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# Flavour capsule cigarette use and perceptions: a systematic review

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## ABSTRACT

**Objective** This systematic review on flavour capsule cigarettes aims to examine prevalence, correlates of use, behaviours and perceptions of these products globally.

**Data sources** A search of original, peer-reviewed research without restrictions in publication year, population, study design or language, using a combination of cigarette and capsule terms was conducted across four databases (Medline, Embase, Web of Science and Scopus), indexed until 30 April 2021.

**Study selection** Studies were included if they presented original, human subjects research on flavour capsule cigarettes.

**Data extraction** Two authors independently extracted data on main outcome results and assessed risk of bias using a validated quality assessment tool (QATSDD).

**Data synthesis** Of 842 unduplicated database records and four studies from citation searching screened, 20 studies were included in the review. Studies reported data from 2009 to 2019 across eight countries, the majority of which used cross-sectional or focus group study designs. Current capsule use among smokers was highest in Chile and Mexico (40%) and was associated with younger age, and in some countries, with being female. Capsule cigarettes are perceived as tasting better, being smoother on the throat, more fun to smoke, and more attractive compared with non-capsule cigarettes, particularly among susceptible non-smokers and non-daily smokers.

**Conclusion** Findings call for the adoption of comprehensive tobacco control policies that account for flavour capsules and similar iterations, which can increase appeal through flavours and innovative features. Continued monitoring and research of these products is critical, with particular attention to low-income and middle-income countries, which make up a disproportionately larger share of the capsule market.

## INTRODUCTION

Innovative product design and flavour additives have historically been used by the tobacco industry to promote market growth by attracting new consumers and sustaining use of tobacco products.<sup>1–4</sup> Flavourings can facilitate smoking initiation by masking the harshness of tobacco and reducing perceptions of harmfulness, while novelty can further stimulate product interest, particularly among young people.<sup>5–8</sup>

In light of the evidence that flavours enhance the palatability and attractiveness of tobacco products, the WHO Framework Convention on Tobacco Control (WHO FCTC) calls parties to prohibit or restrict flavouring ingredients (Article 9).<sup>9</sup> Accordingly, a growing number of countries have adopted

policies banning flavoured cigarettes, including Brazil, Canada, Ethiopia, the 27 European Union (EU) member states, Mauritania, Moldova, Niger, Nigeria, Senegal, Turkey, Uganda, the UK and the USA.<sup>10–11</sup> However, most countries do not have a ban, and among the countries that do, a couple exempt menthol (ie, Niger, the USA), and not all of them explicitly prohibit the delivery of flavours via capsules.<sup>10</sup> The EU member states, Moldova, Turkey and the UK are the only countries that ban flavour capsule cigarettes.<sup>10</sup>

Flavour capsule cigarettes are a relatively new tobacco product that contain a gelatine capsule filled with a flavouring liquid that is embedded into the cigarette filter, which is released when crushed by the consumer, thereby flavouring the mainstream smoke when the cigarette is inhaled.<sup>12</sup> Flavour capsule cigarettes did not gain traction until 2007, when introduced in Japan.<sup>12</sup> Some brands contain two or more capsules that deliver different flavours within the same filter, while some packs have up to five different flavours.<sup>13–14</sup> The most common capsule flavour is menthol; however a plethora of other flavours, particularly those with ‘concept’ descriptors that have no explicit flavour profile (eg, Fusion Blast), have flooded the market, particularly in low-income and middle-income countries.<sup>15</sup> Flavour capsule cigarettes have experienced rapid market growth globally over the last decade.<sup>14–16–17</sup> According to 2020 Euromonitor passport data, flavour capsule cigarettes account for more than a quarter of the cigarette market for countries within the top five capsule markets, four of which are in Latin America: Chile (48%), Peru (35%), Guatemala (33%), Mexico (27%) and South Korea (25%).<sup>18</sup>

Despite being the fastest growing combustible tobacco product,<sup>14</sup> research on flavour capsule cigarettes is relatively limited, with no known published systematic reviews. Moreover, given that flavour capsule cigarettes embody two well-established industry strategies<sup>1–19–20</sup>—the use of flavours and innovative product design—which make youth particularly susceptible to their appeal, it is critical to monitor what populations are using these products and how they are being perceived. Monitoring is also a key tobacco control measure, as stipulated in the WHO FCTC and corresponding to the ‘M’ in the MPOWER package, which identifies six high-impact measures to assist with reducing demand of tobacco products.<sup>21</sup> As such, the aim of this study was to conduct a systematic review examining prevalence, correlates of use and perceptions of flavour capsule cigarettes globally.



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## METHODS

### Search strategy and databases

One author (CK) conducted the search in four databases: Medline, Embase, Web of Science and Scopus, indexed until 30 April 2021. Boolean language was used to connect variants of both cigarette terms (ie, Cigar\*, Cigarette Smoking/, Tobacco Products/) and capsule terms (ie, Capsul\*, Crush\*, Convertible\*, Click, Burst\*, Pop, Duo). The search strategy was intentionally broad to capture all relevant publications on capsule cigarettes. After duplicates were removed, two authors (CK and MZ) independently screened titles and abstracts and then assessed full-text articles for eligibility. Discrepancies were resolved through discussion with the third author (FF). To supplement the database search, one author (CK) manually searched reference lists of the included articles.

### Eligibility criteria

Eligibility was not limited by study design, population, year, country or language. Articles were included if they presented original, human subjects research on flavour capsule cigarettes. Published conference abstracts were included, except if they presented duplicate results of data published as full manuscripts in peer-reviewed journals. Articles were excluded if they were not original research (eg, review or commentary only) or if they only presented non-human subjects data (eg, marketing, sales, product assessment).

### Data extraction and risk of bias assessment

Two authors (CK and MZ) independently extracted data on main outcome results (eg, prevalence, measures of association). One author (CK) extracted additional data, including: study reference, aims, sample characteristics, sampling approach, study design, field work dates, additional outcomes, data analysis, limitations, author conclusions and funding/conflicts of interest. Due to our inclusion of studies with diverse study designs, including both quantitative and qualitative studies, and for comparability purposes, we assessed risk of bias using a 16-item validated quality assessment tool (QATSD) that has demonstrated good reliability and validity among studies with diverse designs, and has been applied in other systematic reviews assessing flavoured tobacco and nicotine products.<sup>23–25</sup> Two authors (CK and MZ) independently scored criteria for each study on a 4-point scale (0=not at all, 1=very slightly, 2=moderately, 3=complete), using the tool's scoring guidance notes.<sup>22</sup> As two of the tool's criteria are specific to quantitative studies and two to qualitative studies only, each study was assessed on 14 criteria, accordingly, with a maximum score of 42. Discrepancies were resolved through iterative discussion that also included the third author (FF).

### Synthesis of results

Given the heterogeneity in outcomes, study results were collated by specified constructs, iteratively determined and informed by theory. Data from studies examining prevalence and correlates of capsule cigarette use were extracted on overall use and use by age, gender and other correlates. Where applicable, results were reported as percentages with 95% CIs with respective measures of association, such as adjusted ORs, including corresponding 95% CIs or p values. Among studies reporting perceptions of flavour capsule cigarettes, extracted results were organised into two overall domains based on the *Hypothetical Model of Tobacco Consumer Response*,<sup>26</sup> including: *product perceptions*, defined as subjective responses to product information, and *responses*

to product, which entails measurement of sensory and other subject responses during product use. Each domain was further organised into overall constructs and subconstructs, which were adapted using the *Context of Consumption Framework*,<sup>27</sup> and a modification of this framework.<sup>28</sup> *Product perceptions* were structured into three overall constructs: *risk perceptions*,<sup>26</sup> *outcome expectancies* (ie, perceptions around expected outcomes or consequences of using the product)<sup>26 29</sup> and *consumer interest* (ie, aspects related to a user or potential user's interest in a product).<sup>26 28</sup> *Responses to the product* were categorised as: *sensory responses* (ie, measurement of sensory responses such as taste, smell, mouthfeel effects)<sup>26</sup> and *other subjective responses* (eg, psychological reward, relief of craving).<sup>26</sup>

## RESULTS

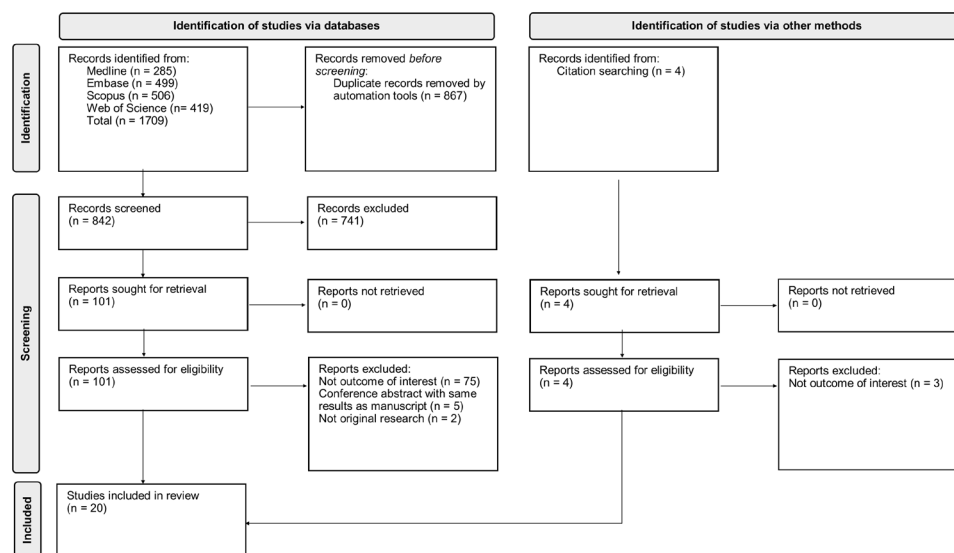
### Identification and description of included studies

A total of 1709 records were identified via databases. Once duplicates were removed, 842 publication titles and abstracts were screened, and subsequently 101 full-text articles were assessed for eligibility. In addition, four articles were identified from citation searching and assessed for eligibility (figure 1). A total of 20 articles, published between 2013 and 2021, and reporting data from 2009 to 2019 were included in the review (table 1). Among the included quantitative studies, 10 were cross-sectional<sup>30–39</sup> (2 of which were discrete choice experiments<sup>37 38</sup> and 1 used an experimental design)<sup>39</sup>, 2 were cohort,<sup>40 41</sup> and 2 used randomised controlled designs.<sup>42 43</sup> Among the included qualitative studies, five reported on focus groups<sup>28 44–47</sup> and one on in-depth interviews.<sup>48</sup> Study subjects varied by age (adolescents;<sup>35 37 39</sup> young adults;<sup>28 38 47</sup> adults;<sup>30 31 33 40–43 48</sup> both adolescents and adults)<sup>32 34 36 44–46</sup> and smoking status (smokers only;<sup>30 32–34 36 40–45 47 48</sup> smokers and non-smokers).<sup>28 31 35 37–39 46</sup> Two studies were conducted exclusively with women.<sup>46 48</sup> Eight countries were represented across the studies: Australia,<sup>35 41 48</sup> Chile,<sup>37</sup> Mexico,<sup>32 36 37 39 41 44</sup> New Zealand,<sup>38</sup> the Philippines,<sup>28</sup> South Korea,<sup>30</sup> the UK<sup>33 45 46</sup> and the USA.<sup>31 40–43 47</sup> One study was a published conference abstract.<sup>30</sup> The full text of one study was in Spanish.<sup>36</sup> All studies examined capsule cigarettes with flavour, therefore the terms 'capsule' and 'flavour capsule' are used interchangeably in this paper.

### Prevalence and correlates of flavour capsule cigarette use

#### Overall use

Eleven studies presented data on prevalence and correlates of flavour capsule cigarette use among smokers.<sup>30–36 38–41</sup> Eight of these measured current use<sup>30–34 36 40 41</sup> (table 2 and online supplemental table 1), while three assessed ever use<sup>35 38 39</sup> (online supplemental table 1). The highest prevalence of current capsule use was observed in Mexico (43% in 2018/2019)<sup>36</sup> and Chile (40% in 2017),<sup>34</sup> followed by South Korea (18% in 2016)<sup>30</sup> and the UK (13% in 2016).<sup>33</sup> Two studies in Mexico found a rapid increase in flavour capsule<sup>41</sup> and Pall Mall (most varieties are capsules)<sup>32</sup> use over time. Flavour capsule use among adult smokers increased from 2012 to 2014 in Mexico (6% to 14%) and Australia (1% to 3%) but not in the USA (4%).<sup>41</sup> Similar values for prevalence of menthol capsule use in the USA were also observed in two other studies (4% in 2013/2014<sup>31</sup> and 6% in 2014/2015).<sup>40</sup> In New Zealand, half of young adult smokers reported ever using capsule cigarettes in 2017.<sup>38</sup> Ever use was also examined in two studies with adolescents in Australia (7% in 2014)<sup>35</sup> and in Mexico (2%–9%, depending on the brand, in 2017).<sup>39</sup>



From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 2021;372:n71. doi: 10.1136/bmj.n71. For more information, visit: <http://www.prisma-statement.org/>

**Figure 1** Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 flow diagram for new systematic reviews which included searches of databases and other sources.

### Use by sociodemographic factors

Findings from all seven studies that assessed smokers' preference for flavour capsules by age, point to an association between capsule use and relatively younger age<sup>30–34 36 41</sup> (table 2). Older age groups generally had lower odds of preferring capsule cigarettes compared with smokers who were 18–24 years old.<sup>30–33 41</sup> In Chile, Mexico and the UK, age was inversely associated with use of and preference for capsule cigarettes.<sup>33 34 36</sup> Current preferred use of capsule cigarettes was associated with being female among smokers in Mexico,<sup>32 36 41</sup> Chile<sup>34</sup> and South Korea.<sup>30</sup> However, the association of capsule preference with gender was less conclusive in Australia,<sup>35 41</sup> the UK<sup>33</sup> and the USA.<sup>31 41</sup> Three studies examined capsule use by race/ethnicity in the UK<sup>33</sup> and USA,<sup>31 41</sup> with mixed results. While one US study found that among smokers who were 18–24 years old capsule use was significantly higher among those identifying as Hispanic compared with all other race/ethnicity groups,<sup>31</sup> another found no association.<sup>41</sup> Findings were mixed across three studies that examined capsule use by education in Australia,<sup>41</sup> Chile<sup>37</sup>, Mexico<sup>36 41</sup> and the USA.<sup>41</sup> One study in the UK that assessed social grade did not find an association with capsule use.<sup>33</sup>

### Use by smoking and quitting behaviours

Findings on correlates of smoking and quitting behaviours with flavour capsule use varied across six studies that assessed this<sup>30 31 33 34 40 41</sup> (table 2). Some studies found that smokers using capsules were more likely than non-capsule smokers to smoke less frequently,<sup>31</sup> smoke less,<sup>31 34</sup> be less nicotine dependent,<sup>30 31</sup> to have started smoking later in life<sup>31</sup> and to have been smoking their current usual brand for less than a year.<sup>30</sup> However, other studies had mixed findings<sup>32 40 41</sup> or found no such associations.<sup>33</sup> While one study in the UK found a positive association between capsule use and intention to quit in the next 6 months,<sup>33</sup> two other studies did not find an association between past<sup>40</sup> or recent<sup>41</sup> quit attempts, quit intentions<sup>41</sup> or successful cessation.<sup>40</sup> In general, models were adjusted for sociodemographic factors and smoking behaviours (online supplemental table 1).

### Behaviours of flavour capsule cigarette use

Two quantitative studies assessed frequency of crushing flavour capsules,<sup>33 41</sup> one of which also measured the timing of crushing the capsule.<sup>41</sup> Always crushing the capsule was reported by about half of capsule smokers in Mexico (52%)<sup>41</sup> and the UK (51%),<sup>33</sup> which was higher than in Australia (30%)<sup>41</sup> and the USA (37%).<sup>41</sup> Correlates of more frequent crushing included: being a woman (USA<sup>41</sup> and the UK),<sup>33</sup> younger age (the UK),<sup>33</sup> being White British (the UK),<sup>33</sup> not intending to quit (USA)<sup>41</sup> and being a heavier smoker (the UK).<sup>33</sup> The most common timing of crushing the capsule in Australia, Mexico and the USA was before lighting the cigarette or during the first few puffs.<sup>41</sup> In three qualitative studies, aspects of crushing behaviours emerged during discussion.<sup>44 47 48</sup> Young women from Australia reported crushing them all of the time, however timing varied.<sup>48</sup> Some crushed at the beginning of smoking—either before lighting up or within the first few puffs, while others liked popping the capsule towards the end or halfway through. Reasons for the latter included being able to change the taste to get the 'mint fresh feeling' and to experience 'the best of both worlds'—crushed and uncrushed,<sup>48</sup> a sentiment that was also shared by some menthol smokers from the USA.<sup>47</sup> Some Mexican female smokers who used double capsule cigarettes described crushing one flavour at the beginning and the other flavour halfway through.<sup>44</sup>

Only one study with a randomised, open-label laboratory design measured smoking topography of capsule cigarette use.<sup>43</sup> Switching from smoking menthol capsule to non-menthol cigarettes (15 days each) resulted in no significant differences in total puff volume and cigarette consumption.<sup>43</sup>

### Flavour capsule cigarette product perceptions and responses to the product

Overall, 15 studies examined product perceptions of flavour capsule cigarettes<sup>28 30 31 33 34 37–39 41 42 44–48</sup> and two studies examined responses to product use<sup>42 43</sup> (table 3 and online supplemental table 2).

**Table 1** Study characteristics (n=20)

Study ID	Country	Year of data collection	Sample	Study design	Outcome measures
Abad-Vivero <i>et al</i> <sup>39</sup>	Mexico	2015	n=10 124 smokers and non-smokers, ages 11–16 years	Cross-sectional, experimental design	Prevalence/use; perceptions
Barrientos-Gutierrez <i>et al</i> <sup>37</sup>	Mexico	2016	n=4251 smokers and non-smokers, ages 12–14 years	Cross-sectional, discrete choice experiment	Perceptions
Brown <i>et al</i> <sup>28</sup>	The Philippines	2019	n=63 smokers and non-smokers, ages 18–24 years	Focus groups (n=8, stratified by gender and smoking status)	Perceptions
Cho and Thrasher <sup>30</sup>	South Korea	2016	n=1940 smokers, ages 18+ years	Cross-sectional	Prevalence/use; perceptions
Emond <i>et al</i> <sup>31</sup>	USA	2013–2014	n=7181 smokers, ages 18–44 years	Cross-sectional	Prevalence/use; perceptions
Gilbert and Ewald <sup>48</sup>	Australia	2019	n=41 female smokers, ages 18–40 years	In-depth interviews	Perceptions
Grilo <i>et al</i> <sup>44</sup>	Mexico	2018	n=56 adolescent smokers and non-smokers and young adult smokers	Focus groups (n=10, stratified by gender, smoking status, socioeconomic status)	Perceptions
Gutiérrez-Torres <i>et al</i> <sup>32</sup>	Mexico	2009, 2011, 2015, 2016	n=12 692 smokers, ages 15–65 years who reported their last cigarette brand purchased	Repeated cross-sectional of two surveys	Prevalence/use
Hoek <i>et al</i> <sup>38</sup>	New Zealand	2017	n=816 smokers and susceptible non-smokers, ages 18–25 years	Cross-sectional, discrete choice experiment	Prevalence/use; perceptions
Moodie <i>et al</i> <sup>45</sup>	UK (Scotland)	2015	n=120 smokers, ages 16+ years	Focus groups (n=20, stratified by gender, age, social grade)	Perceptions
Moodie <i>et al</i> <sup>46</sup>	UK (Scotland)	2013	n=76 female smokers and non-smokers, ages 12–24 years	Focus groups (n=12, stratified by gender, smoking status, age)	Perceptions
Moodie <i>et al</i> <sup>14</sup>	UK	2016	n=3620 factory-made cigarette smokers, ages 18+ years	Cross-sectional	Prevalence/use; crushing behaviour; perceptions
Paraje <i>et al</i> <sup>34</sup>	Chile	2017	n=851 smokers, ages >13 years	Cross-sectional	Prevalence/use; perceptions
Schneller <sup>40</sup>	USA	2013–2014, 2014–2015	n=8292 smokers with a usual brand, ages 18+ years	Cohort, two waves	Prevalence/use
Schneller <i>et al</i> <sup>42</sup>	USA	2017–2019	n=18 menthol smokers not trying to quit with no medical contraindications, ages 18–65 years	Randomised controlled study	Perceptions; product response
Strasser <i>et al</i> <sup>43</sup>	USA	2010–2011	n=32 menthol smokers not trying to quit, ages 21–65 years	Randomised controlled study	Smoking topography; product response
Thrasher <i>et al</i> <sup>41</sup>	Australia, Mexico, USA	2012–2014	n=5864 observations, 2710 smokers (Australia); n=5723 observations, 3366 smokers (Mexico); n=6865 observations, 4154 smokers (USA), ages 18–64 years	Cohort, six quarterly waves	Prevalence/use; crushing behaviour; perceptions
Wackowski <i>et al</i> <sup>47</sup>	USA	2014–2015	n=45 menthol smokers, ages 18–24 years	Focus groups (n=3 black; n=3 other race)	Perceptions
White and Williams <sup>35</sup>	Australia	2014	n=23 007 smokers and non-smokers, ages 12–14 years	Cross-sectional	Prevalence/use
Zavala-Arciniega and Gutiérrez-Torres <sup>36</sup>	Mexico	2018–2019	n=8516 smokers, ages >10 years	Cross-sectional	Prevalence/use

### Risk perceptions

Seven of nine studies found no difference in perceived harm of flavour capsule cigarettes compared with non-capsule cigarettes,<sup>28 31 33 37 38 42 45</sup> with two studies having mixed results.<sup>41 46</sup> One study found that capsule cigarette users were more likely to perceive their brand as less harmful than non-capsule smokers in Mexico and the USA—but not in Australia, however this was moderated by whether the brand was discount or premium.<sup>41</sup> Discussion from focus groups suggested that confusion around relative harmfulness of capsule cigarettes was often linked to mixed perceptions around menthol.<sup>45 46</sup> Some participants viewed capsule cigarettes as more harmful due to the presumed additional chemicals needed to change the flavour.<sup>46</sup>

### Outcome expectancies

Across eight studies, outcome expectancies of flavour capsule cigarettes that were examined quantitatively<sup>30 38 41</sup> or emerged from qualitative data<sup>44–48</sup> included: smoothness on throat/lightness in taste,<sup>30 38 41 48</sup> pleasantness of taste/breath/smell,<sup>38 44–48</sup> satisfaction/fun to smoke,<sup>38 41</sup> and perceived impact on smoking initiation and quitting.<sup>45 46</sup>

#### Smoothness on throat/lightness in taste

All three quantitative studies that measured the extent to which capsule cigarettes are perceived to have a lighter taste or to be smoother on the throat as compared with unflavoured or other cigarettes found a positive association<sup>30 38 41</sup> especially among non-daily smokers, former smokers and susceptible



**Table 2** Prevalence and correlates of current use of flavour capsule cigarette among smokers by country

Country	Study ID	Measure	Prevalence year: %	Use by age (years) % and/or measure of association (95% CI)	Use by gender % and/or measure of association (95% CI)	Other correlates of use % and/or measure of association (95% CI)
Australia	Thrasher <i>et al</i> <sup>41</sup>	Usual or current preferred brand is flavour capsule	2012: 1% 2014: 3%	18–24: 4%, Ref 35–44: 1%, aOR=0.32 (0.14 to 0.75)	Male: 1%, Ref Female: 2%, aOR=1.52 (0.91 to 2.52)	<i>Higher HSI</i> : aOR=0.83 (0.71 to 0.96) <i>NS</i> : Education, smoking status, intentions to quit, recent quit attempt
Chile	Paraje <i>et al</i> <sup>34</sup>	Last pack bought was flavour capsule cigarette	2017: 39.5%	≤25: 60% (SD: 0.49) 26–34: 54.4% (SD: 0.50) 35–49: 31.7% (SD: 0.47) ≥50: 23.0% (SD: 0.43) Each year less in age, likelihood of capsule use increased by 0.8–0.9 percentage points	Male: 32.3% (SD: 0.47), Ref Female: 46.7% (SD: 0.50) If female, likelihood of capsule use increased by 13.4–13.5 percentage points	<i>Price paid</i> : On average, the unit value of prices paid by those who used flavour capsule cigarettes was 14% higher than those who used non-flavoured cigarettes <i>NS</i> : Education, employment status
Mexico	Gutiérrez-Torres <i>et al</i> <sup>32</sup>	Last cigarette brand they purchased was Pall Mall (not specifically capsule, but most variants are)	2009: 1% 2011: 3% 2015: 10% 2016: 14%	Purchase of single cigs: 15–25: Ref 25–44: aOR=0.46 (0.33 to 0.63) 45–65: aOR=0.31 (0.19 to 0.51) Purchase of packs: <i>NS</i>	Purchase of single cigs: Male: Ref Female: aOR=2.21 (1.60 to 3.05) Purchase of packs: Female: aOR=1.99 (1.53 to 2.60)	Purchase of single cigs: <i>Smoking status</i> Non-daily: Ref Daily ≤5 cigs: aOR=0.88 (0.57 to 1.35) Daily >5 cigs: aOR=0.47 (0.24 to 0.90) Purchase of packs: <i>NS</i>
Mexico	Thrasher <i>et al</i> <sup>41</sup>	Usual or current preferred brand is flavour capsule	2012: 6% 2014: 14%	18–24: 12%, Ref 25–34: 9%, aOR=0.66 (0.49 to 0.88) 35–44: 7%, aOR=0.60 (0.43 to 0.83) 45–54: 10%, aOR=0.67 (0.48 to 0.95)	Male: 7%, Ref Female: 13%, aOR=2.07 (1.66 to 2.59)	<i>Smoking status</i> Non-daily: 9%, Ref Daily: 11%, aOR=1.24 (1.02 to 1.51) <i>NS</i> : Education, HSI, quit intentions, recent quit attempt
Mexico	Zavala-Arciniega and Gutiérrez-Torres <sup>36</sup>	Smoke cigarettes with flavoured capsules within the past 30 days	2018–2019: 43%	10–19: 52%, aPR=2.66 (2.07 to 3.43) 20–29: 56%, aPR=2.64 (2.08 to 3.36) 30–39: 50%, aPR=2.41 (1.90 to 3.07) 40–49: 36%, aPR=1.80 (1.39 to 2.32) 50–59: 28%, aPR=1.41 (1.08 to 1.85) ≥60: 19%, Ref	Male: 39%, aPR=0.74 (0.69 to 0.80) Female: 55%, Ref	<i>Education</i> Primary school or less: 25%, Ref Secondary school: 43%, aPR=1.27 (1.13 to 1.43) High school: 51%, aPR=1.41 (1.24 to 1.61) University+: 56%, aPR=1.56 (1.36 to 1.79) <i>NS</i> : Well-being
South Korea	Cho and Thrasher <sup>30</sup>	Usual or current brand is flavour capsule	2016: 18%	19–28: Ref 29–38: aOR=0.38, p<0.001	Male: Ref Female: aOR=1.51, p<0.05	<i>Smoked current usual brand &lt;1 year</i> Regular: Ref Capsule: aOR=4.81, p<0.001 <i>Higher nicotine dependence</i> Regular: Ref Capsule: aOR=0.87, p<0.01
United Kingdom	Moodie <i>et al</i> <sup>14</sup>	Cigarette brand has flavour capsule	2016: 13%	25–34 vs 18–24: aOR=0.46 (0.33 to 0.64) 35–44 vs 18–34: aOR=0.41 (0.30 to 0.54) 45–54 vs 18–44: aOR=0.33 (0.24 to 0.45) 55+ vs 18–54: aOR=0.36 (0.27 to 0.48)	Male: Ref Female: aOR=1.15 (0.92 to 1.43)	<i>Race/ethnicity</i> White British: Ref Other white: aOR=1.85 (1.26 to 2.72) <i>Quit intentions (next 6 months)</i> No: Ref Yes: aOR=1.74 (1.40 to 2.17) <i>NS</i> : Social grade, HSI
United States	Emond <i>et al</i> <sup>31</sup>	Usual or last-smoked cigarette is flavour capsule	2013–2014: 4.3%	18–24: 9.4% (8.2 to 10.8) 25–34: 6.0% (5.1 to 7.0) 35–44: 3.7% (2.9 to 4.7) ≥45: 0.09% (0.6 to 1.0) p<0.001	No association	18 to 24 years old: <i>Race/ethnicity</i> Hispanic: 17.3% (13.1 to 22.4), p<0.05 Non-Hispanic white: 8.4% (7.0 to 10.1) Non-Hispanic black: 3.2% (1.1 to 8.8) Other: 9.1% <i>Smoke some days (vs every day)</i> Non-menthol: 32.5% (29.6 to 35.5) Menthol: 24.9% (21.8 to 28.3) Capsule: 46.3% (39.6 to 53.1), p<0.001 <i>Mean cigs smoked/day</i> Non-menthol: 14.3 (13.0 to 15.6) Menthol: 13.1 (11.6 to 14.6) Capsule: 10.7 (9.1 to 12.30), p<0.01 <i>Started smoking regularly at 18+ years</i> <i>First cig of day &gt;1 hour of waking</i> <i>NS</i> : Polytabacco use

Continued

Table 2 Continued

Country	Study ID	Measure	Prevalence year: %	Use by age (years) % and/or measure of association (95% CI)	Use by gender % and/or measure of association (95% CI)	Other correlates of use % and/or measure of association (95% CI)
United States	Thrasher <i>et al</i> <sup>41</sup>	Usual or current preferred brand variety includes a flavour capsule	2012: 4% 2014: 4%	18–24: 10%, Ref 25–34: 6%, aOR=0.64 (0.45 to 0.89) 35–44: 3%, aOR=0.36 (0.23 to 0.56) 45–54: 2%, aOR=0.16 (0.08 to 0.29) 55–64: 0.4%, aOR=0.08 (0.04 to 0.18)	Male: 4%, Ref Female: 5%, aOR=1.39 (1.03 to 1.88)	Race/ethnicity Caucasian: 4%, Ref African American: 4%, aOR=0.53 (0.26 to 1.09) Latino: 4%, aOR=0.66 (0.47 to 0.94) Other: 9%, aOR=1.35 (0.75 to 2.43) NS: Education, smoking status, HSI, quit intentions, recent quit attempt
United States	Schneller <i>et al</i> <sup>40</sup>	Usual brand is menthol in capsule only or menthol in both tobacco and capsule	2013–2014: 5.3%	N/A	N/A	HSI mean score at Wave 1 Non-menthol: 2.4 (SE: 0.03) Menthol in capsule only: 1.3 (SE: 0.10) p<0.05 NS: HSI at Wave 2, past quit attempt, successfully quit by Wave 2

aOR, adjusted OR; aPR, adjusted prevalence ratio; cig, cigarette; HSI, Heaviness of Smoking Index (time to first cigarette and daily number of cigarettes consumed; higher score (4–6); lower score (0–3)); N/A, not applicable; NS, not statistically significant.

non-smokers.<sup>38</sup> In one qualitative study, menthol capsule cigarettes were described as lighter, milder and less harsh on the throat.<sup>48</sup> In the same study, those who used regular cigarettes preferred them over menthol capsules because they like the burn, heat and substance of regular cigarettes.<sup>48</sup>

#### *Pleasantness of taste, breath, smell*

Across six studies, capsule cigarettes were viewed as tasting better, allowing for fresher breath, and/or concealing the smell from smoking.<sup>38 44–48</sup> Young people, in particular, expressed the allure of the discreet smell of capsule cigarettes in being able to mask their smoking, such as at school or the office.<sup>44–46</sup> Appeal of menthol capsule cigarettes was often tied to being more minty than traditional menthol cigarettes, similar to chewing gum, considered cleaner and fresher, and something better to smoke when sick.<sup>46–48</sup> On the other hand, some smokers who preferred regular cigarettes did not like the more minty taste of menthol capsules, while some also described capsules as tasting ‘plasticky’ and ‘artificial’.<sup>48</sup>

#### *Satisfaction/fun to smoke*

Smokers who preferred flavour capsule cigarettes were more likely to find their brand more satisfying in Australia<sup>41</sup> and Mexico (specifically those who preferred discount varieties, primarily Pall Mall),<sup>41</sup> but not in the USA.<sup>41</sup> In New Zealand, former and non-daily smokers and susceptible non-smokers were more likely to report capsule cigarettes to be more satisfying and/or more fun to smoke compared with daily smokers.<sup>38</sup>

#### *Impact on smoking initiation and quitting*

In two focus group studies, some participants saw flavour capsule cigarettes as a ‘starter cigarette’ meant to encourage non-smokers to experiment, while also making it easier for smokers to smoke more and discourage quitting due to the pleasant taste, reduced harshness and the ability to better conceal smoking.<sup>45 46</sup>

#### *Consumer interest*

Fourteen studies examined aspects of consumer interest.<sup>28 30 31 33 34 37–39 41 44–48</sup>

#### *Brand awareness/recall*

In two studies in Mexico,<sup>39 44</sup> one in Scotland,<sup>45</sup> and one in the USA,<sup>47</sup> flavour capsule cigarettes were generally recognised

among all age groups, but awareness was particularly high among adolescents and younger adults.<sup>39 44 45 47</sup>

#### *Target audience/user associations*

Across all five studies, participants described the perceived audience of flavour capsule cigarettes to be young people, including children, teenagers, students and young adults.<sup>28 44–47</sup> In Mexico, capsule cigarettes were largely perceived to be meant for women and girls, with the pack colours described as reflective of their appeal to this population.<sup>44</sup> In Scotland, the Philippines, and the USA, capsule cigarettes were also viewed to be used by ‘party-goers’,<sup>28</sup> and particularly for special occasions.<sup>46 47</sup> Capsule cigarettes were also regarded to most appeal to newer and occasional smokers,<sup>46 47</sup> as well as to those who don’t like the taste of smoke<sup>45 46</sup> or worry about its smell,<sup>46</sup> who want to look cool,<sup>45</sup> who are bored of their regular cigarettes or want to try something different,<sup>46</sup> and those who ‘like to play with stuff’.<sup>47</sup> Some older adults associated capsule cigarettes with electronic cigarettes due to the flavour options offered.<sup>45</sup>

#### *Appeal, attractiveness, preferred choice*

Ten studies examined aspects related to flavour capsule cigarette’s appeal, attractiveness and preferred choice.<sup>28 37–39 41 44–48</sup> In seven of these studies, participants viewed various types of cigarette packs<sup>28 37–39 44</sup> or actual cigarettes,<sup>45 46</sup> and were instructed to rank or group them according to their appeal,<sup>44–46</sup> attractiveness,<sup>28 37–39</sup> stylishness<sup>38</sup> and/or preferred choice.<sup>38</sup> Across the two discrete choice experiments<sup>37 38</sup> and one cross-sectional survey with an experimental design, capsule cigarettes were perceived as significantly more attractive compared with non-capsule cigarettes. In one cohort study, capsule cigarettes were perceived as more stylish in Mexico and the USA, but not in Australia.<sup>41</sup> Perceptions of greater appeal and attractiveness were also observed across focus group studies.<sup>28 44–47</sup> Flavour capsule cigarettes were often described as being cool and offering novelty and entertainment.<sup>45–47</sup> Aspects that were described as increasing the appeal of flavour capsule cigarettes included nice colour combinations, ‘brightness and shininess’;<sup>28 44</sup> the presence of double-capsules;<sup>44</sup> the ability to choose smoking with or without flavour, making it easier to share with others and providing ‘the best of both worlds’;<sup>45–48</sup> and the ‘bursting’ function.<sup>28 45 46</sup> To that end, the ability to crush the capsule to release and change the flavour was a desirable feature that was associated with being

**Table 3** Product perceptions of flavour capsule cigarettes by construct

Construct	Study ID	Study design	Comparison	Main findings related to perceptions of flavour capsule cigarettes
<b>Risk perceptions</b>				
<i>Perceived harm</i>	Barrientos-Gutierrez <i>et al</i> <sup>37</sup>	Cross-sectional, DCE	View one and two capsule versus non-capsule packs	Less harmful (one capsule)
	Brown <i>et al</i> <sup>28</sup>	Focus groups	View capsule versus non-capsule packs	No different in harm
	Emond <i>et al</i> <sup>31</sup>	Cross-sectional	Usual brand capsule versus menthol/regular	No different in harm
	Hoek <i>et al</i> <sup>38</sup>	Cross-sectional, DCE	View capsule versus non-capsule packs	No different in harm
	Moodie <i>et al</i> <sup>45</sup>	Focus groups	View capsule versus non-capsule packs	No different in harm
	Moodie <i>et al</i> <sup>46</sup>	Focus groups	View capsule versus standard cigarettes	Mixed views on harm
	Moodie <i>et al</i> <sup>14</sup>	Cross-sectional	Usual brand capsule versus regular	No different in harm
	Schneller <i>et al</i> <sup>42</sup>	Randomised controlled	After smoking capsule crushed versus uncrushed	No different in harm
	Thrasher <i>et al</i> <sup>41</sup>	Cohort	Usual brand capsule versus regular premium	Less harmful (discount brands in Mexico, USA); no different (Australia)
<b>Outcome expectancies</b>				
<i>Smoothness on throat and lightness in taste</i>	Cho and Thrasher <sup>30</sup>	Cross-sectional	Usual brand capsule versus regular	Lighter in taste and smoother on throat
	Gilbert and Ewald <sup>48</sup>	Interviews	Menthol capsule versus non-capsule	Lighter, milder, less harsh on throat
	Hoek <i>et al</i> <sup>38</sup>	Cross-sectional, DCE	View capsule versus non-capsule packs	Smoother taste (more likely among non-daily, former smokers and susceptible non-smokers than daily smokers)
	Thrasher <i>et al</i> <sup>41</sup>	Cohort	Usual brand capsule versus regular premium	Smoother (Australia, discount brands in Mexico, USA) and lighter (discount brands in Mexico)
<i>Pleasantness of taste, breath, smell</i>	Gilbert and Ewald <sup>48</sup>	Interviews	Menthol capsule versus non-capsule	Tastes more minty, sweeter, fresher, cleaner, more artificial; masks smell
	Grilo <i>et al</i> <sup>44</sup>	Focus groups	View capsule versus non-capsule packs	Tastes better, masks smell of tobacco, easier to conceal
	Hoek <i>et al</i> <sup>38</sup>	Cross-sectional, DCE	View capsule versus non-capsule packs	Leaves breath more pleasant.
	Moodie <i>et al</i> <sup>73</sup>	Focus groups	View capsule versus non-capsule packs	Tastes better (among younger groups, mixed among older adults), fresher breath, smells less, easier to conceal
	Moodie <i>et al</i> <sup>46</sup>	Focus groups	View capsule versus standard cigarettes	Tastes more pleasant, like gum, fresher breath, smells less
	Wackowski <i>et al</i> <sup>47</sup>	Focus groups	Camel Crush versus regular menthol	Tastes like candy/gum, toothpaste/mouthwash, more minty, less of smoke
<i>Satisfaction/fun to smoke</i>	Hoek <i>et al</i> <sup>38</sup>	Cross-sectional, DCE	View capsule versus non-capsule packs	More satisfying and fun to smoke, respectively (more likely among former smokers and susceptible non-smokers than daily smokers)
	Thrasher <i>et al</i> <sup>41</sup>	Cohort	Usual brand capsule versus regular premium	More satisfying (Australia, discount brands in Mexico); no different (USA)
<i>Perceived impact on initiation quitting</i>	Moodie <i>et al</i> <sup>45</sup>	Focus groups	View capsule versus non-capsule packs	Encourages non-smokers to experiment, smokers to consume more, and discourages attempts to quit. Like a starter cigarette
	Moodie <i>et al</i> <sup>46</sup>	Focus groups	View capsule versus standard cigarettes	Makes it easier for non-smokers to try and smokers to use
<b>Consumer interest</b>				
<i>Brand awareness and recall</i>	Abad-Vivero <i>et al</i> <sup>39</sup>	Cross-sectional, experimental	View capsule versus non-capsule packs	No more likely to be recalled. Pall Mall capsules among top brand varieties with highest levels of recognition and correct brand recall
	Grilo <i>et al</i> <sup>44</sup>	Focus groups	View capsule versus non-capsule packs	In general, able to identify
	Moodie <i>et al</i> <sup>45</sup>	Focus groups	View capsule versus non-capsule packs	Awareness greater among younger adults (16–35 years) than older groups
	Wackowski <i>et al</i> <sup>47</sup>	Focus groups	Camel Crush versus regular menthol	Participants across all age groups were familiar

Continued

Table 3 Continued

Construct	Study ID	Study design	Comparison	Main findings related to perceptions of flavour capsule cigarettes
<i>Perceived target audience and user associations</i>	Brown <i>et al</i> <sup>28</sup>	Focus groups	View capsule versus non-capsule packs	Younger audience, including teens, young adults in their 20s, millennials, students and 'party-goers'
	Grilo <i>et al</i> <sup>44</sup>	Focus groups	View capsule versus non-capsule packs	Young girls and women
	Moodie <i>et al</i> <sup>45</sup>	Focus groups	View capsule versus non-capsule packs	Young people, those who don't like the taste of smoke, but want to look cool, and menthol smokers. Associated with e-cigarettes due to different flavours
	Moodie <i>et al</i> <sup>46</sup>	Focus groups	View capsule versus standard cigarettes	Children, young people. Those starting smoking, wanting to conceal smoking and wanting something different. Associated with being for special occasions, such as a party, wedding, prom or a night out
	Wackowski <i>et al</i> <sup>47</sup>	Focus groups	Camel Crush versus regular menthol cigarettes	Younger, newer smokers, those who like to play with stuff. Associated with toys and as being used by smokers occasionally for entertainment
<i>Appeal, attractiveness and preferred choice</i>	Abad-Vivero <i>et al</i> <sup>39</sup>	Cross-sectional, experimental	View capsule versus non-capsule packs	More attractive. Pall Mall and Camel capsules most often rated as very attractive
	Barrientos-Gutierrez <i>et al</i> <sup>37</sup>	Cross-sectional, DCE	View one and two capsule versus non-capsule packs	More attractive (one capsule, two capsules. Menthol, normal branding and small health warning labels (30%), respectively, enhanced attractiveness
	Brown <i>et al</i> <sup>28</sup>	Focus groups	View capsule versus non-capsule packs	More attractive and most named as favourite pack because of the nice colours and the 'button' imagery that created expectations around taste
	Gilbert <i>et al</i> <sup>48</sup>	Interviews	Menthol capsule versus non-capsule	Improves and personalises the smoking experience because tastes fresher, lighter and more minty, and can decide when to crush the capsule
	Grilo <i>et al</i> <sup>44</sup>	Focus groups	View capsule versus non-capsule packs	Availability of different flavours, the colours, and presence of double capsules increased the appeal of the pack
	Hoek <i>et al</i> <sup>38</sup>	Cross-sectional, DCE	View capsule versus non-capsule packs	More attractive (more likely among non-daily, former smokers and susceptible non-smokers than daily smokers) and more stylish (more likely among former smokers than daily smokers)
	Moodie <i>et al</i> <sup>45</sup>	Focus groups	View capsule versus non-capsule packs	More appealing among young people because novel, cool, fashionable, fun, can share with others, and can conceal. Older adults viewed as a gimmick
	Moodie <i>et al</i> <sup>46</sup>	Focus groups	View capsule versus standard cigarettes	More appealing than standard and menthol because high-tech, cool, novel, choice of flavours. Less appealing than pink coloured and slim cigarettes
	Thrasher <i>et al</i> <sup>41</sup>	Cohort	Usual brand capsule versus regular premium	More stylish (discount brands in Mexico, USA); no different (Australia)
	Wackowski <i>et al</i> <sup>47</sup>	Focus groups	Camel Crush versus regular menthol cigarettes	Reasons for popularity: flavour options, sharing between non-menthol and menthol smokers, fun and entertaining. Some saw as a gimmick
<i>Future use intentions</i>	Abad-Vivero <i>et al</i> <sup>39</sup>	Cross-sectional, experimental	View capsule versus non-capsule packs	Greater likelihood of interest in trying (Pall Mall had greatest odds)
	Barrientos-Gutierrez <i>et al</i> <sup>37</sup>	Cross-sectional, DCE	View one and two capsule versus non-capsule packs	Greater interest in trying (one and two capsule). Menthol, normal branding and small health warning labels, respectively, enhanced interest in trying
	Hoek <i>et al</i> <sup>38</sup>	Cross-sectional, DCE	View capsule versus non-capsule packs	More likely to try if offered by a friend

Continued



Table 3 Continued

Construct	Study ID	Study design	Comparison	Main findings related to perceptions of flavour capsule cigarettes
Reasons for actual use or brand choice	Cho and Thrasher <sup>30</sup>	Cross-sectional	Usual brand capsule versus regular	More likely to choose brand because of taste
	Emond <i>et al</i> <sup>31</sup>	Cross-sectional	Usual brand capsule versus menthol or regular	More likely to choose brand because of taste, less expensive and the design of the pack
	Moodie <i>et al</i> <sup>14</sup>	Cross-sectional	Usual brand capsule versus regular	Reasons for using capsules (>20%): taste, smoother on airways, choice of flavours, clicking capsule, more interesting
	Paraje <i>et al</i> <sup>34</sup>	Cross-sectional	Last brand capsule versus non-capsule	More likely to choose flavour/taste in last purchase

.DCE, discrete choice experiment; e-cigarettes, electronic cigarettes.

technologically advanced,<sup>45 46</sup> dynamic,<sup>45</sup> designer-like<sup>45</sup> and similar to a toy.<sup>47</sup> Being able to pop the capsule also contributed to a sense of personalising the smoking experience.<sup>48</sup> On the other hand, some older adults in Scotland and young adult menthol smokers in the USA described capsule cigarettes as ‘gimmicky’.<sup>45 47</sup> One study found that non-standardised packaging and smaller health warning labels were associated with higher pack attractiveness, for both one and two flavour capsule cigarettes, compared with no capsule.<sup>37</sup> In this study, when evaluating the relative importance of different pack characteristics on pack attractiveness, flavour capsules had a larger (8%) influence than tobacco flavour (6%) and descriptive terms/symbols (4%), but a smaller effect compared with branding (43%), health warning label size (19%) and content (11%), and brand variety (10%).<sup>37</sup>

#### Future use intentions

Three cross-sectional studies with an experimental design found that flavour capsule cigarettes were associated with greater interest in trying the product compared with non-capsule cigarettes.<sup>37–39</sup> One of these studies found that standardised packaging and larger health warnings attenuated this effect.<sup>37</sup> Another study determined that susceptible non-smokers and former smokers were more likely to try a fruit-flavoured capsule cigarette than an unflavoured cigarette, while non-daily smokers were more likely to try a menthol flavour capsule cigarette if offered by a friend compared with daily smokers.<sup>38</sup>

#### Reasons for actual use/brand choice

Four cross-sectional studies examined a priori reasons for brand use or choice among flavour capsule users.<sup>30 31 33 34</sup> Taste was the most prevalent reason across all studies. Flavour capsule smokers were significantly more likely than non-capsule users to indicate ‘taste’ as a reason for brand choice in three studies<sup>30 31 34</sup> and ‘design of the pack’ in one of these studies.<sup>31</sup> In one US study, flavour capsule users were more likely to choose their brand because it was ‘less expensive’ compared with menthol users.<sup>31</sup> However, in a study in Chile, smokers of unflavoured cigarettes were more likely to report choosing it because of the price compared with flavour capsule smokers.<sup>34</sup> In one study, nearly 80% of capsule cigarette users reported choosing their brand due to ‘the amount of satisfaction it gives you’, although this did not differ significantly from non-capsule users.<sup>31</sup> Other moderately prevalent (20%–40%) reasons for brand choice across two studies included: ‘they are smoother on my airways than regular cigarettes’,<sup>33</sup> ‘people who are important to (me) smoke this brand’,<sup>31</sup> ‘I like having the choice of flavours’,<sup>33</sup> ‘I enjoy clicking the capsule’<sup>33</sup> and ‘they are more interesting than regular cigarettes’.<sup>33</sup>

#### Sensory and other subject responses to product use

Two studies measured sensory responses among US adult menthol smokers not trying to quit.<sup>42 43</sup> They concluded that there was minimal sensory impact of menthol being delivered via a crushable capsule compared with uncrushed products, with smokers’ preferred brand generally having the greatest sensory effects.<sup>42 43</sup> In the one study that also examined other subject responses, there were no significant differences in various measures, with the exception of greater relief of craving for the participant’s preferred brand compared with Camel Menthol crushed.<sup>42</sup>

#### Risk of bias assessment

Eighteen of the studies were assessed for risk of bias, with two studies not scored due to not being a full-text manuscript (ie, conference abstract,<sup>30</sup> report)<sup>35</sup> (online supplemental table 3). The mean quality assessment score for quantitative studies (n=12) was 23 out of 42 (range 18 to 26), and the mean score for qualitative studies (n=6) was 22 (range 19 to 26). The main issues were lack of theoretical framework, no evidence of user involvement in the design and inadequate justification for the analytical method selected, including its reliability and/or validity. Despite some risk of bias, none of the studies showed evidence of being severely methodologically flawed that would greatly retract from their validity. Moreover, none of the studies reported a conflict of interest or were funded by the tobacco industry.

#### DISCUSSION

This is the first systematic review on flavour capsule cigarettes, an innovative flavoured tobacco product that has experienced significant market growth over the past decade.<sup>14</sup> We identified 20 studies related to use and perceptions of capsule cigarettes, the majority of which were conducted in Mexico and/or the USA, within the past decade, and used a cross-sectional or focus group design. We found that flavour capsule cigarettes are popular in many countries, particularly in Chile, Mexico and South Korea, and are used most by young people. In some countries, capsule cigarette use is also higher among women. These products are perceived as being designed for young people and novice smokers and to function as a ‘starter cigarette’. Reasons for use and appeal have to do with positive perceptions about the product, such as better taste, smoothness on the airways, the choice of flavours and if/when to crush the capsule, and the enjoyment of clicking the capsule. Perceptions of relative reduced harm were more pronounced in Mexico than in other countries.

Country-level prevalence of flavour capsule cigarette use and increased trends over time were consistent with market share data from Euromonitor passport.<sup>14 18</sup> Current capsule

cigarette use was highest in Chile<sup>37</sup> and Mexico,<sup>36</sup> both countries which have had one of the largest capsule markets globally since 2012.<sup>14 16 18</sup> Rapid increases in capsule use observed in Mexico<sup>32 41</sup> further highlights the growth of these products seen in Latin America.<sup>14 16 49</sup> In many Latin American cities, flavour capsule cigarettes are ubiquitously available for purchase and heavily marketed at the point of sale, notably at retailers located close to schools.<sup>49–52</sup> The high prevalence of capsule use identified in South Korea<sup>30</sup> is likely driven by similar marketing strategies.<sup>20</sup>

Flavour capsule cigarettes were consistently most appealing to and consumed by young people, which mirrored perceptions around the presumed target audience of these products,<sup>28 44–47</sup> and also aligns with research on other flavoured tobacco products.<sup>23 24 53</sup> In some countries, current or ever use of capsule cigarettes among young smokers exceeded 50%.<sup>34 38</sup> Adolescents and young adults were also more likely to want to try capsule cigarettes compared with non-capsule cigarettes.<sup>37–39</sup> This is not surprising given that many of the product and advertising features of flavour capsule cigarettes identified across the studies are known by the tobacco industry to most appeal to this population.<sup>12 6 54 55</sup> Young people's perceptions identified in this review echo tobacco industry consumer research on crushable capsules. An RJ Reynolds focus group found that consumers were enamoured by the product's offering of a multisensory (eg, 'hits four of the five sensory cues—Feel, Hear, Taste, and Smell'), multi-dimensional (eg, 'it is not a one trick pony') and personalised (eg, 'sense of mine') smoking experience.<sup>56</sup> Indeed, advertising slogans (eg, 'taste you can change')<sup>20</sup> and pack descriptors (eg, 'activate')<sup>57</sup> of flavour capsule cigarettes connote a flavourful, high-tech and customisable product. Other 'digital' features, such as the power button symbol,<sup>20 57 58</sup> likely contribute to capsule cigarettes being generally recognised or known, especially among adolescents and young adults.<sup>39 44 45 47</sup>

In addition, women were significantly more likely than men to prefer capsule cigarettes in many countries, a disparity also well documented for use of menthol and other flavoured cigarettes.<sup>59–62</sup> Tobacco industry documents reveal the deliberate targeting and modification of tobacco products to appeal to women,<sup>63 64</sup> whose brand preferences are largely driven by taste.<sup>6</sup> Insights from early industry consumer research on capsule cigarettes also identified greater appeal for women.<sup>56</sup> However, a gender association was not clear across other studies and capsule cigarettes are still clearly popular among men,<sup>35</sup> who may particularly find the gadgetry of capsule cigarettes appealing.

Positive outcome expectancies about using capsule cigarettes were most salient among susceptible non-smokers and non-daily smokers compared with daily smokers, suggesting that these products are designed to recruit new smokers and retain novice smokers rather than established smokers.<sup>38</sup> Similar to other flavoured tobacco products,<sup>3 53 65</sup> capsule cigarettes likely facilitate smoking initiation by making it more palatable and easier to smoke. However, findings around capsule use by smoking and quitting behaviours were mixed,<sup>30 31 33 34 40 41</sup> indicating that more research is needed. Future research should also examine the sensory effects of other capsule cigarette brands and flavours across larger and more diverse sample populations given that the only two studies that assessed responses to the product were conducted among US menthol smokers and tested only one brand—Camel Crush.<sup>42 43</sup>

Accounts of menthol capsule cigarettes tasting more minty than standard menthol cigarettes may be explained by the higher levels of menthol, along with other flavour compounds, that have been observed in chemical analysis studies of these

products.<sup>66 67</sup> In most countries, capsule cigarettes were viewed as no less harmful than standard cigarettes.<sup>28 31 33 37 38 42 45</sup> This may reflect the marketing strategies of flavour capsule cigarettes, which do not appear to focus on promoting a reduced harm product, but rather a product that is customisable and innovative.<sup>12 20 58</sup> It is also possible that perceptions of reduced harm may be counterbalanced by views that the capsules contain additional chemicals to change the taste.<sup>46</sup> However, perceptions of reduced harm observed in Mexico<sup>37 41</sup> is concerning given the high prevalence of use.

Capsule technology has created new avenues for undermining existing tobacco control policies. For instance, in Canada, the industry responded to a flavour cigarette ban with the introduction of crushable water capsule cigarettes.<sup>68</sup> Moreover, in the wake of the EU and UK ban on menthol cigarettes, the industry launched new menthol capsule cigarillos, as well as separate menthol accessories, including capsules.<sup>69</sup> Flavour capsules have also been applied to heated tobacco products.<sup>70</sup> As such, regulations should cover all capsule and filter advancements and other combustible tobacco products. The tobacco industry also responded to the adoption of plain packaging legislation in Australia,<sup>71</sup> Singapore<sup>72</sup> and in the UK<sup>73</sup> by launching new flavour capsule cigarette variants and flavours, along with other filter innovations prior to policy implementation, likely to weaken the impact of the policy on sales and as an alternative means to establish brand differentiation, although standardised packaging and larger health warning labels can reduce capsule cigarette pack attractiveness and interest in trying.<sup>38</sup> Regulatory attention should also be paid to point-of-sale advertising, which has been a particularly prominent channel used to promote flavour capsule cigarettes.<sup>50</sup>

This is the first systematic review on flavour capsule cigarettes and includes both quantitative and qualitative studies, but outcome measures and populations varied across studies and comparing across studies should be done with caution. This further stymied our ability to conduct a meta-analysis. We used theoretical frameworks to strengthen our synthesis of results; however, some of the construct domains for product perceptions (eg, outcome expectancies and consumer interest) may not be mutually exclusive. Study quality was moderate overall, although our assessment could only be based on reported information, hence scores should only be interpreted as a general indication of the relative risk of bias within the context of other studies in this review. Among studies that assessed perceptions around pack design, only two used a discrete choice experiment design,<sup>37 38</sup> a rigorous approach that has shown to have high predictive value between stated preferences and actual behaviours.<sup>74</sup> Moreover, only two studies used a cohort design.<sup>40 41</sup> Given the lack of longitudinal data, it is difficult to discern how consumer profiles may change as the diffusion of this innovation becomes more established. Future research should focus on elucidating these nuances using more robust study designs. Lastly, considering the emerging status of the literature in this field, the exclusion of the grey literature publications may have left out important findings. Nevertheless, we kept our search strategy intentionally broad and crosschecked references of included publications to capture all relevant published studies.

## CONCLUSIONS

Overall, this review offers compelling evidence that flavour capsule cigarette use is growing, particularly in certain countries (eg, Chile, Mexico, South Korea) and populations (eg, adolescents and young adults). These products are perceived as more

appealing and attractive than non-capsule cigarettes, especially by non-smokers and non-daily smokers, which strengthens evidence that capsule cigarettes can facilitate smoking initiation. Continued monitoring and research on flavour capsule cigarettes is critical, with particular attention to low-income and middle-income countries, which make up a disproportionately larger share of the capsule market.<sup>14 16 18</sup> In order to further protect public health from the devastating effects of tobacco-related morbidity and mortality and to mitigate the tobacco industry's attempts to thwart tobacco control policies, countries should adopt comprehensive policies that take into account flavour capsules and similar product iterations that can facilitate smoking initiation through flavours, enhanced sensory effects and innovative features.

## REGISTRATION AND PROTOCOL

The review was not registered and a protocol was not prepared.

### What this papers adds

- ⇒ This first systematic review on flavour capsule cigarettes found that use of these products is growing, with highest prevalence observed in Latin American countries (ie, Chile and Mexico) and among young people.
- ⇒ Flavour capsule cigarette appeal is higher among non-smokers and non-daily smokers than daily smokers, and is often driven by positive outcome expectancies, such as pleasant taste and smoothness on the throat, as well as perceptions that these products offer novelty and customisability.
- ⇒ This paper identifies significant gaps in the literature on flavour capsule cigarettes, particularly highlighting the need for more longitudinal and experimental studies, in order to inform and strengthen policy.

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**Contributors** CK conceptualised the study, conducted the database search and wrote the manuscript. CK and MZ screened and assessed eligibility of articles, extracted data and assessed risk of bias of the studies. FF advised and resolved discrepancies in eligibility and scoring of risk of bias. All authors edited the manuscript and approved the final manuscript.

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