



Original Research

Trends in the profile of smokers registered in a national database from 2001 to 2006: Changes in smoking habits

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ARTICLE INFO

Article history:

Received 11 November 2007

Received in revised form 15 April 2008

Accepted 1 July 2008

Available online 9 December 2008

Keywords:

Smoking cessation services

Carbon monoxide

Compensatory smoking

National database

SUMMARY

Objective: In 2001, an electronic medical record system was designed to collect data from smoking cessation services in France. By comparing two periods (2001–2003 and 2004–2006), this study assessed trends in the profile of smokers registered in the database.

Study design: A cross-sectional analysis on the 33,219 smokers registered in the database in 2001.

Methods: Sociodemographic details, psychological and medical history, and characteristics of tobacco consumption at baseline were examined.

Results: The proportion of young smokers increased from 5.1% to 6.9%, and the proportion of under-privileged smokers increased from 9.3% to 10.9% between 2001–2003 and 2004–2006 ($P < 0.0001$). The medical profile was unchanged, with about 37% of cases with tobacco-related diseases and 31% of cases with past depressive episodes in 2001–2003 and 2004–2006. The main finding was an increase in the mean concentration of carbon monoxide (CO) in expired air [from 18.8 parts per million (ppm) (SD 14.4) to 23.5 ppm (SD 14.1)], despite a decrease in the number of cigarettes smoked per day. The concentration of CO per cigarette also increased from 0.9 (SD 0.9) to 1.3 (SD 1.4).

Conclusion: As the number of cigarettes smoked per day decreased, the increase in mean concentration of CO per cigarette implies that increases in cigarette prices may have led to new smoking habits and/or compensatory smoking.

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Introduction

Following the plan of 3 April 2000,¹ smoking cessation centres in France were set up between 2000 and 2003 with the support of a publicly funded grant of 3.5 million Euros. To evaluate the activity of these funded centres, a 1-week survey was performed for 4 consecutive years,² along with a description of the profile of smokers attending the smoking cessation centres. Sociodemographic details, tobacco use and medical characteristics of patients were analysed in order to determine whether the centres were an efficient response to the French tobacco epidemic. In 2001, data

collection was optimized by the design of an electronic medical record system specific to smoking cessation services.

Le Faou et al. performed a cross-sectional analysis of the database from 2001 to 2003.³ This outlined that individuals seeking treatment were severely nicotine-dependent smokers, suffering from tobacco-related diseases and declaring a background of anxiety-depressive symptoms. The programme had therefore met its original objective of reaching the most severe cases. However, the profile of the population considered did not quite match the characteristics of smokers in the population at large. For instance, some of the sociodemographic groups of smokers of particular concern in France,⁴ such as socially underprivileged people or young people aged 15–25 years, were under-represented in the programme.

In 2003, the Government decided to expand the smoking cessation services.⁵ As such, with more services available and a decreasing national smoking prevalence, an evaluation of the

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activity of specialized smoking cessation services in France appeared to be necessary. From 2000 to 2005, the proportion of French smokers aged 12–75 years decreased from 33.1% to 29.9%.⁴

This paper reports the results of a cross-sectional analysis on the electronic database of smokers seeking treatment at the smoking cessation services between 2001 and 2006. Through the comparison of two periods (2001–2003 and 2004–2006), trends in the profile of smokers over 5 years were assessed.

Methods

Study population

The study was based on a population of smokers attending smoking cessation services in France over 5 years. Two periods were considered. Between 2001 and 2003, 40 services were involved in the programme: 32 public hospitals, two community centres, one general practitioner (GP), one private clinic and four non-hospital-based centres (e.g. health farms and associations). Between 2004 and 2006, 118 services were involved in the programme: 102 public hospitals, four community centres, two GPs, two private clinics and eight non-hospital-based centres. Overall, 33,219 smokers were registered with the online database of the Consultation de Tabacologie (CDT) programme, the national smoking cessation programme database.³

Measures

Sociodemographic variables

During the first visit, baseline data were self-reported by patients. These characteristics included sociodemographic variables such as gender, age, education level and professional status. Patients also indicated how they had been referred to the programme.

Tobacco-related and medical variables

At baseline, medical history (such as cardiovascular and respiratory diseases), current use of psychotropic medication and history of depression were also recorded. Smoking status was evaluated according to the number of cigarettes smoked per day, the number of prior attempts to quit smoking for more than 7 days, and the Fagerström Test for Nicotine Dependence (FTND).⁶ The FTND scale of 0–10 was divided into three categories: 0–4 for low dependence, 5–6 for intermediate dependence and 7–10 for high dependence. The self-reported estimates of tobacco consumption were verified by measuring carbon monoxide (CO) levels. The Hospital Anxiety Depression (HAD) scale,⁷ scored from 0 to 21, was used to identify individuals with anxiety-depressive disorders, with a threshold score of 11. The HAD scale was suitable for screening purposes,^{8,9} but no definite diagnosis was made using this tool.

Data collection

Data could be entered into the database via the Internet (CDTnet) by staff members of smoking cessation units. The database only contained anonymized data, the quality and consistency of which was ensured and checked prior to any analysis. The CDT programme received the approval of the National Auditing Committee on Informatics and Individual Liberty (Commission Nationale Informatique et Libertés).

Statistical analysis

A cross-sectional analysis of smokers was performed based on descriptive statistics and non-parametric tests. Dummy variables

were compared using Chi-square test with continuity correction or Fisher's test with samples of less than five smokers. Continuous variables were compared using Wilcoxon rank sum test. Kendall trend test was performed to evaluate the changes in expired CO levels over the years. The analysis was undertaken using SAS Version 8.02 (SAS Institute, Cary, NC, USA).

Results

Sociodemographic features

Between 2001 and 2003, 14,574 smokers attended a smoking cessation service on at least one occasion (51.4% female vs 48.6% male). Between 2004 and 2006, 18 645 smokers were registered in the CDT programme (51.9% female and 48% male). For each period, the distinction between genders was statistically significant ($P < 0.0001$), but there was no significant difference in the gender ratio between periods. However, when looking at the baseline characteristics, some features varied differently according to gender.

Distributions of sociodemographic details are shown in Table 1. During the 5-year observation period, patients' ages ranged from 12 to 93 years, with an average age of 42.7 years [standard deviation (SD) 11.6 in 2001–2003; SD 12.1 in 2004–2006]. There was no significant difference between age distributions.

In both periods, more than half of the patients were between 35 and 54 years old. However, more patients aged ≤ 24 years were registered in 2004–2006 (6.9% vs 5.1%; $P < 0.0001$).

The 2004–2006 sample had a greater proportion of uneducated people (21.9% vs 18.1%) and people with a low-level vocational education (27.3% vs 25.1%). An increase in the proportion of unemployed people was also observed (10.9% vs 9.3%). All these differences were significant ($P < 0.0001$).

There was a major increase in the number of patients admitted after hospitalization, from 23.5% ($n = 3425$) in 2001–2003 to 50.2% ($n = 9364$) in 2004–2006. The difference was particularly noteworthy among women. Between 2004–2006, almost half as many women accessed the programme on their own initiative compared with 2001–2003, whereas a growing percentage of men were self-referred. Between 2004 and 2006, a huge decrease was seen in the number of patients referred by a GP, from 12.7% ($n = 1851$) to 3.1% ($n = 574$).

Medical history and psychological profile

Table 2 presents details of medical history and psychological indicators. Although statistically significant ($P < 0.001$) according to gender, proportions within medical variables were generally quite stable from one period to another.

Respiratory diseases affected 25.4% ($n = 3709$) of the population in 2001–2003, decreasing to 24% ($n = 4484$) in 2004–2006. Depression was a major issue among the participants. In 2001–2003, 31.6% ($n = 4603$) of smokers reported having had at least one depressive episode, and this was reported by 31.9% ($n = 5939$) of smokers in 2004–2006. By 2006, approximately 40% of smokers registered in the CDT database had a HAD score > 11 for anxiety, suggesting the presence of an anxious disorder, and 45.9% of women and 32.2% of men were concerned by this high score. In 2001–2003, 10.5% ($n = 1537$) of smokers had a HAD score > 11 for depression, and this increased to 12% ($n = 2242$) of smokers in 2004–2006.

These medical details were also common features among patients aged ≤ 24 years. From 2001 to 2006, one out of five young smokers had a history of respiratory disease, particularly asthma (16.4%, $n = 335$ out of 2042 young smokers), and 19.3% ($n = 395$) reported a depressive episode.

Table 1
Characteristics of smokers according to gender

Characteristics	2001–2003		2004–2006		Total n (%)
	Female n (%)	Male n (%)	Female n (%)	Male n (%)	
Age (years)					
≤24	477 (6.4)	273 (3.8)	826 (8.5)	466 (5.2)	2042 (6.1)
25–34	1816 (24.2)	1167 (16.5)	2236 (23.1)	1326 (14.8)	6545 (19.7)
35–44	2472 (33.0)	2008 (28.3)	3026 (31.3)	2478 (27.7)	9984 (30.06)
45–54	1857 (24.8)	2218 (31.3)	2365 (24.4)	2761 (30.8)	9201 (27.7)
55–64	634 (8.5)	1084 (15.3)	959 (9.9)	1486 (16.6)	4163 (12.5)
≥65	233 (3.1)	334 (4.7)	262 (2.7)	442 (4.9)	1271 (3.8)
Missing values					13 (0.04)
Education					
No education	1220 (16.3)	1412 (19.9)	1980 (20.5)	2111 (23.6)	6723 (20.2)
Low-level vocational education	1516 (20.2)	2141 (30.2)	2187 (22.6)	2901 (32.4)	8745 (26.3)
Secondary school	747 (10.0)	617 (8.7)	862 (8.9)	764 (8.5)	2990 (9.0)
Secondary school graduate	1109 (14.8)	801 (11.3)	1427 (14.7)	1015 (11.3)	4352 (13.1)
Higher	2897 (38.7)	2113 (29.8)	3148 (32.5)	2106 (23.5)	10,264 (30.9)
Missing values			70 (0.7)	62 (0.7)	132 (0.4)
Professional status					
Employed	5101 (68.1)	4808 (67.9)	6081 (62.9)	5 627 (62.8)	21,617 (65.1)
Retired	485 (6.5)	813 (11.5)	634 (6.6)	1 026 (11.4)	2958 (8.9)
Unemployed	676 (9.0)	682 (9.6)	1030 (10.6)	1 007 (11.2)	3395 (10.2)
Inactive	916 (12.2)	592 (8.3)	1321 (13.7)	759 (8.5)	3588 (10.8)
Trainee or student	311 (4.2)	189 (2.7)	471 (4.9)	302 (3.4)	1273 (3.8)
Missing values			137 (1.4)	238 (2.7)	375 (1.1)
Referral source					
Hospitalization	1214 (16.2)	2211 (31.2)	5278 (54.6)	4 086 (45.6)	12,789 (38.5)
Self-referred	2459 (32.8)	1776 (25.1)	1693 (17.5)	2 619 (29.2)	8547 (25.7)
Pharmacist	91 (1.2)	77 (1.1)	981 (10.1)	939 (10.5)	2088 (6.3)
General practitioner	919 (12.3)	932 (13.2)	306 (3.2)	268 (3.0)	2425 (7.3)
Occupational physician	237 (3.2)	207 (2.9)	89 (0.9)	78 (0.9)	611 (1.8)
Other	2569 (34.3)	1881 (26.5)	1319 (13.6)	959 (10.7)	6728 (20.3)
Missing values			8 (0.1)	10 (0.1)	18 (0.1)
Total	7489 (100)	7084 (100)	9674 (100)	8959 (100)	33,219 (100)

Tests comparing 2001–2003 and 2004–2006 were significant, $P < 0.0001$ for all variables. Percentages are expressed with respect to column totals.

Smoking profile

Between 2001 and 2003, CDT smokers reported an average number of 1.6 (SD 1.9) previous quit attempts. This figure was unchanged in 2004–2006. The average number of cigarettes

smoked per day decreased significantly ($P < 0.0001$) from 24.1 (SD 12.2) to 22.2 (SD 11.7). Men smoked more cigarettes than women: 22.2 (SD 11.0) for women and 26.1 (SD 13.1) for men in 2001–2003, and 20.1 (SD 10.2) for women and 24.4 (SD 12.8) for men in 2004–2006. The proportion of patients with a low FTDN score increased

Table 2
Medical history and psychological profile of smokers

History	2001–2003		2004–2006		Total n (%)
	Female n (%)	Male n (%)	Female n (%)	Male n (%)	
Cardiovascular NS					
Myocardial infarction NS	205 (2.7)	714 (10.1)	248 (2.6)	1017 (11.4)	2184 (6.6)
Cerebrovascular accident *	100 (1.3)	203 (2.9)	158 (1.6)	307 (3.4)	768 (2.3)
Lower-limb arteritis obliterans**	188 (2.5)	626 (8.8)	218 (2.3)	686 (7.7)	1718 (5.2)
Respiratory**					
Lung cancer**	103 (1.4)	237 (3.4)	102 (1.0)	246 (2.7)	688 (2.1)
Chronic obstructive pulmonary disease ***	1276 (17.0)	1211 (17.1)	1456 (15.0)	1356 (15.1)	5299 (15.9)
Asthma NS	984 (13.1)	674 (9.5)	1333 (13.8)	843 (9.4)	3834 (11.5)
Depressive episode NS					
Drug usage NS	2155 (28.8)	1720 (24.3)	2776 (28.7)	2186 (24.4)	8837 (26.6)
Anxiolytic NS	1579 (21.1)	1363 (19.2)	2080 (21.5)	1719 (19.2)	6741 (20.3)
Antidepressant NS	1507 (20.1)	1065 (15)	1981 (20.5)	1374 (15.3)	5927 (17.8)
Medication for drug substitution**	69 (0.9)	105 (1.5)	68 (0.7)	93 (1.0)	335 (1.0)
HAD score ≥11 NS					
Anxiety NS	3477 (46.4)	2274 (32.1)	4408 (45.6)	2905 (32.4)	13,064 (39.3)
Depression***	817 (10.9)	720 (10.2)	1206 (12.5)	1035 (11.5)	3778 (11.4)
Total	7489 (100)	7084 (100)	9674 (100)	8959 (100)	33,219 (100)

Significance of tests comparing 2001–2003 and 2004–2006: NS, not significant; * $P < 0.05$; ** $P < 0.01$; *** $P < 0.0001$. Percentages are expressed with respect to column totals.

HAD, Hospital Anxiety and Depression scale.

($P < 0.0001$) from 25% ($n = 3643$) to 27% ($n = 5030$), and the proportion of patients with a high FTDN score decreased ($P < 0.0001$) from 45.8% ($n = 6681$) to 41.5% ($n = 7740$).

In 2001–2003, the mean concentration of CO in expired air measured during the initial visit was 18.8 parts per million (ppm) (SD 14.4). In 2004–2006, this increased significantly ($P < 0.0001$) to 23.5 ppm (SD 14.1). Fig. 1 shows the changes in CO levels; the averages increased significantly over the years (trend test $P < 0.0001$) with a peak mean value of 29 ppm (SD 11.5) in 2004. To confirm this increase, the average concentration of CO per cigarette was calculated. This was also found to increase (trend test $P < 0.0001$) from 0.9 ppm per cigarette (SD 0.9) to 1.3 ppm per cigarette (SD 1.4). Fig. 2 shows the changes in concentration of CO per cigarette over the years.

Centres in 2004–2006

Among the 118 services registered in 2004–2006, 30 had been active in 2001–2003. The 88 other centres joined the CDT programme between 2004 and 2006. After the global analysis for 2004–2006, the frequencies of the smokers' characteristics were examined by comparing the 30 'old' centres with the 88 'new' centres. Differences in frequencies or average values are presented in Table 3. None of the figures contradicted with the overall trend observed when comparing 2001–2003 with 2004–2006.

Discussion

Young smokers and underprivileged smokers are two target groups for the French tobacco control policy. Between 2001 and 2006, more smokers from these populations attended CDT smoking cessation services. This paper also reports the remarkable finding of an increase in the average concentration of CO in expired air and concentration of CO per cigarette smoked per day.

The attempts of the global tobacco policy to reach younger smokers had a repercussion on the activity of the smoking cessation services. With smoking prevalence among this group decreasing more quickly than in other age groups,⁴ significantly more people aged ≤ 24 years were registered in the CDT programme. However, the figures revealed a group of young ill smokers. Like older patients, young people appeared to turn to specialized help principally because of tobacco-related illnesses (mainly respiratory) and depressive symptoms. Studies have shown

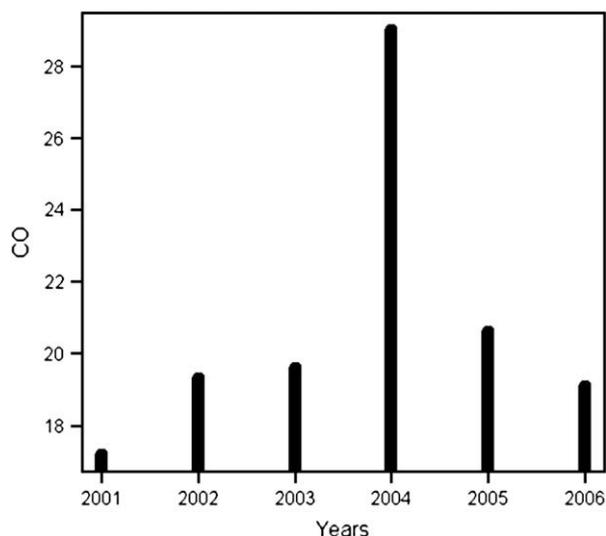


Figure 1. Mean concentration of carbon monoxide (CO) in expired air by year.

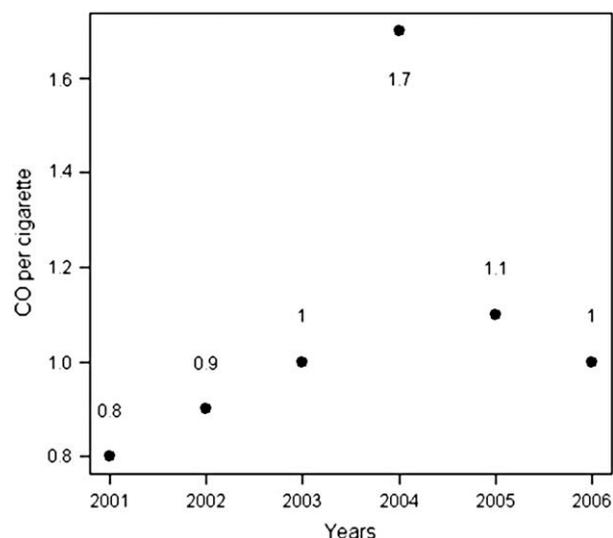


Figure 2. Mean concentration of carbon monoxide (CO) per cigarette by year.

that young smokers (young adults or adolescents), although interested in quitting, do not believe in the efficiency of smoking cessation interventions; they prefer to quit on their own.^{10,11}

Between 2002 and 2004, cigarette prices increased by 19.3% each year.¹² It has been reported that the cost of tobacco is one of the reasons why smokers quit.¹³ The increased cost of cigarettes may therefore be one of the reasons why a few more underprivileged patients (low or no education and unemployed) have turned to the CDT services. Another reason may be the impact of health measures and massive publicity campaigns, part of which specifically targeted underprivileged smokers.^{14,15}

As a result of the increasing cost of cigarettes, the number of cigarettes purchased between 2003 and 2004 decreased by 15.7%.¹² This study found a decrease in the self-reported number of cigarettes smoked per day. Therefore, it was coherent to observe a decreasing proportion of CDT smokers with high nicotine dependence, as that measure is one of the items of the FTND.

However, when assessing changes in the smoking profile of patients, the authors were surprised to notice a significant increase in the average measures of expired CO. The highest values were registered in 2004, with a huge peak in comparison with the three previous years. This corresponds with an unprecedented drop in cigarette sales, mirroring the 2004 level of cigarette prices.¹² One may suspect modifications in the smoking behaviour of CDT patients. The increase in the mean concentration of CO in expired air, despite a decrease in the number of cigarettes smoked per day, could be explained by changes in tobacco consumption. Indeed, the self-reported number of cigarettes smoked per day is not a good indicator of toxin exposure, as it is not linearly¹⁶ or significantly¹⁷ related to biomarkers such as CO.

As demonstrated by the outcomes of tobacco tax increases in other European countries,^{18,19} smokers often react to these policies by reducing their consumption or by changing to cheaper tobacco products, such as hand-rolled tobacco. In France, this has been suggested by Lagrue et al.²⁰ The consumption of hand-rolled tobacco increased from 17.4% of smokers in 2000 to 22.7% in 2005.⁴ Many smokers use various smoked tobacco products. Since filters are often missing or of poor quality, health risks are higher.²⁰

Even for reducing smokers, a review by Hughes and Carpenter²¹ showed that CO levels often reveal compensatory mechanisms of smoking. For instance, smokers tend to inhale more, which leads to higher levels of CO. This theory fits with the present findings revealing an increase in CO per cigarette smoked per day. In

Table 3
Characteristics in 2004–2006 of the centres maintained from 2001–2003 to 2004–2006 ('old' centres) and the centres that joined the programme in 2004–2006 ('new' centres)

Characteristics	'Old' centres	'New' centres	P-value	Total in 2004–2006
	n (%)	n (%)		n (%)
Age (years)			0.015	
≤24	728 (6.7)	564 (7.3)		1292 (6.9)
Education			<0.0001	
No education	2287 (21.0)	1804 (23.3)		4091 (21.9)
Low-level vocational education	2917 (26.7)	2171 (28.1)		5088 (27.3)
Professional status			NS	
Unemployed	1167 (10.7)	870 (11.3)		2037 (10.9)
Medical history				
Cardiovascular diseases	1363 (12.5)	1069 (13.8)	<0.0001	2432 (13.0)
Respiratory diseases	2538 (23.3)	1946 (25.2)	<0.0001	4484 (24.0)
Psychological profile				
Depressive episode	3608 (33.1)	2331 (30.1)	<0.0001	5939 (31.9)
Drug usage	2786 (25.5)	2179 (28.2)	<0.0001	4965 (26.6)
HAD score ≥11 for anxiety	4256 (39.0)	3061 (39.6)	<0.0001	7317 (39.2)
HAD score ≥11 for depression	1287 (11.8)	955 (12.3)	<0.0001	2242 (12.0)
Smoking profile				
Previous quit attempts – mean (SD)	1.56 (1.96)	1.65 (2.02)	0.0005	1.60 (1.99)
Low FTDN ²	2949 (27.0)	2081 (26.9)	<0.0001	5030 (27.0)
High FTDN ²	4698 (43.1)	3042 (39.3)	<0.0001	7740 (41.5)
Cigarettes smoked per day – mean (SD)	22.29 (11.80)	22.03 (11.63)	NS	22.19 (11.73)
CO level – mean (SD)	23.29 (13.67)	24.27 (14.53)	0.007	23.69 (14.03)
CO level per cigarette smoked per day – mean (SD)	1.32 (1.41)	1.35 (1.45)	<0.0001	1.34 (1.43)
Total	10,913 (58.5)	7732 (41.5)		18,645 (100.0)

Percentages are expressed with respect to column totals.

HAD, Hospital Anxiety and Depression scale; SD, standard deviation; FTDN, Fagerström Test for Nicotine Dependence; NS, not significant.

addition, although there is little information available about the levels of CO measured in hand-rolled tobacco compared with manufactured cigarettes,²² smokers of hand-rolled tobacco do report inhaling more deeply than smokers of manufactured cigarettes.²³

Although the impact of increases in the price of cigarettes appears to be obvious, the 2005 national health barometer suggested a short-term effect of price increases and feared a stand-by in smoking prevalence. The present findings imply that in the aftermath of 2004, smokers have adapted; in 2005 and 2006, CO levels were close to those of 2002 and 2003.

An updated version of the CDT programme was set up in 2007. In this version, smokers are asked how many manufactured cigarettes or hand-rolled cigarettes they smoke per day. They are also asked if they use other types of tobacco, such as cigarillos, cigars, pipe, chewed tobacco, snus or narghile.

Over the time frame considered in this paper, the number of participating services expanded from 40 to 118. There were 400 smoking cessation services in France in 2003 and 485 in 2005. Among the latter, 275 were hospital-based services. This study is therefore a good indicator of the activity of smoking treatment in hospitals between 2004 and 2006, as 103 out of 275 joined the CDT programme.

The tripling in the number of hospital-based smoking cessation centres between 2001–2003 and 2004–2006 partly explains why half of the patients in 2004–2006 were referred to the programme after hospitalization. Also, hospital-based smoking cessation services improved their management of inpatients by setting up training sessions for hospital staff and informing patients about smoking cessation treatment. Studies have illustrated that bedside counselling followed by intensive interventions (with follow-up) is quite effective to help inpatients to stop smoking.^{24,25} That is encouraging since, over the years, CDT smokers have remained a diseased group. With 13.1% of smokers with a history of

cardiovascular disease and 24% with a history of respiratory disease in 2006, the medical profile of CDT smokers has not changed a great deal since 2003. Neither has their psychological profile, as approximately one-third reported a history of depressive episodes in both 2001–2003 and 2004–2006. Given the large majority of hospital-based services, CDT smokers are generally motivated by past or current illness. Indeed, it has been shown that concern about health is the main motivation for quitting smoking.¹³

Although non-hospital-based services are under-represented in the CDT programme, reports have shown that they only treated one-third of the number of smokers compared with hospital-based services in 2001–2002.^{26,27} Unfortunately, no information is available regarding whether this is an ongoing situation, because the annual survey of smoking cessation services ended in 2003. Furthermore, the 2005 national health barometer reported that among French smokers considering cessation, 49.3% intend to stop without using NRT or seeking specialized help. This might suggest that it is mainly smokers with health or psychological problems who turn to smoking cessation specialists, especially in the hospital setting.

In 2002, 42 GPs were certified as tobacco specialists, but the number diminished. More and more GPs cover smoking cessation in their usual practice, and no longer register themselves to the health authorities as smoking cessation specialists.²⁷ In a 2003 national survey, 86.5% of the 2057 GPs interviewed declared that they handled smoking cessation.²⁸ Only 2.2% referred smokers to a specialized smoking cessation service, which might explain the drop in the percentage of CDT smokers referred by GPs in the present study.

One of the strengths of the present study is that it relies on a national database. Created in 2001, the CDT programme is an innovative approach to monitoring smoking cessation services. Another similar web-based database exists in Europe, namely the National Health Service Smoking Cessation Database in Scotland.²⁹

Nevertheless, the CDT programme appears to gather more information, especially concerning tobacco-related medical profiles and psychological conditions. The importance of the latter when handling smoking cessation has been documented.³⁰ Furthermore, a new version of the CDT is being discussed that will include more detailed psychological indicators. This will focus on the target population of young smokers aged 12–24 years.

Conclusion

This study found that the recruitment of young smokers and underprivileged smokers to the CDT programme has improved. Therefore, it has succeeded in reaching a more heterogeneous population. Simultaneously, CDT services, which are mainly hospital-based, register heavy smokers and smokers suffering from tobacco-related diseases and anxio-depressive symptoms as a priority. This study also found an increase in the mean concentration of CO in expired air. This suggests that smokers mainly react to increases in the cost of cigarettes by compensatory smoking or by switching to other products. Policy makers may have to take such findings into account when deciding tax policies on tobacco products.

Ethical approval

Not required.

Funding

Ministry of Health.

Competing interests

None declared.

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