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Prevalence and perceptions of flavour capsule cigarettes among adults who smoke in Brazil, Japan, Republic of Korea, Malaysia and Mexico: findings from the ITC surveys

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ABSTRACT

Introduction The global market of flavour capsule cigarettes (FCCs) has grown significantly over the past decade; however, prevalence data exist for only a few countries. This study examined prevalence and perceptions of FCCs among adults who smoke across five countries.

Methods Cross-sectional data among adults who smoked cigarettes came from the International Tobacco Control Policy Evaluation Project Surveys—Brazil (2016/2017), Japan (2021), Republic of Korea (2021), Malaysia (2020) and Mexico (2021). FCCs use was measured based on reporting one's usual/current brand or favourite variety has flavour capsule(s). Perceptions of the harmfulness of one's usual brand versus other brands were compared between those who used capsules versus no capsules. Adjusted logistic regression models examined correlates of FCC use.

Results There were substantial differences in the prevalence of FCC use among adults who smoke across the five countries: Mexico (50.3% in 2021), Republic of Korea (31.8% in 2021), Malaysia (26.5% in 2020), Japan (21.6% in 2021) and Brazil (6.7% in 2016/2017). Correlates of FCC use varied across countries. Capsule use was positively associated with being female in Japan and Mexico, younger age in Japan, Republic of Korea and Malaysia, high education in Brazil, Japan and Mexico, non-daily smoking in Republic of Korea, and having plans to quit in Japan and Republic of Korea. There was no consistent pattern of consumer perceptions of brand harmfulness.

Conclusion Our study documented the high prevalence of FCCs in some countries, pointing to the need to develop and implement regulatory strategies to control these attractive products.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ This study is strengthened by its use of the International Tobacco Control Policy Evaluation (ITC) Project surveys, which are a series of prospective cohort studies designed to be comparable across countries.
⇒ ITC studies use a theory-informed conceptual framework that considers moderators, which have been adjusted for in logistic regression analyses of the current study.
⇒ Cross-sectional data may not capture the full scope of flavour capsule cigarette patterns across countries.
⇒ Most country samples were derived from online consumer panels, and while efforts were made to yield samples that were nationally representative, samples may not represent the entire population of adults who smoke cigarettes.

INTRODUCTION

The incorporation of flavours into cigarettes by tobacco companies poses a significant threat to global tobacco control efforts by enhancing the attractiveness of these products.[1] One such method is through the use of flavour capsules.

Flavour capsule cigarettes (FCCs) contain one or two capsules in the cigarette filter which release flavour when the consumer crushes it.[2] They come in several flavours, including both traditional flavours (eg, menthol, berry) and those with 'concept descriptors' (eg, Mykonos Nightfall).[3–5] The choice of flavours, the enjoyment of clicking the capsule and the ability to customise when and if to crush the capsule contribute to their appeal.[6–8] FCCs are marketed through a mix of strategies.[9–11] In addition to contributing to the appeal of tobacco products through features known to be particularly attractive to young people,[9] research indicates that FCCs contain a myriad of chemical components,

WHAT IS ALREADY KNOWN ABOUT THIS TOPIC

⇒ Flavour capsule cigarettes have experienced significant market growth globally, yet data on the prevalence and correlates of capsule use are scarce.

WHAT THIS STUDY ADDS

⇒ This study of flavour capsule cigarettes in five countries found that a substantial proportion of adults who smoked used/preferred flavour capsule cigarettes: over 20% in four of the five countries (Mexico: 50.3%, Republic of Korea: 31.8%, Malaysia: 26.5%, Japan: 21.6% in 2020/2021), with Brazil having the lowest prevalence (6.7% in 2016/2017).

⇒ There was no consistent pattern across countries in consumer perceptions of relative brand harmfulness (one's usual/current brand relative to other brands) between those whose usual cigarette brand had a capsule versus those whose brand had no capsule.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE, OR POLICY

⇒ Findings support the need to implement comprehensive tobacco policies globally that address use of flavour capsule cigarettes, such as banning flavour additives and filter technologies.

many of which are toxic and possibly carcinogenic.[12 13] Further, components detected in FCCs may increase nicotine delivery and exposure, thereby facilitating addictiveness.[12 13]

In recent years, the market share of FCCs has grown substantially in many countries, particularly in low-income and middle-income countries.[14–16] In 2014, when the global cigarette market experienced a marked acceleration of FCC growth,[15] FCCs accounted for 10%–25% of the cigarette market share in the top 5 countries with the largest FCC shares, all in Latin America (ie, Chile, Peru, Guatemala, Mexico and Argentina).[14] By 2020, FCCs made up 25%–50% of the overall cigarette market in 5 countries with the largest FCC market shares[17] (ie, Chile, Peru, Guatemala, Mexico and Republic of Korea).

Despite these trends, there is a dearth of research on the prevalence of FCC use in countries where these products are available on the market.[18] Prevalence data (current or ever use among people who smoke) exist for only a handful of countries, including Australia,[19] Chile,[20] Mexico,[5 19 21 22] Republic of Korea,[23] the UK[24] and the USA.[19 25 26] Previous studies have found that FCC appeal and use is associated with younger age,[5 19–21 24] and in some countries, with being female.[5 19–21 23] Smoking and quitting behaviours are not consistently associated with FCC use.[18]

Monitoring trends in flavoured tobacco product use is integral to tobacco control as flavours increase the appeal of tobacco, particularly among youth.[1 27 28] Such data can support adoption of Article 9 of the WHO Framework Convention on Tobacco Control, which calls on Parties to prohibit or restrict flavours, as well as to regulate other design features that increase the attractiveness of tobacco products, including the placement of capsules in cigarette filters that release flavour when crushed.[29] In order to fill in research gaps and provide insight into how FCC use may vary across countries with different markets and tobacco control policies, this study aimed to (1) examine prevalence and correlates of use of FCCs across five countries (Brazil, Japan, Republic of Korea, Malaysia and Mexico), (2) describe FCC crushing behaviours and (3) compare perceptions of brand harmfulness and reasons for choosing one's brand among adults who smoke FCCs versus non-capsule cigarettes.

METHODS

Study design

Cross-sectional data came from the latest survey wave conducted in each of five countries participating in the International Tobacco Control Policy Evaluation (ITC) Project surveys: Wave 3 Brazil (September 2016–March 2017), Wave 4 Japan (July–August 2021), Wave 2 Republic of Korea (November–December 2021), Wave 1 Malaysia (February–March 2020) and Wave 8 Mexico (March–April 2021). These five countries were selected based on availability of measures on FCCs among the countries participating in the ITC Project. Other requirements for inclusion entailed having sufficient sample size, not having an implemented national ban on flavoured tobacco products, including FCCs, at the time of the survey, and approval from country survey principal investigators. This broad criterion was used given the scarcity of FCC prevalence data globally. Age-standardised cigarette smoking prevalence in 2021 ranged from 11.2% in Brazil to 13.9% in Mexico, 17.9% in Malaysia, 18.9% in Japan and 19.3% in Republic of Korea.[30] Brazil, Malaysia and Mexico are upper-middle-income countries, while Japan and Republic of Korea are high-income countries (online supplemental table 1).

All surveys sampled adults who smoked cigarettes; however, other groups were also sampled in some surveys (eg, heated tobacco product users, e-cigarette users, non-users) (online supplemental table 1). The current analytic sample was restricted to adults (aged ≥18 years in Brazil, Malaysia and Mexico, ≥19 in Republic of Korea, and ≥20 in Japan) who smoked cigarettes. Cigarette smoking was defined as those who smoked at least 100 cigarettes in their lifetime and smoked at least monthly at the time of the survey. In Mexico, current smoking was only defined as having smoked cigarettes in the last 30 days (yes/no) because of validity concerns around the 100 cigarette screening question.[31]

Data were collected remotely using web-based surveys in all countries except Brazil, where data were collected via computer-assisted telephone interviewing. With the exception of Brazil, in which households were randomly called using systematic sampling, participants were recruited from online consumer panels, with quotas for age, sex and education groups, as well as type of tobacco and nicotine products use, depending on the country.[32–35] In all countries except Malaysia (which was wave 1 of the survey), the sample included both recontact respondents

from previous survey wave(s), as well as replenishment respondents who were newly sampled at the current survey wave to compensate for attrition. Response and cooperation rates are also presented alongside country and survey characteristics in online supplemental table 1. All study participants provided informed consent. Detailed descriptions of the methods employed for the respective surveys used in this study are available on the ITC website for each country[32–35]

Patient and public involvement

Patients were not involved in this study.

Measures

Usual/preferred cigarette brand has a flavour capsule

Respondents in Brazil, Japan, Republic of Korea and Malaysia were asked the question, "Does your usual/current brand have a capsule in the filter that releases flavour when it is crushed?" (yes; no). In Mexico, respondents were told that, "Some varieties of cigarettes have one or more flavor capsules in the filter, which release a flavor when crushed", and subsequently asked, "Does your favorite variety of cigarettes have flavor capsules?" (Yes, they have a flavour capsule in the filter; Yes, they have two or more flavour capsules in the filter; No, they do not have any flavour capsule).

Frequency of crushing FCCs

Respondents from Brazil, Japan, Republic of Korea and Malaysia who indicated 'yes' to the question about usual/current brand with capsule were asked, "When you smoke a pack of your usual/current brand, how often do you crush the flavour capsule?" (Every capsule; Most capsules; About half the capsules; Some capsules, but less than half; Never). This question was not asked among respondents in Mexico.

Perceived harmfulness of usual brand

Perceived harmfulness of usual brand was examined with the question, "Do you think that the brand you usually/currently smoke, might be a little less harmful, no different, or a little more harmful, compared to other cigarette brands?" (a little less harmful, no different, a little more harmful, don't know) among respondents from Brazil, Japan, Republic of Korea and Malaysia. This question was not asked among respondents in Mexico.

Reasons for choosing usual brand

To examine reasons for choosing one's usual brand, respondents in Brazil and Malaysia were asked a series of questions with the prompt: "In choosing your usual brand, was part of your decision to smoke this brand based on any of the following…" The following questions were asked to respondents in Brazil: *How they taste? The price? The tar and nicotine levels for the brand? They may not be as bad for your health? The colour of the pack?* (yes, no; for each response). In Malaysia, respondents were asked the following questions: *How they taste? They may not be as bad for your health? Your friends smoke this brand? The design of the pack?* (yes, no; for each question). These questions were not asked among respondents in Japan, Republic of Korea and Mexico.

Sociodemographic and cigarette smoking behaviours

Covariates examined were sex (male, female), age group (18–24, 25–39, 40–54, 55+ years), education (low (less than high school), moderate (high school) and high (university or higher)), smoking frequency (daily, non-daily) and plans to quit smoking (no plans, plans to quit within the next 6 months, plans to quit in the future beyond 6 months).

Data analysis

Bivariate and multivariable analyses were conducted in Stata/SE V.16.1 (StataCorp, 2019) using weighted data. Poststratification weights were constructed by the ITC team based on the distribution of sex, age and education in the general population of smokers for each country.[32–35] Analyses were country-specific, accounting for the sampling design in each country. Refused/'Don't know' responses were set to missing data for each respective measure (missing n are reported in online supplemental tables). Usual/preferred use of FCCs was examined overall and by sociodemographic and smoking behaviours for each country separately, reported as percentages with 95% CIs. Logistic regression models were estimated separately for each country to examine correlates of usual/preferred use of FCCs. Models were adjusted for sex, age, education, smoking frequency and plans to quit smoking with results presented as adjusted ORs (aORs) with 95% CIs and p values. Covariates were identified conceptually based on the literature[18] and included in the models based on availability of consistent measures across all countries. χ^2 tests were conducted to compare perceptions of harmfulness of one's usual/current brand relative to other brands and reasons for one's usual brand choice, respectively, between those whose usual cigarette brand had a capsule versus no capsule, with p values reported.

RESULTS

Sample characteristics

The overall sample included adults who smoked cigarettes from Brazil (n=1215), Japan (n=2876), Republic of Korea (n=3765), Malaysia (n=1104) and Mexico (n=1331). Sample characteristics varied across the countries (table 1; online supplemental table 2 for full table).

Prevalence and correlates of FCC use

Among adults who smoked cigarettes, the prevalence of FCC use was 50.3% (95% CI 43.1% to 57.4%) (throughout this article, we present the 95% CIs for each estimate as a range between the lower bound and upper bound.) in Mexico, 31.8% (26.4% to 37.8%) in Republic of Korea, 26.5% (23.3% to 30.0%) in Malaysia, 21.6% (17.4% to 26.4%) in Japan, and 6.7% (4.7% to 9.5%) in Brazil (table 2; online supplemental table 3) for full table).

Table 1 Overall sample characteristics of adults who smoke cigarettes across five countries of the International Tobacco Control Policy Evaluation Surveys, weighted*

	Brazil (n=1215)	Japan (n=2876)	Republic of Korea (n=3765)	Malaysia (n=1104)	Mexico (n=1331)
	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)
Sex					
Male	47.9 (43.7 to 42.2)	67.5 (63.0 to 71.8)	89.9 (85.8 to 92.9)	97.3 (96.5 to 97.9)	60.1 (53.3 to 66.5)
Female	52.1 (47.8 to 56.3)	32.4 (28.2 to 37.0)	10.1 (7.1 to 14.2)	2.7 (2.1 to 3.5)	39.9 (33.5 to 46.7)
Age group (years)					
18–24†	4.4 (2.8 to 7.1)	2.7 (0.8 to 8.5)	8.8 (4.5 to 16.5)	13.7 (11.4 to 16.4)	9.6 (6.7 to 13.5)
25–39	34.6 (30.2 to 39.2)	31.9 (27.4 to 36.8)	26.2 (22.6 to 30.2)	51.0 (47.1 to 54.9)	56.1 (49.2 to 62.7)
40–54	34.6 (30.8 to 38.6)	31.7 (28.2 to 35.3)	37.4 (32.7 to 42.4)	29.7 (26.0 to 33.8)	25.9 (20.6 to 32.0)
55+	26.3 (23.4 to 29.5)	33.8 (30.0 to 37.7)	27.6 (22.2 to 33.7)	5.5 (3.9 to 7.8)	8.4 (6.2 to 11.3)
Education					
Low	29.5 (25.8 to 33.4)	2.2 (1.7 to 2.8)	1.9 (1.2 to 3.1)	47.6 (43.7 to 51.5)	47.6 (40.3 to 54.9)
Moderate	37.5 (33.4 to 41.8)	52.5 (48.0 to 56.9)	58.6 (53.6 to 63.5)	36.5 (32.8 to 40.3)	36.7 (31.2 to 42.6)
High	31.9 (28.0 to 36.1)	45.3 (40.9 to 49.8)	39.4 (34.7 to 44.4)	15.9 (14.0 to 18.0)	15.7 (12.7 to 19.2)
Smoking frequency					
Daily	92.8 (90.2 to 94.8)	69.1 (62.9 to 74.7)	69.6 (61.8 to 76.4)	88.5 (86.0 to 90.5)	47.1 (40.0 to 54.3)
Non-daily	1.1 (0.6 to 2.1)	30.9 (25.3 to 37.1)	30.4 (23.6 to 38.2)	11.5 (9.4 to 14.0)	52.9 (45.7 to 60.0)
Plans to quit					
No plans	7.2 (5.2 to 9.8)	46.1 (41.3 to 50.9)	30.0 (25.5 to 35.0)	14.8 (12.1 to 17.9)	23.8 (18.0 to 30.9)
Within the next 6 months	52.9 (48.4 to 57.3)	19.4 (14.3 to 25.7)	40.3 (33.9 to 47.0)	42.0 (38.2 to 46.0)	38.7 (31.5 to 46.5)
In future beyond	23.9	34.5	29.7	43.2	37.4
6 months	(20.5 to 27.7)	(30.4 to 38.9)	(24.5 to 35.4)	(39.2 to 47.2)	(30.6 to 44.8)

*See online supplemental table 2 for full table, including n.
†Age group is 20–24 years for Japan and 19–24 years for Republic of Korea, based on the respective countries' definitions of the start of adulthood.

Use of FCCs was significantly higher among females than males in Japan (aOR=1.79) and Mexico (aOR=3.18), with no differences by sex in the other countries (table 3; online supplemental table 4 for full table). Younger age was associated with FCC use in Japan, Republic of Korea and Malaysia. In Mexico, a higher proportion of use was observed among those aged 18–24 (70.1%) versus 55+ (30.4%) (table 2), but this was marginally not significant after controlling for other factors (aOR=3.10, 0.99 to 9.73) (table 3). Use of FCCs was associated with high compared with low education in Brazil (aOR=2.37), Japan (aOR=4.04) and Mexico (aOR=2.38). Those who smoked cigarettes non-daily had greater odds of usually using FCCs than those who smoked daily in Republic of Korea (aOR=1.76). Having plans to quit was associated with using FCCs in Japan and Republic of Korea.

Frequency of crushing capsules

Adults who smoked FCCs most commonly reported that when they smoke a pack of their usual/current brand they crush every capsule, compared with less frequent response options. Crushing every capsule in a pack was most frequently reported in Japan (76.6%, 67.9% to 83.5%), followed by Republic of Korea (59.7%, 47.1% to 71.1%), Brazil (52.7%, 34.4% to 70.3%), and Malaysia (45.1%, 37.7% to 52.7%) (table 4; online supplemental table 5 for full table).

Perceived harmfulness of usual brand

Findings on perceived harmfulness of one's usual brand relative to other brands were mixed (table 5; online supplemental table 6 for full table). In Brazil, a higher percentage of those smoked FCCs perceived their brand to be a little more harmful than other brands (28.3%, 13.1% to 50.9%), compared with those who used non-capsule cigarettes (10.2%, 7.9% to 13.3%) (p=0.011). In Malaysia, a greater percentage of those who used FCCs perceived their brand to be less harmful than other brands (18.5%, 13.3% to 25.0%) than those whose brand had no capsule (11.1%, 8.5% to 14.4%) (p=0.016).

Reasons for usual brand choice

In Brazil, taste was a more common reason for usual brand choice among those whose usual brand had a flavour capsule (89.5%, 74.8% to 96.1%) compared with no capsule (60.6%, 56.0% to 65.1%) (p <0.001) (online supplemental table 7). No other reasons assessed for usual brand choice differed between those who used FCCs and did not use capsules in Brazil, including price, tar/nicotine levels, not as bad for health and pack colour.

Table 2 Prevalence of usual/preferred brand has a flavour capsule overall and by sociodemographic characteristics and smoking behaviours adults who smoke cigarettes across five countries of the International Tobacco Control Policy Evaluation Surveys, weighted*

	Brazil (n=1215)	Japan (n=2876)	Republic of Korea (n=3765)	Malaysia (n=1104)	Mexico (n=1331)
	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)	% (95% CI)
Overall	6.7 (4.7 to 9.5)	21.6 (17.4 to 26.4)	31.8 (26.4 to 37.8)	26.5 (23.3 to 30.0)	50.3 (43.1 to 57.4)
Sex					
Male	6.1 (4.0 to 9.2)	20.1 (15.0 to 26.4)	31.3 (25.4 to 37.7)	26.3 (23.0 to 30.0)	39.1 (30.0 to 49.0)
Female	7.3 (4.1 to 12.6)	24.5 (18.0 to 32.5)	38.0 (26.8 to 50.8)	32.3 (21.6 to 45.1)	67.2 (58.0 to 75.2)
Age group (years)†					
18–24	12.0 (2.0 to 47.4)‡	80.4 (44.3 to 95.5)‡	61.3 (26.4 to 87.4)	23.7 (16.7 to 32.6)	70.1 (52.2 to 83.4)
25–39	8.5 (4.7 to 14.9)	26.2 (18.5 to 35.7)	43.1 (36.5 to 49.9)	30.3 (26.0 to 35.0)	54.7 (43.4 to 65.5)
40–54	4.6 (2.5 to 8.4)‡	19.7 (14.7 to 25.9)	28.9 (23.0 to 35.7)	25.0 (18.6 to 32.8)	39.6 (29.1 to 51.2)
55+	6.2 (3.5 to 10.8)	13.8 (10.4 to 18.1)	14.3 (6.0 to 30.3)‡	7.6 (2.3 to 22.3)‡	30.4 (18.7 to 45.3)
Education					
Low	4.4 (2.3 to 8.3)‡	6.6 (2.2 to 18.1)‡	22.1 (8.6 to 45.9)‡	26.2 (21.3 to 31.9)	43.7 (30.9 to 57.4)
Moderate	6.7 (3.5 to 12.5)‡	18.9 (14.8 to 23.8)	29.1 (20.7 to 39.1)	24.0 (18.7 to 30.1)	54.8 (48.5 to 61.0)
High	9.0 (5.3 to 14.9)	24.8 (17.7 to 33.7)	36.5 (31.4 to 41.9)	31.6 (26.4 to 37.3)	59.8 (50.5 to 68.6)
Smoking frequency					
Daily	13.8 (4.9 to 33.4)	17.4 (15.7 to 19.1)	26.5 (23.9 to 29.3)	26.3 (22.8 to 30.1)	52.9 (42.8 to 62.8)
Non-daily	6.1 (4.2 to 8.9)‡	31.5 (19.4 to 46.7)	44.5 (28.2 to 62.0)	28.0 (19.7 to 38.0)	47.2 (37.2 to 57.6)
Plans to quit					
No plans	5.4 (2.9 to 9.9)‡	17.8 (11.7 to 26.1)	28.5 (19.9 to 38.9)	27.4 (18.9 to 38.1)	53.6 (37.8 to 68.8)
Within the next 6 months	6.5 (3.7 to 11.1)	27.7 (15.0 to 45.5)	38.0 (26.6 to 50.9)	30.1 (24.9 to 35.9)	52.5 (39.8 to 64.9)
In future beyond 6 months	8.4 (4.0 to 16.6)‡	23.6 (18.0 to 30.4)	30.8 (24.1 to 38.4)	23.7 (18.9 to 29.3)	47.2 (36.3 to 58.4)

*See online supplemental table 3 for full table, including n.
†Age group is 20–24 years for Japan and 19–24 years for Republic of Korea, based on the respective countries' definitions of the start of adulthood.
‡Indicates high sampling variability; relative SE >0.3; interpret with caution.

In Malaysia, a higher proportion of those who used FCCs compared with no capsules reported that they chose their usual brand because it is not as bad for health (50.3%, 42.5% to 58.0% vs 25.7%, 22.5% to 31.5%, p <0.001), the pack design (46.1%, 38.6% to 53.8% vs 20.8%, 17.2% to 24.9%, p <0.001), and because their friends smoke that brand (52.0%, 44.3% to 59.7% vs 35.3%, 30.8% to 40.0%, p <0.001). No significant differences were observed between those who smoked FCCs versus no capsules in Malaysia for taste (95.9%, 91.6% to 98.0% vs 93.0%, 89.9% to 95.2%, p =0.198) and price (79.1%, 72.7% to 84.3%% vs 73.9%, 69.5% to 77.8%, p =0.167).

DISCUSSION

The current study examined the prevalence of FCC use, frequency of crushing capsules, perceived harmfulness of usual brand and reasons for FCC use among adults who smoke from Brazil, Japan, Republic of Korea, Malaysia and Mexico. Prevalence estimates for usual/preferred use of FCCs were highest in Mexico and lowest in Brazil. Demographic factors associated with FCC use varied across countries. FCC users most commonly reported that they crushed every capsule when they smoked a pack of FCCs, and taste was the most commonly reported reason for use in countries that examined this. Perceptions of usual brand harmfulness relative to other brands between those who smoked cigarettes with versus without capsules, varied across countries.

The finding that half of adults (50.3%) who smoke preferred FCCs in Mexico in 2021 is a marked increase from a 2014 estimate of 14%.[19] This is lower than another study assessing ITC Mexico data from 2018 to 2020 (60%), which defined FCC use based on preferred brand or last purchased brand variety.[31] Prevalence of FCC use from our study is higher than Euromonitor market share estimates, which indicated that FCCs made up over one-quarter (27.3%) of the total cigarette market in Mexico in 2020.[17] Although market share depends on consumption and price of different brands, and not necessarily concordant with prevalence, this finding highlights that while market share data have utility, prevalence data are critical for monitoring population-level trends.

The country with the second-highest prevalence of FCC use was Republic of Korea (31.8% in 2021), which showed

Table 3 Correlates of usual cigarette brand smoke have a flavour capsule among adults who smoke across five countries of the International Tobacco Control Policy Evaluation Surveys, weighted, logistic regression analyses†

	Brazil (n=1215)	Japan (n=2876)	Republic of Korea (n=3765)	Malaysia (n=1104)	Mexico (n=1331)
	aOR‡ (95% CI)	aOR‡ (95% CI)	aOR‡ (95% CI)	aOR‡ (95% CI)	aOR‡ (95% CI)
Sex					
Male	1.00	1.00	1.00	1.00	1.00
Female	1.41 (0.69 to 2.86)	1.79*** (1.35 to 2.38)	1.03 (0.61 to 1.75)	1.39 (0.78 to 2.47)	3.18*** (1.69 to 5.98)
Age group (years)§					
18–24	1.69 (0.36 to 7.88)	0.29 (0.04 to 2.26)	16.69*** (8.11 to 34.33)	3.43 (0.84 to 13.98)	3.10 (0.99 to 9.73)
25–39	1.89 (0.83 to 3.83)	1.55** (1.13 to 2.11)	4.61*** (2.94 to 7.22)	4.25* (1.10 to 16.38)	2.13 (0.88 to 5.14)
40–54	0.94 (0.46 to 1.93)	1.18 (0.88 to 1.58)	2.38*** (1.51 to 3.75)	3.19 (0.80 to 12.76)	1.37 (0.57 to 3.28)
55+	1.00	1.00	1.00	1.00	1.00
Education					
Low	1.00	1.00	1.00	1.00	1.00
Moderate	1.28 (0.54 to 3.02)	3.44 (0.87 to 13.51)	0.74 (0.20 to 2.71)	0.82 (0.53 to 1.27)	1.72 (0.87 to 3.42)
High	2.37* (1.12 to 4.99)	4.04* (1.01 to 16.10)	1.20 (0.33 to 4.32)	1.27 (0.86 to 1.86)	2.38* (1.10 to 5.15)
Smoking frequency					
Daily	1.00	1.00	1.00	1.00	1.00
Non-daily	1.68 (0.56 to 5.07)	1.43 (0.93 to 2.22)	1.76* (1.07 to 2.91)	0.96 (0.58 to 1.60)	0.91 (0.47 to 1.77)
Plans to quit					
No plans	1.00	1.00	1.00	1.00	1.00
Within the next 6 months	1.28 (0.56 to 2.93)	2.13*** (1.42 to 3.19)	1.56* (1.10 to 2.22)	1.05 (0.59 to 1.84)	0.93 (0.40 to 2.19)
In future beyond 6 months	1.98 (0.85 to 4.59)	1.51** (1.15 to 1.98)	1.50* (1.04 to 2.17)	0.74 (0.41 to 1.32)	0.66 (0.31 to 1.37)

*P <0.05; **p <0.01; ***p <0.001.
†See online supplemental table 4 for full table, including n and p values.
‡Separate logistic regression models estimated for each country and adjusted for all variables in table.
§Age group is 20–24 years for Japan and 19–24 years for Republic of Korea, based on the respective countries' definitions of the start of adulthood.

a substantial increase from a 2016 ITC study (18%).[23] Our estimates correspond closely with Euromonitor market share data for FCCs (24.7% in 2020). High use may be a consequence of the documented industry marketing tactics for FCCs in Republic of Korea, including price promotions, point-of-sale advertising and packaging.[9 36]

We found that over one-quarter of adults who smoke in Malaysia (26.5% in 2020) and one-fifth of adults who smoke in Japan (21.6% in 2021) use FCCs. Both prevalence estimates are much higher than the market share data from Euromonitor, which reported that in 2020 FCCs made up only 0.7% of the total cigarette market

Table 4 Frequency of crushing capsules among adults who smoke whose usual/ current brand of cigarettes has a flavour capsule across four countries of the International Tobacco Control Policy Evaluation Surveys, weighted*

Frequency of crushing capsules†	Brazil (n=74)		Japan (n=485)		Republic of Korea (n=1216)		Malaysia (n=332)	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Every capsule	52.7	(34.4 to 70.3)	76.6	(67.9 to 83.5)	59.7	(47.1 to 71.1)	45.1	(37.7 to 52.7)
Most capsules	12.1	(3.3 to 35.7)‡	13.6	(8.2 to 21.8)	24.2	(13.1 to 40.3)	26.1	(20.2 to 33.0)
About half of capsules	3.0	(1.0 to 8.9)‡	3.1	(1.8 to 5.0)	5.0	(3.1 to 8.0)	10.5	(7.1 to 15.2)
Some capsules, but less than half	14.3	(5.5 to 32.5)‡	3.7	(2.3 to 5.8)	6.5	(4.0 to 10.4)	7.1	(4.2 to 11.6)
Never	17.8	(8.2 to 34.5)‡	3.1	(1.8 to 5.1)	4.6	(2.8 to 7.6)	11.2	(6.9 to 17.5)

*See online supplemental table 5 for full table, including n.
†"When you smoke a pack of your usual/current brand, how often do you crush the flavour capsule?" This question was not asked in the Wave 8 ITC Mexico survey.
‡Indicates high sampling variability; relative SE >0.3; interpret with caution.

Table 5 Perceptions of usual cigarette brand harmfulness compared with other brands among adults who smoke whose usual/current brand of cigarettes has a flavour capsule compared with no capsule across four countries of the International Tobacco Control Policy Evaluation Surveys, weighted*

Harm of usual brand compared with others†	Brazil			Japan		
	Flavour capsule (n=74)	No capsule (n=1127)		Flavour capsule (n=485)	No capsule (n=2211)	
	%	%	P value‡	%	%	P value‡
Little less harmful	13.7 (6.3, 27.3)§	19.1 (16.0, 22.7)	0.372	8.8 (4.3, 17.1)§	6.9 (5.1, 9.2)	0.533
No different	58.0 (38.6, 75.2)	70.6 (66.5, 74.4)	0.175	85.0 (76.8, 90.6)	77.2 (72.8, 81.1)	0.084
Little more harmful	28.3 (13.1, 50.9)§	10.2 (7.9, 13.3)	**0.011**	6.2 (4.0, 9.6)	15.9 (12.4, 20.1)	**<0.001**
	Republic of Korea			**Malaysia**		
	Flavour capsule (n=1216)	No capsule (n=2414)		Flavour capsule (n=332)	No capsule (n=719)	
Little less harmful	11.5 (4.4, 26.8)§	8.7 (4.2, 16.9)	0.633	18.5 (13.3, 25.0)	11.1 (8.5, 14.4)	**0.016**
No different	74.2 (61.4, 83.8)	78.5 (71.8, 84.0)	0.496	66.9 (58.6, 73.6)	78.6 (74.5, 82.1)	**0.003**
Little more harmful	14.3 (8.8, 22.6)	12.8 (10.1, 16.1)	0.681	14.6 (10.1, 20.6)	10.3 (7.9, 13.4)	0.128

*See online supplemental table 6 for full table, including n.
†"Do you think that the brand you usually/currently smoke, might be a little less harmful, no different, or a little more harmful, compared to other cigarette brands?" This question was not asked in the Wave 8 (2021) ITC Mexico study. However, ITC Mexico data from 2018 to 2020 captured relative harm perceptions in a recent study.[5]
‡P values from weighted $\chi 2$ tests comparing the proportion of each outcome by usual brand flavour capsule versus no capsule; bolded= p<0.05.
§Indicates high sampling variability; relative SE >0.3; interpret with caution.

share in Malaysia and 7.0% in Japan.[17] However, Euromonitor data estimates that menthol (non-capsule cigarettes) made up 24.8% of the total market share in Malaysia and 27.7% in Japan in 2020.[17] The discrepancy may therefore reflect possibly inaccuracies or overlapping of these two categories. Reported tobacco industry tactics in both countries may explain high rates. In 2008, a ban on misleading packaging descriptors was followed by the introduction of menthol FCCs to the Malaysian market and promoted with pack descriptors and imagery highlighting its innovative and technological features.[9 37] The first global market release of modern FCCs was in Japan in 2007.[38] In Japan, marketing tactics for FCCs have been observed at point of sale, including offering different brand variants ranging in reported tar yields that correspond to different package emblem sizes.[39]

Lastly, we found the lowest prevalence of FCC use in Brazil (6.7% in 2016–2017). This is generally consistent with Euromonitor data, which estimated that the market share of FCCs was 3.5% in 2016 and 3.7% in 2017.[40] It is possible that the prevalence of FCC use has since increased from our 2016–2017 estimates, given the continued market growth (ie, 3.9% in 2020).[17] Moreover, it is reported that the number of industry-registered flavoured tobacco products tripled from 2012 to 2021.[41] While lower than other countries examined, our data remain concerning, particularly given Brazil's large population, as well as strong tobacco industry efforts to promote flavoured tobacco products and to suppress policies that banned flavours and other additives.[16 41–43] Brazil adopted a ban on all flavour additives in 2012, which was subsequently upheld by the Supreme Federal Court in 2018, yet ongoing litigation in the lower courts continues to delay implementation.[43 44] Marketing strategies of FCCs in Brazil have included the use of concept flavour names, extensive retail availability near schools and appealing packaging.[9 45 46] Despite these challenges, the relatively lower prevalence of FCC use may be reflective of Brazil's strong tobacco control leadership to address flavour additives.[41] Further, most adults who smoke in Brazil support a ban on additives.[43]

Our findings on correlates of FCC use varied across the countries, but are largely consistent with previous studies.[18 21–24 26] We found that FCC use was associated with younger age in Japan, Republic of Korea and Malaysia, with a marginally non-significant independent association with younger age in Mexico. This also aligns with a previous ITC study in Republic of Korea.[23] Young people are perceived to be the target population of FCCs,[18] as they contain several features known to appeal to this group, including colourful packaging, choice of flavours, the ability to customise and connotations of a 'high-tech' product.[7 9 47 48] Consistent with previous studies in Mexico,[5 19 21 22] we found greater preference for FCCs among females than males. We also found that in Japan, females had greater odds of FCC use. No significant association by sex was found in Brazil, Malaysia or in Republic of Korea, which is inconsistent with a previous study that found that females in Republic of Korea were more likely to use FCCs than males.[23] FCCs have features that could appeal to both females and males, depending on the context and marketing environment.[18 49] Use of FCCs was associated with high education in Brazil, Japan and Mexico, as has been observed in some studies.[5 18] Smoking frequency was only found to be correlated with FCC use in Republic of Korea, while plans to quit was only

significant in Japan and Republic of Korea. Smoking and quitting behaviours have previously been mixed across studies that have examined this.[18]

Our study found that the most common crushing frequency reported by adults who smoke FCCs was crushing every capsule in a pack across the five countries that assessed this. Findings indicate that these products appear to be used as intended by the tobacco industry.[18 19] It is unclear what drives less frequent capsule crushing. However, given that marketing of FCCs is characterised by a focus on the user deciding when and if they release flavour, it is possible that some users enjoy the option of only sometimes smoking flavoured cigarettes.[9] Price differences between FCCs and other types of cigarettes may further influence behaviour. In some countries, FCCs are less expensive than unflavoured cigarettes.[50]

We further found no consistent pattern of consumer perceptions of the harmfulness of FCCs, with those using FCCs (vs no capsules) in Malaysia believing that their brand was less harmful, but those in Brazil using FCCs (vs no capsules) believing their brand was more harmful compared with other brands. These mixed findings are consistent with a review of this issue.[18] Qualitative studies have suggested that there is confusion around relative harm of FCCs, given that on one hand menthol and flavours can be perceived as less harmful, while on the other hand, the flavour-changing technology can be associated with additional chemicals.[7 49] Country differences in harm perceptions may also be modulated by tobacco control policies. For instance, in Republic of Korea, which requires robust graphic health warnings, we observed no differences in harm perceptions. In Japan, which only requires text warnings and does not prohibit misleading descriptors, those whose usual brand did not have capsules perceived their brand to be more harmful compared with those who used FCCs. However, this does not explain why in Malaysia, which has both graphic warnings and a ban on descriptors, we found that FCC users more commonly reported that they perceived their brand to be less harmful. This is further supported by our finding that half of FCC users in Malaysia reported that a reason for choosing their brand is because it is 'not as bad for health', significantly higher than non-capsule users. It is possible that the marketing of FCCs in Malaysia may negate some of these policy effects.[51] One study reported how the tobacco industry used distinct descriptors and imagery on the packaging of FCCs to reinforce its technological and innovative features.[37] This exemplifies the importance of standardised/plain packaging to remove all forms of marketing features that can be conveyed through packaging. Indeed, we also found that FCC users in Malaysia were significantly more likely to report the pack design as a reason for their usual brand choice.

While harm perceptions were not measured in Mexico in our study, other studies, including a recent ITC study,[5] have observed that FCC users perceive their brand to be less harmful,[5 21] particularly those who used discount brands.[19] In Brazil, our finding that those who used FCCs perceived their brand to be more harmful than those who did not use capsules may be a byproduct of its proposed regulation of flavour additives, and possible media attention around ongoing litigation. These findings highlight how the complex interplay between the tobacco policy environment, marketing strategies and other factors might influence how relative harm is perceived, which can also influence prevalence. Further research can help elucidate the factors driving FCC use and perceptions of harm.

Our findings in the two countries that assessed reasons for brand choice, Brazil and Malaysia, suggest that taste is consistently a motivating factor for preference of FCCs, consistent with previous studies.[18] It should be noted that in Brazil, the proportion reporting taste as a reason for usual brand choice was significantly higher among those who used capsules versus no capsules. In Malaysia, however, the proportion was high in both groups, with no significant differences between groups.

The current study has limitations. First, the small sample size of adults who usually smoke FCCs in Brazil overall, as well as conditional subgroup estimates, along with high sampling variability (relative SE >0.3) may increase uncertainty of our estimates. Misclassification bias of predictor and outcome measures could have also occurred due to how questions were asked and categorised. For instance, although education categories were harmonised across countries for general comparative purposes, for Republic of Korea and Japan, categorisations may not accurately reflect standard educational levels in those countries. Given that analyses were country specific, rather than pooled, estimates cannot be directly compared across countries. However, there is utility in examining FCC use across multiple countries to gain an understanding of how commonly these products are used and how they are used, thereby providing a better understanding of the FCC market in countries with varied contexts. This study is also strengthened by its use of comparable measures across multiple countries with varied contexts, many countries for which this is the first known study to estimate the prevalence of FCC use.

CONCLUSION

Our research indicates that FCC use is popular among adults who smoke in Japan, Republic of Korea, Malaysia and Mexico. We found a relatively lower prevalence in Brazil, in which a ban on tobacco flavour additives was adopted in 2012, although not yet implemented. While there were general trends of correlates of FCC use in some countries (eg, females, younger adults), inconsistent patterns across countries suggest that user profiles may be context-specific and, potentially, a result of contrasting tobacco industry marketing practices and priorities. Findings underscore the importance of continuous population-level surveillance and monitoring of FCC use. This study also highlights the need for robust tobacco control policies to address the proliferation of

FCCs, including banning flavour additives and filter technologies. Policy considerations may entail incorporating a ban on flavour capsules through plain/standardised packaging regulations (ie, requirements to standardise the appearance of cigarette sticks), as well as banning flavours in tobacco products, including specification of flavour capsules,[52] following the lead of an increasing number of countries.[44]

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Ethics approval The survey protocols and all materials of the ITC including the survey questionnaires were cleared for ethics. ITC Brazil Wave 3 was cleared for ethics by the National Cancer Institute of Brazil (INCA) International Review Board. ITC Japan Wave 4 was cleared for ethics by the Office of Research Ethics, University of Waterloo, Canada (REB#22508/31428), the Internal Review Board at the Osaka International Cancer Institute, Japan (IRB 21054) and the Internal Review Board at Japan National Cancer Center, Japan (IRB 2021-069). ITC Republic of Korea Wave 2 was cleared for ethics by the Office of Research Ethics, University of Waterloo, Canada (ORE# 41512). ITC Malaysia Wave 1 (New Cohort) Survey was cleared for ethics by the Office of Research Ethics, University of Waterloo, Canada (ORE#40825) and Medical Research Ethics Committee, University of Malaya (MREC ID #2019118-8018). The ITC Mexico Wave 8 was cleared for ethics by the Instituo Nacional de Salud Publica, International Research Board. Participants gave informed consent to participate in the study before taking part.

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