

RESEARCH PAPER

Prevalence and attributes of roll-your-own smokers in the International Tobacco Control (ITC) Four Country Survey

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Accepted 29 November 2005**Background:** Roll-your-own (RYO) cigarettes are often substantially less expensive than factory made (FM) cigarettes, and appear to be increasing in popularity—perhaps because smokers seek out less expensive options to maintain their nicotine addiction. There is surprisingly little research available on the actual prevalence of RYO cigarette usage, and even less on the attributes of those who smoke RYO cigarettes.**Objectives:** This study has two objectives: (1) to compare the prevalence of RYO versus FM cigarette usage among adult smokers in Australia, Canada, the United Kingdom, and the United States; and (2) to compare the attributes of exclusive FM smokers, exclusive RYO smokers, and those who report “mixed” RYO and FM use.**Design:** The data were collected from the International Tobacco Control (ITC) Four Country Survey (ITC-4), a random digit dialed telephone survey of representative samples of over 9046 adult smokers from the following four countries: Australia (n = 2301), Canada (n = 2,206), the UK (n = 2400), and the USA (n = 2,139), surveyed between October and December 2002, and on 6075 smokers followed-up, on average, seven months later.**Results:** The prevalence of RYO cigarette usage varied widely across the four countries, with a low of 6.7% in the USA, to 28.4% in the UK. Exclusive use of RYO cigarettes was more common in the UK than in the other three countries. The use of RYO cigarettes was associated with having a lower annual income, male sex, younger average age, higher level of nicotine addiction, a stronger belief that RYO tobacco is less harmful compared to other forms of tobacco, and a more positive perception of tobacco use. Prevalence of RYO use was relatively stable within each of the four countries between the baseline and follow-up survey. RYO use was unrelated to quitting activity at follow-up, although mixed RYO users who had made a quit attempt were more likely to relapse than either exclusive FM or exclusive RYO smokers.**Conclusions:** Patterns of RYO use vary considerably across Australia, Canada, the USA, and the UK. RYO smokers are a heterogeneous group; however, the factors associated with RYO use appear to be the same across the four countries studied.

Roll-your-own (RYO) cigarettes, also referred to as “hand-rolled” cigarettes or “handmade” cigarettes, can be made completely by hand, or they may be made with the assistance of a “rolling machine”, some of which now come equipped with filters. Equipment for making RYO cigarettes can now be found in many retail shops and can be purchased over the internet. RYO cigarettes are significant for several reasons. First, RYO use is relatively prevalent, while varying substantially by country. For example, any use of RYO tobacco was found to be 30% in the UK (2001),¹ 15% in Canada (2001)² and 22% in Australia (2003).³

Second, use of RYO cigarettes may need to be taken into account in order to understand the effect of price and taxation increases. In many, if not all markets, RYO cigarettes are less expensive than factory made (FM) cigarettes and serve as a “discount” option for smokers. This is especially true in countries where RYO cigarettes are subject to lower taxes than FM cigarettes,⁴ such as the UK.¹ As a result, smokers may compensate for price/taxation increases by shifting from factory-made to RYO cigarettes instead of quitting or reducing their consumption. Indeed, data from the UK Office of National Statistics¹ found a pronounced increase in RYO use between 1996 and 2001, a period when the price of RYO tobacco declined relative to FM cigarettes. In addition, the combination of easy physical access to Europe, lack of restrictions on “own use” purchases in the European Union (EU), and lower RYO tax rates in Europe has led to a

situation where up to 70% of UK RYO consumption is sourced from Europe and UK RYO smokers are more familiar with European brands (for example, Drum) than they are with UK brands.

Third, RYO cigarettes are generally subject to less regulation than factory-made cigarettes. In low and middle income countries, RYO tobacco is often locally grown, with only limited processing. One consequence of lesser regulation is that RYO cigarettes may also be more susceptible to smuggling.⁵ Another consequence is that smokers who purchase “loose” tobacco, with little or no packaging, may not be exposed to “standard” labelling requirements such as government-mandated health warnings. However, this is not the case in the countries under study here.

Little is known about the consequence of RYO tobacco use for health risks, relative to FM cigarettes. It is unclear, for example, what proportion of smokers use a filter when making RYO cigarettes. One study of RYO use in the UK reported that most RYO smokers do not use a filter.⁶ In addition, standard machine-determined yields of RYO cigarettes suggest that RYO smokers may be exposed to higher levels of smoke constituents per cigarette compared to

Abbreviations: CATI, computer assisted telephone interview; EU, European Union; FM, factory made; HSI, heaviness of smoking index; ITC-4, International Tobacco Control Four Country Survey; RYO, roll-your-own

smokers of factory-made cigarettes. A recent UK study found that 57% of RYO cigarettes produced higher levels of tar than 15 mg/cigarette (the maximum allowed for FM cigarettes in the UK at that time), and that 77% of UK RYO smokers make cigarettes with nicotine yields greater than 1.1 mg/cigarette.⁷ Dutch RYO smokers have been found to make cigarettes that, on average, produced 13.2 mg tar and 1.2 mg of nicotine per cigarette,⁸ while machine testing of 31 brands of RYO tobacco in Canada produced average figures of 15.5 mg of tar and 1.1 mg of nicotine per cigarette.⁹

Because the amount of tobacco in a RYO cigarette is not standardised in the same way as FM cigarettes, there will be greater variability in RYO machine smoked yields. Indeed, RYO yields are due to a combination of filtration, the size of the tube, the tobacco blend, and the amount of tobacco rolled in each cigarette.¹⁰ It is also unclear to what extent machine-determined yields translate into increased exposure. Indeed, we know very little about the extent to which RYO smokers adjust their puffing to compensate for unfiltered cigarettes and other design characteristics. So, while available smoking machine data may suggest that RYO cigarettes increase exposure to smoke constituents compared to factory-made cigarettes, the lack of human exposure data make it impossible to say with certainty that RYO cigarettes actually expose the user to greater levels of smoke constituents and are, therefore, more harmful than FM cigarettes. There is, however, some evidence that RYO smokers are more vulnerable to developing cancer of the oesophagus¹¹ and larynx,¹² as well as being vulnerable to all the other smoking-related diseases.

Overall, we have relatively little information on RYO tobacco use, including the characteristics of RYO users. For example, in the UK, the typical RYO smoker has been stereotyped as an “old, poor, grumpy... bloke in a pub”.¹³ However, there is recent evidence from the UK⁶ and France¹⁴ that RYO tobacco manufacturers are now targeting a younger, “hipper” market segment with messages touting the benefits of RYO cigarettes as “natural”, “cool”, and “I’m not rushed”. The older group may typify smokers who exclusively use RYO cigarettes, whereas younger smokers may be more prone to mix RYO and factory-made cigarettes.

The purpose of the current study is to compare the prevalence of RYO versus FM cigarette usage among adult smokers in Australia, Canada, the UK, and the USA and to compare the attributes of smokers who report exclusively using FM cigarettes, with those who make any use of RYO, as well as comparing those who use a mixture of RYO and FM cigarettes, with those who use RYO cigarettes exclusively.

METHOD

Participants

Participants were a total of 9046 adult (18 years of age and older) smokers (defined as having smoked at least 100 cigarettes in their lifetime, and who currently smoked at least once a month) who agreed to be interviewed as part of the International Tobacco Control Four Country Survey (ITC-4) carried out in four English-speaking countries: Canada (n = 2206), the United States (n = 2139), the United Kingdom (n = 2400), and Australia (n = 2301). Of these 9046 smokers, 6075 were followed up, on average, seven months later. The survey was designed as a longitudinal study to simultaneously evaluate several leading tobacco control policies that are subject to implementation during the length of the five-year study.

The survey field work was conducted using computer assisted telephone interview (CATI) by two research firms: Roy Morgan Research (Melbourne) for Australia and UK, and Environics Research Group (Toronto) for USA and Canada. The survey was conducted in English, or in French if desired

in the francophone areas of Canada. Strict protocols were developed and implemented to ensure equivalence of methods across the two companies and between the two languages. Using stratified random-digit dialling technique, households were contacted and screened for adult smokers with the next birthday who would agree to participate in the study. Those who agreed were rescheduled for an in-depth 35-minute phone survey a week later and were sent a cheque or voucher to compensate for their time. These participants were asked to respond to questions related to tobacco control policies, smoking behaviour and associated psychosocial predictors. Cooperation rates (defined as the proportion of eligible respondents who completed the survey) were high for a survey of this kind: Canada 78.5%, USA 77.0%, UK 78.7%, and Australia 78.8%. Further details of the methods and the representativeness of the sample can be found in Thompson *et al*¹⁵ in this supplement.

The current study presents cross-sectional data from Wave 1 of the ITC survey, conducted between October/November 2002, as well as presenting some limited comparisons between Wave 1 and Wave 2 to establish the stability of RYO smoking among the 6075 respondents who participated in both waves. The study protocol was cleared for ethics by the institutional review boards or research ethics boards in each of the countries: the University of Waterloo (Canada), Roswell Park Cancer Institute (USA), University of Illinois-Chicago (USA), University of Strathclyde (UK), and The Cancer Council Victoria (Australia).

MEASURES

Roll-your-own use

All respondents were asked if they smoked FM cigarettes only, RYO cigarettes only, or both. Respondents who smoked both FM and RYO cigarettes were asked to report the number of RYO cigarettes for every 10 cigarettes they smoked. For the current analysis, smokers were categorised as FM only, RYO only, or “mixed”.

Self-exempting beliefs

Four items, $\alpha = 0.67$ —Aggregates smokers’ level of agreement with the statements: “You have the kind of genetic make-up that allows you to smoke without it giving you health problems”, “You have to die of something, so why not enjoy yourself and smoke”, “The medical evidence that smoking is harmful is exaggerated”, “Smoking is no more risky than lots of other things that people do”.

Social denormalisation

Three items, $\alpha = 0.54$ —Aggregates smokers’ level of agreement with the statements: “People who are important to you think you shouldn’t smoke”, “Society disapproves of smoking”, “There are fewer and fewer places where you feel comfortable about smoking”.

Intention of quitting

This was measured by a five point scale: do not intend to quit, intend to quit beyond six months, intend to quit in the next six months, intend to quit in the next month, no date set, intend to quit in the next month, date set. In addition, cessation activity was assessed in terms of both reported quit attempts between waves, and point prevalence for no longer smoking at Wave 2.

Relative harm of RYO

All respondents were asked if any of RYO, FM, cigars or pipes were less harmful. If they answered “yes” they were then asked which product was the least harmful. All respondents were also asked if any of RYO, FM, cigars or pipes were more harmful. If they answered “yes” they were then asked which

product was the most harmful. Two categorical variables were constructed: RYO least harmful (No = 0, Yes = 1), RYO most harmful (No = 0, Yes = 1).

Counter institutional attitudes

Since there are no questions that directly tap into counter-institutional attitudes, it was decided to include three variables and one composite scale related to the role of tobacco companies—frequency of thinking about the harm tobacco companies do, level of agreement with the proposition that you can trust tobacco companies to tell the truth about their products, level of agreement with the proposition that tobacco companies try to convince the public that there are no risks from tobacco smoke pollution, and attitude to increased regulation of tobacco companies (a three item composite scale, $\alpha = 0.66$: “tobacco companies should be allowed to advertise as they please”, “tobacco products should be more tightly regulated”, and “the government should do more to tackle the harm caused”).

In addition, the following items were included in the analysis: a range of sociodemographic variables (country, sex, age, income, education, minority status), heaviness of smoking index¹⁶ (HSI) which combines number of cigarettes per day, with time to first cigarette, self perceived level of addiction, self assessment of depth of inhalation, overall attitude to smoking (where 1 = very negative → and 5 = very positive), frequency of thinking about “the harm my smoking does to others”, reporting having made a special effort to buy cheaper cigarettes, frequency of thinking about the money spent on cigarettes, believing they spend too much on cigarettes, reporting they spent money on cigarettes that would have been better spent on essentials like food, and where did they last purchase cigarettes or tobacco (for example, convenience store, tobacconist or discount store).

Analysis

All analyses were carried out using version 12.0.1 of the SPSS statistical package. Weighted data are reported for the univariate and bivariate analyses, including self-reported prevalence. Two logistic regressions were carried out, using unweighted data. The first compared exclusive FM smokers with smokers who report any use of RYO, in order to establish the independent predictors of RYO use. Then, a logistic regression was carried out comparing “mixed” RYO smokers with exclusive RYO smokers in order to establish the independent predictors of exclusive, as opposed to mixed RYO use. In both cases, a model with country interactions for all predictors was tested and, as there were no significant by country effects, the analyses reported are based on the simplified model, without these interaction terms.

RESULTS

Bivariate results

Table 1 indicates that there are large differences between countries in the prevalence of RYO use, with 28.4% of UK smokers, 24.3% of Australian smokers, 17.1% of Canadian

Table 1 Level of roll-your-own (RYO) use by country (row %)

	Any RYO use	Mixed	Only RYO
Total (n=9046)	19.5	10.8	8.7
Country ($\chi^2=506.56$; $p=0.000$)			
UK	28.4	11.6	16.8
Australia	24.2	15.3	8.9
Canada	17.1	10.3	6.8
USA	6.7	5.5	1.2

Table 2 Level of roll-your-own (RYO) by sociodemographics, price sensitivity, perception of relative harm, quitting intention and beliefs about smoking (column % and means)

(n = 9046)	Only FM	Mixed	Only RYO
Sex ($\chi^2=149.53$; $p=0.000$)			
Female	57.8	45.9	37.7
Income ($\chi^2=128.79$; $p=0.000$)			
Low	28.8	42.1	37.9
Moderate	34.2	31.9	36.5
High	29.3	18.2	18.0
No Answer	7.6	7.9	7.7
Education ($\chi^2=58.99$; $p=0.000$)			
Low	54.1	62.3	64.8
Moderate	32.3	29.0	23.4
High	13.6	8.6	11.8
Age ($\chi^2=93.74$; $p=0.000$)			
18–24	14.0	19.6	7.7
25–39	32.8	36.9	28.9
40–54	33.7	30.8	38.5
55+	19.5	12.7	24.9
Special effort to buy cheaper ($\chi^2=31.56$; $p=0.000$)			
Yes	22.8	30.7	26.2
Spend too much on cigarettes ($\chi^2=256.73$; $p=0.000$)			
Yes	83.8	81.4	60.3
Spent food money on cigarettes ($\chi^2=42.13$; $p=0.000$)			
Yes	31.3	38.5	24.0
Product least/most harmful ($\chi^2=199.13$; $p=0.000$)			
RYO least harmful	5.3	12.7	16.0
Neither most nor least harmful	88.2	84.3	80.5
RYO most harmful	6.5	3.0	3.5
Mean self exempting beliefs*	2.65	2.75	2.81
Mean social denormalisation beliefs*	4.02	3.85	3.92
Mean HSI*	2.51	2.98	2.79
Mean how strongly inhale*	3.77	3.93	3.95
Mean intention to quit*	2.32	2.23	2.03
Mean self efficacy*	2.31	2.29	2.17

* $p \leq 0.001$.

FM, factory made; HSI, heaviness of smoking index.

smokers, and only 6.7% of US smokers making some use of RYO cigarettes. There are also large differences in the proportions of mixed versus RYO only smokers across countries. In the UK, most RYO smokers smoke RYO exclusively, whereas in the other three countries mixed FM and RYO smokers are more common.

A preliminary analysis of where smokers last bought cigarettes/tobacco indicates that, compared to patterns for FM cigarettes, purchasing patterns for RYO are similar in Canada and the USA on the one hand, and Australia and the UK on the other. Canadian and US RYO purchases occurred disproportionately in smaller outlets like grocery and discount stores (43% Canada, 39% USA, compared with 26% UK and 30% Australia). On the other hand, RYO purchases in the UK occurred disproportionately in duty free stores/overseas locations (18%), and purchases from tobacconists were disproportionately associated with both Australia and the UK (23% in Australia and 6% in UK).

In all countries, more men than women use RYO tobacco, and this was more pronounced among those who smoke RYO exclusively, although in both cases there were notable minorities of female users. Table 2 also shows that smokers with low income and/or low education are more likely to use RYO tobacco. When it comes to smoking RYO exclusively, smokers in both the low income (especially) and moderate income categories smoke RYO to a disproportionate degree. However, substantial minorities of higher socioeconomic status individuals use RYO tobacco either exclusively or sometimes.

Table 3 Stability of roll-your-own (RYO) use, and attempts to quit, between Waves 1 and 2 (W1, W2)

n=6075	FM only W2	Mixed W2	RYO only W2	Total W1	Quit attempts between W1 and W2	Quit at W2
FM only W1	87.3 (97.8)*	1.0 (1.2)	0.9 (1.1)	79.7	37.0	10.8
Mixed W1	21.7 (23.2)	64.7 (69.1)	7.2 (7.7)	10.9	35.1	6.5
RYO only W1	4.4 (5.1)	3.9 (4.4)	82.2 (90.6)	9.4	31.1	9.5
Total W2	72.7 (80.2)	8.0 (8.9)	9.2 (10.2)		36.3	10.2

*Brackets indicate the percentage of those still smoking.
FM, factory made.

As predicted, younger smokers make disproportionate use of mixed FM and RYO cigarettes, whereas older smokers are more polarised—either smoking FM exclusively, or RYO exclusively.

Table 2 also shows mean differences in a range of psychosocial variables. In most cases, mixed smokers lie between FM and RYO-only smokers on these variables. However, for reported depth of inhalation, both RYO and mixed smokers report inhaling more deeply than FM smokers. In two cases, mixed smokers have the more extreme position: they are most likely to reject social denormalising beliefs about smoking, and are more addicted (as measured by the HSI).

Table 3 shows the levels of stability associated with exclusive FM, mixed, and exclusive RYO smoking between Waves 1 and 2. Both exclusive FM and exclusive RYO smoking are extremely stable over the seven month period, whereas mixed smoking is less stable: 23% of mixed smokers moved to FM, and 8% moved to exclusive RYO use. As can be seen from table 4, there is a clear tendency for switching between mixed and FM to occur among the younger age groups (18–39 years), as does switching from RYO to either FM or mixed smoking.

We also explored quitting activity and found little difference between the proportions of FM smokers and mixed smokers who made quit attempts between Waves 1 and 2. RYO-only smokers were less likely to have made quit attempts (table 3); however, the effect seems to be largely a function of age, and disappeared after adjusting for demographic variables. Among those who made a quit attempt, mixed smokers were least likely to succeed, and this effect remained when controlling for demographic variables (odds ratio (OR) 0.53, 95% confidence interval (CI) 0.33 to 0.84; $p = 0.008$).

Multivariate analysis

Table 5 reveals the outcome of the two logistic regressions: first, comparing smokers of RYO cigarettes with smokers of FM cigarettes; and second, comparing mixed RYO smokers with exclusive RYO smokers. There were no significant

interaction effects by country. The table reports the analysis without those interactions being included.

Compared to exclusive FM cigarette smokers, RYO smokers are more likely to be male, to have low incomes, and to come from either the UK or Australia, rather than the USA or Canada. RYO users are also more likely to rate RYO tobacco as the least harmful form of smoking. In addition, RYO users are also likely to be younger than FM smokers, to be more addicted (as measured by the HSI), to report higher levels of addiction, to report inhaling more deeply, to reject beliefs that tobacco is social denormalising, and to display a significantly lower motivation to quit. They are more likely to be members of the mainstream culture than of identified minority groups in the four countries studied.

Compared to FM smokers, RYO users do not think as often about how much they spend on cigarettes, and they are also more inclined to reject the idea that they spend too much. On the other hand, they are more likely to admit that they have spent food money on cigarettes and they would make a special effort to buy cheaper cigarettes if the price went up. They think more about the harm caused by tobacco companies, and they display lower levels of trust in tobacco companies.

Compared to mixed smokers, exclusive RYO smokers are significantly older, they report inhaling even more deeply, and are even more likely to be males. They have a higher level of acceptance of the social denormalisation of tobacco smoking, they are even less trusting of tobacco companies than are mixed smokers, and they are more likely to support increased regulation of the tobacco industry. They think less about the money they spend, and they are even less concerned that they are spending too much.

DISCUSSION

RYO smokers form a significant minority of all smokers in three of the four countries studied. The findings also highlight a range of systematic differences between RYO and FM cigarette smokers. RYO smokers are predominantly male, poorer, and more likely to be young. They are also more embedded in a smoking culture, having many friends who smoke, and they view smoking as more normative (especially the mixed group). RYO smokers appear to be more addicted to smoking, claim to inhale more deeply than FM smokers, believe that RYO tobacco is less harmful than other forms of tobacco, and are less interested in quitting. These latter factors may put them at higher risk of harm, compared to other smokers.

RYO smokers are also more critical and less trusting of tobacco companies than are FM smokers. This latter effect is consistent with a hypothesis that many RYO smokers externalise any discomfort they feel about smoking onto the tobacco companies, and significant numbers see their own use of RYO tobacco as a form of non-compliance with the mass-market, pre-packaged smoking culture—something the tobacco companies are only too aware of.⁶

Table 4 Switching between roll-your-own (RYO) and factory made (FM) cigarettes, by age

	n	Age (years)			
		18–24	25–39	40–54	55+
No change	5717	10.4	30.4	36.7	22.5
FM to mixed	48	24.1	34.5	36.2	5.2
FM to RYO	51	9.8	41.2	37.3	11.8
Mixed to FM	154	22.7	32.5	33.8	11.0
Mixed to RYO	51	7.8	33.3	37.3	21.6
RYO to other	54	18.5	27.8	33.3	20.4
Total	6075	10.9	30.6	36.6	21.9

$\chi^2 = 59.3$; $p = 0.000$.

Table 5 Logistic regressions: any use of roll-your-own (RYO) versus factory made (FM), and RYO only versus mixed

Item (n = 9046)	Any RYO versus FM		RYO only versus mixed	
	$\chi^2 = 15.2$, df = 8; ns		$\chi^2 = 7.2$, df = 8; ns*	
	OR	p Value	OR	p Value
Age	0.99	0.001	1.03	0.001
Sex				
Female versus male	0.50	0.001	0.75	0.019
Country				
Canada	2.18	0.001	3.37	0.001
UK	3.88	0.001	5.40	0.001
Australia	2.99	0.001	2.27	0.017
USA (reference)	1.00		1.00	
Education				
Low	1.06	NS	0.92	NS
Moderate	1.11	NS	0.73	NS
High (reference)	1.00		1.000	
Income				
Low	2.98	0.001	1.15	NS
Medium	1.90	0.001	1.34	NS
No answer	1.99	0.001	0.98	NS
High (reference)	1.00		1.00	
Identified minority				
Majority versus minority	1.72	0.001	1.06	NS
HSI	1.17	0.001	0.96	NS
Self rated addiction level	1.20	0.002	1.07	NS
Claim to inhale deeply	1.09	0.010	1.13	0.034
Number of smokers among 5 closest friends	1.17	0.001	0.93	0.035
Overall attitude to smoking	1.05	NS	0.95	NS
Intention to quit	0.92	0.008	0.90	NS
Social denormalisation	0.89	0.024	1.27	0.014
Self exempting beliefs	1.01	NS	0.98	NS
RYO least harmful	2.04	0.001	1.09	NS
RYO most harmful	0.46	0.001	0.75	NS
Spend food money on cigarettes	1.25	0.001	0.94	NS
Think about money spent	0.86	0.001	0.86	0.002
Spend too much	0.73	0.001	0.73	0.001
Make special effort to buy cheaper	1.28	0.001	0.82	NS
Think about harm to others	1.07	0.005	1.07	NS
Think about harm done by tobacco companies	1.07	0.007	1.01	NS
Attitude to regulation of tobacco companies	1.05	NS	1.20	0.031
Can trust tobacco companies to tell the truth	0.91	0.002	0.89	0.040
Tobacco companies try to convince no TSP risk	1.07	0.021	1.08	NS

*Hosmer-Lemeshow goodness-of-fit.

HSI, heaviness of smoking index; NS, not significant; TSP, tobacco smoke pollution

It is important to note that there were no statistically significant interaction effects by country—despite the large differences in the prevalence of RYO use between countries, the characteristics of RYO users varied little. This would imply that the same causal factors determining RYO use are at work in all four countries, albeit to different extents. For example, by most measures, FM cigarettes are cheaper in the USA than in the other three countries,¹⁷ and this may be one reason for the relatively lower level of RYO use among US smokers. However, there may also be important cultural differences between the USA and the other three countries, over and above the economic motivation.

The economic imperative appears to be a powerful motivator for RYO smokers. They are poorer, are more likely to have made a special effort to buy cheaper cigarettes, and acknowledge they have spent money on cigarettes rather than essentials, like food. However, they also report being less concerned with the amount they spend, and think about it less, once they use RYO tobacco. This latter finding may be because they think they are doing all they can to minimise the costs of their smoking, or are otherwise resigned to making this expenditure.

Income differences do not predict exclusive RYO use compared to mixed use; in fact, exclusive RYO smokers are less concerned with the money they spend, and are less likely to claim that they spend too much on cigarettes. Compared to mixed smokers, exclusive RYO smokers are older, dispropor-

tionately male, even less trusting of tobacco companies, and have a more positive attitude to regulating them. They claim to inhale more deeply, they have less friends who smoke and, if anything, they place even more emphasis on the (false) belief that RYO tobacco is safer. Significantly, they are more accepting that tobacco use has become socially denormalised.

The mixed smokers are younger, suggesting a gradual hardening of smoking styles with age among this group—either to FM exclusively, or RYO exclusively.

In addition, the evidence that switching between FM and mixed seems to occur more among younger smokers, whereas changing from mixed or FM to exclusive RYO seems to occur later, is consistent with a hypothesis that younger mixed smokers are smoking FM when their available funds allow it, and are switching to RYO as their salary/allowance runs out. On the other hand switching to exclusive use of RYO may represent a more permanent choice. In the absence of long term follow up, however, it remains possible that exclusive RYO smokers are a separate group, and one that is on the decline.

On the other hand, what data exist on longer term consumption patterns^{18 19} seem to indicate that quite substantial changes can take place over longer periods. While RYO cigarettes were virtually unknown in Norway in the 1950s, having been completely replaced by factory made cigarettes, by 1975, exclusive users of RYO tobacco peaked at 30.8% of the population, mixed smokers were 18.1%, and

exclusive FM smokers were only 7.4%. By 1994, the respective figures had changed to 15.5%, 14.4%, and 14.1%, representing a resurgence in factory made use. Rises on a different timescale have been reported in New Zealand. While RYO tobacco represented only 16% of tobacco consumed in 1990, it had risen to 32% by 2002, a period during which total tobacco consumption declined by 38%. In both countries, tobacco taxes are relatively high, and FM cigarettes are subject to higher taxes than RYO tobacco. This suggests any significant change in RYO use in the countries under study is not necessarily part of a universal response to current conditions, but is determined, at least in part, by local factors.

We clearly need to understand better the dynamics of switching, since points where consumption patterns change may also be points where interventions to encourage quitting might be more effective, and we can minimise the numbers of smokers who become resigned to smoking.

The characteristics of exclusive RYO smokers are superficially consistent with a hypothesis that they are, in many ways, simply resigned to their tobacco use, reporting less interest in quitting among other things. However, they are no less likely to make quit attempts, or succeed, than FM smokers—once their demographics are taken into account. This suggests more a style of rejecting any thoughts of action until they feel ready to take action. They appear to judge themselves as too addicted and habituated to tobacco to see cessation as a realistic option, and their higher levels of acceptance that tobacco use is socially denormalised could indicate feelings of alienation and dissonance. However, they appear to be dealing with their discomforts by having a more deep seated externalisation strategy, evidenced by their even stronger antipathy to tobacco companies, and their willingness to regulate them. It is almost as if they are saying to the companies “you put me here”, while maintaining their long-term addiction, and the rituals of RYO smoking.

By contrast, mixed smokers emerge as a group who are more deeply embedded in smoking networks than both FM smokers and exclusive RYO smokers. They identify more with other smokers, and they see smoking as more socially normative than the other two groups. They are also younger, and 46% of them are women. It is plausible that a significant proportion of these younger mixed smokers are part of a “uni-sex”, smoking subculture. Their low-medium income status is consistent with the hypothesis that they use RYO to supplement the more expensive FM cigarettes when the money runs out. Their embeddedness in a smoking culture may also be a reason why their quit attempts are less likely to be successful than those of exclusive RYO smokers.

The surprisingly high proportion of female RYO smokers, especially among the mixed group, warrants further research as conventional wisdom has seen RYO smoking as a predominantly male activity in developed countries. Are they part of a newly emerging uni-sex smoking subculture, or have women been unnoticed RYO smokers for some time? We should also not discount something we did not investigate here—that RYO use, particularly mixed, might be linked to the use of other smoked drugs, like marijuana.

The finding that RYO smokers are more likely to believe RYO use is less harmful than other forms of tobacco use may suggest, in line with anecdotal evidence, that they perceive it to be more “organic” and “natural”. As RYO cigarettes are often unfiltered, something many believe to increase harm, there needs to be some strong belief about the tobacco itself to justify a belief about reduced harmfulness.

The health risks of RYO cigarettes also need to be better understood, since the existing machine smoking data are mostly useless because they do not accurately reflect human smoking behaviour, exposure, and subsequent disease risk.

What this paper adds

This is one of the first studies to compare the characteristics of smokers who use roll-your-own (RYO) and factory made (FM) cigarettes. Findings show that the stereotypical older, lower socioeconomic status male RYO smoker is merely the “tip of the iceberg”, and that there are significant numbers of younger adult smokers who are using RYO cigarettes. Mixed use of RYO and FM cigarettes is surprisingly common, and RYO use does not appear to be solely motivated by the lower cost of RYO cigarettes. The variation in the prevalence of RYO use among the four Western countries highlights differences between national markets with important implications for tobacco control policy. Future tobacco use surveys need to monitor RYO cigarette usage more closely, including gathering data on reasons for selecting RYO cigarettes since the prevalence of RYO use is not insignificant, and may be a growing phenomenon among younger smokers. To prevent RYO use becoming even more prevalent, countries should ensure that any tax increases apply equally to factory-made and RYO cigarettes.

We can see no justification for taxation policies that make RYO tobacco a financially attractive option to FM cigarettes, as this may reduce incentives to quit. We understand the tobacco industry are aware of this market, and are targeting younger groups. Tobacco control activity is needed to counter these efforts.

In summary, only a minority of RYO smokers seem to fit the stereotypic profile of the “grumpy, poor, old man in the pub”. Rather, what this study indicates is that there are several different motives at play in the use of RYO cigarettes, including economic, since RYO cigarettes are perceived as, and may actually be, less expensive; perceived level of harm, as many RYO smokers believe the tobacco is more “natural” and thus safer to use than FM cigarettes; and subcultural identification, with tobacco use that is surprisingly “unisex”. The variation in the prevalence of RYO use among the four Western countries studied here seems only to be partly attributable to price differentials; more work is needed to understand the dynamics influencing use.

Governments should not ignore RYO cigarettes when it comes to tobacco policy. Future tobacco use surveys should carefully monitor RYO cigarette usage since the prevalence of RYO use is not insignificant and may be growing among younger smokers. Further, mixed use of RYO appears to identify smokers at heightened risk of relapse when they try to quit, and this needs to be countered.

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REFERENCES

- 1 **Lader D**, Meltzer H. *Smoking related behaviour and attitudes*. London: Office for National Statistics, 2001.
- 2 **Health Canada**. 2001. Canadian tobacco use monitoring survey. Supplementary tables. *CTUMS Annual Report*. http://www.hc-sc.gc.ca/hecs-sesc/tobacco/research/ctums/2001/table_10.html.
- 3 **Scollo M**, Younie S, Wakefield M, et al. Impact of tobacco tax reforms on tobacco prices and tobacco use in Australia. *Tob Control* 2003;**12**(suppl II):ii59–66.
- 4 **Mindell J**, Whynes D. Cigarette consumption in the Netherlands 1970–1995: does tax policy encourage the use of hand-rolling tobacco. *Eur J Public Health* 2000;**10**:214–19.
- 5 **HM Customs and Excise**. *Tackling tobacco smuggling*. London: HMT, 2000.
- 6 **Devlin E**, Eadie D, Angus K. *Rolling tobacco*. Report prepared for the National Health Service, Scotland, by The Centre for Tobacco Control Research, The University of Strathclyde, 2003.
- 7 **Darroll KG**, Figgins JA. Roll-your-own smoke yields: theoretical and practical aspects. *Tob Control* 1998;**7**:168–75.
- 8 **Dymond HF**. Making habits of roll-your-own smokers in the Netherlands and tar and nicotine yields from the resulting products. *Tob Sci* 1996;**40**:87–91.
- 9 **Kaiserman MJ**, Rickert WS. Handmade cigarettes: it's the tube that counts. *Am J Public Health* 1992;**82**:107–9.
- 10 **Djordjevic MV**. Nicotine dosing characteristics across tobacco products. In: Boyle P, Gray N, Henningfield J, et al. *Tobacco: science, policy and public health*. Oxford: Oxford University Press, 2004.
- 11 **Tuyns AJ**, Esteve J. Pipe, commercial and hand-rolled cigarette smoking in oesophageal cancer. *Int J Epidemiol* 1983;**12**:110–13.
- 12 **Boffeta P**. Laryngeal cancer. In: Boyle P, Gray N, Henningfield J, et al. *Tobacco: science, policy and public health*. Oxford: Oxford University Press, 2004.
- 13 **M&C Saatchi**. Amber leaf creative briefs. Document No 0505. Reported in Devlin E, Eadie D, Angus K. *Rolling tobacco*. Report prepared for the National Health Service, Scotland, by The Centre for Tobacco Control Research, The University of Strathclyde, 2003.
- 14 **Simpson D**. France: rolling round the curbs. *Tob Control* 2001;**10**:6.
- 15 **Thompson ME**, Fong GT, Hammond D, et al. Methods of the International Tobacco Control (ITC) Four Country Survey. *Tob Control* 2006;**15**(suppl III):iii12–18.
- 16 **Heatherton TF**, Koslowski LT, Frecker RC, et al. Measuring the heaviness of smoking using self-reported time to the first cigarette of the day and number of cigarettes smoked per day. *Br J Addiction* 1989;**84**:791–800.
- 17 **US Department of Health and Human Services**. *Reducing tobacco use: a report of the Surgeon General*, US Department of Health and Human Services, Centres for Disease Control and Prevention, National Centre for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, Atlanta, Georgia; chapter 6, p348, 2000.
- 18 **Wangan KR**, Biørn E. *Prevalence and substitution effects in tobacco consumption: a discrete choice analysis of panel data*, Discussion Paper 312, Research Department, Statistics Norway, 2001. <http://www.ssb.no/publikasjoner/DP/pdf/dp312.pdf>.
- 19 **Laugesen M**. *Tobacco manufacturers' returns for calendar year 2002*. Report to the Ministry of Health, New Zealand, Health New Zealand, 2003. <http://www.ash.org.nz/pdf/TobaccoIndustry/Conduct/Articles/SFRTN2002Final.doc>.