



■ Original Article

Comparison of the Smoking Cessation of Heated Tobacco Product Users and Conventional Cigarette Smokers in Korea

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See editorial commentary page on 127

Background: Since the introduction of heated tobacco products (HTPs) in Korea in 2017, their annual sales have increased. Several studies have investigated the perceptions of HTPs and smoking cessation behaviors. For the first time, In 2019, questions focused on HTP use were introduced in the Korea National Health and Nutrition Examination Survey (KNHNES). This study aimed to compare smoking cessation behaviors between HTP users and conventional cigarette smokers using KNHANES data.

Methods: Data of 947 current adult smokers from the 8th KNHNES (2019) were analyzed. Current smokers were divided into conventional cigarette (CC)-only, HTP-only, and dual-use groups. The general characteristics of the three groups were investigated. Differences in current intention to quit smoking and past attempts to quit smoking among the three groups were analyzed using multivariate logistic regression analysis by IBM SPSS ver. 25.0.

Results: HTP-only users demonstrated fewer future smoking cessation plans (adjusted odds ratio [AOR], 0.398; 95% confidence interval [CI], 0.195–0.813; P=0.012) and fewer smoking cessation attempts in the past year (AOR, 0.533; 95% CI, 0.298–0.954; P=0.034) than CC-only smokers. However, there was no significant difference between dual-use (CC+HTP) and CC-only smokers.

Conclusion: While dual-use and CC-only smokers showed similar smoking cessation behaviors, HTP-only users had fewer previous attempts to quit smoking and were less likely to be currently ready to quit smoking. These findings can be explained by a decrease in the need to quit smoking due to the convenience of HTP and the perception that HTPs are less harmful than CC.

Keywords: Heated Tobacco Products; Smoking Cessation; Quit Smoking; Cigarette

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INTRODUCTION

Heated tobacco products (HTPs) are a new type of cigarette in which nicotine in tobacco leaves is inhaled in the form of an aerosol by the heating of a cigarette containing a stick or pod of compressed tobacco at a temperature lower than that for conventional cigarettes (CCs) (less than 350°C).¹⁾ Since the first HTP (IQOS) was launched in Korea in June 2017, the sales volume of HTPs has been rapidly increasing. In 2021, 3.15 billion packs of CCs were sold in Korea, a decrease of 2.0% from 3.21 billion packs in the previous year; meanwhile, 440 million packs of HTPs were sold, an increase of 17.1% from 380 million packs in the previous year.²⁾

A positive perception in society is that HTPs supplement the shortcomings of CCs. Their advantages include no unpleasant odors, no cigarette smoke, no secondhand smoke, attractive device designs, and affordable prices.³⁾ In addition to these advantages, HTPs are perceived to be less harmful to health. This is because HTP companies have advertised that the generation of tar and other harmful substances, and human exposure to harmful substances, are remarkably reduced by the heating method. The US Food and Drug Administration also designated the HTPs of Philip Morris as modified risk tobacco products, allowing marketing for US consumers that heating cigarettes significantly reduces the generation of harmful substances.⁴⁾ Some even expected the smoking cessation effect of HTPs as a stepping stone from CC use to smoking cessation.

However, the safety and smoking cessation effects of HTPs remain controversial. In a systematic review of 25 studies conducted from 2015 to February 2021 on the harmful effects of HTPs on the body, the risk of chronic diseases, such as respiratory disease, cardiovascular disease, and cancer, may be reduced with HTP versus CC use.⁵⁾ Consistent improvements in respiratory symptoms, exercise tolerance, quality of life, and exacerbation rates were also seen in patients with chronic obstructive pulmonary disease who significantly reduced their smoking burden by quitting smoking or switching to HTPs.⁶⁾ Meanwhile, analyses of harmful tobacco substances by tobacco companies and independent researchers recognized that HTPs reduced the emission of some harmful substances; however, the nicotine and tar concentrations and smoking amounts did not significantly differ from those with CCs.⁷⁾ In 2018, the Ministry of Food and Drug Safety analyzed 11 harmful ingredients of HTPs and found that human carcinogens, such as formaldehyde and benzene, were as prevalent as in CCs.⁸⁾ Even if the exposure to harmful substances is low with HTP use, reducing the concentration of harmful substances may not proportionally reduce a smoker's health risk.⁹⁾ As such, the effect of HTPs on users and public health has not been clearly verified.

The number of participants in smoking cessation clinics in Korea, which had been steadily increasing until 2017, has shown a decreasing trend since 2018, as has the amount of support for smoking cessation drug prescriptions.¹⁰⁾ It is unclear whether the introduction of HTPs was the cause of the declining trend in participation in smoking cessation clinics; nevertheless, this possibility can be questioned. Several

studies have examined the effects of HTPs on smoking cessation. Most were cross-sectional studies, while only a few longitudinal studies or randomized controlled trials (RCTs) considered smoking cessation as an outcome.¹¹⁾ In one study, more HTP smokers reported that HTPs were helpful in quitting smoking than nonsmokers; this trend was greater in dual users of HTPs and CCs and triple users of HTPs, liquid e-cigarettes, and CCs.¹²⁾ However, in several other studies, no significant difference in smoking cessation intentions or success rates were noted between HTP use and non-use.^{3,13,14)} A recent study examining all smoking cessation attempts using CCs, HTPs, and liquid e-cigarettes among Korean adults showed that the rates of future cessation intention and experience attempting smoking cessation were significantly lower in HTP versus CC smokers.¹⁵⁾ Previous studies of HTP use and smoking cessation in Korea were mainly conducted through online surveys and hospital visitor interviews.^{3,13,15)} There also have been studies on specific populations, such as adolescents and military personnel.^{1,16)} The selection bias of these previous studies cannot be ignored. Therefore, this study aimed to compare the smoking cessation behaviors of HTP versus CC smokers based on data from the Korea National Health and Nutrition Examination Survey (KNHNES), which contains representative data for Korean adults.

METHODS

1. Study Participants

Raw data from the 8th KNHNES (2019) were used in this study. Of the 8,110 individuals, 1,009 adults aged ≥ 19 years who smoked CCs or HTPs daily were included. Of these, 947 were finally included in this study, while the other 62 were excluded due to missing values for key variables (59 for education level, three for income, 54 for subjective health, and one for smoking cessation).

2. Measures and Covariates

In this study, the independent variable was set as smoking type to examine its effect on smoking cessation behavior. The smokers who reported they smoked CCs or HTPs (e.g., IQOS, Glo, or Lil) daily were classified into HTP-only, CC-only, or dual-use groups. The dependent variable, smoking cessation behavior, was defined as having a future smoking cessation plan or past smoking cessation attempt and was classified as presence or absence. The smokers with a future smoking cessation plan were defined as those who answered, "I have a plan to quit smoking within 1 month" or "I have a plan to quit smoking within 6 months" to the following question: "Do you plan to quit smoking in the future?" Those with a past smoking cessation attempt were defined as those who answered "yes" to the following question: "Have you ever quit smoking for more than 1 day (24 hours) in the past year?"

The controlled variables included age, sex, educational level, household income, residence type, marital status, perceived health status, and nicotine dependence. Nicotine dependence was defined as the time to the first cigarette consumption in the morning. Age was classified as 19–29 years, 30–39 years, 40–49 years, or ≥ 50 years; sex as male

or female; educational level as lower than middle school, high school graduate, or university degree or higher; household income as low, low to middle, middle to high, or high; residence type as house, apartment, townhouse, or other; marital status as married or unmarried; perceived health status as good, normal, or bad, including “very good” and “good” answers as good and “bad” and “very bad” answers as bad; and the time to first cigarette (TFC), ≤5 minutes, 6–30 minutes, 31–60 minutes, or >60 minutes after first waking.

3. Statistical Analysis

This study used raw data from the KNHNES, which was conducted using a two-stage stratified sampling design. The complex sample analysis method was performed by applying weights during the data analysis as described below.

A frequency analysis was conducted to understand the participants' general characteristics, smoking types, and smoking cessation behaviors. The Rao-Scott chi-square test was conducted to verify whether

smoking cessation behavior differed according to smoking type and general characteristics. A multivariate logistic regression analysis was conducted to verify the effects of CC and HTP smoking on smoking cessation behavior. Age, sex, educational level, household income, residence type, marital status, and perceived health status were adjusted for. Additionally, a chi-square test was conducted to evaluate the participants' general characteristics and smoking behaviors according to smoking type.

IBM SPSS ver. 25.0 (IBM Corp., Armonk, NY, USA) was used for statistical analysis, and the statistical significance level was set at $P < 0.05$.

This study was conducted after the investigators submitted a request for raw data and a summary of the use plan on the KNHANES website of the Korea Centers for Disease Control and Prevention (currently, Korea Disease Control and Prevention Agency). This study was approved by the Institutional Review Board of Samsung Medical Center (IRB no., SMC 2022-07-043; IRB examination exemption approval). Because this study was a retrospective design using publicly available

Table 1. General characteristics of study population according to smoking cessation behavior

Characteristic	Total	Readiness to quit the tobacco products			Quit attempts using tobacco products in the past years		
		Yes (n=239)	No (n=708)	P-value	Yes (n=458)	No (n=489)	P-value
Age (y)							
19–29	150 (19.5)	36 (25.9)	114 (74.1)	0.271	81 (56.9)	69 (43.1)	0.002
30–39	184 (21.0)	43 (20.5)	141 (79.5)		74 (35.0)	110 (65.0)	
40–49	213 (22.9)	63 (30.2)	150 (69.8)		106 (52.0)	107 (48.0)	
≥50	400 (36.5)	97 (24.0)	303 (76.0)		197 (48.9)	203 (51.1)	
Sex							
Male	804 (86.7)	204 (25.0)	600 (75.0)	0.928	387 (47.4)	417 (52.6)	0.220
Female	143 (13.3)	35 (25.3)	108 (74.7)		71 (53.9)	72 (46.1)	
Education							
≤Middle school	191 (15.9)	39 (20.1)	152 (79.9)	0.375	88 (47.5)	103 (52.5)	0.722
High school	413 (44.2)	104 (26.0)	309 (74.0)		206 (49.8)	207 (50.2)	
≥College	343 (39.9)	96 (25.9)	247 (74.1)		164 (46.7)	179 (53.3)	
Household income							
Low	162 (13.8)	40 (25.9)	122 (74.1)	0.630	87 (57.9)	75 (42.1)	0.030
Mid-low	241 (24.6)	55 (23.1)	186 (76.9)		121 (51.8)	120 (48.2)	
Mid-high	277 (30.8)	63 (23.4)	214 (76.6)		118 (41.6)	159 (58.4)	
High	267 (30.9)	81 (27.8)	186 (72.2)		132 (47.8)	135 (52.2)	
Housing type							
Detached house	321 (30.4)	68 (22.8)	253 (77.2)	0.528	158 (50.2)	163 (49.8)	0.585
Apartment	448 (49.9)	125 (26.0)	323 (74.0)		222 (48.7)	226 (51.3)	
Townhouse	171 (19.1)	42 (25.3)	129 (74.7)		75 (44.2)	96 (55.8)	
Others	7 (0.7)	4 (46.0)	3 (54.0)		3 (39.1)	4 (60.9)	
Marriage							
Yes	676 (67.8)	175 (25.7)	501 (74.3)	0.560	332 (48.7)	344 (51.3)	0.725
No	271 (32.2)	64 (23.5)	207 (76.5)		126 (47.3)	145 (52.7)	
Subjective health							
Good	283 (30.2)	71 (27.4)	212 (72.6)	0.354	132 (47.3)	151 (52.7)	0.827
Moderate	493 (52.5)	118 (22.9)	375 (77.1)		248 (49.3)	245 (50.7)	
Bad	171 (17.3)	50 (27.5)	121 (72.5)		78 (46.9)	93 (53.1)	
Type of smoking							
Exclusive CC	797 (83.2)	209 (26.2)	588 (73.8)	0.076	394 (49.8)	403 (50.2)	0.080
Exclusive HTP	80 (8.8)	14 (14.0)	66 (86.0)		32 (34.6)	48 (65.4)	
CC+HTP	70 (8.0)	16 (24.9)	54 (75.1)		32 (47.5)	38 (52.5)	

Values are presented as number (%).

CC, conventional cigarette; HTP, heated tobacco product.

data, the requirement for informed consent from individual patients was omitted.

RESULTS

Among the 6,190 individuals, 947 current smokers (excluding those <19 years of age, nonsmokers, and former smokers) were selected as the final study participants. Of them, 19.5% were 19–29 years old; 21.0% were 30–39 years old; 22.9% were 40–49 years old; and 36.5% were ≥50 years old. Meanwhile, 86.7% were men and 13.3% were women. Their educational levels were below middle school (15.9%), high school (44.2%), and college or higher (39.9%). Household income was classified as low (13.8%), low to middle (24.6%), middle to high (30.8%), or high (30.9%). Approximately 30.4% of the participants lived in houses, 49.9% in apartments, 19.1% in townhouses, and 0.7% elsewhere. Approximately 67.8% were married while 32.2% were unmarried. Approximately 30.2%, 52.5%, and 17.3% perceived their health as good, normal, and bad. Approximately 83.2% (n=797) smoked CCs only, 8.8% (n=80) smoked HTPs only, and 8.0% (n=70) smoked both. Meanwhile, 25.0% (n=239) had a smoking cessation plan within 6 months, and 48.2% (n=458) had previous attempts to stop smoking (Table 1).

Table 1 presents the differences in smoking cessation behavior according to general characteristics and smoking type. The future smoking cessation plans showed no significant differences in any general characteristics, while past smoking cessation attempts showed a significant difference according to age (P=0.002) and household income (P=0.030). The rate of past smoking cessation attempts was 56.9% among participants in their 20s, 35.0% among those in their 30s, 52.0% among those in their 40s, and 48.9% among those in their 50s, indicating that the rate was the highest among those in their 20s, followed by those in their 40s, 50s, and 30s. Meanwhile, the rate of past smoking cessation attempts gradually decreased among participants with low, low to middle, and middle to high household incomes and slightly increased in those with a high household income.

Although the significance probability was slightly higher than 0.05, the rate of having a future smoking cessation plan was 26.2% among CC-only smokers, 14.0% among HTP-only smokers, and 24.9% among

dual users. Among the HTP-only smokers, the rate of having a future smoking cessation plan was relatively low. Conversely, the rate of past cessation attempts was 49.8% among CC-only smokers, 34.6% among HTP-only smokers, and 47.5% among dual users. Similar to the rate of future smoking cessation plans, HTP-only smokers had a relatively low rate of past smoking cessation attempts.

Age, sex, educational level, household income, residence type, marital status, perceived health status, and TTFC in the morning were adjusted for to evaluate the association between smoking cessation behaviors and smoking type (Table 2). Initially, in the analysis using CC-only smokers as reference, HTP-only smokers had significantly lower rates of having a future smoking cessation plan than CC-only smokers (adjusted odds ratio [AOR], 0.398; 95% confidence [CI], 0.195–0.813; P=0.012). Meanwhile, the rate of having past cessation attempts was significantly lower among HTP-only smokers than among CC-only smokers (AOR, 0.533; 95% CI, 0.293–0.954; P=0.034).

Next, in the analysis using CC-only smokers as reference versus CC-only smokers and dual users, HTP-only smokers had significantly lower rates of having a future smoking cessation plan than CC-only smokers (AOR, 0.406; 95% CI, 0.201–0.815; P=0.012), while the HTP-only smokers had a significantly lower rate of having past cessation attempts than CC-only smokers (AOR, 0.529; 95% CI, 0.299–0.935; P=0.029).

We also compared the patients' general characteristics and nicotine dependence according to smoking type (Table 3). Age, sex, educational level, household income, residence type, marital status, perceived health status, TTFC, and average daily smoking amount were analyzed by group. We found significant differences in age, education level, household income, residence type, and TTFC. The proportion of those aged 50+ was also high. The proportions of those in their 40s and 30s were higher among HTP-only smokers and dual users, respectively. Educational level was relatively low among CC-only smokers. HTP-only smokers and dual users were more likely to be college graduates, whereas CC-only smokers were more likely to be high school graduates. Meanwhile, dual users had a relatively high household income, while the CC-only group had the highest proportion of participants with a low to middle income. The proportion of participants living in apartments was generally high, while a relatively high proportion of the

Table 2. Association between of type of smoking and smoking cessation behavior

Variable	Readiness to quit the tobacco products		Quit attempts using tobacco products in the past year	
	AOR* (95% CI)	P-value	AOR* (95% CI)	P-value
Type of smoking				
Exclusive CC	1.000		1.000	
CC+HTP	0.865 (0.480–1.558)	0.627	1.071 (0.616–1.861)	0.808
Exclusive HTP	0.398 (0.195–0.813)	0.012	0.533 (0.298–0.954)	0.034
Type of smoking 2				
CC or CC+HTP	1.000		1.000	
Exclusive HTP	0.406 (0.201–0.815)	0.012	0.529 (0.299–0.935)	0.029

AOR, adjusted odds ratio; CI, confidence interval; CC, conventional cigarette; HTP, heated tobacco product.

*Adjusted for age, sex, education, household income, housing type, marriage, subjective health, and the time to first cigarette.

Table 3. General characteristics and smoking behavior according to type of smoking (n=947)

Characteristic	Exclusive CC	Exclusive HTP	CC+HTP	P-value
Age (y)				<0.001
19–29	131 (20.7)	9 (10.6)	10 (17.1)	
30–39	130 (17.8)	27 (32.3)	27 (42.5)	
40–49	158 (20.3)	34 (45.8)	21 (24.8)	
≥50	378 (41.2)	10 (11.3)	12 (15.6)	
Sex				0.487
Male	674 (86.1)	67 (88.2)	63 (91.0)	
Female	123 (13.9)	13 (11.8)	7 (9.0)	
Education				<0.001
≤Middle school	185 (18.7)	3 (2.3)	3 (2.1)	
High school	362 (46.1)	27 (31.6)	24 (38.5)	
≥College	250 (35.2)	50 (66.1)	43 (59.5)	
Household income				0.045
Low	155 (15.3)	5 (6.7)	2 (5.1)	
Mid-low	210 (25.7)	14 (17.0)	17 (21.2)	
Mid-high	227 (30.2)	27 (36.6)	23 (30.2)	
High	205 (28.7)	34 (39.8)	28 (43.5)	
Housing type				0.010
Detached house	289 (32.6)	19 (21.5)	13 (17.3)	
Apartment	362 (48.4)	51 (66.5)	35 (47.3)	
Townhouse	139 (18.2)	10 (12.0)	22 (35.5)	
Others	7 (0.8)	0	0	
Marriage				0.492
Yes	569 (67.1)	58 (74.3)	49 (67.6)	
No	228 (9.9)	22 (25.7)	21 (32.4)	
Subjective health				0.198
Good	231 (29.6)	24 (29.8)	28 (37.0)	
Moderate	413 (52.0)	47 (61.1)	33 (48.2)	
Bad	153 (18.5)	9 (9.1)	9 (14.8)	
The time to first cigarette (min)				<0.001
≤5	209 (26.4)	19 (26.9)	14 (17.0)	
6–30	256 (31.3)	24 (26.8)	26 (36.2)	
31–60	151 (19.1)	17 (20.3)	15 (24.1)	
>60	181 (23.2)	20 (26.0)	15 (22.7)	
CC smoking amount	14.14±2.62		13.04±0.74	0.153
HTP smoking amount		13.78±0.86	10.82±0.78	0.011

Values are presented as number (%) or mean±standard deviation.
CC, conventional cigarette; HTP, heated tobacco product.

HTP-only group lived in apartments. CC-only smokers were relatively more likely than other smokers to live in houses, whereas the dual-use group was more likely to live in townhouses than the other groups.

Regarding the TTFC, dual users had the lowest smoking rate within 5 minutes of waking up, whereas CC-only and HTP-only smokers showed similar rates. A multivariate logistic regression analysis was conducted to verify the effects of dual-use smoking on TTFC. TTFC was classified as less than 30 minutes or more than 30 minutes, and the influences of age, sex, education level, household income, residence type, marriage, and subjective health perception were corrected. An analysis using CC-only smokers as a reference category revealed no significant effect on TTFC of dual-use smoking or HTP-only smoking versus CC-only smoking (Table 4).

The average number of cigarettes smoked per day for 1 month was also compared according to smoking type. The CC-only smokers

Table 4. Association between of type of smoking and the time to first cigarette in the morning

Type of smoking	The time to first cigarette	
	AOR* (95% CI)	P-value
Exclusive CC	1.000	
CC+HTP	1.102 (0.656–1.850)	0.713
Exclusive HTP	0.904 (0.530–1.541)	0.708

AOR, adjusted odds ratio; CI, confidence interval; CC, conventional cigarette; HTP, heated tobacco product.

*Adjusted for age, sex, education, household income, housing type, marriage, and subjective health.

smoked an average of 14.14 cigarettes; the HTP-only smokers, 13.78 cigarettes; and the dual-use smokers, 23.86 cigarettes. This yielded a combination of 13.78 CC and 10.82 HTP smoked per day overall.

DISCUSSION

This study compared the differences in the rates of having a future smoking cessation plan within 6 months and past cessation attempts within the last year among CC-only, HTP-only, and dual-user smokers using data from the 8th KNHNES. HTP-only smokers had significantly lower rates of future smoking cessation plans and past smoking cessation attempts than CC-only smokers. Similar results were also found in a study examining the smoking cessation attempts of adults using CCs, HTPs, and e-cigarettes in Korea.¹⁵⁾ There were no significant differences in the rate of future smoking cessation plans or past smoking cessation attempts between CC-only smokers and dual-use smokers. Meanwhile, HTP-only smokers had a significantly lower rate of past cessation attempts than CC-only smokers. In contrast to previous similar research results, a comparison of CC-only smokers and dual-use smokers revealed that HTP had less influence on smoking cessation plans than CC.

The overall willingness to quit smoking was low among HTP-only smokers, as the rates of previous cessation attempts and future smoking cessation plans were both low. We speculate that smokers with a low will to quit smoking stopped using CCs and switched to HTPs or that the need to quit smoking decreased with HTP use. However, although dual-use smokers were using HTPs, their rates of future smoking cessation plans and previous cessation attempts were similar to those of CC-only smokers. CC smoking seems to affect one's willingness to quit more than HTP smoking. Thus, HTP-only smoking may be associated with a decreased desire for smoking cessation. Therefore, it is invalid to claim that HTP use helps individuals quit smoking; rather, it may prevent smoking cessation.

This study could not investigate the reasons why smokers did not attempt to quit smoking. However, we assume that the various conveniences of HTP use and the perception that it is less harmful may have influenced these results. A study of 2,000 smokers found that HTP use was perceived to yield less exposure to odor, overall smoke, and secondhand smoke than CC and liquid cigarette use.³⁾ According to a study investigating the reasons for using HTPs in Europe, the most common reason was that HTPs were believed to be less harmful (39.5%).¹⁷⁾ The rate of perception that HTPs are less harmful was higher among HTP users than other users.^{12,15,18)} In addition, the more frequently HTPs were smoked, the higher the rate of such perceptions.¹⁸⁾

There were no significant differences in the rates of future smoking cessation plans according to age, sex, educational level, household income, residence type, marital status, or perceived health status. The rate of past smoking cessation attempts significantly differed according to age and household income, but it did not show a significant proportional relationship with age or household income. Therefore, no general characteristics were distinct in relation to the high rate of fu-

ture smoking cessation plans or past cessation attempts.

To determine the characteristics of HTP smokers, we analyzed their general characteristics, TTFC, and daily smoking amount according to smoking type. We found significant differences in educational level, household income, residence type, and TTFC according to smoking type. Age accounted for the most decreased parameter in the order of CC-only smokers > HTP-only smokers > dual-use smokers. HTP-only smokers had higher educational levels and household incomes than CC-only smokers, and the proportion of participants living in apartments was higher among HTP-only smokers than in the other groups. We found no significant differences in sex, marital status, or perceived health status.

Although there was a statistically significant difference in nicotine dependence based on the TTFC, it was not possible to confirm which type of smoking showed the highest nicotine dependence rate because no tendency toward an increase or decrease in TTFC was found. There was no significant difference in the average number of cigarettes smoked per day between the HTP-only and CC-only smokers, whereas dual-use smokers smoked 10 cigarettes or more a day than the other groups.

1. Strengths

First, this study used data from the KNHNES, which is representative of the general Korean population. Therefore, the data were randomized and surveyed under specific conditions. Because the survey reflected the general population, it included a wide range of smokers and a sufficient number of female smokers. Second, data from the KNHNES, which included the first HTP-related questions, were used when more than 1 year had elapsed since the introduction of HTPs in Korea. Finally, this study compared three groups, including a dual-use smokers group. In a 2017 study conducted in Japan, where HTPs were introduced earlier, 72% of HTP and e-cigarette users also used CCs.¹⁹⁾ At the time of the data collection, since HTPs had only been available in Korea for 1 year, there were as many dual users as single users who also smoked CCs.

2. Limitations

First, because this study used a cross-sectional design, it was impossible to reveal a clear causal relationship between HTP smoking and smoking cessation. A prospective RCT on the effect of HTP use on smoking cessation behaviors is needed to prove causality. Second, smokers who planned to quit smoking within 6 months were defined as those with readiness to quit tobacco products. The intention to quit in 6 months and the intention to quit in 1 month represented different stages of the behavioral change model. Having a smoking cessation plan within 1 month is a stronger indicator of readiness to quit smoking as a preparation stage, while having a plan to quit smoking within 6 months corresponds to the contemplation stage. Third, underlying diseases such as cardiovascular and lung diseases, which are known risk factors for smoking, were not included as controlled variables. Since perceived health status and the necessity to quit smoking would

directly affect smoking cessation behavior rather than diagnosis, only perceived health status was included as a controlled variable. Furthermore, the degree of depression and stress, which can affect smoking, was not included.^{20,21)} Finally, we could not analyze the smoking characteristics and specific smoking cessation behaviors of HTP smokers. As these aspects will help establish a specific smoking cessation policy targeting HTP-only smokers, further research is needed.

3. Conclusion

Although dual users and CC-only smokers showed similar smoking cessation behaviors, HTP-only smokers had lower rates of quitting attempts in the past year and a current readiness to quit smoking within 6 months. These findings can be explained by the convenience of HTP and the perception that it is less harmful to one's health. However, the effects of HTPs on health remain unclear. Since the introduction of HTPs in Korea, sales have gradually increased. In the future, it will be necessary to determine the effects of HTP use on smoking cessation and establish appropriate smoking cessation policies.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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