Factor Structure of the Smoking Temptation Scale: Cross-Validation in Iranian men

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Original Article

Abstract

Background: The transtheoretical model (TTM) is used as a framework to implement smoking cessation programs. This model has some subscales based on which the smoking temptation scale is proposed as stages movement factor. This study aimed to translate and validate the temptation subscales of the TTM questionnaire in the Iranian population.

Methods: This cross-sectional study was conducted on 387 smokers. The participants were selected using convenience sampling method. First, the smoking temptation scale designed by Velicer et al. was translated into Persian, and then, factorial validity of the hierarchical three-factor structure for this subscale was studied using factor analysis and measurement invariance (MI) methods. All analyses were performed using Mplus software.

Findings: It was observed that the hierarchical three-factor structure model had a good fit to the data [confirmatory fit index (CFI) = 0.944, Tucker-Lewis index (TLI) = 0.915, Root Mean Square Error of Approximation (RMSEA) = 0.067, standardized root mean square residual (SRMR) = 0.042]. This study showed that this factorial structure had an identical measurement and structural model in subgroups of the population such as rural and urban residence, highly educated and low educated, high income and low income, three stages of quitting, and across the three ethnicities.

Conclusion: Given the validity and reliability of the hierarchical three-factor structure for smoking temptation scale, this measure can be used in interventional programs for smoking cessation in the Iranian male population.

Keywords: Cigarette smoking; Transtheoretical model; Behavior control; Iran

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Introduction

The transtheoretical model (TTM) is an important theoretical model in health psychology, especially because of its application to smoking cessation investigation. It postulates that the process of health behavior change can be imagined as movement through five stages of change, including pre-contemplation, contemplation, preparation, action, and maintenance. During these stages, individuals need to use different procedures in order to reach and maintain behavior change.[1-3] TTM attempts to promote behavior change by presenting experiential and behavioral feedback specific to the stage of change. Stage progress is accompanied by shifts in smoking temptations.[4,5] The smoking temptation measure reflects the severity of urges to display a specific behavior in difficult situations. The temptation measures are particularly sensitive to the changes that are associated with progress in the latter stage of changes and are good predictors of relapse. Over the five stages from pre-contemplation to maintenance, temptation decreases monotonically.[3]

Another assumption of TTM is that as individuals proceed through the stages of change, due to elevated self-efficacy or the more effective use of coping strategies, individuals will increasingly resist smoking temptations. As such, the TTM temptations construct is associated with both the self-efficacy model introduced by Bandura[6] and Locke[7] and coping models of relapse and maintenance described by Shiffman[8] and Velicer et al.[9]

Population-based studies have indicated that TTM constructs are applicable to a wide variety of populations.[10] Different structures for smoking temptation were proposed in smokers and nonsmokers, and in adolescents and adults.[3,11-14] In adults, temptations were basically imagined as having three factors, which discriminate between temptations to smoke in social situations, negative affect situations, and due to habit strength and addiction.[8]

Psychometric properties and measurement invariance (MI) of the smoking temptation scale were investigated across population subgroups based on gender, ethnicity, race, grade levels of Bulgarian smokers, Bulgarian non-smokers, and in the United States.[11,12,14,15] Reliability and construct validity of this scale were also studied in the Malaysian and Iranian population.[13,16]

A crucial requirement for testing and implementing a theoretical model is operationalizing the constructs in terms of psychometrically sound measures. In addition, the assessment of the psychometric characteristics of the TTM core constructs in distinct groups provides an essential foundation for extending the influence of TTM-tailored interventions.[17]

MI is a technique that determines whether a scale expresses an identical concept in different groups of people. Interpreting discrepancies in scale scores between groups is a rational requirement, for example, reported differences between stage by Plummer et al.[3] Given the TTM assumption that by changes in smoking temptation, individuals progress through the stages toward maintenance,[9] establishing MI is a necessary condition for meaningful interpretation of differences in mean scores among subgroups.[18]

Studies have reported success rates of 4.5% to 39.5% for TTM-based smoking cessation programs, while only 7.9% of smokers are able to quit without help.[19,20]

The goals of this study were the translation and evaluation of the internal consistency, factorial structure, and factorial invariance (FI) of the short form of the temptation to smoke across subgroups defined by (1) residency, (2) education, (3) income, (4) starting age, (5) stage of quitting, and (6) ethnicity by employing baseline assessment.

Methods

Participants and procedure: This cross-sectional study was conducted from February to December 2017 on 387 smokers selected using convenience sampling method from Golestan Province, Iran. The temptation to smoking questionnaire and stage of change were first translated into Persian by the researchers, and then, the translated version was sent to three bilingual people (Persian-English) who translated it back into English with no access to the original version. The back translation was compared to the original version in terms of content and structure. This version was distributed among 30 smokers to revise problems in terms of question perception and questionnaire completion.

All study participants had signed written informed consent forms at the beginning of the study and ethical approval for the present study was obtained from the ethics committee of Golestan University of Medical Sciences (IR.GOUMS.REC.1394.270).

Measures: Stage of change and smoking temptation scale developed by Velicer et al.[9] was utilized to determine the stage of smoking cessation and temptation to smoke. Permission to use the original scales was obtained from the author. The former questionnaire consists of 5 items regarding smoking status and the latter of 9 items. The items were scored based on a 5-point Likert scale ranging from 1 to 5 ("I'm not sure at all" to "I am very confident").

Confirmatory factor analysis (CFA): The fitness of the model was assessed using several indices. confirmatory fit index (CFI) values above 0.90 were considered as acceptable fit. A Root Mean Square Error of Approximation (RMSEA) of less than 0.08 was considered as a fair fit, with a threshold of 0.05 giving a stringent standard of the goodness of fit. Moreover, standardized root mean square residual (SRMR) values of less than 0.08 were considered as the best model fit.[21]

Factorial invariance (FI): FI was checked sequentially with 7 nested models in which constraints increased sequentially from model 1 to model 7. In the first model, configural invariance was examined. Configural invariance explores the similarity of factor structure on each defined subgroup, which means that the factor loadings patterns on the indicators of rural and urban residence, highly educated and less-educated, etc. were equal. The other set of constraints including invariance of first-order factor loadings (Model 2), invariance of second-order factor loadings (Model 3), invariance of intercepts of measured variables (Model 4), invariance of intercepts of first-order latent factors (Model 5), invariance of disturbances of first-order factors (Model 6), and invariance of residual variance of observed variables (Model 7).[21]

Invariances that examine in first 5 models are known as measurements invariance (MI), and invariances in two latter are known as structural invariance. Structural invariance examines whether there are substantive discrepancies in the factors of interest between subgroups (e.g., rural and urban residence, highly educated and less-educated, etc.).[21]

At the end, the invariance factor means determined whether the means of factors were alike in the subgroups, for example, in rural and urban. To evaluate differences between averages of factors across groups, the establishment of MI was required.

CFI change (ΔCFI) is used for model comparisons. ΔCFI is an index that is not not affected by sample size and model complexity. A decline of 0.01 or less in the CFI of the model with more restrictions shows that invariance is established. As identical individuals were measured serially, the MI analyses were based on the augmented covariance matrix.[21]

The relationship between temptation scales and stages: The mean of the three factors was compared between temptation scales simultaneously using MANOVA. Each factor was separately compared between groups using ANOVA with Tukey's post hoc test for pairwise comparisons. All analyses were performed using Mplus software (version 6.12, Muthen & Muthen, LA, USA).

Results

In total, data were gathered on 382 individuals in this study. The mean age of smoking initiation was 20.24 ± 6.19 years. In terms of ethnicity, 170 subjects were Persian, 163 Turkmen, 28 Sistani, 22 Azeri, and 4 Baluch. Given the limited number of Sistani, Baluch, and Azeri ethnicities, they were merged together and considered as others. Distribution of subjects according to the stage of change was such that 271 (70%) were in pre-contemplation, 73 (18.9%) were in contemplation, and others were in the preparation stage.

Reliability: The whole model had good reliability (Cronbach's alpha coefficient = 0.803). Cronbach's alpha coefficient was 0.595, 0.616, and 0.78 for the positive social situations, negative affect situations, and habit subscales, respectively. In assessing the reliability of structure in the subgroups, it was observed that factor varied from 0.483 to 0.694 for positive social situations, from 0.677 to 0.822 for negative social situations, and 0.486 to 0.762 for habit. Further details about the reliability are presented in table 1.

Table 1. Cronbach's alpha coefficient of the three subscales and the whole scale in the subgroups of the sample and the total sample

Variable	Subgroups	Number	Positive social	Habitual	Negative effects
Residence	Rural	127	0.625	0.656	0.794
	Urban	260	0.547	0.522	0.752
Education	High school and lower	233	0.608	0.430	0.731
	Diploma and higher	154	0.560	0.490	0.827
Ethnicity	Turkmen	163	0.541	0.650	0.782
	Persian	170	0.628	0.686	0.756
	Others	54	0.636	0.570	0.786
Income	< 125 dollar	134	0.62	0.588	0.773
	125-250 dollar	151	0.587	0.545	0.775
	> 250 dollar	102	0.571	0.696	0.792
Total		387	0.595	0.617	0.780

CFA for the Measurement Model: All the standardized factor loadings and correlations between factors were statistically significant (Figure 1). There were meaningful positive correlations between temptation and positive social situations (r = 0.90), negative affect situations (r = 0.82), and habit strength (r = 0.90). The values of the factor loading at the first level varied from 0.5 to 0.84. These patterns were similar across all subgroups. For the total sample, goodness of fit indices demonstrate good compatibility of factor structure (CFI = 0.944, TLI = 0.915, RMSEA = 0.067, SRMR = 0.042). In addition, the factor structure demonstrates good compatibility in subgroup analyses (Table 2).

MI Analysis: MI test results for the hierarchical three-factor structure across residency, income, stage of quitting, ethnicity, education level, and initiation age are shown in table 3. In model comparisons, ΔCFI was less than 0.01 for subgroups of residency, income, and ethnicity. This small ΔCFI is evidence of configural, first-order and second-order factor loadings, intercepts, disturbances of first-order factors, and residual variances of measured variables. For stages of quitting, MI was established, but structural invariance was partially established (residual variances of measured variables were not invariant).
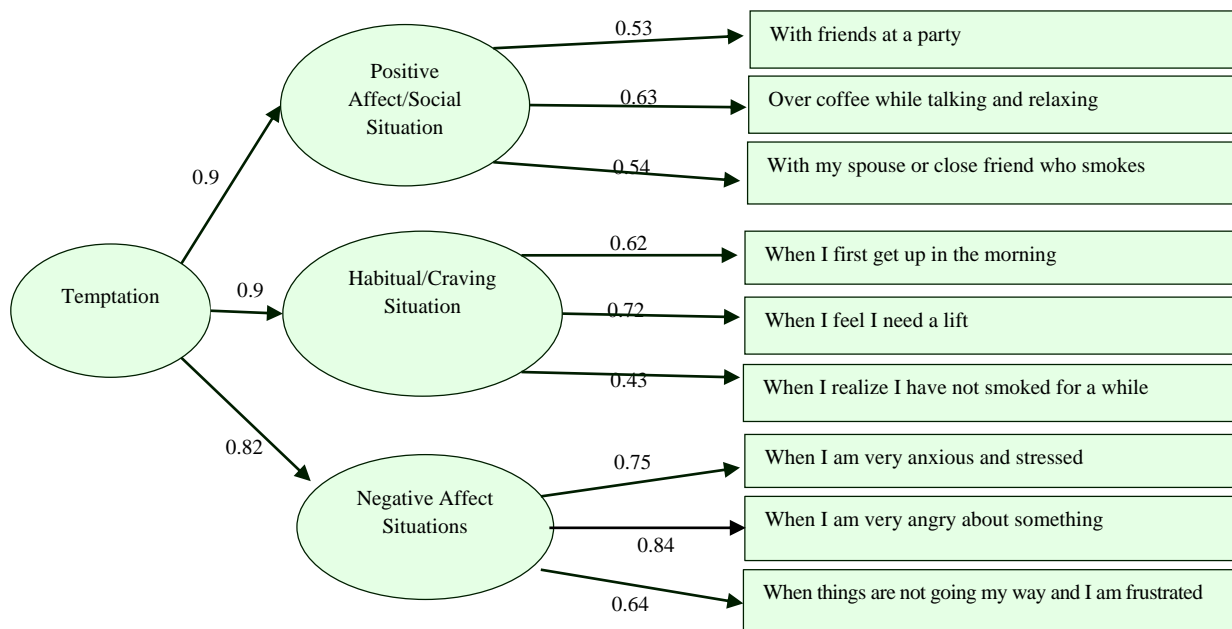
Figure 1. Standardized factor loadings and correlation of the hierarchical three-factor structure
Circles or ovals show the factors and rectangles show the variables.

Table 2. Summary of confirmatory factor analysis (CFA) results in subgroups of the total sample

Variable	Subgroups	CFI	TLI	RMSEA	SRMR
Residence	Rural	0.992	0.987	0.029 (0,0.063)	0.025
	Urban	1.000	1.0000	0 (0,0.045)	0.040
Education Level	High school and lower	0.978	0.967	0.037 (0,0.069)	0.040
	Diploma and higher	0.949	0.923	0.066 (0.026,0.101)	0.051
Ethnicity	Persian	1.000	1.000	0 (0,0.058)	0.034
	Turkmen	0.968	0.952	0.049 (0,0.85)	0.047
	Others	0.960	0.938	0.061 (0,0.134)	0.069
Income	< 125 dollar (low)	0.946	0.915	0.069 (0.023,0.107)	0.057
	125-250 dollar (average)	0.954	0.928	0.061 (0.013,0.098)	0.050
	> 250 dollar (high)	0.975	0.961	0.052 (0,0.102)	0.044

CFI: Comparative Fit Index; TLI: Tucker-Lewis index; RMSEA: Root Mean Square Error of Approximation; SRMR: Root Mean Square Residual

The data also supported equal factor means across subgroups of residency, income, and ethnicity, as presented in table 4; however, for education level, factor mean in high school was greater than that in diploma and higher. For initiation age, MI was not established.

Comparing smoking temptation in the stage of cessation: Means of the three factors in each stage of readiness for smoking cessation are illustrated in figure 2. As shown in this figure, the means of positive social situations and negative affect situations factors slightly decreased with increasing readiness for cessation.

Table 3. Summary of multi-group confirmatory factor analysis (CFA) results in subgroups of the total sample

| Variable	Model		df	CFI	TLI	RMSEA	SRMR	ΔCFI
Residency	MI	Model 1	42	1.000	1.000	0 (0,0.048)	0.036	-
		Model 2	51	1.000	1.000	0 (0,0.045)	0.044	0
		Model 3	53	1.000	1.000	0 (0,0.043)	0.044	0
		Model 4	59	0.993	0.992	0.022 (0,0.050)	0.046	-0.007
		Model 5	62	0.995	0.995	0.017 (0,0.048)	0.046	0.002
	Structural invariance	Model 6	65	0.991	0.990	0.023 (0,0.050)	0.051	-0.004
		Model 7	75	0.993	0.993	0.020 (0,0.047)	0.062	0.002
Income	MI	Model 1	86	0.957	0.946	0.056 (0,0.078)	0.061	-
		Model 2	92	0.958	0.951	0.054 (0.027,0.075)	0.066	0.001
		Model 3	95	0.945	0.937	0.060 (0.037,0.081)	0.080	-0.008
		Model 4	98	0.949	0.944	0.057 (0.033,0.078)	0.076	0.004
		Model 5	104	0.943	0.941	0.058 (0.036,0.078)	0.079	-0.006
	Structural invariance	Model 6	110	0.942	0.943	0.053 (0.036,0.077)	0.079	-0.001
		Model 7	129	0.941	0.951	0.053 (0.0325,0.072)	0.080	-0.001
Ethnicity	MI	Model 1	87	0.974	0.967	0.041 (0,0.066)	0.056	
		Model 2	93	0.966	0.961	0.045 (0.008,0.069)	0.068	-0.008
		Model 3	96	0.966	0.962	0.045 (0.007,0.068)	0.072	0
		Model 4	99	0.966	0.962	0.044 (0.007,0.067)	0.073	0
		Model 5	105	0.960	0.959	0.046 (0.016,0.068)	0.080	-0.006
	Structural invariance	Model 6	111	0.956	0.957	0.047 (0.019,0.068)	0.076	-0.004
		Model 7	130	0.956	0.963	0.044 (0.015,0.064)	0.089	0.000
Education Level	MI	Model 1	49	0.963	0.945	0.052 (0.025,0.074)	0.049	
		Model 2	55	0.967	0.957	0.046 (0.016,0.068)	0.051	0.004
		Model 3	57	0.961	0.951	0.049 (0.023,0.070)	0.062	-0.006
		Model 4	63	0.957	0.951	0.049 (0.025,0.070)	0.064	-0.004
		Model 5	66	0.95	0.945	0.051 (0.029,0.071)	0.076	-0.007
	Structural invariance	Model 6	69	0.951	0.948	0.050 (0.028,0.070)	0.091	0.001
		Model 7	79	0.949	0.953	0.048 (0.026,0.066)	0.105	-0.002

df: Degree of freedom; CFI: Comparative Fit Index; TLI: Tucker-Lewis index; RMSEA: Root Mean Square Error of Approximation; SRMR: Root Mean Square Residual; ΔCFI: Change in CFI between two consecutive models; MI: Measurement invariance

Table 4. Comparisons of factor scores in subgroups of the population

Variable	Subgroups	Number	Mean	Standard deviation	P
Residence	Rural	127	0	0	0.330
	Urban	260	-0.078	0.08	
Education level	High school and lower	233	0	0	0.006
	Diploma and higher	154	-0.209	0.077	
Ethnicity	Turkmen	163	0	0	-
	Persian	170	-0.096	0.118	0.414
	Others	54	-0.031	0.079	0.692
Income	< 125 dollar	134	0	0	-
	125-250 dollar	151	-0.148	0.089	0.098
	> 250 dollar	102	-0.021	0.104	0.843

However, the mean of the habit factor did not decrease monotonically with progression to the preparation stage. In multivariate comparisons, the mean of the three factors across three stages of quitting did not show any significant difference. In univariate comparisons, the mean of the habit factor showed a significant difference across the three stages of quitting ($F_{(2,384)}$ = 3.019, P = 0.050). The pairwise comparison showed that the mean score of the habit factor was significantly higher in the pre-contemplation group than the contemplation group (P = 0.042).
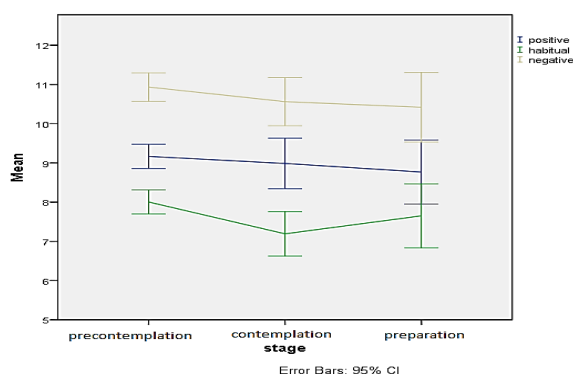
Figure 2. The trend of variation in mean scores of factors in the three groups of smoking cessation

Discussion

In this study, measures for smoking temptation for Iranian male smokers were translated and validated. In addition to construct validity, MI of hierarchical three-factor structure was studied among subgroups of subjects based on residency, income, stage of quitting, ethnicity, education level, and smoking initiation age. The external validity of the measures was examined through the relationships of the constructs with the stages of smoking cessation readiness.

This construct is based on Bandura's self-efficacy theory[6] as well as the coping models of relapse and maintenance described by Shiffman.[8] Self-efficacy represents the situation-specific confidence whereby people can cope with high-risk situations without relapsing to their unhealthy or high-risk behavior.[3] This construct can be operationalized by either a temptation measure or confidence measure. In previous studies, hierarchical structural modeling generated two internally consistent first-order latent factors.

In the present study, the hierarchical three-factor structure of temptation was established in Iranian smokers. This factor structure for smoking temptation regarding smoking cessation in adults primarily developed by Velicer et al. consisted of three factors, including positive social situations, habits, and negative affect.[9]

The psychometric properties of smoking temptation have been investigated in different countries. In Malaysia, Cronbach's alpha coefficients for the three-factor structure was 0.89 (0.54; 0.85).[13] This structure demonstrated good psychometric properties [goodness of fit index (GFI) = 0.92, CFI = 0.91, RMSEA = 0.065 (95% confidence interval (CI) = 0.063-0.067)] in the Iranian population;, and its Cronbach's alpha ranged from 0.60 to 0.84.[16] The differences of the present study with the study by Sarbandi et al.[16] were in relation to the studied population, and further investigation including external validity and MI.

In studies conducted by Anatchkova et al.,[11] Plummer et al.,[3] and Hoeppner et al.,[14] in addition to the aforementioned factors, weight control was identified as an additional factor that impacts the temptation to smoke in adolescent smokers.

In the study by Hoeppner et al., strong FI was observed across gender (CFI = 0.959, RMSEA =

0.085), grade (CFI = 0.962, RMSEA = 0.079), race (CFI = 0.967, RMSEA = 0.074), and ethnicity (CFI = 0.965; RMSEA = 0.078).[14] In the study by Anatchkova et al. on Bulgarian adolescent smokers, the 4-factor hierarchical model demonstrated good psychometric properties (CFI = 0.89, RMSEA = 0.10).[11] Cronbach's alpha coefficients for negative affect, positive social, weight control, habit strength, and global temptations scale were 0.77, 0.69, 0.88, 0.46, and 0.84, respectively. In addition, the tau-equivalent model was observed across gender subsamples.[11]

The global temptations scale in the total sample showed good reliability. The low value of Cronbach's alpha coefficient for the positive social situations and habit subscales may be due to the small number of items of these subscales (only 3 items for each subscale), because it has been proven that with an increase in the number of items, the value of Cronbach's alpha increases. Furthermore, the low value of the overall scale in subgroups of the population could be the result of the small samples size in these subgroups.

The model's goodness of fit indices demonstrated that the hierarchical three-factor structure of smoking temptation has good construct validity. The present study also showed that in subgroups of the population based on residence, education, income, and ethnicity measurement, structural invariance was established, which mean that this construct measure was equal in all subgroups of the population.

In subgroups of people based on smoking initiation age, invariance of intercepts did not exist. In addition, in subgroups of the sample based on the stage of smoking cessation, invariance of item variance was not observed, which means that the reliability of the structure varies in different subgroups. In studying MI, lack of invariance of each model precludes studying invariances of nested models, but for non-invariance of variance, it is possible to investigate partial MI of the next models.[21,22] Therefore, partial invariance of the mean latent factors was studied in people based on smoking initiation age. As for non-invariance that observed in groups of people based on the smoking initiation age, it seems that further investigations are required to identify the reason for the lack of invariance.

It should be noted that the lack of structural invariance, in this case, does not illustrate inefficiency of the instrument, rather it indicates heterogeneity of the population.[21] Some studies that compared the mean scores of factors in different groups based on smoking initiation age reported significant differences between the mean scores of habit and negative affect situations factors. It seems that smoking initiation age can cause heterogeneity in the study population, which must be considered in subsequent studies.

In the present study, it was observed that the distribution of individuals in early smoking stages of change was very similar to the reported pattern in European countries, 70% in pre-contemplation, 20% in contemplation, and 10% in the preparation stages.[23] In the present study, the mean score of positive social situations and negative affect situations was uniformly decreased by moving from the pre-contemplation to the preparation stage that is in line with the TTM hypothesis. Plummer et al.[3] and Anatchkova et al.[11] suggested that the aforementioned decreases were significant, while in the current study MANOVA did not show any significant difference in the mean of construct between stages. This disparity may be due to the presence of people in stages of action and maintenance in studies conducted by Plummer et al.[3] and Anatchkova et al.,[11] who had a lower mean than that of people in the three previous stages. Another possible reason for this discrepancy may be the fact that the studies by Plummer et al.[3] and Anatchkova et al.[11] were conducted on adolescent smokers.

This study had some limitations. One of them was that all subjects were men, and women were not included in this study. This limitation was due to the low prevalence of smoking among women and the difficulty in accessing them. In addition, people who were in the action and maintenance stages of smoking were also not included. The heterogeneity of the population in this study was the strength of the present study. Populations consist of different subgroups. The strength of the present study was considering the heterogeneity of the population which mostly ignored in cross-validation of instruments.

Conclusion

In general, we can conclude that the current study provides strong evidence that the temptation construct of the TTM model in the Iranian population has validity, reliability, and invariance.

Therefore, its application appears to be beneficial in interventional programs for smoking cessation.

Conflict of Interests

The Authors have no conflict of interest.

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مقاله پژوهشی

چکیده

مقدمه: تئوری انتقال به عنوان چارچوبی برای پیادهسازی برنامههای ترک سیگار استفاده میشود. این تئوری دارای چندین خرده مقیاس است که از بین آنها، سازه وسوسه موقعیتی به عنوان عامل تغییر در بین مراحل حرکت شناخته میشود. پژوهش حاضر با هدف ترجمه و رواسازی مقیاس وسوسه مصرف سیگار در جامعه ایرانی انجام شد.

روشها: در این مطالعه مقطعی، ۳۸۷ مرد سیگاری با روش نمونهگیری در دسترس انتخاب شدند. ابتدا پرسشنامه وسوسه مصرف سیگار Velicer و همکاران ترجمه گردید و سپس روایی ساختار سلسله مراتبی سه عاملی با استفاده از روشهای تحلیل عاملی تأییدی و ناوردایی اندازهگیری مورد بررسی قرار گرفت. تمام تحلیلها با استفاده از نرمافزار Mplus انجام شد.

یافتهها: ساختار سلسله مراتبی سه عاملی برازش مناسبی نسبت به دادهها نشان داد (۰/۹۴۴ = Confirmatory fit index (CFI)، ۰/۹۱۵ = Tucker-Lewis index (TLI)، ۰/۰۶۷ = Root Mean Square Error of Approximation (RMSEA)، ۰/۰۴۲ = Standardized root mean square residual (SRMR)]. سازه وسوسه مصرف سیگار، مدل ساختاری و مدل اندازهگیری یکسانی برای افراد روستایی و شهری، افراد دارای تحصیلات بالا و پایین، افراد با درامد بالا و پایین، افراد مراحل مختلف ترک و افراد هر سه گروه قومیتی داشت.

نتیجهگیری: با توجه به روایی و پایایی ساختار عاملی سلسله مراتبی سه عاملی برای وسوسه مصرف سیگار، از این ابزار میتوان در برنامههای مداخلهای جهت ترک سیگار در مردان سیگاری ایرانی استفاده نمود.

واژگان کلیدی: سیگار کشیدن، مدل تئوری انتقال، کنترل رفتار، ایران

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