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Mediator Role of Metacognition in the Relationship between Nicotine Addiction and Emotion Dysregulation in Adult Smokers

Yetişkin Sigara İçicilerinde Nikotin Bağımlılığı ve Duygu Düzensizliği Arasındaki İlişkide Üstbilişin Aracı Rolü

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Abstract

Objective: Examining the psychological factors underlying nicotine addiction seems important in understanding the maintenance of addiction. This study examined the association between severity of nicotine addiction, difficulties in emotion regulation (DER) and metacognitive beliefs (MCBs).

Method: The sample consisted of 255 people at the age of 18 and over, smoking at least one cigarette daily. The data were collected online by using the Turkish versions of Fagerström Test for Nicotine Dependence, Difficulties in Emotion Regulation Scale-Short Form, Metacognitions About Smoking Questionnaire, and Demographic Information Form.

Results: A significant positive relationship was found between daily cigarette consumption and the severity of nicotine addiction. Among difficulties in emotion regulation, nonacceptance emerged as a significant predictor. Additionally, both positive metacognitive beliefs related to cognitive regulation and negative metacognitive beliefs regarding uncontrollability significantly predicted nicotine dependence. Findings also showed that metacognitive beliefs had a mediating role in the relationship between difficulties in emotion regulation and addiction severity. While the initial model accounted for 40% of the variance, the inclusion of metacognitive beliefs increased the explained variance to 58%, underscoring their substantial explanatory power.

Conclusion: The substantial increase in the expained variance reflects the strong explanatory contribution of metacognitive beliefs in understanding the severity of nicotine addiction.

Keywords: Nicotine addiction, emotion regulation, metacognitive beliefs, cognitive regulation

Öz

Amaç: Nikotin bağımlılığının altında yatan psikolojik faktörlerin incelenmesi, bağımlılığın sürdürülmesini anlamak için önemli görünmektedir. Bu çalışmada nikotin bağımlılığının şiddeti, duygu düzenleme güçlüğü ve meta-bilişsel inançlar arasındaki ilişki incelenmiştir.

Yöntem: Örneklem 18 yaş ve üzeri, günde en az bir sigara içen 255 kişiden oluşmuştur. Veriler Fagerström Nikotin Bağımlılığı Testi, Duygu Düzenleme Güçlüğü Ölçeği-Kısa Form, Sigarayla İlgili Meta-Bilişler Anketi ve Demografik Bilgi Formu'nun Türkçe versiyonları kullanılarak çevrimiçi olarak toplanmıştır.

Bulgular: Günlük sigara tüketimi ile nikotin bağımlılığının şiddeti arasında anlamlı pozitif ilişki bulunmuştur. Duygu düzenleme güçlükleri arasında kabul etmeme değişkeni anlamlı bir yordayıcı olarak ortaya çıkmıştır. Ayrıca, hem bilişsel düzenlemeyle ilgili olumlu meta-bilişsel inançlar hem de kontrol edilemezlikle ilgili olumsuz meta-bilişsel inançlar nikotin bağımlılığını anlamlı şekilde yordamıştır. Bulgular meta-bilişsel inançların duygu düzenleme güçlükleri ile bağımlılık şiddeti arasındaki ilişkide aracı bir rol oynadığını da göstermiştir. İlk model varyansın %40'ını açıklarken, meta-bilişsel inançların dahil edilmesi açıklanan varyansı %58'e çıkararak bu inançların önemli açıklayıcı gücünü vurgulamıştır.

Sonuç: Açıklanan varyanstaki önemli artış, meta-bilişsel inançların nikotin bağımlılığının şiddetini anlamada güçlü açıklayıcı katkısını yansıtmaktadır.

Anahtar kelimeler: Nikotin bağımlılığı, duygu düzenleme, meta-bilişsel inançlar, bilişsel düzenleme

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Introduction

Many psychological factors potentially play a role in nicotine addiction, including emotion regulation. Gross defines emotion regulation in terms of internal and external processes that govern which, when, and how emotions are experienced and expressed (1). Meta-analysis studies show that people with low levels of emotion regulation skills have a higher tendency to use addictive substances such as marijuana, chemicals, alcohol and cigarettes and to seek substance use as a coping method (2). Studies also indicate that difficulties in emotion regulation (DER) are associated with nicotine addiction (3-5). Rogers et al. found that strategy and goal sub-dimensions of DER were associated with nicotine addiction (4). Meta-analysis and cross-sectional studies indicate that DER is related to anxiety, depression and maintenance of smoking behavior (6). Adams et al. showed that nonacceptance as a DER mediated the relationship of depression with smoking (3).

Given that DER is closely linked to cognitive processes, it is crucial to explore the role of metacognitions in addiction. Metacognition refers to cognitive factors that are involved in monitoring, controlling and interpreting one's own thinking (7). Most theorists make a fundamental distinction between metacognitive knowledge and metacognitive regulation. Metacognitive knowledge includes metacognitive beliefs (MCBs), which include beliefs related to the meaning of thoughts, and beliefs about how effective one's memory and cognitive control are. MCBs can be positive or negative. Positive MCBs include information about which attention strategies, thinking styles, or coping methods will be beneficial. Examples of positive MCBs may be beliefs that worrying, rumination and threat monitoring are useful. Negative MCBs are negative interpretations of thoughts, feelings, and symptoms and have been viewed on the basis of two categories including beliefs of uncontrollability and danger. That is, these refer to beliefs that cognitive processes are not under one's control and can be harmful (8). To date, addiction is conceptualized on the basis of emotion regulation and metacognition. Some studies show the relationship of metacognitions about addictive behavior like smoking (9-11). Alma et al. showed that as positive MCBs about emotion regulation increased, cigarette addiction decreased (12). Cognitive evaluation, positive MCBs and negative MCBs about smoking predicted daily cigarette consumption. Metacognitions explained more variance in smoking than smoking-related positive outcome expectancies (13). Negative metacognitions about the inability to control smoking and about cognitive barriers were predictors of nicotine addiction (13). Other studies show that metacognitions are full or partial mediators of the relationship between DER, and nicotine addiction (14-15). These studies indicated that smoking was used as a self-regulation strategy to alleviate negative emotions.

Although previous research shows that DER and metacognitions promote and maintain addiction, there is a small number of studies examining the effect of these two variables together on the severity of nicotine addiction (16-17). Despite numerous treatment approaches, nicotine addiction continues to have high rates of persistence and relapse, indicating the need to explore underlying psychological mechanisms beyond behavioral and pharmacological factors. In clinical psychology, increasing attention has been paid to transdiagnostic processes such as metacognition and emotion regulation, which play key roles in the onset and maintenance of psychopathology. Although difficulties in emotion regulation have been associated with a variety of addictive behaviors, their specific role in nicotine addiction has been understudied. Similarly, maladaptive metacognitive beliefs, such as beliefs about the danger or uncontrollability of thoughts, may exacerbate cravings, but these constructs have received limited empirical attention concerning nicotine use. The present study addressed a critical gap by jointly examining MCBs and DER in individuals with nicotine addiction. Its unique contribution is that it integrates these two clinically important cognitive-emotional domains, providing a more nuanced understanding of the psychological vulnerabilities associated with nicotine addiction.

These findings have the potential to inform clinical formulations and guide the development of more specific psychotherapeutic and/or psychoeducational interventions interventions, particularly those utilizing third-wave cognitive-behavioral therapies such as metacognitive therapy or emotion regulation-focused treatment approaches. Indeed, if the findings show that MCBs mediate the relationship of nicotine addiction with DER,

interventions aiming at improving metacognitive skills could potentially enhance smoking cessation efforts and help individuals manage their emotions better. Moreover, nicotine addiction often occurs along with mental problems such as depression and anxiety, which are often characterized by DER. Understanding the role of MCBs in the relationship of nicotine addiction with DER, may inform strategies for managing comorbid psychological problems. That is by addressing problems in MCBs in addition to addiction treatment, clinicians can improve outcomes for individuals with co-occurring nicotine addiction and emotional disorders.

Furthermore, unlike many existing studies that focus on general substance use or clinical populations, the present study examines these mechanisms in a non-clinical community sample of adult smokers, enhancing its ecological validity.

Therefore, the present study examined the relationships between DER, MCBs, and severity of nicotine addiction. The present study also examined MCBs as mediators of the relationship between DER and the severity of nicotine addiction. The following hypotheses were tested. The first hypothesis was that there is a significant relationship between the severity of nicotine addiction and the number of cigarettes smoked daily. The second hypothesis was that there is a significant relationship between the severity of nicotine addiction and DER. The third hypothesis was that there is a significant relationship between the severity of nicotine addiction and smoking-related MCBs. The fourth hypothesis was that smoking-related MCBs have a mediating role in the relationship of DER with severity of nicotine addiction. The fifth hypothesis was that DER and smoking-related MCBs predict severity of nicotine addiction.

Methods

Sample

The sample of the present study comprised 255 adult smokers, all aged 18 years or older, with a range of smoking behaviors captured through categorical analysis. Participants were purposefully selected from the non-clinical community sample of smokers. Participants were not interviewed psychologically, and they were not asked whether they had received a psychiatric diagnosis. Demographic questions and scales were used to determine smoking addiction. The categorization of age and income levels was based on commonly used groupings in national demographic and epidemiological surveys in Türkiye. Age categories were selected to reflect typical developmental and life-stage periods relevant to smoking behavior. Income levels were grouped according to percentile thresholds aligned with national minimum wage brackets and household income distribution reported by the Turkish Statistical Institute (TÜİK). These standard categorizations were employed to enhance interpretability and facilitate comparison with other population-based studies.

A power analysis was conducted using G*Power for multiple linear regression with seven predictors to ensure a sufficient sample size. The analysis aimed for 80% power and a 0.05 significance level to detect a medium effect size ($f^2 = 0.15$). The results indicated that a total of 103 participants is necessary to achieve an actual power of 0.81, confirming the adequacy of the sample size for the intended statistical analysis.

Procedure

After receiving the ethics committee's approval from The Istanbul Arel University ethics committee (Date 05.07.2021; Approval number 2021/10- (E-69396709-050.01.04-176528), the study was piloted with 10 smokers to identify any problems in understanding questionnaire items. Changes were made to the Demographic Information Form prepared by the present authors, where necessary. Based on the feedback obtained from the pilot study with 10 smokers, modifications were made to improve the clarity and comprehensiveness of the Demographic Information Form. Specifically, questions regarding income level, educational attainment, and age of smoking initiation were revised and expanded in detail. These changes aimed to capture more nuanced sociodemographic and behavioral data relevant to smoking patterns.

Data were collected over 3 months via the SurveyMonkey online platform. The participants completed the informed consent form before they answered the questionnaire's items. In the present study, the

confidentiality of participants' information and data security were prioritized during the online data collection process. The survey was administered via a secure online platform accessible only to researchers. Information about participants' identities were not collected, and responses were recorded anonymously. In order to prevent duplicate entries, IP addresses were checked and only one response was allowed from each device. In addition, the survey link was distributed privately and its sharing was restricted.

Measures

The Demographic Information Form, the Turkish versions of the Fargerström Test for Nicotine Dependence, Difficulties in Emotion Regulation Scale-Short Form and the Metacognitions about Smoking Questionnaire were used

Demographic Information Form.

The Demographic Information Form included questions regarding demographic characteristics and information about smoking. The Fagerström Nicotine Dependence Test consisted of 10 closed-ended questions. An increase in scores indicated an increase in severity of nicotine addiction (18). An adaptation study of the scale was conducted (19). The internal consistency coefficient of the scale in the present study was 0.73. In addition, the McDonald's omega (ω) for this scale was calculated as 0.77.

Difficulties in Emotion Regulation Scale-Short Form

The Difficulties in Emotion Regulation Scale-Short Form was a 5-point Likert scale containing 16 items; had 5 subscales: strategies, goals, openness, impulse and non acceptance (20). A total score can be also computed. High scores indicated a high degree of DER, and low scores indicated a low degree of DER. An adaptation study of the scale was conducted (21). The internal consistency coefficient of the scale in the present study was 0.97. Also, the McDonald's omega (ω) for this scale was calculated as 0.97.

Metacognitions about Smoking Questionnaire

The Metacognitions about Smoking Questionnaire consisted of 20 self-reported items (13). An adaptation study of the scale was conducted and was named the Metacognitive Beliefs About Smoking Questionnaire rather than the Metacognitions about Smoking Questionnaire as the original questionnaire (12). The scale included 4 subscales: Positive MCBs About Cognitive Regulation, Positive MCBs About Emotional Regulation, Negative MCBs About Uncontrollability, and Negative MCBs About Cognitive Interference. The internal consistency coefficient of the total scale in the present study was 0.92. Internal consistency coefficients were 0.83, 0.87, 0.88, and 0.91 for Positive MCBs About Cognitive Regulation, Positive MCBs About Emotional Regulation, Negative MCBs About Uncontrollability, and Negative MCBs About Cognitive Interference, respectively. In addition, the McDonald's omega (ω) for the total scale was calculated as 0.93. The McDonald's omega (ω) was 0.82, 0.88, 0.88, and 0.90 for Positive MCBs About Cognitive Regulation, Positive MCBs About Emotional Regulation, Negative MCBs About Uncontrollability, and Negative MCBs About Cognitive Interference, respectively.

Statistical Analysis

The data was screened and outliers were checked with Mahalanobis distance. Findings showed that there were four participants higher than the cut point, $\chi 2$ (df =9) = 7.877, $p < .001$. The statistical analyses were computed again, but findings were identical. Therefore, the original data and findings were used. Descriptive statistics such as kurtosis, and skewness values were calculated. Pearson Correlation analyses and Structural Equation Modeling were used to examine the relationships between variables. IBM SPSS 25, IBM SPSS AMOS 21, and LISREL 8.8 programs were used to analyze the data. $P<0.05$ was considered statistically significant.

In evaluating the model's fit, several indices were used: Non-Normed Fit Index (NNFI), also known as the Tucker-Lewis Index, Comparative Fit Index (CFI), Incremental Fit Index (IFI), Goodness-of-Fit Index (GFI) and Root Mean Square Error of Approximation (RMSEA). For the statistical analysis, a Maximum Likelihood

Robust (MLR) estimation technique was employed. In the construction of the latent variable for the Fagerstrom Test for Nicotine Dependence, a parceling approach was adopted to simplify the model and enhance its stability.

Results

The sample of the present study comprised 255 adult smokers, all aged 18 years or older. Regarding daily cigarette consumption, the majority of participants, 47.8%, reported smoking between 11 and 20 cigarettes per day. The mean number of cigarettes smoked daily was 14.79 (Sd = 8.52). In terms of duration of smoking, 43.1% of participants had been smoking for 11 to 20 years, which was the most common range. The mean Fagerström Nicotine Dependency Test score was 3.61 (Sd = 2.72), the mean age at which the participants smoked their first cigarette was 16.54 (Sd = 3.56), and mean number of years of smoking was 16.63 (Sd = 9.74) (Table 1).

Table 1. Demographic and smoking related characteristics.

Demographic Characteristics		**n**	**%**
Age	19-25	37	14.5
	26-35	112	43.9
	36-55	94	36.9
	56-72	12	4.7
Sex	Female	153	60
	Male	102	40
Marital Status	Single	99	38.8
	Married	135	52.9
	Divorced/Widow(er)	21	8.2
Educational Status	Primary/Secondary School	15	5.9
	High School	42	16.5
	Associate Degree	33	12.9
	Bachelor Degree	127	49.8
	Post-Graduate Degree	38	14.9
Monthly Income	0-2900 TL	45	17.6
	2901-5802 TL	82	32.2
	5803-8700 TL	76	29.8
	8701-12000 TL	32	12.5
	12000 TL and above	20	7.8
The age at which smoking started	Under 15	59	23.1
	15-18	138	54.1
	19-28	58	22.7
The duration of smoking (years)	1-10	82	32.2
	11-20	110	43.1
	21-30	38	14.9
	31-48	25	9.8
Number of cigarettes smoked daily	1-10	99	38.8
	11-20	122	47.8
	21-30	28	11
	31-55	6	2.4

43.9% were between ages of 26-35, 60% were women, 52.9% were married, and 49.8% had a bachelor's degree. 54.1% smoked their first cigarette at the age of 15-18, 43.1% had been smoking for 11-20 years, and 47.8% smoked 11-20 cigarettes a day. More detailed information on demographic characteristics is given in Table 1. The skewness values varied between 0.10 and 1.29 and the kurtosis values varied between -0.08 and 1.04; the scores were within the normal distribution limits. No correlation value between the variables was above 0.90, indicating that parametric tests can be used in the statistical analysis.

Table 2. Pearson correlation analyses of scales about smoking, and the severity of nicotine addiction

Variables	Severity of Nicotine Addiction
Number of cigarettes smoked per day	0.72**
Difficulties in Emotion Regulation (DER) Scale-Short Form	0.14*
Openness	0.14*
Goals	0.07
Impulses	0.13*
Strategies	0.11
Nonacceptance	0.18**
The Metacognitions about Smoking Questionnaire	0.53**
Positive MB about Cognitive Regulation	0.44**
Positive MB about Emotion Regulation	0.26**
Negative MB about Uncontrollability	0.57**
Negative MB about Cognitive Interference	0.44**

*p<.05, **p<.01

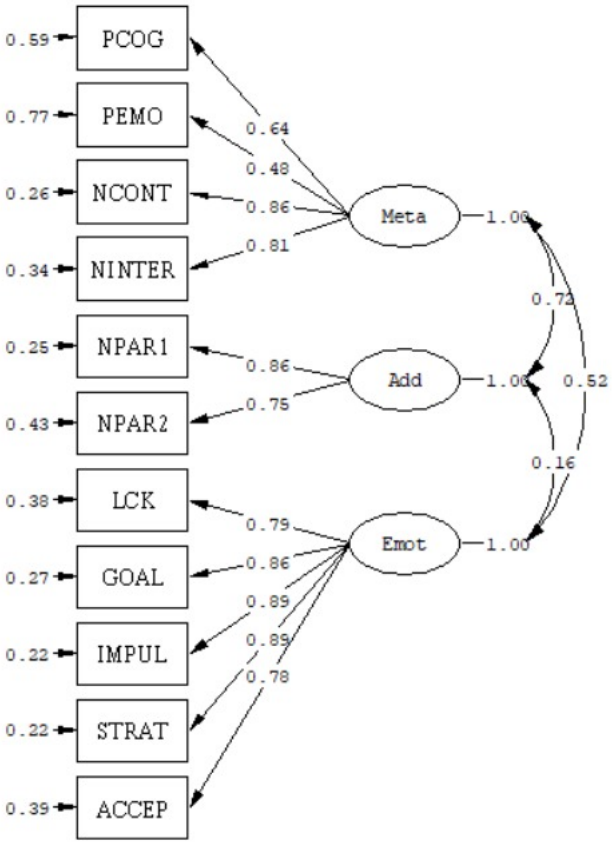

Figure 1. Standardized path coefficients of the measurement model

The present findings confirmed H1 which stated that there would be a significant relationship between the number of cigarettes smoked daily and severity of nicotine addiction, showing that higher daily cigarette consumption was indeed associated with greater nicotine dependence. The present findings also partially supported H2 which stated that DER would be significantly related to nicotine addiction severity, indicating that individuals with greater types of DER including openness, impulses and nonacceptance reported more severe nicotine addiction. This relationship was not valid for other subscales of the Difficulties in Emotion Regulation Scale-Short Form. The present findings also confirmed H3 which stated that smoking-related MCBs would be significantly associated with nicotine addiction severity, suggesting that smoking-related MCBs were associated with higher levels of nicotine addiction (Table 2).

Crucially, H4 stated that MCBs would mediate the relationship between DER and nicotine addiction severity. A structural model was tested. Two observed variables were obtained by parceling and were included in the model as the observed variables of the latent variable "Nicotine Dependence". Scores on the sub-dimensions of the Difficulties in Emotion Regulation Scale-Short Form were included in the model as the "Emotion Regulation" latent variable, and the scores on the Metacognitive Beliefs about Smoking Questionnaire sub-dimensions were included in the model as the "Metacognitions" latent variable.

Table 3. Pearson correlation analyses between observed variables in the structural model

	ACK	AMC	DUR	STR	KAB	BDP	DDP	KEN	BEN	NPAR1
ACK										
AMC	0.67**									
DUR	0.86**	0.77**								
STR	0.70**	0.83**	0.82**							
KAB	0.61**	0.67**	0.73**	0.80**	1					
BDP	0.35**	0.32**	0.40**	0.38**	0.34**					
DDP	0.32**	0.24**	0.35**	0.32**	0.27**	0.69**				
KEN	0.31**	0.32**	0.37**	0.36**	0.46**	0.47**	0.34**			
BEN	0.40**	0.33**	0.44**	0.46**	0.53**	0.50**	0.36**	0.74**		
NPAR1	0.14*	0.08	0.12	0.08	0.17**	0.38**	0.20**	0.58**	0.44**	
NPAR2	0.12	0.06	0.11	0.11	0.16*	0.41**	0.26**	0.48**	0.37**	0.65**

*p<.05, **p<.01, ACK: Difficulties in Emotion Regulation Scale-Short Form Openness Subscale, AMC: Difficulties in Emotion Regulation Scale-Short Form Goals Subscale, DUR: Difficulties in Emotion Regulation Scale-Short Form Impulses Subscale, STR: Difficulties in Emotion Regulation Scale-Short Form Strategies Subscale, KAB: Difficulties in Emotion Regulation Scale-Short Form Nonacceptance Subscale, BDP: Metacognitive Beliefs about Smoking Questionnaire Positive MCBs about Cognitive Regulation Subscale, DDP: Metacognitive Beliefs about Smoking Questionnaire Positive MCBs about Emotion Regulation Subscale, KEN: Metacognitive Beliefs about Smoking Questionnaire Negative MCBs about Uncontrollability Subscale, BEN: Metacognitive Beliefs about Smoking Questionnaire Negative MCBs about Cognitive Interference Subscale, NPAR1: Fargerström Test for Nicotine Dependence Parcel 1, NPAR2: Fargerström Test for Nicotine Dependence Parcel 2

Testing the model involved two steps. The measurement model was tested before the structural model. The fit values of this model were $\chi 2/Sd$ (170.25/41) = 4.15, p=0.001, NNFI=0.97; CFI=0.98; IFI=0.98; GFI=0.98; RMSEA=0.010 (confidence interval =0.094–0.13 for RMSEA) which were considered within the acceptable level. The model obtained from the analysis is given in Figure 1. Correlation coefficients were statistically significant. Among the latent variables, the strongest relationship was between MCBs about smoking and severity of nicotine addiction (r=0.72, p<.01), and the weakest relationship was between DER and severity of nicotine addiction (r= 0.16, p<.01). The relationship between DER and MCBs about smoking was in between (r=0.52, p<.01).

During the testing of the structural model, the resulting goodness of fit values were $\chi 2/Sd$ (170.25/41) =4.15, p=0.001, NNFI=0.97; CFI=0.98; IFI=0.98; GFI=0.98; RMSEA=0.010 (confidence interval=0.094–0.13 for RMSEA) which were all acceptable values. The standardized path coefficients are presented in Figure 2.

DER had a significant effect on MCBs about smoking and severity of nicotine addiction; MCBs about smoking had a significant effect on severity of nicotine addiction. The relationship of DER with severity of nicotine

addiction was positive in the measurement model. However, this relationship was negative in the testing of the model. This showed that the mediator variable had a suppressor effect.

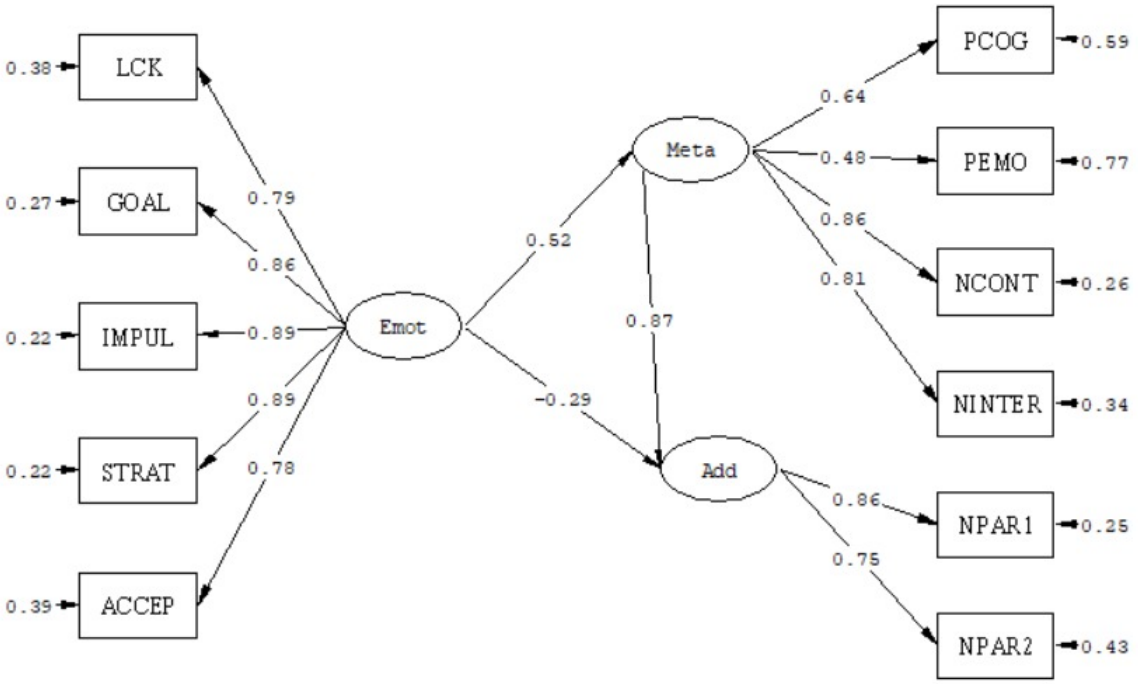

Figure 2. Standardized path coefficients of the measurement model

Correlations between the observed variables in the structural model are presented in Table 3. The significance level of the indirect effects was tested with the Bootstrapping method. Prediction ranges were calculated for the significance of indirect effects. The indirect effects were statistically significant at the 0.05 level. MCBs about smoking had a mediating effect in the relationship of DER with severity of nicotine addiction (β Standardized = -0.29** (0.16**), %95 CI= 0.242, 0.377). H4 was supported by these findings, which demonstrated that MCBs partially explained the impact of DER on the severity of nicotine addiction. This indicates that MCBs significantly mediated the relationship, with a moderately strong effect in reducing the direct association between DER and nicotine addiction severity.

Hierarchical Linear Regression Analysis was performed to examine the predictive power of independent variables on the dependent variable, considering the suppressive effect. DER explained 4% of the variance in the severity of nicotine addiction. The nonacceptance sub-dimension positively predicted the severity of nicotine addiction. MCBs about smoking were added to the regression analysis, and 40% of the variance in severity of nicotine dependence was explained. Positive MCBs about Cognitive Regulation sub-dimension and the Negative MCBs about the Uncontrollability sub-dimension positively predicted the severity of nicotine addiction (Table 4). Consistent with the hypothesis (H5), the combined influence of DER and smoking-related MCBs was found to be a strong predictor of nicotine addiction severity, explaining a significant portion of the variance in addiction outcomes. This suggests that DER alone accounts for a small portion of the variation in nicotine addiction, highlighting its limited predictive power on its own.

In the first regression model, the unique contribution of DER in predicting severity of nicotine addiction was explored. The findings revealed that DER accounted for 2.9% of the variance in nicotine addiction (R^2 = 0.029, $p < 0.05$). This finding indicated that while DER was a significant predictor, it explained a relatively small portion of the variability in nicotine addiction.

To investigate the potential mediating role of MCBs, a second regression analysis, incorporating MCBs as an additional predictor was conducted. The inclusion of MCBs substantially increased the explained variance to 58% (R^2 = 0.58, $p < 0.001$), indicating that MCBs significantly enhanced the prediction of nicotine addiction beyond what was accounted for by DER alone. This substantial increase in R^2 demonstrated the

critical role that MCBs played in the relationship between DER and nicotine addiction, suggesting that MCBs not only mediated but also independently predicted nicotine addiction severity. This substantial increase reflects the strong explanatory contribution of MCBs in understanding the severity of nicotine addiction.

Table 4. Predictors of DER and MCBs on severity of nicotine addiction, results of regression analyses

	Step 1					**Step 2**				
	B	SE	B	t	p	B	SE	β	t	p
(Constant)	2.74	0.47		5.88	0.000	-0.06	0.57		-0.11	0.913
Openness	0.18	0.17	0.13	1.11	0.269	0.18	0.13	0.13	1.36	0.176
Goals	-0.06	0.09	-0.08	-0.70	0.484	-0.07	0.07	-0.09	-0.95	0.341
Impulses	-0.02	0.14	-0.03	-0.18	0.859	-0.13	0.11	-0.15	-1.17	0.242
Strategies	-0.04	0.07	-0.09	-0.64	0.525	-0.04	0.06	-0.08	-0.65	0.516
Nonacceptance	0.20	0.09	0.25	2.32	0.021	0.01	0.07	0.01	0.09	0.928
Positive MCBs About Cognitive Regulation						0.20	0.05	0.33	4.32	0.000
Positive MCBs About Emotion Regulation						-0.08	0.06	-0.09	-1.33	0.185
Negative MCBs About Uncontrollability						0.43	0.07	0.51	6.67	0.000
Negative MCBs About Cognitive Interference						0.00	0.08	0.00	0.04	0.970
Step 1: R2 = .043**, (F (5, 249) = 2.25, p = .050)										
Step 2: R2 = .399**, (F (9, 245) = 18.06, p = .000), ΔR2 = .356, (ΔF (4, 245) = 36.23, p = .000)										

SE: Standard Error, β: Standardized Regression Coefficient

Discussion

The present study examined the relationship between DER, MCBs, and severity of nicotine addiction, and the mediating effect of MCBs in the relationship of DER and severity of nicotine addiction. The findings showed that nicotine addiction increased as the number of cigarettes smoked daily increased. This finding supported H1 and is consistent with previous findings obtained in different samples (22-23). This finding is also consistent with the mechanism involved in the change of nicotine use into addiction. Nicotine activates the reward mechanism, causing pleasure. Due to the rewarding effect of nicotine, smoking behavior is reinforced, and a memory is formed. Thus, smoking behavior is learned with the reinforcing effect of nicotine (24). Prolonged use of nicotine results in tolerance, the same dose fails to produce the same pleasure; then more nicotine needs to be taken to attain the same pleasure. As the level of addiction increases, more cigarettes need to be consumed to have the same effect. The greater the addiction, the greater is the rate of withdrawal. Severe nicotine addiction due to tolerance and withdrawal may lead to more consumption of cigarettes (25).

Findings showed that the severity of nicotine addiction and DER were positively related to some DER including openness, impulses, and nonacceptance. Specifically, the severity of nicotine addiction increased as DER increased. However, this relationship was not present for other types of DER. This finding partially supported H2. There are studies addressing the relationship of DER with nicotine addiction. The present finding is consistent with previous findings. Meta-analysis and cross-sectional studies show that addictive agents like cigarettes are associated with DER (2-5). However, in the present study, this relationship was present only for some DER including openness, impulses, and nonacceptance, although not for other dimensions, such as strategies and goals. This finding is not consistent with the findings of a previous study which found that strategy and goal sub-dimensions of DER were related to the severity of nicotine addiction (4). These differences may be related to cultural characteristics. In collectivist societies such as Türkiye, emotional restraint and social harmony are often emphasized, and individuals may be socialized to suppress or internalize emotional difficulties (26-27). As a result, subdimensions such as "strategies" or "goals" may not

emerge as salient or consciously acknowledged difficulties, even when present. In contrast, more observable or felt difficulties, such as impulsivity or nonacceptance, may be more easily identified and thus show stronger associations with smoking behaviors. This cultural lens offers one possible explanation for why certain DER components were predictive of nicotine addiction while others were not. Future cross-cultural comparative studies are needed to explore how cultural norms shape the manifestation and reporting of DER in addiction contexts.

People with DER may resort to smoking and develop addiction, and experience withdrawal when they do not consume nicotine; they continue smoking because they have difficulties regulating uncomfortable emotions that arise from not smoking (26,28). Recognizing and accepting emotions can increase the ability to tolerate negative emotions and awareness of conditioned responses. Difficulty in recognizing and accepting emotions may lead to the use of strategies that suppress emotions (27, 29). That is, this selective pattern suggests that individuals who experience immediate emotional reactions (impulsivity), have difficulty accepting their emotional states (nonacceptance), or are highly sensitive to internal emotional experiences (openness) may be more prone to using smoking as a rapid emotion regulation tool.

Özdemir and Tunç showed that DER predicted maladaptive and impulsive behaviors such as self-harm and suicidal behavior in people with substance misuse disorder (30). People with DER who also have difficulty controlling their behavior when they experience negative emotions may also use strategies aimed at suppressing emotions. As suppressing emotions does not allow experiencing the emotion, this prevents the reduction of physiological stimulation (31). Smoking may also be a coping strategy for increased physiological stimulation. Therefore, the sub-dimensions of impulsivity, nonacceptance and openness were significantly related to nicotine addiction rather than other dimensions (26-27, 32). Future psychological interventions targeting nicotine addiction need to focus on DER and future research needs to examine this effect.

Findings showed a significant positive and high-level association between MCBs about smoking and the severity of nicotine addiction. Participants with stronger MCBs reported more severe nicotine addiction. This finding supported the H3 hypothesis. Positive MCBs about cognitive regulation and emotion regulation; negative MCBs about the uncontrollability of smoking and cognitive interference were all highly associated with the severity of nicotine addiction. Consistent with previous findings, this finding indicates the importance of smoking-related MCBs in nicotine addiction (12-13,15,33). Consistent with the principles of metacognitive approaches explaining addiction and the Metacognitive Model of nicotine addiction, smokers' positive and negative MCBs about smoking trigger cognitive attention problems by affecting self-regulatory executive functions and leading to smoking (34-36). Future psychological interventions targeting nicotine addiction need to focus on MCBs. Future research needs to examine this effect.

When the relationship between DER and the severity of nicotine addiction was examined through MCBs about smoking, findings showed that the total effect was greater than the direct effect. In other words, the inclusion of MCBs about smoking in the relationship between DER and the severity of nicotine addiction affected the magnitude of the relationship between the two variables, and it was concluded that MCBs had a partial mediator role in this relationship, indicating that the severity of nicotine addiction caused by DER is lower than the severity of nicotine addiction that occurs when MCBs come into play. This finding partially supported H4. Moreover, the strength of the relationship of DER with the severity of nicotine addiction decreased and turned negative. This indicates that the mediator variable has a suppressor effect. This finding suggests that in the presence of DER when MCBs are constructive, the negative impact of DER is bypassed. Future psychological interventions aiming at preventing or reducing nicotine addiction need to target MCBs. Future research can investigate this effect.

This present finding indicates that DER triggers cognitive attention syndrome by activating underlying MCBs (8,37). Negative metacognition is about the uncontrollability of thoughts and cognitive experiences, their meaning, importance, and danger. Positive metacognitions are about the benefits of engaging in cognitive activities that make up the cognitive attention syndrome (38). These beliefs trigger the cognitive attention syndrome, which consists of perseverative thought patterns involving anxiety, rumination and focusing

attention on danger (38). Believing that smoking helps with clearer thinking, focusing, and concentration, as proposed by Nikčević and others, promotes motivation for nicotine use (39). That is, positive MCBs and negative MCBs activate the cognitive attention syndrome, leading to increased negative emotions and cravings. This, in turn, increases the likelihood of using smoking to regulate emotions (34).

In particular, when DER is present, the MCBs that smoking helps regulate cognitions and the MCBs that they cannot control smoking trigger the cognitive attention syndrome. For instance, when dysfunctional self-regulation strategies like suppression are used, these MCBs are reinforced, leading to the development of nicotine addiction. In this way, arguably, MCBs encourage smoking. This finding is consistent with previous findings showing that metacognitions play a full mediating role or a partial mediating role in the relationship of DER with the severity of nicotine addiction (14-15). The present study highlighted the importance of MCBs in smoking. Targeting MCBs in psychological interventions aimed at preventing or reducing nicotine addiction may be beneficial.

Regression analysis examining the predictive role of MCBs and DER in nicotine addiction, considering the suppressive effect of MCBs showed that nonacceptance as a DER, positive MCBs about cognitive regulation, and negative MCBs about uncontrollability were predictors of severity of nicotine addiction. However, these MCBs emerged as stronger predictors compared to nonacceptance. These variables accounted for 40% of the variance in severity of nicotine addiction. To investigate the potential mediating role of MCBs, the findings of a second regression analysis, incorporating MCBs as an additional predictor showed that the inclusion of MCBs substantially increased the explained variance to 58%, indicating that MCBs significantly enhanced the prediction of nicotine addiction beyond what was accounted for by DER alone. This substantial increase in R^2 demonstrated the critical role that MCBs played in the relationship between DER and nicotine addiction, suggesting that MCBs not only mediated but also independently predicted nicotine addiction severity.

In summary, the present study demonstrated that the number of cigarettes smoked daily, DER, and MCBs were related to severity of nicotine addiction. Findings showed that MCBs played a partial mediating role in the relationship of DER with severity of nicotine addiction. MCBs increased severity of nicotine addiction. DER and MCBs about smoking explained 40% of the variance in severity of nicotine addiction. The most powerful predictors were positive MCBs about cognitive regulation and negative MCBs about the uncontrollability of smoking. In the second regression analysis, the inclusion of MCBs substantially increased the explained variance to 58%, indicating that MCBs significantly enhanced the prediction of nicotine addiction beyond what was accounted for by DER alone. This substantial increase in R^2 demonstrated the critical role that MCBs played in the relationship between DER and nicotine addiction, suggesting that MCBs not only mediated but also independently predicted nicotine addiction severity. Overall, these findings indicate the importance of MCBs in understanding the severity of nicotine addiction and suggest that MCBs are the fundamental motivation for sustaining nicotine addiction. Targeting MCBs in psychosocial interventions aiming at preventing or reducing nicotine addiction could be beneficial.

The present study highlights the importance of MCBs in understanding the severity of nicotine addiction. The primary motivation for smoking is emotion regulation, and MCBs play an important role in providing this motivation. No previous study examined this effect. The present study extends previous findings by providing insights into the relationship between DER and MCBs about smoking. The present findings suggest that approaching the relationship of DER with severity of nicotine addiction within the framework of MCBs can help towards a better understanding of nicotine addiction. Psychological interventions for nicotine addiction may be effective if they focus on DER and MCBs. Future research could investigate the effect of these interventions. By examining the relationship between DER, MCBs, and the severity of nicotine addiction, the present findings contribute to the literature by guiding clinicians in creating effective psychosocial interventions.

The present study makes several contributions to relevant literature. Firstly, the present study highlighted the importance of considering psychological and cognitive factors in understanding addiction behaviors. Secondly, the present study identified specific factors that predicted severity of nicotine addiction, including nonacceptance as a DER and certain MCBs related to cognitive regulation and perceived control. These

findings can be used as targets for interventions aiming at reducing nicotine addiction. Thirdly, by demonstrating the mediating effect of MCBs in the relationship between DER and nicotine addiction, the study sheds light on the underlying mechanisms involved, suggesting interventions targeting MCBs may be effective in addressing both DER and nicotine addiction. Fourthly, the present findings provide practical implications for intervention programs designed to help individuals quit smoking. By highlighting the importance of addressing MCBs and DER, interventions can be tailored to target these beliefs. Fifthly, the present study used Turkish versions of the questionnaires, making its findings relevant to people living in Türkiye. This underscores the importance of considering cultural factors in understanding nicotine addiction and DER and provides valuable insights for researchers and practitioners working in Türkiye or similar cultural contexts. One study undertaken in Türkiye among substance use disorder (40) showed that there were associations between the level of addiction severity, metacognitive beliefs and DER, although the mediating effects were not examined. Extensive comparisons cannot be made across the findings of the present study and these findings because although the same questionnaire was used to measure DER across two studies, in the present study the subscales scores were used as opposed to total score. Therefore, further studies need to be undertaken within the present culture to have a deeper understanding of these effects.

The present study has some limitations. First, although the sample size was larger than that of identified by the power analysis, this was relatively small, questioning the external validity of findings. Also, accessing participants through the Internet may have introduced a sampling bias in terms of age, education level, and marital status. The sample of the present study predominantly consisted of individuals with a high level of education, which posed a limitation in terms of external validity. Educational attainment may influence individuals' cognitive frameworks, problem-solving approaches, and awareness of psychological processes. Therefore, the generalizability of the findings to populations with lower levels of education may be limited. Future studies are recommended to include more heterogeneous samples and larger ones to enhance the findings' applicability across diverse educational backgrounds. Second, the present study was cross-sectional. Future longitudinal studies can examine similar effects. Third, mediation analyses have limitations in establishing causal relationships in that there may be other unmeasured variables. Fourth, the present study used self-report scales. These scales may be subject to social desirability. Finally, participants were not asked whether they had received a psychiatric diagnosis, and no clinical interviews were conducted. Therefore, it is not known whether some participants had comorbid psychiatric conditions, which may have influenced their DER or MCBs. This represents a methodological limitation that should be taken into account when interpreting the findings.

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