

Comparison of Two Nicotine Dependence Measures for Use with Korean American Women: The FTND and AUTOS

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Abstract

This study compares psychometric properties of the Fagerström Test for Nicotine Dependence (FTND) and Autonomy over Tobacco Scale (AUTOS), which are measures of nicotine dependence. This study is a secondary analysis of data obtained from a smoking cessation study conducted with 49 Korean American women. We compared the FTND and AUTOS assessed at baseline regarding their internal consistency reliability and concurrent and predictive validities. The AUTOS outperformed the FTND in reliability and concurrent validity by yielding a higher Cronbach's alpha and having significant relationships with smoking-related variables such as age at smoking onset, perceived risks of quitting, and self-efficacy in quitting. In contrast, there was no relationship between the FTND and any of the variables. Both measures had a significant relationship with post-quit nicotine withdrawal symptoms but failed to predict abstinence at follow-ups. The AUTOS seems to be a better assessment tool for Korean American women than the FTND. Before fully adopting the AUTOS as a measure of nicotine dependence for this group, factor structure of the scale should be tested with a larger sample of Korean American women.

Keywords: psychometrics, nicotine dependence, women, Asian Americans

Understanding the relationship between nicotine dependence and successful smoking cessation is important to provide an efficient smoking cessation intervention. Depending on the severity of nicotine dependence, clinicians can assign smokers to more or less intensive counseling and recommend a particular type and dosage of a cessation medication. Efforts have been made by clinicians and researchers to standardize a measurement of nicotine dependence. These measures include the Fagerström Test for Nicotine Dependence (FTND; Heatherton, Kozlowski, Frecker, & Fagerström, 1991), the Tobacco Dependence Screening (Kawakami, Takatsuka, Inaba, & Shimizu, 1999), the Cigarette Dependence Scale (Etter, Le Houezec, & Perneger, 2003), the Nicotine Dependence Syndrome Scale (Shiffman, Waters, & Hickcox, 2004), the Hooked on Nicotine Checklist (Wellman et al., 2005), the Autonomy over Tobacco Scale (AUTOS; DiFranza, Wellman, Ursprung, & Sabiston, 2009), and the Wisconsin Inventory of Smoking Dependence Motives (Smith et al., 2010).

The purpose of this study was to compare the performance of the FTND and AUTOS in Korean American women. The reasons for selecting these two measures were because smoking cessation clinics and studies have widely used the FTND, and the AUTOS

was developed to capture factors that make quitting difficult. The present study assessed the internal consistency reliability and concurrent and predictive validities of the two measures by calculating Cronbach's alpha and correlations with smoking-related variables and smoking abstinence. We hypothesized that the AUTOS would outperform the FTND in Korean American women.

The FTND consists of four dichotomous and two 4-response items. The sum of the items is scored on a 0 to 10 range (Heatherton et al., 1991). A score of 4 or higher is considered to be indicative of nicotine dependence (Agrawal et al., 2011; de Meneses-Gaya, Zuardi, Loureiro, & Crippa, 2009). Baker et al. (2007) reported that FTND scores were the strongest predictor of short- and long-term smoking abstinence relative to other assessment tools. However, others did not find the predictability of the FTND (e.g., Kim et al., 2015; Sledjeski et al., 2007; Yang & Hall, 2016). Likewise, findings of the relationship between FTND

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scores and nicotine withdrawal symptoms have not been consistent. For example, in studies conducted with the general U.S. population, Robinson et al. (2011) did not find a relationship between baseline FTND scores and any post-quit withdrawal symptoms. However, Baker et al. (2012) found significant correlations between baseline FTND scores and post-quit craving and between FTND scores and post-quit negative affect withdrawal symptoms. Baseline FTND scores did not predict post-quit withdrawal symptoms or cessation outcomes in studies with Korean Americans (Kim et al., 2015; Kim, Fang, McKee, & Ziedonis, 2016).

Poor internal consistency and poor item-to-total score correlations in factor analysis are criticisms of the FTND (de Menezes-Gaya et al., 2009; DiFranza, Savageau, & Wellman, 2012; Kim, Fang, DiFranza, Ziedonis, & Ma, 2012; Yamada, Acton, & Tsoh, 2009). Psychometric findings have been problematic among individuals prohibited from smoking (i.e., adolescents [Schroeder & Moolchan, 2007], pregnant women [Yang & Hall, 2016], and Asian women [Kim et al., 2012]). DiFranza et al. (2012) asserted that the FTND scale assesses smoking patterns, not nicotine dependence, which might be one of the reasons for its poor psychometric findings. Smoking patterns can vary by smokers depending on their particular sociocultural circumstances. Physiologic differences, such as genetic and hormonal variations, in nicotine metabolism, could also affect the measurement of nicotine dependence (Benowitz, Lessov-Schlaggar, Swan, & Jacob, 2006; Torchalla, Okoli, Hemsing, & Greave, 2011).

The AUTOS was developed based on the Theory of Autonomy for use with both adolescents and adults, and the theory posits that nicotine dependence begins when symptoms appear that make quitting difficult or unpleasant (DiFranza et al., 2009). There are three types of symptoms that are suggested to characterize people who have lost control over smoking, and they are nicotine withdrawal, psychological dependence, and cue-induced urges to smoke (DiFranza et al., 2009; DiFranza et al., 2012; Wellman et al., 2012). The AUTOS was tested with multiple samples of the general U.S. population and yielded high internal consistency reliability and validity with a single factor solution explicating 59% of the variance in adults and 61-74% of the variance in adolescents (DiFranza et al., 2009, 2012; Wellman et al., 2012).

Methods

Research Design

This study is a secondary analysis of data obtained from a smoking cessation study conducted with Korean American women in the United States. The parent study (Kim, Sitthisongkram, et al., 2016) was a

two-arm randomized controlled trial of a videoconferencing arm and a telephone counseling arm. The theoretical framework of the Theory of Planned Behavior (Ajzen, 1988, 1991) guided the study. Changing the three theoretical variables of the theory (attitudes, perceived social norms, and perceived behavioral control) was the focus of the smoking cessation intervention. The University of Massachusetts Boston institutional review board approved the study.

Participants

Participants were community-residing Korean American women in the United States. Advertising in online Korean American communities (i.e., www.missyusa.com and www.mizville.com) and offline newspapers across the nation was used to recruit participants. A total of 49 women participated in the study, of whom approximately 44.9% were from the west coast, 36.7% from the east coast, and the remaining from southern or central states.

Procedure

Participants were randomized at the ratio of 1:1 to either the video or the telephone arm. Participants in both arms received the same smoking cessation intervention – eight individualized therapy sessions of a culturally adapted cessation intervention. The cultural adaptation entails incorporating core cultural values of Korean Americans such as conformity and collectivism, while informing harms associated with exposure to secondhand smoke and underscoring the importance of family support for successful smoking cessation. Reported elsewhere is a detailed description of the Korean cultural adaptation (Kim, Sitthisongkram, et al., 2016). The length of each session was 30 minutes. Participants in both arms received transdermal nicotine patches for eight weeks: 21 mg for four weeks, 14 mg for two weeks, and 7 mg the remaining two weeks. Dosages were the same irrespective of daily cigarettes consumption, following the *U.S. Public Health Service's Clinical Practice Guideline* (Fiore et al., 2008).

Measures

Research questionnaires along with a consent form were prepared and mailed in Korean or English depending on the preferred language, to prospective participants. Five participants preferred a telephone survey to a mailing survey and hence, completed the questionnaire by answering questions over the phone. The time spent to complete the questionnaires ranged from 30 to 45 minutes. Participants were followed monthly over three months from the target quit day. All variables were assessed except nicotine withdrawal symptoms and smoking abstinence at baseline. Nicotine withdrawal symptoms and smoking abstinence were assessed during or after the intervention.

Demographic Data

Demographics included age, marital status, education, employment status, and health insurance coverage.

Acculturation

Acculturation was assessed using a brief form of the Suinn-Lew Asian Self-Identify Acculturation Scale (Leong & Chou, 1998). Instead of the full 21-item scale (Suinn, Rickard-Figueroa, Lew, & Vigil, 1987), the brief form comprises one's familiarity with spoken and written languages between English and Korean, ethnicities of childhood friends, and preference for ethnic identity. These were the items that had the highest item-to-total score correlations ($\alpha = 0.74$; Leong & Chou, 1998).

History of Smoking

The data included age at smoking onset, any attempts to quit that lasted for at least 24 hours within the past year, and the average number of cigarettes smoked per day for the past week.

Nicotine Dependence

Information on nicotine dependence was assessed using two measures: the FTND (Heatherton et al., 1991) and the AUTOS (DiFranza et al., 2012). The FTND consists of four dichotomous (e.g., "Do you find it difficult to refrain from smoking where it is forbidden?") and two 4-response items (e.g., "How soon after you wake up do you smoke your first cigarette?"; Heatherton et al., 1991). The total score is from 0 to 10. A higher score indicates more dependence on nicotine. A previous study reported that the FTND is not a reliable and valid measure for Korean American women because of its problematic psychometric findings (Kim et al., 2012). Nevertheless, the test was used in the present study because it is the most widely used assessment tool for nicotine dependence.

The AUTOS consists of 12 questions such as "when I go too long without a cigarette I get impatient" and "I rely on smoking to focus my attention." The items are assessed on a 4-point scale ranging 0 (*not at all*) to 3 (*very well*). The AUTOS score is computed by summing all 12 items for a score of 0 to 36. The higher the score, the higher nicotine dependence. The scale demonstrates excellent internal consistency reliability ($\alpha = 0.91-0.97$; DiFranza et al., 2012). The face validity was assessed by focus group evaluation and concurrent validity with other existing nicotine dependence scales such as the FTND.

Alcohol Use Problems

The Alcohol Use Disorders Identification Test is used to assess alcohol use problems. Alcohol

Use Disorders Identification Test consists of 10 items, scored 0 to 4 (Babor, Higgins-Biddle, Saunders, & Monteiro, 2001). Items 1 to 3 assesses individuals' alcohol consumption, 4 to 6 examines abnormal drinking behavior, 7 to 8 detects adverse psychological reactions, and 9 to 10 assesses alcohol-related problems. The measure has been found to be valid and reliable for use with Korean Americans in the United States ($\alpha = 0.92$; Kim, Gulick, Nam, & Kim, 2008).

Depressive Symptoms

Depressive symptoms were assessed using the Center for Epidemiologic Studies-Depression scale that consists of 20 items. The Center for Epidemiologic Studies-Depression is an adequate assessment tool for depressive disorder in the general population (Radloff, 1977). Participants rate how often they have experienced each symptom over the past week on a 4-point Likert scale ranging from 0 (*rarely* [once per day]) to 3 (*most of the time* [5-7 days]). Koreans have tested the scale and found that instead of a cutoff point of 16, a cutoff point of 21 is recommended as the best predictor of depression among this group ($\alpha = 0.95$; Cho & Kim, 1998).

Attitudes toward Quitting

Quitting smoking attitudes were assessed using a short version of the Perceived Risks and Benefits Questionnaire (McKee, O'Malley, Salovey, Krishnan-Sarin, & Mazure, 2005). The Perceived Risks and Benefits Questionnaire consists of 18 items for perceived risks of quitting (e.g., "I will be less able to concentrate" and "I will miss the taste of cigarettes") and 22 items for perceived benefits of quitting (e.g., "I will smell cleaner" and "I will feel proud that I was able to quit"). A short version of the scale was adapted with 28 items, 14 items for each subscale. The composite score of perceived risks and perceived benefits subscale predicted willingness to quit smoking within the next 30 days but did not predict actual smoking cessation ($\alpha = 0.87$ for perceived risks, $\alpha = 0.84$ for perceived benefits subscales; Kim, 2014; Kim et al., 2015).

Perceived Social Norms toward Quitting Smoking

These beliefs were assessed using the Perceived Social Norm Index (Kim, Sithisongkram, et al., 2016). This measure consists of two items regarding normative beliefs (e.g., "I believe that my family or my friends want me to quit smoking") and motivation to comply (e.g., "I am willing to comply with the belief"). Smokers are often conflicted by the discrepancy between perceived family and perceived peer social norms, for quitting. Hence, the scores of two-referent (family and peers) groups were not combined to estimate internal consistency.

Table 1. Spearman's Correlation Coefficients between Nicotine Dependence and Demographics and Psychosocial Variables at Baseline (N = 49)

Variable	FTND	AUTOS
Age	-0.103	-0.352*
Age at smoking onset	-0.022	-0.446**
Years of education	0.143	-0.071
Acculturation	0.047	-0.076
Number of cigarettes per day	0.500***	0.206
Past-year 24-hour abstinence	-0.253†	0.070
Alcohol use problems	0.062	0.065
Depressive symptoms	-0.265†	0.344*
Perceived risks of quitting	0.179	0.440**
Perceived benefits of quitting	-0.108	0.021
Perceived family norm for quitting	0.172	-0.236†
Perceived peer norm for quitting	-0.116	-0.012
Self-efficacy in quitting	-0.030	-0.538***

Note. † $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$.

Self-efficacy in Quitting

Self-efficacy was assessed using Resisting Smoking Temptation Scale (Velicer, DiClemente, Rossi, & Prochaska, 1990). The measure is a 5-point Likert-type scale asking an individual how confident he or she is in resisting smoking temptation at ten high-risk situations (e.g., "When I feel tense or anxious" and "When I wake up in the morning"). The scale score is the sum of the scores of 10 items. It has been validated with Korean Americans, yielding excellent internal consistency reliability, test-retest stability, and content validity ($\alpha = 0.87$; Kim, Kim, & Gulick, 2009).

Nicotine Withdrawal Symptoms

The Minnesota Nicotine Withdrawal Scale was used to assess nicotine withdrawal symptoms. The scale has nine 5-point Likert scale items: craving, irritability/frustration/anger, difficulty concentrating, anxiety, restlessness, increased appetite, disturbed sleep, depression, and impatience (Hughes & Hatsukami, 1986). Nicotine withdrawal symptoms were assessed before each weekly counseling session during the first four weeks of quitting. The total score ranges from 0 to 36. Validated in a previous study on Korean Americans, this scale yielded high internal consistency, reliability and content validity, with a two-factor solution that explained 66% of the variance in Korean American smokers (Kim, Gulick, Kim, & Seo, 2007).

Smoking Abstinence

Abstinence was assessed by self-report at 1- and 2-month follow-ups and by a combination of self-report and a salivary cotinine test at the 3-month follow-up. Seven-day point prevalence abstinence was used, meaning having not smoked a puff for the past seven days (Hughes et al., 2003). Those, who reported abstinence at the 3-month follow-up, were invited to conduct a home-based salivary cotinine test using a

NicAlert® test strip (Nymox Pharmaceutical Corporation, Hasbrouck Heights, NJ, USA). The test strip displays seven zones with a range of cotinine levels from 0 (0-10 ng/ml) to 6 (≥ 2000 ng/ml). The test is a semi-quantitative measure based on a colorimetric immunoassay reaction. The standard salivary cotinine concentration cutoff for smoking is 14 ng/ml, and therefore, level 1 (cotinine concentration > 10 ng/ml) or higher of the test strip was used as an indicator of smoking (Cooke et al., 2008).

Data Analysis

Data analyses were performed using STATA 14 (Stata Corp LP, College Station, TX, USA). The parent study was underpowered to detect an actual treatment effect because of the small sample. Nevertheless, 24 subjects per arm are suggested to yield a near-accurate estimate of an adequate size for pilot studies (Hertzog, 2008). Descriptive statistics were used to identify characteristics of participants in regards to demographics, smoking-related variables, theoretical and psychosocial variables, and cessation outcomes. Cronbach's alpha was calculated to assess the reliability of the FTND and the AUTOS. Spearman's rank correlation coefficients were estimated to evaluate the concurrent and predictive validities of the measures.

Results

Reliability

FTND scores ranged from 2 to 9 with a mean of 5.80 ($SD = 1.70$). AUTOS scores ranged from 9 to 36 with a mean of 22.40 ($SD = 7.55$). Item-to-total score correlation coefficients varied from .21 to 0.63 for the FTND ($\alpha = .32$) and from 0.51 to 0.76 for the AUTOS ($\alpha = 0.87$).

Table 2. Spearman's Correlation Coefficients between Nicotine Dependence and 4-Week Post-Quit Nicotine Withdrawal Symptoms and Smoking Abstinence at Each Follow-Up Month

Variable	FTND	AUTOS
Nicotine withdrawal symptoms at 4 weeks post-quit ($n = 41$)	0.360*	0.514**
7-day point prevalence abstinence at 1 month post-quit ($n = 49$)	-0.172	-0.034
7-day point prevalence abstinence at 2 months post-quit ($n = 49$)	-0.064	0.075
7-day point prevalence abstinence at 3 months post-quit ($n = 49$)	-0.024	-0.003

Note. * $p < .05$; ** $p < .01$.

Concurrent Validity

The correlation between FTND and AUTOS scores was nonsignificant ($r_s = .21$, $p > .05$). The two measures showed marked differences in their relationships with the main study variables assessed at baseline (Table 1). There was a strong correlation between FTND scores and the number of cigarettes smoked per day ($r_s = 0.50$, $p < .001$). Except for this, there were no significant relationships with FTND scores. On the other hand, AUTOS scores showed a significant relationship with 6 of 17 variables, including age at smoking onset, depressive symptoms, perceived risks of quitting, and self-efficacy in quitting. The relationships were all in expected directions. Participants, who had higher AUTOS scores (i.e., having higher nicotine dependence) initiated smoking younger, were more depressed, perceived greater risks of quitting, and had lower self-efficacy in quitting.

Predictive Validity

Both FTND and AUTOS scores were significantly correlated with nicotine withdrawal symptoms at four weeks post-quit. However, the relationship was stronger for the AUTOS than for the FTND (Table 2). A total of 28 participants (57.1%) self-reported 7-day point prevalence abstinence at one-month follow-up and 27 participants (55.1%) at two months follow-up. The rates declined to 20 participants (40.8%) at three months follow-up, of whom 15 (30.6%) verified the abstinence with a salivary cotinine test. Participants ($n = 3$) who reported smoking but refused to perform the test, or yielded a cotinine level higher than 0 (0-10ng/ml) were all treated as smokers. Both FTND and AUTOS scores failed to predict abstinence in a binary logistic regression analysis.

Discussion

The study compared two measures of nicotine dependence on reliability and concurrent and predictive validities for Korean American women. As expected, the internal consistency of the AUTOS was much higher than that of the FTND; the AUTOS yielded high internal consistency. In contrast, the FTND had a low reliability coefficient, which was consistent with the findings from a previous study with

Korean American women (Kim et al., 2012). With regards to concurrent validity, the AUTOS demonstrated a significant relationship with 6 of 17 smoking-related variables, whereas the FTND was correlated with the number of cigarettes smoked per day that is one of the six items of the measure (Heatherton et al., 1991).

The predictive validity of the FTND and AUTOS was partially supported. Baseline nicotine dependence assessed by either measure had a significant relationship with 4-week post-quit nicotine withdrawal symptoms. In contrast, nicotine dependence, irrespective of the measures, was not correlated with smoking abstinence at any follow-up point. The nonsignificant relationship between FTND scores and abstinence is in support of previous studies (e.g., Kim et al., 2015; Sledjeski et al., 2007; Yang & Hall, 2016). On the other hand, no previous studies exist that tested the predictive validity of the AUTOS about smoking abstinence (unpublished work).

Limitations

The present study has several limitations. First, the study is a secondary data analysis conducted with Korean American women who migrated from South Korea and participated in a smoking cessation study. Thus, it may be difficult to generalize findings to Korean American women who were born in the United States, or do not participate in a smoking cessation study. Second, due to the small sample, factor analysis could not be performed. A minimum of 10 subjects per item for factor analysis is recommended (Tabachnick & Fidell, 2001). This study was the first to administer the AUTOS to Korean American women, and hence, no previous studies exist for comparison.

Despite the limitations stated above, this is one of a few studies that tested psychometric properties of nicotine dependence measures among Korean female smokers. Previous findings (Kim et al., 2012) support that the FTND is not a useful assessment tool for Korean American women. Findings of the AUTOS were preliminary. Nicotine dependence assessed by the measure had a strong relationship with post-quit nicotine withdrawal symptoms indicating predictive validity. In a previous study of Korean American women ($N = 97$), nicotine withdrawal symptoms predicted short-term smoking abstinence (Kim, Fang, et al., 2016). To assist clinicians, future studies will need a larger sample of Korean American women. Studies

should examine whether the AUTOS can identify women who require more intensive counseling, require a different type of intervention (e.g., motivational interviewing), and/or medications such as Varenicline HCL and Bupropion SR to help clinicians. Future studies should conduct a factor analysis of the measure before fully adopting it for use in Korean American women.

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