

A step forward, a step back: Smoking cessation & relapse

by Margot Shields

Despite substantial declines in smoking rates over the past 40 years, close to one in four Canadians aged 18 or older smoked in 2003. This rate is high, given that smoking is the single most important risk factor associated with chronic illness¹ and remains the number one preventable cause of death in Canada.² In 1998, approximately 48,000 deaths in Canada were attributable to smoking, an increase of about 25% over the previous decade.² Recent estimates suggest that 50% of smokers will die as a result of a smoking-related illness.³

Smoking is a cause of lung and other cancers, coronary heart disease, stroke and chronic lung disease. Quitting reduces the risks of developing these diseases.^{1,4,5} In fact, regardless of the age of the smoker, quitting lengthens life expectancy.^{2,4} It has been estimated that the risk of mortality for former smokers who have been abstinent for 10 to 15 years approaches the levels of those who never smoked.⁴



Although quitting is one of the most important steps that smokers can take to improve their health, it is not easy. Smoking is highly addictive. It is not uncommon for smokers to have three or four serious quit attempts before successful abstinence, a process that can take several years.^{6,7}

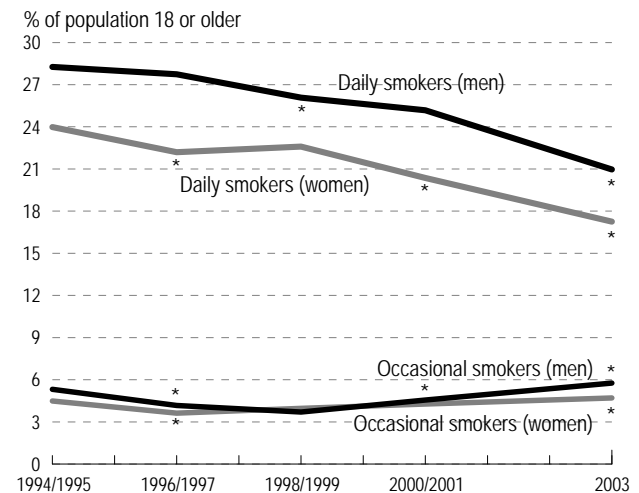
With longitudinal data from five cycles (1994/95 to 2002/03) of the National Population Health Survey (NPHS), this analysis estimates the percentage of daily smokers aged 18 or older who quit over successive two-year periods and examines the factors associated with quitting. A similar analysis shows the percentage of former daily smokers who start smoking daily again and the characteristics that make a relapse more or less likely. (See *Definitions, Data sources, Analytical techniques and Limitations.*)

A downward trend

When Statistics Canada first began collecting information about smoking in the mid-1960s, close to half of Canadian adults smoked cigarettes. Four decades later, in 2003, the figure was 24%. The decline in smoking rates was more pronounced among men than women. In the mid-1960s, men's smoking rate exceeded women's by 22 percentage points (59% versus 37%). By 2003, the difference was five percentage points (27% versus 22%).

Most people who smoke do so daily. As well, trends in daily and occasional smoking differ. Since 1994/95, daily smoking rates have dropped among both sexes, but the percentage of people who smoke occasionally has been relatively stable, fluctuating between 4% and 6% (Chart 1). By 2003, 21% of men aged 18 or older and 17% of women were daily smokers. Both rates were about seven percentage points lower than they had been in 1994/95.

Chart 1
In the last decade, daily smoking has declined, but occasional smoking has been stable



Notes: The daily smoking rate for men is significantly higher than the rate for women for all periods. The occasional smoking rate for men is significantly higher than the rate for women for 2003.

* Significantly different from preceding period ($p < 0.05$)

Data sources: 1994/95, 1996/97 and 1998/99 National Population Health Survey, cross-sectional sample, Health file; 2000/01 and 2003 Canadian Community Health Survey

Quitting

The quit rate is the percentage of people who had been daily smokers in one NPHS cycle, but when they were re-interviewed two years later, reported that they did not smoke. (Because occasional smokers are a small and unique group, the analysis of quitting is limited to daily smokers.)

The percentage of daily smokers who quit over a two-year period has risen since the mid-1990s (Table 1). Between 1994/95 and 1996/97, about 10% of daily smokers quit; between 2000/01 and 2002/03, the percentage was 17%.

Not all smokers were equally likely to quit. Some characteristics and situations seem to facilitate the process, while others may be impediments. For this analysis, quitting is considered in relation to smoking behaviour, health, psycho-social variables, lifestyle, and



Table 1
 Percentage of daily smokers who quit in a two-year period, by sex, household population aged 18 or older, Canada excluding territories, 1994/95 - 2002/03

	Both sexes	Men	Women
	%	%	%
Overall 2-year quit rate	12.7	13.1	12.2
1994/95 - 1996/97	9.6	8.7	10.7
1996/97 - 1998/99	11.8 ¹	12.7 ¹	10.8
1998/99 - 2000/01	13.9 ¹	15.0 ¹	12.8
2000/01 - 2002/03	16.8 ¹	17.9 ¹	15.6 ¹

¹ Significantly higher than 1994/95 to 1996/97 ($p < 0.05$)
 Date source: 1994/95 to 2002/03 National Population Health Survey, longitudinal square file

socio-demographic characteristics. Of course, these factors do not exist in isolation. At older ages, for instance, smokers may develop chronic conditions that would increase their motivation to quit. Or it could be that people who began smoking at a very young age smoke more than people who began later in life. When eight years of NPHS data were examined and such interrelationships were taken into account, several variables emerged as being significantly associated with smoking cessation.

Highly addictive

The addictiveness of nicotine has been cited as the main impediment to smoking cessation.⁸ And indeed, the results of the analysis of NPHS data show that indicators of addiction were associated with the likelihood of quitting. Men and women who were heavy smokers (25 or more cigarettes a day) were much less likely than light smokers (fewer than 10 cigarettes a day) to quit (Appendix Table A).

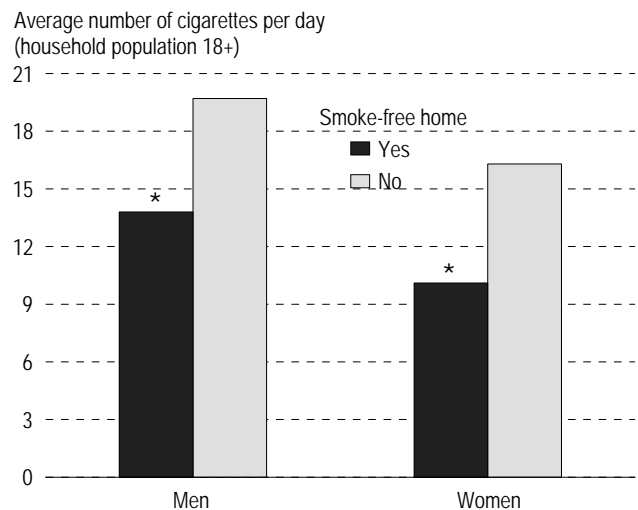
The timing of the first cigarette of the day also indicates the degree of addiction.⁹ Men and women who reported that they had their first cigarette within 30 minutes of waking were less likely to quit than were those who waited for more than an hour.

Men and women who began smoking when they were younger than 18 were less likely to quit than were those who started at older ages.

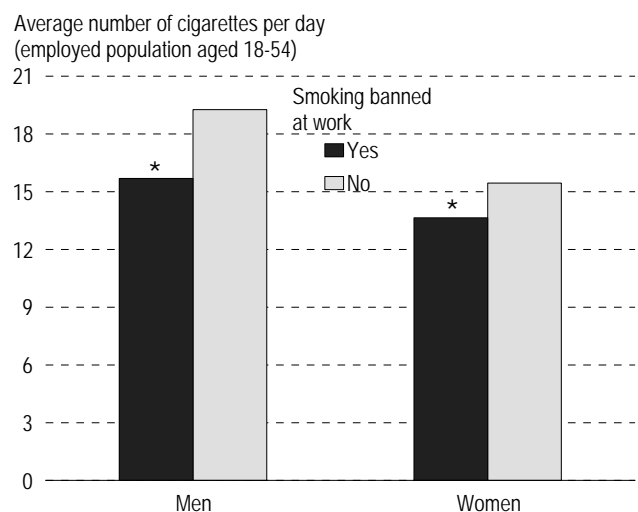
Restricted opportunities

The growing number of constraints on smoking in public places and in private households may be conducive to a behavioural change for smokers.^{1,10,11} Smokers living in smoke-free homes were more likely to quit (17%) than those who did not face such restrictions (12%). However, this finding did not persist for either

Chart 2
 Daily smokers' cigarette consumption is lower in smoke-free homes . . .



. . . and in workplaces with smoking bans



* Significantly lower than "no" ($p < 0.05$)
 Date source: 1994/95 to 2002/03 National Population Health Survey, longitudinal square file



sex when the number of cigarettes smoked per day was taken into account.

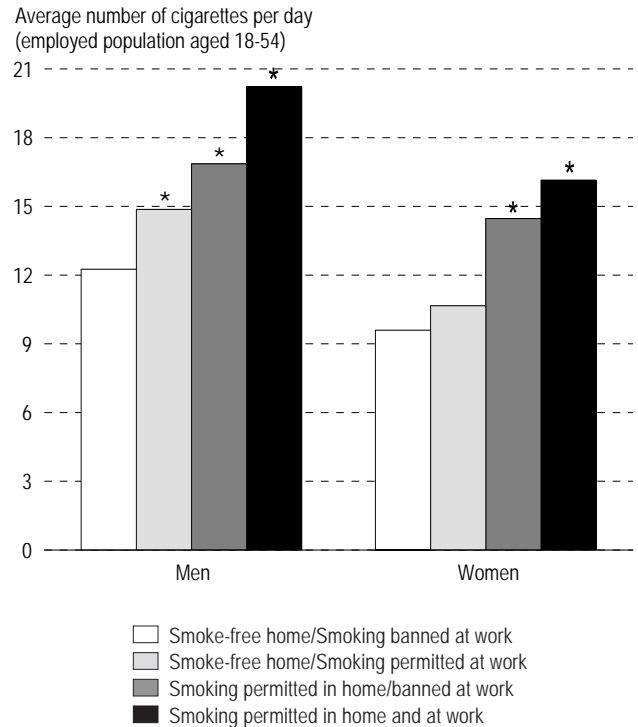
Nonetheless, smoke-free environments were related to cigarette consumption among both sexes. Men who were daily smokers but lived in a smoke-free home averaged 14 cigarettes a day, compared with 20 a day for those in households where smoking was permitted (Chart 2). The corresponding averages for female smokers were 10 and 16 cigarettes a day.

Smoking restrictions at work were also related to cigarette consumption, but to a lesser extent. Male daily smokers employed in workplaces where smoking was banned averaged 16 cigarettes a day, compared with 19 a day for those in locations with partial or no bans; for female smokers, the comparable averages were 14 and 15 cigarettes a day. It is unclear if restrictions cause smokers to reduce their consumption, or if heavy smokers seek workplaces where there are no restrictions. However, some longitudinal studies of worksites before and after the implementation of bans suggest that smokers reduce their consumption after restrictions are introduced.¹²

The combination of living in a smoke-free home and working in a location where smoking is banned yields even larger differences in cigarette consumption (Chart 3). Male daily smokers who lived in smoke-free homes and were also employed in workplaces where smoking was banned averaged 8 fewer cigarettes a day than did those who could smoke at home and at work. For women, the difference was 6.5 cigarettes a day.

Given the strong relationship between the number of cigarettes smoked per day and quitting, the finding that smoke-free homes and workplace bans are related to lower consumption is particularly important. Although restrictions at home and at work may not have an immediate impact on quitting, the reduced consumption levels associated with smoke-free environments may eventually make quitting easier.

Chart 3
The more restrictions that daily smokers encounter, the lower their cigarette consumption



Note: Employed population aged 18 to 54
* Significantly higher than previous categories (p < 0.05)
Data source: 1994/95 to 2002/03 National Population Health Survey, longitudinal square file

A wake-up call?

Even allowing for the strong influence of addiction indicators, a number of health factors played a role in the likelihood of smoking cessation.

Male and female daily smokers who had been newly diagnosed with a vascular condition—heart disease, high blood pressure, stroke or diabetes—were much more likely to quit than those who had not developed such conditions over the same two-year period. However, pre-existing vascular problems were not associated with quitting. Other research, too, has shown that the prevalence of illness^{13,14} is not related to smoking cessation, but recently developed conditions may motivate a smoker to quit.^{15,16}

Somewhat surprisingly, neither a pre-existing nor a newly diagnosed respiratory disease



(chronic bronchitis, emphysema or asthma) was associated with quitting for either sex.

The relationship between weight and smoking cessation is complex. While overweight or obese smokers may be motivated to quit because of the added health risks, concerns about even more weight gain may be a deterrent. Based on NPHS data, overweight or obese daily smokers were no more likely to quit than were those whose weight was in the normal range.

Heavy drinking reduced the likelihood of smoking cessation for women, but was not significant for men.

Upset, alone, stressed out

Psychological distress is measured in terms of the frequency with which an individual feels sad, nervous, restless, hopeless, worthless or that everything is an effort. Emotional support consists of having someone to talk to about private feelings, to count on in a crisis, to give advice about important personal decisions, and to provide love and care. For male smokers, moderate or high psychological distress and low emotional support reduced the odds that they would quit. Neither psychological distress nor emotional support was associated with women's likelihood of quitting.

More important for female smokers was the number of stressors they faced in their day-to-day lives: trying to take on too much at once, feeling that others expect too much, or problems with a partner or children, for example. Women who reported six or more stressors were less likely to quit smoking than were those who reported no stressors or just one. Chronic stress was not associated with quitting for men.

Socio-demographic and lifestyle factors

Several other factors were significantly related to smoking cessation, but those that seemed to make a difference for one sex were often not important for the other.

For instance, female smokers aged 18 to 29 had high odds of quitting compared with those aged 30 to 64. When it comes to smoking

cessation, younger women's advantage over middle-aged women could be related to plans to become pregnant or to actually have done so.^{5,17} Among men, age was not associated with quitting.

Male smokers in homes with young children were more likely to quit than those in households without young children. For female smokers, the presence of young children in the household was not associated with smoking cessation, although it is possible that many women with young children had quit while they were pregnant.¹⁷

Higher levels of education and household income were associated with quitting among both men and women.

Relapsing

Not every smoker who quits, does so for good. Several attempts may be needed before success. Moreover, certain circumstances may be conducive to starting again, even for people who thought that they had finally stopped smoking.

In the NPHS, it was possible to identify "former daily smokers"—people who were non-smokers, but reported that they had been daily smokers in the past. When they were re-interviewed two years later, some of them had resumed daily smoking. They were defined as "relapsers". Over the eight years from 1994/95 to 2002/03, the two-year relapse rate was stable at about 4% (Table 2).

Table 2
Two-year relapse rates among former daily smokers, by sex, household population aged 18 or older, Canada excluding territories, 1994/95 - 2002/03

	Both sexes	Men	Women
	%	%	%
Overall 2-year relapse rate	4.2	3.8	4.7
1994/95 - 1996/97	4.2	3.6 ^{E1}	4.9
1996/97 - 1998/99	4.7	4.1	5.5
1998/99 - 2000/01	4.0	4.3	3.6 ^{E1}
2000/01 - 2002/03	4.0	3.3	4.7 ^{E1}

E Use with caution

1 Coefficient of variation between 16.6% and 33.3%

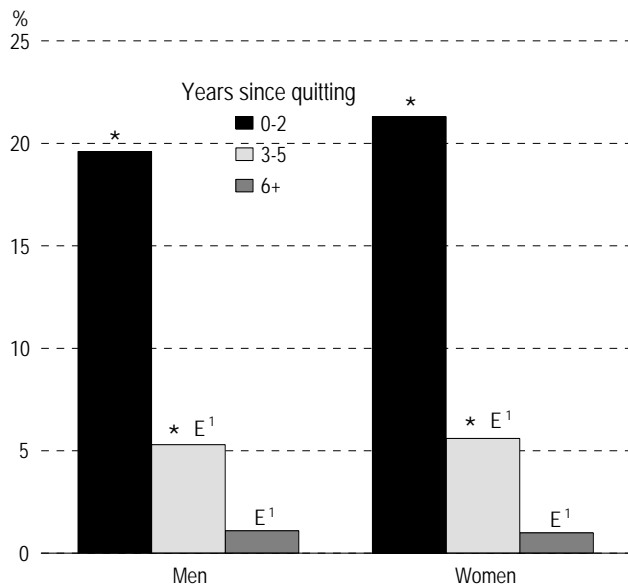
Data source: 1994/95 to 2002/03 National Population Health Survey, longitudinal square file



Years since quitting

Relapsing was strongly associated with the length of time an individual had quit. Approximately one in five men and women who had quit smoking for two years or less had started again within the next two years (Chart 4). By contrast, approximately 5% of former daily smokers who had quit for three to five years had resumed smoking, and among those who had quit for more than five years, the figure was only 1%.

Chart 4
Two-year relapse rates among former daily smokers vary by years since quitting . . .



Note: Based on household population aged 18 or older
 * Significantly higher than subsequent group(s) ($p < 0.05$)
 E Use with caution
 1 Coefficient of variation between 16.6% and 33.3%
 Data source: 1994/95 to 2002/03 National Population Health Survey, longitudinal square file

Level of addiction

Although a high level of addiction reduces the odds of smoking cessation, its relationship with relapsing is less clear.⁷ Women who had been moderate or heavy daily smokers were more likely to relapse, compared with women who had smoked fewer than 10 cigarettes a day (Table B). For men, such a relationship was

evident for moderate, but not heavy, smokers. The age at which an individual had started smoking was not associated with a relapse for either sex.

Smoke-free environments

The presence of smokers in the household or in the immediate social environment of a former smoker has been identified as a predictor of relapse.^{7,18} According to the results of the analysis of NPHS data, men living in smoke-free homes were much less likely to start smoking again than were those in households where smoking was permitted. However, living in a smoke-free home was not related to relapsing among women.

On the other hand, women employed in locations where smoking was banned were less likely to relapse than were those who were permitted to smoke at work (data not shown). Relapse rates for men were similar regardless of workplace smoking restrictions.

Few consistent patterns

No associations were found between relapsing and having a vascular condition for either sex. However, women who had a respiratory condition were less likely to relapse. Overweight or obese men were less likely to relapse than were men of acceptable weight. For women, weight was not related to relapsing.

Emotional support was not associated with relapsing among former smokers of either sex, although for women, elevated levels of chronic stress and psychological distress were related to starting to smoke again.

Some studies have found a positive association between alcohol use and relapsing,^{7,19,20} but based on NPHS data, heavy drinking was not associated with a relapse.

While smokers with high levels of education and household income had high odds of quitting, neither education nor household income was significantly related to relapsing.

Young women (18 to 29) were more likely than middle-aged women to quit smoking, but they were also more likely to start again.



Concluding remarks

In 2003, 19% of the Canadian population aged 18 or older smoked cigarettes daily. Although this was down 7 percentage points from the mid-1990s, it is still high given the serious health consequences. According to a recent study, the gap in life expectancy between smokers and non-smokers has been widening over the past few decades.³ This disturbing trend reinforces the need to understand the factors associated with successful smoking cessation.

Based on longitudinal results from the National Population Health Survey, the level of addiction, particularly the number of cigarettes smoked per day, was one of the most important factors related to quitting. For relapsing, the strongest factor was the number of years of abstinence.

The relationship between women's emotional state and smoking is particularly notable. Chronic stress—having too much to do in little time, trying to meet others' expectations, not feeling appreciated, ongoing relationship difficulties and financial problems, for example—reduced the likelihood that women would stop smoking and increased the likelihood that those who had stopped would start again. Similarly, women who had quit but reported high psychological distress were likely to relapse.

Smoke-free homes and workplace bans were associated with reduced cigarette consumption for both sexes. This finding is particularly relevant in light of the link between smoking intensity and the likelihood of quitting. A reduction in the number of cigarettes smoked per day may be a first step along the difficult road to successful cessation. ■■

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Appendix

Table A

Adjusted odds ratios relating selected characteristics of daily smokers to quitting in a two-year period, by sex, household population aged 18 or older, Canada excluding territories, 1994/95 to 2002/03

	Men		Women		Men		Women	
	Adjusted odds ratio ¹	95% confidence interval	Adjusted odds ratio ¹	95% confidence interval	Adjusted odds ratio ¹	95% confidence interval	Adjusted odds ratio ¹	95% confidence interval
Smoking variables								
Cigarettes per day								
1-9 (light)	2.5 ⁶	1.7, 3.7	1.7 ⁶	1.1, 2.5				
10-24 (moderate)	1.1	0.9, 1.5	1.0	0.7, 1.4				
25 or more (heavy) ²	1.0	...	1.0	...				
First cigarette of day³								
Within 30 minutes of waking	0.6 ⁶	0.4, 0.8	0.7 ⁶	0.5, 1.0				
31 to 60 minutes after waking	0.8	0.5, 1.1	1.0	0.7, 1.4				
More than 60 minutes after waking ²	1.0	...	1.0	...				
Age of smoking initiation								
Younger than 18 ²	1.0	...	1.0	...				
18 or older	1.4 ⁶	1.1, 1.7	1.3 ⁶	1.0, 1.6				
Smoke-free home								
Yes	1.1	0.8, 1.6	1.3	1.0, 1.9				
No ²	1.0	...	1.0	...				
Smoking banned at work³ (workers aged 18-54)								
Yes	0.9	0.7, 1.4	0.8	0.6, 1.2				
No ²	1.0	...	1.0	...				
Chronic conditions								
Vascular								
At least one new condition	2.9 ⁶	2.0, 4.2	2.4 ⁶	1.7, 3.3				
At least one existing condition	0.8	0.6, 1.2	1.1	0.7, 1.5				
None ²	1.0	...	1.0	...				
Respiratory								
At least one new condition	0.8	0.5, 1.5	0.7	0.4, 1.2				
At least one existing condition	0.8	0.5, 1.2	1.0	0.7, 1.4				
None ²	1.0	...	1.0	...				
Health behaviours								
Body mass index (BMI)								
Not overweight (< 25) ²	1.0	...	1.0	...				
Overweight/Obese (≥ 25)	1.1	0.9, 1.4	1.1	0.8, 1.3				
Heavy monthly drinking								
Yes	0.8	0.6, 1.0	0.7 ⁶	0.5, 0.9				
No ²	1.0	...	1.0	...				
Psycho-social factors								
Psychological distress								
Low ²	1.0	...	1.0	...				
Moderate	0.7 ⁶	0.6, 0.9	0.9	0.7, 1.2				
High	0.7 ⁶	0.5, 1.0	0.9	0.7, 1.3				
Low emotional support⁴								
Yes	0.6 ⁶	0.4, 0.9	0.8	0.5, 1.3				
No ²	1.0	...	1.0	...				
Chronic stress⁵								
0-1 stressors (low) ²	1.0	...	1.0	...				
2-5 stressors (moderate)	1.2	0.8, 1.9	0.8	0.5, 1.2				
6+ stressors (high)	1.0	0.6, 1.7	0.5 ⁶	0.3, 0.8				
Socio-demographic factors								
Age group								
18-29	1.0	0.8, 1.4	1.5 ⁶	1.1, 2.0				
30-64 ²	1.0	...	1.0	...				
65+	1.3	0.9, 1.9	1.1	0.7, 1.5				
Education								
Less than secondary graduation	1.2	0.8, 1.6	1.2	0.9, 1.7				
Secondary graduation ²	1.0	...	1.0	...				
Some postsecondary	1.6 ⁶	1.1, 2.2	1.2	0.9, 1.7				
Postsecondary graduation	1.5 ⁶	1.1, 2.2	1.4 ⁶	1.1, 1.9				
Household income								
Low/Lower-middle ²	1.0	...	1.0	...				
Middle/Upper-middle/High	1.7 ⁶	1.2, 2.3	1.4 ⁶	1.1, 1.8				
Child(ren) aged 5 or younger in household								
Yes	1.4 ⁶	1.0, 1.8	0.9	0.7, 1.2				
No ²	1.0	...	1.0	...				

Note: Because of rounding, some confidence intervals with 1.0 as lower/upper limit are significant.

¹ Adjusted for cigarettes per day, age of smoking initiation, smoke-free home status, chronic conditions (vascular and respiratory), BMI, heavy monthly drinking, psychological distress, age, education, household income and children aged 5 or younger in household

² Reference category

³ Based on cohorts 2, 3 and 4 (see Analytical techniques)

⁴ Based on cohorts 1 and 2 (see Analytical techniques)

⁵ Based on cohorts 1 and 4 (see Analytical techniques)

⁶ $p < 0.05$

... Not applicable

Data source: 1994/95 to 2002/03 National Population Health Survey, longitudinal square file



Table B
Adjusted odds ratios relating selected characteristics of former daily smokers to relapsing in a two-year period, by sex, household population aged 18 or older, Canada excluding territories, 1994/95 to 2002/03

	Men		Women		Men		Women	
	Adjusted odds ratio ¹	95% confidence interval	Adjusted odds ratio ¹	95% confidence interval	Adjusted odds ratio ¹	95% confidence interval	Adjusted odds ratio ¹	95% confidence interval
Smoking variables								
Years since quitting								
2 or less	18.9 ⁵	12.0, 29.7	18.3 ⁵	11.1, 30.1				
3-5	4.3 ⁵	2.4, 7.6	4.4 ⁵	2.4, 8.2				
More than 5 ²	1.0	...	1.0	...				
Cigarettes per day								
1-9 (light) ²	1.0	...	1.0	...				
10-24 (moderate)	2.1 ⁵	1.2, 3.7	2.5 ⁵	1.5, 4.3				
25 or more (heavy)	1.6	0.8, 3.2	2.9 ⁵	1.6, 5.4				
Age of smoking initiation								
Younger than 18	1.1	0.7, 1.7	1.2	0.8, 1.8				
18 or older ²	1.0	...	1.0	...				
Smoke-free home								
Yes	0.6 ⁵	0.4, 0.9	1.0	0.6, 1.6				
No ²	1.0	...	1.0	...				
Chronic conditions								
Vascular								
One or more	1.0	0.6, 1.6	0.7	0.4, 1.1				
None ²	1.0	...	1.0	...				
Respiratory								
One or more	1.3	0.7, 2.5	0.5 ⁵	0.3, 1.0				
None ²	1.0	...	1.0	...				
Health behaviours								
Body mass index (BMI)								
Not overweight (< 25) ²	1.0	...	1.0	...				
Overweight/Obese (≥ 25)	0.6 ⁵	0.5, 0.9	1.1	0.8, 1.5				
Heavy monthly drinking								
Yes	1.1	0.7, 1.5	1.4	0.7, 2.5				
No ²	1.0	...	1.0	...				
Psycho-social factors								
Psychological distress								
Low ²	1.0	...	1.0	...				
Moderate	1.0	0.7, 1.5	0.9	0.6, 1.4				
High	0.9	0.5, 1.7	1.7 ⁵	1.0, 2.8				
Low emotional support³								
Yes	0.9	0.5, 1.6	1.6	0.8, 3.0				
No ²	1.0	...	1.0	...				
Chronic stress⁴								
0-1 stressors (low) ²	1.0	...	1.0	...				
2-5 stressors (moderate)	1.0	0.5, 1.8	1.9 ⁵	1.1, 3.4				
6+ stressors (high)	1.0	0.4, 2.3	2.8 ⁵	1.4, 5.6				
Socio-demographic factors								
Age group								
18-29	1.0	0.7, 1.7	2.1 ⁵	1.3, 3.4				
30-64 ²	1.0	...	1.0	...				
65+	0.5	0.3, 1.1	0.7	0.4, 1.3				
Education								
Less than secondary graduation	1.0	0.6, 1.8	1.2	0.7, 2.1				
Secondary graduation ²	1.0	...	1.0	...				
Some postsecondary	1.0	0.6, 1.9	1.2	0.7, 2.0				
Postsecondary graduation	0.9	0.5, 1.7	0.9	0.6, 1.6				
Household income								
Low/Lower-middle	1.4	0.9, 2.4	1.2	0.8, 1.7				
Middle/Upper-middle/High ²	1.0	...	1.0	...				
Child(ren) aged 5 or younger in household								
Yes	1.5	1.0, 2.4	0.9	0.6, 1.3				
No ²	1.0	...	1.0	...				

Note: Because of rounding, some confidence intervals with 1.0 as lower/upper limit are significant.

¹ Adjusted for years since quitting, cigarettes per day, age of smoking initiation, smoke-free home status, chronic conditions (vascular and respiratory), BMI, heavy monthly drinking, psychological distress, age, education, household income and children aged 5 or younger in household

² Reference category

³ Based on cohorts 1 and 2 (see Analytical techniques)

⁴ Based on cohorts 1 and 4 (see Analytical techniques)

⁵ $p < 0.05$

... Not applicable

Data source: 1994/95 to 2002/03 National Population Health Survey, longitudinal square file



Definitions

To classify smokers, the National Population Health Survey (NPHS) and the Canadian Community Health Survey (CCHS) asked:

1. At the present time do you smoke cigarettes daily occasionally or not at all?
2. Have you ever smoked cigarettes daily?

Daily smokers are those who answered "daily" to question 1; *occasional smokers* are those who answered "occasionally." *Former daily smokers* are those who answered "not at all" to question 1 and "yes" to question 2.

Smoking cessation and relapsing were defined by considering successive pairs of cycles of the NPHS, which is conducted every two years. For each pair of cycles, smoking status was derived for the baseline and follow-up interviews. *Quitters* were those who reported smoking cigarettes daily at the baseline interview and not at all at the follow-up interview. *Relapsers* were former daily smokers at the baseline interview, who reported that they smoked daily at the follow-up interview.

Smoking intensity was assessed by asking daily smokers and former daily smokers the number of cigarettes they smoke (smoked) each day. Light smokers were those who answered 1-9; moderate smokers, 10-24, and heavy smokers, 25 or more.

Age of smoking initiation was established with the question: "At what age did you begin smoking cigarettes daily?" Responses were grouped into two categories: younger than 18 and 18 or older.

The timing of the *first cigarette of the day* was based on the question: "How soon after you wake up do you smoke your first cigarette?" The possible response categories were: within 5 minutes, 6 to 30 minutes after waking, 31 to 60 minutes after waking, and more than 60 minutes after waking.

A *smoke-free home* was identified by a response of "no" to the question: "Does anyone in this household smoke regularly inside the house?"

Workplace smoking restrictions were measured by asking employed NPHS respondents about smoking restrictions at their workplace. The possible responses were: restricted completely, allowed only in designated areas, restricted only in certain places, and not restricted at all. The "restricted completely" group was compared with the other three categories combined.

Three *age groups* were established for this analysis: 18 to 29, 30 to 64, and 65 or older.

NPHS respondents were grouped into four *education* categories based on the highest level attained: less than secondary graduation, secondary graduation, some postsecondary, and postsecondary graduation.

Household income was based on the number of people in the household and total household income from all sources in the 12 months before the interview.

Household income group	People in household	Total household income
Lowest	1 to 4	Less than \$10,000
	5 or more	Less than \$15,000
Lower-middle	1 or 2	\$10,000 to \$14,999
	3 or 4	\$10,000 to \$19,999
	5 or more	\$15,000 to \$29,999
Middle	1 or 2	\$15,000 to \$29,999
	3 or 4	\$20,000 to \$39,999
	5 or more	\$30,000 to \$59,999
Upper-middle	1 or 2	\$30,000 to \$59,999
	3 or 4	\$40,000 to \$79,999
	5 or more	\$60,000 to \$79,999
Highest	1 or 2	\$60,000 or more
	3 or more	\$80,000 or more

Respondents were asked if they had "any long-term health conditions that have lasted or are expected to last six months or more that have been diagnosed by a health professional." The interviewer then read a checklist. Two groups of *chronic conditions* were considered in this analysis: *vascular conditions* (high blood pressure, heart disease, the effects of a stroke, and diabetes) and *respiratory conditions* (asthma and chronic bronchitis or emphysema). In the analysis of quitting smoking, three categories were considered for each group of conditions: those who reported one or more newly diagnosed condition(s) between the baseline and follow-up interview; those who did not have a new condition but had reported at least one condition at the baseline year, and those with no conditions.

Heavy drinking was measured by asking respondents the number of times in the past year they had five or more alcoholic drinks on one occasion. Those who reported at least once a month were classified as heavy drinkers. (In cycle 1, NPHS respondents were asked the exact number of times in the past year they had five or more drinks on one occasion. Heavy drinkers were defined as those who responded 12 or more times.)

Weight was defined in terms of body mass index (BMI), which was calculated by dividing weight in kilograms by the square of height in metres. BMI is not calculated for pregnant women. Based on the World Health Organization's standards,²¹ BMI was grouped into two categories: overweight or obese (BMI 25 or more), and not overweight (less than 25.0).



Definitions - continued

Four "yes/no" questions were used to measure perceived *emotional support*.

- Do you have someone you can talk to about your private feelings or concerns?
- Do you have someone you can really count on in a crisis situation?
- Do you have someone you can really count on to give you advice when you are making important personal decisions?
- Do you have someone who makes you feel loved and cared for?

Respondents were classified as having low emotional support if they answered "no" to at least one question.

Psychological distress was based on responses to the following questions:

- During the past month, about how often did you feel:
- ... so sad that nothing could cheer you up?
 - ... nervous?
 - ... restless or fidgety?
 - ... hopeless?
 - ... worthless?
 - ... that everything was an effort?

Each question was answered on a five-point scale: all of the time (score 4), most of the time (3), some of the time (2), a little of the time (1), or none of the time (0). Responses were scored and summed; the possible range was 0 to 24, with a higher score indicating more distress. High distress was defined as a score of 7 or more (an average score per item of over 1); moderate distress as 1 to 6, and low distress as 0.

Chronic stress was measured by asking respondents to reply "true" or "false" to 17 statements:

- 1) You are trying to take on too many things at once.
- 2) There is too much pressure on you to be like other people.
- 3) Too much is expected of you by others.
- 4) You don't have enough money to buy the things you need.
- 5) Your partner doesn't understand you.
- 6) Your partner doesn't show enough affection.
- 7) Your partner is not committed enough to your relationship.
- 8) You find it is very difficult to find someone compatible with you.
- 9) One of your children seems very unhappy.
- 10) A child's behaviour is a source of serious concern to you.
- 11) Your work around the home is not appreciated.
- 12) Your friends are a bad influence.
- 13) You would like to move but you cannot.
- 14) Your neighbourhood or community is too noisy or too polluted.
- 15) You have a parent, a child or partner who is in very bad health and may die.
- 16) Someone in your family has an alcohol or drug problem.
- 17) People are too critical of you or what you do.

Respondents were classified as having high stress if they replied "true" to 6 or more items, moderate stress for 2 to 5 items, and low stress for 1 or 0 items.



Data sources

The time series smoking data in this article for 1994/95 to 2003 are from the National Population Health Survey and the Canadian Community Health Survey. The data for the mid-1960s are from the 1966 Survey of Smoking Habits and pertain to the population aged 17 or older.

National Population Health Survey: Since 1994/95, Statistics Canada's biennial National Population Health Survey (NPHS) has collected information about the health of the Canadian population. The survey covers household and institutional residents in all provinces and territories, except residents of Indian reserves, Canadian Forces bases, and some remote areas.

For each of the first three cycles (1994/95, 1996/97 and 1998/99), two cross-sectional files were produced: General and Health. The General file contains socio-demographic and some health information for each member of participating households (collected using the General questionnaire). The Health file contains additional, in-depth health information (collected using the Health questionnaire) about one randomly selected household member, as well as the information from the General file pertaining to that individual. Starting in 2000/01 (cycle 4), the NPHS became strictly longitudinal, and the General and Health questionnaires were combined.

For the first three cycles, two cross-sectional response rates are calculated: household and person. The household response rate is based on the number of households where at least the General questionnaire was completed for the randomly selected respondent. The General file for each cycle is made up of records for all members of these responding households. The person response rate is based on responding households for which the Health questionnaire was completed for the randomly selected respondent. In 1994/95, the household response rate was 88.7%, and the person response rate was 96.1%. The rates were 82.6% and 95.6% in 1996/97; in 1998/99, 87.6% and 98.5%.

The time series smoking data presented in this article for 1994/95, 1996/97 and 1998/99 were calculated using the NPHS cross-sectional health files for those years. The rates are based on the household population aged 18 or older in the 10 provinces.

A longitudinal file is also produced for each cycle. In 1994/95, a member of each selected household was randomly chosen to be in the longitudinal panel (17,276), and these longitudinal panel members were followed over time. The response rates for this panel were 92.8% in cycle 2 (1996/97), 88.2% in cycle 3 (1998/99), 84.8% in cycle 4 (2000/01), and 80.6% in cycle 5 (2002/03). The analyses of factors associated with smoking cessation and relapsing in this article are based on the cycle 5 (2002/03) longitudinal "square" file, which contains records for all originally selected panel members about whom cycle 1 information is available, regardless of whether information about them was obtained in later cycles. More detailed descriptions of NPHS design, sample and interviewer procedures can be found in published reports.^{22,23}

Canadian Community Health Survey: The time series smoking rates for 2001/02 and 2003 are based on data for the population aged 18 or older from the Canadian Community Health Survey (CCHS), cycles 1.1 and 2.1. The CCHS collects cross-sectional information about the health of Canadians every two years. The survey covers the household population aged 12 or older in the provinces and territories, except residents of Indian reserves, Canadian Forces bases, and some remote areas. Cycle 1.1 began in September 2000 and continued over 14 months. The majority of interviews were conducted face-to-face. The response rate was 84.7%, yielding a sample of 131,535 respondents. Cycle 2.1 began in January 2003 and ended in December that year. Most interviews were conducted by telephone. The response rate was 80.6%, yielding a sample of 135,573 respondents. A description of the CCHS methodology is available in a published report.²⁴



Analytical techniques

Daily and occasional smoking prevalence rates from 1994/95 to 2003 were estimated using cross-sectional data from the National Population Health (NPHS) Survey and the Canadian Community Health Survey (CCHS).

The analyses of factors associated with smoking cessation and relapsing were based on longitudinal data from cycles 1 to 5 of the NPHS (1994/95 to 2002/03). The technique used for both sets of analyses was "pooling of repeated observations" combined with logistic regression analysis.^{15,25} This technique is particularly useful in predicting the short-term risk of an event where it is expected that the risk factors associated with the event may change over time.²⁵ This is the case for smoking cessation, during which most smokers relapse several times before success. As well, risk factors such as emotional support and stress levels may change over time.⁴

The analysis of factors associated with smoking cessation was based on four cohorts of pooled observations. The baseline years for these four cohorts were 1994/95, 1996/97, 1998/99 and 2000/01. For each baseline year, all daily smokers aged 18 or older were selected. A quitter was defined as someone who reported not smoking at all in the follow-up interview two years later.

Sample sizes for daily smokers and quitters

Cohort	Daily smokers (baseline)		Quitters (follow-up)	
	Men	Women	Men	Women
1 1994/95-1996/97	1,650	1,701	146	180
2 1996/97-1998/99	1,538	1,532	189	157
3 1998/99-2000/01	1,325	1,413	180	195
4 2000/01-2002/03	1,095	1,145	178	181
Total	5,608	5,791	693	713

Logistic regression analysis was then used on this set of pooled observations to examine characteristics of smokers at the baseline of each two-year interval in relation to having quit two years later. Multiple logistic regression analysis was used to estimate the effect of each factor conditional on the effects of a combination of factors. Variables entered into the multivariate model

were selected based on the literature and availability in the NPHS: smoking intensity, age of smoking initiation, smoke-free home status, age, education, household income, presence of young children in the household, chronic conditions (vascular and respiratory), BMI, heavy monthly drinking and psychological distress. Some variables were not asked in every cycle. In such cases, the logistic regression models were run only on the cohorts for whom information was collected in the baseline year. These variables included timing of the first cigarette of the day (cohorts 2, 3, 4), workplace smoking bans (cohorts 2, 3, 4), social support (cohorts 1, 2), and chronic stress (cohorts 1, 4).

The analysis of factors associated with relapsing was carried out in a similar fashion. For each of the four baseline years, former daily smokers aged 18 or older were selected (someone who did not currently smoke but in the past had smoked daily). A "relapser" was someone from this population who reported that they smoked daily at the follow-up interview two years later.

Sample sizes for former daily smokers and "relapsers"

Cohort	Former daily smokers (baseline)		"Relapsers" (follow-up)	
	Men	Women	Men	Women
1 1994/95-1996/97	1,602	1,429	68	69
2 1996/97-1998/99	1,595	1,449	72	84
3 1998/99-2000/01	1,522	1,382	67	48
4 2000/01-2002/03	1,575	1,551	54	64
Total	6,294	5,811	261	265

Logistic regression was used to identify factors associated with relapsing, taking account of variables similar to those in the quitting models. Again, associations with variables asked only in certain NPHS cycles were studied based on the applicable cohorts.

Variances on smoking prevalence rates, quitting rates, recidivism rates, differences between rates and differences between odds ratios were calculated using the bootstrap technique, which accounts for survey design effects.²⁶⁻²⁸



Limitations

The information on smoking status and smoking intensity is self-reported, so some smokers may not admit that they smoke or underestimate the amount they smoke. Nonetheless, several validity studies have found that self-reported smoking information is concordant with biochemical assessments.²⁹

The definition of quitting in this analysis required only that smokers report that they did not smoke at the follow-up interview two years after the baseline interview. The time since quitting is unknown, so the group may include people who quit the day before the follow-up interview, as well as some who had been non-smokers for almost two years. Similarly, some who began smoking again may have relapsed the day before the follow-up interview, while others may have resumed smoking close almost two years earlier. The extent to which such diversity among quitters and “relapsers” affected associations with baseline factors is unknown.

To maximize sample size and increase precision, the sample considered for the smoking cessation and relapsing analyses comprised all respondents to cycle 1 of the National Population Health Survey (NPHS), regardless of their response status in subsequent cycles. For the smoking cessation analysis, two-year quitting records were created for all cases where a respondent was a daily smoker in the baseline year and smoking status was known in the follow-up interview (see *Analytical techniques*). Likewise, two-year relapse records were created for respondents who were former daily smokers at the baseline year and smoking status was known in the follow-up interview. If there was a non-response in either the baseline or follow-up interview, records were not created for inclusion in the analyses. The survey weights used were based on response status in cycle 1 and were not inflated to account for subsequent non-

response. This may have biased the estimates if the characteristics of continuers in the longitudinal panel differed from non-respondents.

To assess the potential for non-response bias, the characteristics at the baseline interview were compared for continuers and dropouts. In total, 12,750 respondents were identified as being daily smokers across the four baseline interviews; 11,399 were included in the analysis, and 1,351 were excluded due to non-response in the follow-up interview. For the relapse analysis, 13,083 former daily smokers were identified across the four baseline interviews; 12,105 were included in the analysis, and 978 were dropouts. For both analyses, dropouts were slightly more likely to be males, young (12 to 29), and to have low incomes. For the quitting analysis, dropping out was also associated with having less than secondary graduation. Smoking intensity was not associated with dropping out in either analysis.

In some cases, small sample sizes prevented examining certain variables. For example, although being diagnosed with cancer may be related to quitting, sample sizes were too small to consider this variable. As well, sample size constraints necessitated broad age groups (18 to 29, 30 to 64, and 65 or older), which may have masked associations that would have been evident if finer age breakdowns had been possible.

The NPHS collects information about smoking status for the selected respondent only; the smoking status of other household members is not known. Therefore, it was not possible to determine if the presence of other smokers in the household was related to quitting or relapsing. Furthermore, if the effects of this variable could have been controlled, this might have altered associations between quitting, relapsing and smoke-free home status.

