

RESEARCH PAPER

Individual-level predictors of cessation behaviours among participants in the International Tobacco Control (ITC) Four Country Survey

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Background: The International Tobacco Control (ITC) Four Country Survey (ITC-4) is a prospective cohort study designed to evaluate the psychosocial and behavioural impact of national-level tobacco control policies enacted in the Australia, Canada, the UK, and the USA. Wave 1 of ITC-4 survey was conducted between October 2002 and December 2002. Wave 2 survey was conducted between May 2003 and August 2003.

Objective: To test for individual-level predictors of smoking cessation behaviours (that is, quit attempts and smoking cessation) among cigarette smokers in the ITC Four Country Study measured between Wave 1 and Wave 2. This set of predictors will serve as the base for evaluating the added effect of tobacco control policies and other factors.

Methods: Respondents included in this study are 6682 adult current smokers in the Wave 1 main survey who completed the Wave 2 follow-up (1665 were in Canada, 1329 were in the USA, 1837 were in the UK and 1851 were in Australia).

Results: Factors predictive of making a quit attempt included intention to quit, making a quit attempt in the previous year, longer duration of past quit attempts, less nicotine dependence, more negative attitudes about smoking, and younger age. Lower levels of nicotine dependence were the main factor that predicted future cessation among those that made a quit attempt.

Conclusion: Intention to quit and other cognitive variables were associated with quit attempts, but not cessation. Behavioural variables related to task difficulty, including measures of dependence, predicted both making attempts and their success. Predictors of making quit attempts and cessation were similar for each of the four countries, but there were some differences in predictors of success.

Trends in tobacco use behaviours vary in different regions of the world.¹ In the four large developed nations that are the focus of this paper and where on some level each society has taken on the tobacco problem by at least educating the public about the risks and implementing other tobacco control measures, the smoking prevalence rates have decreased over time. In the United States, smoking prevalence among adults (18 years or older) decreased from 33.2% in 1980 to 22.8% in 2001.² In Canada, smoking prevalence dropped from 35.1% in 1985 to 21.7% in 2001.³ Australia also experienced a continual decline in the prevalence of smoking from 35% in 1980 to 23% in 2001.⁴ Smoking rates in the United Kingdom have declined from 39% in 1980 to 27% in 2001.⁵

In contrast, different patterns of smoking exist in many lower income countries where smoking rates are high, often, but not always, with higher rates among males compared with females.^{6,7} Given the difference between countries and the importance of smoking cessation, studies are needed to compare and contrast the predictors of quitting in these countries.

The central aim of this paper is to test a model of proximal individual level predictors of quitting that was built into the International Tobacco Control (ITC) Four Country Survey (ITC-4) and to test whether this model applies in all four countries studied. The essence of the model is a combination of expectancy-value models⁸ and behavioural predictors. Classical expectancy value theories such as the theory of planned behaviour⁹ have most, if not all, cognitive predictors mediated through intentions, while social cognitive theory¹⁰ does not incorporate intentions. However, in concert with the

empirical evidence that shows that variables that predict the intention to quit include stronger desire to quit and knowledge and perceptions of smoking,^{11–13} we postulate that at least some cognitive variables will predict quitting independent of intention. This is because smoking is a difficult behaviour to change, and most current smokers have tried and thus failed. In addition, behavioural variables are added to these measures because past behaviour is a strong predictor of future behaviour.

Attempting to quit smoking has two major components, actually initiating an attempt and maintaining cessation once quit. These are two quite distinct tasks, so we should not expect the predictors to be equivalent.^{14,15} For example, self-efficacy is more constantly predictive of success than it is of making attempts.^{14,16} Other studies examining factors predicting making a quit attempt found they include motivation to quit and past quit attempts,^{14,17,18} indicators of nicotine dependence,^{17–20} concern for health effects caused by smoking,¹⁵ and demographic factors such as younger age, white race and higher education.^{18,20–22}

Factors that have been associated with quitting success include level of nicotine dependence,^{14–18,23–34} self-efficacy,^{14,16} demographics including older age, male sex, white race, and higher socioeconomic status,^{14,21,23,25,30,33,35,36} stronger desire to quit,^{12,14,21,23,24,32} and longer length of past quit attempt.^{35,37}

There are several studies that examine basic intrinsic predictors of cessation,^{14,15,23–27,29} although few utilise nationally representative samples of smokers (or even samples that

Abbreviations: CPD, cigarettes per day; HSI, heaviness of smoking index; ITC-4, International Tobacco Control Four Country Survey

are drawn from non-help-seeking populations) and even fewer that compare predictors of cessation across countries. Comparing differences in predictors of tobacco use behaviours across countries offers the opportunity to gauge the extent to which differences in tobacco control environments and socio-cultural factors may contribute to varying trends in tobacco use behaviours in contrast to individual-level or intrinsic factors such as nicotine dependence, and also to explore the universality of some influences.

The central goal of the ITC Project is to understand the mediational pathways by which policies impact on cessation behaviour.³⁸ The set of predictors identified here will be used in other studies on the ITC dataset for some analyses, whereas more detailed mediational models may be used in others, to attempt to understand how and why policies influence behaviours.

METHODS

Data source

Data analysed in this paper came from the first two waves of the ITC-4 Survey. A detailed description of ITC-4 Survey can be found elsewhere.³⁸⁻⁴⁰ Briefly, the ITC-4 Survey is a prospective cohort study designed to evaluate the psychosocial and behavioural impact of key national-level tobacco control policies enacted in Australia, Canada, the UK, and the USA. All aspects of the study protocol and survey measures are standardised across the four countries.

Wave 1 of the ITC-4 Survey was conducted between October 2002 and December 2002. The Wave 1 survey could be divided into two stages. During the recruitment stage, random digit dialling was used to recruit current smokers aged 18 years or older within strata defined by geographic region and community size in the four countries. Qualifying respondents were asked to participate in a 35-minute survey (the main survey) and the subsequent follow-up surveys. The main survey was conducted typically one week after the recruitment. Study participants were asked questions in several policy domains. A total number of 9058 respondents completed the Wave 1 main survey, which included 2214 in Canada, 2401 in the UK, 2138 in the USA, and 2305 in Australia. Among these 8915 respondents reported that they were still smoking at the time of the main interview.

The Wave 2 follow-up survey was conducted between May 2003 and August 2003 among respondents who completed the Wave 1 survey. A total number of 6754 respondents completed the follow-up survey (follow-up rate 75%). Respondents included in this study are current smokers in Wave 1 main survey who completed Wave 2 follow-up and responded to at least 80% of the survey. A total number of 6682 respondents met these criteria. Among them, 1665 were in Canada, 1329 were in the USA, 1837 were in the UK, and 1851 were in Australia. The follow-up completion rate in each country was: 75% in Canada, 63% in the USA, 78% in the UK, and 81% in Australia.

Outcome measures

The outcomes assessed in this study were: (1) quit attempts; (2) quitting among those who made a quit attempt; and (3) quitting among the entire baseline sample. All data are based on self-report and are not subject to biochemical validation. At Wave 1, all respondents were current smokers defined as having smoked at least 100 cigarettes in their lifetime and currently smoking on at least a monthly basis. Definitions of each outcome are given below.

A subject was defined as having made a quit attempt if they responded affirmatively to the question, "Have you made any attempts to stop smoking since we last talked with you in [month of last interview]?"

Successful smoking cessation was defined as a current smoker at Wave 1 who now reports not smoking at all or smoking less than once per month in Wave 2 based on the following questions, "The last time we spoke to you in [month] you said that you smoked [daily/weekly/monthly]. Do you still smoke [daily/weekly/monthly]?" Those who indicated otherwise were then asked if they are now smoking daily, less than daily but at least once a week, less than once a week but at least once a month, or less than once per month. Those who reported they smoked less than once per month were defined as quitters in Wave 2. Two models are constructed using this outcome. The first is restricted only to those who made a quit attempt, and the second model includes all Wave 1 smokers.

Core predictor variables

The following core set of predictor variables is examined in this study.

Sociodemographic variables

- Country (Australia, Canada, UK, and USA)
- Age at recruitment, in years (18–24, 25–39, 40–54, 55 and older)
- Sex (female, male)
- Education (low, moderate, high): The education questions differed among the four countries due to different educational systems. For each country, low levels of education were considered to be: completed high school or less in Canada, USA, and Australia, or secondary/vocational 3 or less in the UK; moderate levels were considered to be: community college/trade/technical school/some university (no degree) in Canada and the USA, college/university (no degree) in the UK, or technical/trade/some university (no degree) in Australia; and high levels were those who completed university or postgraduate in all countries.
- Income (low, moderate, high): In this study, those whose annual household income was less than \$30 000 (or £30 000 in the UK) were coded as "low income", those between \$30 000 and \$59 999 (or £30 000 and £44 999 in the UK) were coded as "moderate income", and those equal to or greater than \$60 000 (or £45 000 in the UK) were coded as "high income". Those who refused to provide their income were given a valid code for "refused".
- Identified minority group: We used the primary means of identifying minorities used in official surveys conducted in each nation, and this was racial/ethnic group (USA, Canada, and UK) and language other than English spoken at home (Australia). Respondents were classified as being in the majority group if they were white (USA, Canada, UK) or spoke English in the home (Australia) and were defined in the identified minority group otherwise.

Beliefs about quitting variables

- Intention to quit (in next month, in next 6 months, beyond 6 months, not planning to quit): This variable comes from the question "Are you planning to quit smoking (in next month, in next 6 months, beyond 6 months, not planning to quit)?"
- Self-efficacy of quitting: At Wave 1 of the ITC-4 Survey, current smokers were asked, "If you decided to give up smoking completely in the next 6 months, how sure are you that you would succeed?" Categories of the answer include: not at all sure, slightly sure, moderately sure, very sure, and extremely sure. The variable was coded as a continuous measure from 1 (weak) to 5 (strong).

Motivational variables

- Outcome expectancy of quitting: At baseline survey, smokers were asked, "How much do you think you would benefit from health and other gains if you were to quit smoking permanently in the next 6 months?" Categories of the answer include: not at all, slightly, moderately, very much, and extremely. The variable was coded as a continuous measure from 1 (weak) to 5 (strong).
- Worries about health and quality of life: This variable was created based on smokers' responses to two questions at baseline: (1) "How worried are you, if at all, that smoking will lower your quality of life in the future?" (2) "How worried are you, if at all, that smoking will damage your health in the future?" Categories of the answers include: not at all worried, a little worried, moderately worried, very worried. Each variable was coded as a continuous measure from 1 (weak) to 4 (strong) and the average of the two measures was used in analyses.
- Favourable attitudes about smoking: This variable was created based on smokers' response to the following two statements: (1) "You enjoy smoking too much to give it up"; (2) Smoking is an important part of your life. Each variable was coded as a continuous measure from 1 (weak) to 5 (strong) and the average of the two measures is used in analyses.
- Overall attitude about smoking: At baseline, smokers were asked: "What is your overall opinion of smoking?" The variable was coded into a three-category variable: positive or neutral (very positive, positive, or neither positive nor negative), negative, or very negative.

Past quitting history variables

- Tried to quit within last year (yes, no)
- Longest time off smoking (never, 1 week or less, between 1 week and 6 months, 6 months or more)

Nicotine dependence variables

- Heaviness of smoking index (HSI): The heaviness of smoking index was created as the sum of two categorical measures: number of cigarettes smoked per day (coded: 0: 0–10 cigarettes per day (CPD), 1: 11–20 CPD, 2: 21–30 CPD, 3: 31+ CPD), and time to first cigarette (coded: 0: 61+min, 1: 31–60 min, 2: 6–30 min, 3: 5 min or less). Values for this variable range from 0 to 6. This index is positively associated with nicotine dependence.⁴¹
- Baseline smoking frequency (daily smoker, less than daily smoker)

Statistical analysis

Multivariate logistic regression was used to examine the association between cessation outcomes and all intrinsic predictor variables entered into the model such that the relative risks presented for a given variable are adjusted for all other covariates in the model. The interactions between country and other independent variables were also examined. Backward (Wald) stepwise selection was used to choose significant interaction terms at the 5% level after entering all the main effects in the model.

RESULTS

Thompson *et al* present the characteristics of the ITC-4 sample in another paper in this issue.^{39 40}

Table 1 shows the predictors of making serious quit attempts between wave 1 and 2 surveys among baseline smokers. Overall, 36% of the baseline smokers made quit

attempts in the 8–10 months between Waves 1 and 2. After adjusting for covariates, quit attempt rates were higher, relative to other categories in each variable mentioned: among those who lived in Canada, were 18–24 years of age, intended to quit sooner, had tried to quit in the past year, had a previous attempt lasting for six months or longer, had low levels of nicotine dependence, smoked less than daily, had very negative opinions about smoking, were more worried about health effects of smoking, and perceived few benefits from smoking. No two-way interactions between country and predictor variables were significant at the 5% level.

Table 2 shows the predictors of successful quitting among 2426 smokers who made a quit attempt between Waves 1 and 2. Overall, 25% of those who made a quit attempt were still stopped at Wave 2. While cessation rates were highest in the UK (29%) followed by Canada (24%), Australia (23%), and the USA (22%), these differences were not significant in multivariate analysis. Overall, those with lower levels of nicotine dependence (those with lower HSI or smoked less than daily) were more likely to quit. Those with a longest past quit attempt of less than a week were less likely to quit successfully compared to those without any past quit attempts. Those who expected smaller health and other gains from quitting were more likely to quit successfully while a borderline association was observed for self-efficacy. Other factors were not significant in the overall model, although some predictors were significant in country-specific analyses. The reduced sample size resulting from the focus on only those who made a quit attempt might partly explain the general lack of significant factors. Significant interactions were found between the country variable and the following three independent variables ($p < 0.05$): (1) heaviness of smoking index (generally significant in the USA, Canada, and Australia but not significant in the UK); (2) favourable attitudes about smoking (a significant predictor of relapse in Canada, but non-significantly positive in the other three countries); and (3) self-efficacy (a non-significant association with successful cessation was found in the UK and Australia compared to no effect in Canada and the USA).

Table 3 shows the predictors of quitting among 6682 smokers who completed both Waves 1 and 2 surveys, regardless of whether they made a quit attempt or not. Overall, 9% of the baseline sample of smokers had quit by Wave 2 with no statistical differences found between countries. Significant predictors of increased cessation in multivariate analysis included those who showed less nicotine dependence, smoked in a less than daily basis, had greater intention to quit, tried to quit within last year, and had past history of a quit attempt lasting six months or longer. Those who had higher expectations of health and other benefits of quitting and were aged 40–54 had lower rates of cessation. One significant interaction was found between country and ever tried to quit within last year, with the association not being present in Australia but significant in the other three countries.

We summarise the findings in fig 1, where the unexpected associations are in *italics* and the expected ones **bolded**.

DISCUSSION

There are four main findings from this study: (1) nicotine dependence was the most consistent variable associated with quit attempts and cessation across all four countries; (2) motivational factors including intention to quit and a history of past quit attempts were strongly associated with making a quit attempt, but not independently associated with succeeding in that attempt; (3) overall quit rates were a function of the percentage of smokers making a quit attempt and the success rate among those who tried to quit; and (4) there

Table 1 Predictors of making serious quit attempts between International Tobacco Control Four Country Survey (ITC-4) Wave 1 and Wave 2

	Entire sample			USA			Canada			UK			Australia		
	n	% attempted	OR	n	% attempted	OR	n	% attempted	OR	n	% attempted	OR	n	% attempted	OR
Country															
USA	1253	36%	Ref												
Canada	1575	44%	1.30												
UK	1686	31%	1.01												
Australia	1746	34%	0.88												
Age at recruitment (years)															
18-24	710	49%	Ref	146	56%	Ref	198	51%	Ref	111	47%	Ref	255	43%	Ref
25-39	1989	38%	0.69	346	36%	0.43	509	47%	0.86	502	34%	0.62	632	36%	0.82
40-54	2268	32%	0.64	468	32%	0.45	574	40%	0.76	606	28%	0.62	620	30%	0.68
55 and up	1293	34%	0.88	293	33%	0.59	294	41%	0.94	467	30%	0.96	239	31%	0.94
Sex															
Female	3481	37%	Ref	730	37%	Ref	863	45%	Ref	954	33%	Ref	934	33%	Ref
Male	2779	36%	1.00	523	36%	1.02	712	43%	0.98	732	29%	0.79	812	36%	1.18
Highest level of education															
Low	3462	35%	Ref	508	37%	Ref	700	44%	Ref	1097	31%	Ref	1157	33%	Ref
Moderate	1969	37%	0.89	567	35%	0.87	653	44%	0.81	386	31%	0.92	363	36%	1.02
High	829	39%	0.98	178	38%	1.04	222	44%	0.87	203	36%	1.04	226	38%	1.03
Income															
Low	1870	37%	Ref	445	40%	Ref	445	44%	Ref	504	32%	Ref	476	33%	Ref
Moderate	2174	36%	0.88	447	36%	0.83	561	47%	0.91	577	28%	0.83	589	34%	0.94
High	1811	37%	0.86	287	32%	0.69	463	43%	0.79	484	37%	1.06	577	35%	0.91
No response	405	30%	0.77	74	27%	0.54	106	37%	0.67	121	25%	0.73	104	32%	1.18
Identified majority group															
White/English only	5551	36%	Ref	995	34%	Ref	1404	44%	Ref	1615	31%	Ref	1537	34%	Ref
Non-white/non-English	709	42%	1.09	258	47%	1.27	171	47%	1.10	71	31%	0.84	209	35%	1.04
Intention to quit															
No intention	1622	14%	Ref	313	13%	Ref	283	18%	Ref	597	13%	Ref	429	14%	Ref
Plan to quit beyond 6 months	2380	30%	1.85	505	33%	2.95	568	35%	1.81	604	27%	1.70	703	27%	1.41
Plan to quit within 6 months	1576	52%	3.76	296	50%	4.69	532	54%	3.25	345	52%	4.44	403	50%	3.18
Plan to quit within 1 month	682	75%	8.82	139	70%	9.04	192	82%	7.04	140	77%	11.52	211	69%	5.87
Tried to quit within last year															
Yes	2645	51%	Ref	558	51%	Ref	731	57%	Ref	583	46%	Ref	773	47%	Ref
No	3615	26%	0.55	695	24%	0.57	844	33%	0.54	1103	24%	0.56	973	24%	0.50
Longest time off smoking															
Never	1179	22%	Ref	247	17%	Ref	269	27%	Ref	367	20%	Ref	296	23%	Ref
1 week or less	1017	33%	0.90	212	33%	1.29	260	39%	0.90	257	30%	0.93	288	29%	0.67
Between 1 week and 6 months	1909	40%	1.14	365	40%	1.79	497	47%	1.09	495	34%	0.93	552	38%	1.01
6 months or more	2155	43%	1.45	429	46%	2.39	549	52%	1.70	567	38%	1.24	610	38%	1.01
Heaviness of smoking index															
0	896	48%	Ref	178	52%	Ref	229	52%	Ref	213	46%	Ref	276	43%	Ref
1	682	45%	0.93	132	51%	0.91	159	57%	1.15	201	39%	0.77	190	38%	0.86
2	1040	38%	0.72	193	42%	0.76	287	44%	0.74	296	31%	0.60	264	38%	0.81
3	1793	32%	0.64	369	30%	0.50	405	40%	0.66	575	29%	0.57	444	31%	0.78
4	1072	32%	0.69	195	26%	0.40	309	41%	0.81	260	25%	0.50	308	32%	0.86
5	570	29%	0.68	126	26%	0.54	145	37%	0.77	109	23%	0.68	190	27%	0.72
6	207	29%	0.71	60	33%	0.86	41	34%	0.60	32	22%	0.65	74	24%	0.72
Baseline smoking frequency															
Daily smoker	5740	35%	Ref	1143	34%	Ref	1444	43%	Ref	1576	30%	Ref	1577	32%	Ref
Weekly/monthly smoker	520	54%	1.43	110	56%	1.38	131	56%	1.34	110	54%	1.55	169	50%	1.44

Table 1 Continued

	Entire sample			USA			Canada			UK			Australia		
	n	% attempted	OR	n	% attempted	OR	n	% attempted	OR	n	% attempted	OR	n	% attempted	OR
Overall opinion of smoking	2758	28%	Ref	552	28%	Ref	587	35%	Ref	842	24%	Ref	777	25%	Ref
Positive or neutral	2235	40%	1.07	428	40%	1.22	626	46%	0.91	565	34%	1.06	616	38%	1.19
Negative	1267	49%	1.24	273	48%	1.18	362	55%	1.12	279	48%	1.40	353	46%	1.34
Continuous variables															
Outcome expectancy			1.04			0.94			1.08			1.06			1.04
Self-efficacy			0.99			1.02			0.94			0.92			1.08
Worries about health and QOL			1.15			1.10			1.13			1.13			1.28
Favourable attitudes about smoking			<u>0.88</u>			1.00			0.89			<u>0.75</u>			<u>0.88</u>
Total	6260	36%	0.27	1253	36%	0.29	1575	44%	0.25	1686	31%	0.29	1746	34%	0.26
Nagelkerke's R ²															

p > 0.05 for odds ratios that are underlined.
 Outcome expectancy: Based on smokers' responses to the question: "How much do you think you would benefit from health and other gains if you were to quit smoking permanently in the next 6 months?" Coded: 1: "not at all", 2: "slightly", 3: "moderately", 4: "very much", and 5: "extremely".
 Self-efficacy: Based on smokers' responses to the question: "If you decided to give up smoking completely in the next 6 months, how sure are you that you would succeed?" Coded: 1: "not at all sure", 2: "slightly sure", 3: "moderately sure", 4: "very sure", and 5: "extremely sure".
 Worries about health and QOL: Based on smokers' responses to the following two questions: (1) "How worried are you, if at all, that smoking will lower your quality of life in the future?"; (2) "How worried are you, if at all, that smoking will damage your health in the future?" Both questions were coded: 1: not at all worried, 2: a little worried, 3: moderately worried, 4: very worried. Here we used the average for the two variables.
 Favourable attitudes about smoking: Based on smokers' responses to the following two questions: (1) "You enjoy smoking too much to give it up"; (2) "Smoking is an important part of your life". Both questions were coded: 1: strongly disagree, 2: disagree, 3: neither agree or disagree, 4: agree, and 5: strongly agree. Here we used the average of the two variables.
 Overall opinion of smoking: Based on smokers' responses to the question of: "What is your overall opinion of smoking?"
 Outcome expectancy is highly correlated with worries about health and QOL (Pearson's correlation coefficient 0.51, p < 0.01).
 OR, odds ratio; QOL, quality of life.

Table 2 Predictors of quitting by ITC-4 Wave 2 among baseline current smokers who made serious quit attempts between Waves 1 and 2

	Entire sample			USA			Canada			UK			Australia		
	n	% quit	OR	n	% quit	OR	n	% quit	OR	n	% quit	OR	n	% quit	OR
Country															
USA	454	22%	Ref												
Canada	694	24%	3.62												
UK	530	29%	0.65												
Australia	596	23%	0.30												
Age at recruitment (years)															
18–24	345	23%	Ref	82	26%	Ref	101	23%	Ref	52	19%	Ref	110	24%	Ref
25–39	761	28%	1.09	123	27%	0.95	240	29%	0.95	169	34%	1.37	229	21%	0.76
40–54	733	23%	0.95	151	18%	0.84	232	23%	0.84	167	25%	1.07	183	26%	1.13
55 and up	435	23%	0.89	98	20%	0.77	121	19%	0.92	142	30%	0.97	74	19%	0.80
Sex															
Female	1282	25%	Ref	267	23%	Ref	390	25%	Ref	319	30%	Ref	306	23%	Ref
Male	992	24%	0.90	187	21%	1.07	304	23%	0.88	211	27%	0.71	290	23%	1.05
Highest level of education															
Low	1210	23%	Ref	186	19%	Ref	310	21%	Ref	337	30%	Ref	377	21%	Ref
Moderate	737	24%	0.94	200	24%	1.59	286	25%	0.94	119	21%	0.51	132	25%	1.04
High	327	31%	1.18	68	28%	1.32	98	33%	1.30	74	34%	0.98	87	28%	1.04
Income															
Low	693	21%	Ref	180	22%	Ref	196	18%	Ref	159	28%	Ref	158	16%	Ref
Moderate	790	24%	1.17	162	18%	0.78	261	27%	1.66	164	26%	0.96	203	24%	1.57
High	669	28%	1.23	92	29%	1.37	198	28%	1.40	177	31%	1.17	202	27%	1.56
No response	122	27%	1.39	20	30%	1.33	39	21%	1.17	30	37%	1.57	33	24%	1.52
Identified majority group															
White/English only	1978	25%	Ref	334	21%	Ref	613	25%	Ref	508	29%	Ref	523	24%	Ref
Non-white/non-English	296	21%	0.76	120	25%	1.39	81	17%	0.52	22	18%	0.63	73	18%	0.71
Intention to quit															
No intention	232	26%	Ref	40	28%	Ref	52	17%	Ref	80	33%	Ref	60	23%	Ref
Plan to quit beyond 6 months	716	23%	1.04	168	18%	0.58	199	24%	0.58	162	26%	1.64	187	25%	1.50
Plan to quit within 6 months	817	26%	1.21	149	20%	0.73	285	28%	2.02	180	29%	2.02	203	25%	1.54
Plan to quit within 1 month	509	24%	1.08	97	30%	2.01	158	22%	1.27	108	29%	1.18	146	17%	0.89
Tried to quit within last year															
Yes	1338	22%	Ref	285	23%	Ref	416	25%	Ref	270	23%	Ref	367	19%	Ref
No	936	28%	1.03	169	21%	0.65	278	24%	0.94	260	35%	1.33	229	30%	1.28
Longest time off smoking															
Never	254	30%	Ref	41	22%	Ref	73	22%	Ref	72	35%	Ref	68	40%	Ref
1 week or less	331	10%	0.36	70	10%	0.30	101	9%	0.47	76	13%	0.46	84	7%	0.24
Between 1 week and 6 months	756	20%	0.78	146	16%	0.65	233	23%	1.10	167	20%	0.76	210	18%	0.65
6 months or more	933	32%	1.33	197	31%	1.57	287	32%	1.68	215	39%	1.63	234	28%	0.95
Heaviness of smoking index															
0	431	39%	Ref	93	39%	Ref	120	45%	Ref	98	34%	Ref	120	37%	Ref
1	310	26%	0.71	67	28%	0.71	91	24%	0.48	79	30%	0.90	73	21%	0.53
2	399	20%	0.51	82	17%	0.38	127	17%	0.32	91	19%	0.57	99	27%	0.90
3	569	22%	0.64	109	20%	0.55	160	21%	0.51	164	29%	1.01	136	18%	0.60
4	343	22%	0.60	50	8%	0.14	128	21%	0.57	66	36%	1.74	99	19%	0.63
5	163	15%	0.41	33	9%	0.19	54	19%	0.53	25	24%	0.90	51	10%	0.24
6	59	14%	0.45	20	15%	0.54	14	14%	0.40	7	14%	0.46	18	11%	0.35
Baseline smoking frequency															
Daily smoker	1995	22%	Ref	392	19%	Ref	620	22%	Ref	471	28%	Ref	512	20%	Ref
Weekly/monthly smoker	279	41%	1.41	62	40%	1.32	74	49%	2.00	59	32%	0.62	84	39%	1.81

Table 2 Continued

	Entire sample			USA			Canada			UK			Australia		
	n	% quit	OR	n	% quit	OR	n	% quit	OR	n	% quit	OR	n	% quit	OR
Overall opinion of smoking	766	24%	Ref	154	25%	Ref	208	25%	Ref	206	25%	Ref	198	23%	Ref
Positive or neutral	883	26%	1.22	170	24%	1.08	287	24%	0.86	191	33%	2.15	235	24%	1.24
Negative	625	23%	1.22	130	17%	0.68	199	25%	0.86	133	29%	1.99	163	21%	1.60
Continuous variables															
Outcome expectancy			0.87			0.82			0.98			0.79			0.77
Self-efficacy			1.09			0.89			0.97			1.33			1.17
Worries about health and QOL			0.90			0.86			0.98			1.33			1.06
Favourable attitudes about smoking			1.05			1.27			0.78			1.12			1.32
Total	2274	25%	0.14	454	22%	0.21	694	24%	0.16	530	29%	0.21	596	23%	0.18
Nagelkerke's R ²															

Statistically significant interactions exist between country and (1) heaviness of smoking index; (2) self-efficacy; and (3) favourable attitudes about smoking
 p < 0.05 for odds ratios that are underlined.

Outcome expectancy: Based on smokers' responses to the question: "How much do you think you would benefit from health and other gains if you were to quit smoking permanently in the next 6 months?" Coded: 1: "not at all", 2: "slightly", 3: "moderately", 4: "very much", and 5: "extremely".

Self-efficacy: Based on smokers' responses to the question: "If you decided to give up smoking completely in the next 6 months, how sure are you that you would succeed?" Coded: 1: "not at all sure", 2: "slightly sure", 3: "moderately sure", 4: "very sure", and 5: "extremely sure".

Worries about health and QOL: Based on smokers' responses to the following two questions: (1) "How worried are you, if at all, that smoking will lower your quality of life in the future?" (2) "How worried are you, if at all, that smoking will damage your health in the future?" Both questions were coded: 1: "not at all worried", 2: "a little worried", 3: "moderately worried", 4: "very worried". Here we used the average for the two variables.

Favourable attitudes about smoking: Based on smokers' responses to the following two questions: (1) "You enjoy smoking too much to give it up", (2) "Smoking is an important part of your life. Both questions were coded: 1: strongly disagree, 2: disagree, 3: neither agree or disagree, 4: agree, and 5: strongly agree. Here we used the average of the two variables.

Overall opinion of smoking: Based on smokers' responses to the question of: "What is your overall opinion of smoking?"

Table 3 Predictors of quitting by ITC-4 Wave 2 among all baseline current smokers

	Entire sample			USA			Canada			UK			Australia		
	n	% quit	OR	n	% quit	OR	n	% quit	OR	n	% quit	OR	n	% quit	OR
Country															
USA	1253	8%	Ref	146	14%	Ref	198	12%	Ref	111	9%	Ref	255	10%	Ref
Canada	1575	11%	1.23	346	10%	0.59	509	14%	1.15	502	12%	1.15	632	8%	0.76
UK	1686	9%	1.25	468	6%	0.46	574	9%	0.86	606	7%	0.65	620	8%	0.86
Australia	1746	8%	0.91	293	7%	0.56	294	8%	0.86	467	9%	1.06	239	6%	0.87
Age at recruitment (years)															
18-24	710	11%	Ref	730	8%	Ref	863	11%	Ref	954	10%	Ref	934	7%	Ref
25-39	1989	11%	0.88	523	7%	1.01	712	10%	0.89	732	8%	0.69	812	8%	1.15
40-54	2268	7%	0.70	508	7%	Ref	700	9%	Ref	1097	9%	Ref	1157	7%	Ref
55 and up	1293	8%	0.86	567	8%	1.22	653	11%	0.86	386	6%	0.56	363	9%	1.15
Sex															
Female	3481	9%	Ref	730	8%	Ref	863	11%	Ref	954	10%	Ref	934	7%	Ref
Male	2779	8%	0.93	523	7%	1.01	712	10%	0.89	732	8%	0.69	812	8%	1.15
Highest level of education															
Low	3462	8%	Ref	508	7%	Ref	700	9%	Ref	1097	9%	Ref	1157	7%	Ref
Moderate	1969	9%	0.87	567	8%	1.22	653	11%	0.86	386	6%	0.56	363	9%	1.15
High	829	12%	1.08	178	11%	1.27	222	14%	1.22	203	12%	1.03	226	11%	1.02
Income															
Low	1870	8%	Ref	445	9%	Ref	445	8%	Ref	504	9%	Ref	476	5%	Ref
Moderate	2174	9%	1.02	447	6%	0.70	561	13%	1.44	577	7%	0.89	589	8%	1.33
High	1811	10%	1.15	287	9%	0.97	463	12%	1.20	484	11%	1.30	577	9%	1.38
No response	405	8%	1.14	74	8%	0.99	106	8%	0.99	121	9%	1.27	104	8%	1.64
Identified majority group															
White/English only	5551	9%	Ref	995	7%	Ref	1404	11%	Ref	1615	9%	Ref	1537	8%	Ref
Non-white/non-English	709	9%	0.81	258	12%	1.15	171	8%	0.56	71	6%	0.53	209	6%	0.78
Intention to quit															
No intention	1622	4%	Ref	313	4%	Ref	283	3%	Ref	597	4%	Ref	429	3%	Ref
Plan to quit beyond 6 months	2380	7%	1.89	505	6%	1.95	568	8%	2.27	604	7%	1.79	703	7%	2.14
Plan to quit within 9 months	1576	14%	3.38	296	10%	3.73	532	15%	3.73	345	15%	3.82	403	13%	3.77
Plan to quit within 1 month	682	18%	4.17	139	21%	7.57	192	18%	3.79	140	22%	5.69	211	12%	3.10
Tried to quit within last year															
Yes	2645	11%	Ref	558	12%	Ref	731	14%	Ref	583	11%	Ref	773	9%	Ref
No	3615	7%	0.74	695	5%	0.59	844	8%	0.70	1103	8%	0.91	973	7%	0.80
Longest time off smoking															
Never	1179	7%	Ref	247	4%	Ref	269	6%	Ref	367	7%	Ref	296	9%	Ref
1 week or less	1017	3%	0.38	212	3%	0.52	260	3%	0.48	257	4%	0.44	288	2%	0.21
Between 1 week and 6 months	1909	8%	0.85	365	7%	1.08	497	11%	1.19	495	7%	0.67	552	7%	0.63
6 months or more	2155	14%	1.57	429	14%	2.59	549	17%	2.18	567	15%	1.62	610	11%	0.85
Heaviness of smoking index															
0	896	19%	Ref	178	20%	Ref	229	24%	Ref	213	15%	Ref	276	16%	Ref
1	682	12%	0.72	132	14%	0.78	159	14%	0.61	201	12%	0.79	190	8%	0.59
2	1040	8%	0.49	193	7%	0.42	287	7%	0.36	296	6%	0.42	264	10%	0.83
3	1793	7%	0.55	369	6%	0.41	405	8%	0.48	408	8%	0.77	444	6%	0.54
4	1072	7%	0.60	195	2%	0.15	309	9%	0.57	260	6%	0.11	308	6%	0.71
5	570	4%	0.42	126	2%	0.21	145	7%	0.53	109	6%	0.75	190	3%	0.29
6	207	4%	0.44	60	5%	0.50	41	5%	0.41	32	3%	0.36	74	3%	0.42
Baseline smoking frequency															
Daily smoker	5740	8%	Ref	1143	7%	Ref	1444	9%	Ref	1576	8%	Ref	1577	7%	Ref
Weekly/monthly smoker	520	22%	1.56	110	23%	1.63	131	27%	2.07	110	17%	0.86	169	20%	1.81

Table 3 Continued

	Entire sample		USA		Canada		UK		Australia	
	n	% quit	n	OR	n	OR	n	OR	n	OR
Overall opinion of smoking	2758	7%	552	Ref	587	Ref	842	Ref	777	Ref
Positive or neutral	2235	10%	428	1.19	626	1.14	565	0.80	616	1.82
Negative	1267	11%	273	1.24	362	0.74	279	0.85	353	1.97
Very negative										
Continuous variables										
Outcome expectancy				0.90		0.85		1.05		0.90
Self-efficacy				1.06		0.94		0.95		1.17
Worries about health and QOL				1.02		0.94		1.10		0.84
Favourable attitudes about smoking				0.92		1.17		0.77		0.90
Total	6260	9%	1253	0.14	1575	0.22	1686	0.18	1746	0.18
Nagelkerke's R ²										

Statistically significant interactions exist between country and ever tried to quit within last year variable. p > 0.05 for odds ratios that are underlined.

Outcome expectancy: Based on smokers' responses to the question: "How much do you think you would benefit from health and other gains if you were to quit smoking permanently in the next 6 months?" Coded: 1: "not at all", 2: "slightly", 3: "moderately", 4: "very much", and 5: "extremely".

Self-efficacy: Based on smokers' responses to the question: "If you decided to give up smoking completely in the next 6 months, how sure are you that you would succeed?" Coded: 1: "not at all sure", 2: "slightly sure", 3: "moderately sure", 4: "very sure", and 5: "extremely sure".

Worries about health and QOL: Based on smokers' responses to the following two questions: (1) "How worried are you, if at all, that smoking will lower your quality of life in the future?"; (2) "How worried are you, if at all, that smoking will damage your health in the future?". Both questions were coded: 1: not at all worried, 2: a little worried, 3: moderately worried, 4: very worried. Here we used the average for the two variables.

Favourable attitudes about smoking: Based on smokers' responses to the following two questions: (1) "You enjoy smoking too much to give it up"; (2) "Smoking is too important part of your life. Both questions were coded: 1: strongly disagree, 2: disagree, 3: neither agree or disagree, 4: agree, and 5: strongly agree. Here we used the average of the two variables.

Overall opinion of smoking: Based on smokers' responses to the question of: "What is your overall opinion of smoking?"

Outcome expectancy is highly correlated with worries about health and QOL (Pearson's correlation coefficient 0.51, p < 0.01).

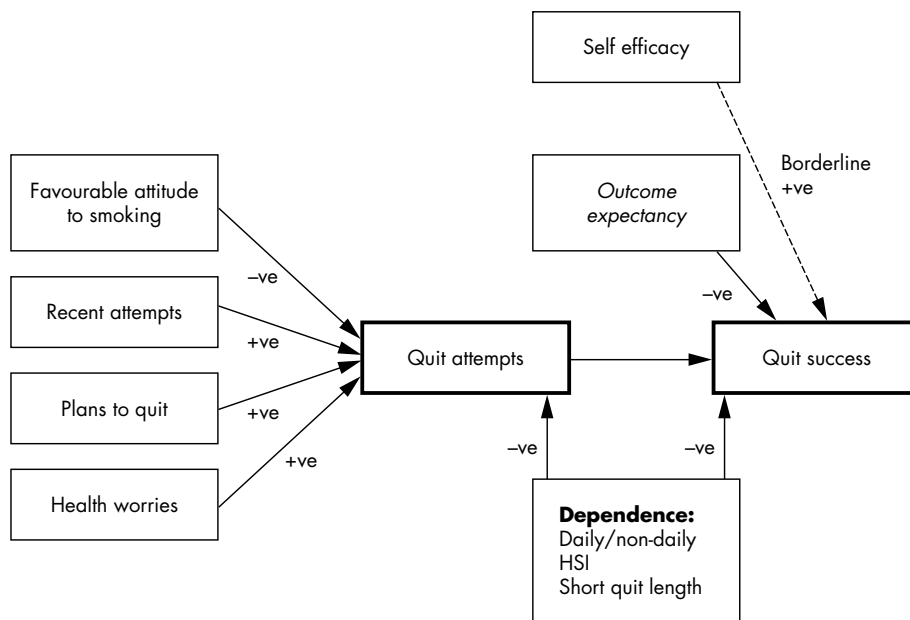


Figure 1 Schematic model of the main predictors of making quit attempts and of the success of those attempts. HSI, heaviness of smoking index; +ve, significant increase between the two variables connected by the given line; -ve, significant decrease between the two variables connected by the given line; younger age and living in Canada are predictive for making quit attempts; sex, race, education, and income are not predictive for making quit attempts in this study; country, age, sex, race, education and income are not predictive for successful quitting among smokers who made serious quit attempts in this study.

were no significant differences in predictors of quit attempts but some differences in success of attempts across countries.

Indicators of motivation to quit are the strongest predictors of making a serious quit attempt, although indicators of nicotine dependence also add predictive value. These findings are consistent with previous studies.^{14–19} Previous research has shown demographic characteristics are also associated with making a serious quit attempt^{21–22}; however, in the present study sex and education were not associated with making a serious quit attempt. This may be because we were better able to control for more direct correlates, such as level of dependence, which are correlated with the demographic variables.

The main finding that nicotine dependence is strongly associated with quit rates is also consistent with previous literature.^{14–18 23–34} Looking in more detail at the findings, it is clear that non-daily smokers and those who scored zero on the HSI were particularly likely to quit. The lack of linearity in the relationship between HSI and quit attempts suggests a threshold effect where quitting is much more likely at low levels of nicotine dependence. This suggests that interventions that reduce consumption to these very low levels may indirectly boost future cessation rates.^{42–44} An alternative explanation is that low HSI scores are a marker for an environment that discourages smoking and encourages quitting.

Also related to dependence is the duration of past quit attempts. The finding that short previous past attempts (less than a week) was associated with reduced success while longer attempts (six months or more) was associated with increased success compared with no previous attempts, is of note. It suggests that quick failures of quit attempts may have a negative effect on subsequent attempts, while longer attempts may be advantageous. This raises the question of whether we should try to encourage smokers to make a quit attempt that lasts as long as they can manage to test their readiness to quit, regardless of the perceived likelihood of success on that quit attempt. We think it premature to make

such suggestions on the basis of this study alone, but encourage research around this issue.

The findings suggest that, with the possible exception of self-efficacy, the variables used in expectancy-value based models of behaviour change apply primarily to the making of the attempt to change rather than to the success of attempts. For hard-to-change behaviours like smoking, different models are required for understanding success than for understanding efforts to try to change. Measures of dependence were the only measures in this study that predicted both quit attempts and quitting, which suggests that interventions that focus on dependence are preferable to interventions that only focus on expectancy-based variables.

Some other studies have found demographic differences between quitters and continued smokers; however, we found few such differences in this study. For example, we found no sex differences for quitting in the present study; however, other large population-based studies have found lower cessation rates among females.²⁵ Other studies have reported that older age was another strong predictor of successful cessation^{21 23 29}; however, age was not associated with quitting independent of the likelihood of making a quit attempt in the present study. Some other studies show race/ethnicity is associated with cessation,^{29 45} but race/ethnicity was also unrelated to cessation in the present study after adjusting for other factors. It should also be noted that the quit rates in this study are higher than those presented in some other studies. This is likely attributed to the difference in the definition of cessation, which is the current self report of smoking not at all or on less than a monthly basis.

One surprising factor was the general lack of an association between nicotine dependence and quit success of those who made a quit attempt in the UK, particularly in the mid-range levels of the HSI. We do not have a simple explanation for this observation. We hope that future data from this project may provide additional insight.

The finding that those with the highest expectancies that quitting would enhance their health relapsed at a greater rate

is interesting. It could be that some smokers overestimate the short-term health improvements from smoking and are more prone to relapse when the gains are measured in perceived small, continual improvements over many months and years. Alternatively, it could be that good reasons for maintaining motivation to remain smoke-free after quitting are reasons that stress the realistic immediate short-term benefits of quitting rather than more distant, long-term reasons (that is, long-term health) that are difficult for a person to quantify or unrealistic expectations. If this is so, it would suggest the need to articulate more carefully alternatives for the perceived benefits smokers think they get from smoking, and thus which they think they forfeit when they quit. Dijkstra *et al* found evidence that beliefs of this kind do predict relapse.¹⁶ However, in our study beliefs about the benefits of quitting did not have direct predictive effects. Future work is needed to identify smokers who might derive more benefit from behavioural interventions that stress positive versus negative reasons for quitting smoking.

Another interesting observation is the finding in Canada that having a strongly negative attitude to smoking was associated with relapse, something that was not the case in the other three countries. Again we have no ready explanation for this, and will be looking closely in subsequent waves to see if it persists and to try to find explanations if it does.

The overall cessation rate in the baseline sample is a function of both the prevalence of respondents that make a quit attempt and the success rate among those who try to quit. While overall quit rates were not statistically different between countries, the highest overall quit rates were observed in Canada where the fraction of smokers trying to quit was much higher although the rate of success among those who tried was comparable to the lowest country. This is in contrast to the UK, which had the second highest overall cessation rate, where the lowest rate of making a quit attempt was observed but those who did try to quit had the highest success rate. Taken together, tobacco control interventions that increase the fraction of smokers making a quitting attempt as well as their likelihood of success are effective measures for increasing cessation in the population.¹⁵

Another noteworthy point to address is the similarity of findings across the four countries. Country specific analysis for predictors of quitting and quit attempts among the entire sample only reveals one significant two-way interaction with country. The model examining cessation among those who made a quit attempt found three significant two-way interactions with country. It is unclear if these observations are real or artefactual because the mechanism of action is unclear and we have no ready explanation. The general similarity of the findings across the four countries suggests that the relationships between these intrinsic measures and cessation are the essentially same and may be broadly generalisable to other countries with similar norms about smoking and personal characteristics.

The major strengths of this study include the large sample size of nationally representative samples of smokers and involvement of multiple countries. Limitations include the reliance on self-report cessation information, a relatively long follow-up time for cognitive predictors that can fluctuate notably over time, and the 25% attrition rate. This study also focused on individual-level predictors and thus is unable to shed light on possible effects of social and contextual variables. Forthcoming papers will focus on these important effects as experienced by our cohort members.¹⁶

In summary, nicotine dependence is the most important predictor of smoking cessation; it is also associated with making serious quit attempts, whereas motivational factors are only related to the likelihood of making a quit attempt.

What this paper adds

While there are several studies that examine basic intrinsic predictors of cessation, few utilise longitudinal data from nationally representative samples of smokers and even fewer that compare predictors of both cessation attempts and successful cessation across countries. Results from this study show that, in the four countries studied in this paper (Australia, Canada, the UK, and the USA), intention to quit and other cognitive variables were associated with quit attempts, but not cessation. Behavioural variables related to task difficulty, including measures of dependence, predicted both making attempts and their success. Predictors of making quit attempts and cessation were similar for each of the four countries, but there were some differences in predictors of success. The general similarity of results across countries suggests that these results are generalisable to other developed nations.

Few country-specific differences were observed, which suggests the observed predictors may generalise to other similar countries. Efforts to increase cessation rates should aim to increase the proportion of the population attempting to quit and should encourage the use of proven interventions for cessation.

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