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Fagerstrom test for nicotine dependence vs heavy smoking index in a general population survey

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Abstract

Background: The Fagerström Test for Nicotine Dependence (FTND) is used for assessing nicotine dependence. A shorter test derived from the FTND used for the general population is the Heavy Smoking Index (HSI) (six questions vs. two). The objective of this study is to compare the validity of the HSI versus the FTND.

Methods: A survey of tobacco use in the general population was carried out in the northern Spanish region of Galicia using both the FTND and the HSI to study a representative sample of 1655 daily smokers. The HSI was compared with the FTND, considered the gold standard. Measures of sensitivity, specificity and predictive values were calculated. Concordance between the tests was also established (Cohen's kappa).

Results: Cohen's kappa showed good agreement between measures (Kappa = 0.7); specificity values were also high (Sp = 96.2%). Sensitivity analysis in females (Se = 62.3%) did not show good agreement.

Conclusions: The HSI can be used as a reasonably good screening test in order to identify daily smokers with high nicotine dependence. Nevertheless, for populations or subpopulations having low nicotine dependence, such as women, the FTND is more reliable.

Background

Cross-sectional studies, especially those focused on tobacco use, generally employ long and overloaded questionnaires. The assessment of nicotine dependence is one of the main objectives addressed in tobacco studies. Hence, the availability of brief and reliable self-reported measures of addiction for epidemiological studies would be highly desirable. Several instruments have been developed to assess nicotine tobacco dependence. One of them is the Fagerström Test for Nicotine Dependence (FTND), a non invasive and easy-to-obtain self report tool that conceptualizes dependence through physiological and behavioral symptoms. The current version includes six items [1] and though the test is brief, its completion requires a few

minutes. Therefore a time saving test was developed, the Heavy Smoking Index (HSI) derived from the FTND [2]. This test includes only 2 items from the FTND and can also be used to estimate the degree of dependence.

The HSI's usefulness in assessing nicotine dependence in general population surveys aimed at health planning has not yet been completely established. Furthermore, most studies have not examined the measures of validity of HSI versus FTND test by gender in general population. The main goal of the present study was to estimate the agreement between the HSI compared with the FTND in a representative population sample with special attention to gender differences.

Methods

A survey of tobacco use in the general population was carried out in Galicia (Spain) between December 2004 and January 2005. Galicia is located in northwest Spain; in 2004 it had a population of 2.7 million and a prevalence of tobacco consumption of 25%. The sampled population was taken from the Galician GP patients database (*Tarxeta Sanitaria*), which accounts for 97% of the Galician population. The data collection was done mainly by computer-assisted telephone interview (90%); however, 10% of the interviews (the percentage of people in the register without a landline or a mobile phone) were conducted face-to-face at the individuals' homes. The initial selected sample (n = 6492) was representative according to sex and age groups: 16-24, 25-44, and 45-74. The participants were asked about smoking history, tobacco labours consumption (different types of tobacco consumed by the population, i.e. cigars, cigarettes, pipes and so on), dependence, relapse or cessation motivation. They were also asked if they were current (daily or occasional), former or never smokers. Demographic and socio-cultural information were also ascertained. Daily smokers were defined as individuals who smoke cigarettes regularly, i.e., at least one cigarette per day. Individuals who were exclusively cigar or pipe smokers were excluded from this analysis. The FTND and the HSI were administered only to the daily smokers. The FTND has 6 items with an overall score ranging between 0-10. The HSI has two items with an overall score ranging between 0-6. As in other studies, high dependence was defined as a FTND score ≥ 6 [3-11] and a HSI score ≥ 4 [5,8,12].

FTND was established as gold standard and the following statistics, summarizing the diagnostic accuracy of the HSI, were obtained, and also stratified by sex: sensitivity, specificity, accuracy and positive and negative predictive values. The concordance between HSI and FTND was evaluated using Cohen's kappa. The data were analyzed with Stata v9.2. 95% CIs were computed.

Ethical approval from Galician ethics committee was not required because this was a voluntary and anonymous research study with confidentially fully guaranteed. Written informed consent was not applicable in this case because the study was conducted mainly by telephone and agreement to participate implies consent.

Results

The daily smokers included in this study, with a response rate of 85%, were 1655 (941 males and 714 females). Their mean age was 36.7 years (CI 95%: 36.3-37.1), 63% were employed, 52% had intermediate or superior degree studies and 61% were married. Their mean tobacco consumption was 15.4 (CI 95%: 14.8-15.9) cigarettes per day. The age of first experience with tobacco was 16.2 years (CI 95%: 15.9-16.4) and the onset age of regularly smoking was 18.7 (CI 95%: 18.4-18.9). More than half of the smokers had not attempted smoking cessation during the last year [56.3% (CI 95%: 52.9-59.6)].

Males smoked more cigarettes per day than females (17.3 versus 12.6; p < 0.05) and had higher FTND and HSI scores [FTND (2.9 vs. 2.3; p < 0.05) and HSI (2.1 vs. 1.5; p < 0.05)]. The percentage of males and females who responded to the various FTND/HSI categories can be observed in Figure 1.

Table 1 describes dependence measured with FTND and HSI tests in both sexes and in the whole population. The percentage of the population classified as high dependent did not differ significantly based on the test applied. Also, this table shows agreement between tests results using Cohen's kappa. The agreement was good [13] for the whole population (kappa = 0.70, p < 0.05), but concordance was higher in males (0.75) than in females (0.6), p < 0.05.

Diagnostic tests are also shown in this table. The results verified that HSI has good specificity and good sensitivity in males; however, for females the test misses nearly 40% of highly dependent female smokers (sensitivity: 62.3%).

The proportion of persons correctly classified by dependence level using the HSI test, accuracy, is high (94%). The negative predictive value, low dependence, of the HSI is higher (97%) than the positive predictive value, high dependence (71.6%).

Discussion

The HSI and FTND identified almost the same percentage of daily smokers with high dependence. Though the specificity, accuracy and concordance between the two instruments were high in males and females, the HSI sensitivity for the latter was relatively low. For planning purposes it is preferable to use tests with high sensitivity [14], and
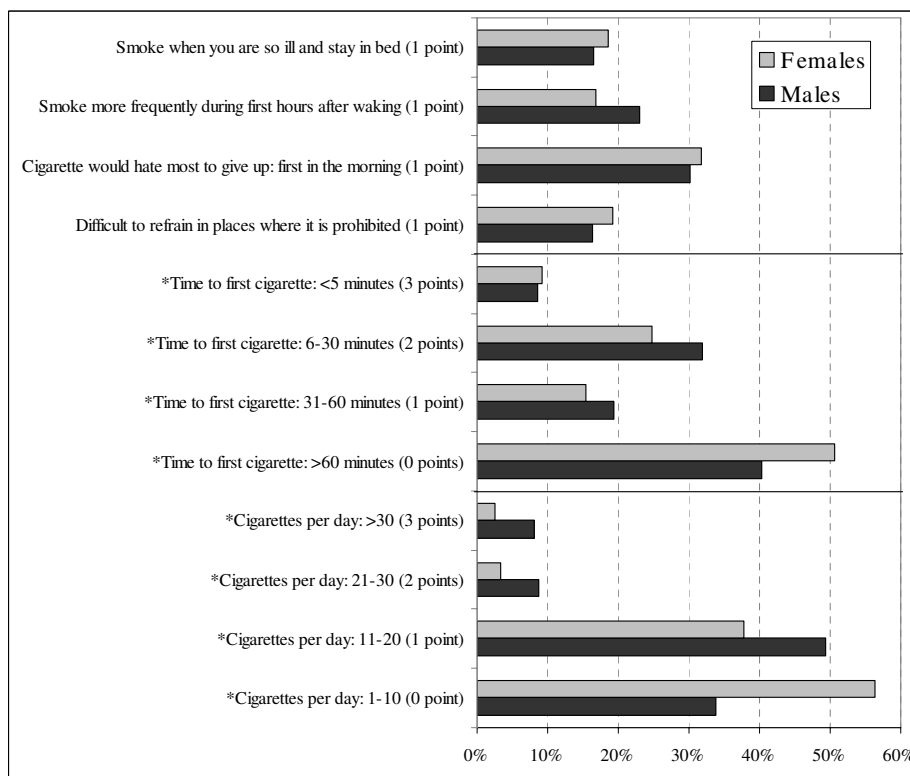
Figure 1
Percentage of males and females who responded to the various FTND/HSI categories. * Answers that belong to both tests.

therefore this result supports the use of the FTND instead of HSI. Nevertheless it should be acknowledged that using FTND as the gold standard has some limitations. FTND does not cover different aspects of dependence such as the difficulties in controlling tobacco consumption or unsuccessful efforts to quit.

Our study has similar results in comparison to other studies analyzing HSI versus FTND test when assessing nicotine dependence [5,6,8,12]: HSI performs as well as FTND when both sexes are analyzed as a whole [5,6,8,12]. Table

2 shows the results of these studies with the exception of the study of Kozlowski, because we were not able to retrieve its results [6]. We have also included some results that were not reported by the authors of the papers. When sex is taken into account our results differ from the only study that reports the results by gender [12]. This study observes a good performance of HSI for men and women. The differences with our study could be related to differences in the population studied (workers vs. general population), different prevalence of tobacco consumption, age or dependence.

Table 1: Dependence measured with FTND and HSI tests in the 1655 daily smokers: concordance between them, and diagnostic accuracy statistics of HSI.

	Males	**Females**	**All**
N	**941**	**714**	**1,655**
FTND-High dependence	15.6% (13.0-18.3)	10.6% (7.8-13.4)	13.6% (11.6-15.5)
HSI-High dependence	18.3% (15.5-21.1)	10.0% (7.2-12.8)	14.9% (12.9-16.9)
Kappa	0.75 (p < 0.0001)	0.60 (p < 0.0001)	0.70 (p < 0.0001)
Sensitivity, CI (95%)	83.1% (76.1-90.1)	62.3% (49.3-75.3)	76.2% (69.8-82.6)
Specificity, CI (95%)	95.7% (94.3-97.2)	96.8% (95.4-98.2)	96.2% (95.2-97.2)
Accuracy, CI (95%)	94.1% (92.5-95.6)	93.8% (92.0-95.7)	94.0% (92.8-95.1)
+PV, CI (95%)	74.6% (67.0-82.3)	64.4% (51.3-77.5)	71.6% (65.0-78.1)
-PV, CI (95%)	97.4% (96.2-98.6)	96.5% (95.0-98.0)	97.0% (96.1-97.9)

CI: confidence interval, +PV: positive predictive value, -PV: negative predictive value.

Table 2: Prior studies comparing FTND and HSI as measures of high nicotine dependence.

	Population studied	Interview	Cohen's Kappa	Se (%) 95% CI	Sp (%) 95% CI	Accuracy(%) 95% CI	+PV 95% CI	-PV (%) 95% CI
[12]	749 smokers Age range: 18-64	Face to face	0.74	79.6% (70.6-88.5)	96.5% (95.1-98)	94.5% (92.8-96.2)	75.3% (66-85.6)	97.3% (95.9-98.6)
	351 males		0.72	78.1% (64.2-91.9)	96.1% (93.8-98.4)	94% (91.4-96.6)	72.7% (58.4-87)	97.1% (95-99.2)
	398 females		0.76	80.9% (68.5-93.2)	96.9% (94.9-98.8)	95% (92.7-97.3)	77.6% (64.9-90.3)	97.4% (95.6-99.2)
[8]	1,462 smokers (5 samples from the US and Spain)	Face to face	0.78	94.4% (92.2-96.7)	88.1% (86-90.1)	90% (88.4-91.6)	77.8% (74.2-81.3)	97.3% (96.2-98.4)
[5]	819 smokers Age range: 15 and over	Face to face	0.71	85.0% (79.3-90.7)	91.3% (89-93.5)	90% (87.9-92.1)	71.4% (64.8-77.9)	96.0% (94.3-97.6)

CI: Confidence interval, Se: Sensitivity, Sp: Specificity, +PV: positive predictive value, -PV: negative predictive value.

One explanation for the differences found in this study for men and for women is that, in general, women tend to smoke fewer cigarettes per day. In our sample 94% smoke less than 20 cigarettes per day and 56% less than 11. For males these figures are 83% and 34% respectively. Differences also appear for time to first cigarette but are of a less magnitude. The differences for both questions are statistically significant but it appears that cigarettes per day have a higher influence than time to first cigarette.

Our data supports other findings supporting the HSI as a valuable test for the assessment of nicotine dependence [1,5,6,8,12,15,16] and busy clinicians can use this test as an accurate screener of high nicotine dependence.

Some identified limitations of this study were: (a) data were gathered only by self-reporting and were not verified by other measures [17]; (b) originally both tests were developed using face to face written forms but we utilized mainly telephone calls; (c) the study did not take into account the use of other tobacco products such as pipes or cigars; (d) the self-reported data may be limited by misclassification bias or some other bias that may have influenced the dependence values, such as the digit preference of smokers reporting consumption in multiples of 10 cigarettes per day [18]; and (e) limitations related to the fact that analysis with Kappa values is influenced by prevalence. Among the study strengths was the use of a general population framework, a large sample randomly selected and a high participation rate.

When planning and managing health resources directed to prevent tobacco consumption it is important to know the nicotine dependence of the objective population. Although concordances between both tests were relatively high, FTND test should be considered the best option for screening of nicotine dependence since it has a better performance on both sexes. If resources are scarce and the sample is high, HSI can be an option since it is low-time consuming but keeping in mind its limitations when measuring women dependence.

Thereby, efforts to develop a short self-report tool in order to assess nicotine dependence for epidemiological studies should continue.

Conclusions
The sensitivity values in females cause us to choose the FTND test as the preferred dependence screening instrument for health policy design.

Thereby, efforts to develop a short self-report measure of nicotine dependence for epidemiological studies should continue.

Competing interests
The authors declare that they have no competing interests.

Authors' contributions
Authors MP-R, MIS-P, AM, BA and XH design the study, MP-R managed the literature searches, MIS-P, JdL and MP-R undertook the statistical analysis and MP-R wrote the first version of the manuscript. All authors contribute to and approved the final version.

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