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Validation of the Korean-Metacognitions about Smoking Questionnaire

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This study aims to validate the Korean version of the Metacognitions about Smoking Questionnaire (K-MSQ), which measures positive and negative metacognitions about smoking. The factor structure, reliability, and validity of the K-MSQ were investigated among 397 adult smokers. Data were randomly divided into two subsamples:an exploratory factor analysis (n = 199), which supported a four-factor model; and a confirmatory factor analysis (n = 198), which yielded an acceptable model fit after modification and supported the original structure. Additionally, the K-MSQ exhibited convergent validity with nicotine dependence, daily cigarette use, depression and anxiety scales, and discriminant validity with the smoking outcome expectancy scale. Furthermore, the K-MSQ had more power than the effects of depression, anxiety, and smoking outcome expectancy on nicotine dependence and daily cigarette use, confirming incremental validity. The K-MSQ displayed strong internal consistency, and test-retest reliability was satisfactory when retested after an eight-week interval. Therefore, these results suggest that the K-MSQ is a valid scale for measuring positive and negative metacognitions about smoking.

Keywords: metacognition, metacognitions about smoking, nicotine dependence, cigarette use, smoking outcome expectancies

Introduction

Smoking is a major public health problem that not only threatens individual health but also causes a societal burden, and many smokers find it difficult to quit (Gunter et al., 2020; West, 2017). To better understand smoking behaviors and develop effective intervention strategies, it is necessary to identify the psychological factors that initiate and maintain smoking. Previous studies on smoking have primarily focused on the cognitive aspects, including beliefs associated with smoking outcome expectancies (Beck et al., 1993; Brown et al., 2001). In particular, cognitive therapeutic approaches centered on reframing positive outcome expectancies and reinforcing negative outcome expectancies have been effective in modifying the belief systems of individuals with nicotine dependence, with most approaches emphasizing changes in mental content (Wells, 2008). However, the focus on cognitive content has limitations, particularly in explaining how such beliefs are processed, controlled, and maintained (Spada et al., 2006; Wells, 2000). This distinction highlights the need to clarify the conceptual difference between cognition and metacognition. This has led to the suggestion that focus should explicitly be placed on the processes by which beliefs influence and regulate cognitive functioning rather than solely on the content of thoughts (Nikčevič & Spada, 2010). To fill this gap, attempts have been made to apply metacognition as a mechanism for the development and maintenance of psychological dysfunction.

Metacognition can be defined as "thinking about thinking" and refers to the cognitive processes by which individuals appraise,

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control, and monitor their thinking (Flavell, 1979; Spada et al., 2015). Wells and Matthews (1996) suggested that occurrence and persistence of psychopathologyare more closely associated with the presence of metacognitive beliefs than with cognition itself. This explanation is grounded in the Self-Regulatory Executive Function (S-REF) theory, which proposes that psychological dysfunction arises from maladaptive metacognitive beliefs that bias executive control and sustain ineffective coping strategies. According to this model, metacognitions influence the evaluation and selection of coping strategies in response to stress, while feedback on the outcomes of these strategies in turn reinforces these beliefs, resulting in a circular process (Wells & Matthews, 1994). When this process is repeated and negative feedback accumulates, maladaptive cognitive patterns such as rumination, worry, and threat monitoring become entrenched, thereby impairing flexible responses and contributing to psychological disorders (Wells, 2000, 2008). Based on this framework, several studies have demonstrated that metacognition is closely associated with addictive behaviors and that metacognitive processes are fundamentally important in driving and perpetuating addictive behaviors, most notably nicotine dependence (Nikčevič & Spada, 2010; Nikčevič et al., 2015).

Previous studies have shown that individuals with nicotine dependence tend to hold positive and negative metacognitions about smoking, a pattern that can be conceptually understood using the S-REF model (Spada et al., 2015). Positive metacognitions about smoking are characterized by beliefs that smoking facilitates emotional regulation or improves cognitive functioning. These beliefs often contribute to the initial engagement in smoking, as individuals perceive smoking as a functional coping mechanism. However, over time, repeated use reinforces behavioral patterns and leads to the accumulation of negative outcomes. Negative metacognitive beliefs emerge in response to these negative outcomes. Such beliefs are activated during or after smoking episodes and are often accompanied by negative affective states. These emotional responses prompt further smoking as a means of temporary relief, thereby perpetuating a maladaptive cycle. This feedback loop strengthens dependency over time and highlights the critical role that positive and negative metacognitions play in the maintenance and escalation of smoking behaviors (Nikčevič & Spada, 2010; Wells, 2000). Given these mechanisms, it is important to consider the need for assessment tools that can effectively capture positive and negative metacognitive beliefs about smoking.

Based on this theoretical background, Nikčevič et al. (2015) developed the Metacognitions about Smoking Questionnaire (MSQ) to assess metacognitions about smoking. The MSQ had a four-factor structure, comprising positive metacognitions about cognitive regulation (PM-CR), positive metacognitions about emotional regulation (PM-ER), negative metacognitions about uncontrollability (NM-U), and negative metacognitions about cognitive interference (NM-CI). In line with its conceptual advantages, the MSQ demonstrated greater explanatory power for smoking behavior than existing measures. One of the most widely used measures of beliefs about smoking is the Smoking Effects Questionnaire (SEQ), which assesses expectations regarding the positive and negative outcomes of smoking. Although the SEQ conceptually overlaps with smoking-related metacognition in distinguishing positive and negative beliefs, it primarily focuses on outcome-based beliefs such as stress relief or health risks. It does not capture how individuals monitor, evaluate, or regulate their thoughts about smoking. In contrast, the MSQ explicitly differentiates between cognitive and metacognitive beliefs, assessing higher-order processes such as perceived uncontrollability of urges and intrusive smoking-related thoughts. These features allow the MSQ to capture internal self-regulatory mechanisms that sustain smoking behavior, which are overlooked in traditional expectancy-based measures like the SEQ. These distinctions demonstrate that the MSQ provides a more refined delineation between cognition and metacognition, suggesting that it is a more appropriate tool for assessing the psychological mechanisms involved in maintaining smoking behavior beyond outcome expectations. Previous studies have shown that the MSQ explainsnicotine dependence and cigarette consumption more strongly than the SEQ (Alma et al., 2018; Najafi et al., 2018; Nikčevič et al., 2015). Given these conceptual and empirical advantages, we prioritized validating the MSQ, which provides a more comprehensive and theoretically informed assessment of smoking-related regulation compared to earlier-measures.

The MSQ has been validated in diverse cultural contexts, including Persian and Turkish populations, demonstrating acceptable re-

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liability and validity even in the presence of cultural differences. This supports the view of metacognition as a self-regulatory process involving the monitoring and control of cognition, which may be considered a universal psychological construct that transcends cultural boundaries (Wells, 2000). Therefore, this study aimed to validate the Korean version of the Metacognitions about Smoking Questionnaire (K-MSQ). A survey was conducted among smokers in Korea to identify the factor structure and examine its internal consistency, concurrent and discriminant validity, and incremental validity. An eight-week follow-up survey was also conducted to examine the test-retest reliability and further assess the psychometric properties of the K-MSQ.

Methods

Participants and Procedure

The sample comprised 397 self-declared Korean smokers who had smoked within the past 30 days, aged 19-59 years (M = 29.69, SD = 8.31; 181 females). Of the 432 individuals who initially responded, 35 were excluded because of incomplete or inconsistent responses. For analysis, the sample was randomly assignedto two subsamples: Subsample 1 (n = 199; M = 30.06, SD = 9.25; 87 females) was used for exploratory factor analysis, and Subsample 2 (n = 198; M = 29.31, SD = 7.25; 94 females) was used for confirmatory factor analysis. The sample included individuals who had attended or graduated from college (83.1%), those with a high school education or below (6.1%), and those who held a graduate degree or had attended graduate school (10.8%). Daily cigarette use was defined as theself-reported average number of cigarettes smoked per day during the past 30 days. The participants indicatedusing an average of 11.01 cigarettes per day (SD = 6.54). Survey was administered online using Google Forms, and recruitment was conducted through online communities affiliated with universities in Seoul and regional community platforms. This study was approved by the Institutional Review Board of ** University (IRB no. 1041078-20240319-HR-050). Permission to translate and validate the scale was obtained from the original author. A native Korean-speaking researcher conducted the initial translation, and the back-translation was independently performed by a bilingual speaker fluent in English and Korean. A review panel comprising one clinical psychologist and two master's-level psychology students compared the original and back-translated items.

Material

Metacognitions about Smoking

The MSQ developed by Nikčevič et al. (2015) is a self-report measure designed to assess metacognitive beliefs related to smoking. The original version contains 20 items scored usinga 4-point Likert scale, where higher scores indicate stronger endorsement of metacognitive beliefs. The items are grouped into four subscales: PM-ER, PM-CR, NM-CI, and NM-U, with each subscale being comprised of five items. In the original study, the internal consistency for PM-ER, PM-CR, NM-CI, and NM-U were .88, .92, .93, and .85 respectively.

Nicotine Dependence

The Korean version of the Fagerström Test for Nicotine Dependence (FTND), originally developed by Heatherton et al. (1991), assesses nicotine dependence. This was then translated into Korean by Ahn et al. (2002), with established psychometric properties. The FTND consists of six items, with overall scores from 0 to 10, where elevated scores suggest greater nicotine dependence. In a study by Ahn et al. (2002), the internal consistency was found to be .69, while in this study, it was found to be .64. This scale was selected to reflect smoking behavior and its association with smoking-related metacognitive factors (Nikčevič et al., 2015).

Smoking Outcome Expectations

The SEQ, developed by Rohsenow et al. (2003), assesses positive and negative effects of smoking, which are theoretically related yet distinct from metacognitions (Nikčevič et al., 2015). The scalecontains 33 items, each with a 4-point Likert scaleand shows seven-factor structure: four positive smoking outcome expectations (POSE) and three negative smoking outcome expectations (NOSE). The SEQ, originally designed in English, was translated into Korean and back-translated by two bilingual speakers to ensure linguistic equivalence (Supplementary Table 3). A principal component analysis confirmed that the Korean version preserved the original seven-factor structure, and the internal consistency for each subscale —positive social effects, stimulation, weight control, reduction of

negative affect, negative psychological effects, negative physical effects, and future health concerns—was found to be .84, .88, .91, .77, .85, .83, and .91, respectively.

Depression

The Beck Depression Inventory-II (BDI-II), a widely used self-report measure developed by Beck et al. (1996), assesses the severity of depressive symptoms. The Korean version, as used in this study, was standardized by Lim et al. (2011). The scale contains 21 items, each with a 4-point Likert scale from 0 to 3. In the study by Lim et al. (2011), the internal consistency was found to be .89, and in this study, it was found to be .94. This scale was selected to control depressive symptoms related to smoking-related metacognitions (Wells, 2000).

Anxiety

The Beck Anxiety Inventory (BAI), a self-report instrument developed by Beck et al. (1988), assesses the severity of anxiety symptoms. The Korean version was standardized by Lee et al. (2016). The scale contains 21 items describing physical, emotional, and cognitive symptoms of anxiety. In the study by Lee et al. (2016), the internal consistency was found to be .91, and in this study, it was found to be .94. This scale was selected to control anxiety symptoms related to smoking-related metacognitions (Wells, 2000).

Data Analysis

Statistical analyses were performed using SPSS 25.0 and AMOS 30.0. The 397 participants were randomly assigned to two subsamples: Subsample 1 ($n=199$) for EFA and Subsample 2 ($n=198$) for CFA. The EFA was conducted using maximum likelihood extraction with Direct Oblimin rotation. The CFA was conducted to assess the model fit using the Comparative Fit Index (CFI), the Tucker-Lewis Index (TLI), the Root Mean Square Error of the Approximation (RMSEA), and the Standardized Root Mean square Residual (SRMR). The CFI and TLI $\geq .90$ indicate an acceptable fit, and RMSEA $\leq .06$ and SRMR $\leq .08$ indicate a good fit (Hu & Bentler, 1999). Cronbach's α was calculated to assess internal consistency, with coefficients $\geq .70$ considered acceptable (Hunsley & Mash, 2008). Test-retest reliability was assessed for an eight-week interval with a subset of 60 participants. Correlation analyses were performed to assessthe concurrent and discriminant validity. A hierarchical regression analysis was performed to determine whether the K-MSQ accounted for additional variance in nicotine dependence beyond that explained by the SEQ.

Results

Exploratory Factor Analysis

Prior to conducting factor analysis, the suitability of the data in Sample 1 was confirmed. Skewness (-.85-1.21) and kurtosis (-.97–.64) for each item were acceptable (Curran et al., 1996). The Kaiser-Meyer-Olkin (KMO) score (.85) indicated sufficient inter-item correlations (Kaiser, 1974), and Bartlett's Test of Sphericity was significant ($\chi^2=2{,}185.34$, $p<.001$). The EFA was performed using maximum likelihood estimation with Direct Oblimin rotation to identify correlated factors. Factors were determined based on eigenvalues greater than 1.0 (5.964, 4.379, 1.625, and 1.255), and the analysis revealed a four-factor structure accounting for the 66.11% of the total variance. All items demonstrated primary loadings of .30 or greater on a single factor. Items with cross-loadings on multiple factors were allocated to the factor in which they showed the highest loading, unless the difference between loadings was .10 or smaller. Although Item 13 met the statistical criterion for exclusion, it was retained because of its conceptual consistency with Factor 1 and sufficiently high standardized loading ($>.60$), supporting its theoretical coherenceand empirical relevance. The final scale consisted of 20 items, with five items allocated to each of the four factors (Table 1, Supplementary Table 1).

Confirmatory Factor Analysis

CFA was conducted using data from Sample 2 to assess the adequacy of the four-factor structure identified through EFA. The standardized factor loadings, which represented the relationships between items and their corresponding latent variables, ranged from .60 to .87 and were all statistically significant at $p<.001$ level. The detailed standardized coefficients are presented in Supplementary Table 2. The initial model fit indices for the four-factor structure were CFI=.910, TLI=.896, SRMR=.061, and RMSEA=.076. Based on both item content and modification indices, a correlated error term was added between Items 1 and 13 because

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of their conceptual overlap. After this revision, the model fit improved slightly, with updated indices of CFI=.914, TLI=.900, SRMR=.059, and RMSEA=.074, indicating a satisfactory model fit and further supporting the adequacy of the proposed four-factor model (Table 2).

Reliability and Test–Retest Reliability

To evaluate the reliability of the K-MSQ, internal consistency coefficients (Cronbach's α) were calculated for each subscale. The results indicated satisfactory internal consistency: PM-CR=.86, PM-ER=.83, NM-U=.90, and NM-CI=.84. None of the items demonstrated item-total correlations below .40. Table 3 shows the item-total correlations and internal consistency coefficients. To assess the temporal stability of the K-MSQ, the test-retest reliability was examined in a subsample of 60 participants with an eight-week interval between administrations. The resulting coefficients were PM-CR=.70, PM-ER=.73, NM-U=.76, and NM-CI=.76. These findings indicate that the K-MSQ has adequate test-retest reliability.

Concurrent and Discriminant Validity

Pearson's correlation analyses were conducted using the full sample to assess the concurrent and discriminant validity of the K-MSQ. Correlations were examined between the four K-MSQ subscales and the following variables: nicotine dependence (FTND), daily cigarette use (DCU), depression, anxiety, and the positive and negative outcome expectancy subscales of the SEQ (POSE and NOSE). Table 4 presents the results of the study.

Table 1. *Factor Loadings for Items of the K-MSQ Based on Exploratory Factor Analysis (n=199)*

Item		F1	F2	F3	F4
5	Smoking helps me to focus my mind	**.845**	.416	.021	.255
9	Smoking helps me to order my thoughts	**.813**	.396	.058	.245
17	Smoking helps me concentrate	**.797**	.398	.037	.236
1	Smoking helps me think more clearly	**.668**	.425	.040	.228
13	Smoking helps me order things in my mind	**.606**	.581	-.022	.136
2	Smoking helps me torelax when I am agitated	.432	**.789**	-.105	.073
6	When I get stressed smoking calms me down	.337	**.739**	.010	.035
14	Smoking helps me to unwind	.518	**.725**	.081	.167
18	Smoking distracts me from feeling pressured	.432	**.683**	.064	.237
10	When I get up set smoking comfortsme	.287	**.644**	-.007	.102
7	It is hard to control my desire for cigarettes	.047	.064	**.904**	.541
15	My smoking is uncontrollable	.109	.025	**.849**	.530
3	Smoking me ans I have low will power	-.011	-.039	**.808**	.387
19	I cannot control my urge to smoke	.068	.046	**.771**	.646
11	My smoking me an sthat I'm mentally weak	-.012	-.045	**.665**	.481
16	My preoccupation with cigarettes takes over my life	.261	.077	.487	**.811**
12	My thoughts about smoking are becoming an obsession	.209	.175	.466	**.733**
4	Thinking so much about smoking interferes with me seeing things clearly	.126	.054	.413	**.693**
8	I have lost control of my thoughts about smoking	.166	.110	.521	**.684**
20	My thought about cigarettes interfere with my functioning	.315	.175	.316	**.661**

Table 2. *Model Fit Indices of the K-MSQ (n=198)*

	χ^2	*df*	TLI	CFI	SRMR	RMSEA
4Factor Model	349.306***	164	.896	.910	.061	.076
4Factor Model with incorporation of MI	340.360***	163	.900	.914	.059	.074

CFI=Comparative Fit Index; TLI=Tucker Lewis Index; SRMR=Standardized Root Mean square Residual; RMSEA=Root Mean Square Error of Approximation.
****p<.001.*

All four K-MSQ subscales were positively associated with FTND and DCU, indicating that the metacognitive dimensions of the scale were meaningfully associated with the severity of smoking behavior. By contrast, the NOSE showed only limited associations with smoking behavior variables, suggesting that negative outcome expectations may be less relevant to actual behavioral indicators of smoking. In terms of psychological symptoms, the negative metacognitive subscales of the K-MSQ, namely the NM-U and NM-CI, showed stronger positive correlations with depression and anxiety than the positive metacognitive subscales. Regarding discriminant validity, thecorrelations between the K-MSQ and SEQ were generally low to moderate. These findings are consistent with those of the original validation study and support the conceptual independence of the K-MSQ from outcome expectancy-based measures.

Table 3. *Reliability of K-MSQ*

Factor	No.	Item-total correlation	Cronbach's Alpha for item-deleted	Reliability (Cronbach's alpha)
PM-CR	1	.61	.85	.86
	5	.74	.79	
	9	.70	.81	
	13	.85	.85	
	17	.73	.80	
PM-ER	2	.67	.79	.83
	6	.66	.79	
	10	.59	.81	
	14	.63	.80	
	18	.61	.81	
NM-U	3	.74	.87	.90
	7	.81	.86	
	11	.67	.89	
	15	.76	.87	
	19	.75	.87	
NM-CI	4	.62	.81	.84
	8	.63	.81	
	12	.70	.79	
	16	.66	.80	
	20	.61	.82	

PM-CR = Positive Metacognitions about Cognitive Regulation; PM-ER = Positive Metacognitions about Emotional Regulation; NM-U = Negative Metacognitions about Uncontrollability; NM-CI = Negative Metacognitions about Cognitive Interference.

Incremental Validity

Hierarchical regression analyses were performed to examine whether the K-MSQ accounted for additional variance in smoking behavior beyond that explained by the SEQ. Two outcome variables were used: FTND and DCU. In Step 1, the SEQ subscales POSE and NOSE were entered along with depression and anxiety as control variables, as these are well-established predictors of smoking severity. In Step 2, the four K-MSQ subscales were added to the model.

In the model predicting nicotine dependence, the addition of the K-MSQ to Step 2 significantly increased the explained variance by approximately 15%. Among the metacognitive subscales, the NM-CI emerged as a significant predictor. In the model predicting daily cigarette use, the K-MSQ subscales increased the explained variance by approximately 12%. The NM-CI and NM-U

Table 4. *Correlation Coefficients between Measurements*

	1	2	3	4	5	6	7	8	9	10
1. PM-CR										
2. PM-ER	.51**									
3. NM-U	.11*	.14**								
4. NM-CI	.31**	.24**	.61**							
5. FTND	.30**	.23**	.32**	.47**						
6. DCU	.24**	.20**	.27**	.33**	.63**					
7. BDI	.07	.13**	.32**	.39**	.18**	.02				
8. BAI	.13*	.17**	.39**	.50**	.23**	.03	.78**			
9. PSOE	.49**	.48**	.30**	.43**	.32**	.23**	.22**	.33**		
10. NSOE	.00	.11*	.49**	.46**	.13**	.08	.36**	.42**	.27**	

PM-CR = Positive Metacognitions about Cognitive Regulation; PM-ER = Positive Metacognitions about Emotional Regulation; NM-U = Negative Metacognitions about Uncontrollability; NM-CI = Negative Metacognitions about Cognitive Interference; FTND = Fagerstrom Test for Nicotine Dependence; DCU = Daily Cigarette Use; BDI = Beck Depression Inventory; BAI = Beck Anxiety Inventory; PSOE = Positive Smoking Outcome Expectances; NSOE = Negative Smoking Outcome Expectances.
*$p < .05$, **$p < .01$.*

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Table 5. *Hierarchical Regression with FTND and DCU as the Outcome Variables*

		Predictor	R^2	ΔR^2	B.	S.E	β	*t*
FTND	Step1	BDI	.12***	.12***	.00	.01	.02	.30
		BAI			.02	.01	.12	1.54
		PSOE			.26	.05	.28	6.48***
		NSOE			-.01	.05	-.01	-.11
	Step2	BDI	.27***	.15***	.00	.01	.02	.29
		BAI			-.00	.01	-.01	-.18
		PSOE			.08	.05	.09	1.58
		NSOE			-.13	.05	-.13	-2.36*
		PM-CR			.29	.16	.10	1.86
		PM-ER			.13	.17	.04	.76
		NM-U			.25	.15	.10	1.66
		NM-CI			1.13	.18	.39	6.16***
DCU	Step1	BDI	.06***	.06***	.01	.04	.02	.20
		K-BAI			-.04	.04	-.08	-1.00
		PSOE			.72	.16	.24	4.61***
		NSOE			.13	.18	.04	.73
	Step2	BDI	.18***	.12***	.01	.04	.01	.12
		BAI			-.10	.04	-.20	-2.54*
		PSOE			.18	.18	.06	1.02
		NSOE			-.27	.18	-.08	-1.47
		PM-CR			.76	.53	.09	1.44
		PM-ER			.77	.58	.08	1.33
		NM-U			1.37	.51	.17	2.71**
		NM-CI			2.75	.62	.30	4.44***

FTND = Fagerstrom Test for Nicotine Dependence; DCU = Daily Cigarette Use; BDI = Beck DepressionInventory; BAI = Beck Anxiety Inventory; PSOE = Positive Smoking Expectances; NSOE = Negative Smoking Expectances; PM-CR = Positive Metacognitions about Cognitive Regulation; PM-ER = Positive Metacognitions about Emotional Regulation; NM-U = Negative Metacognitions about Uncontrollability; NM-CI = Negative Metacognitions about Cognitive Interference.
$^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

were identified as significant predictors of daily smoking. Table 5 presents the results.

Discussion

The current study aimed to validate the MSQ, originally developed by Nikčevič et al. (2015). This study examined whether the K-MSQ can serve as a psychometrically sound measure of smoking-related metacognition in the Korean population, and the detailed findings are as follows.

First, the results of the EFA supported a four-factor structure, consistent with that of the original scale and previous validation studies conducted in Turkey and Iran (Alma et al., 2018; Najafi et al., 2018; Nikčevič et al., 2015). However, Item 13 demonstrated cross-loadings above .30 on cognitive and emotional regulation factors, with a difference of less than .10 between the two. Although the item was originally developed to capture beliefs about cognitive regulation, Korean participants may have interpreted it as emotional relief, as "calm the mind" often connotes emotional regulation in Korean. This interpretation may have contributed to the blurred differentiation between cognitive and emotional metacognitive factors. Nonetheless, given its substantial primary loading (>.60) and alignment with cognitive control processes, the item was retained. This decision was based on theoretical coherence and alignment with the conceptual framework of the scale rather than exclusion based solely on statistical criteria.

Second, the CFA results indicated an acceptable model fit for the proposed four-factor structure. The initial model showed a TLI of .896, slightly below the conventional cutoff of .900, and remained at a marginal level despite incorporating modification in-

dices. Nevertheless, the model was considered to demonstrate overall acceptable fit based on the criteria proposed by Hu and Bentler (1999). This result may be due to estimation instability caused by the relatively limited sample size (n = 198). Future studies using larger and more diverse samples may help clarify the model structure and enhance generalizability. Also, a correlated error term was added between Items 1 and 13, reflecting their conceptual similarity in cognitive processing and supported by modification indices, resulting in improved fit. This finding is consistent with that of the original scale development and the Persian validation study, supporting the appropriateness of the four-factor model (Najafi et al., 2018; Nikčevič et al., 2015). These results suggest that positive and negative metacognitive beliefs about smoking comprise four distinct dimensions that are consistently identifiable across cultural contexts.

Third, reliability analysis demonstrated good internal consistency and adequate test-retest reliability, supporting the use of the scale as a reliable tool for assessing smoking-related metacognitive beliefs. A retest was conducted after an eight-week interval to examine the temporal stability of the measure. This reflected the theoretical assumption that metacognition represented relatively stable and enduring cognitive structures (Wells, 2009).

Finally, the validity of the K-MSQ was supported by correlational analyses of related psychological constructs and behavioral indicators. The results from the concurrent validity analysis showed significant positive associations between K-MSQ and measures of depression and anxiety, with negative metacognitive beliefs displaying stronger correlations than positive ones. This supports metacognition theory, which posits that negative metacognitions exacerbate negative affect and contribute to maladaptive coping mechanisms (Nosen& Woody, 2014; Wells, 2009). Furthermore, all four K-MSQ subscales were positively correlated with nicotine dependence and daily cigarette use, indicating a significant association between metacognition and smoking severity. By contrast, the negative outcome expectancy subscale of the SEQ was not significantly associated with daily cigarette use, suggesting its limited predictive value for actual smoking behavior. These findings align with those of previous studies showing that metacognitions are more consistent predictors of smoking behavior than outcome expectancies (Najafi et al., 2018; Nikčevič et al., 2015). The results of the discriminant validity analysis showed low-to-moderate correlations across K-MSQ and SEQ subscales. This suggests that although the two scales share some conceptual overlap as both assess smoking-related beliefs, they reflect theoretically distinct constructs. While the SEQ measures primary beliefs about the consequences of smoking, the K-MSQ assesses second-order beliefs concerning the control, regulation, and interference of smoking-related thoughts (Wells, 2000). This theoretical distinction is further supported by the results of the incremental validity analysis, in which only negative metacognitive beliefs significantly predicted smoking severity beyond outcome expectancies. In contrast, positive metacognitionsdid not contribute additional predictive power. This suggests that positive beliefs such as "smoking helps regulate thoughts or emotions" may serve as an initial justification or permissive cognitive framework for smoking, rather than a direct driver of dependence. Notably, POSE was a significant predictor in Step 1, became non-significant in Step 2, implying that its explanatory role was supplanted by higher-order metacognitive beliefs. These findings support the metacognitive model of psychopathology (Wells & Matthews, 1994), which highlights the importance of maladaptive metacognitive beliefs in sustaining unhelpful thinking patterns and behavioral dysregulation. Individuals who believe their smoking-related thoughts are uncontrollable or cognitively interfering may rely on smoking to manage internal discomfort, thereby reinforcing dependence. Compared with traditional outcome expectancy models, this framework offers a more nuanced understanding of smoking maintenance. These results highlight the potential value of metacognition-based therapeutic approaches in Korea to target maladaptive beliefs and support smoking cessation effectively. In clinical contexts, the K-MSQ may inform metacognitive case formulations by identifying maladaptive beliefs, including perceived uncontrollability and the assumed necessity of cognitive regulation, which sustain smoking behavior. Whereas traditional cognitive therapy focuses on modifying the content of maladaptive thoughts, metacognitive therapy targets beliefs about thinking itself, including perceived danger or inevitability of smoking-related thoughts. This distinction indicates that the K-MSQ can support interventions such as detached mindfulness or postponement of urges, which aim to modify cognitive processing styles.

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This study has several limitations. First, the use of self-report measures may introduce response bias, as factors such as social desirability or recall limitations can influence responses. Future studies should incorporate more objective indicators (e.g., biochemical markers such as cotinine levels, ecological momentary assessment, or third-party reports) to strengthen the validity of the conclusions. Second, The participants primarily consisted of young adults in their 20s and 30s, which aligned with the demographics typically targeted by early intervention and prevention programs in Korea. While the sample suited the aims of the study, future studies should consider including a more heterogeneous sample varying in age and nicotine dependence tocapture the characteristics of the broader smoking population. Finally, the present study raises concerns about the adequacy of the criterion measures used to examine validity. The SEQ has been used to assess discriminant validity, although it has not yet been formally validated in the Korean population. However, the translated version used in this study maintained its original seven-factor structure and showed acceptable internal consistency. This suggests that, despite the lack of formal validation, the SEQ can serve as a reasonably appropriate comparative instrument for this research. In addition, no domestically validated instrument that conceptually corresponds to the K-MSQ in capturing the nuanced dimensions of positive and negative metacognitive beliefs about smoking is currently available. Therefore, convergent validity was not assessed in this study, which was consistent with the validation procedures followed in the original scale development and subsequent studies. Future studies should incorporate a broader range of validated reference measures to comprehensively assess the construct validity of the K-MSQ.

In conclusion, while the present study has acknowledged limitations, the findings provide meaningful contributions to the literature on metacognitions about smoking. This study successfully validated the K-MSQ and confirmed its reliability and factor structure using a domestic sample. The K-MSQ is based on Wells' metacognitive theory, which has been widely applied in addiction research and offers a theoretically grounded tool to understand the cognitive mechanisms that sustain smoking. Even after controlling for outcome expectancies, the independent predictive power of negative metacognitions highlighted their clinical significance. Therefore, the K-MSQ may serve not only as a reliable assessment instrument but also as a foundational resource for developing metacognition-based interventions for smoking and other addictive behaviors.

Author contributions statement

Da-Young Ko, a graduate student at Chung-AngUniversity, collected and analyzed data, and created the initial draft of the manuscript. Gi-Eun, Lee a Ph.D. at Chung-Ang University, reviewed and revised the manuscript. Jang-Han Lee, a professor at Chung-Ang University, revised the manuscript and supervised the research process. All authors provided critical feedback, participated in revision of the manuscript, and approved the final submission.

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Supplementary Table 1. *Factor Loadings for the Korean-translated Items of the K-MSQ*

Item		F1	F2	F3	F4
5	흡연은 정신을 집중하는데 도움이 된다	**.845**	.416	.021	.255
9	흡연은 생각을 정리하는데 도움이 된다	**.813**	.396	.058	.245
17	흡연은 집중하는데 도움이 된다	**.797**	.398	.037	.236
1	흡연은 생각을 명확하게 하는데 도움이 된다	**.668**	.425	.040	.228
13	흡연은 정신을 가다듬는데 도움이 된다	**.606**	.581	-.022	.136
2	흡연은 불안감을 진정할 때 도움이 된다	.432	**.789**	-.105	.073
6	스트레스 받을 때 흡연을 하면 진정이 된다	.337	**.739**	.010	.035
14	흡연은 긴장을 푸는데 도움이 된다	.518	**.725**	.081	.167
18	나는 압박감을 느낄 때 흡연을 통해 기분을 전환한다	.432	**.683**	.064	.237
10	속상한 일이 있을 때 흡연을 하면 위로가 된다	.287	**.644**	-.007	.102
7	나는 흡연 욕구를 조절하기 어렵다	.047	.064	**.904**	.541
15	나는 흡연을 통제할 수 없다	.109	.025	**.849**	.530
3	흡연을 하는 것은 의지가 약하다는 것을 의미한다	-.011	-.039	**.808**	.387
19	나는 흡연에 대한 충동을 억제할 수 없다	.068	.046	**.771**	.646
11	흡연을 하는 것은 정신적으로 나약하다는 것을 의미한다	-.012	-.045	**.665**	.481
16	흡연에 대한 집착적인 생각이 내 삶을 지배하고 있다	.261	.077	.487	**.811**
12	흡연에 대한 생각이 집착적으로 든다	.209	.175	.466	**.733**
4	나는 흡연에 대한 생각을 너무 많이 해서 명확한 사고를 방해 받고 있다	.126	.054	.413	**.693**
8	나는 흡연에 대한 생각을 스스로 조절할 수 없다	.166	.110	.521	**.684**
20	흡연에 대한 생각으로 일상생활에 지장을 받고 있다	.315	.175	.316	**.661**

Supplementary Table 2. *Results of the Confirmatory Factor Analysis of the K-MSQ (n = 198)*

Factor	Item	B	S.E	Std.B	C.R.
PM-CR	1	1.00	.00	.63	
	5	1.26	.14	.82	9.07***
	9	1.21	.14	.77	8.71***
	13	1.11	.14	.71	8.20***
	17	1.31	.15	.79	8.81***
PM-ER	2	1.00	.00	.75	
	6	.97	.09	.79	10.32***
	10	.89	.10	.66	8.67***
	14	.99	.11	.70	9.20***
	18	.88	.11	.60	7.95***
NM-U	3	1.00	.00	.70	
	7	1.06	.09	.87	11.34***
	11	.87	.10	.66	8.76***
	15	1.05	.09	.85	11.13***
	19	1.07	.10	.85	11.15***
NM-CI	4	1.00	.00	.64	
	8	1.21	.14	.75	8.65***
	12	1.36	.15	.82	9.27***
	16	1.00	.13	.67	7.96***
	20	1.09	.14	.71	8.19***

PM-CR = Positive Metacognitions about Cognitive Regulation; PM-ER = Positive Metacognitions about Emotional Regulation; NM-U = Negative Metacognitions about Uncontrollability; NM-CI = Negative Metacognitions about Cognitive Interference.
****p < .001.*

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Supplementary Table 3. *Korean-translated Items of the SEQ*

Item		
1	Smoking makes me short of breath	흡연은 나를 숨차게 만든다
2	Smoking makes me feel weaker physically	흡연은 내가 신체적으로 약해지는 것 같은 느낌이 들게 한다
3	Smoking makes it so I get tired easily	흡연은 나를 쉽게 피곤하게 한다
4	Smoking makes it harder for me to exercise or play sports	흡연은 내가 운동을 하거나 스포츠 활동을 하기 힘들게 만든다.
5	Smoking gives me a morning cough	흡연은 내가 아침에 기침이 나게 만든다.
6	My smoking makes my family or friends respect me less	내가 담배를 피우는 것은 내 가족이나 친구들이 나를 덜 존중하게 만든다
7	My smoking makes me respect myself less	내가 담배를 피우는 것은 나 자신을 덜 존중하게 만든다
8	My smoking makes some people think I lack the character to quit	내가 담배를 피우는 것은 다른 사람들이 나를 의지박약한 사람으로 보도록 한다
9	I sometimes feel embarrassed when I smoke	나는 가끔 담배를 피우는 것이 부끄럽다는 생각이 든다
10	My smoking makes me feel less attractive	내가 담배를 피우는 것이 나를 덜 매력적인 사람으로 만든다고 느낀다
11	Smoking makes me worry about getting or having cancer	담배를 피우는 것은 내가 암에 걸렸거나, 걸릴 것이라는 걱정을 하게 만든다
12	Smoking makes me worry about getting or having heart trouble	담배를 피우는 것은 내가 심장질환이 있거나, 가지게 될 것이라는 걱정을 하게 만든다
13	Smoking makes me worry about getting or having emphysema	담배를 피우는 것은 내가 폐병에 걸렸거나, 걸릴 것이라는 걱정을 하게 만든다
14	Smoking makes me worry about getting or having high blood pressure	담배를 피우는 것은 내가 고혈압이 생겼거나, 생길 것이라는 걱정을 하게 만든다
15	Smoking helps me when I am angry, irritable, or frustrated	흡연은 내가 화가 날 때나, 짜증이 날 때, 혹은 좌절감을 느낄 때 도움이 된다
16	Smoking helps me when I am bored	흡연은 내가 지루할 때 도움이 된다
17	Smoking feels especially good after a meal	담배는 특히 식후에 흡연할 때 더 맛이 좋다
18	Smoking helps me when I am upset or uncomfortable about something	담배를 피우는 것은 내가 속상하거나 마음이 불편할 때 도움이 된다
19	Smoking helps me when I am uptight, nervous, or tense	담배를 피우는 것은 내가 초조할 때나 긴장할 때, 혹은 신경이 날카로울 때 도움이 된다
20	Smoking keeps me from slowing down	담배를 피우는 것은 내가 쳐지지 않게 도와준다
21	Smoking stimulates me, perks me up	담배는 나를 각성시켜주고, 힘이 나게 해준다
22	Smoking helps wake me up when I am sleepy	담배는 피곤할 때 잠이 깨는 데 도움이 된다
23	Smoking gives me a lift	담배는 나에게 활기를 불어넣어 준다
24	Smoking helps me to work hard	담배를 피우는 것은 내가 열심히 일할 수 있도록 도와준다
25	I like the way smoking gives me something to do with my hands	나는 담배를 피우는 것이 내 손을 심심하지 않게 만들어주는 점이 좋다
26	Smoking makes social occasion feel better	담배를 피우는 것은 다른 사람과의 사회적인 상황들은 더 편하게 만들어준다
27	Smoking makes me feel more self-confident with others	담배를 피우는 것은 내가 다른 사람들과 있을 때 더 자신감 있게 만들어준다
28	Smoking helps me feel more relaxed when I am with other people	담배를 피우는 것은 내가 다른 사람들과 있을 때 더 편하게 만들어준다
29	Smoking gives me something to do with my hands in a group	담배를 피우는 것은 내가 집단 안에 있을 때 내 손이 심심하지 않게 해준다
30	Smoking helps me lose weight	흡연은 내가 살을 빼는 것에 도움이 된다
31	Smoking makes it easier for me to resist sweets	흡연은 단 음식을 절제하는 데 도움이 된다
32	Smoking helps me keep slim	흡연은 나를 날씬하게 유지시켜 준다
33	Smoking helps me not eat as much	흡연은 내가 평소보다 적게 먹도록 도와준다