Journal of Health, Population and Nutrition

# **BRIEF REPORT**

# **Open Access**

# Check for updates

# Use of flavor capsule cigarettes and their preliminary impact on smoking cessation in Mexico: an exploratory study

Rosibel Rodríguez-Bolaños<sup>1</sup>, Paula Ramírez-Palacios<sup>2</sup>, Katia Gallegos-Carrillo<sup>3</sup>, Arlette Chávez-Iñiguez<sup>4</sup>, Daimarelys Lara<sup>5</sup>, Deborah J. Ossip<sup>5</sup>, Ana Paula Cupertino<sup>4</sup> and Francisco Cartujano-Barrera<sup>5\*</sup>

# Abstract

**Background** No study has assessed the impact of flavor capsule cigarettes (FCCs) on smoking cessation. Thus, the purpose of this exploratory study was to assess (1) the sociodemographic and smoking-related characteristics associated with using FCCs, and (2) the preliminary impact of FCCs on smoking cessation.

**Methods** This study is a secondary data analysis of a single-arm study with 100 individuals living in Mexico who smoked and received a smoking cessation mHealth intervention and pharmacotherapy support. The primary outcomes were self-reported and biochemically verified 7-day smoking abstinence at Month 3.

**Results** Just over one-third of participants (36%) used FCCs, with a preference for one capsule and menthol/mint flavor. Compared to participants who smoked non-FCCs, participants who smoked FCCs were (1) younger, (2) more likely to be women, and (3) more likely to smoke less than 10 cigarettes per day (CPD; all p's < 0.05). After controlling for all significant associations, age younger than 50 years old (AOR = 3.26, 95% CI 1.25–8.51) and being a woman (AOR = 3.62, 95% CI 1.41–9.35) were positively and independently associated with smoking FCCs. Treating those lost to follow-up as participants who continued smoking, 41.7% (15/36) of participants who smoked FCCs self-reported smoking abstinence at month 3 compared to 42.2% (27/64) of participants who smoked non-FCCs (p = 0.96). Furthermore, 33.3% (12/36) of participants who smoked non-FCCs (p = 0.10).

**Conclusions** Younger age and being a woman were associated with using FCCs. Self-reported smoking abstinence at Month 3 was comparable between participants who smoke FCCs and non-FCCs. However, biochemically verified abstinent at Month 3 was higher among participants who smoke FCCs compared to participants who smoke non-FCCs, although the difference was not statistically significant. Prospective and adequately powered comparisons must be made between individuals who smoke FCCs and non-FCCs to effectively assess differences in smoking abstinence, and the reasons for these differences.

Keywords Smoking, Smoking cessation, Flavor capsule cigarettes

\*Correspondence: Francisco Cartujano-Barrera Francisco\_Cartujano@URMC.Rochester.edu

Full list of author information is available at the end of the article



© The Author(s) 2025. **Open Access** This article is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License, which permits any non-commercial use, sharing, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if you modified the licensed material. You do not have permission under this licence to share adapted material derived from this article or parts of it. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit http://creativecommons.org/licenses/by-nc-nd/4.0/.

# Introduction

Flavor capsule cigarettes (FCCs) are cigarettes that include capsules in the filter. These capsules can be crushed to flavor and smooth cigarettes. Currently, some FCCs contain up to three capsules with various flavors. The most common flavor is a combination of fruit and mint [1, 2]. A pack of FCCs can contain up to five different flavors. The cost of FCCs is similar to non-FCCs [3].

In Latin America, the market share for FCCs experienced an exponential growth over the past 10 years. For example, in Chile, Guatemala, and Peru, the market share for FCCs went from less than 5% in 2007 to 30% in 2017 [4–6]. In Mexico, the market share for FCCs was 27% in 2020. Some countries (e.g., the United States of America) have prohibited FCCs been since 2009 [7].

FCCs are perceived as tasting better, being smoother on the throat, more fun to smoke, and more attractive compared with non-capsule cigarettes [8]. Moreover, people who smoke FCCs report that FCCs' pleasant taste and discreet smell discourages them from quitting smoking [8]. However, to the best of our knowledge, no study has assessed the impact of FCCs on smoking cessation. Thus, the purpose of this exploratory study was to assess (1) the sociodemographic and smoking-related characteristics associated with using FCCs, and (2) the preliminary impact of FCCs on smoking cessation.

# Methods

## Study design

This exploratory study is a secondary data analysis of *Decídetexto México*, a single-arm study with 100 individuals living in Mexico who smoked and received a smoking cessation mHealth intervention. Details of *Decídetexto México* have been described elsewhere [9].

#### Participants

Participants were recruited between June and October of 2021. Participants (1) self-identified as Mexican, (2) were  $\geq$  18 years of age, (3) lived in the state of Morelos, (4) had smoked cigarettes for at least six months, (5) smoked cigarettes three or more days within a typical week, (6) were interested in quitting smoking in the next 30 days, (7) had access to a cellphone with unlimited text messaging capability, (8) knew how to read and send text messages, (9) had access to a device that would allow them to join a Zoom<sup>®</sup> video call, and (10) were willing to complete a follow-up assessment at Month 3. Exclusion criteria included: (1) use of other tobacco products more than one day within a typical week, (2) current participation in any other smoking cessation program or utilization of any type of medication to quit smoking, (3) having a household member currently enrolled in the study, (4) being pregnant, breastfeeding, or planning to become pregnant in the next year, and (5) planning to move out of their current residential address in the next six months. Informed consent was obtained from participants prior to study procedures. Details of the recruitment have been described elsewhere [9].

#### Intervention

All participants received *Decídetexto*, a smoking cessation mHealth intervention. *Decídetexto* involved three integrated components: (1) a tablet-based software that collected smoking-related information to support the development of an individualized smoking cessation plan and guided the ensuing text messaging program; (2) a 12-week text messaging counseling program with interactive capabilities; and (3) pharmacotherapy support (provision of nicotine patches at no cost). Details of the intervention have been described elsewhere [10, 11]. Dosage of nicotine patches followed the Clinical Practice Guidelines for Treatment of Tobacco Use [12].

#### Measures

The baseline assessment collected sociodemographic information such as age, gender, and educational attainment. This assessment also collected smoking-related information such as current use of FCCs, number of cigarettes per day, use of menthol cigarettes, and prior quit attempts.

The follow-up assessment at Month 3 assessed selfreported 7-day smoking abstinence (no cigarette smoking in the past 7 days). Urine samples were collected from participants who self-reported 7-day smoking abstinence, regardless of the use of nicotine patches. Participants whose urine sample had cotinine levels below 50 ng/mL were considered to be biochemically verified abstinent [13, 14]. The follow-up assessment also assessed use of nicotine patches.

#### Analyses

Frequencies and percentages were calculated for categorical variables. Means and standard deviations were calculated for continuous variables. Chi square tests and Student's t tests were used to evaluate differences in sociodemographic and smoking-related characteristics between participants who smoked FCCs and non-FCCs. Effect sizes were calculated using Cramér's V for categorical variables. Chi square tests were also used to evaluate differences in self-reported and biochemically verified abstinence at Month 3 between participants who smoked FCCs and non-FCCs. Logistic regression models were used to evaluate factors associated with smoking FCCs.

The primary analyses on self-reported and biochemically verified abstinence were conducted using the Russell standard, treating those lost to follow-up as participants who continued smoking [15]. Secondary analyses on self-reported and biochemically verified abstinence were

		Smoke flavor capsule			
Variable	Total <i>n</i> = 100	No <i>n</i> =64	Yes <i>n</i> = 36		
	n (%)	n (%)	n (%)	Cra- mér's V	P- value
Age					
50 + years old	45 (45.0)	35 (54.7)	10 (27.8)	0.259	0.009
< 50 years old	55 (55.0)	29 (45.3)	26 (72.2)		
Gender					
Male	49 (49.0)	38 (59.4)	11 (30.6)	0.276	0.006
Female	51 (51.0)	26 (40.6)	25 (69.4)		
Educational attainment					
Below college	48 (48.0)	29 (45.3)	19 (52.8)	0.071	0.473
College graduated	52 (52.0)	35 (54.7)	17 (47.2)		
Daily smoking					
No	9 (9.0)	5 (7.8)	4 (11.1)	0.055	0.580
Yes	91 (91.0)	59 (92.2)	32 (88.9)		
Cigarettes per day (CPD)					
CPD<10	59 (59.0)	33 (51.6)	26 (72.2)	0.201	0.044
CPD≥10	41 (41.0)	31 (48.4)	10 (27.8)		
Use of menthol cigarettes					
No	83 (83.0)	56 (87.5)	27 (75.0)	0.159	0.110
Yes	17 (17.0)	8 (12.5)	9 (25.0)		
Quit attempt(s) in the past year					
No	54 (54.0)	38 (70.4)	16 (29.6)	0.143	0.150
Yes	46 (46.0)	26 (56.5)	20 (43.5)		
Number of capsules					
One capsule			23 (63.9)		
Two or more			13 (36.1)		
capsules					
Favorite flavor					
Menthol/mint			27 (75.0)		
Menthol/mint			5 (13.9)		
plus other flavor					
Red fruits			2 (5.6)		
Cucumber			1 (2.8)		
Violet			1 (2.8)		

Table 1 Baseline characteristics of participants

Bold indicates statistical significance at p < 0.05

conducted with completers only. The analyses on use of nicotine patches were conducted using complete case analysis, in which missing values were considered to be missing. All analyses were performed using Stata software version 15.1. 
 Table 2
 Logistic regression models of smoking flavor capsule cigarettes

	0/-	OP (CL050/4)				
	70	OK (CI 95%)	AUR (CI 95%)			
Age						
50 + years old	27.8	1.0	1.0			
<50 years old	72.2	3.14 (1.30–7.56)*	3.26 (1.25–8.51)*			
Gender						
Male	30.6	1.0	1.0			
Female	69.4	3.32 (1.40-7.90)**	3.62 (1.41–9.35)**			
Cigarettes per day (CPD)						
CPD<10	72.7	1.0	1.0			
CPD≥10	27.8	0.41 (0.17–0.99)*	0.70 (0.25–1.95)			
* indicates statistical significance at $p < 0.05$						

indicates statistical significance at p < 0.0

\*\* indicates statistical significance at p < 0.01

# Results

## **Baseline characteristics**

At baseline, participants mean age was 47.3 (SD 11.5), 51% were women, and 52% were college graduates (Table 1). Almost all participants (91%) smoked daily, 59% smoked fewer than 10 cigarettes per day (CPD), 17% smoked menthol cigarettes, and 46% had attempted to quit in the last year. Thirty-six participants smoked FCCs (36%). Two thirds of participants who smoked FCCs (63.9%, 23/36) reported that their favorite cigarette only had one capsule. The most popular flavor was menthol/ mint (75%, 27/36).

#### **Correlates of smoking FCCs**

Compared to participants who smoked non-FCCs, participants who smoked FCCs were (1) younger, (2) more likely to be women, and (3) more likely to smoke less than 10 CPD (Table 1; all p's < 0.05). Results of the unadjusted logistic regression model are presented in Table 2. After controlling for all significant associations, age younger than 50 years old (AOR = 3.26, 95% CI 1.25–8.51) and being a woman (AOR = 3.62, 95% CI 1.41–9.35) were positively and independently associated with smoking FCCs.

#### Preliminary impact of FCCs

Follow-up rate was comparable between participants who smoked FCCs and non-FCCs [83.3% (30/36) compared to 87.5% (56/64), respectively]. Treating those lost to follow-up as participants who continued smoking, 41.7% (15/36) of participants who smoked FCCs self-reported smoking abstinence at month 3 compared to 42.2% (27/64) of participants who smoked non-FCCs (p = 0.960). Furthermore, 33.3% (12/36) of participants who smoked FCCs were biochemically verified abstinent at Month 3 compared to 18.8% (12/64) of participants who smoked non-FCCs (p = 0.101). In secondary analyses with completers only, 50.0% (15/30) of participants who smoked FCCs self-reported smoking abstinence at month 3 compared to 48.2% (27/56) of participants who smoked

non-FCCs (p = 0.875). Furthermore, 40.0% (12/30) of participants who smoked FCCs were biochemically verified abstinent at Month 3 compared to 21.4% (12/56) of participants who smoked non-FCCs (p = 0.067). The average number of days that participants used nicotine patches was comparable between participants who smoke FCCs and non-FCCs (44.27, SD = 22.42 compared to 42.67, SD = 21.24; p = 0.763).

## Discussion

To the best of our knowledge, this is the first study assessing the preliminary impact of FCCs on smoking cessation. Self-reported smoking abstinence at Month 3 was comparable between participants who smoke FCCs and non-FCCs (41.7% compared to 42.0%, respectively). However, biochemically verified abstinence at Month 3 was higher among participants who smoke FCCs compared to participants who smoke non-FCCs (33.3% compared to 18.8%, respectively), although the difference was not statistically significant. Use of nicotine patches – one of the most consistent predictors of smoking cessation [16, 17]– was comparable between participants who smoke FCCs and non-FCCs.

In this study, 36% of participants smoked FCCs. This prevalence is lower compared a prior report from a national survey Mexico from 2018 to 2019 (43%).<sup>18</sup> However, factors associated with use of FCCs across both studies are consistent: (1) individuals who smoke FCCs prefer FCCs with one capsule, and (2) smoking FCCs is positively associated with younger ages and being a woman. (18–19)

This study has important implications for future research and, potentially, policy. First, study findings could guide future directed prevention efforts. Specifically, efforts aimed at preventing the use of FCCs could be directed to young adults and women. Second, while no differences were found in self-reported smoking abstinence, biochemically verified abstinence was higher among participants who smoke FCCs compared to participants who smoke non-FCCs. It is important to note that this finding should be interpreted with caution given the exploratory nature of the study, that the difference was not statistically significant, and that the sample size was moderate and limited to those who had met study inclusion criteria. Nevertheless, the preliminary findings of this study suggest the need for further research on smoking abstinence among individuals who smoke FCCs and non-FCCs, and the reasons for any differences. To answer these questions most effectively, prospective and adequately powered comparisons - stratified by age and gender - must be made between individuals who smoke FCCs and non-FCCs. Moreover, factors explaining any differences in smoking abstinence (e.g., attitudes toward cessation, sensory effects) must be concurrently evaluated.

This study has some limitations that should be considered when interpreting the findings. First, this single-arm study was not designed to assess the impact of FCCs on smoking cessation. Second, there is a possibility that some participants who self-reported 7-day smoking abstinence at Month 3 were still using nicotine patches, which precluded biochemical verification of abstinence. This concern is mitigated as the use of nicotine patches was comparable between participants who smoke FCCs and non-FCCs. Third, the study had a moderate sample size and a relatively small number of participants using FCCs (n = 36). Lastly, given the relatively small number of participants using FCCs and low variability, the study did not assess the impact of number of capsules and favorite flavor on smoking cessation.

# Conclusion

(2025) 44:22

In this exploratory study, just over one-third of participants used FCCs, with a preference for one capsule and menthol/mint flavor. Younger age and being a woman were associated with using FCCs. Self-reported smoking abstinence at Month 3 was comparable between participants who smoke FCCs and non-FCCs (41.7% compared to 42.0%, respectively). However, biochemically verified abstinent at Month 3 was higher among participants who smoke FCCs compared to participants who smoke non-FCCs (33.3% compared to 18.8%, respectively), although the difference was not statistically significant. Prospective and adequately powered comparisons must be made between individuals who smoke FCCs and non-FCCs to effectively assess differences in smoking abstinence, and the reasons for these differences.

#### Abbreviations

CPD Cigarettes per day

- FCC Flavor capsules cigarette
- NCI National Cancer Institute

#### Acknowledgements

The authors are grateful to the individuals who participated in this study.

#### Author contributions

R.R.B., P.R.P., K.G.C., A.P.C., and F.C.B. contributed to the study design. R.R.B., P.R.P., and F.C.B. contributed to the analysis of data. All authors contributed to the interpretation of data. R.R.B., P.R.P., and F.C.B. drafted the manuscript. K.G.C., A.C.I., D.L., D.J.O. and A.P.C. reviewed the manuscript critically for important intellectual content. All authors have read and approved the final manuscript for publication.

## Funding

Research reported in this publication was supported by the National Cancer Institute (NCI) under an Administrative Supplement to Stimulate or Strengthen Global Cancer Health Disparities Research to grant R01CA212189. The content is solely the responsibility of the authors and does not necessarily represent the official views of the NCI.

#### Data availability

The datasets generated for this study are available from the corresponding author upon request.

#### Declarations

#### Ethics approval and consent to participate

The Human Subjects Committee of the National Institute of Public Health in Mexico approved and monitored the study procedures (Study identifier: CI:1712-CB:1703). Informed consent was obtained from participants prior to study procedures.

# Consent for publication

Not applicable.

#### Competing interests

The authors declare no competing interests.

#### Author details

<sup>1</sup>Department of Reproductive Health, National Institute of Public Health, Cuernavaca, Morelos, Mexico

<sup>2</sup>Center for Evaluation and Surveys Research, National Institute of Public Health, Cuernavaca, Morelos, Mexico

<sup>3</sup>Epidemiological and Health Services Research Unit, Mexican Social Security Institute, Cuernavaca, Mexico

<sup>4</sup>Department of Surgery, University of Rochester Medical Center, Rochester, New York, USA

<sup>5</sup>Department of Public Health Sciences, University of Rochester Medical Center, Saunders Research Building Crittenden Blvd, Rochester, New York 14642, USA

## Received: 28 October 2024 / Accepted: 11 January 2025 Published online: 29 January 2025

#### References

- 1. Thrasher JF, Rodríguez-Bolaños R, Gallegos-Carrillo K. Cigarros con cápsulas de sabor en México: Evidencia científica e implicaciones para las políticas públicas. In: Mandujano JL, Morales SEC, Icaza METM, eds. *Cigarrillos y Nuevos Productos de Tabaco:¿Nuevas Problemáticas?* 1era.; 2020:51–72.
- Kyriakos CN, Qi D, Chang K, Laverty AA, Filippidis FT. Global market trends of flavor capsule cigarettes and menthol (non-capsule) cigarettes: an ecological analysis using commercial data across 78 countries, 2010–2020. Tob Induc Dis. 2022;20(October). https://doi.org/10.18332/tid/153974.
- Rajani NB, Qi D, Chang K, Kyriakos CN, Filippidis FT. Price differences between capsule, menthol non-capsule and unflavoured cigarettes in 65 countries in 2018. Prev Med Rep. 2023;34:102252. https://doi.org/10.1016/j.pmedr.2023.10 2252.
- Moodie C, Thrasher JF, Cho YJ, Barnoya J, Chaloupka FJ. Flavour capsule cigarettes continue to experience strong global growth. Tob Control Published Online 2018:1–2. https://doi.org/10.1136/tobaccocontrol-2018-054711
- Paraje G, Araya D, Drope J. M Cummings ed. 2019 The association between flavor capsule cigarette use and sociodemographic variables: evidence from Chile. PLoS ONE 14 10 e0224217 https://doi.org/10.1371/journal.pone.02242 17.

- Thrasher JF, Islam F, Barnoya J, et al. Market share for flavour capsule cigarettes is quickly growing, especially in Latin America. Tob Control. 2017;26(4):468–70. https://doi.org/10.1136/tobaccocontrol-2016-053030.Mar ket.
- Kahnert S, Pötschke-Langer M, Schunk S, Nair U, Schaller KMU. Menthol capsules in cigarette filters-increasing the attractiveness of a harmful product. Vol 17. DKFZ; 2012. Accessed November 20, 2023. www.tabakkontrolle.de.
- Kyriakos CN, Zatoński MZ, Filippidis FT. Flavour capsule cigarette use and perceptions: a systematic review. Tob Control. 2023;32(e1):e83–94. https://doi .org/10.1136/tobaccocontrol-2021-056837.
- Rodríguez-Bolaños R, Ramírez-Palacios P, Bolaños A, et al. Decídetexto México: recruitment and baseline characteristics of Mexican individuals who smoke in a cessation study. Tob Use Insights. 2023;16:1179173X2311573. https://doi.org/10.1177/1179173X231157378.
- Cartujano-Barrera F, Arana-Chicas E, Catley D, et al. Decídetexto: Mobile cessation support for latino smokers. Study protocol for a randomized clinical trial. Contemp Clin Trials. 2020;99(October). https://doi.org/10.1016/j.cct.2020 .106188.
- Cartujano-Barrera F, Sanderson Cox L, Catley D et al. Decídetexto: Mobile cessation support for Latino adults who smoke. A randomized clinical trial. *Chest.* 2024 Aug 10:S0012-3692(24)04904-3. https://doi.org/10.1016/j.chest.2024.07. 160
- 12. Fiore MC, Jaén CR, Baker TB et al. *Treating Tobacco Use and Dependence: 2008 Update. Clinical Practice Guideline;* 2008. Accessed November 22, 2022. https://www.ncbi.nlm.nih.gov/books/NBK63950/?report=reader
- Benowitz NL, Bernert JT, Foulds J, et al. Biochemical verification of tobacco use and abstinence: 2019 update. Nicotine Tob Res. 2020;22(7):1086–97. https://doi.org/10.1093/ntr/ntz132.
- Kim S. Overview of cotinine cutoff values for smoking status classification. Neuroscience of Nicotine. Elsevier; 2019. pp. 419–31. https://doi.org/10.1016/ B978-0-12-813035-3.00051-4.
- West R, Hajek P, Stead L, Stapleton J. Outcome criteria in smoking cessation trials: proposal for a common standard. Addiction. 2005;100(3):299–303. https://doi.org/10.1111/j.1360-0443.2004.00995.x.
- Lindson N, Chepkin SC, Ye W, Fanshawe TR, Bullen C, Hartmann-Boyce J. Different doses, durations and modes of delivery of nicotine replacement therapy for smoking cessation. Cochrane Database Syst Rev. 2019;2019(4). https://doi.org/10.1002/14651858.CD013308.
- Handschin J, Hitsman B, Blazekovic S, et al. Factors associated with adherence to transdermal nicotine patches within a smoking cessation effectiveness trial. J Smok Cessat. 2018;13(1):33–43. https://doi.org/10.1017/jsc.2017.2.
- Zavala-Arciniega L, Gutiérrez-Torres DS, Reynales-Shigematsu LM, et al. Cigarros con cápsulas de sabor en México: prevalencia, proporción de uso entre fumadores y predictores de consumo. Ensanut 2018-19. Salud Publica Mex. 2020;62(6):820–8. https://doi.org/10.21149/11566.
- Ogunnaike A, Gallegos-Carrillo K, Barrientos-Gutierrez I, Arillo Santillán E, Cho YJ, Thrasher JF. Why smoke flavor capsule cigarettes? Preferences and perceptions among adult smokers in Mexico. Nicotine Tob Res. 2022;24(10):1635–44. https://doi.org/10.1093/ntr/ntac057.

#### Publisher's note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.