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Exploring the Severity of Dependence Scale (SDS) as a Possible Measure of Nicotine Dependence

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Abstract

Background—The time to first cigarette (TTFC) of the day is an emerging single-item indicator of nicotine dependence due to its robust associations with indices of physical dependence. However, it is unclear if this measure adequately captures other dimensions of dependence. The Severity of Dependence Scale (SDS) is a brief questionnaire used to assess psychological aspects of dependence that has not yet been extensively applied to smoking research.

Methods—We examined associations between the SDS and TTFC among 255 smokers during the baseline session of a cessation trial. We also examined associations of the SDS and TTFC with biobehavioral dependence indices, quitting behaviors, and cognitive-affective variables, and compared the relative contributions of both measures in predicting these variables.

Results—TTFC was unrelated to SDS total score, but was related to individual SDS items. TTFC, but not SDS, was correlated with indices of physical dependence (e.g., CPD, CO). Both TTFC and SDS were associated with quitting behaviors, with opposite directionality of associations. TTFC and SDS were both associated with cognitive-affective variables, but SDS outperformed TTFC in strength and number of these relationships. Including both the SDS and TTFC as regression model predictors often increased the amount of variance explained.

Conclusions—Findings suggest that SDS and TTFC assess different constructs of nicotine dependence; among smokers, the SDS appears to tap into non-physical components of dependence (e.g., loss of control) that relate to quitting motivation and affect. Assessing nicotine dependence using only the SDS may fail to capture physical dependence and, further, may not reflect the same domains of addiction the SDS assesses in other drugs of abuse. Nonetheless, using three SDS items in addition to TTFC may offer utility over using TTFC alone.

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Author contributions: DC was the principal investigator on the parent intervention study; he designed and conducted the study, including the collection and management of data. In consultation with JMS and DC, MM conceived the present study, undertook the statistical analyses, interpreted results, and prepared the first draft of the manuscript. JMS, SAB, and DC contributed to data interpretation and the development of subsequent manuscript drafts. All authors reviewed and approved the final manuscript for submission.

Keywords

nicotine dependence; time to first cigarette; TTFC; Severity of Dependence Scale; SDS

Introduction

Although US cigarette smoking rates have declined overall since 1965,¹ smoking remains the leading cause of preventable death.² Most smokers express interest in quitting smoking, yet dependence on nicotine – the primary addictive component in cigarettes³ – prevents many from initiating and maintaining abstinence. Proper classification of nicotine dependence prior to initiation of a quit attempt may help clinicians to identify, and potentially assign additional resources to, individuals at the greatest risk of cessation failure/relapse. Many questionnaires have been developed for the purpose of accurately diagnosing nicotine dependent individuals, yet there is little agreement among researchers about which measure provides the most clinical utility.

Nicotine dependence is commonly assessed in research and clinical settings using the Fagerström Test for Nicotine Dependence,^{4,5} recently renamed the Fagerström Test for Cigarette Dependence (FTCD⁶). Recent work⁷ suggests the FTCD's utility is largely attributed to just one of its six items, which asks "How soon after you wake up do you smoke your first cigarette of the day?" The time to first cigarette [TTFC] item has been associated with several behavioral measures of addiction (e.g., cigarettes/day [CPD], cessation outcomes) and biological markers of nicotine exposure (e.g., carbon monoxide [CO], cotinine) among daily and nondaily adult and adolescent smokers.^{7–11} Accordingly, TTFC has been suggested as the optimal single-item measure of nicotine dependence.¹² TTFC's clinical utility as a dependence measure has been further demonstrated by studies which have assigned greater dosages of nicotine replacement therapy to smokers with an earlier TTFC to promote cessation success.^{13,14}

TTFC is, however, not without limitations. For example, the majority of smokers report a TTFC within the first half hour of waking, thus reducing variability.¹⁵ Additionally, nicotine dependence is likely a multidimensional construct,¹⁶ and it is unclear if the single-item TTFC captures dimensions of tobacco use disorders beyond physical dependence (i.e., the manifestation of withdrawal symptoms after ceasing cigarette use). Instruments created to capture other dependence domains (e.g., the Wisconsin Inventory of Smoking Dependence Motives [WISDM¹⁶], Nicotine Dependence Syndrome Scale [NDSS¹⁷]) are lengthy (e.g., WISDM is 68 items), making their use in many clinical and research settings less attractive than using TTFC. Thus, there is need for a brief, multidimensional dependence measure.

The Severity of Dependence Scale (SDS) is a short, 5-item questionnaire designed to assess psychological components of dependence (e.g., compulsive behaviors) among users of various types of illicit drugs.¹⁸ The SDS has demonstrated good psychometric properties among heroin, cocaine, and amphetamine users¹⁹; given that these illicit drugs and nicotine share many characteristics (e.g., all stimulate the ventral tegmental mesolimbic dopamine pathway in the brain²⁰, all have well-defined withdrawal syndromes), the SDS may also have applicability to smokers. Only one study to date has validated use of the SDS with

smokers,²¹ finding both an Italian version of the SDS and FTND total scores significantly predicted continued smoking one year after a cessation program. Given the SDS's brevity (i.e., 5-item), ability to predict cessation outcome, and potential to capture non-physical aspects of nicotine dependence, it may have utility as a supplemental measure to TTFC.

This study explores if the SDS offers utility alone, or in addition to TTFC, as a nicotine dependence measure among a population of non-treatment seeking, daily smokers at the onset of a cessation program. We first examine the relation of SDS total score and individual items to TTFC. Second, we examine the association of biological and behavioral dependence indices to TTFC and SDS. Third, we examine associations of TTFC and SDS with quitting behaviors and cognitive-affective variables.

Methods

Design

This study utilized baseline data from a cessation trial²² of 255 non-treatment seeking smokers. Participants completed a prescreening telephone interview to determine study eligibility. Eligibility criteria included being 18 years old, English speaking, smoking 1 CPD, having reliable contact information, not currently or planning to become pregnant within 6 months, not currently using a cessation medication, not planning to move within 6 months, having no intention to quit smoking in the next week, and scoring ≤ 6 on a 0–10 point scale of motivation to quit. After eligibility criteria were confirmed during the baseline session, participants provided informed consent. The consent document was explained by a research assistant and participants were provided with a copy. Following the consent process, participants were randomized to a treatment condition, and completed baseline questionnaire assessments. All study procedures were reviewed and approved by the Institutional Review Board of the University of Missouri - Kansas City (#0978).

Measures

Nicotine dependence measures included TTFC and SDS. TTFC was assessed using: 0 = "After 60 minutes", 1 = "31–60 minutes", 2 = "6–30 minutes", 3 = "Within 5 minutes." SDS total score comprised the sum of 5 items which asked participants to consider their smoking over the past year: 1) "Did you ever think your smoking was out of control?" 2) "Did the prospect of missing a cigarette make you very anxious or worried?" 3) "Did you worry about your use of cigarettes?" 4) "Did you wish you could stop smoking?" 5) "How difficult did you find it to stop smoking, or go without a cigarette?" Items were scored: 0 = "Never/almost never" to 3 = "Always/nearly always" for items 1–4, and 0 = "Not difficult" to 3 = "Impossible" for item 5.

Exhaled CO readings were used as a biological index of dependence (Bedfont Scientific piCO + Smokerlyzer®). CO collection was implemented after some participants had completed the baseline session, thus only 206 of 255 participants provided CO samples. Behavioral dependence indices included self-reported measures of past 7-day CPD and years smoking.

Quitting behaviors included number of previous quit attempts (defined as not smoking 24 hours; lifetime and prior 3 months), and current plans, motivation, and confidence to quit smoking. Current plans to quit were measured using a contemplation ladder²³ on a 0–10 scale (0 = no recognition of smoking being problematic and no intention to cut down/quit, 10 = decision). Motivation and confidence to quit were assessed using the Autonomous Regulation, Amotivation, External Regulation, and Introjection subscales from the Treatment Self-Regulation Questionnaire (TSRQ²⁴) and the general questions: “How motivated are you to quit smoking?” and “How confident are you that you could quit smoking if you wanted to?” from 0 (not at all) to 10 (extremely).

Cognitive-affective variables included depressive symptoms (20-item Center for Epidemiologic Study Depression scale [CESD²⁵]), perceived stress (4-item Perceived Stress Scale total score [PSS^{26,27}]), risk perception (the sum of three items [0 = “Not at all”, 7 = “Very much”]: “To what extent do you feel your smoking is currently affecting your health?”, “To what extent do you feel that stopping smoking right now is important to your health?”, “How much would you benefit from health or other gains from quitting smoking in the next 6 months?”), decisional balance (Pros and Cons subscales and final score from the 20-item Decisional Balance Scale²⁸), and self-efficacy (using the total score and Negative Affect, Positive Social, and Habit Strength subscales from the 10-item Situational Temptations Inventory for Smoking Acquisition^{29–31}).

Analytic Plan

The majority of the sample reported smoking their first cigarette within a half hour of waking (TTFC 5 min = 50.2%; 6–30 min = 40.0%; 31–60 min = 3.9%, >1 hr = 5.9%). Given the small numbers of participants in the latter two categories, these were combined to yield a 3-category variable (TTFC 5 min = 50.2%; 6–30 min = 40.0%; 31 min = 9.8%). Correlation analyses examined bivariate relations. Linear regression analyses evaluated the unique contributions of TTFC and SDS in predicting biological and behavioral dependence indices, quitting behaviors, and cognitive-affective measures. For each variable, TTFC was entered as a predictor in the first step, followed by SDS total score in the second step. An exploratory factor analysis and reliability statistics were used to examine internal consistency of the SDS. Principal components analysis was used as the method of extraction, utilizing a varimax rotation. The number of retained factors was determined based on Eigenvalues >1, and through visual examination of a scree plot. Items with loadings of 0.70 were retained. Correlation analyses were then repeated to explore factor associations with baseline variables.

Results

Sample characteristics

Participants were 255 daily smokers (56.9% male) aged 18–70 ($M = 45.8$, $SD = 10.8$), with 65.1% identifying their race/ethnicity as Black/African American, 29.8% as White, and 5.1% as multiracial or other. The majority were single (58.0%), unemployed (78.0%), childless (76.1%), and completed a high school degree/GED (65.5%). Participants reported smoking 2–55 CPD ($M = 16.8$, $SD = 9.5$) over the past 7 days, and smoking for 2–58 years

($M = 29.5$, $SD = 11.8$). Of the 206 participants who provided CO samples, readings ranged from 7–64 ppm ($M = 18.6$, $SD = 9.1$). SDS scores ranged from 0–15 ($M = 6.5$, $SD = 3.2$).

Relationships of SDS, TTFC, and baseline variables

TTFC and SDS total score were not correlated ($r = .09$, $p = .16$), but TTFC was positively related to SDS items 2 ($r = .32$, $p = .000$) and 5 ($r = .27$, $p = .000$). As expected, TTFC was positively correlated with CO ($r = .25$, $p = .000$) and past 7-day CPD ($r = .29$, $p = .000$), but was unrelated to years smoking. SDS total score was not related to any dependence indices. TTFC was negatively correlated with lifetime quit attempts, general quitting confidence, general quitting motivation, plans to quit, and Autonomous Regulation TSRQ subscale (Table 1). SDS total score was negatively correlated with general quitting confidence, but positively correlated with lifetime quit attempts, general quitting motivation, plans to quit, and Autonomous Regulation, External Regulation, and Introjection TSRQ subscales.

Both TTFC and SDS total score were positively correlated with the decisional balance Pros subscale and negatively correlated with self-efficacy scores (Table 2). TTFC was negatively correlated with risk perception and positively correlated with decisional balance final score; SDS total score demonstrated opposite associations. SDS total score was positively correlated with perceived stress, the decisional balance Cons subscale, and depressive symptoms.

Independent associations of SDS and TTFC with baseline variables

For regression analyses predicting biobehavioral indices of dependence, both model step 1 (TTFC) and 2 (SDS total score) significantly predicted CO and past 7-day CPD (R^2 s = .06–.08, F s = 7.32–23.55, p 's = .000–.001); the addition of SDS in the second step did not significantly change R^2 values (see Table 3). Models predicting years smoking were not significant.

For quitting behaviors, both model steps significantly predicted lifetime quit attempts, general quitting motivation, general quitting confidence, plans to quit, and the TSRQ Autonomous regulation subscale (R^2 s = .02–.17, F s = 4.14–25.88, p 's = .000–.040). Adding SDS in the second model step significantly increased R^2 values (R^2 s = .03–.14). TTFC was not predictive of Introjection and External Regulation TSRQ subscales, but models became significant when SDS was added (R^2 s = .04–.15, F s = 4.68–22.42, p 's = .000–.01). Models were not significant for previous 3-month quit attempts or Amotivation TSRQ subscale.

For cognitive-affective variables, both model steps significantly predicted decisional balance final score and Pros subscale, risk perception, and self-efficacy scores (R^2 s = .03–.27, F s = 7.59–47.26, p 's = .000–.006). Adding SDS significantly increased variance explained (R^2 s = .04–.21). TTFC alone was not predictive of depressive symptoms, perceived stress, and the decisional balance Cons subscale, but models became significant when SDS was added (R^2 s = .04–.23, F s = 5.46–36.75, p 's = .000–.005).

Exploratory factor analysis of the SDS

To explore the divergent results between the SDS and TTFC, and to extend the preliminary observation that only two items from the SDS correlated with TTFC, an exploratory factor analysis of the SDS was conducted. This analysis revealed a two-factor solution (Table 4). Factor 1 contained items 1 ("Did you ever think your cigarette smoking was out of control?"), 3 ("Did you worry about your use of cigarettes?") and 4 ("Did you wish you could stop smoking?"), and appeared to reflect loss of control over one's smoking. Factor 2 contained items 2 ("Did the prospect of missing a cigarette make you very anxious or worried?") and 5 ("How difficult did you find it to stop smoking, or go without a cigarette?"), reflecting negative affect or withdrawal resultant from inability to smoke. Factor 1 accounted for 44.91% of the variance and produced a Cronbach's $\alpha = .80$, whereas Factor 2 explained 27.42% of the variance and produced a Cronbach's $\alpha = .66$.

Exploratory associations between SDS factor subscales, TTFC, and baseline variables

To further explore the divergence between SDS total score and TTFC, correlation analyses of SDS factor subscales and baseline variables were conducted. TTFC was unrelated to SDS factor 1 ($r = -.12, p = .06$) but positively associated with SDS factor 2 ($r = .35, p = .000$). Factor 2 demonstrated positive associations with CPD ($r = .25, p = .000$) and CO ($r = .19, p = .007$) and showed similar associations with baseline variables as TTFC (see Tables 1 and 2) with some exceptions: unlike TTFC, factor 2 was not related to lifetime quit attempts and risk perception, but was correlated with depressive symptoms and perceived stress (which TTFC was not). Factor 1 was either unrelated to variables TTFC predicted (e.g., 3-month quit attempts, decisional balance: Cons subscale), or demonstrated opposite directions of associations. For example, greater factor 1 scores were associated greater risk perception, quitting motivation, and readiness/plans to quit whereas earlier TTFC and greater factor 2 scores were associated with less risk perception, quitting motivation, and readiness/plans to quit.

Discussion

Contrary to our initial expectations, SDS total scores were not associated with TTFC or other biobehavioral indices of nicotine dependence, and did not account for additional variance when added to TTFC to predict these outcomes. SDS was associated with several quitting behaviors generally in directions opposite to those between TTFC and these outcomes, and accounted for additional variance in many of these outcomes when added to models containing TTFC. Moreover, SDS significantly predicted several quitting behaviors that TTFC did not. Finally, we found that SDS and TTFC measures were similarly associated with several cognitive-affective variables (e.g., self-efficacy total score and subscales), yet differed in directionality of associations with others (e.g., risk perception). SDS, but not TTFC, was associated with depressive symptoms and perceived stress. Taken together, these findings suggest that SDS total scores are largely unrelated to indices of physical nicotine dependence, and instead may be related to motivational and affective aspects of smoking (e.g., stress, depression). These findings are important for researchers

and clinicians seeking to use the SDS to measure nicotine dependence, as these physical indices are strong indicators of dependence, and are additionally predictive of clinical outcomes. Thus, the ability of the SDS to assess dependence among users of other drugs of abuse does not appear to cleanly generalize to assessing dependence among smokers.

Examination of the exploratory factor analysis of the SDS helps to clarify why the SDS and TTFC measures diverge. In contrast to studies using the SDS to assess dependence in opiate, amphetamine, heroin, and cannabis users – yet consistent with the only study to use the SDS among a population of smokers²¹ – results of an exploratory factor analysis revealed a two-factor solution. Items that correlate with TTFC constitute the second factor (that explains less of the variance in the SDS), and appear to primarily reflect negative affect or withdrawal symptoms resulting from inability to smoke (i.e., physical dependence). Thus, the SDS in its entirety taps both physical and psychological aspects of nicotine dependence. However, it appears to predominantly reflect psychological aspects related to loss of control over smoking, given that three items comprising this construct explain the majority of the variability within this measure. These findings reiterate that the use of SDS total score for defining nicotine dependence among smokers may not generalize from its use to assess dependence among users of other drugs of abuse.

These conclusions are further supported by the results of exploratory correlation analyses of the SDS subscales, which found that the subscale related to negative affect resulting from inability to smoke shared considerable overlap with – and therefore offered little information beyond that already assessed by – TTFC. Higher scores on this factor (i.e., greater physical dependence) were associated with earlier TTFC, lower self-efficacy, lower quitting confidence, lower quitting motivation, less readiness/plans to quit smoking, and lower autonomous regulation, but greater depressive symptoms and stress. Of particular note, this factor was positively associated with the decisional balance Pros subscale and final score, indicating higher ratings of positive aspects of smoking, and positive aspects outweighing negative aspects of smoking. These results suggest that endorsing higher responses on this SDS subscale may primarily be indicative of greater physical dependence on nicotine, an inability to recognize experiencing negative consequences of smoking, and less motivation to attempt to quit smoking.

In contrast, associations of quitting behaviors and cognitive-affective variables with the subscale related to loss of control were either unique or occurred in directions opposite to those of TTFC. Higher scores on this factor (i.e., greater recognition of loss of control over smoking) were associated with making a greater number of lifetime and previous 3 month quit attempts, greater quitting motivation, greater readiness/plans to quit, greater depressive symptoms, risk perception, stress, and greater recognition of consequences of smoking/ consequences outweighing positive aspects of smoking. Thus, smokers reporting higher scores on this subscale are more motivated to quit smoking, and have previously made more quit attempts, because they recognize their smoking as problematic. Although this subscale may not assess dependence domains per se, these domains are nonetheless implicated in cessation failure and relapse and thus may be useful for assessing prior to making a cessation attempt.

Clinical Implications

The current findings offer utility to clinicians in demonstrating that the SDS, in its typically administered 5-question format, is not appropriate for diagnosing nicotine dependence among smokers. Overall, the SDS does not appear to assess physical dependence on nicotine, a central component of nicotine addiction. This may be due to the SDS assessing two constructs (both physical and psychological dependence) among smokers, in contrast to measuring only psychological dependence among users of other drugs. It is possible that the three-item factor subscale assessing psychological dependence among smokers may be of utility to the cessation workforce if this factor is predictive of clinical outcomes such as cessation and relapse; however, this needs to be further explored. The two-item factor subscale assessing physical dependence appeared to offer little advantage over using TTFC.

Limitations

This study must be interpreted with a few caveats. First, TTFC - as opposed to the entire FTCD - was used as a comparison criterion measure to establish concurrent validity of the SDS. Conceptually, we believe TTFC to be the "gold standard" in assessing nicotine dependence given its robust associations with clinical outcomes^{7,9,10} and tobacco exposure biomarkers;^{8,11} however, psychometrically, analyses may be limited in comparing a 5-item sum to a single-item. Additionally, analyses examining associations of the SDS with other baseline variables are cross-sectional and do not allow for strong causal or temporal interpretation. Future prospective studies which examine the SDS's ability to predict outcomes such as abstinence and relapse following a cessation attempt are needed to establish the SDS's clinical utility.

Conclusions

In summary, our study results suggest that the SDS may assess different components/constructs of dependence among smokers compared to users of other drugs of abuse. The SDS appears to be comprised of two factors, one sharing overlap with TTFC and assessing physical dependence, the other identifying loss of control over smoking. As such, that the SDS in its entirety may be inappropriate for assessing nicotine dependence among cigarette smokers.

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Table 1
Associations of TTFC, SDS, and SDS Factor Subscales with Quitting Behaviors

Measures	1	2	3	4	5	6	7	8	9	10	11	12	13
1. TTFC	–												
2. SDS total score	.09	–											
3. SDS factor 1	–.12	.86***	–										
4. SDS factor 2	.35***	.64***	.15*	–									
5. 3-month quit attempts	–.00	.05	.14*	–.11	–								
6. Lifetime quit attempts	–.17**	.15*	.24***	–.08	.20**	–							
7. Gen. quitting confidence	–.13*	–.16*	.01	–.32***	.13*	.07	–						
8. Gen. quitting motivation	–.17**	.26***	.45***	–.17**	.25***	.25***	.23***	–					
9. Contemplation ladder	–.24***	.28***	.51***	–.23***	.23***	.28***	.21**	.72***	–				
10. TSRQ: Amotivation	.07	–.02	–.07	.06	.01	–.07	–.09	–.07	–.04	–			
11. TSRQ: Auto. Reg.	–.18**	.35***	.55***	–.15*	.09	.19**	.24***	.52***	.54***	–.03	–		
12. TSRQ: Exter. Reg.	–.06	.38***	.47***	.03	.09	.10	.07	.34***	.41***	.14*	.50***	–	
13. TSRQ: Introjection	–.06	.37***	.44***	.06	.22***	.21**	–.01	.38***	.36***	.02	.44***	.59***	–

Note:

* $p < .05$,

** $p < .01$,

*** $p < .001$

Table 2
Associations of TTFC, SDS, and SDS Factor Subscales with Cognitive-affective Variables

Measures	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. TTFC	–													
2. SDS total score	.09	–												
3. SDS factor 1	-.12	.86***	–											
4. SDS factor 2	.35***	.64***	.15*	–										
5. CESD total score	.06	.26***	.16*	.27***	–									
6. PSS 4 item	.07	.20**	.15*	.16*	.64***	–								
7. Dec. balance: Pros	.35***	.29***	.01	.56***	.16*	.09	–							
8. Dec. balance: Cons	-.02	.47***	.56***	.06	-.00	.05	.24***	–						
9. Dec. balance final score	.29***	-.16*	-.46***	.40***	.13*	.03	.59***	-.64***	–					
10. Risk perception	-.25***	.44***	.60***	-.06	.12	.11	-.16**	.47***	-.53***	–				
11. Self-efficacy: Negative Affect	-.17**	-.26***	-.08	-.39***	-.19**	-.19**	-.43***	-.02	-.32***	-.03	–			
12. Self-efficacy: Positive Social	-.19**	-.24***	-.08	-.36***	-.14*	-.11	-.28***	.06	-.27***	.04	.59***	–		
13. Self-efficacy: Habit Strength	-.44***	-.26***	-.06	-.41***	-.19***	-.12	-.44***	.03	-.38***	.13*	.64***	.66***	–	
14. Self-efficacy total score	-.31***	-.27***	-.07	-.18**	-.18**	-.14*	-.43***	.04	-.37***	.07	.83***	.88***	.86***	–

Note:

* $p < .05$,

**

$p < .01$,

*** $p < .001$

Table 3

Variance in Baseline Variables Explained by TTFC Alone and TTFC and SDS Together^a ($n = 255$)

Outcomes	Model 1: TTF C only				Model 2: TTFC + SDS				Model Stats	
			TTFC		SDS				R ²	F
	Unst B (SE)	t	B (SE)	t	B (SE)	t				
Biobehavioral dependence indices										
7-day CPD	4.19 (0.86)	4.85***	4.11 (0.87)	4.74***	0.19 (0.18)	1.07	0.00	1.13		
CO	3.38 (0.90)	3.75***	3.32 (0.15)	3.68***	0.15 (0.19)	0.77	0.00	0.59		
Years smoking	-0.24 (1.12)	-0.22	-0.11 (1.12)	-0.10	-0.32 (0.24)	-1.36	0.00	1.86		
Quitting behaviors										
Lifetime quit attempts	-1.34 (0.48)	-2.78**	-1.45 (0.48)	-3.03**	0.27 (0.10)	2.64**	0.03	6.97**		
Previous 3-month quit attempts	-0.00 (0.08)	-0.03	-0.01 (0.08)	-0.10	0.01 (0.02)	0.83	0.00	0.41		
General quitting confidence	-0.65 (0.32)	-2.03*	-0.58 (0.32)	-1.84	-0.15 (0.07)	-2.34*	0.02	5.47*		
General quitting motivation	-0.58 (0.21)	-2.77**	-0.66 (0.20)	-3.27**	0.20 (0.04)	4.62***	0.08	21.37***		
Plans to quit (Contemplation ladder)	-0.79 (0.20)	-3.90***	-0.87 (0.19)	-4.52***	0.21 (0.04)	5.13***	0.09	26.28***		
TSRQ: Autonomous Regulation	-2.85 (0.93)	-3.05***	-3.34 (0.87)	-3.83***	1.17 (0.18)	6.40***	0.14	40.98***		
TSRQ: External Regulation	-0.44 (0.50)	-0.87	-0.71 (0.47)	-1.52	0.65 (0.10)	6.63***	0.15	43.95***		
TSRQ: Amotivation	0.40 (0.36)	1.10	0.42 (0.37)	1.14	-0.04 (0.08)	-0.45	0.00	0.21		
TSRQ: Introjection	-0.24 (0.27)	-0.90	-0.38 (0.25)	-1.53	0.34 (0.05)	6.46***	0.14	41.76***		
Cognitive-affective variables										
Depressive symptoms	0.94 (0.98)	0.96	0.59 (0.95)	0.62	0.85 (0.20)	4.24***	0.07	17.94***		
Perceived stress	0.29 (0.28)	1.05	0.22 (0.27)	0.80	0.18 (0.06)	3.13**	0.04	9.77**		
Decisional balance: Pros	4.74 (0.79)	5.99***	4.43 (0.77)	5.79***	0.74 (0.16)	4.64***	0.07	21.48***		
Decisional balance: Cons	-0.24 (0.89)	-0.27	-0.83 (0.79)	-1.05	1.41 (0.16)	8.57***	0.23	73.41***		
Decisional balance final score	4.98 (1.02)	4.88***	5.26 (1.01)	5.23***	-0.67 (0.21)	-3.16**	0.04	10.02**		
Risk perception	-2.12 (0.52)	-4.10***	-2.46 (0.46)	-5.37***	0.82 (0.10)	8.54***	0.21	72.95***		
Self-efficacy: Positive Social	-0.85 (0.27)	-3.09**	-0.76 (0.27)	-2.83**	-0.21 (0.06)	-3.78***	0.05	14.32***		
Self-efficacy: Negative Affect	-0.69 (0.25)	-2.76**	-0.60 (0.24)	-2.47*	-0.21 (0.05)	-4.07***	0.06	16.55***		

Outcomes	Model 1: TTF C only					Model 2: TTFC + SDS					Model	Stats
	Unst <i>B</i> (<i>SE</i>)	<i>t</i>	TTFC		<i>t</i>	SDS		<i>t</i>	<i>R</i> ²	<i>F</i>		
			<i>B</i> (<i>SE</i>)	<i>t</i>		<i>B</i> (<i>SE</i>)	<i>t</i>					
Self-efficacy: Habit Strength	−1.83 (0.24)	−7.69***	−1.75 (0.23)	−7.53***	−0.20 (0.05)	−4.06***	0.05	16.46***				
Self-efficacy total score	−3.74 (0.72)	−5.21***	−3.48 (0.70)	−4.99***	−0.62 (0.15)	−4.26***	0.06	18.15***				

Note:

* $p < .05$,

** $p < .01$,

*** $p < .001$;

^a all outcome variables tested as independent models;

^b $n = 255$ for all outcomes except CO ($n = 206$)

Table 4

Factor Loadings Resulting from Exploratory Factor Analysis of SDS

SDS Items	Factor 1 Loading	Factor 2 Loading
Item 1: Did you ever think your smoking was out of control?	0.83	0.24
Item 2: Did the prospect of missing a cigarette make you very anxious or worried?	−0.05	0.84
Item 3: Did you worry about your use of cigarettes?	0.88	0.10
Item 4: Did you wish you could stop smoking?	0.82	−0.13
Item 5: How difficult did you find it to stop smoking, or go without a cigarette?	0.16	0.82
Variance explained	44.91%	27.42%