

## SPECIAL COMMUNICATION

# Nicotine dependence versus smoking prevalence: comparisons among countries and categories of smokers

Karl O Fagerström\*, Michael Kunze, Rudolph Schoberberger, Naomi Breslau, John R Hughes, Richard D Hurt, Pekka Puska, Lars Ramström, Witold Zatoński

Pharmacia Consumer  
Pharma, Research  
Laboratories,  
Helsingborg, Sweden  
KO Fagerström

Institute for Social  
Medicine, University  
of Vienna, Austria  
M Kunze  
R Schoberberger

Henry Ford Health  
Sciences Center, Case  
Western Reserve  
University School of  
Medicine,  
Department of  
Psychiatry, and  
University of  
Michigan School of  
Medicine,  
Department of  
Psychiatry, Detroit,  
Michigan, USA  
N Breslau

University of  
Vermont Department  
of Psychiatry,  
Burlington, Vermont  
JR Hughes

Nicotine Dependence  
Center, Mayo Clinic,  
Rochester, Minnesota  
RD Hurt

National Public  
Health Institute  
Department of  
Epidemiology and  
Health Promotion,  
Helsinki, Finland  
P Puska

Institute for Tobacco  
Studies, Stockholm,  
Sweden  
L Ramström

Department of  
Cancer Control and  
Epidemiology, Maria  
Skłodowska-Curie  
Memorial Cancer  
Center, Warszawa,  
Poland  
W Zatoński

Correspondence to: Karl O  
Fagerström, Pharmacia  
Consumer Pharma,  
Research Laboratories, PO  
Box 941, S-251 09  
Helsingborg, Sweden.

\*Dr Fagerström is  
employed by Pharmacia  
Upjohn Consumer  
Healthcare, which  
manufactures Nicorette  
and Nicotrol nicotine  
replacement medications.

## Abstract

**Objectives** – To collect available international data on nicotine dependence as defined by the Fagerström Test of Nicotine Dependence, and to compare levels of dependence among countries and categories of smokers.

**Data sources** – Published and unpublished studies known to the authors and a search of EMBASE from 1985–1995.

**Study selection** – Studies included were those based on a nationally representative sample of a country's population, or a sample of smokers seeking cessation assistance.

**Data synthesis** – Smokers who seek help in stopping smoking are much more dependent than the average smoker. Men consistently score higher on dependence than women. Ex-smokers appear to have lower dependence than current smokers. A country with low smoking prevalence, the United States, seems to have smokers with higher dependence scores than countries where smoking is more prevalent (such as Austria and Poland).

**Conclusions** – Successful tobacco control may result in a higher dependence among the remaining smokers (due to selective quitting by low-dependent smokers). The remaining highly dependent smokers may need more intensive treatment.

(*Tobacco Control* 1996; 5: 52–56)

Keywords: nicotine dependence, smoking prevalence

## Introduction

Tobacco smoking is no longer regarded as just a habit. The two most recent decades of research have resulted in its classification as a drug addiction<sup>1,2</sup> on par with other so-called hard drugs<sup>3</sup> and as a consequence, a medicine-licensing authority, the United States Food and Drug Administration, has proposed regulations to control the promotion, sale, and distribution of cigarettes and smokeless tobacco.<sup>4</sup>

On the individual level, however, not all regular users of a dependence-producing substance are dependent. For example, cannabis and alcohol are used most often in a non-dependent way whereas most tobacco users (87%) appear dependent on tobacco.<sup>5</sup> Because

dependence on a certain substance varies among individuals, it may also vary among social classes, subcultures, regions, and countries.

In this study we reviewed data on nicotine dependence in different countries and categories of smokers. We assumed that the lower the smoking prevalence in a country, the higher the dependence level of remaining smokers would be – due to selective quitting (that is, less dependent smokers are probably stopping to a greater extent than more dependent smokers).

## Methods

The nicotine dependence data in our study came from two types of records: population-based samples of smokers representing the population of a country, and smokers attending cessation in prospective clinical trials.

## INSTRUMENTS

Dependence can be seen as a dichotomous variable (*International Classification of Diseases*, 10th ed. (ICD-10)<sup>1</sup>) or, as in our study, as a continuous variable where it can be quantified. The instruments used for assessing the degree of nicotine dependence were the Fagerström Tolerance Questionnaire (FTQ)<sup>6</sup> and its more recent version, the Fagerström Test for Nicotine Dependence (FTND).<sup>7</sup> Both of these produce a range of scores (FTQ, 0–11; and FTND, 0–10) with higher scores indicating more dependence. The FTQ has been validated against many indicators of dependence; has been found to predict the ability to stop smoking; and is related to nicotine, cotinine, and carbon monoxide levels in the body, tolerance to nicotine, severity of withdrawal symptoms, and positive response to nicotine gum.<sup>6</sup>

The FTQ is the original scale, consisting of eight questions.<sup>6,8</sup> Although validity and reliability of the FTQ have been satisfactory,<sup>9</sup> internal consistency has been problematic.<sup>10</sup> Thus, a new version (FTND) has been developed that has improved internal consistency<sup>7</sup> and better reliability.<sup>9</sup> In this version, greater weight has been added to the number of cigarettes smoked per day and time to the first cigarette of the day. The two questions in

Table 1 The Fagerström Tolerance Questionnaire (FTQ), the Fagerström Test for Nicotine Dependence (FTND), and their scoring

	FTQ	Points	FTND	Points
1 How soon after you wake up do you smoke your first cigarette?	Within 30 min	1	Within 5 min	3
	After 30 min	0	6-30 min	2
2 Do you find it difficult to refrain from smoking in places where it is forbidden?	Yes	1	31-60 min	1
	No	0	After 60 min	0
			Yes	1
3 Which cigarette would you hate most to give up?	The first one in the morning	1	No	0
	Any other	0	The first one in the morning	1
4 How many cigarettes per day do you smoke?	0-15	0	Any other	0
	16-25	1	≤ 10	0
	26 or more	2	11-20	1
			21-30	2
5 Do you smoke more frequently during the first hours after waking than during the rest of the day?	Yes	1	≥ 31	3
	No	0	Yes	1
6 Do you smoke if you are so ill that you are in bed most of the day?	Yes	1	No	0
	No	0	Yes	1
7 What is the nicotine content of your cigarettes?	< 1 mg	0	No	0
	1.0-1.2 mg	1		
	> 1.2 mg	2		
8 Do you inhale the smoke?	Never	0		
	Sometimes	1		
	Always	2		

the FTQ on inhalation of smoke and nicotine yield of the smoked brand have been deleted (table 1).

#### SAMPLES

Studies that used the FTND were collected from the authors' own research as well as other work (published and unpublished) that was known to the authors. In addition, we conducted a search of the electronic database EMBASE (formerly *Excerpta Medica*) for the years 1985-1995 to look for other published studies that might have used the FTND. Studies selected for inclusion in our review were those based on representative samples of a country's population, or samples of smokers seeking smoking cessation assistance.

#### Population-based samples

**Austria<sup>11</sup>** - In 1994 the Austrian Gallup Institute conducted in-person interviews of a representative sample of 2000 Austrians aged 14 and older, recruited from the National Population Register.

**Denmark<sup>12</sup>** - In 1994 the Danish Gallup Institute interviewed by telephone a sample of 2398 Danes aged 13 years and older, recruited from the National Population Register.

**Finland<sup>13</sup>** - The National Public Health In-

stitute of Finland mailed questionnaires to a sample of 5000 persons, aged 15-64 recruited from the National Population Register, in 1994.

**France<sup>14</sup>** - A sample recruited from the National Population Register (n = 2027) of the French population, 15 years and older, were interviewed in person in 1987.

**Poland** - In 1993 the National Cancer Center mailed questionnaires to a sample of 1073 persons, aged 16 and older, recruited from the National Population Register (Witold Zatoński, written communication, 1994).

**USA<sup>15</sup>** - In late 1993 a nationwide (except Hawaii and Alaska) telephone survey was administered to 753 randomly chosen smokers over 18 years of age. Group ethnicity was: white, 85%; African American, 7%; Hispanic, 2%; Asian, 1%; and other, 3%.

**Sweden** - A questionnaire was mailed to a sample of 5000 individuals, aged 16-80 years, recruited from the National Population Register in 1992 (Lars Ramström, written communication, 1994).

**UK** - A sample of 3499 individuals 16 years and older recruited from the National Population Register were interviewed by telephone in 1993 (Lars Ramström, written communication, 1994).

Table 2 provides additional information on these samples.

Table 2 Characteristics of the random samples of smokers

Survey	n	Smokers in sample (%)	Questions to define smoker	Retention (R) or response rate (RR)
Austria <sup>11</sup>	2000	33	Do you smoke cigarettes?	NR
Denmark <sup>12</sup>	2398	39	Do you smoke cigarettes, pipes or cigars?	RR = 70%
Finland <sup>13</sup>	5000	23	Do you smoke cigarettes, pipes or cigars regularly?	RR = 70%
France <sup>14</sup>	1027	37	Not known	NR reported
United States <sup>15</sup>	753	26	Do you smoke cigarettes regularly?	RR = 18%
Poland*	1073	36	Do you smoke cigarettes daily?	RR = 72%
United Kingdom**	3499	26	Do you smoke tobacco daily?	NR
Sweden**	5000	23	Do you smoke tobacco daily?	RR > 70%

\* Witold Zatoński, written communication, 1994.

\*\* Lars Ramström, written communication, 1994.

NR = no data.

Downloaded from <http://nph.sagepub.com/> at 18:20 22 February 2012

Table 3 Characteristics of the samples of smokers seeking cessation help

Study	n	Mean age (years)	Females (%)	Average cigarettes per day
Kozlowski <i>et al</i> <sup>16</sup>	932	40	65	27
Fagerström, Heatherston, and Kozlowski <sup>17</sup>	1877	44	ND	26
Kozlowski <i>et al</i> <sup>16</sup>	1447	40	64	ND
Hurt <sup>18</sup>	240	43	54	29
Transdermal nicotine study group <sup>19</sup>	935	42	60	30

ND = no data.

Table 4 Fagerström Test for Nicotine Dependence (FTND) scores in random samples of smokers (SD where available within parentheses)

Survey	n	FTND score		
		Males	Females	Total
Austria <sup>11</sup>	667	3.81	3.26	3.59
Denmark <sup>12</sup>	2398	3.13	3.02	3.07
Finland <sup>13</sup>	667	3.97 (2.31)	2.97 (2.22)	3.52
France <sup>14</sup>	307	ND	ND	3.44*
United States <sup>15</sup>	753	ND	ND	4.30*
Poland**	386	3.98 (2.11)	2.97 (2.14)	3.59 (2.17)
Total average				3.59
<i>FTND scores in smokers seeking cessation help</i>				
Kozlowski <sup>16</sup>	932	5.41	5.22	5.29
Fagerström <sup>17</sup>	1447	ND	ND	5.15 (2.23)
Kozlowski <sup>16</sup>	1877	5.50	5.30	5.37
Transdermal Nicotine Study Group <sup>19</sup>	935	ND	ND	5.80*
Hurt <sup>18</sup>	240	ND	ND	6.55 (2.0)
Total average				5.63

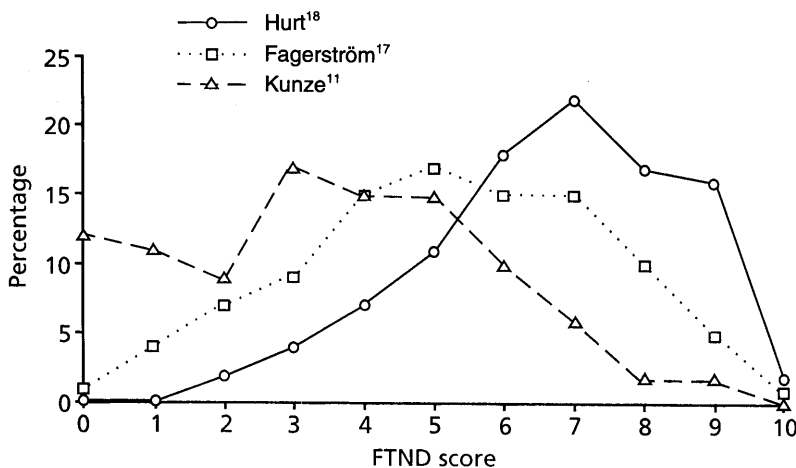
\* Original FTQ scores converted to FTND scores by the formula FTND = FTQ × 0.82.

\*\* Witold Zatoński, written communication, 1994.

ND = no data.

Table 5 Fagerström Tolerance Questionnaire (FTQ) scores across three samples of smokers in France<sup>14</sup>

FTQ score	Population-based sample (%)	Sample from healthcare workers (%)	Cessation clinic attendees (%)
≤ 3	34	22	1
4-6	47	40	41
> 7	19	38	58

Figure 1 Distribution of Fagerström Test for Nicotine Dependence (FTND) scores in a representative population-based sample,<sup>11</sup> a low-cost group smoking cessation sample,<sup>17</sup> and a smoking clinic sample.<sup>18</sup>

*Samples of smokers seeking cessation assistance*  
Table 3 lists the studies of help-seeking smokers, including group size, age, gender, and daily cigarette consumption. Two of the

studies<sup>18,19</sup> included smokers recruited by advertisements in local media. Intensive pharmacological and behavioural treatment was offered on an individual<sup>18</sup> or group<sup>19</sup> basis. The remaining three studies used less intensive behavioural treatment of a self-help nature.

## Results

Across the six nationally representative population samples, the mean FTND scores ranged from 3.07 to 4.30. In the five treatment-seeking samples, the mean FTND scores ranged from 5.15 to 6.55 (table 4). The overall means for the two types of categories were 3.59 and 5.63, respectively. There was no overlap in mean FTND scores between the two categories, suggesting that those who seek help for cessation are more dependent.

In all six studies, where dependence was recorded by gender, men recorded a higher score than women. Among the help-seeking samples, those seeking help in more intensive treatment settings – that is, nicotine replacement plus group behaviour therapy<sup>18,19</sup> – were more dependent than those seeking a less intensive treatment (table 4).

The French survey is of special interest as it reports FTQ scores for three types of populations or settings: a representative population sample, a sample from health care professionals, and smokers coming to a cessation clinic. As can be seen in table 5, smokers in the general population were less dependent than the sample from health care workers, who in turn were less dependent than those attending a cessation clinic.<sup>14</sup>

Figure 1 illustrates the distribution of FTND scores from the three studies where these data were available: a representative population-based study,<sup>11</sup> a low-cost group smoking cessation sample,<sup>17</sup> and a randomised clinical trial in smoking cessation.<sup>18</sup> These samples have different distributions. Whereas only 20% of the population-based sample have a FTND score of 6 or higher, which might be considered highly dependent, 45% are in that category in the low-cost cessation group and 76% fall into this category among the clinical trial subjects.

The UK and the Swedish surveys asked not only current smokers but also ex-smokers about their dependence. Only two questions, time to first cigarette and number of cigarettes smoked per day, were used, yielding scores from 0 to 6. Former daily smokers had a statistically significant lower score than current daily smokers (UK: 1.95 vs 2.12,  $p < 0.05$ ; Sweden: 1.44 vs 2.06,  $p < 0.05$ ), suggesting that those who quit are less dependent than those who do not quit. In both these countries, those who had ever used nicotine chewing gum had higher dependence scores than other smokers.

In Figure 2 the FTND scores from the population-based studies shown in table 2 are plotted against the smoking prevalence rates reported in those studies. The scatterplot suggests that the lower the smoking prevalence rate, the higher the FTND score is.

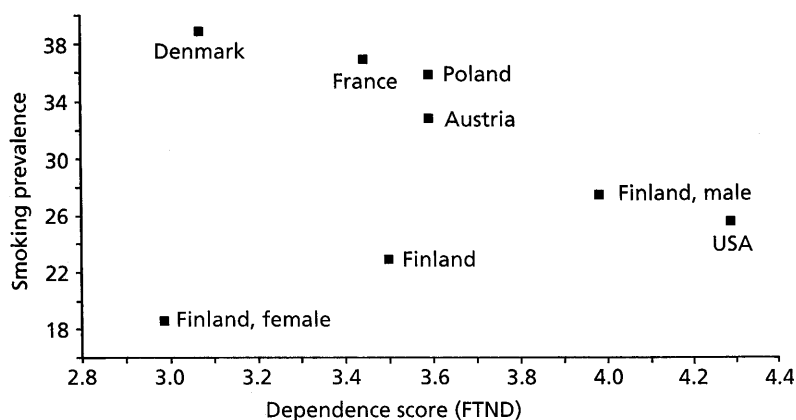


Figure 2 Smoking prevalence rates plotted against Fagerström Test for Nicotine Dependence (FTND) scores from population-based studies in six countries.

### Discussion

When using the Fagerström tests to indicate dependence, a few things seem evident. First, dependence is much stronger in smokers seeking help to stop smoking than in the total population of smokers. It should be pointed out that among those seeking help for smoking cessation some studies have been clinical trials of nicotine replacement products with an inclusion criterion of a minimum number of cigarettes smoked per day. However, even after allowing for that selection bias, a difference would still remain. It is, of course, no surprise that those seeking help are more dependent. Their higher dependence could be a cause for their seeking help in stopping smoking. It has been found consistently that those with higher dependence do less well in cessation programmes, particularly when no nicotine replacement therapy is employed.<sup>6</sup> This may explain the finding that smokers in cessation clinics are no more successful than smokers who quit on their own.<sup>20</sup>

The natural history of mostly unaided quitting in a population may also be related to dependence.<sup>21,22</sup> Consistent with data that highly dependent smokers are less likely to succeed at quitting,<sup>6</sup> in the surveys where data were available (UK and Sweden) former daily smokers had lower dependence than current daily smokers. In addition a prospective study following 1338 smokers over one year in Minnesota found that the quitting percentage was higher among less dependent smokers compared with the other smokers.<sup>23</sup>

Male smokers consistently had higher dependence scores than female smokers. As with smokers seeking help, men tend to smoke more cigarettes than women; thus, it remains to be seen whether women and men will differ on dependence scores when cigarette consumption is controlled for.

At the level of countries, the degree of nicotine dependence correlated negatively with the proportion of the population who are smokers – that is, the lower the prevalence of smoking in a country, the higher the average dependence is among those who do smoke. Finland is of particular interest here. The prevalence of smoking among males has dec-

reased approximately as much as in North America, and their mean FTND score is 3.97. Females in Finland have never had a smoking prevalence higher than the current 19%, and their FTND score is only 2.97. If one looks only at Finnish men, the association between dependence and smoking prevalence becomes much stronger (figure 2). Thus, the correlation between dependence and prevalence may only exist when prevalence has started to decline. The correlation is likely due to selective quitting; prevalence decreases due to increased quitting, which occurs mostly among low-dependent smokers, leaving more highly dependent smokers in the population. More research is clearly needed to further examine the nature of this association.

It would, for example, be particularly interesting to know the nicotine dependence levels among Japanese men, of whom 60% are daily smokers. Our hypothesis would predict low mean dependence scores in such a population. Conversely one would expect that the few physicians smoking in North America would be very dependent. Future mapping of nicotine dependence will help clarify whether declines in smoking prevalence are accompanied by increases in dependence. If this pattern is confirmed, it will have implications for future cessation strategies. The remaining highly dependent smokers may need more intensive treatment, similar to that which is common today for alcoholics and illicit drug addicts.

JRH was supported by Research Scientist Development Award K02-DA00109 from NIDA.

- 1 World Health Organisation. *International classification of disorders*. Geneva: World Health Organisation, 1992.
- 2 American Psychiatric Association, eds. *Diagnostic and statistical manual of mental disorders*. 4th ed. Washington, DC: American Psychiatric Association, 1994.
- 3 US Department of Health and Human Services. *The health consequences of smoking: nicotine addiction. A report of the Surgeon General*, 1988. Rockville, Maryland: Public Health Service, Centers for Disease Control, Office on Smoking and Health, 1988. (DHHS Publication No (CDC) 88-8406.)
- 4 US Food and Drug Administration. Regulations restricting the sale and distribution of cigarettes and smokeless tobacco products to protect children and adolescents: proposed rule. *Federal Register* 1995 (11 Aug); 60: 41314-75.
- 5 Woody GE, Cottler LB, Cacciola J. Severity of dependence: data from the DSM-IV field trials. *Addiction* 1993; 88: 1573-9.
- 6 Fagerström KO, Schneider NG. Measuring nicotine dependence: a review of the Fagerström Tolerance Questionnaire. *J Behav Med* 1989; 12: 159-82.
- 7 Heatherton TF, Kozlowski LT, Frecker RC, Fagerström KO. The Fagerström Test for Nicotine Dependence: a revision of the Fagerström Tolerance Questionnaire. *Brit J Addict* 1991; 86: 1119-27.
- 8 Fagerström KO. Measuring degree of physical dependence to tobacco smoking with reference to individualization of treatment. *Addict Behav* 1978; 3: 235-40.
- 9 Pomerleau CS, Carton SM, Lutzke ML, Flessland KA, Pomerleau OF. Reliability of the Fagerström Tolerance Questionnaire and the Fagerström Test for Nicotine Dependence. *Addict Behav* 1994; 19: 339.
- 10 Lichtenstein E, Mermelstein RJ. Some methodological cautions in the use of the tolerance questionnaire. *Addict Behav* 1986; 11: 439-42.
- 11 Kunze M, Schoberberger, R. *Nikotinhängigkeit der Österreichischen Bevölkerung*. Vienna: Institut der Sozialmedizin. Universität Wien, 1994.
- 12 The Danish Office on Tobacco and Health, the Danish Heart Foundation and the Danish Cancer Society. *Gallup Survey for the Danish Council on Smoking and Health*, Copenhagen, 1995.
- 13 Puska P, Helakorpi S, Berg A-M, Uutela A. *Health behaviour among Finnish adult population, Spring 1994*. Helsinki: National Public Health Institute, 1994.
- 14 Lagrue G, Grimaldi B, Demaria C, Loufrani E, Levaillant C. *Epidémiologie de la dépendance physique à la nicotine*

- (test de Fagerström) – Résultats d'une enquête IFOP. *J Dépend Tabag* 1989; 40: 2448–50.
- 15 Hellebusch S. *Committed quitters study*. Cincinnati, Ohio: Q2 Marketing Research Inc., 1994.
  - 16 Kozlowski LT, Porter CQ, Orleans CT, Pope MA, Heatherton T. Predicting smoking cessation with self-reported measures of nicotine dependence: FTQ, FTND, and HSI. *Drug Alcohol Depend* 1994; 34: 211–6.
  - 17 Fagerström KO, Heatherton TF, Kozlowski LT. Nicotine addition and its assessment. *Ear Nose Throat J* 1990; 69: 763–8.
  - 18 Hurt RD, Dale LC, Fredrickson PA, et al. Nicotine patch therapy for smoking cessation combined with physician advise and nurse follow-up. One-year outcome and percentage of nicotine replacement. *JAMA* 1994; 271: 595–600.
  - 19 Transdermal Nicotine Study Group. Transdermal nicotine for smoking cessation: Six-month result from two multicenter controlled clinical trials. *JAMA* 1991; 266: 3133–8.
  - 20 Fiore MC, Smith SS, Jorenby DE, Baker TB. The effectiveness of the nicotine patch for smoking cessation. *JAMA* 1994; 271: 1940–7.
  - 21 Coombs RB, Kozlowski L, Ferrence RG. The future of tobacco use and smoking research. In: Nay T, Gale A, eds. *Smoking and human behaviour*. New York: John Wiley & Sons, 1989: 337–48.
  - 22 Hughes JR. Pharmacotherapy for smoking cessation: unvalidated assumptions, anomalies, and suggestions for future research. *J Consult Clin Psychol* 1993; 61: 751–60.
  - 23 Venters MH, Kotke TE, Solberg LI, Brekke ML, Roomer B. Dependency, social factors, and the smoking cessation process: the doctors helping smokers study. *Am J Prev Med* 1990; 6: 185–93.