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# Heated tobacco product use among Korean adolescents

Heewon Kang ,<sup>1</sup> Sung-il Cho  <sup>1,2</sup>

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<sup>1</sup>Department of Public Health Science, Graduate School of Public Health, Seoul National University, Seoul, Korea  
<sup>2</sup>Institute of Health and Environment, Seoul National University, Seoul, Korea

## Correspondence to

Dr Sung-il Cho, Department of Public Health Science, Graduate School of Public Health, Seoul National University, Seoul 08826, Korea; [persontime@hotmail.com](mailto:persontime@hotmail.com)

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## ABSTRACT

**Background** Heated tobacco products (HTPs) may compromise decades-long efforts to marginalise the tobacco industry. Their appeal to adolescents imposes a risk of a new tobacco epidemic. Empirical evidence on the behavioural patterns of HTP use among adolescents is required. We investigated the prevalence of HTP use and the association between use of HTPs and e-cigarettes and attempts to quit smoking cigarettes. **Methods** Nationally representative cross-sectional survey data of South Korean adolescents aged 12–18 years (mean age: 15 years) were used. The survey was conducted 1 year after the introduction of HTPs in Korea. A total of 59 532 adolescents were identified. Descriptive statistics and multiple logistic regression results are presented.

**Results** In all, 2.8% of South Korean adolescents were ever HTP users. Among these, 75.5% were current cigarette users, 45.6% were current e-cigarette users and 40.3% were concurrent users of cigarettes and e-cigarettes. Unlike ever use of e-cigarettes, which was associated with a higher likelihood of cigarette quit attempts (adjusted OR (aOR)=1.35, 95% CI: 1.16 to 1.58), no difference in cigarette quit attempts was found for ever use of HTPs (aOR=1.07, 95% CI: 0.91 to 1.26).

**Conclusion** Considering the recent introduction of HTPs to the Korean market and less than 1% prevalence of e-cigarette when first introduced, the prevalence of ever HTP use among Korean adolescents is an important concern. The results showing high polytobacco use and the lack of an association between HTP use and cigarette quit attempts call for a ban on HTP advertisements with modified harm claims.

## INTRODUCTION

Although the tobacco industry's diversification of products may appear to be mere attempts to increase profitability and unburden stigmatised smokers, it may in fact be a strategy to rehabilitate the industry's public image. Heated tobacco products (HTPs), or heat-not-burn tobacco products, are the latest tactic in tobacco renormalisation,<sup>1</sup> appealing to non-users, appearing as responsive to public health concerns, and absolving the industry from the responsibility of creating countless smokers and tobacco-related harms.<sup>2</sup> If successful, these products will serve as key players in the resurgence of the tobacco epidemic.<sup>1</sup>

Since the introduction of IQOS by Philip Morris International (PMI) in South Korea in June 2017, HTPs have gained popularity. Following IQOS, British American Tobacco's glo and KT&G's lil became available. HTPs were advertised with reduced harm claims.<sup>3</sup> Aggressive marketing

was implemented, for example, stores selling lil nearly tripled within 3 months of launch.<sup>3</sup> Among sales quantity sum of cigarettes and HTPs, HTPs accounted for 2.2% in 2017, and this increased to 9.6% in 2018.<sup>4</sup>

In Korea, regulations on HTPs, including a sales ban to minors, are similar to those on cigarettes, although weaker rules apply regarding taxation and warning labels. Given the initial confusion about defining and regulating HTPs,<sup>5</sup> they were taxed at half the per-pack amount of cigarettes and labelled with a syringe image and text (electronic cigarettes cause nicotine addiction).<sup>3</sup> However, the growth of HTPs and a WHO recommendation<sup>6</sup> have driven the government to increase the tax to 90% of that of cigarettes<sup>3</sup> and to change the warning label to a cancer-stricken organ and text (addiction to nicotine, exposure to carcinogens).<sup>7</sup>

HTPs may entice youths as the tobacco industry advertises products with likely-to-be-refuted<sup>1</sup> 'reduced harm' claims, pursue high-tech designer looks and convey beliefs they are more socially acceptable than conventional cigarettes.<sup>8</sup> Although evidence remains unclear on whether HTPs attract young tobacco non-users to initiate or cause cigarette users to switch, evidence from other non-cigarette tobacco/nicotine products suggests gateway effects to cigarettes and concurrent tobacco/nicotine use.<sup>8</sup> Moreover, due to the marketing of e-cigarettes as cessation aids<sup>9</sup> and the resemblance between HTPs and e-cigarettes,<sup>8</sup> adolescents may view HTPs as aids to stop cigarette smoking.

As a countermeasure to the uncontrolled expansion of HTPs based on unverified beliefs, information regarding the behavioural experiences of HTPs is urgently required. This is particularly important for adolescents, considering their interest in novel and tech-centric products.<sup>8–10</sup> Furthermore, understanding HTP use in comparison to a similar formerly introduced product, e-cigarettes, may have relevance for forecasting the growth of HTPs and future prevention efforts.

Using a large, nationally representative sample of South Korean adolescents, this study examined HTP use, solely or jointly with conventional cigarettes and/or e-cigarettes, and assessed whether the use of HTPs or e-cigarettes was associated with attempts to quit cigarette smoking.

## METHODS

### Data and study participants

We used data from the 14th Korea Youth Risk Behavior Survey (KYRBS), conducted in June 2018, 1 year after HTP introduction. KYRBS is a nationally representative, cross-sectional, self-reported survey designed to assess health-related behaviours of



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Korean adolescents aged 12–18 (mean: 15) years old. A detailed description of the KYRBS, including its design and measures, is provided elsewhere.<sup>11</sup> Survey participants included middle and high school students from 800 schools (response rate 95.6%). From a total sample of 60 040 students, we excluded individuals with missing data for age and age at cigarette smoking initiation (n=508). The final analyses included 59 532 adolescents.

## Measures

Ever HTP users were defined as those responding 'yes' to the question: 'Have you ever used heated tobacco products (IQOS, glo, lil)? (※ cigarettes and e-cigarettes excluded)'. No data were available to measure current HTP use.

Ever e-cigarette users were defined as those answering 'yes' to 'Have you ever used e-cigarettes?' Current e-cigarette users were defined as those who gave responses in the range '1 to 2 days' to 'everyday' to the question: 'During the past 30 days, how many days did you use e-cigarettes?'

Ever cigarette smokers were identified as participants answering 'yes' to the question: 'Have you ever smoked a cigarette, even one puff?' Current cigarette smokers were defined as those who gave responses in the range '1 to 2 days' to 'everyday' to the question: 'During the past 30 days, how many days did you smoke cigarettes, even one cigarette?' Then, current users of both cigarettes and e-cigarettes were defined as current dual users. Cigarette quit attempters were defined as current cigarette smokers who answered 'yes' to the question: 'During the past 12 months, have you made attempts to quit smoking?'

Covariates used in the logistic regression model were sex, age, perceived household wealth (1=low to 5=high), age at cigarette smoking initiation and past 12-month participation of each student's school-based smoking prevention education (yes/no).

## Statistical analyses

All analyses considered survey weights for the complex sampling design of the KYRBS. Descriptive statistics of tobacco/

nicotine product use and cigarette quit attempts are presented as unweighted frequencies and weighted percentages. A logistic regression analysis was conducted on current cigarette smokers, using a model which included ever HTP use along with ever e-cigarette use, to examine their independent associations with cigarette smoking quit attempts. Odds ratio (OR) estimates were obtained with adjustment (adjusted OR (aOR)) for the aforementioned covariates. All statistical analyses were done using SAS 9.4.<sup>12</sup>

## RESULTS

Table 1 shows the prevalence of HTP, cigarette and e-cigarette use along with attempts to quit cigarette smoking. The prevalence of ever HTP use in the study population was 2.8% (1496 of 59 532 unweighted individuals). The prevalence of ever cigarette use and e-cigarette use were 14.4% and 7.7%, respectively.

Among ever HTP users, 75.5% were current cigarette users, 45.6% were current e-cigarette users and 40.3% were concurrent cigarette and e-cigarette users. Only 3.7% had never used conventional cigarettes or e-cigarettes (online supplementary table S1). Approximately 32% of current cigarette users were ever HTP users. Participant numbers in each use group are provided in detail in the online supplementary file.

The proportion of current cigarette users who had attempted to quit cigarette smoking was 71.7%. Cigarette quit attempts were similar regardless of ever HTP use (70.9% in never-users, 73.6% in ever users). However, there was a greater difference in terms of ever e-cigarette use (67.9% in never-users, 73.8% in ever users).

The last two columns show the results of a logistic regression analysis on current cigarette smokers, examining the association between HTP and e-cigarette use and cigarette quit attempts. No significant association was found for ever HTP use and quit attempts (aOR=1.07, 95% CI: 0.91 to 1.26). However, ever e-cigarette use was positively associated with quit attempts (aOR=1.35, 95% CI: 1.16 to 1.58).

**Table 1** Prevalence of use of HTPs, cigarettes and e-cigarettes, and the association between HTP and e-cigarette use and attempts to quit cigarette smoking

	Total		HTP use: ever		Cigarette use: current		Attempted to quit cigarette smoking			P value
	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	n	%* (95% CI)	n/aOR† (95% CI)	
<b>Total</b>	59 532	100.0	1496	2.8 (2.5 to 3.0)	3611	6.5 (6.1 to 6.9)	2584	71.7 (70.3 to 73.2)	3611	
<b>HTP</b>										
Never	58 036	97.2 (97.0 to 97.5)			2485	68.1 (66.2 to 70.0)	1758	70.9 (69.1 to 72.7)	Reference	
Ever	1496	2.8 (2.5 to 3.0)			1126	31.9 (30.0 to 33.8)	826	73.6 (71.2 to 76.0)	1.07 (0.91 to 1.26)	0.4181
<b>Cigarette</b>										
Never	51 334	85.6 (84.9 to 86.2)	139	9.3 (7.8 to 10.8)						
Ever	8198	14.4 (13.8 to 15.1)	1357	90.7 (89.2 to 92.2)						
Current	3611	6.5 (6.1 to 6.9)	1126	75.5 (73.4 to 77.7)						
<b>E-cigarette</b>										
Never	55 284	92.3 (91.8 to 92.7)	199	12.8 (11.2 to 14.4)	1336	34.8 (33.0 to 36.6)	910	67.9 (65.4 to 70.3)	Reference	
Ever	4248	7.7 (7.3 to 8.2)	1297	87.2 (85.6 to 88.8)	2275	65.2 (63.4 to 67.0)	1674	73.8 (72.0 to 75.6)	1.35 (1.16 to 1.58)	0.0002
Current	1371	2.6 (2.3 to 2.8)	668	45.6 (43.0 to 48.2)	1108	31.8 (30.0 to 33.5)	812	73.8 (71.3 to 76.3)		
<b>Cigarette and e-cigarette</b>										
Current dual	1108	2.1 (1.9 to 2.3)	595	40.3 (37.8 to 42.7)						

Descriptive data are summarised in unweighted frequencies (n) and weighted percentages (%).

The results from unadjusted (not shown) and adjusted models were consistent.

\*Per cent among current cigarette smokers.

†Adjusted for sex, age, perceived household wealth, age at cigarette smoking initiation and past 12-month participation in school-based smoking prevention education.

HTP, heated tobacco product.

## What this paper adds

- ▶ The prevalence of heated tobacco product (HTP) use among South Korean adolescents is worrisome as it is expanding much faster than e-cigarette use.
- ▶ The majority of ever HTP users are currently using cigarette and/or e-cigarette products.
- ▶ Unlike use of e-cigarettes, use of HTPs is not associated with attempts to quit conventional cigarette smoking in adolescents.
- ▶ Bans on advertising with 'harm reduction' claims are required to protect adolescents, the priority group in tobacco control.

## DISCUSSION

Despite the survey being conducted only 1 year after HTP introduction to Korea, ever HTP use among adolescents reached 2.8%. Given the experience with e-cigarettes, even faster expansion within a few years is possible. Indeed, a year after e-cigarette introduction, 0.5% of adolescents reported ever using e-cigarettes.<sup>13</sup> Three years later, a 20-fold increase to 9.4% was observed.<sup>14</sup> Furthermore, considering the sales ban on all tobacco products to minors and the expensive purchasing price of the device required, adolescent HTP use is not fairly low compared with older counterparts. In a survey conducted among Korean young adults 3 months after IQOS introduction, ever IQOS use was 5.7%.<sup>5</sup>

Use of cigarettes and/or e-cigarettes among HTP users suggest that the tobacco industry's reduced harm claims are misleading. In the application to market IQOS as a modified risk tobacco product, PMI asserted only *switching completely* from cigarettes to IQOS would modify risk or exposure.<sup>15</sup> Nevertheless, complete switching is unlikely, as three-quarters of adolescent ever HTP users are currently smoking cigarettes. Adolescent polytobacco users are unlikely to discontinue the use of all tobacco products.<sup>16</sup> These users require public health action as they are associated with greater nicotine dependence and detrimental health outcomes.<sup>16 17</sup>

HTPs do not appear to be a perceived cessation regimen among cigarette smokers wishing to quit. In contrast, our findings corroborate results from studies on Korean adolescents showing e-cigarette use is associated with attempts to quit cigarette smoking among conventional cigarette smokers.<sup>14 18</sup> The lack of an association between HTP use and cigarette quit attempts is notable, as it suggests HTPs have a role in polytobacco use rather than serving as a method to quit cigarettes. Prevention efforts regarding HTPs should inform adolescents that concurrent use poses even more serious health consequences.<sup>16 17</sup>

The limitations of this study include its cross-sectional nature, which precludes causal inferences. Second, self-report measures of tobacco/nicotine products use may have underestimated prevalence. Third, HTP users were defined as ever users, and such a definition may not imply continued use. However, experimental use of new tobacco/nicotine products can provide insight, as it often predicts continued use.<sup>19</sup> Ever and current use measures of all tobacco product types, including HTPs, are required to monitor market penetration.<sup>20</sup>

HTP use among Korean adolescents reached 3% within 1 year of introduction. HTPs penetrated into 32% of current cigarette smokers. Use of cigarettes and/or e-cigarettes among HTP users were highly prevalent. Based on the precautionary principle,

bans on advertisements with harm reduction claims are required immediately.

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## ORCID iDs

Heewon Kang <http://orcid.org/0000-0002-1519-5678>

Sung-il Cho [0000-0003-4085-1494](http://orcid.org/0000-0003-4085-1494)

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