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## The influence of cigarette packet branding and colours on young male smokers' appeal and harm perceptions of tobacco brands in Cambodia: a mixed-methods study

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**TITLE**

The influence of cigarette packet branding and colours on young male smokers' appeal and harm perceptions of tobacco brands in Cambodia: a mixed-methods study

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## ABSTRACT

### Objectives

Cigarette packet branding influences the appeal and harm perceptions of tobacco brands among young people. Low- and middle-income countries (LMICs) in Southeast Asia have largely banned tobacco advertising, promotion, and sponsorship (TAPS), but cigarette packet branding is still permitted in most countries. This study explored how cigarette packet branding and colours influenced young male smokers' appeal and harm perceptions of tobacco brands in Cambodia.

### Methods

With a convenience sample of 147 young male smokers (18-24 years) in Cambodia, mixed-methods surveys were conducted to assess participants' tobacco brand recognition on cigarette packets with labels removed, and perceptions of appeal and harm associated with local cigarette packet branding and colours. Descriptive statistics were calculated for quantitative data and reflexive, thematic analysis was used to explore qualitative short responses.

### Results

Most participants recognised one or more tobacco brands on packets with brand names removed and most identified fully-branded packet as the most appealing. Participants qualitatively described their chosen brand as appealing due to beliefs about its superior taste/quality and reduced harm. They also described symbolic attitudes surrounding tobacco brands which they associated with smokers in a social hierarchy. Participants identified lighter coloured packets as the most appealing and least harmful, while darker coloured

packets as the most harmful. They associated packet colours with abstract imagery concerning smoking-related harms and their future wellbeing.

**Conclusions**

The findings demonstrate that packet branding and colours influence young male smokers’ appeal and harm perceptions of tobacco brands in Cambodia. Since packet branding provides tobacco companies with an influential marketing tool where advertising is banned, Cambodia and other LMICs in Southeast Asia should implement plain packaging.

**Strengths and limitations of this study**

- Data were collected by local research assistants using a mixed-methods survey that has been pre-tested with participants
- Quantitative and qualitative data were analysed to address the research aim
- Study findings address an important gap in understanding how cigarette packet branding influences young people in LMICs in Southeast Asia
- Participants were recruited using convenience sampling, which may not be representative of all young male smokers in Cambodia

## INTRODUCTION

In response to restrictions on tobacco advertising, promotion, and sponsorship (TAPS), tobacco companies turned to cigarette packet branding to advertise their brands.[1,2] This marketing tool – which includes brand elements on product packaging such as logos, colours, images, and descriptions – provides tobacco companies with various opportunities to reach current and potential smokers.[3] For example, individuals are exposed to brand elements when cigarette packets are displayed in retail stores or when smokers publicly display their packets while retrieving a cigarette or during smoking.[3,4] Consequently, smokers become a “*silent salesperson*” for tobacco companies, unknowingly exposing others to brand elements.[5]

Packet brand elements have been shown to influence attitudes and consumption behaviours, with branded packets perceived as more appealing and having better quality cigarettes than plain packets.[6-8] One way packet branding may influence the appeal of tobacco brands is through brand imagery, with young people describing tobacco brands that utilised appealing images on their packets as “*mature*” and “*sophisticated*”.[9] Packet brand elements may also influence perceived characteristics of typical smokers of the brand, with brand names, descriptions, colours, and images associated with “*masculine*” or “*feminine*” brands.[6,10] Qualitative studies also suggest that young people utilise tobacco brands as a way to define and communicate their self-image to others and elevate their social status.[11,12]

The tobacco industry has a history of using marketing tactics to try to create the impression that certain tobacco products are less harmful than others.[13] Literature suggests that packet branding may influence young people’s harm perceptions about tobacco products, with brand descriptors (such as “*light*”, “*smooth*”, or “*additive free*”) potentially creating an impression



of reduced harm.[14-17] Analysis of tobacco industry documents has shown that companies used packet colours to influence consumers’ perceptions about the taste, strength and health impacts of cigarettes.[18] Research suggests that smokers associate lighter coloured packets with cigarettes that are weaker in strength, contain fewer harmful substances and are less harmful, while darker coloured packets are associated with increased harm and reduced appeal.[19,20]

Low- and middle-income countries (LMICs) in Southeast Asia have made substantial efforts to reduce tobacco use, with most ratifying the World Health Organization’s (WHO) Framework Convention of Tobacco Control (FCTC) and introducing comprehensive bans on TAPS.[21] However, most of these countries still permit cigarette packet branding. Evidence shows that tobacco companies use packet branding as a marketing tool in the region.[22,23] In the Philippines, one qualitative study showed that young people describe flavoured cigarette packets as attractive and associated the colour of those packets with product harm – often perceiving lighter colours with reduced harm and red or darker colours with increased harm.[24] With data showing that smoking uptake mainly occurs among males during adolescence and young adulthood,[21] there is a lack of evidence from LMICs in Southeast Asia to explain how packet branding impacts young people’s smoking attitudes and consumption behaviours, or how plain packaging might interrupt this marketing tool.[25]

Cambodia is a lower-middle income country in Southeast Asia that continues to face a significant health and economic burden from tobacco use. An estimated 15,000 Cambodians die each year from tobacco-related illnesses, with annual costs reaching 3% of the country’s gross domestic product.[26] Like other countries in the region, smoking is a male-dominated practice in Cambodia – with data showing that men account for more than 90% of the

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country's 1.68 million smokers.[27] Similarly, smoking uptake predominately occurs during adolescence to young adulthood in Cambodia.[27] The Cambodian government has also introduced TAPS restrictions, but still permits marketing through cigarette packet branding.[28] To our knowledge, however, no study has explored how the tobacco industry has used cigarette packet branding as a marketing tool in Cambodia, or how packet branding might influence young people's smoking and brand attitudes.

This study explored how cigarette packet branding (such as logos, descriptions, and colours) influence the appeal and harm perceptions of tobacco products among young male smokers in Cambodia. Three questions guided the research:

1. To what extent can young male smokers recall specific tobacco brands from cigarette packets?
2. Is there evidence that cigarette packet branding influences the appeal of, and attitudes towards, different tobacco brands?
3. Is there evidence that cigarette packet colours influence the appeal and harm perceptions of tobacco brands or products?

## METHODS

### Approach

To answer the research questions, this research used a mixed-methods design which involved quantitative and qualitative to obtain insights from participants.[29] This research was part of a broader study exploring below-the-line marketing, cigarette packet branding, and e-cigarette use among young male smokers in Cambodia, which has been detailed previously.[30]

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**Sample and recruitment**

We recruited a convenience sample of young male smokers from Phnom Penh, Cambodia. To obtain insights from participants of diverse socio-economic backgrounds, we aimed to recruit an approximately equal numbers of participants who were currently studying at university or working in the country’s leading employment sectors: tourism, construction, and garment manufacturing.[31] We planned to recruit approximately 150 individuals to reach saturation for the qualitative, short-response questions in the survey.[32] Eligibility criteria included: Cambodian citizenship, male, 18-24 years, and current smoker (defined as having smoked at least one cigarette in the past month). We provided individuals with the study’s plain language statement and consent form in Khmer. Participants provided written consent and received a US\$3 phone voucher for their time.

**Data collection**

We trained local research assistants on data collection protocols and pre-tested the survey with a sample of young male smokers in Cambodia. In early 2020, we supported local research assistants to conduct mixed-methods, interview-administered surveys. The survey was implemented using digital tablets installed with Qualtrics, with participants selecting the language (Khmer or English) for the survey. Closed-ended questions obtained data on participants’ demographic characteristics, smoking behaviours. Short-response questions were used to collect qualitative data, which were recorded verbatim in text format. Interviewer probes were used to illicit additional details.

Section 1. Packet brand recognition

To explore brand recognition, we showed participants a picture of three cigarette packets sold in Cambodia, with brand names removed (Figure 1). These three brands were identified in a

previous study as having appealing packet branding in Cambodia and neighbouring countries.[23] Using open ended questions, we asked participants if they could name the tobacco brand of each packet.

### Figure 1. Packets with brand names removed

#### Section 2. Packet brand appeal and attitudes

We showed participants a picture of three fully-branded packets of cigarettes sold in Cambodia and three matching plain packets, which include brand names printed on neutral, plain grey packets with no brand elements (Figure 2). All six packets included graphic health warnings (GHWs) used in Cambodia at the time of this study. We asked participants to select the packet they thought would be the most appealing in terms of taste and most appealing to young people in Cambodia. Participants then provided short responses to describe why they thought their chosen packet was the most appealing. Responses were recorded verbatim in text.

### Figure 2. Fully-branded packets and matching neutral plain packets

#### Section 3. Packet colour appeal and harm perceptions

We then showed participants a picture of six unbranded cigarette packets. Each packet was a different colour with no brand name or brand elements (Figure 3). Each packet included a GWH used in Cambodia at the time of the study. The packets included a mix of lighter and darker colours as well as colours used in the branding of tobacco brands sold in Cambodia (Marlboro, Mevius, ARA). Participants selected the packet they thought would be: most

appealing in terms of taste, least harmful, and most harmful. Participants then provided short responses to describe these choices, which were recorded verbatim in text.

**Figure 3. Unbranded packets in different colours**

**Data analysis**

We used descriptive statistics (using SPSS version 27) to assess participants’ demographic characteristics, regular cigarette brand smoked, packet brand recognition, cigarette packet brand appeal, and packet colour appeal and harm perceptions. We collapsed participants’ regular cigarette brand smoked into a binary variable of “*Mevius*” smokers (the most commonly smoked brand) and all other brands (combined to ensure sufficient sample size for comparison). We used chi-squared analyses to examine whether responses to packet brand recognition, packet brand appeal, packet colour appeal and harm perceptions differed between participants who smoked “*Mevius*” and those who smoked the other brands. For some analyses involving small cell sizes, we used Fisher’s exact test to examine differences.

The qualitative data were translated from Khmer to English by two professional translators, with minor grammatical errors corrected. We then analysed the qualitative data using inductive, reflexive thematic analysis. This involved data familiarisation, data coding, and arranging codes into themes and sub-themes.[33] Field notes were used to embed contextual information through this process.[34] We practised reflexivity to determine how their socio-cultural backgrounds might have impacted the data analysis and interpretation.[35] Potential factors that may have influenced data analysis included our nationality and experience working in Cambodia and other LMICs across the region. We also discussed data analysis to promote reflexivity, which led to the refinement of qualitative themes.

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## Patient and Public Involvement

No patient involved.

## RESULTS

### Participant characteristics

One hundred and forty-seven young males participated (Table 1). Most participants were aged 21 years or younger (n=83, 56.5%), over one-third had not completed secondary school (n=63, 42.9%), and around half earned more than US\$200 per month (n=80, 54.4%). Most smoking was at a relatively low level, with half smoking an average of five or less cigarette per day (n=82, 55.7%). Around three-quarters of participants indicated “*Mevius*” as their regular cigarette brand smoked (n=112, 76.2%).

**Table 1. Demographic characteristics**

Characteristics	n (%)
<b>Age</b>	
18 - 21	83 (56.5)
22 - 24	64 (43.5)
<b>Education</b>	
Less than secondary school completed	63 (42.9)
Secondary school completed	14 (9.5)
Post-secondary education (current/completed)	68 (46.2)
Missing	2 (1.4)
<b>Occupation</b>	
Garment manufacturing	31 (21.1)
Construction	16 (10.9)
Hospitality/tourism	51 (34.7)
University student	49 (33.3)
<b>Monthly income</b>	
Less than \$200	67 (45.6)
More than \$200	80 (54.4)
<b>Average cigarettes smoked per day</b>	
Less than 1 - 5	82 (55.7)
6 - 10	38 (25.9)
11 - 20	22 (15.0)
More than 20	5 (3.4)

<b>Regular cigarette brand</b>	
Mevius	112 (76.2)
ESSE	6 (4.1)
Luxury	5 (3.4)
Fine	5 (3.4)
555	4 (2.7)
Marlboro	2 (1.4)
ARA	2 (1.4)
Various other brands	4 (2.7)
Missing*	7 (4.7)

\* Missing responses were group with other brands for analysis

Section 1. Packet brand recognition (Figure 1)

Nearly all participants correctly recognised the brand name of packet one as Mevius (n=145, 98.6%), approximately one-fifth recognised packet two as Marlboro (n=31, 21.1%), and one-third recognised packet three as 555 (n=57, 38.8%). Nearly half correctly recognised the brand on two or more packets (n=66, 44.9%), while one in seven participants recognised all three brands (n=22, 14.9%). There was no significant difference between participants who smoked “Mevius” and those who smoked other brands for recognition of the three brands (all p-values >.05).

Section 2. Packet branding appeal and attitudes (Figure 2)

Over four-fifth of the participants selected a fully-branded packet as the most appealing in terms of taste (n=122, 83.0%), with a similar proportion selecting a fully-branded packet as the most appealing to youth (n=120, 81.7%) (Table 2). Around one-tenth of the participants thought there was no difference between all the packets regarding taste (n=16, 10.9%) or appeal to youth (n=18, 12.2%). More participants selected the Mevius plain packet as the most appealing taste (n=7, 4.7%) and to youth (n=4, 2.7%) than the ARA or Marlboro plain packets. Brand smoked was not related to brand selection for taste appeal (p=.166) or youth appeal (p=.265).

**Table 2. Appeal of fully-branded packets and matching plain packets**

	Taste appeal	Youth appeal
<b>Packet 1 (ARA fully-branded)</b>	2 (1.4)	2 (1.4)
<b>Packet 2 (Marlboro fully-branded)</b>	1 (0.7)	2 (1.4)
<b>Packet 3 (Mevius fully-branded)</b>	119 (80.9)	116 (78.9)
<b>Packet 4 (ARA plain packet)</b>	1 (0.7)	5 (3.4)
<b>Packet 5 (Marlboro plain packet)</b>	1 (0.7)	0 (0.0)
<b>Packet 6 (Mevius plain packet)</b>	7 (4.7)	4 (2.7)
<b>No difference</b>	16 (10.9)	18 (12.2)

NOTE: Numbers are frequencies for “most” appealing and those in parentheses are percentage of sample, N = 147.

Qualitative data on packet branding appeals (taste and youth) revealed four themes, with specific quotes for each theme presented in Table 3. The influence of participants’ familiarity with some brands was noted in each of the themes.

#### Theme 1. Brand appeal

When describing why they selected a branded packet, participants commonly mentioned the attributes of the cigarettes. Two main subthemes were found: quality and taste appeal and attractiveness of flavour change capsules. The first subtheme indicates that participants saw the brand selected as providing superior quality and tasting cigarettes, describing them as “*the best quality*”, “*fragrant*”, “*very delicious*”, or as having a “*nice smell*”. Some participants noted that the lighter smell and taste of these brands were particularly appealing to young people. For the second subtheme, some participants noted the branded packets were



appealing because they offered cigarettes with flavour change capsules, which could be used to change the taste of the smoke to “*menthol*”, “*fruit*”, “*grape*”, or “*chocolate*”.

Theme 2. Harm perceptions

Perceived strength of cigarettes and ease of smoking the cigarette was associated with perceptions of harm. Participants indicated that some branded packets were weaker than others, describing them as “*light*”, “*not too strong*”, or “*easy to smoke*”. One participant likened this weaker smoke to the aerosol produced from electronic cigarettes, claiming it was “*like smoke from vaping... sort of light*”. Participants also associated these weaker cigarettes as being less harmful than other brands, stating that these brands contained “*less nicotine*”, were “*less addictive*”, and caused less damage to their “*lungs*” or “*throat*”. Some participants noted that the weaker cigarettes were suitable for youth or those trying smoking for the first time, while others described these cigarettes as suitable for smokers who are trying to reduce their smoking.

Theme 3. Social hierarchies

When describing branded packets, participants associated tobacco brands with different socio-economic groups. For example, participants often distinguished between brands smoked by young people and those smoked by older smokers. Participants also associated brands with different socio-economic groups, with some seen as brands for rural residents. Some participants indicated that smoking the youth brand elevated one’s social status, with one participant stating that young people smoked this brand to “*show off to other people*”. Others stated that smoking the youth brand meant that they could engage in social smoking with other young people, like sharing cigarettes within their peer groups.

#### Theme 4. Brand loyalty

Some participants appeared to select branded packets out of a sense of loyalty to that brand, often recalling it as familiar or identifying it as the brand that they regularly smoked. For example, participants indicated their preference for their brand over other alternatives, with one participant claiming that *"I just smoke Mevius, the brand I know"*. Some stated that they consistently smoked the same brand of cigarettes and were hesitant to change. For example, one participant claimed that *"I cannot change my brand"*. Moreover, there was evidence that some participants developed a sense of connection with their brand during smoking initiation, stating that they had been smoking *"this brand from the beginning"*.

**Table 3. Participants' quotes demonstrating themes relating to packet branding appeal, perceptions, and attitudes**

##### Theme 1. Packet branding and product appeal

Quality and taste	<p><i>"I just know that Mevius tastes better than the other brands, which are like cheap or old brands."</i> 18-21 years, garment manufacturing employee</p> <p><i>"Mevius has the best quality."</i> 22-24 years, garment manufacturing employee</p> <p><i>"I think this packet would taste the best because it looks like Mevius, which has a strong taste."</i> 18-21 years, hospitality/tourism employee</p> <p><i>"This packet of cigarettes tastes the best because it looks like Mevius, the brand I smoke... I like the taste."</i> 22-24 years, hospitality/tourism employee</p> <p><i>"This packet of cigarettes would taste the best because it has the light flavour and smooth smoke."</i> 18-21 years, construction worker</p>
Flavour change capsules	<p><i>"Young people probably like this brand because it has a light smoke and good taste, like fruit flavours."</i> 22-24 years, garment manufacturing employee</p> <p><i>"This brand also have the flavour click. So when you press the cigarette, the smoke starts to taste like grape. It tastes really fresh."</i> 22-24 years, hospitality/tourism employee</p> <p><i>"This packet of cigarettes would taste the best because it has the click option on the filter, which you can use to make the cigarette taste like fruit."</i> 22-24 years, hospitality/tourism employee</p> <p><i>"This packet of cigarettes would be the most popular with young people because it has the click option, where you can change the flavour of the cigarette to menthol or fruit."</i> 18-21 years, university student</p>

##### Theme 2. Packet branding and harm perceptions

Weaker smoke and	<p><i>"This packet of cigarettes would taste the best because they look easy to smoke, not like the other packets which would be too strong for me."</i> 18-21</p>
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3	less	years, university student
4	harmful	<i>"The other brands like ARA have a strong taste and smell, but Mevius has a</i>
5		<i>light taste and smell which young people like."</i> 22-24 years, university student
6		<i>"This brand of cigarettes makes smoke that is like smoke from vaping, sort of</i>
7		<i>like not as strong and sort of light."</i> 22-24 years, hospitality/tourism
8		employee
9		<i>"I know this packet of cigarettes is Mevius. If I smoke another brand, then I</i>
10		<i>feel dizzy and sick, so I just smoke Mevius."</i> 18-21 years, university student
11		<i>"It makes a light smoke which is not too strong for your lungs."</i> 18-21 years,
12		university student
13	Suitable	<i>"Young people would like this brand because it looks the cigarettes would be</i>
14	for young	<i>a light flavour, which means the smoke is not too strong for young people.</i>
15	smokers	<i>"This light smoke is good for them because it does not leave a bad smell on</i>
16		<i>their body or mouth after they smoke it."</i> 22-24 years, garment manufacturing
17		employee
18		<i>"The other ones make me cough, and I don't like them. This brand is also</i>
19		<i>good because the smoke is not too strong, which is good for me because I am</i>
20		<i>trying to reduce how many cigarettes I have each week"</i> 22-24 years, garment
21		manufacturing
22		<i>"This packet would be popular to young people because it doesn't look too</i>
23		<i>strong, so it's a good brand for young people who are new to smoking or just</i>
24		<i>want to try it."</i> 18-21 years, hospitality/tourism employee

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**Theme 3. Tobacco brands and social hierarchies**

31	Different	<i>"Young people would prefer the Mevius cigarettes because the other brands</i>
32	brands for	<i>are more for older smokers. Like ARA is what older people smoke."</i> 22-24
33	young and	years, university student
34	older	<i>"This brand would be the most popular among young smokers because</i>
35	smokers	<i>everybody has friends who smoke Mevius. It is kind of like the youth brand."</i>
36		22-24 years, hospitality/tourism employee
37		<i>"This packet is Mevius which is for young people. The other brands are for</i>
38		<i>older people."</i> 18-21 years, hospitality/tourism employee
39		<i>"This brand of cigarettes is the most popular with young people because the</i>
40		<i>other brands are just for older people to smoke."</i> 22-24 years,
41		hospitality/tourism employee
42	Social	<i>"Young people like Mevius because they think it makes them look handsome</i>
43	status	<i>and cool, like special."</i> 22-24 years, construction worker
44		<i>"I guess people feel cool when they smoke this brand."</i> 18-21 years, university
45		student
46		<i>"I think Mevius is a brand of cigarette for young people in the city. Other</i>
47		<i>brands like ARA are for older people in the rural area, like lower-class</i>
48		<i>people."</i> 18-21 years, hospitality/tourism employee
49	Social	<i>"I think about 90% of young people I know smoke Mevius. I guess that it is</i>
50	connection	<i>popular among our friends, so we just copy each other. Like, I share</i>
51		<i>cigarettes with my friends and they share their cigarettes with me, so we are</i>
52		<i>always smoking the same brands as our friends."</i> 22-24 years, university
53		student
54		<i>"This packet of cigarettes would be the most popular among young people in</i>
55		<i>Cambodia because it looks like Mevius, which everybody smokes, so they just</i>
56		<i>follow their friends. They do what their friends do."</i> 18-21 years,

hospitality/tourism employee

*"This packet would be popular among young people because all their friends smoke this brand. It's very popular, so most people know it and then just follow what their friends do."* 22-24 years, hospitality/tourism employee

*"This brand is popular among young people because they just follow what their friends do, and everyone smokes this brand."* 22-24 years,

hospitality/tourism employee

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#### Theme 4. Brand loyalty

*"I know that this one is the most delicious because it is the brand that I smoke now, so I already know that it tastes good."* 22-24 years, hospitality/tourism employee

*"This brand of cigarettes is popular among me and my friends. Even though the price is sort of high, we still all smoke this brand."* 18-21 years, hospitality/tourism employee

*"For me, this packet is the best taste because it is the brand that I smoke now, which has a good flavour. I have tried other brands, but I prefer this brand."*

22-24 years, garment manufacturing employee

*"This is the Mevius brand that I know. Mevius is the brand that I smoke when I first try a cigarette. I never change my brand. I keep smoking Mevius now."*

22-24 years, hospitality/tourism employee

*"I think this packet of cigarettes would taste the best because it is the European brand. I first started smoking this brand, so now I cannot change my brand."* 18-21 years, hospitality/tourism employee

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#### Section 3. Packet colour appeal and harm perceptions (Figure 3)

More than half of the participants selected the blue cigarette packet as the most appealing for taste (n=75, 51.0%) and nearly eight per cent selected the white packet (n=11, 7.5%) (Table 4). When harm was considered, 25.2% (n=37) selected the white cigarette packet as the least harmful to health and 10.2% (n=15) selected the blue packet. In contrast, 15% (n=22) selected the red packet and 12.9% (n=19) selected the black packet as the most harmful.

Between participants who smoked "Mevius" and those who smoked all other brands, there was no significant difference in the selection of packets in terms of taste ( $p=.071$ ), least harmful ( $p=.464$ ), or most harmful ( $p=.445$ ).

**Table 4. Packet colour appeal and harm perceptions**

	Taste appeal	Least harmful to health	Most harmful to health
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Packet 1 (black)	6 (4.1)	4 (2.7)	19 (12.9)
Packet 2 (blue)	75 (51.0)	15 (10.2)	8 (5.4)
Packet 3 (brown)	2 (1.3)	5 (3.4)	4 (2.7)
Packet 4 (grey)	1 (0.7)	2 (1.4)	3 (2.1)
Packet 5 (red)	5 (3.4)	5 (3.4)	22 (15.0)
Packet 6 (white)	11 (7.5)	37 (25.2)	11 (7.5)
No difference	47 (32.0)	79 (53.7)	80 (54.4)

NOTE: Numbers are frequencies for the most appealing and the least and most harmful with corresponding percentages in parentheses, N = 147)

Two themes emerged regarding packet colour appeal and harm perceptions. Specific quotes for each theme are presented in Table 5.

Theme 1. Packet colour and product appeal

Packet colour was associated with the appeal of the underlying cigarette, with comments suggesting that cigarettes from blue packs tasted “light” or “kind of soft”, while others associated it with “menthol” flavoured cigarettes. In contrast, red and darker coloured packets were associated with stronger flavoured cigarettes. Participants also associated packet colours with tobacco brands, relating the blue packet with the tobacco brand “Mevius” and the red packet with “ARA” or “Marlboro”. Brand associations influenced the appeal with some stating that “it looks the same as Mevius, so I think it would taste good”. They also displayed a sense of familiarity and preference with packet colours similar to their current tobacco brand, stating that “I kind of already know it” or “I feel like I already know this taste”.

Theme 2. Packet colour and harm perceptions



Comments regarding pack colour and harm indicated that participants often associated lighter coloured packets (such as blue and white) with cigarettes that had fewer harmful substances. Participants also associated lighter coloured packets with abstract, positive imagery (such as “purity” or “a good heart”) which indicated a less harmful product. In contrast, due to the stronger cigarettes associated with black or red packets, these colours, were also seen as most dangerous to smoke. Participants also described black and red packets with negative imagery such as “death and danger”, “blood”, or an “accident in the car”. They perceived this imagery as negative consequences for smoking cigarettes in these packets.

**Table 5. Participants’ quotes demonstrating themes relating to packet colour appeal and harm perceptions**

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**Theme 1. Packet colour and product appeal**

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Product strength and appeal	<p><i>“This packet of cigarettes would taste the best because the blue colour reminds me of the ocean, so it makes me think these cigarettes would taste cool and fresh.”</i> 22-24 years, hospitality/tourism employee</p> <p><i>“The blue colour of this packet makes me think the cigarettes are menthol, which is a nice taste and like fresh feeling in your mouth when you smoke it.”</i> 18-21 years, hospitality/tourism employee</p> <p><i>“This packet of cigarettes would taste the best because the blue colour makes me think they are good quality and light smell.”</i> 22-24 years, university student</p> <p><i>“I think the black packet would taste the best because it looks like it has a strong flavour... I like to smoke this strong flavour.”</i> 22-24 years, construction worker</p>
Tobacco brands and attributes	<p><i>“I think this packet of cigarettes would taste the best because it looks like Mevius, which is the brand that I like to smoke. Even though this picture does not have a name on it, I still know that these cigarettes would be like Mevius cigarettes because of the same colour packet.”</i> 18-21 years, hospitality/tourism employee</p> <p><i>“I believe this packet would taste the best because it looks similar to Mevius, the type of cigarette that me and all my friends smoke. It looks the same as Mevius, so I think it would taste good too.”</i> 18-21 years, university student</p> <p><i>“This red packet would taste better than the other packets because it is the same colour as ARA, which is the brand that I like to smoke now.”</i> 22-24 years, garment manufacturing employee</p> <p><i>“I think the red packet would taste the best because it looks like the cigarette brand that I usually smoke, so I feel like I already know this taste.”</i> 22-24 years, hospitality/tourism employee</p>

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**Theme 2. Packet colour and harm perceptions**

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Reduced harm	<p><i>“These cigarettes are not too harmful for your health because they are in a white packet. This colour makes me think they have less nicotine and less tobacco in them, so they don’t harm your body as much as the other packets.”</i> 18-21 years, hospitality/tourism employee</p> <p><i>“The white colour of this packet means that these cigarettes only have a small amount of poison in them. So I think they would be the least harmful to the smoker’s lungs compared to the darker packets.”</i> 18-21 years, university student</p> <p><i>“The white colour makes me think of honesty and integrity, so I think these cigarettes would not be too harmful for my health.”</i> 18-21 years, hospitality/tourism employee</p> <p><i>“This cigarette is not very bad because the white colour of the packet reminds me of purity and a good heart. I don’t think it looks very dangerous.”</i> 18-21 years, university student</p>
Increased harm	<p><i>“I think that the black packet would be the most harmful to your body because the black colour makes me think that these cigarettes would be very strong and probably harmful to your lungs.”</i> 18-21 years, university student</p> <p><i>“I think these cigarettes would be the most harmful because they are in a red packet, which reminds me of blood and a stop sign on the road, and this makes me think of something bad like an accident In the car.”</i> 18-21 years, garment manufacturing employee</p> <p><i>“These cigarettes are dangerous because the black colour of the packet represents a bad future, so the smoker of this packet might have a bad future or problem in their life.”</i> 18-21 years, hospitality/tourism employee</p> <p><i>“I think this packet of cigarettes is the worse for your lungs because the black colour represents death and danger.”</i> 18-21 years, hospitality/tourism employee</p>

DISCUSSION

The research showed that regardless of the brand smoked, most young male smokers recognise the tobacco brand on altered cigarette packets with the brand names removed and correctly named them. With mass media TAPS banned in Cambodia,[26] these findings indicate that packet branding still provides tobacco companies with a marketing tool to communicate brand awareness among young smokers. This finding is concerning given tobacco companies’ successful use of cigarette packet branding as a marketing tool in high-income countries prior to packet advertising restrictions being introduced.[1,2]

Quantitative findings showed that most participants selected a specific fully-branded packet as the most appealing in taste and to young people. Participants qualitatively described this branded packet as having a superior taste and quality (often citing flavour varieties and

flavour change capsules) or because they perceived it as less harmful than other brands.

While studies in high-income countries have demonstrated that individuals perceive branded packets as more appealing[6-8] and less harmful than plain packets,[14-16] this is the first study, to our knowledge, to demonstrate these same perceptions in young people in Cambodia. This finding aligns with previous studies in the region which showed that cigarette packets include brand elements and flavours that may appeal to young people.[23,24]

Analyses of responses to open ended questions revealed that young Cambodian males also held symbolic attitudes towards the tobacco brands, such as believing that a particular brand was suitable for young, higher-class smokers while other brands were associated with older, lower-class smokers. Findings also showed that participants perceived consumption of certain brands as a way to identify and interact with specific social groups – particularly young, higher-class smokers. These findings align with studies in high-income countries which demonstrated that young people associate tobacco brands with symbolic imagery and user profiles of smokers,[6,9,10] and consume tobacco brands to communicate and elevate their social status.[11,12] Taken together, this evidence shows that cigarette packet branding influences sophisticated brand attitudes among young people, beyond just communicating brand names and product attributes.

Similar to research findings from high-income countries[19,20] and the Philippines,[24] this study found that young male smokers in Cambodia associated lighter coloured packets (blue and white) with less harmful cigarettes and red and black packets with more harmful cigarettes. The qualitative data also revealed that some participants associated blue coloured packets with menthol flavoured cigarettes. While menthol cigarettes were commonly



associated with green packets in high-income countries,[19] our findings align with a recent Filipino study which showed that menthol cigarettes were also promoted in blue packets, and young people perceived them as less harmful than menthol cigarettes in green packets.[24] These finding suggest that tobacco companies may have modified their traditional colour schemes in Southeast Asian LMICs, and that these colours may contribute to further reduced harm perceptions among young people. Moreover, the qualitative data revealed that participants often associated packet colours with abstract imagery concerning smoking-related harms – with lighter colours associated with safer cigarettes and darker colours and red associated with danger and negative outcomes to their wellbeing. This novel finding provides insights into how young Cambodians perceive and associate packet colours, often in abstract and emotionally-driven ways.

This research has important policy implications. Article 11 of the WHO FCTC requires countries to implement measures to ensure that packaging does not promote tobacco products in any ways that are false, misleading, deceptive, or likely to create the false impression of reduced harm compared to other products.[36] To this end, the Guidelines on Implementation of Article 11 call for countries to introduce plain packaging legislation that prohibits brand logos, colours, images or promotional information on packaging; and requires brand names to be displayed in a standard colour and font.[36] Experimental and longitudinal studies in high-income, Western countries demonstrate that plain packaging is effective in reducing the attractiveness of tobacco products and brand imagery[37-39] While all Southeast Asian countries have implemented some restrictions on mainstream forms of TAPS, only Singapore and Thailand have introduced plain packaging (Myanmar planned to introduce this legislation in 2022).[21] Consequently, Cambodia and other LMICs in the region should introduce plain

packaging to restrict tobacco companies from using this salient and influential marketing tool to influence young people.

## LIMITATIONS

The research findings should be considered alongside important limitations. First, all participants were current cigarette smokers. Therefore, they would possibly smoke a regular brand of cigarettes and would have pre-existing attitudes towards that brand, which may have impacted their recall, appeal, and perceptions of the tobacco brands used in this study. This influence was noticed in the qualitative responses; however, the quantitative analysis did not find any association between participants' regular cigarette brand and their brand recall and attitudes. Second, a limited number of tobacco brands and colours were displayed on the packets used in this study, so these packets do not reflect all the tobacco brands and colours sold in Cambodia. Further research is required to explore a broader range of packet colours, including potentially new colour schemes concerning menthol or flavoured cigarettes. Third, convenience sampling was used to recruit participants, so the results cannot be generalised to all young male smokers or non-smokers in Cambodia. Fourth, only males were included in the research. While smoking is largely male dominated in Cambodia, these findings should not be used to explain how females may perceive cigarette packet branding directly. Fifth, this research only collected cross-sectional data. Therefore, experimental and longitudinal studies are needed to explore how packet branding, or future changes to plain packaging, may influence young Cambodians' smoking susceptibility, uptake, and consumption.

## CONCLUSIONS

This study demonstrated that cigarette packet branding and colours influence young male smokers' appeal and harm perceptions of tobacco brands sold in Cambodia. Despite

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increased TAPS restrictions, this research shows that cigarette packet branding and colours still provide tobacco companies in Cambodia with an influential marketing tool to reach young people. This research supports calls for Cambodia and other LMICs in Southeast Asia to implement plain packaging legislation according to Article 11 of the FCTC.

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## DECLARATIONS

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### Contributions

TS conceptualised the study, designed the survey questionnaire, conducted the fieldwork, analysed the data, and drafted the manuscript. HY, VW and JT assisted with data analysis and provided critical revisions of the manuscript. CC assisted with coordinating data collection and provided critical revisions of the manuscript. All authors have seen and approved the final manuscript.

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### Competing interests

None declared.

### Patient consent for publication

Not required.

### Ethics approval

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This research was approved by the Deakin University Human Research Ethics Committee [2019-353] and the National Ethics Committee for Health Research of the Ministry of Health in Cambodia [277].

**Provenance and peer review**

Not commissioned; externally peer-reviewed.

**Data availability statement**

No data is available for sharing.

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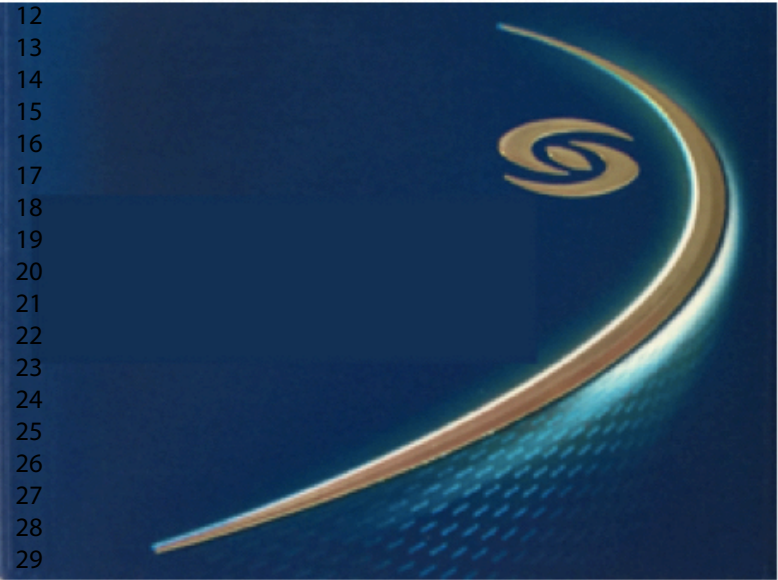
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Packet 1



Packet 2



Packet 3





Packet 1



Packet 4



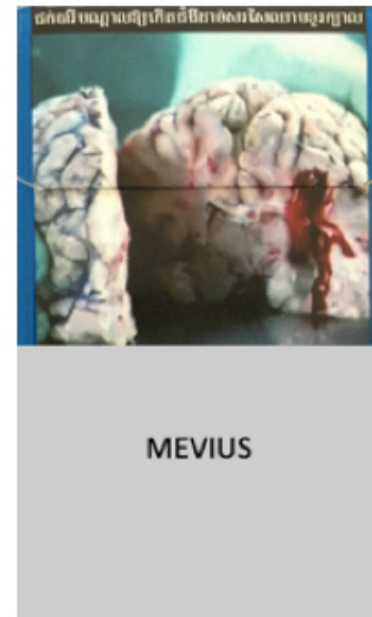
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Packet 6



Packet 1



Packet 4



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Packet 5



Packet 3



Packet 6

STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5,6,7
Objectives	3	State specific objectives, including any prespecified hypotheses	7
Methods			
Study design	4	Present key elements of study design early in the paper	8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	8
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	8
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	9,10,11
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	9,10,11
Bias	9	Describe any efforts to address potential sources of bias	N/A
Study size	10	Explain how the study size was arrived at	8
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	11
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	11
		(b) Describe any methods used to examine subgroups and interactions	11
		(c) Explain how missing data were addressed	N/A
		(d) If applicable, describe analytical methods taking account of sampling strategy	N/A
		(e) Describe any sensitivity analyses	N/A
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	12
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	12,13
		(b) Indicate number of participants with missing data for each variable of interest	13



Outcome data	15*	Report numbers of outcome events or summary measures	13,14, 18, 19
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	13,18
		(b) Report category boundaries when continuous variables were categorized	N/A
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	21,22,23,24
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	24
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	24
Generalisability	21	Discuss the generalisability (external validity) of the study results	24
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	26

\*Give information separately for exposed and unexposed groups.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).

# BMJ Open

## The influence of cigarette packet branding and colours on young male smokers' recognition, appeal, and harm perceptions of tobacco brands in Cambodia: a mixed-methods study

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Secondary Subject Heading:	Global health, Public health, Communication
Keywords:	PUBLIC HEALTH, QUALITATIVE RESEARCH, Health policy < HEALTH SERVICES ADMINISTRATION & MANAGEMENT

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**TITLE**

The influence of cigarette packet branding and colours on young male smokers' recognition, appeal, and harm perceptions of tobacco brands in Cambodia: a mixed-methods study

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tobacco, smoking, cigarette, young people, cigarette packaging, marketing, branding, plain  
packaging, Cambodia, Southeast Asia, LMICs

## ABSTRACT

### Objectives

To explore how cigarette packet branding and colours influence young male smokers perceptions of tobacco brands in Cambodia.

### Design

Mixed-methods study.

### Setting

Worksites, living accommodations, a university, and public locations in Phnom Penh, Cambodia.

### Participants

147 male Cambodian smokers (18-24 years).

### Interventions

Participants were shown mock-up pictures of different cigarette packet branding and colour variations and asked to respond to closed-ended and short-response questions.

### Outcome measures

Brand recognition, appeal, and harm perceptions of cigarette packet branding and colours.

### Results

When shown three packets with brand names removed, 98.6% of participants recognised packet one as Mevius brand, 21.1% recognised packet two as Marlboro, and 38.8%

recognised packet three as 555. For the three fully-branded and three matching plain packets, most participants selected a fully-branded packet as the most appealing taste (83.0%) and most appealing to youth (81.7%). Participants described their chosen brand as appealing due to beliefs about its superior taste/quality, reduced harm, and symbolic attitudes surrounding tobacco brands and smokers of different brands in a social status hierarchy. When shown six different colours of unbranded packets, participants selected the blue packet (51.0%) as the most appealing for taste, the white packet as the least harmful (25.2%), and the red (15.0%) and black (12.9%) packets as the most harmful to health. They described their associations of packet colours with abstract imagery concerning smoking-related harms and their future wellbeing.

**Conclusions**

Findings suggest that packet branding and colours influence young male smokers’ recognition, appeal, and harm perceptions of tobacco brands in Cambodia, and remain an influential marketing tool for tobacco companies where advertising is banned. Consequently, Cambodia and other LMICs in Southeast Asia should implement plain packaging.

**Strengths and limitations of this study**

- This is the first study to explore the influence of cigarette packet branding and colours in Cambodia.
- The survey was pre-tested with a sample of young male smokers in Cambodia to ensure the questions were linguistically and culturally appropriate
- Data were collected by Cambodian research assistants and in the local language of participants.

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- Participants were recruited using non-probability, convenience sampling, hence the results may not generalise to the broader population.

For peer review only



INTRODUCTION

In response to restrictions on tobacco advertising, promotion, and sponsorship (TAPS), tobacco companies turned to cigarette packet branding to advertise their brands.[1,2] This marketing tool – which includes brand elements on product packaging such as logos, colours, images, and descriptions – provides tobacco companies with various opportunities to reach current and potential smokers.[3] For example, individuals are exposed to brand elements when cigarette packets are displayed in retail stores or when smokers publicly display their packets while retrieving a cigarette or during smoking.[3,4] Consequently, smokers become a “*silent salesperson*” for tobacco companies, unknowingly exposing others to brand elements.[5]

Packet brand elements have been shown to influence attitudes and consumption behaviours, with branded packets perceived as more appealing and having better quality cigarettes than plain packets.[6-8] One way packet branding may influence the appeal of tobacco brands is through brand imagery, with young people describing tobacco brands that utilised appealing images on their packets as “*mature*” and “*sophisticated*”.[9] Packet brand elements may also influence perceived characteristics of typical smokers of the brand, with brand names, descriptions, colours, and images associated with “*masculine*” or “*feminine*” brands.[6,10] Qualitative studies also suggest that young people utilise tobacco brands as a way to define and communicate their self-image to others and elevate their social status.[11,12]

The tobacco industry has a history of using marketing tactics to try to create the impression that certain tobacco products are less harmful than others.[13] Literature suggests that packet branding may influence young people’s harm perceptions about tobacco products, with brand descriptors (such as “*light*”, “*smooth*”, or “*additive free*”) potentially creating an impression

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of reduced harm.[14-17] Analysis of tobacco industry documents has shown that companies used packet colours to influence consumers' perceptions about the taste, strength and health impacts of cigarettes.[18] Research suggests that smokers associate lighter coloured packets with cigarettes that are weaker in strength, contain fewer harmful substances and are less harmful, while darker coloured packets are associated with increased harm and reduced appeal.[19,20]

Low- and middle-income countries (LMICs) in Southeast Asia have made substantial efforts to reduce tobacco use, with most ratifying the World Health Organization's (WHO) Framework Convention on Tobacco Control (FCTC) and introducing comprehensive bans on TAPS.[21] However, most of these countries still permit cigarette packet branding. Evidence shows that tobacco companies use packet branding as a marketing tool in the region.[22,23] In the Philippines, one qualitative study showed that young people describe flavoured cigarette packets as attractive and associated the colour of those packets with product harm – often perceiving lighter colours with reduced harm and red or darker colours with increased harm.[24] With data showing that smoking uptake mainly occurs among males during adolescence and young adulthood,[21] there is a lack of evidence from LMICs in Southeast Asia to explain how packet branding impacts young people's smoking attitudes and consumption behaviours, or how plain packaging might reduce the effectiveness of packaging as a marketing tool.[25]

Cambodia is a lower-middle income country in Southeast Asia that continues to face a significant health and economic burden from tobacco use. An estimated 15,000 Cambodians die each year from tobacco-related illnesses, with annual costs reaching 3% of the country's gross domestic product.[26] Like other countries in the region, smoking is a male-dominated

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practice in Cambodia – with data showing that men account for more than 90% of the country’s 1.68 million smokers.[27] Similarly, smoking uptake predominately occurs during adolescence to young adulthood in Cambodia.[27] The Cambodian government has also introduced tobacco advertising, promotion, and sponsorship (TAPS) restrictions, but still permits marketing through cigarette packet branding.[28] To our knowledge, no study has explored how the tobacco industry has used cigarette packet branding as a marketing tool in Cambodia, or how packet branding might influence young people’s smoking and brand attitudes.

This study explored how cigarette packet branding (such as logos, descriptions, and colours) influence the recognition, appeal, and harm perceptions of tobacco products among young male smokers in Cambodia. Three questions guided the research:

1. To what extent can young male smokers recognise specific tobacco brands from cigarette packets?
2. Is there evidence that cigarette packet branding influences the appeal of, and attitudes towards, different tobacco brands?
3. Is there evidence that cigarette packet colours influence the appeal and harm perceptions of tobacco brands or products?

**METHODS**

**Approach**

This research used a mixed-methods design, which collected quantitative and qualitative data, to obtain insights from participants.[29] This research was part of a broader study that explored young male smokers’ attitudes and experiences surrounding combustible cigarette smoking, tobacco marketing, and e-cigarette use in Cambodia.[30] These topics were

presented to participants in discrete sections to avoid any potential confusion or cross-influence in responses between combustible cigarette smoking and e-cigarette use.

### Sample and recruitment

In early 2020, we recruited a convenience sample of approximately equal numbers of young male smokers from worksites, living accommodations, a university, and public locations in Phnom Penh, Cambodia – enabling insights from participants of diverse socio-economic backgrounds to be obtained. Tourism, and garment manufacturing were the targeted workplaces reflecting the country’s leading employment sectors.[31] We planned to recruit approximately 150 individuals to reach saturation for the qualitative, short-response questions in the survey.[32] Eligibility criteria included: Cambodian citizenship, male, 18-24 years, and current smoker (defined as having smoked at least one cigarette in the past month). We provided individuals with the study’s plain language statement and consent form in Khmer. Participants provided written consent and received a US\$3 phone voucher for their time.

### Data collection

We designed a mixed-methods, interview-administered survey, which included concepts and questions based on previous studies that explored young people’s attitudes towards cigarette packet branding and colours [14,15,17,19,20]. The survey was translated from English to Khmer by professional translators and pre-tested with a sample of young male smokers in Cambodia, which led to minor revisions to ensure the questions were linguistically and culturally appropriate. We trained and supported local research assistants (two were bilingual in English and Khmer) on data collection protocols and to conduct surveys. The surveys were implemented using digital tablets installed with Qualtrics, with participants selecting their language preference (Khmer or English). Closed-ended questions obtained data on

participants’ demographic characteristics, and smoking behaviours. Short-response questions were used to collect qualitative data, which were recorded verbatim in text format. Interviewer probes were used to illicit additional details. The surveys took approximately 30 minutes to complete for each participant.

Section 1. Packet brand recognition

To explore brand recognition, we showed participants a picture of three cigarette packets sold in Cambodia, with brand names removed (Figure 1). These three brands were identified in a previous study as having appealing packet branding in Cambodia and neighbouring countries.[23] Using open-ended questions, we asked participants if they could name the tobacco brand of each packet.

**Figure 1. Packets with brand names removed**

Section 2. Packet brand appeal and attitudes

We showed participants a picture of three fully-branded packets of cigarettes sold in Cambodia and three matching plain packets, which include brand names printed on neutral, plain grey packets with no brand elements (Figure 2). All six packets included graphic health warnings (GHWs) used in Cambodia at the time of this study. We asked participants to select the packet they thought would be the most appealing in terms of taste and most appealing to young people in Cambodia. Participants then provided short responses to describe why they thought their chosen packet was the most appealing. Responses were recorded verbatim in text.

**Figure 2. Fully-branded packets and matching neutral plain packets**

### Section 3. Packet colour appeal and harm perceptions

We then showed participants a picture of six unbranded cigarette packets. Each packet was a different colour with no brand name or brand elements (Figure 3). Each packet included a GHW used in Cambodia at the time of the study. The packets included a mix of lighter and darker colours as well as colours used in the branding of tobacco brands sold in Cambodia (Marlboro, Mevius, ARA). Participants selected the packet they thought would be: most appealing in terms of taste, least harmful, and most harmful. Participants then provided short responses to describe these choices, which were recorded verbatim in text.

### **Figure 3. Unbranded packets in different colours**

#### **Data analysis**

We used descriptive statistics (using SPSS version 27) to assess participants' demographic characteristics, regular cigarette brand smoked, packet brand recognition, cigarette packet brand appeal, and packet colour appeal and harm perceptions. We collapsed participants' regular cigarette brand smoked into a binary variable of "*Mevius*" smokers (the most commonly smoked brand) and all other brands (combined to ensure sufficient sample size for comparison). We used chi-squared analyses to examine whether responses to packet brand recognition, packet brand appeal, packet colour appeal and harm perceptions differed between participants who smoked "*Mevius*" and those who smoked the other brands. For analyses with small cell sizes, we used the Fisher's exact test to examine differences.

The qualitative data were translated from Khmer to English by two professional translators, with minor grammatical errors corrected. We then analysed the qualitative data using

inductive, reflexive thematic analysis. This involved data familiarisation, data coding, and arranging codes into themes and sub-themes.[33] Field notes were used to embed contextual information through this process.[34] We practised reflexivity to consider how our socio-cultural backgrounds might have impacted our data analysis and interpretation.[35] Potential factors that may have influenced data analysis included our nationality and experience working in Cambodia and other LMICs across the region. The authors discussed the analysis to promote reflexivity, which led to refinement of qualitative themes.

**Patient and public involvement**

Patients or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

**RESULTS**

**Participant characteristics**

One hundred and forty-seven young males participated (Table 1). Most participants were aged 21 years or younger (n=83, 56.5%), over one-third had not completed secondary school (n=63, 42.9%), and around half earned more than US\$200 per month (n=80, 54.4%). Most smoking was at a relatively low level, with half smoking an average of five or less cigarette per day (n=82, 55.7%). Around three-quarters of participants indicated “*Mevius*” as their regular cigarette brand smoked (n=112, 76.2%).

**Table 1. Demographic characteristics**

Characteristics	n (%)
<b>Age</b>	
18 – 21	83 (56.5)
22 – 24	64 (43.5)
<b>Education</b>	
Less than secondary school completed	63 (42.9)

Secondary school completed	14 (9.5)
Post-secondary education (current/completed)	68 (46.2)
Missing	2 (1.4)
<b>Occupation</b>	
Garment manufacturing	31 (21.1)
Construction	16 (10.9)
Hospitality/tourism	51 (34.7)
University student	49 (33.3)
<b>Monthly income</b>	
Less than \$200	67 (45.6)
More than \$200	80 (54.4)
<b>Average cigarettes smoked per day</b>	
Less than 1 – 5	82 (55.7)
6 – 10	38 (25.9)
11 – 20	22 (15.0)
More than 20	5 (3.4)
<b>Regular cigarette brand</b>	
Mevius	112 (76.2)
ESSE	6 (4.1)
Luxury	5 (3.4)
Fine	5 (3.4)
555	4 (2.7)
Marlboro	2 (1.4)
ARA	2 (1.4)
Various other brands	4 (2.7)
Missing*	7 (4.7)

\* Missing responses were group with other brands for analysis

### Section 1. Packet brand recognition (Figure 1)

Nearly all participants correctly recognised the brand name of packet one as Mevius (n=145, 98.6%), approximately one-fifth recognised packet two as Marlboro (n=31, 21.1%), and one-third recognised packet three as 555 (n=57, 38.8%). Nearly half correctly recognised the brand on two or more packets (n=66, 44.9%), while one in seven participants recognised all three brands (n=22, 14.9%). There was no significant difference between participants who smoked “Mevius” and those who smoked other brands for recognition of the three brands (all p-values >.05).

### Section 2. Packet branding appeal and attitudes (Figure 2)



Most participants selected a fully-branded packet as the most appealing in terms of taste (n=122, 83.0%), with a similar proportion selecting a fully-branded packet as the most appealing to youth (n=120, 81.7%) (Table 2). Around one-tenth of the participants thought there was no difference between all the packets regarding taste (n=16, 10.9%) or appeal to youth (n=18, 12.2%). More participants selected the Mevius plain packet as the most appealing taste (n=7, 4.7%) and to youth (n=4, 2.7%) than the ARA or Marlboro plain packets. Brand smoked was not related to brand selection for taste appeal (p=.166) or youth appeal (p=.265).

**Table 2. Appeal of fully-branded packets and matching plain packets**

	Taste appeal	Youth appeal
Packet 1 (ARA fully-branded)	2 (1.4)	2 (1.4)
Packet 2 (Marlboro fully-branded)	1 (0.7)	2 (1.4)
Packet 3 (Mevius fully-branded)	119 (80.9)	116 (78.9)
Packet 4 (ARA plain packet)	1 (0.7)	5 (3.4)
Packet 5 (Marlboro plain packet)	1 (0.7)	0 (0.0)
Packet 6 (Mevius plain packet)	7 (4.7)	4 (2.7)
No difference	16 (10.9)	18 (12.2)

NOTE: Numbers are frequencies for “most” appealing and those in parentheses are percentage of sample, N = 147.

Qualitative data on packet branding appeals (taste and youth) revealed four themes, with specific quotes for each theme presented in Table 3. The influence of participants’ familiarity with some brands was noted in each of the themes.

Theme 1. Brand appeal

When describing why they selected a branded packet, participants commonly mentioned the attributes of the cigarettes. Two main subthemes were found: quality and taste appeal and attractiveness of flavour change capsules. The first subtheme indicates that participants saw the brand selected as providing superior quality and tasting cigarettes, describing them as “the best quality”, “fragrant”, “very delicious”, or as having a “nice smell”. Some participants noted that the lighter smell and taste of these brands were particularly appealing to young people. For the second subtheme, some participants noted the branded packets were appealing because they offered cigarettes with flavour change capsules, which could be used to change the taste of the smoke to “menthol”, “fruit”, “grape”, or “chocolate”.

## Theme 2. Harm perceptions

Perceived strength of cigarettes and ease of smoking the cigarette was associated with perceptions of harm. Participants indicated that some branded packets were weaker than others, describing them as “light”, “not too strong”, or “easy to smoke”. One participant likened this weaker smoke to the aerosol produced from electronic cigarettes, claiming it was “like smoke from vaping... sort of light”. Participants also associated these weaker cigarettes as being less harmful than other brands, stating that these brands contained “less nicotine”, were “less addictive”, and caused less damage to their “lungs” or “throat”. Some participants noted that the weaker cigarettes were suitable for youth or those trying smoking for the first time, while others described these cigarettes as suitable for smokers who are trying to reduce their smoking.

## Theme 3. Social hierarchies

When describing branded packets, participants associated tobacco brands with different socio-economic groups. For example, participants often distinguished between brands

smoked by young people and those smoked by older smokers. Participants also associated brands with different socio-economic groups, with some seen as brands for rural residents. Some participants indicated that smoking the youth brand elevated one’s social status, with one participant stating that young people smoked this brand to “*show off to other people*”. Others stated that smoking the youth brand meant that they could engage in social smoking with other young people, like sharing cigarettes within their peer groups.

Theme 4. Brand loyalty

Some participants appeared to select branded packets out of a sense of loyalty to that brand, often recalling it as familiar or identifying it as the brand that they regularly smoked. For example, participants indicated their preference for their brand over other alternatives, with one participant claiming that “*I just smoke Mevius, the brand I know*”. Some stated that they consistently smoked the same brand of cigarettes and were hesitant to change. For example, one participant claimed that “*I cannot change my brand*”. Moreover, there was evidence that some participants developed a sense of connection with their brand during smoking initiation, stating that they had been smoking “*this brand from the beginning*”.

Table 3. Participants’ quotes demonstrating themes relating to packet branding appeal, perceptions, and attitudes

Theme 1. Packet branding and product appeal	
Quality and taste	<p>“<i>I just know that Mevius tastes better than the other brands, which are like cheap or old brands.</i>” 18-21 years, garment manufacturing employee</p> <p>“<i>Mevius has the best quality.</i>” 22-24 years, garment manufacturing employee</p> <p>“<i>I think this packet would taste the best because it looks like Mevius, which has a strong taste.</i>” 18-21 years, hospitality/tourism employee</p> <p>“<i>This packet of cigarettes tastes the best because it looks like Mevius, the brand I smoke... I like the taste.</i>” 22-24 years, hospitality/tourism employee</p> <p>“<i>This packet of cigarettes would taste the best because it has the light flavour and smooth smoke.</i>” 18-21 years, construction worker</p>

Flavour change capsules  
*"Young people probably like this brand because it has a light smoke and good taste, like fruit flavours."* 22-24 years, garment manufacturing employee  
*"This brand also have the flavour click. So when you press the cigarette, the smoke starts to taste like grape. It tastes really fresh."* 22-24 years, hospitality/tourism employee  
*"This packet of cigarettes would taste the best because it has the click option on the filter, which you can use to make the cigarette taste like fruit."* 22-24 years, hospitality/tourism employee  
*"This packet of cigarettes would be the most popular with young people because it has the click option, where you can change the flavour of the cigarette to menthol or fruit."* 18-21 years, university student

## Theme 2. Packet branding and harm perceptions

Weaker smoke and less harmful  
*"This packet of cigarettes would taste the best because they look easy to smoke, not like the other packets which would be too strong for me."* 18-21 years, university student  
*"The other brands like ARA have a strong taste and smell, but Mevius has a light taste and smell which young people like."* 22-24 years, university student  
*"This brand of cigarettes makes smoke that is like smoke from vaping, sort of like not as strong and sort of light."* 22-24 years, hospitality/tourism employee  
*"I know this packet of cigarettes is Mevius. If I smoke another brand, then I feel dizzy and sick, so I just smoke Mevius."* 18-21 years, university student  
*"It makes a light smoke which is not too strong for your lungs."* 18-21 years, university student

Suitable for young smokers  
*"Young people would like this brand because it looks the cigarettes would be a light flavour, which means the smoke is not too strong for young people."*  
*"This light smoke is good for them because it does not leave a bad smell on their body or mouth after they smoke it."* 22-24 years, garment manufacturing employee  
*"The other ones make me cough, and I don't like them. This brand is also good because the smoke is not too strong, which is good for me because I am trying to reduce how many cigarettes I have each week"* 22-24 years, garment manufacturing  
*"This packet would be popular to young people because it doesn't look too strong, so it's a good brand for young people who are new to smoking or just want to try it."* 18-21 years, hospitality/tourism employee

## Theme 3. Tobacco brands and social hierarchies

Different brands for young and older smokers  
*"Young people would prefer the Mevius cigarettes because the other brands are more for older smokers. Like ARA is what older people smoke."* 22-24 years, university student  
*"This brand would be the most popular among young smokers because everybody has friends who smoke Mevius. It is kind of like the youth brand."* 22-24 years, hospitality/tourism employee  
*"This packet is Mevius which is for young people. The other brands are for older people."* 18-21 years, hospitality/tourism employee  
*"This brand of cigarettes is the most popular with young people because the other brands are just for older people to smoke."* 22-24 years, hospitality/tourism employee

Social status	<p><i>“Young people like Mevius because they think it makes them look handsome and cool, like special.”</i> 22-24 years, construction worker</p> <p><i>“I guess people feel cool when they smoke this brand.”</i> 18-21 years, university student</p> <p><i>“I think Mevius is a brand of cigarette for young people in the city. Other brands like ARA are for older people in the rural area, like lower-class people.”</i> 18-21 years, hospitality/tourism employee</p>
Social connection	<p><i>“I think about 90% of young people I know smoke Mevius. I guess that it is popular among our friends, so we just copy each other. Like, I share cigarettes with my friends and they share their cigarettes with me, so we are always smoking the same brands as our friends.”</i> 22-24 years, university student</p> <p><i>“This packet of cigarettes would be the most popular among young people in Cambodia because it looks like Mevius, which everybody smokes, so they just follow their friends. They do what their friends do.”</i> 18-21 years, hospitality/tourism employee</p> <p><i>“This packet would be popular among young people because all their friends smoke this brand. It’s very popular, so most people know it and then just follow what their friends do.”</i> 22-24 years, hospitality/tourism employee</p> <p><i>“This brand is popular among young people because they just follow what their friends do, and everyone smokes this brand.”</i> 22-24 years, hospitality/tourism employee</p>

**Theme 4. Brand loyalty**

*“I know that this one is the most delicious because it is the brand that I smoke now, so I already know that it tastes good.”* 22-24 years, hospitality/tourism employee

*“This brand of cigarettes is popular among me and my friends. Even though the price is sort of high, we still all smoke this brand.”* 18-21 years, hospitality/tourism employee

*“For me, this packet is the best taste because it is the brand that I smoke now, which has a good flavour. I have tried other brands, but I prefer this brand.”* 22-24 years, garment manufacturing employee

*“This is the Mevius brand that I know. Mevius is the brand that I smoke when I first try a cigarette. I never change my brand. I keep smoking Mevius now.”* 22-24 years, hospitality/tourism employee

*“I think this packet of cigarettes would taste the best because it is the European brand. I first started smoking this brand, so now I cannot change my brand.”* 18-21 years, hospitality/tourism employee

**Section 3. Packet colour appeal and harm perceptions (Figure 3)**

More than half of the participants selected the blue cigarette packet as the most appealing for taste (n=75, 51.0%) and nearly eight per cent selected the white packet (n=11, 7.5%) (Table 4). When harm was considered, 25.2% (n=37) selected the white cigarette packet as the least harmful to health and 10.2% (n=15) selected the blue packet. In contrast, 15% (n=22)

selected the red packet and 12.9% (n=19) selected the black packet as the most harmful. Between participants who smoked “*Mevius*” and those who smoked all other brands, there was no significant difference in the selection of packets in terms of taste ( $p=.071$ ), least harmful ( $p=.464$ ), or most harmful ( $p=.445$ ).

**Table 4. Packet colour appeal and harm perceptions**

	<b>Taste appeal</b>	<b>Least harmful to health</b>	<b>Most harmful to health</b>
<b>Packet 1 (black)</b>	6 (4.1)	4 (2.7)	19 (12.9)
<b>Packet 2 (blue)</b>	75 (51.0)	15 (10.2)	8 (5.4)
<b>Packet 3 (brown)</b>	2 (1.3)	5 (3.4)	4 (2.7)
<b>Packet 4 (grey)</b>	1 (0.7)	2 (1.4)	3 (2.1)
<b>Packet 5 (red)</b>	5 (3.4)	5 (3.4)	22 (15.0)
<b>Packet 6 (white)</b>	11 (7.5)	37 (25.2)	11 (7.5)
<b>No difference</b>	47 (32.0)	79 (53.7)	80 (54.4)

NOTE: Numbers are frequencies for the most appealing and the least and most harmful with corresponding percentages in parentheses, N = 147)

Two themes emerged regarding packet colour appeal and harm perceptions. Specific quotes for each theme are presented in Table 5.

#### Theme 1. Packet colour and product appeal

Packet colour was associated with the appeal of the underlying cigarette, with comments suggesting that cigarettes from blue packs tasted “*light*” or “*kind of soft*”, while others associated it with “*menthol*” flavoured cigarettes. In contrast, red and darker coloured packets were associated with stronger flavoured cigarettes. Participants also associated packet colours with tobacco brands, relating the blue packet with the tobacco brand “*Mevius*” and the red



packet with “ARA” or “Marlboro”. Brand associations influenced the appeal with some stating that “it looks the same as Mevius, so I think it would taste good”. They also displayed a sense of familiarity and preference with packet colours similar to their current tobacco brand, stating that “I kind of already know it” or “I feel like I already know this taste”.

Theme 2. Packet colour and harm perceptions

Comments regarding pack colour and harm indicated that participants often associated lighter coloured packets (such as blue and white) with cigarettes that had fewer harmful substances. Participants also associated lighter coloured packets with abstract, positive imagery (such as “purity” or “a good heart”) which indicated a less harmful product. In contrast, due to the stronger cigarettes associated with black or red packets, these colours, were also seen as most dangerous to smoke. Participants also described black and red packets with negative imagery such as “death and danger”, “blood”, or an “accident in the car”. They perceived this imagery as negative consequences for smoking cigarettes in these packets.

Table 5. Participants’ quotes demonstrating themes relating to packet colour appeal and harm perceptions

Theme 1. Packet colour and product appeal	
Product strength and appeal	<p>“This packet of cigarettes would taste the best because the blue colour reminds me of the ocean, so it makes me think these cigarettes would taste cool and fresh.” 22-24 years, hospitality/tourism employee</p> <p>“The blue colour of this packet makes me think the cigarettes are menthol, which is a nice taste and like fresh feeling in your mouth when you smoke it.” 18-21 years, hospitality/tourism employee</p> <p>“This packet of cigarettes would taste the best because the blue colour makes me think they are good quality and light smell.” 22-24 years, university student</p> <p>“I think the black packet would taste the best because it looks like it has a strong flavour... I like to smoke this strong flavour.” 22-24 years, construction worker</p>
Tobacco brands	<p>“I think this packet of cigarettes would taste the best because it looks like Mevius, which is the brand that I like to smoke. Even though this picture does not have a name on it, I still know that these cigarettes would be like Mevius</p>

and attributes cigarettes because of the same colour packet.” 18-21 years, hospitality/tourism employee  
 “I believe this packet would taste the best because it looks similar to Mevius, the type of cigarette that me and all my friends smoke. It looks the same as Mevius, so I think it would taste good too.” 18-21 years, university student  
 “This red packet would taste better than the other packets because it is the same colour as ARA, which is the brand that I like to smoke now.” 22-24 years, garment manufacturing employee  
 “I think the red packet would taste the best because it looks like the cigarette brand that I usually smoke, so I feel like I already know this taste.” 22-24 years, hospitality/tourism employee

## Theme 2. Packet colour and harm perceptions

Reduced harm “These cigarettes are not too harmful for your health because they are in a white packet. This colour makes me think they have less nicotine and less tobacco in them, so they don’t harm your body as much as the other packets.” 18-21 years, hospitality/tourism employee  
 “The white colour of this packet means that these cigarettes only have a small amount of poison in them. So I think they would be the least harmful to the smoker’s lungs compared to the darker packets.” 18-21 years, university student  
 “The white colour makes me think of honesty and integrity, so I think these cigarettes would not be too harmful for my health.” 18-21 years, hospitality/tourism employee  
 “This cigarette is not very bad because the white colour of the packet reminds me of purity and a good heart. I don’t think it looks very dangerous.” 18-21 years, university student

Increased harm “I think that the black packet would be the most harmful to your body because the black colour makes me think that these cigarettes would be very strong and probably harmful to your lungs.” 18-21 years, university student  
 “I think these cigarettes would be the most harmful because they are in a red packet, which reminds me of blood and a stop sign on the road, and this makes me think of something bad like an accident In the car.” 18-21 years, garment manufacturing employee  
 “These cigarettes are dangerous because the black colour of the packet represents a bad future, so the smoker of this packet might have a bad future or problem in their life.” 18-21 years, hospitality/tourism employee  
 “I think this packet of cigarettes is the worse for your lungs because the black colour represents death and danger.” 18-21 years, hospitality/tourism employee

## DISCUSSION

The research showed that, regardless of the brand smoked, most young male smokers recognise the tobacco brand on altered cigarette packets with the brand names removed and correctly named them. With mass media TAPS banned in Cambodia,[26] these findings



indicate that packet branding still provides tobacco companies with a marketing tool to communicate brand awareness among young smokers. This finding is concerning given tobacco companies’ successful use of cigarette packet branding as a marketing tool in high-income countries prior to packet advertising restrictions being introduced.[1,2]

Quantitative findings showed that most participants selected a specific fully-branded packet as the most appealing in taste and to young people. Participants qualitatively described this branded packet as having a superior taste and quality (often citing flavour varieties and flavour change capsules) or because they perceived it as less harmful than other brands. While studies in high-income countries have demonstrated that individuals perceive branded packets as more appealing[6-8] and less harmful than plain packets,[14-16] this is the first study, to our knowledge, to demonstrate these same perceptions in young people in Cambodia. This finding aligns with previous studies in the region which showed that cigarette packets include brand elements and flavours that may appeal to young people.[23,24]

Analyses of responses to open-ended questions revealed that young Cambodian males also held symbolic attitudes towards the tobacco brands, such as believing that a particular brand was suitable for young, higher-class smokers while other brands were associated with older, lower-class smokers. Findings also showed that participants perceived consumption of certain brands as a way to identify and interact with specific social groups – particularly young, higher-class smokers. These findings align with studies in high-income countries which demonstrated that young people associate tobacco brands with symbolic imagery and user profiles of smokers,[6,9,10] and consume tobacco brands to communicate and elevate their social status.[11,12] Taken together, this evidence shows that cigarette packet branding

influences sophisticated brand attitudes among young people – beyond just communicating brand names and product attributes.

Similar to research findings from high-income countries[19,20] and the Philippines,[24] this study found that young male smokers in Cambodia associated lighter coloured packets (blue and white) with less harmful cigarettes and red and black packets with more harmful cigarettes. The qualitative data also revealed that some participants associated blue coloured packets with menthol flavoured cigarettes. While menthol cigarettes were commonly associated with green packets in high-income countries,[19] our findings align with a recent Filipino study which showed that menthol cigarettes were also promoted in blue packets, and young people perceived them as less harmful than menthol cigarettes in green packets.[24] These findings suggest that tobacco companies may have modified their traditional colour schemes in Southeast Asian LMICs, and that these colours may contribute to further reduced harm perceptions among young people. Moreover, the qualitative data revealed that participants often associated packet colours with abstract imagery concerning smoking-related harms – with lighter colours associated with safer cigarettes and darker colours and red associated with danger and negative outcomes to their wellbeing. This novel finding provides insights into how young Cambodians perceive and associate packet colours, often in abstract and emotionally-driven ways.

This research has important policy implications. Article 11 of the WHO FCTC requires countries to implement measures to ensure that packaging does not promote tobacco products in any ways that are false, misleading, deceptive, or likely to create the false impression of reduced harm compared to other products.[36] To this end, the Guidelines on Implementation of Article 11 call for countries to introduce plain packaging legislation that prohibits brand

logos, colours, images or promotional information on packaging; and requires brand names to be displayed in a standard colour and font.[36] Experimental and longitudinal studies in high-income, Western countries demonstrate that plain packaging is effective in reducing the attractiveness of tobacco products and brand imagery.[37-39] While all Southeast Asian countries have implemented some restrictions on mainstream forms of TAPS, only Singapore and Thailand have introduced plain packaging (Myanmar planned to introduce this legislation in 2022).[21] Consequently, Cambodia and other LMICs in the region should introduce plain packaging to restrict tobacco companies from using this salient and influential marketing tool to influence young people.

**LIMITATIONS**

The research findings should be considered alongside important limitations. First, all participants were current cigarette smokers. Therefore, they would possibly smoke a regular brand of cigarettes and would have pre-existing attitudes towards that brand, which may have impacted their recognition, appeal, and perceptions of the tobacco brands used in this study. This influence was noticed in the qualitative responses; however, the quantitative analysis did not find any association between participants’ regular cigarette brand and their brand recognition and attitudes. Second, a limited number of tobacco brands and colours were displayed on the packets used in this study, so these packets do not reflect all the tobacco brands and colours sold in Cambodia. Further research is required to explore a broader range of packet colours, including potentially new colour schemes concerning menthol or flavoured cigarettes. Third, convenience sampling was used to recruit participants, so the results cannot be generalised to all young male smokers or non-smokers in Cambodia. Fourth, only males were included in the research. While smoking is largely male dominated in Cambodia, these findings should not be used to explain how females may perceive cigarette packet branding

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directly. Fifth, despite efforts to recruit participants from different sources and diverse socio-economic backgrounds, data were collected from a non-probability, convenience sample of young male smokers. Therefore, the findings may not generalise to the broader population. Sixth, this research only collected cross-sectional data. Therefore, experimental and longitudinal studies are needed to explore how packet branding, or future changes to plain packaging, may influence young Cambodians' smoking susceptibility, uptake, and consumption.

## CONCLUSIONS

This study demonstrated that cigarette packet branding and colours influence young male smokers' appeal and harm perceptions of tobacco brands sold in Cambodia. Despite increased TAPS restrictions, this research shows that cigarette packet branding and colours still provide tobacco companies in Cambodia with an influential marketing tool to reach young people. This research supports calls for Cambodia and other LMICs in Southeast Asia to implement plain packaging legislation according to Article 11 of the FCTC.

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**DECLARATIONS**

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**Contributions**

TS conceptualised the study, designed the survey questionnaire, conducted the fieldwork, analysed the data, and drafted the manuscript. HY, VW and JT assisted with data analysis and provided critical revisions of the manuscript. CC assisted with coordinating data collection and provided critical revisions of the manuscript. All authors have seen and approved the final manuscript.

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**Competing interests**

None declared.

**Patient consent for publication**

Not required.

**Ethics approval**

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This research was approved by the Deakin University Human Research Ethics Committee [2019-353] and the National Ethics Committee for Health Research of the Ministry of Health in Cambodia [277].

### **Provenance and peer review**

Not commissioned; externally peer-reviewed.

### **Data availability statement**

No data is available for sharing.

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## FIGURE LEGEND

### Figure 1

Title of figure: Packets with brand names removed

Caption: Authors' own picture

### Figure 2

Title of figure: Fully-branded packets and matching neutral plain packets

Caption: Authors' own picture

### Figure 3

Title of figure: Unbranded packets in different colours

Caption: Authors' own picture



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Packet 1



Packet 2



Packet 3



Packet 1



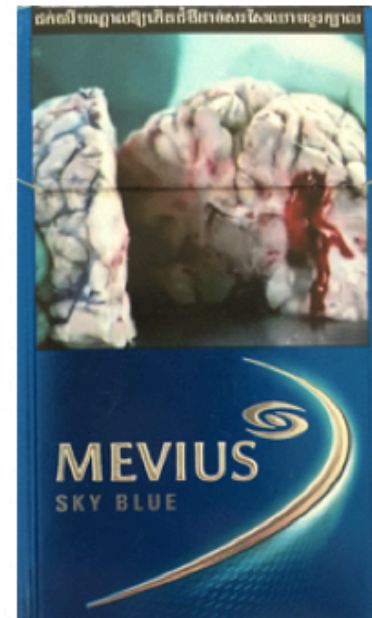
Packet 4



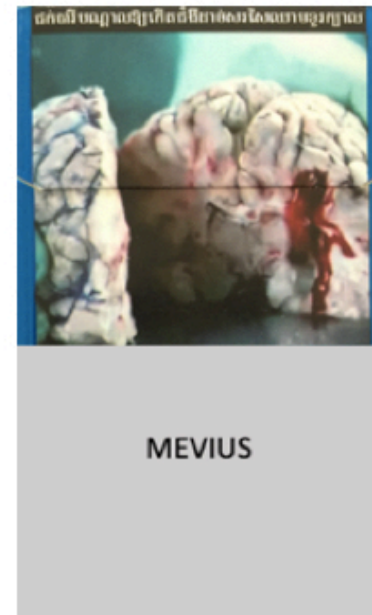
Packet 2



Packet 5



Packet 3



Packet 6



Packet 1



Packet 4



Packet 2



Packet 5



Packet 3



Packet 6



STROBE Statement—Checklist of items that should be included in reports of *cross-sectional studies*

	Item No	Recommendation	Page No
Title and abstract	1	(a) Indicate the study’s design with a commonly used term in the title or the abstract	1
		(b) Provide in the abstract an informative and balanced summary of what was done and what was found	3
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	5,6,7
Objectives	3	State specific objectives, including any prespecified hypotheses	7
Methods			
Study design	4	Present key elements of study design early in the paper	8
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	8
Participants	6	(a) Give the eligibility criteria, and the sources and methods of selection of participants	8
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	9,10,11
Data sources/measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	9,10,11
Bias	9	Describe any efforts to address potential sources of bias	N/A
Study size	10	Explain how the study size was arrived at	8
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	11
Statistical methods	12	(a) Describe all statistical methods, including those used to control for confounding	11
		(b) Describe any methods used to examine subgroups and interactions	11
		(c) Explain how missing data were addressed	N/A
		(d) If applicable, describe analytical methods taking account of sampling strategy	N/A
		(e) Describe any sensitivity analyses	N/A
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	12
		(b) Give reasons for non-participation at each stage	N/A
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	12,13
		(b) Indicate number of participants with missing data for each variable of interest	13

Outcome data	15*	Report numbers of outcome events or summary measures	13,14, 18, 19
Main results	16	(a) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	13,18
		(b) Report category boundaries when continuous variables were categorized	N/A
		(c) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
<b>Discussion</b>			
Key results	18	Summarise key results with reference to study objectives	21,22,23,24
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	24
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	24
Generalisability	21	Discuss the generalisability (external validity) of the study results	24
<b>Other information</b>			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	26

\*Give information separately for exposed and unexposed groups.

**Note:** An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at <http://www.plosmedicine.org/>, Annals of Internal Medicine at <http://www.annals.org/>, and Epidemiology at <http://www.epidem.com/>). Information on the STROBE Initiative is available at [www.strobe-statement.org](http://www.strobe-statement.org).