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ORIGINAL RESEARCH

A Cut-off Level to Predict Quit Smoking Based on Smoking Cessation Success Prediction Scale (SCSPS): A Preliminary Study

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Main Points

- A cut-off value at 45 points of SCSPS was founded as a possible score that achieved successful smoking cessation in an early period of quitting smoking.
- Reliability analysis of the scale indicated a high value of Cronbach's Alpha coefficient (0.723) concerning our study sample.
- A short (3-month) post-cessation period revealed the cessation success in favor of Varenicline more than NRT based on prediction scale score and comparison of the success difference.

Abstract

This prospective study aimed to establish a cut-off score associated with a prediction of treatment success based on the smoking cessation success prediction scale (SCSPS) in daily smokers who were admitted to family medicine clinics of a tertiary hospital between August and November 2019. In this study, 48% of the 319 smokers who completed a 3-month control after smoking cessation treatment revealed the quit success. The Cronbach alpha coefficient of the scale was found at 0.723. Current smokers who received an SCSPS score of 45 and above (area under the curve (AUC)=0.768; p<0.001, sensitivity=74%; specificity=66%) in their first admission were successful in the assessment of the first 3-month follow-up. Quitting success of the varenicline users was higher than those who used nicotine replacement therapy (NRT). The SCSPS score average was higher in the varenicline user group compared with NRT, and accordingly the rate of treatment success would increase as the scale score increased; the varenicline seemed to be preferable in smokers with a low SCSPS score. This is a short-term preliminary study on the early prediction of smoking cessation treatment success and the decision on the treatment types, suggesting that longer-term and multicenter studies about SCSPS may be beneficial.
Keywords: Prediction scale, public health, smoking cessation, varenicline

Introduction

Not much attention has been paid to the harmful effects of cigarette smoke in individuals defined as healthy smokers who appear normal on routine testing (Zhou, Chen, & Peng, 2016). Smoking, besides its relationship with cardiovascular disease (Teo et al., 2006), chronic respiratory diseases, and lung cancer (Lubin et al., 1984), also harms the immune system and the defense mechanism against infections, making smokers more vulnerable to infectious diseases (Zhou et al., 2016). From the published data of current analysis, it has been calculated that smokers are 1.4 times more likely to have severe COVID-19 symptoms and 2.4 times more likely to be admitted to the intensive care unit and need mechanical ventilation than non-smokers (Vardavas & Nikitara, 2020). In addition, smokers have twice the risk of developing influenza and have higher mortality as seen in the previous MERS-CoV epidemic (Arcavi & Benowitz, 2004; Park, Jung, & Kim, 2018). On the basis of the knowledge that even healthy looking smokers are not healthy (Zhou et al., 2016), strategies on nicotine addiction are becoming more and more valuable by the day.

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Nowadays, studies are ongoing on prediction models for personalized addiction treatments. A study using machine learning as an adjunct to clinical decision making in alcohol dependence treatment accurately has predicted treatment results in 77% of the patients using machines and decision trees that learned to predict results following treatment. Although these results have excited the researchers in areas of addiction treatment, including smoking cessation, the literature data show the need for larger studies in the future (Connor, Symons, Feeney, Young, & Wiles, 2007). Therefore, until the best one is found, all kinds of prediction scale studies are valuable for predicting treatment success in both smoking cessation and other addictions.

Our study intended to contribute to the literature with one of the prediction scales used in nicotine addiction. Smoking cessation success prediction scale (SCSPS) is a scale that may provide an increase in the success of smoking cessation based on predicting which individuals have a higher potential for smoking cessation, by determining whom to give priority concerning the treatment types (Aydemir, Doğu, Dede, & Çınar, 2019). To our knowledge, this study is a new study about SCSPS, exploring the scale's reliability and calculating a cut-off score to predict the success of smoking cessation in a short-term evaluation. This study aimed to make an initial prediction of smokers who will possibly quit smoking in the 3 months following and compare initial treatment types on final success.

Methods

Study Design and Selection Criteria

Data were collected from 319 smokers who were admitted to the family medicine clinics at a tertiary hospital between August and November 2019. Treatment seeking volunteers aged over 18 years old undergoing cessation treatment for the first time were enrolled in this study. All the participants attended a 3-month program with a 15-minute monthly individual smoking cessation intervention and prescription of free nicotine replacement therapies (NRTs) (transdermal patches or varenicline).The first smoking cessation experiment for all volunteers of this study started with our cessation treatment. They were all recent smokers. All the participants were extensively questioned about possible previous attempts and treatment use, and those who tried to quit smoking at any time before were excluded from the study. The participants were asked to fill out a questionnaire that included SCSPS, the Fagerstrom test for nicotine dependence (FTND), and sociodemographic data (age, marriage, sex, education level, and income level). After 3 months from the end of the smoking cessation treatment, the patients were divided into 2 groups as smokers (continued smoking) and non-smokers (quit smoking). The initial SCSPS scores of the participants were used to compare the 2 groups for a cut-off score to predict smoking cessation. The group that quit smoking was compared with the unsuccessful group according to the treatment types as well on the basis of the final situation.

Scales in This Study

Reliability in the Turkish version of FTND and factor analysis was carried out in 2004 by Uysal et al. (2004). FTND was used for scoring (0-10 points) nicotine dependence severity and defining the addiction level as mild, moderate, or heavy nicotine dependence.

SCSPS was developed in 2019 by Aydemir et al. as a 5-point Likert-type scale with 10 items. The maximum and the minimum scores were 50 and 10 points, respectively. Higher scores revealed higher smoking cessation success. SCSPS seems to have high sensitivity, validity, reliability, and adequate psychometric properties for being able to predict which individuals have a high potential for smoking cessation (Aydemir et al., 2019).

Statistical Analysis

Data were analyzed using IBM Statistical Package for Social Sciences version 22 (IBM SPSS Corp.; Armonk, NY, USA) program and Med Calc online calculator. The sample size (minimum 234 participants) was decided with an 0.47 effect size, which was calculated on the basis of a pilot study with 5% type 1 error (bi-directional) and 5% type 2 error (power 95%). Chi-squared test (comparing categorical data), student t-test/Mann-Whitney U test (comparing continuous data), and receiver operator characteristics (ROC) curve were statistically used for data assessment.

Compliance with Ethical Standards

All volunteers participating in this study were informed about this research, and their verbal consents were obtained. Ethics committee approval was received for this study from the Taksim Training and Research Hospital, clinical research ethics committee on 22/08/2019; file no: 165-6. All authors of this study read and applied the ethical principles of the Helsinki Declaration during this study.

Results

Evaluation of the Demographic Data, Nicotine Addiction, and Scale Scores

Patients (n=319; age=37.3±10.4 years; 58.3% men) undergoing smoking cessation treatment had a 6.24±2.36 FTND score and a 42.85±4.58 SCSPS score. Of them, 14.7% had a cardiovascular (CVS) or respiratory system (RS) disease. Half of the smokers (53.3%) were high school/university graduates. The final cessation success rate at the end of the 3-month follow up was 48%. Table 1 shows the difference in the SCSPS scores between groups. Patients with CVS/RS disease (p=0.03) and varenicline users had a higher SCSPS score than those without disease and those on NRT (p=0.002), respectively. The mean SCSPS scores were similar among different sexes, marital status, and education levels.

As shown in Table 2, it was observed that individuals who continued to smoke had a higher daily use (p=0.014) and a lower SCSPS score (p<0.001) than individuals who quit smoking. The rates of varenicline and NRT use were different between smokers and quitters (p=0.046). The rate of varenicline use in the successful cessation group (64.1%) was higher than the rate of NRT use (35.9%).

Correlation between FTND and SCSPS Scores

The relationship between SCSPS and FTND scores was examined using the Spearman correlation test, and no relation was found (p=0.321, r=0.056). Although there was no relationship between the SCSPS score and age (p=0.695, r=0.022), a weak linear correlation was observed between the age of first cigarette and SCSPS score (p=0.019, r=0.131). When the relationship of SCSPS score with other continuous variables was examined, the age of regular smoking (p=0.194, r=0,073) and daily smoking (p=0.422, r= 0,045) were found to be unrelated to the SCSPS score.

ROC Curve Analysis

The Cronbach alpha coefficient of the SCSPS was found at 0.723 as a good reliability level for this study sample. Figure 1 and Table 3 reveal that current smokers who received an SCSPS score of 45 and above (area under the curve [AUC]=0.768 [0.711-0.814]; p<0.001, sensitivity=74%; specificity=66%; accuracy=70%) in their first admission were successful in the assessment of first 3-month follow-up.

Table 4 shows that as the number of cigarettes smoked per day decreased (increase in the number of cigarettes smoked per cessation success by about 5%) and the total scale score increased (approximately 1.3 times higher than the individuals who failed to quit smoking), the quitting success increased.

Table 1.
Evaluation of the SCSPS Total Score According to Categorical Data of Study Sample

Variables	Groups	Initial SCSPS Total Score mean±SD	[1]p
Sex	Female	42.33±4.90	0.089
	Male	43.21±4.30	
Marital status	Married	43.10±4.31	0.135
	Single	42.28±5.08	
Education level	Basic education	43.01±4,.6	0.542
	High school/University	42.70±4.59	
Additional disease	Absent	41.49±5.07	*0.03
	Present	43.09±4.45	
Treatment type	NRT	41.84±5.41	*0.002
	Varenicline	43.57±3.72	

[1]Student t-test
*p<0.05
SCSPS: Smoking cessation success prediction scale; SD: Standard deviation

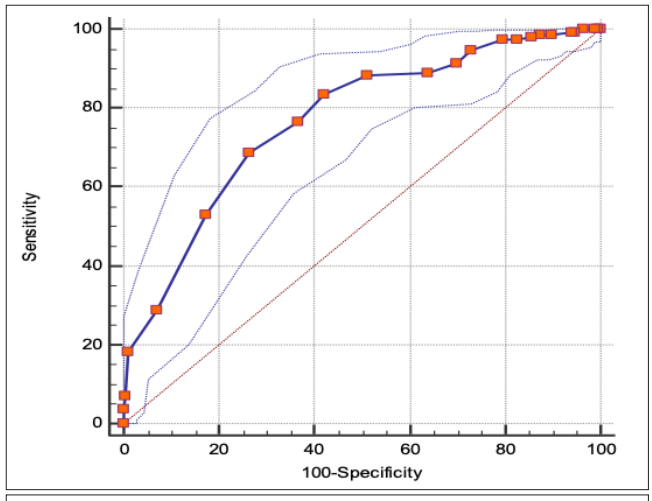

Figure 1. Receiver operator characteristics curve.

Table 2.
Evaluation of the Demographic Data, Nicotine Addiction Score, Cessation Success Prediction Score, and Treatment Types Based on Smoker (continued smoking) and Non-Smoker (Quit Smoking) Groups

		Continued Smoking mean±SD(median)	Quit Smoking mean±SD(median)	p
Age		37.3±10.29	37.25±10.48	[1]0.968
First smoking age onset		16.04±3.78 (15)	16.73±5.06 (16)	[2]0.248
Regular smoking age onset		18.04±4.37 (17)	18.41±5.45 (18)	[2]0.649
Daily smoking Consumption (per day)		23.25±8.61 (25)	20.92±7.83 (15)	[2]0.014*
FTND score		6.34±2.45 (7)	6.12±2.27 (6)	[2]0.206
SCSPS score		40.93±4.79 (42)	44.92±3.26 (46)	[2]0.000*
		n (%)	**n (%)**	
Sex	Female	69 (41.6)	64 (41.8)	[3]0.962
	Male	97 (58.4)	89 (58.2)	
Marital status	Single	57 (34.3)	43 (28.1)	[3]0.231
	Married	109 (65.7)	110 (71.9)	
Education level	Basic education	77 (46.4)	72 (47.1)	[3]0.904
	High school/University	89 (53.6)	81 (52.9)	
Additional disease	Absent	137 (82.5)	135 (88.2)	[4]0.201
	Present	29 (17.5)	18 (11.8)	
Treatment type	Varenicline	88 (53)	98 (64.1)	[3]0.046*
	NRT	78 (47)	55(35.9)	

[1]Student t-test
[2] Mann-Whitney U test
[3]Chi-squared test
[4]Continuity (Yates) corrected
*p<0.05
SD: Standard deviation; SCSPS: Smoking cessation success prediction scale; FTND: Fagerstrom test for nicotine dependence

Table 3.
Evaluation of the Cut-Off Score Features Between Smokers and Quitters Based on Treatment Success by ROC Analysis

AUC	SE	p	95% CI lower-upper limits
0.768	0.026	<0.001	(0.711-0.814)
Features of cut-off score (⩾45 points)			95% CI lower-upper limits
Sensitivity		0.74 (0.66-0.81)	
Specificity		0.66 (0.58-0.73)	
PPV		0.63 (0.58-0.68)	
NPV		0.76 (0.71-0.81)	
Accuracy		0.70 (0.64-0.75)	

ROC: Receiver operator characteristics; AUC: Area under curve; SE

Table 4.
Logistic Regression Evaluation Between Smokers and Non-Smokers

	OR	95% CI	p	Nagelkerke R square
Daily cigarette consumption (per day)	0.952	0.923-0.982	0.002*	0.301
SCSPS score	1.322	1.222-1.429	0.000*	

SCSPS: Smoking cessation success prediction scale

Discussion

This present study enabled us to find the cut-off score of a prediction scale and treatment type that can be used to predict the cessation success of a cigarette smoker at the beginning of cessation treatment. The findings obtained in this study showed that our patients who scored 44 and below continue to smoke, and individuals who scored ⩾45 points stopped smoking on a 3-month follow-up.

Reliability of SCSPS in the Study Sample

The Cronbach alpha coefficient of the SCSPS was found 0.782 in the original scale study sample (Aydemir et al., 2019), and we found a similar result (Cronbach alpha coefficient=0.723) in our study, which meant that SCSPS has high reliability for being able to predict which individuals have a high potential for smoking cessation.

Prediction Scales in the Smoking Cessation Process

There are many scale development studies about the factors of the smoking cessation process in the literature. A smoking cessation fatigue scale was designed in 2017 (Mathew, Heckman, Meier, & Carpenter, 2017) and validated to the Turkish language in 2019 (Öztürk, Kıraç, Kıraç, Mermerkaya, & Research, 2018), which was used to investigate the relationship between cessation fatigue and risk of relapse (Heckman et al., 2018). In addition to the study in which the high fatigue score was associated with a higher risk of relapse (Heckman et al., 2018), another study investigated but did not find a fatigue cut-off value that would predict the success of smoking (Başpınar & Basat, 2019). Another scale was developed in 2005, the heavy smoking index (HSI), which combined 2 items of the FTND (the number of cigarettes per day and the time of the first cigarette of the day) was compared with the FTND. A cut-off score ⩾4 on the HSI detected a similar rate of nicotine dependence as a cut-off score ⩾6 on the FTND (Chabrol, Niezborala, Chastan, & de Leon, 2005). In our study, no statistical relationship was found between the FTND score and the SCSPS score. This situation was first interpreted as the evaluation of the FTND score as an expected result, which defined dependence but did not have a determining effect on cessation success.

Treatment Types and Cessation Success

In the study consisting of 320 people, the smoking cessation rate with NRT was found to be 43.7% and 66.7% for varenicline users (Yaşar, Kurt, Talay, & Kargı, 2014). In another study conducted with 757 individuals, the findings showed that the success of smoking cessation was 43.2% with NRT and 55.9% with varenicline (Aubin et al., 2008). In our study, the rate of smoking cessation of varenicline users was 52.7%, whereas it was 41.3% for individuals using NRT. Transdermal nicotine is widely used for smoking cessation. However, only approximately 20% of the smokers quit successfully with this medication. Interindividual variability in nicotine metabolism rate may influence treatment response (Schnoll et al., 2009). Comparing varenicline and NRT, craving, withdrawal symptoms, and smoking satisfaction were less at the end of the treatment with varenicline than with NRT (Aubin et al., 2008). In our study, the SCSPS score average was higher in the varenicline user group compared with NRT, and accordingly the rate of treatment success would increase as the scale score increased; the varenicline seemed to be preferable in individuals with a low SCSPS score.

In 2000, approximately a third (33.3%) and in 2015, a quarter (24.9%) of the global population aged 15 years and older were users of some form of tobacco. The rate is projected to decline further to around a fifth (20.9%) of the global population by 2025 (Organization, 2019). However, according to a 2012 economic analysis of a university report conducted in our country, it was observed that the demand for cigarettes was not affected by the relative price increases and anti-smoking campaigns and prohibitions (Gürsel, Uysal, Aktar, & Güner, 2012). A novel study suggests that controlling the cigarette prices and educating people about the hazardous effects of smoking are significant policies for reducing cigarette consumption (Yıldız, 2020). Thus, smoking cessation treatments seem to be the solution to prevent smoking, and cost-effective cessation strategies need prediction scales to choose the best personal treatment.

Limitations and Suggestions for Future Research

NRTs have been changing according to free stocks at public health centers; therefore, a clear or stepwise therapy was not possible depending on the stock status. This was a limitation in terms of using free treatment and continuing the cessation process. Our study was a short-term preliminary study on the early prediction of smoking cessation treatment success and the decision on treatment types. Thus, the 3-month follow-up time was the most important limitation of this study because it was too short a period to generalize the results obtained in this study. However, we did include a large number of participants (n=319) in our study according to the minimal number (n=234) of calculated power analysis. Longer term (6-month, 1-year, and 2-year

follow-ups) and multicenter studies in the further research for SCSPS and other prediction scales will have benefits to smoking cessation treatments.

Ethics Committee Approval: Ethics committee approval was received for this study from the Clinical Research Ethics Committee of Taksim Training and Research Hospital on 22/08/2019; file no: 165-6.

Informed Consent: Verbal informed consent was obtained from all patients who participated in this study.

Peer-review: Externally peer-reviewed.

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Conflict of Interest: The authors have no conflicts of interest to declare.

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