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# Cross-sectional study of the associations between the implementation of the WHO FCTC tobacco advertising, promotion and sponsorship bans and current e-cigarette use among youth from countries with different income levels

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## ABSTRACT

**Background** The WHO Framework Convention on Tobacco Control (WHO FCTC) Article 13 requires countries to ban tobacco advertising, promotion and sponsorship (TAPS), and bans are recommended to cover electronic cigarettes (e-cigarettes). We examined youth e-cigarette prevalence by TAPS regulations in countries with different income levels.

**Methods** We analysed data on 165 299 respondents from 48 countries with 2016/2018 WHO FCTC implementation reports and 2016–2019 Global Youth Tobacco Survey. We used multilevel logistic regressions to examine associations between TAPS regulations and current e-cigarette use, stratified by country income.

**Results** About 1 in 10 respondents was currently using e-cigarettes. Respondents in countries with TAPS bans on the internet were less likely to use e-cigarettes (adjOR=0.58; 95% CI 0.39 to 0.86) than youth in countries without such bans. In lower middle-income and low-income countries, bans on displaying tobacco products at the point of sale (adjOR=0.55; 95% CI 0.34 to 0.90), bans on product placement (adjOR=0.44; 95% CI 0.28 to 0.69) and strength of additional TAPS measures were associated with lower prevalence of e-cigarette use among students. Being taught about the dangers of the use of tobacco in school was associated with lower odds of e-cigarette use. No differences in the use of e-cigarettes were observed by types of TAPS among respondents in high-income countries.

**Conclusions** Strengthening implementation of TAPS policies and assuring they cover new and emerging products, online channels and points of sales are essential, especially in lower income countries. Maintaining tobacco health education is also important to protect youth from e-cigarette use.

## INTRODUCTION

Electronic cigarette (e-cigarette) use is associated with nicotine addiction, respiratory diseases and other adverse health effects in children and adolescents.<sup>1</sup> Prevalence of youth e-cigarette use has increased worldwide during the past decade.<sup>1</sup> In a global study of adolescents aged 12–16 from 68 countries, the prevalence of past 30-day e-cigarette use among youth was higher in low-income and high-income countries than in middle-income

## WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Exposure to tobacco advertising, promotion and sponsorship (TAPS) is a risk factor of youth e-cigarette use. There is limited evidence on the impact of the TAPS measures for e-cigarette use among youth.

## WHAT THIS STUDY ADDS

- ⇒ Few countries have restrictions on TAPS on both domestic and global internet.
- ⇒ Our study has shown older age, male gender, higher amount or perceived sufficiency of pocket money, current use of combustible cigarettes and residence in the high-income countries were associated with higher odds of current e-cigarette use.
- ⇒ Almost all Article 13 measures were significantly protective of current e-cigarette use among youth residing in lower middle-income and low-income countries.

## HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ To mitigate a potential further escalation of e-cigarette use among youth in low-income countries, as has happened in high-income countries, further research on policy-level interventions for youth is warranted. This calls for enhanced support of proper surveillance of e-cigarette and novel tobacco product use among youth globally and proactive legislative as well as community-based and educational solutions.

countries between 2012 and 2019.<sup>2</sup> Significant increases in prevalence of current (or past month) e-cigarette use among youth have been observed in the European Region countries by 2019. For example, it increased by twofold in Georgia and Italy and nearly doubled in Latvia.<sup>3</sup> Encouragingly, the prevalence of e-cigarette use among high school students in the USA declined from 14.1% to 10.0% from 2022 to 2023.<sup>4,5</sup>

Individual-level risk factors associated with youth e-cigarette use include male gender,<sup>2,3,6</sup> older age,<sup>2,7</sup> current use of combustible cigarettes<sup>2,3</sup> and having



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a higher amount of pocket money.<sup>3</sup> Exposure to tobacco advertising, promotion and sponsorship (TAPS) has been associated with a higher risk of e-cigarette use among youth.<sup>8</sup> Direct and indirect tobacco product marketing aimed at youth<sup>7 9 10</sup> includes billboards and visuals on the streets, at events and in minimarkets,<sup>11 12</sup> social media and broadcasting or television programmes containing tobacco-related images.<sup>17 8</sup> Seeing vaping imagery in films has been associated with increased likelihood of ever vaping in two cross-sectional studies and five longitudinal studies.<sup>13</sup> Additionally, exposure to e-cigarette advertising has been shown to be a risk factor for increased e-cigarette use.<sup>14</sup>

Globally, most countries have committed to adopting and implementing bans on TAPS under Article 13 of the WHO Framework Convention on Tobacco Control (WHO FCTC). In 2014, Parties to the Convention were urged to consider banning or restricting e-cigarette advertising, promotion and sponsorship.<sup>15</sup> However, implementation progress remains uneven across countries.<sup>9</sup> According to the WHO Report on the Global Tobacco Epidemic in 2023, one hundred and five countries do not restrict the advertising and promotion of e-cigarettes.<sup>16</sup> A global progress report on the implementation of the WHO FCTC emphasised the lack of comprehensiveness in TAPS bans in general.<sup>9</sup> While TAPS bans and policies have been shown to be effective in reducing smoking prevalence in the general population,<sup>17–19</sup> effects on e-cigarette use need further investigation.<sup>20</sup> Overall, the impact of tobacco control policies on e-cigarette use is less studied.<sup>21–23</sup>

Differences in tobacco control policies may partially be attributed to country-level factors such as income level. According to WHO, while 85% of high-income countries had either a regulation or a sales ban in effect for e-cigarettes, 40% of middle-income countries and 79% of low-income countries had taken no regulatory action concerning the products in 2023.<sup>16</sup> Previous literature has indicated, for example, that the country's ability for enforcing policies influences FCTC implementation.<sup>24</sup> This implies that bans could have different effectiveness on youth e-cigarette use in high/high-middle-income and low/low-middle-income countries. Tobacco growing has been associated with the overall enactment of different tobacco control policies,<sup>25 26</sup> which might also influence enactment of e-cigarette policies. For instance, in Zambia, the implementation of the WHO FCTC provisions has been reportedly lagging given priorities and interests of many institutional actors, both within and outside of government, related to tobacco growing.<sup>27</sup>

Further, the impact of TAPS bans may differ by the country's contribution to other preventive policies. These include measures also emphasised in the WHO MPOWER package, namely smoke-free environments (WHO FCTC Article 8), taxation (Article 6), packaging and health warnings (Article 11) and awareness raising and education (Article 12).<sup>16</sup> In a study conducted with 32 European countries, comprehensiveness of e-cigarette regulations (assessed with the WHO MPOWER package applied to e-cigarettes) was associated with lower e-cigarette use among youth.<sup>28</sup> Especially in countries that lack comprehensive TAPS bans, health education has an important role in prevention, as youth tend to associate e-cigarette use with low harm.<sup>29</sup> Promising results have been obtained from a school-based programme addressing e-cigarette use.<sup>30</sup> Antismoking marketing and advertising campaigns in mass media may reduce and delay smoking initiation among youth,<sup>31</sup> and anti-e-cigarette mass media campaigns have been associated with lower odds of both intentions to use and current use of e-cigarettes among youth and young adults.<sup>32</sup>

**Table 1** Description of countries by data sources and years

Countries	GYTS year	WHO FCTC year
Antigua and Barbuda, Cambodia, Cook Islands, Croatia, Czech Republic, Ecuador, Fiji, Georgia, Ghana, Grenada, Jamaica, Laos, Macedonia, Marshall Islands, Mauritius, Oman, Panama, Papua New Guinea, Poland, Romania, Samoa, Serbia, Slovakia, St Lucia, Suriname, Trinidad and Tobago, Tunisia, Ukraine, Vanuatu (n=97 346)	2016/2017	2016
Bolivia, Brunei Darussalam, Congo, Iraq, Italy, Kiribati, Kyrgyzstan, Latvia, Mauritania, Moldova, Mongolia, Niue, Paraguay, Peru, Qatar, San Marino, St Vincent and the Grenadines, Togo, Venezuela (n=67 953)	2018/2019	2018
GYTS, Global Youth Tobacco Survey; WHO FCTC, WHO Framework Convention on Tobacco Control.		

To strengthen the evidence base for preventive tobacco control measures, our study examined the associations between the Article 13 TAPS bans and youth e-cigarette use. Our research questions were: (a) Is implementation of TAPS bans associated with youth e-cigarette use? (b) Do country-level factors, such as country income, tobacco growing and implementation of other key tobacco control measures required by the WHO FCTC, contribute to these associations? (c) Do individual-level factors, namely exposure to TAPS, health education in school and socio-economic status, contribute to these associations?

## METHODS

### Study design and participants

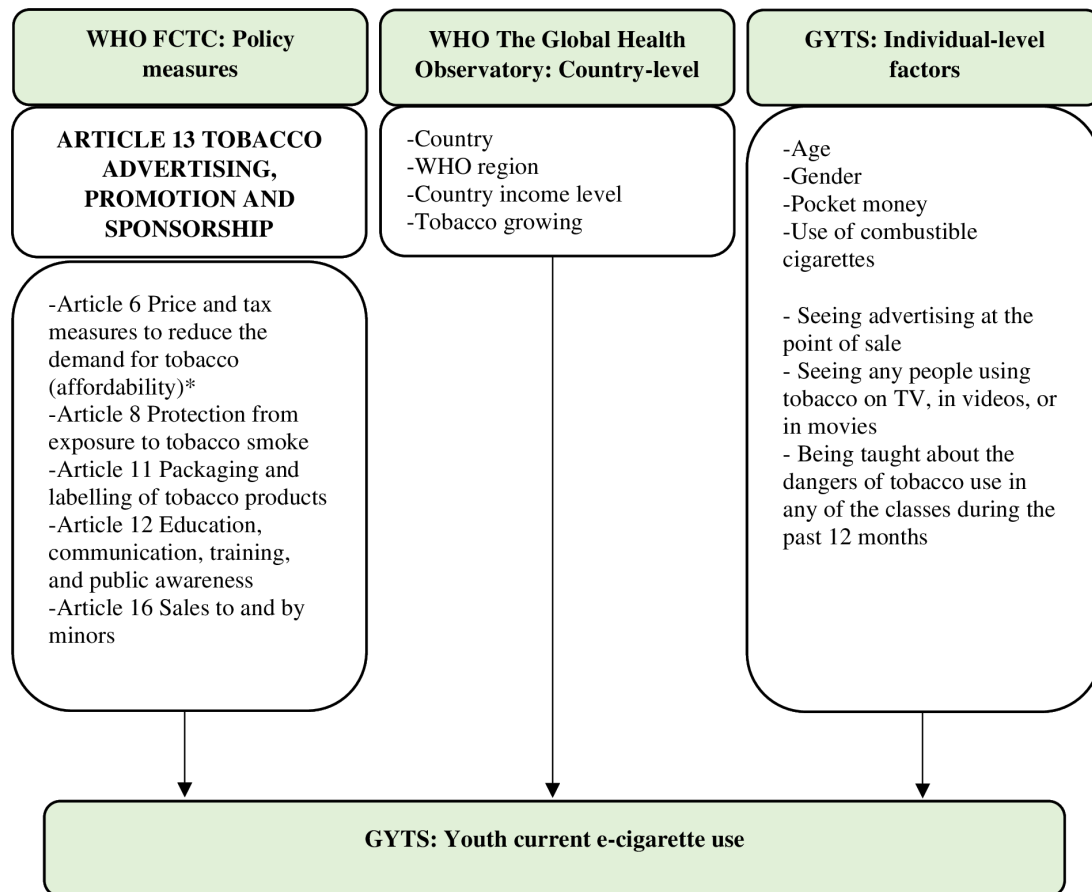
A country was included in the study if it (1) had been a Party to the WHO FCTC; (2) had submitted at least one WHO FCTC implementation report in 2016 or 2018<sup>33</sup>; and (3) had Global Youth Tobacco Survey (GYTS) data available on current use of electronic and combustible cigarettes from 2016 to 2019.<sup>34</sup> Out of 181 countries required to report by 2020 to the WHO FCTC,<sup>9</sup> 48 met the study inclusion criteria (table 1).

The individual-level data came from the latest GYTS rounds (during 2016–2019). The GYTS is a nationally representative school-based survey focused on students aged 13–15 years while including students aged 11–17 years. GYTS uses standard core questionnaire, sample design, data collection and management procedures, and set of optional questions depending on the needs and priorities of countries. In a majority of countries, including our study sites, the GYTS uses a two-stage cluster sampling. The questionnaire and survey methodology are detailed elsewhere.<sup>34</sup> The country-level data came from the WHO FCTC implementation reports and the WHO Global Health Observatory.<sup>35</sup> Parties are required to submit periodic reports on the WHO FCTC implementation biennially. The officially submitted implementation reports of the WHO FCTC are publicly available in the WHO FCTC Implementation Database.<sup>33</sup> In the present study, we used full datasets derived from the reporting platform of the WHO FCTC, including updated information provided by the Parties. GYTS data from each of the countries were appended and combined with the FCTC data using country identifiers and years.

### Measures

#### Individual-level measures

Consistent with the GYTS definitions of current use of electronic and combustible cigarettes, respondents were operationalised as



**Figure 1** Data sources and variable selection. \*Report on the Global Tobacco Epidemic, 2021 web annexes. WHO FCTC, WHO Framework Convention on Tobacco Control; GYTS, Global Youth Tobacco Survey.

having used these products on one or more days in the 30 days prior to the survey. The amount of weekly allowance (pocket money) or their sufficiency perceived by students was dichotomised to capture the highest level versus all others. This variable was used as a proxy of students' socioeconomic position, taking into account its differing definitions.<sup>3</sup> Age, reported using one of the seven response options ranging from '11 years old or younger' to '17 years old or older', and gender were included as covariates.

Seeing advertising at the point of sale and seeing any people using tobacco on TV, in videos or in movies during the 12 months prior to being surveyed were each coded as 0/no, 1/yes and 2/did not visit or did not watch any, respectively. Being taught about the dangers of tobacco use in any of the classes was coded as 0/no or 1/yes. These potential confounding variables were included as proxies for the enforcement of the national policies and health literacy and awareness. In our preliminary analyses, we did not find these variables to be effect modifiers (for the stratified analyses, see online supplemental table 1).

#### Country-level variables

Implementation of Article 13 (TAPS) of the WHO FCTC was measured using countries' responses on whether they had instituted a comprehensive ban on all TAPS. Binary indicators were created for bans covering display and visibility of tobacco products at the point of sale; product placement as a means of advertisement or promotion; and depiction of tobacco or tobacco use in entertainment media products (vs lack thereof). Internet bans included domestic online settings and cross-border advertising

(including where the organisations that conduct TAPS may be located abroad), and the score captured the number of such bans in a country.

Preventive measures under Article 8 (protection from exposure to tobacco smoke), Article 11 (packaging and labelling of tobacco products) and Article 16 (sales to and by minors) were combined into a composite score using countries' responses on whether they have implemented requirements (online supplemental appendix). Similarly, a composite score was created for 15 measures on educational and public awareness programmes under Article 12 (education, communication, training and public awareness) (online supplemental appendix). For Article 6 (price and tax measures to reduce the demand for tobacco), countries reported what proportion of the retail price of the most popular price category of tobacco product consists of taxes. As a proxy of tax effects, we used cigarette affordability reported by WHO in years 2016 and 2018, defined as percentage of gross domestic product (GDP) per capita required to purchase 2000 cigarettes of the most sold brand.<sup>35</sup> The higher the percentage, the less affordable cigarettes are. Country income level was classified, according to the World Bank, into four income-level classifications: low, lower middle, upper middle and high income.<sup>36</sup> A binary indicator was created to distinguish countries with and without tobacco growing. The data were obtained from the WHO FCTC Implementation Database. Figure 1 summarises measures and data sources. Prevalence of e-cigarette use among study participants and policy indicators by country are reported in online supplemental table 2.

**Table 2** Characteristics of the study participants

Characteristics	Frequency	% (mean; SD)
Current use of e-cigarettes		
None	146 184	90.3
Yes	15 678	9.7
Current use of combustible cigarettes		
None	142 317	90.6
Yes	14 826	9.4
Mean age in years, from <11 years to 17+ years	164 476	(14; 1.4)
Sex		
Male	80 107	48.8
Female	84 023	51.2
Pocket money		
<Highest	147 971	89.6
Highest amount	17 141	10.4
Saw advertising at the point of sale		
No	77 238	47.5
Yes	45 230	27.8
Did not visit	40 046	24.6
Seeing any people using tobacco on TV, video or in movies		
No	42 658	26.3
Yes	92 420	57.0
Did not watch any	27 147	16.7
Being taught about the dangers of tobacco use in any of the classes		
No	44 092	34.3
Yes	84 560	65.7
Unweighted total number of observations=165 299; number of countries=48.		

### Statistical analyses

Frequency counts and percentages were used to describe categorical individual-level and county-level characteristics of the study participants; means, SDs and ranges were calculated for the scores on regulations and affordability. Multilevel binary logistic regression models with random intercept for countries were used to estimate unadjusted and adjusted odds of current e-cigarette use. The adjusted models included each of the Article 13 policy measures and other characteristics associated with the current e-cigarette use in unadjusted analyses. We also considered models controlling for Articles 8, 11, 12 and 16; however, simultaneous inclusion of all policy measures was not warranted due to multicollinearity. To examine differential effects by country income levels, we conducted stratified analyses of associations between each Article 13 policy measure and current e-cigarette use among study participants in low and lower middle-income versus upper middle and high-income countries, adjusting for individual-level and country-level characteristics. Given differences in weighting methods across the countries and study focus on associations rather than generalisability of findings, the analyses were not weighted. Stata/SE V.14.2. was used for all analyses. Statistical significance level was set at 5%. All tests were two tailed.

## RESULTS

### Descriptive results

The average age of respondents was 14 years (table 2). The respondents were similarly divided in terms of sex. Less than 10% of youth respondents were currently using e-cigarettes and currently smoking combustible cigarettes. Approximately 10% of the respondents had the highest amount of pocket money.

Slightly over one in four study participants had seen advertisements or promotions for tobacco products at the point of sale and one in four reported they had not visited such places. Similarly, over half of respondents saw people using tobacco on TV, video or in movies in the last year. One in three respondents were not taught about the dangers of tobacco use at school.

Over half of the respondents lived in countries classified by the World Bank as upper middle-income or high-income economies with the highest representation from Europe (32.4%), followed by the Americas (26.8%) and the Western Pacific Regions (20.8%) (table 3). On average, the affordability of cigarettes was 8.7% of GDP per capita required to purchase 2000 cigarettes of the most sold brand (SD=16.2), with a range of 0.4 in Qatar to 82.0 in Venezuela (not shown). Product display and visibility at points of sale was prohibited in 18 countries. Nine countries had restrictions on TAPS on both domestic and global internet, 27 countries had bans covering product placement and 23 countries had a ban on depiction of tobacco or tobacco use in entertainment media.

### Individual-level factors associated with adolescents' e-cigarette use

In the multilevel analyses, all individual-level characteristics were significantly associated with current e-cigarette use in unadjusted and adjusted models (table 4). Older age, male gender and higher perceived amount of pocket money were associated with higher odds for e-cigarette use. Adolescents who currently smoke were significantly more likely to currently use e-cigarettes based on all regression analyses. Compared with respondents who did not see promotions or advertisements of tobacco products at the point of sale, those who did and those who reported not visiting such places were more likely to currently use e-cigarettes. Compared with respondents who did not report seeing people using tobacco on TV, video or in movies in the past year, those who did had significantly higher unadjusted and adjusted odds of current e-cigarette use. Being taught about the dangers of tobacco use at school was associated with lower odds for current e-cigarette use.

### Policies and adolescents' e-cigarette use

Based on the multilevel unadjusted analyses, study participants residing in countries with a stronger TAPS ban for the internet had 0.56 (95% CI 0.36 to 0.88) times the odds of currently using e-cigarettes than adolescents residing in countries without such restrictions ( $p=0.012$ ) (table 4). The protective effect of these regulations attenuated slightly but remained statistically significant in model 2 controlling for all individual-level characteristics and country income level. Ban covering product placement as means of advertisement or promotion and stronger additional TAPS measures were also associated with lower odds for current e-cigarette use among survey respondents, based on adjusted analyses (models 3 and 5, respectively). Other regulations were not significantly associated with current e-cigarette use.

### Factors associated with adolescents' e-cigarette use stratified by country income level

When stratified by country income level, all Article 13 measures except the ban on depiction of tobacco or tobacco use in entertainment media products were associated with lower odds for current e-cigarette use among youth residing in lower middle-income and low-income countries (table 5). Specifically, youth residing in lower middle-income and low-income countries with a ban on display and visibility of tobacco products at the point of



**Table 3** Description of the WHO FCTC regulations in the study countries and their selected characteristics

WHO FCTC regulations	Number of countries (respondents)	Frequency (mean)	% (SD)
Ban covers display and visibility of tobacco products at point of sale			
No	30	107 371	65.0
Yes	18	57 928	35.0
Ban covers internet (domestic and global)			
No	27	87 922	53.2
Either or	12	41 802	25.3
Both	9	35 575	21.5
Ban covers product placement as means of advertisement or promotion			
No	21	75 537	45.7
Yes	27	89 762	54.3
Ban covers depiction of tobacco or tobacco use in entertainment media products			
No	25	86 961	52.6
Yes	23	78 338	47.4
Strength of additional TAPS measures*			
Article 12 score†	48 (165 299)	(2.5)	(2.1)
Article 8, 11 and 16 scores‡	47 (163 804)	(9.5)	(4.3)
Affordability of cigarettes	44 (159 296)	(32.6)	(13.6)
Tobacco growing			
No	29	93 161	59.6
Yes	17	63 154	40.4
World Bank country income group			
Low income (Cambodia, Togo)	2	7633	4.6
Lower middle income (Bolivia (Plurinational State of), Congo, Georgia, Ghana, Kiribati, Kyrgyzstan, Laos, Mauritania, Moldova, Mongolia, Papua New Guinea, Samoa, Ukraine, Vanuatu)	14	57 179	34.6
Upper middle income (Ecuador, Fiji, Grenada, Iraq, Jamaica, Macedonia, Marshall Islands, Mauritius, Panama, Paraguay, Peru, Romania, Serbia, St Lucia, St Vincent and the Grenadines, Suriname, Tunisia, Venezuela)	18	63 504	38.4
High income (Antigua and Barbuda, Brunei Darussalam, Cook Island, Croatia, Czech Republic, Italy, Latvia, Niue, Oman, Poland, Qatar, San Marino, Slovakia, Trinidad and Tobago)	14	36 983	22.4
WHO region			
Africa	5	23 858	14.4
The Americas	13	44 276	26.8
The Eastern Mediterranean	4	9287	5.6
Europe	14	53 540	32.4
The Western Pacific	12	34 338	20.8

\*Tobacco sponsorship of advertisement, promotion, international events or activities, contributions from tobacco companies and cross-border advertising, range between 0 and 5.  
†Educational and public awareness programmes, range between 0 and 15.  
‡Protections from exposure to tobacco smoke, packaging and labelling and sales to and by minors, range between 0 and 55.  
TAPS, tobacco advertising, promotion and sponsorship; WHO FCTC, WHO Framework Convention on Tobacco Control.

sale had 0.55 (95% CI 0.34 to 0.90) times the odds of currently using e-cigarettes than adolescents in countries without such ban, adjusting for all individual-level characteristics and country income level ( $p=0.017$ ). The odds of an adolescent's use of e-cigarettes were significantly lower in lower middle-income and low-income countries that had bans on TAPS for domestic and global internet (OR=0.41; 95% CI 0.26 to 0.64), product placement as means of advertisement or promotion (OR=0.44; 95% CI 0.28 to 0.69) and strength of TAPS measures (OR=0.84; 95% CI 0.76 to 0.93) compared with their counterparts in countries without such bans (all  $p<0.001$ , 0.001 and 0.001, respectively). No statistically significant associations on Article 13 measures and e-cigarette use were found in high-income and upper middle-income countries.

## DISCUSSION

We examined the associations between the implementation of the TAPS policies of WHO FCTC Article 13 and youth e-cigarette

use in countries with varying income levels. The prevalence of current e-cigarette use was 9.7%, which is consistent with findings from other global studies.<sup>2 37</sup> Male gender, higher adolescent's age and higher amount of pocket money were risk factors of current e-cigarette use, as documented in prior studies.<sup>3 38</sup> In our study, combustible cigarette use was significantly associated with current e-cigarette use. A previous systematic review and meta-analysis found a fourfold increased risk between e-cigarette use and initiating smoking combustible cigarettes in youth.<sup>39</sup>

Our study identified that TAPS bans on the internet are associated with lower e-cigarette use prevalence. E-cigarettes are being marketed to young people most aggressively through social media platforms, such as Instagram,<sup>1</sup> YouTube and TikTok.<sup>40</sup> Overall, tobacco use on the small screen has more than doubled between 2015 and 2017,<sup>41</sup> indicating the need for counteradvertising measures to help prevent e-cigarette and tobacco use among adolescents. While the evidence is mixed on whether internet-based interventions are effective in preventing youth

**Table 4** Association of WHO FCTC regulations and individual-level characteristics with current e-cigarette use among study participants from selected countries

Characteristics	Unadjusted OR (95% CI)	Model 1 Adjusted OR (95% CI)	Model 2 Adjusted OR (95% CI)	Model 3 Adjusted OR (95% CI)	Model 4 Adjusted OR (95% CI)	Model 5 Adjusted OR (95% CI)
<b>Article 13</b>						
Ban covers display and visibility of tobacco products at point of sale (vs none)	0.88 (0.61–1.27)	0.79 (0.58–1.08)				
Ban covers internet (domestic and global) (vs none)			0.84 (0.59–1.20)			
Either or Both	0.95 (0.63–1.42)* 0.56 (0.36–0.88)*		0.58 (0.39–0.86)**			
Ban covers product placement as means of advertisement or promotion (vs none)	0.85 (0.59–1.21)			0.73 (0.53–0.99)*		
Ban covers depiction of tobacco or tobacco use in entertainment media products (vs none)	1.01 (0.71–1.44)				0.88 (0.65–1.20)	
Strength of additional TAPS measures	0.94 (0.86–1.02)					0.91 (0.85–0.98)*
Age, in years	1.16 (1.15–1.18)***	1.04 (1.02–1.06)***	1.04 (1.02–1.06)***	1.04 (1.02–1.06)***	1.04 (1.02–1.06)***	1.04 (1.02–1.06)***
Female (vs male)	0.56 (0.54–0.58)***	0.62 (0.59–0.64)***	0.62 (0.58–0.64)***	0.62 (0.59–0.64)***	0.62 (0.59–0.64)***	0.61 (0.59–0.64)***
Saw advertising at the point of sale (ref No)						
Yes	1.91 (1.84–1.99)***	1.62 (1.54–1.71)***	1.62 (1.54–1.71)***	1.62 (1.54–1.71)***	1.62 (1.54–1.71)***	1.62 (1.54–1.71)***
Did not visit	1.26 (1.21–1.32)***	1.24 (1.17–1.32)***	1.24 (1.16–1.32)***	1.24 (1.17–1.32)***	1.24 (1.17–1.32)***	1.24 (1.17–1.32)***
Being taught about the dangers of tobacco use in any of the classes (ref No)	0.82 (0.79–0.85)***	0.86 (0.82–0.91)***	0.86 (0.82–0.91)***	0.86 (0.82–0.91)***	0.86 (0.82–0.91)***	0.86 (0.82–0.91)***
Seeing any people using tobacco on TV, video or in movies (ref No)						
Yes	1.31 (1.26–1.37)***	1.12 (1.06–1.19)***	1.12 (1.06–1.19)***	1.12 (1.06–1.19)***	1.12 (1.06–1.19)***	1.12 (1.06–1.19)***
Did not watch any	1.65 (1.56–1.74)***	1.37 (1.27–1.48)***	1.37 (1.27–1.48)***	1.37 (1.27–1.48)***	1.37 (1.27–1.48)***	1.37 (1.27–1.48)***
Highest amount of pocket money (vs all lower perceived levels)	1.71 (1.63–1.80)***	1.46 (1.37–1.57)***	1.46 (1.37–1.57)***	1.46 (1.37–1.57)***	1.46 (1.36–1.57)***	1.46 (1.37–1.57)***
Current use of combustible cigarettes (vs none)	10.36 (9.92–10.82)***	8.86 (8.40–9.34)***	8.86 (8.40–9.34)***	8.86 (8.40–9.34)***	8.86 (8.40–9.34)***	8.86 (8.41–9.34)***
<b>World Bank country income group (ref High-income economy)</b>						
Upper middle	0.68 (0.48–0.97)*	0.64 (0.44–0.93)*	0.61 (0.42–0.88)**	0.61 (0.42–0.88)**	0.64 (0.44–0.94)*	0.63 (0.44–0.91)*
Lower middle	0.68 (0.47–0.99)*	0.53 (0.36–0.78)**	0.56 (0.38–0.81)**	0.55 (0.37–0.81)**	0.53 (0.36–0.79)**	0.59 (0.40–0.86)**
Low income	0.13 (0.06–0.29)***	0.16 (0.07–0.37)***	0.18 (0.08–0.40)***	0.15 (0.07–0.34)***	0.16 (0.07–0.36)***	0.16 (0.08–0.36)***
<b>WHO region (ref Africa)</b>						
The Americas	1.48 (0.79–2.76)					
The Eastern Mediterranean	1.22 (0.55–2.70)					
Europe	1.83 (0.99–3.40)					
The Western Pacific	1.59 (0.84–2.99)					
Affordability of cigarettes	1.00 (0.99–1.01)					
Tobacco growing	1.00 (0.69–1.47)					
Article 12 score	0.99 (0.95–1.04)					
Article 8, 11 and 16 scores	0.99 (0.98–1.01)					

Multilevel models (column 1) with listed variables included as fixed effects with a country random intercept; 48 countries. Adjusted models (columns 2–5): n=118788; 47 countries. Models 1–5 adjusted for age; gender; saw advertising at the point of sale (ref No), yes, did not visit; being taught about the dangers of tobacco use in any of the classes (ref No); seeing any people using tobacco on TV, video or in movies during within 1 year prior to being surveyed (ref No), yes, did not watch any; highest amount of pocket money (vs all lower perceived levels); current use of combustible cigarettes (vs none); World Bank country income group (ref High-income economy), upper middle, lower middle, low income.

\* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ .

TAPS, tobacco advertising, promotion and sponsorship; WHO FCTC, WHO Framework Convention on Tobacco Control.

**Table 5** Association of Article 13 measures and current e-cigarette use among study participants stratified by country income level

Characteristics	High and upper middle income OR (95% CI)	Lower middle and low income OR (95% CI)
Ban covers display and visibility of tobacco products at point of sale (vs none)	0.95 (0.65–1.39)	0.55 (0.34–0.90)*
Ban covers internet (domestic and global) (vs none)		
Either or	0.86 (0.55–1.32)	0.87 (0.51–1.47)***
Both	0.85 (0.48–1.49)	0.41 (0.26–0.64)***
Ban covers product placement as means of advertisement or promotion (vs none)	0.93 (0.64–1.36)	0.44 (0.28–0.69)***
Ban covers depiction of tobacco or tobacco use in entertainment media products (vs none)	0.96 (0.66–1.39)	0.76 (0.45–1.30)
Strength of additional TAPS measures	0.95 (0.87–1.05)	0.84 (0.76–0.93)**
Number of countries	31	16
Number of observations	71 606	47 182
Multilevel models with age, sex, perceived sufficiency of pocket money, current use of combustible cigarettes, exposure to advertising at the point of sale, seeing people using tobacco on TV, video or in movies, and being taught about dangers of tobacco use in any of the classes, and country income level included as fixed effects with a country random intercept.		
*P<0.05; **p<0.01; ***p<0.001.		
TAPS, tobacco advertising, promotion and sponsorship.		

e-cigarette use, research on developing effective web-based preventive measures is warranted considering social media is an important channel used to reach youth. Our findings also suggest seeing people using tobacco on TV, video or in movies increases the likelihood of adolescent e-cigarette use. Previous studies have reported similar findings on the association between vaping imagery in films and increased likelihood of vaping.<sup>8 13</sup>

In our study, higher odds of e-cigarette use were observed among respondents who reported that they did not watch any of the aforementioned platforms. Today's youth have shifted their consumption from broadcast TV to digital channels, especially mobile phones and streaming services, such as Netflix, where exposure to seeing tobacco use is high. An estimated 28 million young people had been exposed to tobacco through TV and streaming programmes favoured by youth around 2015–2017.<sup>41</sup> Implementation of cross-border TAPS bans is warranted to tackle tobacco product promotion through all media.<sup>1</sup> Overall, our findings suggest more countries would benefit from implementing comprehensive TAPS bans under Article 13 of the WHO FCTC, and especially covering channels most used by youth.

We also found that having seen promotions or advertisements of tobacco products at the point of sale increased the odds of e-cigarette use among youth, although the association was statistically non-significant. The tobacco industry has been relying on this more traditional advertising venue in its promoting campaigns.<sup>1</sup> Point-of-sale TAPS bans are therefore important especially in settings where youth may not have frequent access to the internet and social media. Furthermore, our study found school education on the dangers of tobacco use was associated with lower odds for current e-cigarette use. It is critical to ensure educational programmes in schools take into account new and emerging tobacco and nicotine products.

Countries regulate e-cigarettes differently.<sup>21</sup> Since the tobacco industry expands the market by developing new products, it is pivotal to implement more consistent regulations on novel nicotine products, including e-cigarettes. Monitoring and evaluating the policy impact and enhancing and sharing the knowledge about the effects support countries that have not yet implemented these measures. Prior studies show policy measures, such as tax and price increases and health warnings, reduce population smoking rates<sup>17 19</sup>; yet further research on policy-level interventions tailored for younger populations is warranted.

Corroborating earlier studies,<sup>6</sup> we found the odds of using e-cigarettes were higher among adolescents in high-income

countries than in upper middle, lower middle and low-income countries.<sup>6</sup> Our results show adolescents' current use of e-cigarettes was significantly lower in lower middle-income and low-income countries with bans on TAPS than countries without these bans. Previously, it has been shown that the implementation of the TAPS bans after the WHO FCTC ratification has strengthened among lower middle-income countries, but low-income countries tend to lag behind.<sup>42</sup> The implementation needs to be supported in low-income countries as TAPS regulations are effective in strengthening tobacco control efforts overall.<sup>10 43</sup>

One of the strengths of our study is reliance on the GYTS used globally to monitor tobacco use and its patterns and allowing cross-country comparisons. GYTS is the largest youth tobacco surveillance system, providing current indicators for e-cigarettes and other novel tobacco products.<sup>44</sup> The WHO FCTC implementation questionnaire also includes the same measures for all the countries. Finally, although a cross-sectional study is not conducive of causal inference, it helps identify areas of concern by indicating subpopulation groups at a higher risk of e-cigarette use.

This study has some limitations. First, reliance on operational definition of current use as using an e-cigarette or combustible cigarette on at least 1 day during the month preceding the survey. While such definition is consistent with the GYTS and other data sources (eg, European School Survey Project on Alcohol and Other Drugs, Global School Health Survey), examining frequency of use and number of cigarettes may provide more insights on implementation of regulations and their effects.<sup>45</sup> Second, regarding the policy measures, it is not possible from the WHO FCTC implementation data to assess whether the TAPS bans cover e-cigarettes specifically. While WHO has noted a large number of countries do not ban or regulate e-cigarette TAPS,<sup>16</sup> tobacco control legislation also differs between countries on whether e-cigarettes are defined as tobacco products and whether direct and indirect TAPS bans are interpreted to apply to e-cigarettes. Third, self-reported WHO FCTC implementation data contain information on adopted measures rather than policy enforcement, compliance or year of adoption. Fourth, many high-income countries reporting high or increasing levels of e-cigarette use among youth (eg, UK, USA, Canada) have not conducted the GYTS survey. Finally, cross-sectional nature of our data and reliance on limited number of individual and aggregate measures precluded us from inferring causality and

attributing observed differences between countries by income level to policies alone.

## CONCLUSION

Our study provides new evidence on the importance of the WHO FCTC measures for current e-cigarette use among youth, especially in lower income countries. Additionally, our work highlights the need for further research on tobacco control interventions tailored to younger populations, assuring these interventions include new and emerging products.

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