



## Tobacco use and E-cigarette regulation: Perspectives of University Students in the Asia-Pacific



Heather Wipfli<sup>a,\*</sup>, Mahfuzur Rahman Bhuiyan<sup>b</sup>, Xuezheng Qin<sup>c</sup>, Yuliya Gainullina<sup>d</sup>, Erlinda Palaganas<sup>e</sup>, Masamine Jimba<sup>f</sup>, Junko Saito<sup>g</sup>, Karin Ernstrom<sup>h</sup>, Rema Raman<sup>i</sup>, Mellissa Withers<sup>a</sup>

<sup>a</sup> University of Southern California, Keck School of Medicine, 2001 N Soto Street, Los Angeles, CA 90032, USA

<sup>b</sup> Organization for Human Development Initiatives through Research (OHDIR) Foundation, 403 East Kajrul, Dhaka Cantonment, Dhaka 1206, Bangladesh

<sup>c</sup> Peking University, School of Economics, No 5 Yiheyuan Rd, Beijing 100871, China

<sup>d</sup> Far Eastern Federal University, School of Arts and Humanities, Sukhanova 8, Vladivostok, Russia

<sup>e</sup> University of the Philippines Baguio, Governor Pack Road, Baguio City 2600, Philippines

<sup>f</sup> Department of Community and Global Health, Graduate School of Medicine, The University of Tokyo, 7-3-1, Hongo, Bunkyo-ku, Tokyo 113-0033, Japan

<sup>g</sup> Division of Prevention, Centre for Public Health Sciences, National Cancer Centre, 5-1-1 Tsukiji, Chuo-ku, Tokyo 104-0045, Japan

<sup>h</sup> Alzheimer's Therapeutic Research Institute, Keck School of Medicine of USC University of Southern California, 9860 Mesa Rim Rd, San Diego, CA 92121, USA

<sup>i</sup> University of Southern California, Keck School of Medicine. 2001 N Soto Street SSB 318G, Los Angeles, CA 90032, USA

### HIGHLIGHTS

- 14% of students had ever tried an e-cigarette.
- Support for e-cigarette regulation is strong in economies with strict tobacco control.
- Widespread student support for regulation of e-cigarettes.
- Asia-Pacific universities can be important advocates for tobacco control.

### ARTICLE INFO

#### Keywords:

Electronic cigarettes  
Tobacco  
Smoking  
Asia  
Students

### ABSTRACT

**Introduction:** The Asia-Pacific is home to 30% of the world's smokers. Additional efforts are needed to reduce negative health impacts of tobacco, including e-cigarettes. The study objectives were to 1. Investigate Asian-Pacific students' knowledge, attitudes, and use of tobacco products; 2. Determine the level of student support for tobacco control policies; and 3. Examine differences in students' attitudes by the strength of national tobacco control policies based on implementation of WHO's MPOWER package, and e-cigarette regulation in their countries.

**Methods:** A total of 1953 students from members of the Association of Pacific Rim Universities in 13 countries completed the online survey. We compared the results by the Fisher-Freeman-Halton test.

**Results:** While about 83% of students had heard of e-cigarettes; only 14.1% had tried them. Students in countries with e-cigarette bans were the least likely to report having experimented with e-cigarettes (8.1%). While the vast majority of students (87.9%) reported having seen health campaigns targeting combustible cigarettes, far fewer (42.5%) had seen any health campaigns targeting e-cigarettes. About 80% of students supported smoke-free campuses, with the most support coming from those in countries with the weakest adoption of MPOWER policies (88.7%) and no e-cigarette regulations (80.4%). Students in countries with the weakest MPOWER policies were also the most likely to support campus bans and government regulation of e-cigarettes.

**Conclusions:** The adoption of tobacco control policies by government may have an impact on e-cigarette smoking behavior among students, and student support for tobacco control, including noncombustible products, is high. Universities should take action by adopting comprehensive tobacco control measures that include e-cigarette regulations.

\* Corresponding author.

E-mail addresses: [hwipfli@usc.edu](mailto:hwipfli@usc.edu) (H. Wipfli), [xqin@pku.edu.cn](mailto:xqin@pku.edu.cn) (X. Qin), [gaynullina.yi@dvfu.ru](mailto:gaynullina.yi@dvfu.ru) (Y. Gainullina), [ecpalaganas@up.edu.ph](mailto:ecpalaganas@up.edu.ph) (E. Palaganas), [mjimba@m.u-tokyo.ac.jp](mailto:mjimba@m.u-tokyo.ac.jp) (M. Jimba), [jsaito@ncc.go.jp](mailto:jsaito@ncc.go.jp) (J. Saito), [ernstrom@usc.edu](mailto:ernstrom@usc.edu) (K. Ernstrom), [remar@usc.edu](mailto:remar@usc.edu) (R. Raman), [mwithers@usc.edu](mailto:mwithers@usc.edu) (M. Withers).

<https://doi.org/10.1016/j.addbeh.2020.106420>

Received 19 September 2019; Received in revised form 28 January 2020; Accepted 26 March 2020

Available online 28 March 2020

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## 1. Introduction

Data from North America, the European Union (EU) and Republic of Korea indicate that the use of e-cigarettes at least doubled among both adults and adolescents from 2008 to 2012 (Grana, Benowitz, & Glantz, 2014). Over US\$ 3.5 billion is spent on these products globally and sales are forecasted to increase by a factor of 17 by 2030 (Mincer, 2015; World Health Organization (WHO), 2017). On September 12, 2018, the United States (U.S.) Food and Drug Administration (FDA) announced a series of historic actions related to the sale and marketing of electronic cigarettes in recognition of the fact that youth e-cigarette use had reached ‘epidemic proportion’ (United States Food and Drug Administration (FDA), 2018). This action was just another step in a decades-long battle against tobacco use and nicotine addiction in the U.S. and throughout the world (Brandt, 2008; Proctor, 2016). However, the FDA’s recognition of the magnitude of the problem of adolescent e-cigarette use highlighted just how quickly the tobacco control landscape has shifted over the past decade and many organizations around the world have highlighted the need for regulatory agencies to move quickly to keep pace (Brady, De La Rosa, Nair, & Leischow, 2019).

Countries throughout the Asia-Pacific are, like the U.S., struggling to respond to the quickly changing tobacco landscape and develop regulatory approaches appropriate to reduce negative public health impacts from emerging tobacco products. The Asia-Pacific is home to 30% of the world’s smokers, representing more than 400 million people (Global Burden of Disease Study, 2015; Tobacco Collaborators, 2017). In China, over one-half of males (52.9%) are current tobacco smokers. In other low- and middle-income countries in Asia, almost one-half of men are current smokers and smoking rates among women are increasing (Survey (GATS), 2010). Research shows that most adult smokers in these countries initiate smoking in their late teenage years (Rani, Thamarangsi, & Agarwa, 2017; Stone & Peters, 2017). Some public health advocates have raised the concern that e-cigarettes may be a ‘starter’ or initiation product for youth who will progress to smoking conventional cigarettes (Campaign for Tobacco Free Kids, 2013; Xi et al., 2016). Further, studies from Asia have highlighted that high adolescent smoking rates are associated with high adult smoking rates and that e-cigarette use is associated with later dual use of e-cigarettes and combustible cigarettes (Ab Rahman et al., 2019; Chien et al., 2019; Lee & Lee, 2019).

In 2013, the WHO Tobacco Free Initiative commissioned a report to help countries around the world develop policies to regulate e-cigarettes (Grana, Benowitz, & Glantz, 2013). This report provided detailed policy suggestions for countries to regulate e-cigarettes including banning the use of e-cigarettes anywhere that the use of conventional cigarettes is prohibited, banning the sale of e-cigarettes to anyone who cannot legally buy cigarettes or in any venues where sale of conventional cigarettes is prohibited, applying the same marketing restrictions to e-cigarettes as are applied to conventional cigarettes, banning the use of flavors, banning companies from making claims regarding tobacco-use cessation, and prohibiting e-cigarette companies from making health claims about their products unless approved by appropriate regulatory agencies (World Health Organization (WHO), 2014). Although most countries in the Asia-Pacific have ratified the Framework Convention on Tobacco Control (FCTC), few have implemented the required policies at the needed levels for conventional cigarettes and even fewer have adopted the recommendations of the WHO with regard to e-cigarettes (Kennedy, Awopegba, De León, & Cohen, 2017; World Health Organization (WHO), 2005; World Health Organization (WHO), 2018). Electronic cigarettes, although regulated differently in different countries, are also now widely available in the Asia-Pacific region and represent a new challenge to tobacco control among youth in the region (Kennedy et al., 2017; Mackay, Ritthiphakdee, & Reddy, 2013).

In 2017, members of the Association of Pacific Rim Universities (APRU) Global Health Program recognized the growing prevalence of e-cigarette use among their diverse student bodies and consequently

organized a cross-university survey to collect information about student awareness and behaviors related to tobacco products, including e-cigarettes and other novel tobacco products. The study objectives were to 1. investigate Asian-Pacific students’ knowledge, attitudes, and use of tobacco products; 2. determine the level of student support for tobacco control policies; and 3. examine differences in students’ attitudes by strength of tobacco control, and e-cigarette regulation policies in their countries. The findings of this study can inform university-wide tobacco control initiatives in the region, such as movements for tobacco-free campuses. This comparative data can also help inform public health professionals and national policymakers about the scope of the problem among young adults in the region and which interventions might be most effective.

## 2. Methods

The survey was developed and administered by the Association of Pacific Rim Universities’ (APRU) Global Health Program (GHP). APRU is a non-profit network of 50 leading research universities in the region, representing 17 countries and more than two million students. Launched in 2007, the GHP currently has a membership of approximately 2500 faculty, students, and researchers who are actively engaged in global health work. The main objective of the GHP is to advance global health research, education and training in the Asia-Pacific to respond to regional and global health challenges.

The online survey instrument was initially designed by faculty at the University of Southern California (USC) after reviewing similar studies in the literature (Loomis et al., 2015; Warren et al., 2000) and with input from members of the GHP’s Tobacco Control Working Group. It was administered online through Qualtrics Survey Software in English in all countries except Japan, where it was translated into Japanese. The survey link was sent to the central GHP contact at APRU institutions in 17 different countries who was then responsible for disseminating the link to students through on-campus list-serves or by administering the survey in classes. The contact was specifically instructed to include students from all disciplines and programs. It was available online for 10 months in 2017. Participants were directed to read the informational sheet online and give written informed consent prior to beginning the survey. No personal identifying information was collected. The survey included 26 questions that specifically asked students about whether they had ever used combustible or electronic cigarettes and frequency of use, seen them being advertised or used, or had personally purchased them. Students were also asked about agreement with tobacco control policies, such as smoke-free campuses and government regulation of e-cigarettes. Those who indicated that they use e-cigarettes were asked seven additional questions, including motivations for use (such as perceived health benefits and social acceptability versus combustible cigarettes, and ability to use them in public), initiation and frequency of use, and flavors and amount of nicotine used.

Because we were interested in the impact of tobacco control policies on student exposure, use, and perceptions relating to both combustible and electronic cigarettes, and because sample sizes were small in some countries (such as Australia and Singapore), we decided to create categories of tobacco control environment instead of examining data by country. The countries represented in the survey were grouped into three categories based on strength of tobacco control, which was measured according to national progress in implementing WHO’s MPOWER package as reported in the WHO’s 2017 Report on the Global Tobacco Epidemic (World Health Organization (WHO), 2017). Since our survey asked questions about both traditional cigarettes as well as e-cigarettes, we felt it was important to include a measure about tobacco control in general. The availability and use of e-cigarettes in many Asia-Pacific countries is a recent phenomenon; therefore historical support for tobacco control may be an indicator of governmental and public support for e-cigarette policies in the future. As shown in

**Table 1**  
Categorization of countries by compliance with MPOWER Items.

Economy	Monitor	Protect	Offer	Ww*	Wm*	Enforce	Raise taxes
<b>HIGH-LEVEL</b>							
Australia							
New Zealand							
Thailand							
Russia							
Singapore							
<b>MEDIUM-LEVEL</b>							
Philippines							
Bangladesh							
South Korea							
United States							
<b>LOW-LEVEL</b>							
Malaysia							
Indonesia							
China**							
Japan							

\*W (Warning of dangers of tobacco) is split into two facets: Ww (Health warnings on cigarette packaging) and Wm (Mass media anti-tobacco campaigns); \*\*Note: WHO includes the Special Administrative Region of Hong Kong & Taiwan in China compliance. (WHO, 2017)

\*W (Warning of dangers of tobacco) is split into two facets: Ww (Health warnings on cigarette packaging) and Wm (Mass media anti-tobacco campaigns); \*\*Note: WHO includes the Special Administrative Region of Hong Kong & Taiwan in China compliance ([World Health Organization \(WHO\), 2017](#)).

Key

	Most strict compliance
	Moderate compliance
	Least strict compliance
	No data/lack of compliance

**Table 1**, countries that had four or more items in the strictest category were categorized as “high tobacco control” countries (n = 5, Australia, New Zealand, Thailand, Russia, and Singapore), those with three in the strictest category were put into the medium category (n = 4, Bangladesh, Philippines, South Korea, and the U.S.) and those with two or less in the strictest category were put into the low category (n = 4, China, Indonesia, Japan, and Malaysia). However, it is important to note that even among countries categorized as having weak tobacco control policies, all had implemented some tobacco control measures, such as health advertising campaigns against smoking, and smokefree laws.

The MPOWER objectives examine general tobacco control and not e-cigarette policies specifically. Thus, analyses were also done based on strength of national e-cigarette regulation. Countries were divided into three categories: banned, regulated, unregulated (**Table 2**), which was measured according to national progress in implementing regulations as reported in the WHO’s 2017 Report on the Global Tobacco Epidemic. The banned category included (n = 3) Thailand, Singapore, Japan; the regulated category (n = 5) included Australia, New Zealand, USA, Indonesia, and Korea; and the unregulated category (n = 5) included Russia, Philippines, Bangladesh, China, and Malaysia.

The Fisher-Freeman-Halton test was used to compare each survey question among strength of tobacco control and strength of national e-cigarette policies categories, respectively. Since this analysis is of exploratory, no true adjustment for multiple comparison was used; comparisons with  $p < 0.01$  were followed-up by pairwise comparisons using Holm’s p-value adjustment.

### 3. Results

#### 3.1. Participant characteristics

As shown in **Table 3**, the total sample included 1,953 students from 13 different countries, with the largest proportion coming from Korea (n = 521) and Bangladesh (n = 474). Slightly more student respondents were female (52.59%), were undergraduates (52.38%), with an average age of 24 years (SD = 5.1). Most were single (87.05%) and only 6.89% had children. About 23.24% were international students and about two-thirds were living off campus.

#### 3.2. Characteristics of combustible and E-Cigarette use

**Table 4** shows combustible cigarette and e-cigarette use in the total sample, as well as by tobacco control and e-cigarette regulation categories. Overall, the majority of students surveyed (65.8%) had never smoked a combustible cigarette, while 13.8% had smoked over 100 combustible cigarettes in their lifetime and 16.1% indicated that they had smoked combustible cigarettes in the last 30 days. The majority of students who had used tobacco reported having tried their first combustible cigarette before age 21 years, with 12.0% of all respondents indicating that they had tried their first cigarette between age 13–17 years and slightly more (14.6%) indicating that they had first tried it between age 18–21 years. In terms of e-cigarette use, the vast majority of students had heard of e-cigarettes (82.7%), however, significantly fewer students had ever tried one as compared to combustible cigarettes (14.1% versus 34.2%). First experimentation with e-cigarettes was once again highest between 13 and 19 years of age. < 5% of respondents indicated that they had used an e-cigarette in the past 30 days and only 21 students (or 1%) had used an e-cigarette daily in the past 30 days.

In analyzing tobacco and e-cigarette use by tobacco control category, the highest percentage of *ever* smokers and *daily* smokers of combustible cigarettes were found in countries with stronger tobacco control policies. For example, 7.4% of students in the high tobacco control category were daily smokers, as compared to only 5.8% in the middle and 2.2% in the low categories. However, the proportion of students who had *never* tried a combustible cigarette was also *lowest* in

**Table 2**  
Categorization of Countries by E-cigarette Regulation.

Category	Countries
Banned (n = 3)	Thailand, Singapore, Japan
Regulated (n = 5)	Australia, New Zealand, USA, Indonesia, Korea
Unregulated (n = 5)	Russia, Philippines, Bangladesh, China, Malaysia

**Table 3**  
Participant demographics.

Participant demographics	Count	Percentage
Gender		
Male	926	47.41%
Female	1027	52.59%
Total	1953	100%
Marital Status		
Married	210	10.79%
Single	1694	87.05%
Divorced/Widowed	8	0.41%
Other	34	1.75%
Total	1946	100%
Country of Residence		
Australia	4	0.20%
Bangladesh	474	24.27%
China	221	11.32%
Indonesia	4	0.20%
Japan	102	5.22%
Korea	521	26.68%
Malaysia	145	7.42%
New Zealand	22	1.13%
Philippines	113	5.79%
Russia	218	11.16%
Singapore	3	0.15%
Thailand	68	3.48%
USA	58	2.97%
Total	1953	100%
Degree Program		
Undergraduate	1023	52.38%
Masters	664	34%
PhD	202	10.34%
Post-doctoral	14	0.72%
Other	50	2.56%
Total	1953	100%
International Student		
No	1437	76.76%
Yes	435	23.24%
Total	1872	100%
Has Children		
No	1812	93.11%
Yes	134	6.89%
Total	1946	100%
Parents Smoking Status		
Neither	1248	64.13%
Both	69	3.55%
Father only	521	26.77%
Mother only	63	3.24%
Don't know	45	2.31%
Total	1946	100%

the countries with the strongest tobacco control policies (43.8% in the high versus 66.4% in the middle and 70.1% in the low categories.) In terms of age at first use of combustible cigarettes, 39.6% of students in the high tobacco control category had used them before age 18, compared to 13.1% in the middle category and 15.1% in the low category. About 82.7% of students had heard of e-cigarettes but differences were found in terms of awareness among the tobacco control categories; 86.8% in the low category versus 79.9% in the middle and 87.3% in the high. Yet, 66.8% of those in the high tobacco control category had

**Table 4**  
Use of combustible and E-cigarettes, by tobacco control category and e-cigarette regulation category.

Variable	Tobacco Control Legislation							E-Cigarette Legislation						
	Total %	Low	Medium	High	Total %	Unregulated	Regulated	Banned						
<b>Cigarettes smoked in life</b>														
None	65.79%	337	73.74%	748	67.21%	134	47.35%	65.79%	744	65.55%	357	63.98%	118	73.75%
1–10	15.70%	65	14.22%	160	14.38%	66	23.32%	15.70%	200	17.62%	69	12.37%	22	13.75%
11–99	4.70%	19	4.16%	45	4.04%	23	8.13%	4.70%	45	3.96%	35	6.27%	7	4.38%
100 or more	13.82%	36	7.88%	160	14.38%	60	21.20%	13.82%	146	12.86%	97	17.38%	13	8.13%
Total	100%	457	100%	1113	100%	283	100%	100%	1135	100%	558	100%	160	100%
<b>Age first tried a cigarette</b>														
I have never tried this	63.86%	321	70.09%	739	66.40%	124	43.82%	63.86%	725	63.93%	347	62.08%	112	69.57%
Under age 13	5.61%	35	7.64%	36	3.23%	33	11.66%	5.61%	80	7.05%	17	3.04%	7	4.35%
13–17	12.03%	34	7.42%	110	9.88%	79	27.92%	12.03%	161	14.20%	60	10.73%	2	1.24%
18–19	8.68%	22	4.80%	106	9.52%	33	11.66%	8.68%	105	9.26%	43	7.69%	13	8.07%
20–21	5.88%	25	5.46%	75	6.74%	9	3.18%	5.88%	44	3.88%	51	9.12%	14	8.70%
Over 21	3.94%	21	4.59%	47	4.22%	5	1.77%	3.94%	19	1.68%	41	7.33%	13	8.07%
Total	100%	458	100%	1113	100%	283	100%	100%	1134	100%	559	100%	161	100%
<b>Days used cigarettes last 30 days</b>														
I did not use this product in the last 30 days	83.91%	421	92.32%	918	82.48%	215	75.97%	83.91%	921	81.22%	482	86.23%	151	94.97%
1–3 days	3.56%	10	2.19%	37	3.32%	19	6.71%	3.56%	44	3.88%	19	3.40%	3	1.89%
4–10 days	2.27%	8	1.75%	29	2.61%	5	1.77%	2.27%	35	3.09%	5	0.89%	2	1.24%
11–19 days	2.92%	3	0.66%	38	3.41%	13	4.59%	2.92%	40	3.53%	14	2.50%	0	0.00%
20–29 days	2.16%	4	0.88%	26	2.34%	10	3.53%	2.16%	30	2.65%	9	1.61%	1	0.63%
All 30 days	5.18%	10	2.19%	65	5.84%	21	7.42%	5.18%	64	5.64%	30	5.37%	2	1.26%
Total	100%	456	100%	1113	100%	283	100%	100%	1134	100%	559	100%	159	100%
<b>Heard of E-Cigarettes</b>														
No	17.31%	59	13.20%	221	20.13%	35	12.73%	17.31%	242	21.78%	44	7.90%	29	19.08%
Yes	82.69%	388	86.80%	877	79.87%	240	87.27%	82.69%	869	78.22%	513	92.10%	123	80.92%
Total	100%	447	100%	1098	100%	275	100%	100%	1111	100%	557	100%	152	100%
<b>Age first tried an E-Cigarette</b>														
I have never tried this	85.87%	416	90.83%	987	88.68%	189	66.78%	85.87%	981	86.51%	463	82.83%	148	91.93%
Under 20	7.01%	13	2.83%	50	4.49%	67	23.67%	7.01%	96	8.47%	31	5.55%	3	1.86%
20 and over	7.12%	29	6.33%	76	6.83%	27	9.54%	7.12%	57	5.03%	65	11.63%	10	6.21%
Total	100%	458	100%	1113	100%	283	100%	100.00%	1134	100%	559	100%	161	100%
<b>Age tried other electronic nicotine device</b>														
I have never tried this	94.85%	445	97.16%	1082	97.21%	232	81.98%	94.88%	1064	93.83%	535	95.71%	160	99.38%
Under 20	3.02%	5	1.09%	15	1.35%	36	12.72%	3.02%	46	4.06%	10	1.79%	0	0.00%
20 and over	2.15%	8	1.75%	16	1.44%	15	5.30%	2.10%	24	2.11%	14	2.50%	1	0.62%
Total	100%	458	100%	1113	100%	283	100%	100.00%	1134	100%	559	100%	161	100%
<b>Days used E-cigarettes last 30 days</b>														
I did not use this product in the last 30 days	95.90%	445	97.59%	1085	97.48%	246	86.93%	95.90%	1084	95.59%	535	95.71%	157	98.74%
1–10 days	2.05%	6	1.32%	10	0.90%	22	7.78%	2.05%	31	2.73%	6	1.07%	1	0.63%
11 days and over	2.05%	5	1.11%	18	1.62%	15	5.30%	2.05%	19	1.68%	18	3.22%	1	0.63%
Total	100%	456	100%	1113	100%	283	100%	100.00%	1134	100%	559	100%	159	100%
<b>Days used other electronic nicotine device last 30 days</b>														
I did not use this product in the last 30 days	98.49%	451	98.90%	1104	99.19%	269	95.05%	98.49%	1114	98.24%	551	98.57%	159	100.00%
1–10 days	0.59%	2	0.43%	3	0.27%	6	2.12%	0.59%	9	0.79%	2	0.36%	0	0.00%
11 days and over	0.92%	3	0.65%	6	0.54%	8	2.83%	0.92%	11	0.97%	6	1.07%	0	0.00%
Total	100%	456	100%	1113	100%	283	100%	100.00%	1134	100%	559	100%	159	100%
<b>E-Cigarettes sold near your university campus</b>														
No	67.00%	132	53.44%	287	69.49%	111	84.73%	67.00%	427	78.93%	77	49.04%	26	27.96%
Yes	33.00%	115	46.56%	126	30.51%	20	15.27%	33.00%	114	21.07%	80	50.96%	67	72.04%
Total	100%	250	100%	413	100%	131	100%	100%	541	100%	157	100%	93	100%

never tried an e-cigarette, as compared to 88.7% in the middle and 90.8% in the low tobacco control categories. No differences were found in terms of current e-cigarette users by category. A total of 33% students reported e-cigarettes were sold near their campus. Students in strong tobacco control policy countries were far less likely to report presence of e-cigarettes sales near their university campus (15.3% compared to 45.6% of students in low and 30.5% of students in medium strength countries) ( $p < 0.001$ ).

By category of e-cigarette regulation, the proportion of students who had ever smoked a combustible cigarette and who were daily smokers were very similar across categories. Students in countries that regulate e-cigarettes had the greatest awareness of e-cigarettes (92.1%), followed by students in countries that ban e-cigarettes (80.9%) and in countries where e-cigarettes are unregulated (78.2%). While the total

proportion of students that had ever tried e-cigarettes was low (14.1%), students in countries with an e-cigarette ban were the least likely to have experimented with e-cigarettes (8.1%), as compared to those in countries that regulate them (17.2%) and those with no regulations (13.5%).

### 3.3. Motivations for E-Cigarette use among E-Cigarette users

Table 5 shows the results of questions posed only to e-cigarette users ( $n = 256$ ). The vast majority of those in this category were dual users of both traditional cigarettes and e-cigarettes. Participants were asked to select all possible motivations for their use. One-half of e-cigarette users (50.2%) used flavors and one-third (34.0%) indicated they used e-cigarettes specifically because of the flavors offered. A minority of users

indicated that they considered e-cigarettes to be affordable (29.3%) or that they used them because they were more affordable than other tobacco products (22.8%). Students in countries with strong tobacco control policies reporting that e-cigarettes cost upward of US\$50.

A substantial proportion (35.0%) responded that they used e-cigarettes because they could use them in places where they could not smoke combustible cigarettes. A sizable number of e-cigarette users also indicated that they believed e-cigarettes were less harmful than combustible cigarettes to both the smoker (45.1%) and to people around them (46.2%) Overall, about one-quarter (24.2%) used e-cigarettes to help them quit traditional smoking. Almost one-third (32.8%) used them because of the belief that were more acceptable to non-smokers and 40.5% indicated that they used them because they did not smell as bad as combustible cigarettes.

In terms of tobacco control category, there were statistically significant differences between the groups for the motivations of being able to use them in places where you can't smoke combustible cigarettes, they are flavored ( $p < 0.001$ ), they don't smell as bad as combustible cigarettes ( $p < 0.001$ ), they feel like smoking combustible cigarettes ( $p < 0.001$ ), and they are more acceptable to non-smokers ( $p < 0.001$ ). However, no significant differences were found by tobacco control category for the following reasons: usually use flavor,

they are affordable, they are more affordable than other tobacco products, less harmful than combustible cigarettes, less harmful to people around them, help them quit combustible cigarette smoking.

### 3.4. Awareness of E-Cigarette health campaigns and policy support

Student responses regarding support for e-cigarette regulation policies according to the strength of tobacco control, as well as the strength of e-cigarette regulations, as seen in Table 6. In comparing responses based on tobacco control category, exposure to health information against tobacco was high across tobacco control categories. The vast majority of students (87.9%) reported having seen health campaigns targeting combustible cigarettes; however, there were no statistically significant differences between the groups. Far fewer (42.5%) of students overall had seen any health campaigns targeting e-cigarettes as compared to combustible tobacco use and there were no significant differences found by tobacco control category. Overall, the vast majority of students (79.3%) supported their campus going smoke-free (or vape-free), with the highest support coming from students living in countries with weak tobacco control policies (88.7%), followed by those in medium strength tobacco control policies (78.1%) and high (69.3%) ( $p < 0.001$ ). A similar pattern of support was found

**Table 5**  
E-cigarette preferences and behaviors.

Variable	Tobacco control legislation							E-cigarette legislation								
	Total %	Low	Medium	High	p-value		Total %	Unregulated	Regulated	Banned						
<b>Usually use flavor</b>																
No	49.80%	18	54.55%	66	52.80%	40	43.96%	0.371	49.80%	78	49.37%	38	46.34%	8	88.89%	0.051
Yes	50.20%	15	45.45%	59	47.20%	51	56.04%		50.20%	80	50.63%	44	53.66%	1	11.11%	
<b>Total</b>	<b>100%</b>	<b>33</b>	<b>100%</b>	<b>125</b>	<b>100%</b>	<b>91</b>	<b>100%</b>		<b>100%</b>	<b>158</b>	<b>100%</b>	<b>82</b>	<b>100%</b>	<b>9</b>	<b>100%</b>	
<b>Use because comes in flavor</b>																
No	66.15%	84	86.60%	58	62.37%	28	41.49%	< 0.001	66.02%	73	57.94%	24	42.11%	72	98.63%	< 0.001
Yes	33.85%	13	13.40%	35	37.63%	39	58.21%		33.98%	53	42.06%	33	57.89%	1	1.37%	
<b>Total</b>	<b>100%</b>	<b>97</b>	<b>100%</b>	<b>93</b>	<b>100%</b>	<b>67</b>	<b>100%</b>		<b>100%</b>	<b>126</b>	<b>100%</b>	<b>57</b>	<b>100%</b>	<b>73</b>	<b>100%</b>	
<b>Affordable</b>																
No	70.52%	20	64.52%	67	73.63%	35	68.63%	0.577	70.52%	84	76.36%	30	56.60%	8	80.00%	0.032
Yes	29.48%	11	35.48%	24	26.37%	16	31.37%		29.48%	26	23.64%	23	43.40%	2	20.00%	
<b>Total</b>	<b>100%</b>	<b>31</b>	<b>100%</b>	<b>91</b>	<b>100%</b>	<b>51</b>	<b>100%</b>		<b>100%</b>	<b>110</b>	<b>100%</b>	<b>53</b>	<b>100%</b>	<b>10</b>	<b>100%</b>	
<b>More affordable than other tobacco products</b>																
No	77.22%	21	70.00%	71	78.02%	47	79.35%	0.552	77.22%	97	84.35%	34	64.15%	8	66.67%	0.007
Yes	22.78%	9	30.00%	20	21.98%	12	20.34%		22.78%	18	15.65%	19	35.85%	4	33.33%	
<b>Total</b>	<b>100%</b>	<b>30</b>	<b>100%</b>	<b>91</b>	<b>100%</b>	<b>59</b>	<b>100%</b>		<b>100%</b>	<b>115</b>	<b>100%</b>	<b>53</b>	<b>100%</b>	<b>12</b>	<b>100%</b>	
<b>Use in places where can't smoke combustible cigarettes</b>																
No	65.00%	16	64.00%	68	73.91%	33	52.38%	0.021	65.00%	81	66.39%	32	60.38%	4	80.00%	0.634
Yes	35.00%	9	36.00%	24	26.09%	30	47.62%		35.00%	41	33.61%	21	39.62%	1	20.00%	
<b>Total</b>	<b>100%</b>	<b>25</b>	<b>100%</b>	<b>92</b>	<b>100%</b>	<b>63</b>	<b>100%</b>		<b>100%</b>	<b>122</b>	<b>100%</b>	<b>53</b>	<b>100%</b>	<b>5</b>	<b>100%</b>	
<b>Less harmful than combustible cigarettes</b>																
No	54.89%	15	48.39%	57	62.64%	29	46.77%	0.109	54.89%	72	59.50%	20	38.46%	9	81.82%	0.008
Yes	45.11%	16	51.61%	34	37.36%	33	53.23%		45.11%	49	40.50%	32	61.54%	2	18.18%	
<b>Total</b>	<b>100%</b>	<b>31</b>	<b>100%</b>	<b>91</b>	<b>100%</b>	<b>62</b>	<b>100%</b>		<b>100%</b>	<b>121</b>	<b>100%</b>	<b>52</b>	<b>100%</b>	<b>11</b>	<b>100%</b>	
<b>Less harmful to people around</b>																
No	53.80%	15	53.57%	53	56.38%	31	50.00%	0.759	53.80%	71	60.17%	19	33.93%	9	90.00%	< 0.001
Yes	46.20%	13	46.43%	41	43.63%	31	50.00%		46.20%	47	39.83%	37	66.07%	1	10.00%	
<b>Total</b>	<b>100%</b>	<b>28</b>	<b>100%</b>	<b>94</b>	<b>100%</b>	<b>62</b>	<b>100%</b>		<b>100%</b>	<b>118</b>	<b>100%</b>	<b>56</b>	<b>100%</b>	<b>10</b>	<b>100%</b>	
<b>Help quit combustible cigarettes</b>																
No	75.78%	79	83.16%	69	74.19%	46	67.65%	0.063	75.78%	96	76.19%	33	57.89%	65	89.04%	< 0.001
Yes	24.22%	16	16.84%	24	25.81%	22	32.35%		24.22%	30	23.81%	24	42.11%	8	10.96%	
<b>Total</b>	<b>100%</b>	<b>95</b>	<b>100%</b>	<b>93</b>	<b>100%</b>	<b>68</b>	<b>100%</b>		<b>100%</b>	<b>126</b>	<b>100%</b>	<b>57</b>	<b>100%</b>	<b>73</b>	<b>100%</b>	
<b>More acceptable to non-smokers</b>																
No	67.21%	71	78.89%	65	69.89%	30	46.88%	< 0.001	67.21%	80	65.57%	27	48.21%	59	85.51%	< 0.001
Yes	32.79%	19	21.22%	28	30.11%	34	53.12%		32.79%	42	34.43%	29	51.79%	10	14.49%	
<b>Total</b>	<b>100%</b>	<b>90</b>	<b>100%</b>	<b>93</b>	<b>100%</b>	<b>64</b>	<b>100%</b>		<b>100%</b>	<b>122</b>	<b>100%</b>	<b>56</b>	<b>100%</b>	<b>69</b>	<b>100%</b>	
<b>Doesn't smell as bad</b>																
No	59.54%	76	80.85%	50	51.02%	30	42.86%	< 0.001	59.54%	73	57.03%	16	26.23%	67	91.78%	< 0.001
Yes	40.46%	18	19.15%	48	48.98%	40	57.14%		40.46%	55	42.97%	45	73.77%	6	8.22%	
<b>Total</b>	<b>100%</b>	<b>94</b>	<b>100%</b>	<b>98</b>	<b>100%</b>	<b>70</b>	<b>100%</b>		<b>100%</b>	<b>128</b>	<b>100%</b>	<b>61</b>	<b>100%</b>	<b>73</b>	<b>100%</b>	

for campus e-cigarette bans by tobacco control category; the majority of students (67.2%) supported a campus e-cigarette ban but the highest support for campus e-cigarette bans came from low tobacco control countries (75.6% in low, 66.2% in medium, and 58.2% in high) ( $p < 0.001$ ). About 71.6% of students overall supported government regulation of e-cigarettes. The highest support was also found in the low tobacco control category; 79.9% support was found in the low category versus 69.4% in the medium and 68% in high categories ( $p < 0.001$ ).

The analysis of student opinions by e-cigarette regulation category also demonstrated some differences. Students in countries that ban e-cigarettes were significantly more likely to report e-cigarette sales near their campus (72% compared to 51% in regulated and 21.1% in countries with no regulation) ( $p < 0.001$ ). Significant differences were also found in terms of exposure to health campaigns and warning labels for combustible cigarettes. Among students in the no regulation countries, 84.3% reported having seen health campaigns against combustible cigarettes, as compared to 94.6% in those with regulations, and 93.9% in those in bans ( $p < 0.001$ ). Among those in the no regulation category, only 83.1% had seen warning labels on combustible cigarette packages, as compared to 92.8% in the regulated and 93.9% in the banned categories ( $p < 0.001$ ). No significant differences were found in terms of exposure to health campaigns against e-cigarettes. While not statistically significant, the highest levels of support for smoke-free campuses came from students in countries with no e-cigarette regulations (80.4%), followed by those with regulations (77.7%) and those where they were banned (74.0%). However, statistically significant differences were found in terms of support of a campus e-cigarette ban; the highest support was found among students in countries with current e-cigarette bans (81.3%), as compared to 53.7% in regulated and 72.5% in unregulated countries ( $p < 0.001$ ). Support for government e-cigarette regulation was lowest in countries that do not currently regulate e-cigarettes (68.3% compared to 77.7% among those with regulations and 75.8% among those where e-cigarettes were banned) ( $p = 0.002$ ).

#### 4. Discussion

The survey results represent an initial glance at the knowledge and attitudes of university students throughout the Asia-Pacific in 2017 when e-cigarettes were emerging in the region. Little published research exists regarding the attitudes and behaviors of students in the Asian-Pacific region regarding e-cigarettes. The study results were consistent with numerous previous studies that showed that the majority of tobacco users first tried tobacco products during their teens – or just before or at the age at which they attend university (Nur Atikah et al., 2019; Sinha, Palipudi, Rolle, Asma, & Rinchen, 2011; Stone & Peters, 2017; Xi et al., 2016). Consequently, research within this age group allows us to study what drives young people as they first experiment with tobacco products, including their perceptions of potential benefits and risks and what motivates them to become regular users.

The findings also highlight the impact that government policies towards tobacco control have on smoking behavior among youth. While the total proportion of students that had ever tried e-cigarettes was low (14.1%), students in countries with strong tobacco control were the least likely to have experimented with them. In addition, students in strong tobacco control policy countries were far less likely to report presence of e-cigarettes sales near their university campus (15.3% compared to 45.6% of students in low and 30.5% of students in medium strength countries).

Generally, student support for tobacco control policies was high. Overall, the vast majority of students supported a smoke-free campus (79.3%) and a campus ban on e-cigarettes (67.2%). There was also widespread support for government regulation of e-cigarettes among students (71.6%). Students in countries with the weakest tobacco control policies were the most likely to endorse smoke-free campuses, campus bans on e-cigarettes, and government regulation of e-cigarettes. This suggests that students in countries where tobacco control policies were lax perceive a need for stricter tobacco control policies. Our results demonstrated a higher level of support than Chen, Ho, Leung, Wang, and Lam (2019) study on adolescent support for tobacco control

**Table 6**  
Support for tobacco and E-cigarette policies.

Variable	Tobacco control legislation					E-cigarette legislation										
	Total %	Low	Medium	High	p-value	Total %	Unregulated	Regulated	Banned	p-value						
Seen health campaigns against regular cigarettes?																
No	12.14%	37	10.16%	134	12.85%	30	12.05%	0.407	12.14%	169	15.71%	27	5.42%	5	6.10%	< 0.001
Yes	87.86%	327	89.84%	909	87.15%	219	87.95%		87.86%	907	84.29%	471	94.58%	77	93.90%	
Total	100%	364	100%	1043	100%	249	100%		100%	1076	100%	498	100%	82	100%	
Noticed warning labels on cigarette packaging?																
No	13.47%	16	4.40%	186	17.83%	21	8.43%	< 0.001	13.47%	182	16.91%	36	7.23%	5	6.10%	< 0.001
Yes	86.53%	348	95.60%	857	82.17%	228	91.57%		86.53%	894	83.09%	462	92.77%	77	93.90%	
Total	100%	364	100%	1043	100%	249	100%		100%	1076	100%	498	100%	82	100%	
Seen health campaigns against e-cigarettes?																
No	57.51%	161	51.27%	560	58.09%	129	64.50%	0.011	57.51%	555	56.40%	258	60.28%	37	56.06%	0.382
Yes	42.49%	153	48.73%	404	41.91%	71	35.50%		42.49%	429	43.60%	170	39.72%	29	43.94%	
Total	100%	314	100%	964	100%	200	100%		100%	984	100%	428	100%	66	100%	
Support smokefree campuses?																
No	20.75%	40	11.33%	209	21.95%	67	30.73%	< 0.001	20.75%	192	19.61%	104	22.27%	20	25.97%	0.246
Yes	79.25%	313	88.67%	743	78.05%	151	69.27%		79.25%	787	80.39%	363	77.73%	57	74.03%	
Total	100%	353	100%	952	100%	218	100%		100%	979	100%	467	100%	77	100%	
Support e-cigs banned from campus?																
No	32.83%	76	24.26%	296	33.83%	82	41.84%	< 0.001	32.83%	246	27.46%	196	46.34%	12	18.75%	< 0.001
Yes	67.17%	236	75.64%	579	66.17%	114	58.16%		67.17%	650	72.54%	227	53.66%	52	81.25%	
Total	100%	318	100%	875	100%	196	100%		100%	896	100%	423	100%	64	100%	
Support e-cigs regulated by governments?																
No	28.41%	63	20.13%	263	30.62%	63	31.98%	< 0.001	28.41%	278	31.66%	95	22.35%	16	24.24%	0.002
Yes	71.59%	250	79.87%	596	69.38%	134	68.02%		71.59%	600	68.34%	330	77.65%	50	75.76%	
Total	100.00%	313	100%	859	100%	197	100%		100%	878	100%	425	100%	66	100%	

policies in Hong Kong, which found weak to moderate support for tobacco control policies, such as tobacco taxes and banning smoking in public places.

Students in countries that regulated e-cigarettes were more aware of the products, had an overall more favorable attitude about them, and were more likely to use them. It is possible that the regulations stemmed from a government response to rising popularity of e-cigarettes in these countries. Students in countries with e-cigarette bans had the *least* favorable attitudes towards e-cigarettes and were the least likely to have ever or currently use them, despite reporting access. Students in countries that had not regulated the products at the time of the study fell in between, with less favorable attitudes about the products but earlier experimentation and more acceptance about their continued availability and use. These student attitudes may reflect domestic policy debates about e-cigarettes, where in some cases proponents of e-cigarettes as a method of harm reduction have gained traction in the media and influence over regulatory decisions. However, our results demonstrate that bans on e-cigarettes are effective in reducing demand, and likely contributed to the negative attitudes that students reported towards e-cigarettes.

To date, the most effective tobacco control policy in reducing youth tobacco use is tax increases that result in higher prices for tobacco products (Ho, Schafferer, Lee, Yeh, & Hsieh, 2018; Jones, 2018). This study's results suggest that at the time of the study, price was a major hurdle to regular e-cigarette use for many students. The majority of students who had used e-cigarettes indicated that they were not affordable, with students in countries with strong tobacco control policies reporting that e-cigarettes cost upward of US\$50. The high price of e-cigarettes has been found to be a major barrier to their use in other studies among adolescents (Saminathan et al., 2019; Stoklosa, Drope, & Chaloupka, 2016) This points to the need to raise taxes on traditional tobacco products further to reduce use and to devise new taxation schemes for electronic tobacco products as their prices are likely to drop quickly in the future.

The study results also provide a number of interesting findings in regard to e-cigarette users' perceptions and use of e-cigarettes. First, e-cigarette manufacturers often claim that their products are intended as a less harmful alternative to traditional combustible cigarettes for adult smokers and as a tool to aid in smoking cessation. Yet, approximately one-half of e-cigarette users believed e-cigarettes were less harmful to both themselves and to those around them, a finding that is supported by the existing literature (Chan et al., 2019; Minh Dao et al., 2019). However, less than a quarter of the e-cigarette users surveyed indicated that they used e-cigarettes to help them quit smoking, which has been found to be a significant motivator for their use in other studies from the region (Chan et al., 2019; Nur Atikah et al., 2019; Saminathan et al., 2019). Alternatively, over 30% indicated they used e-cigarettes because of their flavorings and for use in places where they can't smoke traditional cigarettes. This points to the need for further research related to potential dual use of traditional and electronic products by students in different settings and how regulations on product flavors may impact demand. The data also suggests that stronger tobacco control policies in general may result in higher demand for e-cigarettes to bypass smoking bans. Additional research is also needed on the health effects of heat-not-burn tobacco, as the demand for these products has seen recent tremendous growth, especially among young people (Caputi, Leas, & Dredze, 2017; Tabuchi, Gallus, & Shinozaki, 2017).

There are multiple reasons for universities to take a lead in tobacco control. First, as discussed above, their primary stakeholder, students, are a prime target for tobacco industry marketing and at-risk for tobacco use initiation. Universities have a responsibility to protect student health and wellbeing, such as through the establishment of tobacco free campus policies which include the prohibition of the sale and advertisement of tobacco products. Universities are also among the largest employers in their communities. Comprehensive tobacco-free campus policies, therefore, not only have an impact on the health and

wellbeing of students but also on the thousands of people employed at the university campuses. Universities can also work closely with local government agencies and community-based organizations to support the passage of tobacco-free policies in places frequented by their students and staff, such as sports venues, recreational sites, bars and nightclubs (Mackay et al., 2013). Second, the primary mission of universities is to educate future leaders and discover, preserve and disseminate information to enhance the lives and livelihoods of their students, their communities and the world. Schools of public health, nursing and medicine, in particular, promote health and well-being and are well-situated to take on the task of educating their communities on the harms of tobacco use and advocate for tobacco control policies. University faculty can, for example, carry out policy-relevant research and disseminate their findings to key stakeholders, such as local government agencies and community-based organizations who share the common goal of tobacco control. Universities can also provide powerful models of how to implement smoke-free environments in diverse communities and development of effective smoking cessation programs in the workplace. Finally, university students could provide a previously untapped source for advocacy in countries in need of greater momentum and political will for tobacco control. Student support for tobacco-free campuses also points to the critical role students can play in pushing for their own communities to model effective tobacco control. Indeed, university students, as well as faculty, and officials can be called upon to take action against increasing rates of tobacco use on their university campus and bring publicity to tobacco control efforts at local, regional and national levels.

This study has several limitations. First, it was administered using a convenience sample based on accessibility of GHP members to student listservs and participant participation varied greatly between countries. Not all countries with APRU member institutions were represented. It was also distributed in English in most countries, which could have biased the study. The data are self-reported, which could introduce bias. However, we feel the fact that it was anonymous and administered online helps to reduce this potential bias. The e-cigarette environment is also shifting rapidly and current surveys would likely include updated questions that reflect new products, practices and policies. However, the study results still provide insight on how national tobacco control and e-cigarette policy differences impacted attitudes and behaviors regarding e-cigarettes use on university campuses throughout the region just as these products were emerging.

## 5. Conclusion

E-cigarette marketing, use, and regulation is changing rapidly within countries globally. The data collected through this study provide insight into the very early days of e-cigarette use in the Asia-Pacific – before many countries had a comprehensive plan in place to deal with them. As such, it provides a strong baseline from which to compare future usage rates among university students in the region and to analyze how different domestic regulatory approaches impact the future availability and use of e-cigarettes and other electronic nicotine delivery products. While e-cigarette use is projected to rise in the region, traditional cigarette smoking will continue to be a significant driver of death and disease. Additional advocacy efforts are urgently needed to spearhead campaigns to fully implement the FCTC and MPOWER package and reduce tobacco smoking of all types among young people in Asia-Pacific countries. These measures should include prohibiting smoking and implementing bans on advertising and sales of tobacco products on university campuses, as well as providing cessation programs for students. The Association of Pacific Rim Universities' Global Health Working Group calls on universities' administration, faculty and students to take a lead in this life-saving movement.



## 6. Role of funding sources

No funding sources.

## 7. Contributors

HW and MW designed and managed the study, conducted preliminary basic analysis, and wrote the manuscript. MB, ZQ, YG, EP, MJ assisted with data collection. KE and RR conducted the statistical analyses. All authors approved the final manuscript.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Acknowledgments

The authors wish to thank Steve Sussman and Jessica L. Barrington-Trimis for their guidance. We appreciate the support of our student researchers, including Jarod Majeika. We also wish to acknowledge the APRU Secretariat, especially Christina Schonleber and Tina Lin, for their long-standing support.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.addbeh.2020.106420>.

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