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Gender Differences in the Fagerström Test for Nicotine Dependence in Korean Americans

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Abstract

Introduction—This study was conducted to compare gender differences in the psychometric properties of the Fagerström Test for Nicotine Dependence (FTND).

Methods—The sample comprised 334 Korean immigrants (97 women and 237 men) who reported daily smoking for the past six months. Item-by-item responses and exploratory factor analyses (EFA) were compared by gender. Promax rotation was selected based on findings from previous studies suggesting correlated factors.

Results—Compared with men, women smoked fewer cigarettes per day, were more likely to smoke when ill in bed, and were less likely to smoke frequently in the morning. The entire sample and men within the sample had the same factor loading pattern, where three items (time to first cigarette, the cigarette most hate to give up, and smoke more frequently in the morning) were loaded on Factor 1 (morning smoking) and the remaining three items (difficult to refrain from smoking in public places, number of cigarettes smoked per day, and smoking even when ill in bed) on Factor 2 (daytime smoking). For women, however, neither the 1- nor 2-factor model fit the data well.

Conclusions—For Korean American male smokers, the psychometric properties of the FTND were similar to those seen in other populations, but this was not the case with Korean American women. Clinicians may need to modify their interpretation of nicotine dependence severity if basing only on the FTND with Korean Women. The FTND assesses smoking patterns which has a cultural influence and other measures of nicotine dependence should be considered

Keywords

smoking; psychometric testing; gender; Asian; culture

Declaration of Interests
None declared.

Introduction

In clinical practice and research, the Fagerström Test for Nicotine Dependence (FTND) (Heatherton, 1991) is the most commonly used measure of nicotine dependence. The FTND consists of four dichotomous and two multi-response items. The FTND score (range 0–10) is calculated by summing scores for the six items. A score of 4 or higher is considered to be indicative of nicotine dependence (Agrawal et al., 2011; de Meneses-Gaya, Zuardi, de Azevedo Marques et al., 2009). A review of 26 studies on the FTND revealed that the Cronbach's alpha ranged from .55 to .74 (de Meneses-Gaya, Zuardi, Loureiro, & Crippa, 2009). On the other hand, violation of tau-equivalence that is assumed in the measurement of Cronbach's alpha was suggested as a possible explanation for the low internal reliability (Raykov, 1997a). Thus, instead of Cronbach's alpha, some authors (Huang, Lin, & Wang, 2006; Richardson & Ratner, 2005) have assessed construct reliability using a congeneric measurement model (Raykov, 1997b)

Factor analysis of the FTND has yielded inconsistent results. Some (Etter, Duc, & Perneger, 1999; Heatherton, Kozlowski, Frecker, & Fagerström, 1991; Wellman et al., 2006) have reported that the measure has only one factor, whereas others (Chabrol, Niezborala, Chastan, Montastruc, & Mullet, 2003; Etter, 2005; Huang et al., 2006; Jhanjee & Sethi, 2010; Radzius et al., 2003; Yamada, Acton, & Tsoh, 2009) have found two factors (i.e., morning and daytime smoking), with some differences in item-factor loadings. However, the validity of the second factor is still in question because of its relatively low internal consistency and cross-loadings of some items

Schroeder and Moolchan (2007) found ethnic differences in responses to the FTND between White and African American adolescents. They stated that the differences could be attributable to sociocultural factors influencing opportunities for smoking. In Korea, smoking is forbidden for women, whereas smoking is ubiquitous for their male counterparts (Kim, Son, Nam, 2005). Korean men in the United States have high rates of smoking; however, their female counterparts have been identified as a group with relatively low rates of smoking compared with the general U.S. population (Baluja et al., 2003; Kim, Ziedonis, & Chen, 2007). Many Korean American women may manifest smoking patterns still bound by the cultural proscription against women's smoking in their native culture. Given the strong gender difference in the sociocultural context of smoking, Korean women may respond differently from Korean men to the questions of the FTND

Park et al. (2004) examined the FTND with smokers in Korea and reported that it is a valid and reliable measure for Koreans. However, the proportion of women in the sample (7.5%) was very small. We could identify no studies that examined the measurement properties of the FTND for women of Asian ethnicities including Korean. The purpose of our study was to compare the psychometric properties of the FTND in Korean American men and women.

Methods

Subjects

The sample consisted of 334 Korean immigrants (97 women and 237 men) in the United States who reported having smoked daily for the past six months. They were participants in two different studies: Study One was a telephone survey conducted with a nationwide sample of Korean Americans (N = 264) who were identified in an online telephone directory by their Korean surnames and randomly selected, and Study Two was a smoking cessation study that was conducted with Korean Americans (N = 99) residing in the northeast region. We used the data only from subjects who administered all research questionnaires in

Korean. Both studies were approved by the University of Massachusetts Medical School review board.

Procedures and Measures

Study One was conducted between November 2008 and September 2010 and Study Two between October 2009 and August 2011. The same questionnaires were used in both studies and administered in the same order, which allowed us to combine the data from the two studies. The data for Study Two was collected prior to the intervention. We used a Korean translation of the FTND previously published by Park and colleagues (2004).

In addition to the FTND, demographic data, smoking history, and psychosocial variables associated with smoking and quitting were assessed. Demographic variables included gender, age, marital status, education level, health insurance, and religion. Smoking history was gathered in the following areas: age at the onset of regular smoking, use of cigarettes and other tobacco products, and history of past-year quit attempts that lasted at least 24 hours. Participants were also asked about them smoking indoors at work and at home. Detailed description of these measures has been reported elsewhere (Kim, Kim, & Ziedonis, in press).

Data Analysis

Gender differences in demographics and smoking behavior were compared, using two-sample *t* tests for continuous variables and chi-square tests for categorical variables. Gender differences in response rates for each item of the FTND were also compared. Multiple regression analyses were performed to compare gender differences in correlates of nicotine dependence. We did not know a priori the latent factors of FTND items used for Korean Americans. Thus, we conducted explanatory factor analyses (EFA) using Mplus 6.0 for the whole sample, followed by men and women separately. Promax rotation was selected based on findings from previous studies indicating moderate to high correlations between the two factors (Buckley et al., 2005; Chabrol et al., 2003). As FTND items are ordered categorical variables, the estimator for this type of EFA analysis is a Robust Weighted Least Squares estimator (Muthen, 1984; Muthen, du Toit, & Spisic, 1997). For this estimator, the $\chi 2$ difference test based on scaling correction factors (Satorra, 2000; Muthen & Muthen, 2011) was used for model comparison where significant results suggest that the new model fits the data (e.g., supposing we test a new 2-factor EFA against 1-factor EFA, a significant *p*-value indicating 2-factor model fits, otherwise, 1-factor model does). Four additional model fit indices were considered: 1) the root-mean square error of approximation (RMSEA); 2) standardized root mean square residual (SRMR) fit indices; 3) Tucker-Lewis Index (TLI); and 4) Comparative Fit Index (CFI). RMSEA values less than .05 and SRMR values less than .08 are generally considered a good fit. TLI and CFI were examined using a cutoff value of .95 (Hu & Bentler, 1999). Instead of Cronbach's alpha, congeneric reliability of the measure was calculated for the entire sample and then women and men separately.

Results

Table 1 presents the comparison of demographic characteristics and smoking behavior by gender. Compared with men, women were younger ($t(332) = -3.11$, $p = 0.002$), more likely to be unmarried ($X^2(2, 334) = 30.36$, $p < 0.001$), and had fewer years of education ($t(330) = -4.56$, $p < 0.001$). Women started smoking later ($t(332) = 4.36$, $p < 0.001$) and were more likely to smoke at home ($X^2(1, 334) = 21.38$, $p < 0.001$), whereas men were more likely to smoke at work ($X^2(1, 334) = 16.73$, $p < 0.001$). Of the six FTND items, three (4, 5 and 6) showed differences in response rates by gender (see Table 1). Compared with men, women smoked fewer cigarettes per day ($X^2(2, 334) = 12.11$, $p = 0.001$) but were more likely to

smoke when ill in bed ($X^2(1, 334) = 12.11$, $p = 0.001$). Men showed a greater tendency to smoke frequently in the morning ($X^2(1, 334) = 4.16$, $p = 0.053$). The results for the remaining three items did not show gender differences. Women and men showed similar distributions in time to first cigarette. The correlation coefficient between time to first cigarette and the total score of the FTND was .75 ($p < 0.001$) and .84 ($p < 0.001$) for women and men, respectively. Additionally, the coefficient between cigarettes per day and the total score of the FTND was .51 ($p < 0.001$) and .66 ($p < 0.001$) for women and men, respectively.

Multiple regression analyses revealed gender differences in the relationship of FTND scores to other smoking-related variables. For women, smoking at home ($\beta = .19$, $p = 0.05$), past-year quit attempts ($\beta = -.21$, $p = 0.03$), and self-efficacy in resisting smoking temptation ($\beta = -.316$, $p = 0.001$) were all significant predictors of FTND score. For men, age at the onset of regular smoking ($\beta = -.18$, $p = 0.003$), smoking at home ($\beta = .16$, $p = 0.008$), smoking at work ($\beta = .15$, $p = 0.012$), and self-efficacy in resisting smoking temptation ($\beta = -.26$, $p < 0.001$) were significant predictors of FTND score.

Table 2 presents the factor model fit statistics for the entire sample, and for each gender. For the entire sample and for men, all model fit statistics favored the 2-factor model. The entire sample as well as men had the same factor loading pattern where items 1, 3 and 5 loaded on Factor 1 (morning smoking) and items 2, 4, and 6 on Factor 2 (daytime smoking, see Table 3). For women, however, neither the 1- nor the 2-factor model fit the data well. The insignificant chi-square difference test between the two models (1-factor vs. 2-factor) based on the scaling-correction factor suggested that the 1-factor model fit the data well. The remaining fit indices were not much different between the two models. However, in the 1-factor model for women, items 2, 4, and 6 showed unacceptable factor loadings, all below .30. In the 2-factor model for women, items 1, 3, and 5 loaded on Factor 1 and items 2 and 6 on Factor 2. However, item 4 showed low loadings on both factors (.24 and .23). The construct reliability of the measure was .76, .65, and .80 for the entire sample, for women, and for men, respectively.

Discussion

To our knowledge, this is the first study to evaluate the psychometric properties of the FTND by gender in Asians in general and Korean Americans specifically. This study was undertaken to determine if social and cultural factors that influence opportunities for smoking impact the psychometric properties of measures of nicotine dependence that assess smoking behavior as opposed to symptoms of nicotine dependence. It was found that Korean American women and men differed in their responses to three FTND items and how the FTND correlates with other variables. Although Korean women smoked fewer cigarettes per day, they were more likely to smoke when ill in bed. These findings might be related to the following two facts: first many women in this study reported that they smoked only at home or smoked in hiding, which might have delimited the number of cigarettes they could smoke; and second women were far more likely to smoke at home than men and therefore, they might be also more likely to smoke when they were ill in bed. No significant gender difference was found for time to first cigarette, which might indicate that this item alone may be sufficient to assess nicotine dependence in this group. Fagerström (2003) suggested that the item is the best single indicator of tobacco dependence.

Multiple regression analyses indicated that the FTND showed significant correlations with smoking-related variables in expected directions for both men and women, which suggests its concurrent validity. Age at smoking initiation was a significant correlate of nicotine dependence for men only. This finding supports what Park and colleagues (2004) found in

Korea.Furthermore, a construct reliability of .80 and 2-factor solution found for men in this study were similar to findings from previous studies with male smokers of other Asian ethnic groups (Huang et al., 2009; Yamada et al., 2009; Yang, Shiffman, Rockett, Cui, & Cao, 2011). Based on these findings, the FTND appeared to be a reliable and valid measure to assess nicotine dependence for Korean American male smokers. Our results, however, do not support the use of the FTND with Korean American women. The reliability of the FTND was low and the measure did not show an acceptable factor structure (with either a 1 or 2 factor model).

This is the first study to examine gender differences in the measurement of nicotine dependence in Korean Americans whose culture has strong gender-based social norms regarding smoking. A strength of this study was the use of a national telephone sample and a clinical smoking cessation trial. Although the sample of female smokers was relatively small, it exceeded the recommended minimum of 10 subjects per item for factor analyses (Tabachnick & Fidell, 2001). The FTND measures nicotine dependence indirectly, by assessing its impact on smoking patterns. Other scales such as Hooked on Nicotine Checklist (DiFranza et al., 2002; Wellman et al., 2006) assess nicotine dependence more directly by assessing the symptoms that motivate behaviors. Korean American women face social proscriptions that may affect when they smoke. That the FTND performed adequately with Korean American men, but not women, suggests an important limitation to the approach of measuring nicotine dependence based on smoking patterns. Further studies are needed to determine how other nicotine dependence measures perform with Asian female smokers.

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Table 1

Demographic characteristics and smoking behavior by gender

Variable	All (N = 334)	Women (N = 97)	Men (N = 237)	*p*-value
	Mean ± SD or %	Mean ± SD or %	Mean ± SD or %	
Age	49.6 ± 13.2	45.9 ± 14.4	51.1 ± 12.4	**0.00**
Marital Status				**0.00**
Married	72.8%	52.6%	81.0%	
Single	14.4%	21.6%	11.4%	
All Others	12.9%	25.8%	7.6%	
Years of Education	14.2 ± 3.3	12.9 ± 3.8	14.7 ± 3.0	**0.00**
Health Insurance				0.72
Yes	57.5%	55.7%	58.2%	
No	42.5%	44.3%	41.8%	
Religion				0.80
Christianity	66.8%	68.0%	66.2%	
All others	33.2%	32.0%	33.8%	
Age of Smoking Onset	21.0 ± 5.3	23.3 ±6.9	20.1 ± 4.0	**0.00**
Smoking at Indoor Work Area				**0.00**
Yes	18.9%	5.2%	24.5%	
No	81.1%	94.8%	75.5%	
Smoking at Home				**0.00**
Yes	32.9%	51.5%	25.3%	
No	67.1%	48.5%	74.7%	
Past-year Quit Attempts				0.10
Yes	55.1%	47.4%	58.2%	
No	44.9%	52.6%	41.8%	
Acculturation (1–5)	1.8 ± 0.47	1.8 ± 0.49	1.8 ± 0.47	0.93
FTND total score (1–10)	4.1 ± 2.3	4.0 ± 2.0	4.1 ± 2.4	0.78
Time to first cigarette				0.55
≤5 minutes	18.6%	17.5%	19.0%	
6–30 minutes	15.9%	13.4%	16.9%	
31–60 minutes	28.1%	25.8%	29.1%	
> 60 minutes	37.4%	43.3%	35.0%	
Difficult to refrain from smoking				0.43
Yes	29.6%	33.0%	28.3%	
No	70.4%	67.0%	71.7%	
The cigarette most hate to give up				0.46
The first one in the morning	41.0%	44.3%	39.7%	
Any others	59.0%	55.7%	60.3%	
Number of cigarettes smoked per day				**0.00**
0 = ≤10	35.3%	48.5%	30.0%	
1 = 11 ~20	52.1%	46.4%	54.4%	

Variable	All (N = 334)	Women (N = 97)	Men (N = 237)	*p*-value
	Mean ± SD or %	Mean ± SD or %	Mean ± SD or %	
2 = 21~30	10.5%	5.2%	12.7%	
3 = ≥31	2.1%	0.0%	3.0%	
Smoke more frequently in the morning				0.05
Yes	45.8%	37.1%	49.4%	
No	54.2%	62.9%	50.6%	
Smoke even when sick in bed				**0.02**
Yes	26.0%	35.1%	22.4%	
No	74.0%	64.9%	77.6%	

Table 2

Results of model testing

Fit Indices	Sample		
	All (N = 334)	**Women (N = 97)**	**Men (N = 237)**
Factor Solution	2 factors	1 factor	2 factors
X^2 (df)[1]	24.38 (5)	5.99 (5)	18.04 (5)
p-value (2-factor vs. 1-factor model)	<0.01	0.31	<0.01
Tucker-Lewis Index (TLI)[2]	1.01	1.03	1.01
Comparative Fit Index (CFI)[3]	1.00	1.14	1.00
Root Mean Square Error of Approximation(RMSEA)[4]	.00	.00	.00
Standard Root Mean Square Residual (SRMR)[5]	.02	.09	.03

Note.

[1] X^2difference tests based on scaling correction factor;

[2] TLI of 1-factor model for all and men groups are 0.88, 0.89, respectively and TLI of 2-factor model for women is 1.31;

[3] CFI of 1-factor model for all and men are the same as 0.93, and CFI of 2-factor model for women is 1.00;

[4] RMSEA of 1-factor model for all and men groups are 0.08 and 0.08, RMSEA of 2-factor model for women is 0.00;

[5] SRMSR of 1-factor model for all and men groups are the same as 0.10, SRMSR of 2-factor model for women is 0.02.

Table 3

Exploratory factor analysis of the Fagerström Test for Nicotine Dependence in Korean Americans

FTND Items	All (N=334)		Women (N = 97)			Men (N = 237)	
	Factor 1	Factor 2	Factor 1	Factor 1	Factor 2	Factor 1	Factor 2
Time to first cigarette	**0.580**	0.232	**0.536**	**0.526**	0.037	**0.518**	0.387
Difficult to refrain in public places	−0.168	**0.651**	−0.009	−0.122	**0.503**	−0.162	**0.628**
The cigarette most hate to give up	**0.852**	−0.119	**0.849**	**0.892**	−0.110	**0.828**	−0.045
Number of cigarettes smoked per day	0.252	**0.368**	0.280	0.241	0.231	0.136	**0.560**
Smoke more frequently in the morning	**0.885**	0.007	**0.858**	**0.834**	0.043	**0.859**	0.100
Smoke even if ill and in bed	0.018	**0.524**	0.092	−0.018	**0.585**	0.052	**0.533**

Note. Values in boldface indicate factor loadings meeting the criterion for loading on the specific factor.

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