Activation level as a mediator between behavioral activation, sex, and depression among treatment-seeking smokers

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Abstract

Introduction: Behavioral activation (BA) has gained interest when combined with tobacco interventions as it relates to improved depression and cessation rates. However, no prior efforts have examined mediators of BA effectiveness and sex-dependent effects. This secondary analysis assesses the main and interactive effects of sex and type of smoking cessation intervention [a cognitive behavioral treatment (CBT) only, or CBT+BA] on depressive symptoms among treatment-seeking patients with depression. It also examines the activation level as a mediator between BA, BA by sex, and depression. **Method:** 120 smokers were assigned to an 8-week CBT or to CBT + BA. They completed the Beck Depression Inventory-II (BDI-II) and the Behavioral Activation for Depression scale-short-form (BADS-SF). A two-way ANOVA assessed the effects of sex and treatment condition on participants' BDI-II scores. A moderated mediational analysis tested whether the indirect effect of treatment condition on BDI-II through BADS-SF differed by sex. **Results:** After controlling for end-of-treatment smoking status and baseline BDI-II, there were no significant effects of treatment condition, sex, and their interaction on end-of-treatment BDI-II. Being a male was indirectly associated with higher BDI-II scores through lower BADS-SF score (point estimate = -3.440; *SE* = 1.637; BC 95% CI [-7.105, -0.749]). This effect was not found for women. **Conclusions:** There is a need to tailor interventions by sex when treating smokers with depression. It is recommended to assess symptoms such as mental rumination or self-consciousness, which tend to be more pronounced in women.

Keywords: depression; sex; behavioral activation; smoking

1. Introduction

Global smoking rates have decreased from 22.5% in 2007 to 19.2% in 2017, and they are expected to decline to about 16% by 2030 (World Health Organization, 2019). Nevertheless, prevalence data remain stable among smokers with psychiatric comorbidity, suggesting that cessation efforts are not equally distributed (Steinberg, Williams, & Li, 2015). In particular, tobacco smoking has been linked to both depression diagnosis and depressive symptoms (Dierker et al., 2015; Fluharty, Taylor, Grabski, & Munafo, 2017; McClave et al., 2009). The smoking rate in depressed individuals is about twice the rate of the general population, and conversely, smokers are about twice as likely to have depression than nonsmokers (Cook et al., 2014). Although the number of quitting attempts does not differ between depressed and nondepressed smokers (Cooper, Borland, McKee, Yong, & Dugue, 2016), depressed smokers have a decreased likelihood of continued smoking abstinence compared to non-depressed smokers (Leventhal, Piper, Japuntich, Baker, & Cook, 2014; Weinberger, Pilver, Desai, Mazure, & McKee, 2013).

Co-occurrence between depression and smoking is more common among women than men (Husky, Mazure, Paliwal, & McKee, 2008; Luk & Tsoh, 2010), and it is more likely to hinder effective cessation in female smokers (Weinberger, Mazure, Morlett, & McKee, 2013). Moreover, depression vulnerability predicts smoking, but only among females (Morrell, Cohen, & McChargue, 2010). Despite this evidence, the interplay between depression, sex, and other clinical variables has only been addressed in recent years among treatment-seeking smokers. For instance, the interaction between smoking craving and history of major depressive disorder (MDD) was related to a greater risk of relapse, but only for women (Rodríguez-Cano et al., 2017). Also, women smokers showed an association between severity of nicotine dependence and depression

(Komiyama et al., 2018). Hazardous drinking and its association with depressive symptomatology also predicted post-treatment smoking craving, but only in men (Rodríguez-Cano et al., 2018).

Behavioral activation (BA) has recently gained interest when combined with standard tobacco cessation interventions, as together they hold great promise in improving cessation rates and reducing depressive symptoms (González-Roz, Secades-Villa, & Alonso-Pérez, 2019; MacPherson, Collado, Lejuez, Brown, & Tull, 2016; Martínez-Vispo et al., 2019). The foundation of BA lies in increasing contact with rewarding daily activities so as to enhance positive mood, while reducing negative affect and avoidance behaviors (Lejuez, Hopko, Acierno, Daughters, & Pagoto, 2011). This treatment is of particular relevance as limited sources of reinforcement are a core feature of both smoking and depression (Audrain-McGovern, Rodríguez, Rodgers, & Cuevas, 2011). BA has also been used to treat other emotion dysregulation disorders than depression, such as anxiety and stress (Lehmann & Bördlein, 2020; Soleimani et al., 2015). From a transdiagnostic perspective, BA emerges as a parsimonious intervention for smokers because it targets avoidance behaviors that underlie both anxiety and depressive symptoms, which may, in turn, facilitate smoking abstinence (Hopko, Lejuez, & Hopko, 2004). Moreover, BA can be easily delivered in a group format (Martínez-Vispo et al., 2019), which further supports its cost-efficacy.

The effect of BA as a relevant factor that could impact the potential sex-depression association has only been assessed in a mixed sample of clinical and nonclinical community adults (Wagener, Baeyens, & Blairy, 2016) and in university students (Ryba & Hopko, 2012). In these studies, BA negatively predicted all depression symptoms in both sexes (Wagener et al., 2016), and the association between depression and sex was attenuated when levels of environmental reward were

considered as a mediator (Ryba & Hopko, 2012). Nevertheless, environmental reward is similar, but not identical, to BA as the former captures changes in satisfaction and reward experienced with activities and the latter measures specific changes in activation (Manos, Kanter, & Luo, 2011). Moreover, Ryba & Hopko (2012) assessed environmental reward thorough an ad-hoc questionnaire rather than with a validated instrument. To our knowledge, no previous study has tested the mediator effect of BA on the potential relationship between sex and depression among treatment-seeking smokers.

Against this background, this study sought to elucidate on BA as a mediator of cognitive behavioral treatment (CBT) and BA effectiveness for depression and, more particularly, to examine sex-dependent differences. The aim was two-fold: (1) to assess the main and interactive effects of sex and treatment condition (i.e., CBT only or CBT+BA) on BDI-II scores among adult treatment-seeking smokers with depression, and (2) to examine whether activation level mediates the association between a BA treatment and depressive symptoms. Based on prior research conducted in a community sample (Wagener et al., 2016), two hypotheses were formulated: (1) an interaction effect of sex and treatment condition on BDI-II scores would emerge, and (2) BA levels would mediate the association between treatment condition and BDI-II scores.

2. Method

2.1. Participants

This research was developed at the facilities of the Clinical Unit of Addictive Behaviors of the University of Oviedo (Spain). It is a secondary analysis derived from a parent randomized controlled trial (NCT03163056) aimed at assessing the effectiveness of CBT combined with BA and the same intervention plus a contingency management (CM) component among treatment-seeking smokers with depressive symptoms. In

order to test the effects of BA on depression, only individuals who received CBT + BA (n =60) and CBT (n =60) were included in this study. There were no significant differences in abstinence rates by treatment condition [CBT = 70%, CBT + BA = 63.3%; $\chi 2 = 0.338$; $p = .561$] or by sex [Women = 69.8%, Men = 58.8%; $\chi 2 = 0.867$; $p = .352$]. Also, drop-out rates were not statistically different according to treatment condition [CBT = 91.5%, CBT + BA = 88.3%; $\chi 2 = 0.075$; $p = .784$] or sex [women = 92.9%, men = 82.4%; $\chi 2 = 1.949$; $p = .163$]. The total sample was composed of 86 women [CBT = 47, CBT + BA = 39] and 34 men [CBT = 13, CBT + BA = 21], with no significant differences in the sex distribution by treatment condition ($\chi 2 = 2.011$; $p = .156$). Participants' baseline sociodemographic characteristics by treatment condition and sex are shown in Table 1. There were no significant differences in any sociodemographic variable. Participants smoking, depression and BA scores by treatment condition and sex are presented in Tables 2 and 3, respectively. No significant differences were found, with the exception of baseline depressive symptomatology by treatment condition (see Table 2). It is of note that, consistent with previous literature (Chen et al., 2017), cotinine levels were higher for men than for women at both baseline and end of treatment, although such trend did not reach statistical significance (see Table 3).

Table 1. Participants baseline sociodemographic characteristics by treatment condition and sex.

	CBT (n = 60)	CBT + BA (n = 60)	Statistic	p	Women (n = 86)	Men (n = 34)	Statistic	p
Sex (%women)	78.30	65	2.011[1]	.156	71.70	28.30	-	-
Age (years)[a]	53.74 ± 9.90	50.62 ± 10.23	-1.685[2]	.095	52.88 ± 9.71	50.17 ± 11.13	1.257[2]	.211
Marital status (% married)	62.10	46.70	7.030[3]	.071	49.40	66.70	6.429[3]	.092
Education level (%)			5.377[3]	.068			2.976[3]	.226
<High School	25.50	15			21.2	24.2		
High School	60	53.30			51.8	63.6		
≥University	14.50	31.70			27	12.2		

CBT = Cognitive Behavioral Treatment; CBT + BA = Cognitive Behavioral Treatment + Behavioral Activation.
[a] = Means ± SD; [1]Yates' Continuity Correction; [2]Student's t; [3]Chi-squared.

Table 2. Participants' smoking, depression and behavioral activation scores by treatment condition.

	Baseline				End of treatment			
	CBT (n = 60)	CBT + BA (n = 60)	Student's t	p	CBT (n = 60)	CBT + BA (n = 60)	Student's t	p
Cigarettes per day[a]	22.54 ± 10.38	22.95 ± 8.23	0.236	.814	8.31 ± 6.08	6.94 ± 7.73	-0.521	.607
Years of regular smoking[a]	33.46 ± 9.79	31.70 ± 11.52	-0.892	.374	-	-	-	-
FTND[a]	6.39 ± 1.73	6.85 ± 1.79	1.424	.157	4.00 ± 1.87	3.42 ± 2.15	-0.725	.476
CO (ppm)[a]	25.86 ± 20.72	25.68 ± 15.16	-0.053	.958	3.98 ± 4.36	4.36 ± 5.67	0.373	.710
Cotinine (ng/ml)[a]	2,454.25 ± 2,591.60	2,509.11 ± 1,252.08	0.144	.886	320.12 ± 724.88	383.08 ± 1,010.22	-0.336	.717
BDI-II[a]	30.88 ± 7.44	27.10 ± 9.72	2.393	.018	14.53 ± 11.12	11.66 ± 8.51	1.507	.135
BADS-SF[a]	13.93 ± 9.20	13.90 ± 6.87	0.022	.982	18.13 ± 9.55	20.46 ± 9.25	-1.296	.198

FTND = Fagerström Test for Nicotine Dependence; CO = carbon monoxide; ppm = parts per million; ng/ml = nanogram/milliliter; BDI-II = Beck Depression Inventory, Second Edition; BADS-SF = Behavioral Activation for Depression scale-Short Form; CBT = Cognitive Behavioral Treatment; CBT + BA = Cognitive Behavioral Treatment Behavioral Activation.

[a] = Means ± SD.

Table 3. Participants' smoking, depression and behavioral activation scores by sex.

	Baseline				End of treatment			
	Women (n = 86)	Men (n = 34)	Student's t	p	Women (n = 86)	Men (n = 34)	Student's t	p
Cigarettes per day[a]	21.89 ± 8.50	24.94 ± 10.84	-1.448	.154	6.81 ± 6.52	9.50 ± 8.12	-0.929	.361
Years of regular smoking[a]	32.32 ± 10.71	33.18 ± 10.76	-0.390	.697	-	-	-	-
FTND[a]	6.49 ± 1.79	6.97 ± 1.70	-1.329	.187	3.39 ± 1.72	4.57 ± 2.50	-1.357	.188
CO (ppm)[a]	23.83 ± 16.59	30.70 ± 20.66	-1.875	.063	3.51 ± 3.61	6.04 ± 8.08	-1.597	.120
Cotinine (ng/ml)[a]	2,417.43 ± 2,223. 28	2,651.92 ± 1,251.29	-0.557	.581	217.00 ± 492.80	740.21 ± 1454.57	-1.799	.083
BDI-II[a]	29.27 ± 8.76	28.29 ± 9.10	0.542	.589	12.56 ± 10.07	14.71 ± 9.75	-0.981	.329
BADS-SF[a]	14.31 ± 8.62	12.91 ± 6.53	0.963	.339	18.86 ± 9.51	20.50 ± 9.27	-0.789	.432

FTND = Fagerström Test for Nicotine Dependence; CO = carbon monoxide; ppm = parts per million; ng/ml = nanogram/milliliter; BDI-II = Beck Depression Inventory, Second Edition; BADS-SF = Behavioral Activation for Depression scale-Short Form.

[a] = Means ± SD.

Participants were recruited through advertisements in the local media and flyers posted in the community. Inclusion criteria were: being aged ≥18, smoking ≥10 cigarettes per day, meeting diagnostic criteria for nicotine dependence according to the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition-text revised (DSM-IV-TR; American Psychiatric Association, 2000), meeting criteria for current unipolar major depressive disorder (MDD) according to the DSM-IV-TR (American Psychiatric Association, 2000), and/or scoring ≥14 on the Beck Depression Inventory, Second Edition (BDI-II; Beck, Steer, & Brown, 1996). Participants were excluded from the study if they had been diagnosed with a current psychiatric disorder apart from MDD (including any other SUD besides nicotine dependence), and if they were receiving another smoking cessation treatment at the study onset. This study was approved by the Institutional Review Board of the University of Oviedo (approval number: nº124/15), and informed consent was obtained from all participants prior to study initiation.

2.2. Instruments and variables

Participants completed an ad hoc questionnaire in a single baseline assessment to collect data on sociodemographic variables (age, sex, marital status, and education level). Nicotine dependence severity was explored using the Fagerström Test for Nicotine Dependence (FTND) (Heatherton, Kozlowski, Frecker, & Fagerstrom, 1991). The Spanish validation of the FTND has an adequate reliability (Cronbach's α = .66; Becoña & Vázquez, 1998). Participants also reported their mean number of cigarettes smoked per day and years of regular smoking. Smoking status was biochemically verified by asking participants to provide breath carbon monoxide (CO) and urine specimens. Breath samples of CO were obtained through a piCO Smokerlyzer (Bedfont Scientific Ltd., Rochester, United Kingdom). A BS-120 chemistry analyzer (Shenzhen

Mindray Bio-Medical Electronics Co. Ltd., Shenzhen, P.R. China) was used to assess urine cotinine levels through a homogeneous enzyme immunoassay system. Smoking abstinence was defined as presenting a CO level of ≤4 parts per million (ppm) and a urinary cotinine sample of ≤80 nanograms/milliliter (ng/ml).

The BDI-II (Beck et al., 1996) was used to assess the presence of depressive symptoms. Scores range from 0 to 63, and they are ranked according to the following criteria: minimal (0 – 13), mild (14 – 19), moderate (20 – 28), and severe (29 or above).

The Spanish validation (González-Roz, Secades-Villa, & Muñiz, 2018) of the Behavioral Activation for Depression scale-short-form (BADS-SF) (Manos et al., 2011) was used to assess BA. This is a 6-item questionnaire that captures goal-directed activation patterns and, more specifically, completion of activity scheduling within the prior week. It is composed of two factors: activation and avoidance. According to the authors' guidelines, we only considered items included in the activation subscale (items 2, 3, 4, 5, 8, and 9) to compute the BADS-SF score.

Participants completed the BDI-II and the BADS-SF at the intake assessment and at the end of treatment.

2.3. Treatment conditions

Both interventions were delivered by master's and doctoral level psychologists with clinical background in smoking cessation treatments. Therapists practiced with a minimum of three training cases supervised by the principal investigator. Sessions were audio-recorded. There was a one-hour weekly supervision session during the interventions. Both protocols were implemented in group-based sessions of a maximum of four patients. Each session took about 90 minutes, and they were all carried out over an 8-week period. During the treatment, patients attended the clinic twice a week for

biochemical measures of smoking status via CO and cotinine to be taken. One of the visits coincided with the therapy session and the other was scheduled midweek between sessions.

2.3.1. CBT

The treatment consisted of an adaptation of a multicomponent manualized protocol for quitting smoking (Becoña, 2007). Patients with depression require high intensity interventions in terms of treatment length and session duration (Whisman, 2008). Thus, CBT was extended and adapted to 8 weeks in order to address patients' depression and smoking cessation concerns appropriately. This treatment has been broadly described in previous studies (Secades-Villa, García-Rodríguez, López-Núñez, Alonso-Pérez, & Fernández-Hermida, 2014). Its core components are information about tobacco, behavioral contract to promote treatment attendance and adherence, nicotine fading, self-monitoring and graphical representations of progressions in nicotine intake, stimulus control, strategies for managing nicotine withdrawal symptoms, and relapse prevention strategies.

2.3.2. CBT + BA

Participants allocated to this condition received the intervention previously described in combination with a BA module (MacPherson et al., 2016). Though treatment length and content were the same as in CBT only, the time devoted to depression and smoking cessation modules was adjusted. The BA module was previously described in the parent randomized controlled trial (Secades-Villa et al., 2019) and it included the following components: analysis of the functional association between depression and smoking, self-monitoring of daily activity as well as its importance and enjoyment, identification of life areas and values that guide the

generation of meaningful positive activities, engagement in 2-3 weekly activation goals, and social support through behavioral contracts.

2.4. Data analysis

Chi-squared tests and independent-samples *t* tests were used to evaluate differences by treatment condition and sex in any socio-demographic or smoking-related variable.

With the aim of addressing whether treatment condition (CBT vs. CBT + BA) or sex (women vs. men) affect BDI-II scores at the end of treatment, a preliminary two-way between-groups analysis of variance (ANOVA; after the performance of Levene's test for homogeneity of variances) was conducted. Smoking status at the end of treatment and baseline BDI-II score were entered as covariates in the analysis to control for their influence in the results. Effect sizes of principal comparisons were calculated using the partial eta squared (η^2p) statistic.

A moderated mediation model was conducted with the macro PROCESS for SPSS (A. F. Hayes, 2018) to test whether the indirect effect of treatment condition [independent variable (X)] on BDI-II score at the end of treatment [dependent variable (Y)] through BADS-SF score at the end of treatment [mediator (M)] differed by sex [moderator (W)]. The SPSS model used was 7, which allows us to obtain any potential conditional indirect effect of sex [moderator (W)] on the pathway between treatment condition [independent variable (X)] and BADS-SF score at the end of treatment [mediator (M)]. Bootstrapping techniques (with 10,000 resamples) were performed to reduce Type I error (A. F. Hayes, 2018). Smoking status at the end of treatment and baseline BDI-II score were included as covariates. The confidence level for all analyses was 95% and the statistical package used was the SPSS (V24; SPSS, Inc., Chicago, IL).

3. Results

3.1. Main and interactive effects of treatment condition and sex on BDI-II scores at the end of treatment

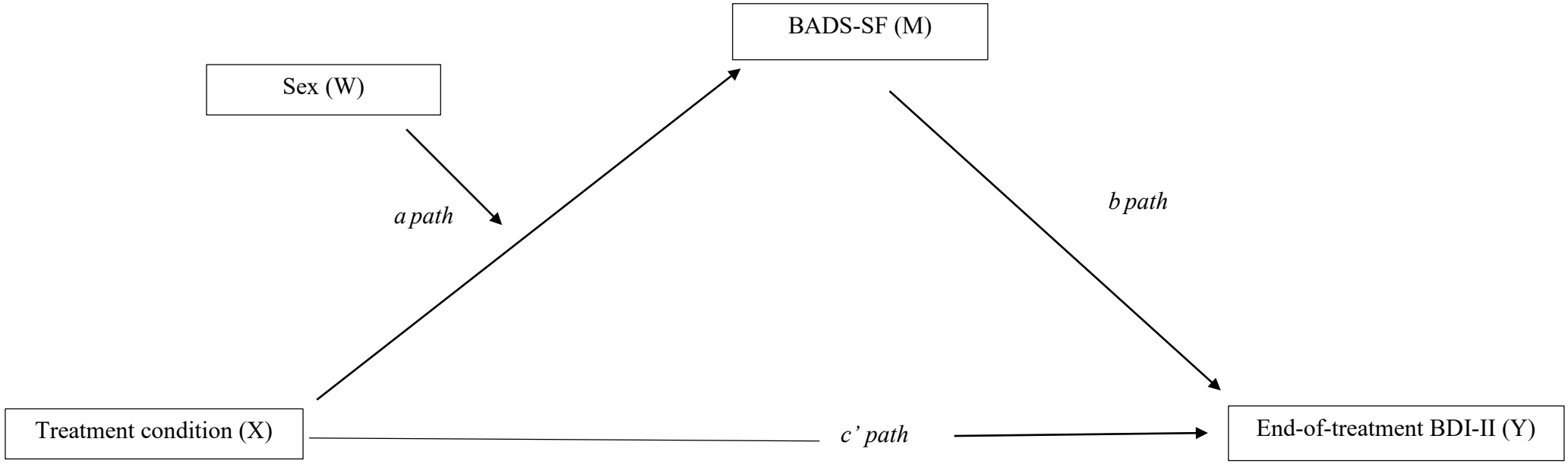
Results from the two-way between-groups ANOVA revealed a non-significant effect of treatment condition [$F(1, 102) = 2.327$, $p = .130$] and sex [$F(1, 102) = 2.244$, $p = .137$] on end-of-treatment BDI-II scores. Likewise, treatment condition by sex had not a significant effect on end-of-treatment BDI-II scores [$F(1, 102) = 0.625$, $p = .431$]. Nevertheless, the effect of the first covariate (smoking status at the end of treatment) was significant [$F(1, 102) = 7.435$, $p = .008$, $\eta^2p = .068$]. Specifically, smokers showed higher BDI-II scores ($M = 16.96$, $SD = 10.54$) than abstainers ($M = 11.77$, $SD = 9.49$). The second covariate (baseline BDI-II scores) also revealed a significant effect on end-of-treatment BDI-II scores [$F(1, 102) = 4.670$, $p = .033$, $\eta^2p = .044$].

3.2. Moderated mediational analyses

Figure 1 depicts the moderated mediation model. The indirect effect of treatment condition (CBT vs. CBT + BA) on BDI-II score through BADS-SF score differed by sex, while accounting for the effect of smoking status at the end of treatment and baseline BDI-II score. Specifically, sex moderated the indirect effect of treatment condition on BDI-II score through BADS-SF score. Table 4 shows the main results of the moderated mediation model. The conditional indirect effects showed that being a male is indirectly associated with higher BDI-II scores through lower BADS-SF scores, while this effect was not found for women. The index of moderated mediation was statistically significant, which further supports that the indirect effect of treatment condition is moderated by sex. With regard to the covariates, there was a significant effect of end-of-treatment smoking status on both BADS-SF score ($b = -4.147$; $SE = 2.032$; $t = -2.041$; $p = .044$; BC 95% CI [-8.177, -0.116]) and end-of-treatment BDI-II

score (b = 4.181; SE = 1.983; t = 2.108; p = .037; BC 95% CI [0.248, 8.113]). The effect of baseline BDI-II score on end-of-treatment BDI-II was also significant (b = 0.228; SE = 0.101; t = 2.260; p = .026; BC 95% CI [0.028, 0.429]).

Figure 1. Moderated mediational model for treatment condition (X), sex (W), BADS-SF (M), and BDI-II (Y) at the end of treatment. *c'* represents the direct effect, *a* and *b* the indirect effects.



Note. BADS-SF = Behavioral Activation for Depression scale-Short Form; BDI-II = Beck Depression Inventory, Second Edition.

Table 4. Results of the moderated mediational model.

Model path	*b*[a]	*SE*[b]	*t*	*p*	95 % CI (Lower)[c]	95% CI (Upper)[c]
a_1 path: Treatment condition (X)→BADS-SF (M)	4.479	2.142	2.218	.0288	0.501	8.998
a_2 path: Sex (W)→ BADS-SF (M)	-5.840	3.417	-1.709	.0905	-12.618	0.937
a_3 path: Treatment condition (X) x Sex (W)→ BADS-SF (M)	4.127	2.092	1.973	.0512	-0.023	8.276
b_1 path: BADS-SF (M)→ End-of-treatment BDI-II (Y)	-0.386	0.093	-4.148	.0001	-0.573	-0.202
c' path: Treatment condition (X) → End-of-treatment BDI-II (Y)	-1.134	1.771	-0.640	.5236	-4.647	2.379
Conditional indirect effect (women)	-0.241	0.987	-	-	-2.102	1.535
Conditional indirect effect (men)	-3.440	1.637	-	-	-7.105	-0.749
Index of moderated mediation	-3.198	1.763	-	-	-7.118	-0.271

BADS-SF = Behavioral Activation for Depression scale-Short Form; BDI-II = Beck Depression Inventory, Second Edition.

[a] = Unstandardized coefficients; [b] = Standard Error; [c] = Confidence Interval.

Covariates included in the model = End-of-treatment smoking status; Baseline depression assessed by the Beck Depression Inventory-II.

4. Discussion

This is the first study to assess the impact of a BA protocol on depressive symptomatology, and the mediator effect of activation level between BA and depressive symptoms among treatment-seeking smokers with depression. The major findings were: (1) when controlling for both smoking status and baseline depressive symptomatology, neither treatment condition and sex nor their interaction had a significant effect on end-of-treatment depressive symptoms; and (2) the effects of BA on end-of-treatment depressive symptoms were mediated by activation levels in men but not in women.

This study shows no differential effects of treatment condition, sex and their interaction on end-of-treatment depressive symptomatology. A plausible explanation for this finding may be related to the significant effect that both smoking status and baseline depressive symptoms had on end-of-treatment depression, that, in fact, reveal moderate magnitude effect sizes. The impact that both covariates had on end-of-treatment depression was also replicated in the moderated mediational analysis. This result is consistent with previous literature showing that high baseline depression is associated with reduced odds of smoking cessation (Ranjit, Latvala, Kinnunen, Kaprio, & Korhonen, 2020), even after controlling for relevant factors such as sociodemographic, substance use or health status variables (Huffman, Bromberg, & Augustson, 2018). Baseline depression also predicts higher relapse rates (Cooper et al., 2016). Such poor outcomes may in turn lead to the persistence of depression symptoms over time (Bakhshaie, Zvolensky, & Goodwin, 2015).

The present study shows that sex needs to be taken into account as the BA effectiveness on depression was mediated by activation levels in men but not in women. This result is in line with that obtained by Wagener et al. (2016), who found that BA

was negatively associated with depressive symptoms for both sexes, but the strength of this relationship appeared to be of greater importance in men than in women. The fact that maintaining factors of depression such as mental rumination, brooding, and reflection are more present in women than in men (Johnson & Whisman, 2013), and that women are more prone to engage in social activities as well as in passive or sedentary behaviors, while men spend more time in active behaviors such as physical and recreational activities (Ryba & Hopko, 2012) may explain why the decrease of depression in women is not mediated by activation levels. The BA intervention is typically designed to help patients to identify weekly activation goals that are congruent with their life values. Nevertheless, when BA is implemented in the context of a smoking cessation intervention, therapists provide the BA rationale focused on structuring a variety of reinforcing activities to promote a more rewarding and healthier lifestyle that directly competes with smoking (MacPherson et al., 2010). Thus, physical and active behaviors are indirectly promoted more than those involving passive or sedentary actions. The present results suggest that therapists' subtle encouragement of specific forms of active behaviors favors male as opposed to female smokers.

These results highlight the need to consider sex when designing interventions for depression symptoms. Patients may benefit from the use of assessment tools targeting specific symptoms such as mental rumination or self-consciousness, which tend to be more pronounced in women (Else-Quest, Higgins, Allison, & Morton, 2012; Johnson & Whisman, 2013). When such symptomatology is evident, other intervention strategies such as mindfulness, acceptance and commitment, and meta-cognitive therapies are advisable (S. C. Hayes & Hofmann, 2017), as they may reduce the sex disparities observed in smoking cessation and maintenance of long-term abstinence (Smith, Bessette, Weinberger, Sheffer, & McKee, 2016). It is of interest for future research to

explore the efficacy of these interventions for managing depression in women with comorbid SUDs, including smoking.

Several limitations should be acknowledged. First, we only consider the effects of sex, so it is not possible to determine whether the same results would be obtained if gender identity had been assessed. Second, the sample is unequally distributed by sex, and there is an imbalance in the distribution of baseline depressive symptoms by treatment condition. Nevertheless, abstinence rates and end-of-treatment depressive symptomatology did not differ neither by sex nor by treatment group, so such imbalance does not appear to affect the results found. Moreover, similar results were obtained when a less common analytical method known as a permutational ANOVA (not reported herein) was conducted, which allows the handling of unbalanced designs (Anderson, 2017).

Despite these shortcomings, these findings show that association between a BA protocol and depression symptoms differed by sex and highlight the need to develop targeted interventions that consider specific depressive symptomatology to improve psychological treatments for managing depressive disorders among treatment-seeking smokers.

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