Measuring cigarette dependence: A comparison of two scales in two different groups of smokers

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ABSTRACT

INTRODUCTION The Fagerström Test for Cigarette Dependence (FTCD) and the Cigarette Dependence Scale (CDS) are usually used to assess cigarette dependence in clinical- and population-based studies. Our objective was to compare these two scales within groups of smokers from both contexts.

METHODS The study was observational with smokers from a representative sample of the adult general population (n=188) and smokers attending a smoking cessation clinic in Barcelona, Spain (n=759). The FTCD and the CDS-5 (short version of 5 items) were used to assess cigarette dependence. We compared the standardized median scores obtained with both scales within each group of smokers by selected variables. To this aim, we re-scaled the scores of both scales to allow their comparison and assess their correlation within both groups.

RESULTS The scores obtained with both scales were highly correlated within both groups of smokers (p<0.001), indicating good agreement in the assessment of cigarette dependence. Nevertheless, higher standardized CDS-5 scores were observed more frequently in the population group overall (3.9 vs FTCD score=3.7, p=0.001), among women (4.5 vs 4.2; p<0.001), in the youngest group of smokers (3.9 vs 3.2; p<0.007) and in light smokers (time to the first cigarette >60 min; 1.7 vs 1.1; p<0.001).

CONCLUSIONS While the CDS-5 scored higher more frequently in the population group, the FTCD scored higher more frequently in the clinical group. These differences should be considered when designing either clinical- or population-based studies.

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INTRODUCTION

The assessment of cigarette dependence is crucial to designing smoking cessation interventions. In fact, smokers with high dependence may need more intensive interventions to reduce the associated withdrawal symptoms[1,2]. For this reason, instruments assessing cigarette dependence have to be valid and reliable. Many instruments have been developed in this regard; some of them focus on the physical dimensions of dependence, while others also include its psychological and behavioral dimensions. Among the instruments to assess cigarette dependence, the Fagerström Test for Cigarette Dependence (FTCD)[3,4] and the Cigarette Dependence Scale (CDS)[5] are very popular in the clinical context. Moreover, the monitoring of smokers' characteristics in population studies both at individual and ecological

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levels has incorporated these dependence scales. Several studies have assessed their psychometric properties[4,6,7], mostly among smokers seeking support to quit smoking in clinical settings. However, there is a paucity of research assessing cigarette dependence in smokers from the general population[8], which is crucial to identify key issues for tobacco control policies at the population level when epidemiological studies are carried out.

The FTCD, formerly known as the Fagerström Test for Nicotine Dependence[9], is a scale comprising 6 questions: time to the first cigarette smoked after waking up, difficulty to refrain from smoking in places where it is forbidden, the indication of the cigarette the smoker hates more to give up, the number of cigarettes smoked per day, the time of the day the smoker smokes more frequently, and smoking when ill. The CDS, developed by Etter et al.[5], covers the criteria of dependence stated in the Diagnostic and Statistical Manual of Mental Disorders in its fourth version (DSM-IV) and the International Classification of Diseases in its tenth version (ICD-10). The CDS scale is available in its full version of 12 questions (CDS-12) and as a short version of five questions (CDS-5). Both versions fulfil the criteria of content and construct validity[7]. The short version CDS-5 comprises a self-assessment of addiction to cigarettes, the number of cigarettes smoked per day, the time to the first cigarette smoked after waking up, how difficult the smoker thinks it would be to quit and the degree of urgency to smoke after a few hours without smoking.

The CDS-5 has been shown to have good psychometric properties; it contains a couple of questions already included in the FTCD, but it also includes a self-assessment component not included in the FTCD. Nevertheless, the latter is more used both in clinical settings and in population-based research. Comparing both FTCD and CDS-5 scales and their performance in smokers from the general population and in smokers attending a smoking cessation clinic may provide useful information for the design of smoking prevention programs and also for research purposes. Hence, the objective of this study is to compare these two scales within two groups of smokers: those seeking help to quit in a smoking cessation clinic, and those from the general population.

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cigarette dependence, nicotine dependence, general population, clinical setting, Fagerström test, Cigarette Dependence Scale

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METHODS

Study design

This is an observational study that uses data from two independent groups of smokers, namely, the population group and the clinical group.

Population group

The population group comprises all smokers from a representative sample of the adult general population drawn in the context of the DCOT-2 Study, conducted in 2011–2012 in Barcelona, Spain. A random sample was drawn from the official population census of Barcelona of 2010, representative of the population in terms of age, sex and district[10]. A letter was posted to eligible individuals explaining the study objectives and the participation requested. Individuals who agreed to participate were interviewed face-to-face in their homes by trained interviewers; 360 out of 1307 participants were current smokers. The questionnaire gathered information about their smoking behavior and included both the FTCD and the CDS-5[10]. Both scales were included at random order within the questionnaire to avoid any effect of the order in which they were administered.

Clinical group

The clinical group consists of all smokers who attended a smoking cessation clinic in a comprehensive cancer center located in L'Hospitalet de Llobregat, Barcelona, Spain, between 2010 and 2017 (n=579). At the first visit, smokers' cigarette dependence was assessed face-to-face with both the FTCD and the CDS-5 in the context of the usual clinical assessment, and they were presented at random order, among other assessment scales.

The DCOT-2 Study received ethical approval from the Research and Ethics Committee of the Bellvitge University Hospital (PR137/12). No permission was necessary for the administration of the scales in the clinical group, as the assessment of cigarette dependence is already part of the smoking cessation intervention. All the participants provided consent to participate. This investigation was carried out following the Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Inclusion and exclusion criteria

This study uses information from current smokers, defined as persons declaring themselves as daily smokers (at least one cigarette per day) or occasionally smokers (less than one cigarette per day). Their smoking status was verified biochemically with cotinine concentration in saliva in the population group (cut-off level >12 ng/mL)[11] and with exhaled carbon monoxide in the clinical group (cut-off level ≥12 ppm)[12]. We included smokers of manufactured cigarettes and excluded those who smoked only cigars, cigarillos, pipes or roll-your-own cigarettes (<1% in both groups). We included data of smokers with complete information about the number of cigarettes smoked and the time to the first cigarette. The final sample consisted of 767 smokers (188 from the population group and 579 from the clinical group).

Variables

The main outcome was cigarette dependence, assessed with the FTCD and CDS-5 scales, using the scores as continuous variables. The FTCD score ranges from 0 to 10 and the CDS-5 score ranges from 5 to 25. In both scales, higher scores indicate higher cigarette dependence.

Another main variable studied was the type of smoker (from the population group or the clinical group). Other variables studied were sex (men, women), age (<45, 45–64, >64 years), number of cigarettes smoked per day (0–10, 11–20 and >20 cigarettes) and time to the first cigarette smoked after waking (0–5, 6–30, 31–60 and >60 min).

Statistical analysis

We described both groups of smokers by sociodemographic (sex, age) and smoking characteristics (number of cigarettes smoked per day, time to the first cigarette smoked) with absolute and relative frequencies. These characteristics were compared using chi-squared tests. Due to the skewed distribution of the scores, we computed medians and interquartile ranges (IQR) obtained with both scales, overall and by the studied variables. Within each group of smokers, we compared the cigarette dependence score obtained with both scales according to the sociodemographic and smoking characteristics of interest with the Wilcoxon matched-pairs signed-rank test. To allow this comparison, we standardized the scores by subtracting from each value the group mean and dividing the result by the standard deviation. Assuming a variability of two standard deviations, we re-scaled the scores to have a common range between 0 and 10. Values outside this range were excluded from the analysis (n=37; 4.8%). We also checked trends in the scores obtained with each scale across variable groups. Finally, we plotted the standardized scores of both scales within each group of smokers and calculated their correlation using the Kendall rank correlation coefficient (τ). Statistical significance was set at $p<0.05$. All analyses were conducted with Stata version 14 (StataCorp, College Station, Texas).

RESULTS

Table 1 shows the sociodemographic and smoking characteristics of both groups of smokers. Both groups were distributed similarly by sex. On average, smokers from the clinical group were significantly older than smokers from the population group (mean age of 48.8 ± 11.3 and 42.1 ± 15.0 years, respectively, $p<0.001$) and smoked more cigarettes per day (37.1% and 12.2% smoked >20 cigarettes per day, respectively, $p<0.001$). About 78% of smokers from the clinical group smoked their first cigarette of the day ≤30 min after waking, while 52.7% of smokers from the population group did so ($p<0.001$, Table 1).

Table 2 compares the median standardized scores of both scales within each group of smokers. In the population group, the overall median score obtained with the CDS-5 was significantly higher than the median score obtained with the FTCD (3.9 and 3.7, respectively, $p<0.001$). When stratifying by sex, the CDS-5 score was significantly higher than the FTCD score among women, but no differences were found

Table 1. Sociodemographic and smoking characteristics of two groups of smokers (N=767)

	Population group		Clinical group		p*
	n	%	n	%	
Total	188	24.5	579	75.5	
Sex					0.275
Men	100	53.2	280	48.6	
Women	88	46.8	296	51.4	
Age (years)					<0.001
<45	112	59.6	199	34.6	
45–64	61	32.4	336	58.4	
>64	15	8.0	40	7.0	
Cigarettes smoked per day					<0.001
0–10	85	45.2	117	20.2	
11–20	80	42.6	247	42.7	
>20	23	12.2	215	37.1	
Time to first cigarette (min)					<0.001
0–5	34	18.1	182	31.4	
6–30	65	34.6	269	46.5	
31–60	26	13.8	75	13.0	
>60	63	33.5	53	9.1	

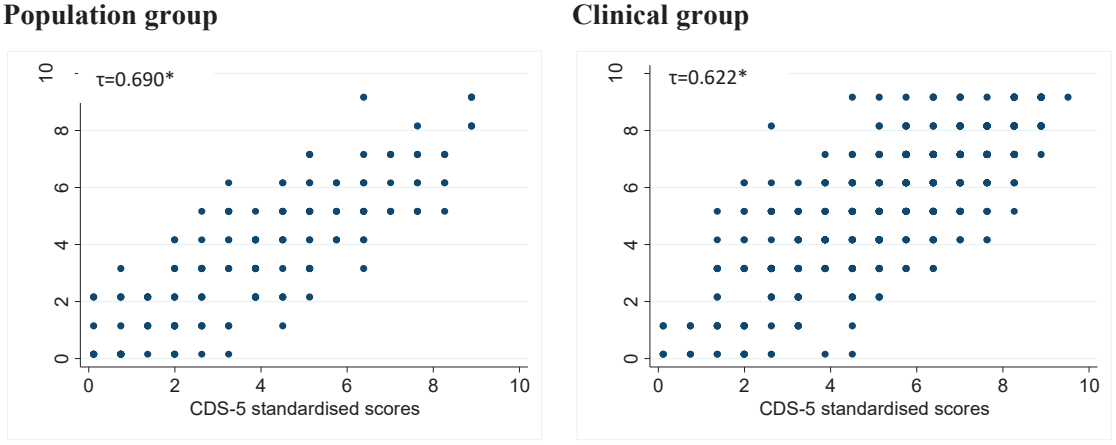
*Chi-squared test.

Table 2. Median standardized and interquartile range (IQR) scores of cigarette dependence assessed with the FTCD and CDS-5 scales in population and clinical groups of smokers

	Population group					Clinical group				
	FTCD scores (n=186)		CDS-5 scores (n=170)		p*	FTCD scores (n=570)		CDS-5 scores (n=571)		p*
	Median	IQR	Median	IQR		Median	IQR	Median	IQR	
Total	3.7	2.2–5.2	3.9	2.0–5.8	0.001	6.2	4.2–7.2	5.8	4.5–7.0	0.377
Sex										
Men	3.2	2.2–5.2	3.9	2.0–5.1	0.536	6.2	4.2–7.2	5.8	3.9–7.0	0.046
Women	4.2	1.2–5.2	4.5	2.0–6.4	<0.001	5.2	4.2–7.2	5.8	4.5–7.0	0.002
Age (years)										
<45	3.2	1.2–5.2	3.9	2.0–5.1	0.007	5.2	3.2–7.2	5.1	3.9–6.4	0.033
45–64	4.2	2.2–5.2	3.9	2.0–6.4	0.048	6.2	4.2–7.2	5.8	4.5–7.3	0.705
>64	4.2	3.2–5.2	3.9	2.6–5.8	0.972	6.2	4.7–7.2	5.8	3.9–7.0	0.008
p for trend	0.288		0.418			<0.001		0.011		
Cigarettes smoked per day										
0–10	2.2	0.1–3.2	2.0	0.7–3.2	0.046	3.2	1.2–4.2	3.2	2.0–4.5	0.088
11–20	5.2	3.2–5.2	4.5	3.2–5.8	0.034	5.2	4.2–6.2	5.8	4.5–6.4	0.561
>20	7.2	5.2–8.2	7.6	5.1–8.3	0.122	8.2	6.2–8.2	7.0	6.4–8.3	0.619
p for trend	<0.001		<0.001			<0.001		<0.001		
Time to first cigarette (min)										
0–5	6.2	5.2–7.2	7.0	5.4–7.6	0.421	7.2	7.2–8.2	7.0	6.4–8.3	0.001
6–30	4.2	3.2–5.2	4.8	3.2–5.8	0.399	5.2	4.2–6.2	5.8	4.5–6.4	0.107
31–60	3.2	2.2–4.2	3.9	2.6–4.5	0.638	3.2	3.2–5.2	3.9	2.6–5.1	0.757
>60	1.1	0.1–1.2	1.7	0.7–2.0	<0.001	1.2	0.1–1.2	2.0	1.4–3.2	<0.001
p for trend	<0.001		<0.001			<0.001		<0.001		

*Wilcoxon matched-pairs signed-rank test.

Figure 1. Distribution of the standardized scores of the FTCD and CSD-5 scales in population and clinical groups of smokers



*Significant at 0.001 level.

among men. No clear pattern in the scores emerged by age group. By smoking characteristics, the CDS-5 scores were significantly lower in those smoking up to 20 cigarettes per day but significantly higher in those who smoked their first cigarette >60 min after waking up. In the clinical group, there were no significant differences in the overall median scores (FTCD: 6.2; CDS-5: 5.8; p=0.377). The CDS-5 score was significantly higher than the FTCD score among women, but it was significantly lower among men; it was also lower in the younger and older age groups. By smoking characteristics, no differences were observed in the scores according to the number of cigarettes per day. No clear trends were observed according to the time to the first cigarette; while the CDS-5 scored higher among those smoking their first cigarette >60 min after waking up, the FTCD scored higher among those lasting up to 5 min to do so. Within each group of smokers, there were significant trends in the scores obtained with both scales across smoking characteristics' categories and age strata, but in this latter case only in the clinical group.

Finally, the standardized scores obtained with both scales were highly correlated in both groups of smokers (Figure 1).

DISCUSSION

To our knowledge, few studies have compared cigarette dependence measured with two of the most popular scales, the FTCD and the CDS-5, in two different groups of smokers: from the general population and a smoking cessation clinic. Previous studies have used the overall scores in specific populations of smokers, but they have not described them according to selected variables. Most of them have addressed the psychometric properties of these two scales in samples of smokers from the general population[13] or using the full version of the CDS[14], showing that their performance might be different according to the population studied.

In our study, we found that the scores obtained with both scales were highly correlated within both groups of smokers; that is in line with another study using a sample of pregnant smokers[15]. This also agrees with the positive trends we found in the scores according to smoking characteristics within each group of smokers. We also found a positive trend in the scores obtained with both scales according to age in the clinical group only. This is probably because smokers from the clinical group are older on average and may have a more established smoking behavior and are more prone to seek help to quit smoking because they probably failed to do it by themselves due to their high cigarette dependence.

Despite the high correlation between the scores obtained with both scales, we observed different patterns in the comparison of the scores within both groups of smokers. In the population group, the CDS-5 score was higher than the FTCD overall, among women, in the younger age group and

among those lasting more to smoke their first cigarette after waking up, that is, in smokers who are more likely to be more affected by psychosocial dimensions of dependence. In the clinical group, however, the FTCD score was higher than the CDS score among men, in some age groups (youngest and oldest groups), and among those smoking their first cigarette very soon after waking up, that is, in smokers who are more likely to be mainly affected by physical dimensions of dependence. These results suggest that the CDS-5 explores psychological or subjective dimensions of cigarette dependence more deeply than the FTCD, while the latter explores its physical dimensions more deeply. In fact, the CDS-5 includes two questions about the smokers' subjective perception of the dependence: a self-assessment of their dependence and of how difficult quitting smoking would be for them. This may determine why the CDS-5 identifies higher cigarette dependent smokers in the population context while the FTCD does the same in the clinical context, particularly among men. While there are some studies pointing to sex differences in nicotine addiction, there are still some discrepancies that need to be elucidated by future research[16]. Studies including sex as a factor will help clinicians and researchers to better understand addiction and develop more tailored strategies for smoking cessation.

Another point that deserves to be mentioned is the clinical implications of the results found. Our results show some significant differences in the scores obtained with both scales within both groups of smokers, even when some median values were not very different; this is because the statistical test detects differences in the whole distribution of scores and because the range of values is limited (rescaled scores from 0 to 10). The results show differences in the overall scores obtained with both scales in the population group only, where a higher score was obtained with the CDS-5. This pattern is consistent across all the variables where significant differences were found between the scales in this group of smokers, except according to cigarettes per day (up to 20 cigarettes), where higher scores were obtained with the FTCD. Surprisingly, this is the only variable in which no differences in the scores were found at all in the clinical group. This may probably indicate that the number of cigarettes per day is a good indicator of dependence in a group of smokers that do not have high dependence, as indicated by the overall scores obtained with both scales. In the clinical group of smokers, in contrast, more heterogeneity was observed in the comparison of the scores across the studied variables; in this group of smokers, it seems that the number of cigarettes per day is not as important as other variables when assessing cigarette dependence.

Although the psychometric properties of the CDS-5 seem to be higher than those of the FTCD[7], the latter continues to be the most used scale to assess cigarette dependence, probably because the CDS-5 is less consolidated among clinicians as it was developed later than the FTCD[17]. Our results show that, while these scales provide a similar assessment of cigarette dependence in the clinical context, this assessment differs in the general population; these findings should be taken into account when designing studies or comparing studies using different scales. Furthermore, these scales measure specifically dependence on cigarettes, but nowadays other forms of tobacco use are increasing, particularly among youth, such as roll-your-own tobacco and electronic cigarettes. Scales addressed to assess dependence on these types of products are still scarce[18–21]; thus, further studies are needed to adapt these scales to other forms of tobacco consumption, including poly-tobacco product use.

Strengths and limitations

This study has some limitations, such as having little sociodemographic information of participants, that prevent more detailed analyses. Nevertheless, we were able to compare the results by sex and age, which are key determinants of tobacco use, along with smoking characteristics, that has been scarcely described when comparing dependence scales. While the FTCD scale has been validated in a Spanish population and its usefulness has been verified[6], the CDS-5 has not been validated in this population yet. Direct comparison of the scales is limited by the different range their scores may take. However, we standardized the scores from 0 to 10 to allow direct comparison. Although this procedure led us to exclude some smokers from the analysis (4.8%), we observed that there were no differences between both groups of smokers according to the variables studied. Finally,

the information was collected from 2010 onwards and thus some smoking characteristics may be changed among these populations of smokers; nevertheless, our objective was not to describe the populations with the aim to extrapolate the results to a wider population of smokers, but to compare two scales of nicotine dependence in two populations of smokers to explore potential differences, taking into account some selected sociodemographic variables and smoking characteristics, which is the main strength of this study. Another strength is that both scales were administered face-to-face, and that tobacco use was biochemically validated in all smokers with the use of cotinine in saliva (population group) and exhaled carbon monoxide (clinical group).

CONCLUSIONS

We found some heterogeneity in the comparative assessment of cigarette dependence within each group of smokers: while the CDS-5 scored higher more frequently in the population group, the FTCD scored higher more frequently in the clinical group. These differences should be taken into account when designing either clinical or population-based studies.

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CONFLICTS OF INTEREST
The authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest and none was reported.

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ETHICAL APPROVAL AND INFORMED CONSENT
The study DCOT-2 received ethical approval from the Research and Ethics Committee of the Bellvitge University Hospital (PR137/12) and was carried out following the Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans. All the participants provided informed consent.

DATA AVAILABILITY
The data supporting this research are available from the authors on reasonable request.

AUTHORS' CONTRIBUTIONS
MF: conceptualization, methodology, software, validation, formal analysis, investigation, writing of original draft, writing, reviewing and editing. DCP: conceptualization, methodology, software, validation, formal analysis, investigation writing of original draft, writing, reviewing and editing. YC: conceptualization, methodology, software, validation, formal analysis, investigation, resources, data curation, writing of original draft, visualization. MB: conceptualization writing of original draft, writing, reviewing and editing. XS: writing, reviewing and editing. AR: writing, reviewing and editing. JMMS: writing, reviewing and editing. CM:. writing, reviewing and editing AB: writing, reviewing and editing. AR: resources, writing, reviewing and editing. ME: resources, writing, reviewing and editing. EF: conceptualization, methodology, investigation, writing, reviewing and editing, supervision, project administration, funding acquisition.

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