Heaviness of Smoking Index versus Fagerstrom Test for Nicotine Dependence among Current Smokers of Ahmedabad City, India

Parkar Sujal[1] ⓘ, **Patel Anand[2]** ⓘ, **Sharma Abhishek[3]** ⓘ

Original Article

Abstract

Background: The purpose of this research was to compare Heaviness of Smoking Index (HSI), high early smoking, and heavy smoking with the Fagerstrom Test for Nicotine Dependence (FTND) and further to evaluate the sensitivity of HSI, high early smoking, and heavy smoking among existing smokers.

Methods: A cross sectional study was conducted by using FTND questionnaire among 200 existing smokers. The cut-off point for HSI was kept at 4; high early smokers and heavy smokers were classified as those individuals who smoked within 30 minutes after waking up and individuals who smoked 30 cigarettes or more daily, respectively. Receiver-operating characteristic (ROC) analysis and Cohen's Kappa statistics were evaluated.

Findings: A significant agreement was observed between the HSI and the FTND, having Kappa value of 0.70, with good sensitivity of 78.16% and specificity as high as 91.15%. The ROC analysis confirmed that a cut-off score of 4 for HSI was suitable. Agreement between FTND and high early smoking was observed to be moderate (Kappa = 0.47, P < 0.001), while very low agreement (Kappa = 0.19, P < 0.001) was observed for FTND and heavy smoking.

Conclusion: Results show that HSI is an effective tool which can be substituted for the conventional FTND by the clinicians, psychotherapists, and investigators in health research.

Keywords: Tobacco use disorder; Sensitivity and specificity; Tobacco smoking; Screening

1- Department of Public Health Dentistry, Siddhpur Dental College and Hospital, Hemchandracharya North Gujarat University, Patan, Gujarat, India
2- Department of Oral Medicine and Radiology, Government Dental College and Hospital, Gujarat University, Ahmedabad, Gujarat, India
3- Department of Public Health Dentistry, Government Dental College and Hospital, Rajasthan University of Health Sciences College of Dental Sciences, Jaipur, India
Correspondence to: Parkar Sujal; Department of Public Health Dentistry, Siddhpur Dental College and Hospital, Hemchandracharya North Gujarat University, Patan,Gujarat, India; Email: drsujal_pcd@live.com

Introduction

Tobacco consumption is a major public health threat responsible for half of all the cancers in men, one fourth of all cancers in women, in addition to being a risk factor for non-communicable diseases (NCDs).[1] According to World Health Organization (WHO), tobacco kills more than eight million people annually around the globe. Among the majority of these premature deaths, more than seven million deaths are caused by direct tobacco use, and only a small portion, nearly 1.2 million premature deaths, are caused by second-hand smoke.[2]

Tobacco smoke contains more than 7000 chemicals and compounds, of which hundreds are toxic and at least 69 are carcinogenic.[3] Nicotine is the major constituent of tobacco which leads to addiction. Addictive effect of nicotine triggers the release of dopamine which is a chemical in the brain that is associated with feelings of pleasure.[4] However, research has suggested that in the long term, nicotine depresses the ability of the brain to experience pleasure.[5] Thus, smokers need a considerable amount of the nicotine to achieve satisfaction of the same level. Quitting tobacco may cause withdrawal symptoms, so continuing smoking can be considered as a type of self-medication to lessen these withdrawal symptoms. The nicotine dependence is the main constraint which needs to be controlled during the process of quitting tobacco.

Estimation of tobacco smoking with dependence on nicotine has posed a great challenge during examination of smoker's addiction and behavioural pattern, especially in developing countries. Hence, various questionnaires are framed to estimate nicotine dependence. One such questionnaire is the Fagerstrom Test for Nicotine Dependence (FTND). Since its inception, FTND has been popularly used as a comprehensive self-reporting questionnaire to estimate nicotine dependence based on individual's physiological and behavioural symptoms across the world.[6,7] There are six questions in commonly-used present version. Although this test is short, it consumed valuable time of physicians who had a busy schedule in assessing other medical problems. Therefore, Heaviness of Smoking Index (HSI) which is a short version of FTND was developed to assess nicotine dependence. There are two components in HSI, which have been framed from two items of FTND (namely viz.– item 1- time of 1st cigarette and item 4- number of cigarettes daily).[8]

Through extensive literature review, it was revealed that very little is known about whether nicotine dependence assessed by HSI is equivalent to that provided by FTND or not. The purpose of this research was to compare HSI, high early smoking, and heavy smoking with the FTND and further to evaluate the sensitivity of HSI, high early smoking, and heavy smoking among existing smokers.

Methods

Study subjects and ethical permission: A cross-sectional study was conducted among 200 dental patients attending the out-patient department of Dental Institute in Ahmedabad City, Gujarat State, India. Before starting the research, permission to conduct the research was sought after the submission of research protocol to the Ethics Committee of Dental Institute. The purpose of the study research was explained to the patients and the informed consent was taken from those who were keen to participate in the study. A total of 200 patients who were current smokers with habit of smoking cigarettes for more than three years were enrolled in the study. Current smokers were defined as participants who smoked cigarettes at the time of the interview and had smoked more than 100 cigarettes in their lifetime.[9] Those patients who had "ever used" or were "current user" of other forms of tobacco were excluded from this study.

Data collection: Data related to sociodemographic details, current smoking behaviour, and smoking history were collected by using a self-designed pretested questionnaire. It included personal details like age, gender, marital status, and socioeconomic status (SES) by Kuppuswamy scale.[10]

Nicotine dependence was evaluated by using the FTND questionnaire. The FTND has six items having the score range from 0 to 10. Two items of the FTND, item 1- high early smoking (time to the first cigarette of the day, scored between 0 and 3) and item 4- heavy smoking (number of cigarettes per day, scored between 0 and 3) may be the most important items to reflect dependence.[11] The combination of item 1 and item 4 gives HSI having the score range from 0 to 6. As reported by the previous studies, the cut-off score for high dependence on nicotine was found at 6 with FTND[8,12] and 4 with HSI.[7,13-15] High early smoking and heavy smokers were classified as those who smoked within 30 minutes of awakening (a score of 2 or more at the time to first cigarette of day

calculated by FTND item 1)[16] and those who smoked thirty cigarettes or more daily (a score of 3 in the number of cigarettes daily described by FTND item 4),[17]respectively.

After completion of data collection, the data were coded and entered into Microsoft Excel 2019. Categorical and continuous data were presented as proportion and mean values, consecutively. The sensitivity and specificity of the HSI and items 1 (high early smoking) and 4 (heavy smoking) were evaluated. Receiver-operating characteristic (ROC) curve and its area under curve (AUC) were plotted to observe whether the HSI and items 1 (high early smoking) and 4 (heavy smoking) were effective in identifying dependence on nicotine. The concordance between HSI and FTND was assessed by Cohen's Kappa. SPSS software (version 22, IBM Corporation, Armonk, NY, USA) was used for data analysis. An alpha level of 5% was considered as a level of significance.

Results

The age of participants ranged from 22 to 62 years with mean age of 45.69 ± 11.26 years. The distribution of level of nicotine dependence among study subjects according to demographic variables is shown in table 1. Out of 200 subjects, 87 (43.50%) participants had high level of nicotine dependence. A total of 43 (21.50%) subjects above 50 years had high level of nicotine dependence having no

significant difference (P > 0.05) when the levels of dependence were compared age-wisely. The average length of smoking was 19.56 ± 14.29 years. On an average, 12.46 ± 9.96 number of cigarettes were consumed per day. The overall mean FTND score was 4.71 ± 2.74.

A total of 68 (34.0%) participants were having high nicotine dependence measured by the HSI and the FTND, presenting relatively good sensitivity (78.16%) and high specificity (91.15%). Agreement between FTND and HSI was significant (Kappa = 0.70, P < 0.001). Nearly half of subjects reported high early smoking within 30 minutes of awakening and high dependence with FTND presenting high sensitivity (96.55%) but relatively low specificity (53.10%). The specificity for heavy smoking was larger (98.23%); however, the sensitivity was very low (19.54%). Concordance between FTND and high early smoking was moderate (Kappa = 0.47, P < 0.001), while it was very low (Kappa = 0.19, P < 0.001) for FTND and heavy smoking (Table 2).
ROC for HSI, high early smoking (item 1), and heavy smoking (item 4) is shown in figure 1. The AUC for HSI was observed as 0.85 [confidence interval (CI) = 0.79-0.91] as well as 0.75 (CI = 0.68-0.82) and 0.59 (CI = 0.51-0.67) for items 1 and 4, respectively. AUC was found significantly more for HSI when compared to item 1 (P = 0.002) and item 4 (P < 0.001) of FTND (Table 2).

Table 1. Distribution of level of nicotine dependence among the study subjects according to demographic variables

Variable	Low dependence[a] (n = 113, 56.50%) [n (%)]	High dependence[b] (n = 87, 43.50%) [n (%)]	P
Age (year)			
< 30	17 (8.50)	9 (4.50)	0.53
31-40	24 (12.00)	14 (7.00)	
41-50	24 (12.00)	21 (10.50)	
> 50	48 (24.00)	43 (21.50)	
Gender			
Men	107 (53.50)	79 (39.50)	0.23
Women	6 (3.00)	8 (4.00)	
Marital status			
Married	103 (51.50)	79 (39.50)	0.93
Unmarried	10 (5.00)	8 (4.00)	
SES			
Upper	10 (5.00)	5 (2.50)	0.13
Upper middle	15 (7.50)	15 (7.50)	
Lower middle	44 (22.00)	21 (10.50)	
Upper lower	38 (19.00)	37 (18.50)	
Lower	6 (3.00)	9 (4.50)	

[a]Cut off point < 6 is classified as low dependence, [b]Cut off point ≥ 6 is classified as high dependence, P > 0.05 was not significant
SES: Socioeconomic status

Table 2. Comparison of Heaviness of Smoking Index (HSI), "high early smoking", and "heavy smoking" category with Fagerstrom Test for Nicotine Dependence (FTND)

Measures	FTND[a] (n = 200)		Cohen's Kappa[*]	Sensitivity (95% CI)	Specificity (95% CI)	AUC (95% CI)
	High dependence [n (%)]	Low dependence [n (%)]				
HSI[b]						
High dependence	68 (34.00)	10 (5.00)	0.70	78.16 (68.39-85.55)	91.15 (84.47-95.12)	0.85 (0.79-0.91)
Low dependence	19 (9.50)	103 (51.50)				
High early smoking[c]						
Item 1 ≥ 2	84 (42.00)	53 (26.50)	0.47	96.55 (90.35-98.82)	53.10 (43.95-62.04)	0.75 (0.68-0.82)
Item 1 < 2	3 (1.50)	60 (30.00)				
Heavy smoking[d]						
Item 4 = 3	17 (8.50)	2 (1.00)	0.19	19.54 (12.57-29.08)	98.23 (93.78-99.51)	0.59 (0.51-0.67)
Item 4 < 3	70 (35.00)	111 (55.50)				

[a]Cut-off point < 6 is classified as low dependence, [b]Cut-off point ≥ 6 is classified as high dependence, cut-off point < 4 is classified as low dependence (item 1 + 4 < 4); cut-off point ≥ 4 is classified as high dependence (item 1 + 4 ≥ 4), [c]Smoking within 30 minutes of awakening, [d]Smoking more than 30 cigarettes daily, [*]P < 0.001
FTND: Fagerstrom Test for Nicotine Dependence; HSI: Heaviness of Smoking Index; AUC: Area under curve; CI: Confidence interval
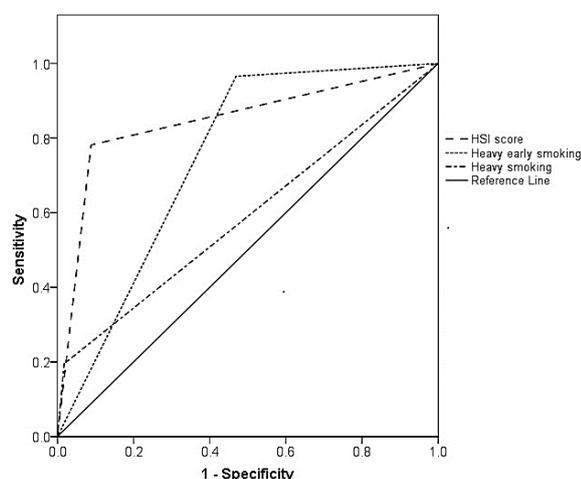

Figure 1. Receiver-operating characteristic (ROC) curve of Heaviness of Smoking Index (HSI), high early smoking, and heavy smoking for high nicotine dependence according to a score on the Fagerstrom Test for Nicotine Dependence (FTND) of ≥ 6

Discussion

Evaluation of nicotine dependence level plays a vital role in management of addiction; hence, we evaluated nicotine dependence among existing smokers attending the out-patient department of Dental Institute in Ahmedabad City. In this study, 43.50% of subjects reported high level of nicotine dependence. This figure was on higher side as compared with previous studies conducted by Islam et al.[12] (27.3%) and Clemente Jimenez et al.[18] (3.3%); this might be due to the fact that subjects in their study belonged to higher SES. The nicotine dependence increases with the age as reported by

Saha et al.[19] and Wu et al.;[20] this finding was consistent with the result of this study showing that 21.50% of subjects above 50 years had high nicotine dependence. The findings of this study were parallel to the findings of the study conducted by Islam et al. when the nicotine dependence was compared based on the gender and SES. Nicotine dependence was high among the married subjects which was in line with findings of Saha et al. and Wu et al., while contrasting result was found with Islam et al. and Schmidt et al.[21] The overall mean FTND score was 4.71 ± 2.74 which was similar to previous studies.[12,22,23]

The result of this study shows substantial concordance (Kappa = 0.70) between HSI and FTND. This was in line with results of previous studies.[7,13-15,23] However, the studies conducted by Lim et al.[24] and John et al.[25] show lower level of agreement. The sensitivity between HSI and FTND in the current study was relatively good (78.16%) which was similar to the result of Diaz et al.[13] This finding was on the lower side when compared to other studies,[7,14,15] where the sensitivity ranges from 83.1% to 94.4%. However, the specificity between HSI and FTND (91.15%) in this study was comparable with the previous studies,[7,13-15,23] where the specificity ranges from 80.90% to 96.10%. The level of agreement between high early smoking and FTND in this study was moderate (Kappa = 0.47); this was in line with previous study conducted by de Leon et al.[14] Both sensitivity (96.55%) and specificity (53.10%) recorded in this study were in accordance with the result obtained by de Leon et al. Poor agreement (Kappa = 0.19)

was found between the heavy smoking and FTND in this study. This result is inferior to the findings reported by previous studies.[14,23,24] The sensitivity for heavy smoking (19.54%) was very low; however, the specificity (98.23%) was in accordance with previous studies.[14,23,24] Differences in variables like demographic characteristics, frequency of tobacco usage, age at which smoking was initiated, cultural factors, and various statistical analytical methods employed in previous studies can be responsible for variations in Kappa agreement, sensitivity, and specificity.

The HSI was significantly more effective for detecting high nicotine dependence compared to items 1 and 4 of FTND as confirmed by ROC and AUC analyses. A score of 4 on HSI was optimal according to ROC showing sensitivity and specificity which were plotted against the cut-off scores of 6 or higher of FTND as the reference. The score of 2 was appropriate cut-off score for item 1 of FTND; however, the score of 3 was moderate cut-off score for item 4 of FTND.

The results of the present study were comparable with the results obtained by previous studies. However, the results should be interpreted with caution as there are some limitations in this study. The first limitation includes that there is possibility of information bias as the information of smoking was collected through self-report without biochemical verification. Secondly, the degree and direction of relationship between FTND score and study variables was not determined. Hence, there is a scope of further research to substantiate the findings of this study. Multi-centric studies are needed to be carried out in future, as this study includes the patients attending only one institute, to make the findings of this study more generalizable.

Conclusion

Within the limitations of this research, it can be concluded that current smokers were having high levels of nicotine dependence. The results also conclude that the HSI is a valuable screening tool to identify high nicotine dependence as a substitute for the gold standard FTND. This brief measurement can be used as an effective tool for determining level of nicotine dependence by the clinicians, psychotherapists, and investigators in health research.

Conflict of Interests

The Authors have no conflict of interest.

Acknowledgements

Authors' Contribution

Contributed to conceptualization of study design and methodology, data analysis, writing manuscript, reviewing and editing: PS; contributed to data collection, literature search and investigation: PA; contributed to methodology, critically reviewed the manuscript and helped in manuscript preparation: SA.

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شاخص مصرف شدید سیگار در مقایسه با تست وابستگی به نیکوتین Fagerstrom در میان افراد سیگاری شهر احمدآباد، هند

پارکار سوجال[1]، پاتل آناند[2]، شارما آبیشک[3]

مقاله پژوهشی

چکیده

مقدمه: هدف از انجام پژوهش حاضر، مقایسه شاخص مصرف شدید سیگار (Heaviness of Smoking Index یا HSI)، مصرف زودهنگام سیگار و مصرف زیاد سیگار با تست وابستگی به نیکوتین Fagerstrom (Fagerstrom Test for Nicotine Dependence یا FTND) و همچنین، ارزیابی حساسیت HSI، مصرف زودهنگام سیگار و مصرف زیاد سیگار در میان افراد سیگاری حاضر بود.

روش‌ها: در این مطالعه مقطعی، پرسش‌نامه FTND بین ۲۰۰ فرد سیگاری حاضر توزیع گردید. نقطه برش HSI، ۴ در نظر گرفته شد. مصرف زودهنگام سیگار و مصرف زیاد سیگار به ترتیب به صورت «افرادی که طی ۳۰ دقیقه بعد از بیدار شدن از خواب سیگار می‌کشند و افرادی که روزانه ۳۰ عدد سیگار یا بیشتر مصرف می‌کنند»، دسته‌بندی گردید. منحنی مشخصه عملکرد سیستم (Receiver-operating characteristic یا ROC) و Cohen's Kappa مورد ارزیابی قرار گرفت.

یافته‌ها: توافق معنی‌داری بین HSI و FTND با مقدار Kappa، ۰/۷۰ و حساسیت خوب ۷۸/۱۶ درصد و ویژگی بالای ۹۱/۱۵ درصد وجود داشت. تحلیل ROC تأیید کرد که نقطه برش ۴ برای HSI مناسب است. توافق متوسطی بین FTND و مصرف زودهنگام سیگار مشاهده گردید (۰/۰۰۱ > P، ۰/۴۷ = Kappa)؛ در حالی که توافق بسیار کمی بین FTND و مصرف زیاد سیگار (۰/۰۰۱ > P، ۰/۴۷ = Kappa) وجود داشت.

نتیجه‌گیری: HSI ابزار مؤثری است که می‌تواند جایگزین FTND توسط پزشکان، روان‌درمانگران و محققان حوزه سلامت شود.

واژگان کلیدی: اختلال مصرف دخانیات؛ حساسیت و ویژگی؛ استعمال دخانیات؛ غربالگری

۱- گروه بهداشت عمومی دندان‌پزشکی، کالج و بیمارستان دندان‌پزشکی Siddhpur، دانشگاه Hemchandracharya، پاتان، گجرات، هند

۲- گروه رادیولوژی و پزشکی دهان، بیمارستان و کالج دندان‌پزشکی دولت، دانشگاه گجرات، احمدآباد، گجرات، هند

۳- گروه بهداشت عمومی دندان‌پزشکی، بیمارستان و کالج دندان‌پزشکی دولت، کالج علوم دندان دانشگاه علوم بهداشت راجستان، جیپور، هند

نویسنده مسؤول: پارکار سوجال؛ گروه بهداشت عمومی دندان‌پزشکی، کالج و بیمارستان دندان‌پزشکی Siddhpur، دانشگاه Hemchandracharya، پاتان، گجرات، هند

Email: drsujal_pcd@live.com