characteristics in standard treatments (González-Roz et al., 2019). In recent years, a transdiagnostic evaluation and treatment model has been

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implemented for analyzing psychopathological factors common to different diagnostic categories (Leventhal & Zvolensky, 2015). One of the transdiagnostic variables most widely studied with regards to tobacco use and which could have a significant impact in tobacco cessation is anxiety sensitivity (AS) (López-Núñez et al., 2021; Zvolensky et al., 2019).

AS is the concept sustaining the Reiss anxiety expectancy model (Reiss, 1991). It is defined as the fear of interoceptive sensations or symptoms indicative of anxiety based on the perception that such sensations have negative somatic, social, or psychological consequences for the person who experiences them. The AS concept is based on classic conditioning and has been proposed as a significant factor predisposing to development of several mental health problems (Rodríguez et al., 2012). Regarding its impact on smoking and smoking cessation, previous studies have shown that smokers with high levels of AS have higher nicotine dependence rates (Zvolensky, Farris, et al., 2014), additional barriers to quitting smoking given their lower tolerance to abstinence symptoms (Farris et al., 2014; Leventhal & Zvolensky, 2015; Zvolensky, Farris, et al., 2014; Zvolensky et al., 2019), higher treatment dropout rates (Langdon et al., 2016), and higher probability of not achieving smoking abstinence or relapse after successful attempts (Guillot et al., 2016; Martínez-Vispo et al., 2021). Moreover, AS in combination with brooding rumination predicts higher levels of anxiety and depression in treatment-seeking smokers, hindering their quitting success (Martínez-Vispo et al., 2022). Consequently, combined approaches addressing both smoking cessation and AS not only enable transdiagnostic levels of AS to be reduced, but also increase long-term abstinence rates (Farris et al., 2015; Schimdt et al., 2016; Zvolensky, Bogiaizian, et al., 2014).

In this context, it should be mentioned that most of the studies on AS and smoking addiction, whether in the general population or in clinical subsamples, have been carried out in the United States and Argentina, and very few with Spanish population. In view of the above, the main objectives of this study were: 1) to examine sex differences in variables related to smoking and AS and 2) to examine the mediating effect of AS in a population of adult smokers.

## Method

### Participants

The inclusion criteria for participants were: 1) being 18 to 65 years of age, 2) having smoked at least 100 cigarettes in their life, and 3) smoking daily. We excluded participants who: 1) did not give their informed consent for participation in the study, 2) had smoked cannabis in the previous week, and 3) had filled out the survey at random or left it incomplete. Recruitment was carried out through snowball sampling and dissemination of the survey on social networks. A total of 340 participants (see Figure 1) were included in the study ( $M_{\text{age}} = 33.59$ ,  $SD = 11.98$ , 68.5% women). Their sociodemographic characteristics are shown in Table 1.

### Measures

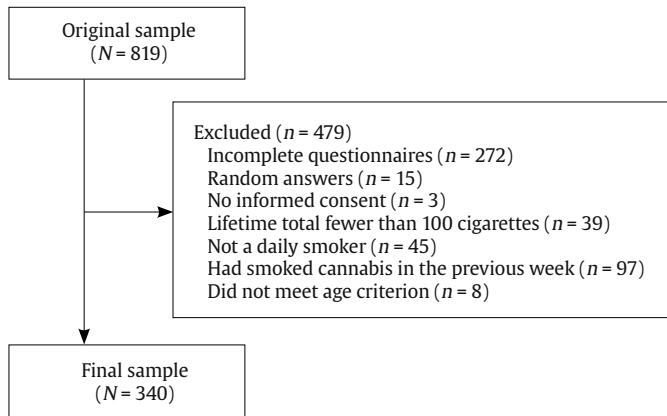
Data were collected through an online survey to evaluate smoking addiction in an adult Spanish population. The survey included information on sociodemographic data (i.e., age, sex,

**Table 1.** Participant Sociodemographic Characteristics

		N = 340 (%)
Nationality	Spanish	329 (96.7)
	Other	11 (3.3)
Education	No education	1 (0.3)
	Primaria education	9 (2.6)
	Secondary education	37 (10.9)
	Vocational training, Middle Grade	44 (12.9)
	Vocational training, Upper Grade	39 (11.5)
	Senior high school	54 (15.9)
	University, Bachelor's or Master's degree	105 (30.9)
	University, Ph.D.	51 (15)
Occupation	Management	17 (5)
	Scientific and intellectual	32 (9.4)
	Mid-level technical and professional	67 (19.7)
	Administration	28 (8.2)
	Services and sales, marketing	36 (10.6)
	Agriculture, livestock-raising, forestry and fishing	2 (0.6)
	Journeyman, operators and mechanics and other trades	3 (0.9)
	Elementary occupations	8 (2.4)
	Military	5 (1.5)
	Other	142 (41.8)
Employment	Full time	140 (41.2)
	Part time	47 (13.8)
	Unemployed/with benefits	28 (8.2)
	Unemployed/no benefits	21 (6.2)
	Retired	4 (1.2)
	Housewife	13 (3.8)
Student	87 (25.6)	
Marital status	Single	206 (60.6)
	Married	84 (24.7)
	Separated or divorced	28 (8.2)
	Common-law partner	22 (6.5)
Other ways of smoking <sup>1</sup>	No other way of smoking	240 (70.6)
	Other ways of smoking	100 (29.4)

Note. <sup>1</sup>Includes pipe, cigars, mini-cigars, e-cigarettes, and hookah.

nationality, education, marital status, and occupation) and variables related to smoking behavior (i.e., cigarettes per day, age of tobacco onset, previous quitting attempts, longest period of abstinence, and main reason for the last relapse). Participants also completed the Fagerström Test for Nicotine Dependence (FTND; [Heatherton et al., 1991](#)), where five levels of dependence were set by their total score: very low (0-2), low (3-4), moderate (5), high (6-7), or very high (8-10). Lastly, AS was evaluated using the Spanish adaptation ([Sandín et al., 2007](#)) of the Anxiety Sensitivity Index-3 (ASI-3). The test consists of 18 items answered on a 5-point Likert-type scale (0 = *none or almost none*, 4 = *very much*). The ASI-3 questionnaire has three anxiety sensitivity subscales (physical, cognitive, and social) with six items each ([Taylor et al., 2007](#)). Completing all questionnaires took 15-20 minutes.



**Figure 1.** Participants Flow Chart.

## Procedure

This was a simple correlational, cross-sectional study. The survey was applied in an online format with the Qualtrics platform. The online notebook that included the evaluation instruments was accompanied by an information sheet and the corresponding informed consent, where the objective of the study and confidentiality of data were specified. This study was approved by the Ethics Committee of Universidad Loyola Andalucía (20-01-2020) and complies with the principles expressed in the Helsinki Declaration.

## Data Analysis

Descriptive analyses were performed to analyze the main variables of interest. Smoking variables and AS were also analyzed

by participant sex with a Student's *t* test for independent samples. The effect size was calculated using the Cohen's *d*, with values lower than 0.40 being considered a small effect, values between 0.40 and 0.70 an intermediate effect, and values over 0.70 a large effect. The relationship between smoking variables (i.e., number of cigarettes per day, years smoking, attempts at quitting, and nicotine dependence) and the AS subscales (physical, cognitive, and social) was analyzed with bivariate correlations using the Pearson's correlation coefficient (*r*).

A structural equations modelling was carried out to examine the mediating effect of AS on the relationship between smoking variables (number of cigarettes per day and nicotine dependence) and previous quit attempts. The model fit parameters were estimated using the maximum likelihood estimation method. Three indices were used to evaluate model fit: 1) Tucker-Lewis index (TLI), where values over .90 indicate adequate model fit; 2) Comparative fit index (CFI), where values over .90 suggest good model fit; and 3) root mean square error of approximation (RMSEA), where values below .08 suggest good model fit ([Byrne, 2009](#); [Schermelleh-Engel et al., 2003](#)). The confidence level was 95%, and both IBM SPSS (version 26.0; SPSS, Inc., Chicago, IL) and AMOS (version 23) were used for the analyses.

## Results

### Characteristics Related to Tobacco and Anxiety Sensitivity

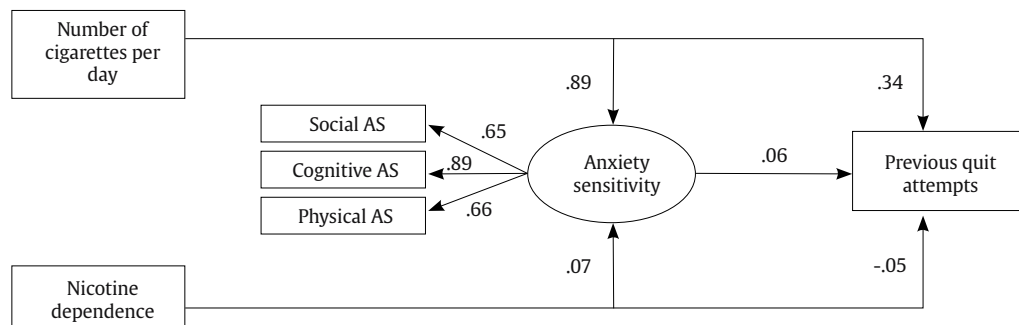
Participants smoked an average of 11.03 cigarettes per day ( $SD = 4.15$ ), had been smoking for an average 15.18 years ( $SD = 10.84$ ), had low nicotine dependence ( $M = 3.50$ ,  $SD = 2.46$ ), and had tried to quit smoking a mean of 2.14 times ( $SD = 2.63$ ). The only significant sex difference was found in the number of cigarettes per day, with men smoking more than women ( $12.43 \pm 8.86$  vs.  $10.37 \pm 7.17$ ,  $p = .041$ ).

The mean score of participants on the total AS scale was 35.51 ( $SD = 11.89$ ), and the mean scores on the three AS subscales were 12.61 ( $SD = 5.33$ ) in physical AS, 9.69 ( $SD = 4.15$ ) in cognitive AS, and 13.21 ( $SD = 4.87$ ) in social AS. Results on sex differences showed that women scored higher on the AS scales than men (see [Table 2](#)).

**Table 2.** Sex differences in Anxiety Sensitivity Index

	Men		Women		<i>p</i>	<i>d</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
ASI-3 Total	33.11	9.16	36.61	12.82	.005	0.36
ASI-3 Physical	11.68	4.46	13.04	5.64	.018	0.26
ASI-3 Cognitive	8.68	2.84	10.15	4.56	< .001	0.38
ASI-3 Social	12.75	4.53	13.42	5.01	.237	0.14

Note. ASI-3 = Anxiety Sensitivity Index-3; *M* = mean; *SD* = standard deviation; *d* = Cohen's *d*.



**Figure 2.** Structural Equation Modelling.  
Note. AS = anxiety sensitivity.

## Anxiety Sensitivity as a Mediator Variable

The structural equation model yielded adequate fit to data, evidenced by the fit indices,  $\chi^2(6) = 2.65$ ,  $p = .851$ ; TLI = 1.02; CFI = 1; RMSEA = .005. AS was directly related to the number of previous failed quit attempts ( $\beta = .064$ ). There were no significant differences in the structural equation model based on sex. The structural equation model is shown in Figure 2.

## Discussion

The main objective of this study was to examine sex differences in tobacco use variables and AS, and to evaluate the mediating effect of AS in a sample of adult smokers. The main results showed that men smoke more cigarettes per day, whereas women score higher in AS. Furthermore, AS is a significant mediator between variables related to tobacco use (i.e., number of cigarettes per day and nicotine dependence) and number of previous quit attempts.

In line with previous research (Chinwong et al., 2018; Nagrath et al., 2019), men scored higher on variables related to tobacco use. However, this difference was only significant for the number of cigarettes smoked per day. On the other hand, women had higher scores in total, physical, and cognitive AS. Also in accordance with previous research, there is a clear sex difference in anxiety-related variables (Nakajima & al'Absi, 2012) and, in particular, in AS (Norr et al., 2015; Zvolensky et al., 2001). These differences emphasize the need to apply the gender perspective in future clinical trials addressing smoking cessation, since both the number of cigarettes per day and AS have shown to be powerful predictors (Martínez-Vispo et al., 2021; Pérez-Pareja et al., 2020).

On the other hand, our findings evidenced a significant relationship between smoking variables (i.e., number of cigarettes per day and nicotine dependence) and AS, demonstrating the mediating effect of AS between the main variables in smoking addiction research (Zvolensky et al., 2019). This relationship may be a consequence of smokers with higher AS perceiving a stronger interoceptive threat in the effects of abstinence (Farris et al., 2014), and also thinking that smoking enables them to manage their emotional distress in different situations (Gregor et al., 2008). Furthermore, some authors have demonstrated that smokers have higher levels of AS compared to non-smokers (Martínez-Vispo et al., 2016; Martínez-Vispo et al., 2021), and that its reduction during smoking cessation treatment is related to a faster decrease in withdrawal symptomatology (Bakshshaie et al., 2018). In fact, persons with lower levels of AS have shown to be more likely to achieve tobacco abstinence (Martínez-Vispo et al., 2021). Identifying transdiagnostic variables, such as AS, and their relationship with tobacco use, is crucial for improving existing smoking cessation treatments, and especially those aimed at difficult-to-treat smokers, such as those with other mental disorders (e.g., depression and anxiety) (Cornellà-Font et al., 2020; González-Sanguino et al., 2022; Drope et al., 2018). Overall, addressing high levels of AS into existing smoking cessation programs leads to increased cessation rates at both short- and long-term as well as improved healthcare services for smokers (Feldner et al., 2008; Zvolensky, Borgiaizian, et al., 2014; Zvolensky et al., 2018; Zvolensky et al., 2008). As no previous studies have included the treatment of AS into Spanish smoking cessation treatments, both clinicians and researchers should focus on developing novel protocols to quit smoking from this transdiagnostic approach (López-Núñez et al., 2021).

All of the above suggest that interventions for smoking cessation including an AS approach should include components such as psychoeducation (i.e., information on smoking, AS, and how they are related), techniques for decreasing emotional sensitivity, and increasing tolerance to internal feelings that could appear when

attempting smoking cessation (e.g., Capron et al., 2014; Gonzalez et al., 2017; Smits et al., 2016), as well as cognitive-behavioral techniques (e.g., relapse prevention).

This study was not exempt from limitations. First, although the sample size was large, generalization of the results is limited because the sampling method was by convenience and not random. Second, the participants were from the general population and did not include smokers receiving treatment for quitting. Therefore, in future studies, it would be advisable to examine the relationship between smoking abstinence and AS in clinical populations. It is also worth mentioning that participants took the survey during the COVID-19 lockdown, which may have had an impact on the results.

In conclusion, it seems fundamental for future research to continue evaluating the relationship between smoking addiction and transdiagnostic variables, including AS. It would be of particular interest to delve deeper into the relationship between these variables in clinical populations. Relationship between smoking addiction and other transdiagnostic clinical variables such as distress tolerance, negative affect or anhedonia, that could influence cessation and maintenance of tobacco use, should also be explored.

## Conflict of Interest

The authors of this article declare no conflict of interest.

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