



Original Research

Changes in smoking patterns and characteristics of Koreans using the Korea National Health and Nutrition Examination Survey 2013–2021 data

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ARTICLE INFO

Article history:

Received 7 September 2023

Received in revised form

30 November 2023

Accepted 8 December 2023

Keywords:

Non-cigarette tobacco products

Electronic nicotine delivery devices

Public policy

ABSTRACT

Objectives: This study explored factors related to Korean adults' smoking patterns and also the reasons for using new types of tobacco products.

Study design: Cross-sectional survey.

Methods: Data from the Korea National Health and Nutrition Examination Survey from 2013 to 2021 were used. The prevalence of the use of electronic cigarettes (e-cigarettes) or heated tobacco products (HTPs) alone or in combination with conventional cigarettes (CC) and the reasons for using new tobacco products are presented. Factors associated with using new types of tobacco products alone or in combination with CC compared to exclusive CC users were identified using multinomial logistic regression analysis.

Results: The prevalence of current smoking was 25.54% in 2013 and 23.05% in 2021, with no significant change. The prevalence of CC decreased from 23.39% in 2013 to 15.77% in 2021. The prevalence of new tobacco use in combination with CC did not show a definite trend. The prevalence of exclusive use of new tobacco was <1% until 2018 and has rapidly increased thereafter. Of the HTPs users, 46.68% responded with 'no cigarette smell' as the main reason for HTPs use, followed by 'It seems less harmful than cigarette' (19.19%), and 'It seems to be helpful for quitting smoking' (15.04%). Of the e-cigarette users, 45.19% responded 'It seems to be helpful for quitting smoking' as the main reason for e-cigarette use, followed by 'It is less harmful than cigarettes' (19.98%). Compared to CC users, new tobacco users were younger, had a higher household income or education, and used more nutritional supplements.

Conclusion: Regulations for newer tobacco products are more lenient than for traditional cigarettes, leading to misunderstandings, especially among women and young people. To increase awareness of the risks of these products, specific policies such as disclosure of ingredients, ban on online sales, and increase in consumption tax, are needed.

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Introduction

Tobacco smoking causes diseases, including cancer, cardiovascular diseases, respiratory diseases, reproductive disorders, and premature death.¹ The number of deaths due to tobacco use is eight million, including 1.3 million deaths of non-smokers due to

secondhand smoke, as estimated by the World Health Organization in 2023.² Despite the decreased prevalence of smoking since the 1990s, which is more pronounced in high-income countries where tobacco control policies and strategies were implemented early.^{3,4} In 2020, the global smoking rate among people aged 15 years and older was estimated to be 32.6% in men and 6.5% in women.³

Although countries have implemented various policies to control and manage cigarette smoking, tobacco companies have actively promoted new forms of tobacco products, such as electronic cigarettes (e-cigarettes) and heated tobacco products (HTPs). E-cigarettes comprise cartridges filled with e-liquids, heating elements/atomizers, mouthpieces, and rechargeable batteries. When

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e-liquid is vaporized as an aerosol, a sensation similar to that of smoking tobacco can be provided to users.⁵ Meanwhile, HTPs or 'heat-not-burn products' is an electronic device and heats tobacco at 350°C, which is lower than the conventional cigarette burn at 600°C.⁶ Tobacco companies have introduced these new products as odorless, less harmful, and helpful in quitting tobacco and have been proven to change smoking patterns.⁷ The shift from cigarette smoking to E-cigarettes or HTPs was accompanied by lower perceived barriers to using these products, contributing to a notable increase in their usage, particularly among young adults or adolescents.^{8,9}

Since the enactment of the National Health Promotion Act in 1995, Korea has implemented antismoking policies and projects. The projects included the expansion of non-smoking areas in 2002, increase in cigarette taxes, introduction of health warnings and pictorial warnings on cigarette packs in 2015, and regulation of tobacco advertising promotions in 2011.¹⁰ However, since e-cigarettes were on the market in 2007 and HTPs in 2018, Korea has applied the same standards to the new cigarettes, including nicotine, as the conventional cigarettes. Separate policies or regulations specifically for the new cigarettes have not been established.¹¹ In particular, in the case of e-cigarettes, in Korea, according to Article 2, Paragraph 1 of the Tobacco Industry Act, cigarettes are defined as manufactured entirely or partially from 'tobacco leaves,' so nicotine and pure water extracted from stems or roots rather than tobacco leaves are used.¹² Synthetic nicotine manufactured according to a chemical formula is added, so it is classified as an industrial product rather than a cigarette. Therefore, it is possible to sell it online or purchase it at unmanned stores, but there is a lack of legal sanctions for sales.

In Korea, E-cigarettes became available in the market in 2007, followed by the introduction of HTPs in 2018. However, the changes in smoking patterns after the introduction of new cigarette products and their related factors in the Korean population have rarely been investigated. Therefore, this study explored changes in smoking patterns, reasons for the use of new types of tobacco products, and factors associated with their usage among Korean adults.

Methods

Data and study participants

We used data from the Korea National Health and Nutrition Examination Survey (KNHANES). The KNHANES was initiated in 1998 in accordance with the National Health Promotion Act. The KNHANES is a nationwide cross-sectional survey with representative samples that monitors trends in the prevalence of health risk factors and major chronic diseases in Koreans. The first three surveys were conducted in 1998, 2001, and 2005. Since 2007, the KNHANES has become a continuous program conducted annually.¹³ The target population of the KNHANES comprises non-institutionalized Korean citizens residing in Korea, and representative samples, including approximately 10,000 individuals, are selected annually using a multistage clustered probability design. After obtaining informed consent, health interviews and nutrition surveys based on face-to-face interviews and health examinations were conducted.¹³

Because questionnaires about e-cigarettes use were included in 2013 and questionnaires about HTPs use were included in 2019 in the KNHANES, this study used KNHANES data from 2013 to 2021. Of the 69,776 individuals who participated in the survey from 2013 to 2021, 13,662 aged <19 years, 4368 with missing smoking-related questionnaire data, 10,859 former smokers, and 31,231 non-smokers, were excluded (Fig. 1). This study was approved by the

Institutional Review Board of the Hanyang University College of Medicine (IRB No. HYUIRB-202307-006).

Definition of smoking

To define smoking types, questionnaires of lifetime habit of cigarette smoking (never, <100 cigarettes, ≥100 cigarettes), current smoking cigarette status (smoking every day, smoking sometimes, had smoked but not currently), lifetime e-cigarettes use, e-cigarettes use during the past 1-month, lifetime HTPs use, and current use of HTPs were applied. We classified the participants into seven groups based on current combustible cigarettes, e-cigarettes, and HTPs use as follows: conventional combustible cigarettes-only users (CC); both conventional cigarettes and e-cigarettes users (CE); both conventional cigarettes and HTPs users (CH); both e-cigarette and HTPs users (EH); conventional cigarettes, e-cigarettes, and HTPs users (CEH); sole e-cigarette users (SE); and sole HTPs users (SH). In the KNHANES, current smoking rate was defined as the proportion of participants aged ≥19 years who had smoked ≥100 cigarettes in their lifetime and were smoking at the time of the survey. CC was defined as participants who used only combustible cigarettes and did not use EC or HTPs at the time of the survey. CE was defined as current smokers who used CC in combination with e-cigarettes. CH is a current smoker who uses conventional cigarettes in combination with HTPs. EH was defined as those who currently smoke both e-cigarettes and HTPs but not combustible cigarettes. CEH was defined as a current smoker using conventional cigarettes combined with E-cigarettes and HTPs. Participants exclusively utilizing either E-cigarettes or HTPs were defined as SE or SH, respectively.

To present an intuitive result, each specific smoker's characteristic was regrouped. 'CC + new tobacco' are defined as those who currently smoked a combustible cigarette and concurrently used a new tobacco type (e.g. CE, CH, CEH) at the time of participation in the KNHANES. 'New tobacco' referred to participants who smoked new types of tobacco but did not smoke combusted tobacco (e.g. EH, SE, SH) at the time of participation in the KNHANES.

Smoking-related variables

Of the questions included in the KNHANES, 'Are you planning to quit smoking?' with choices including 'within the next 1 month,' 'within the next 6 months,' 'sometime in the future, beyond 6 months,' and 'not planning to quit,' were applied to measure intention to quit smoking. The choice of 'within the next 1 month' was regarded as having the intention to quit smoking; the remaining responses were regarded as not having intention to quit, as previously described.¹⁴ A questionnaire was used to assess the daily consumption of combustible cigarettes and HTPs cigarettes. Questions on the motivation for using HTPs were measured in 2020, whereas reasons for using e-cigarettes were surveyed in 2015 and 2016.

Other considered variables

The demographic characteristics of the participants include sex, and age classified into groups: 19–29, 30–39, 40–49, 50–59, and ≥60 years. Socio-economic factors included the participant's household income as a quartile level and education (less than middle school, high school, college or more). Health behavior-related factors included average drinking frequency, which was defined as the average number of days of drinking per week during the past year (never, ≤1 days per week, 2–3 days a week, ≥4 days per week); aerobic exercise (≥2.5 h of moderate-intensity physical activity or ≥1.25 h of high-intensity physical

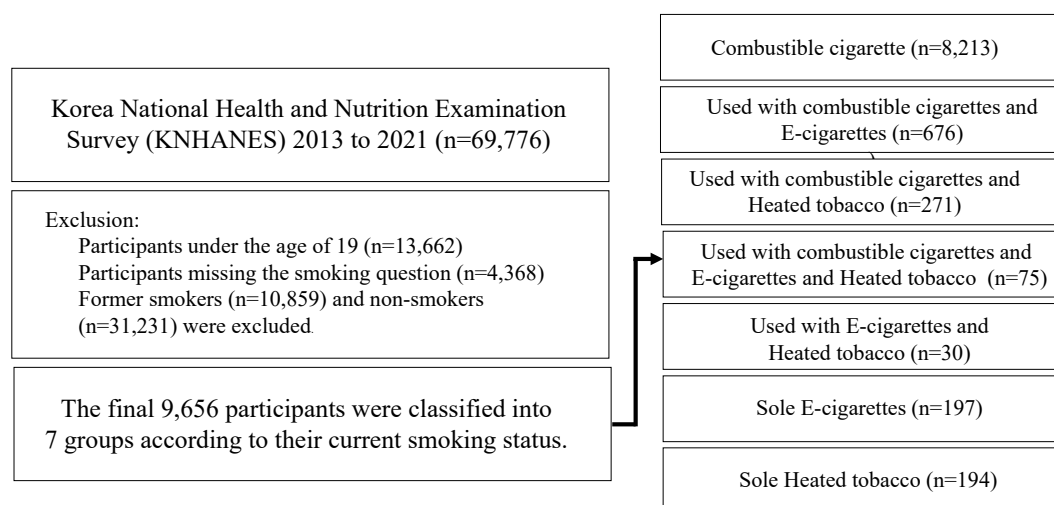


Fig. 1. Flowchart of the selection of study participants.

activity defined as physical activity guideline in Korean population¹⁴) per week (no, ≥ 1 day); strength exercise, which was defined as the number of days during the last week with strength exercises such as push-ups, sit-ups, dumbbells, weights, and barbells (no, 1–2 day, 3–4 days, ≥ 5 days); dietary supplementary use (no or yes); and body mass index (BMI), which was calculated by measured height and weight (<23 kg/m², 23.1–24.9 kg/m², and ≥ 25 kg/m², according to the definition of the Korean Society for Obesity¹⁵).

Statistical analyses

The analysis was performed using the sample weights assigned to each participant. In the KNHANES, sample weights were constructed to represent the Korean population by accounting for the complex survey design, survey non-response, and post-stratification.¹³ The general characteristics of the study population according to the seven smoking status groups were compared using the Chi-squared test for categorical variables and analysis of variance for continuous variables. Subsequently, the Scheffe's test was applied for post hoc multiple comparisons. The age-standardized proportion of the seven smoking status groups for each year from 2013 to 2021 was depicted using the midyear population of 2006 as the reference standard. The reason for using E-cigarettes or HTPs among e-cigarette or HTPs users is presented as a proportion. To explore the factors associated with the use of new types of tobacco product, polynomial logistic regression was applied for users of both conventional cigarettes and new tobacco (e.g. CE, CH, and CEH) and for new tobacco users (e.g. EH, SE, and SH), compared with CC. The factors considered included sex, age, household income, education, drinking frequency, weekly aerobic exercise, weekly strength exercise, dietary supplement use, BMI, and willingness to quit smoking. The factors based on P -value <0.05 in simple polynomial regression analysis were included in the multiple polynomial regression analysis. The results were reported as odds ratios (ORs) and 95% confidence intervals (CIs) to determine the associations between factors. For ordinal variables with three or more levels, the P -trend was estimated to identify trends in the association according to order. Statistical significance was set at $P < 0.05$. All data analyses were performed using SAS 9.4 software (version 9.4, SAS Institute Inc., Cary, NC).

Results

Of the 9656 current smokers, the number of CC, CE, CH, CEH, EH, SE, and SH were 8213 (85.06%), 676 (7.00%), 271 (2.81%), 75 (0.78%), 30 (0.31%), 197 (2.04%), and 194 (2.01%), respectively (Fig. 1 and Table 1). Table 1 presents the demographic, socio-economic, and health behavioral characteristics of the study participants according to the smoking type. The mean age of the group that used new tobacco products was lower than that of the CC group (CC: 44.54; CE: 35.69; CH: 36.82; CEH: 33.89; EH: 36.74; SE: 36.64; SH: 40.78). More than 80% of the current smokers were male. The SH group included 18.17% female smokers, which was the highest proportion compared to the other smoking status groups ($P < 0.0001$). The average BMI of the CH, EH, and SH groups was higher than 25 kg/m². Groups using only new tobacco (EH, SE, and SH) and CH showed a higher proportion of education level of college or higher ($>50\%$) and use of dietary supplements ($>60\%$) compared with other types of smoking. The proportion of participants with an education level of college or higher was the lowest in the CC group (36.46%). The proportion of participants willing to quit smoking within the next 1 month was the highest in CE (22.01%) and lowest in SH (11.98%). The average number of daily combustible cigarettes use in the CC, CE, CH, and CEH groups was 13.70, 13.38, 10.99, and 11.95, respectively ($P < 0.0001$). Meanwhile, the number of HTPs used per day in the CH, CEH, EH, and SH groups was 8.80, 6.73, 11.45, and 11.93, respectively ($P < 0.0001$).

Fig. 2 shows changes in current smoking rates among adults aged 19 years and older in Korea from 2013 to 2021. Proportions are expressed as percentages in Supplementary Table 2. The current smoking rate decreased slightly to 25.54% in 2013 and 23.05% in 2021. The prevalence of CC decreased from 23.39% in 2013 to 15.77% in 2021. The current smoking rate among men decreased from 42.67% in 2013 to 37.18% in 2021. In particular, CC is showing a sharp decline from 40.66% in 2013. Current smoking prevalence among women gradually increased from 6.43% in 2013 to 8.46% in 2021, and no significant trend of change was observed in the prevalence of CC. Prevalence trends for traditional and new cigarette use increased from 2013 to 2015 and 2017 to 2019, respectively. The use of both regular cigarettes and new tobacco products decreased between 2015 and 2017 and after 2019. In contrast, the prevalence

Table 1
Demographic, socio-economic, and health behavioral characteristics of study participants according to smoking type.

n (%)	CC	CE	CH	EH	CEH	SE	SH	P-value ^a
	8213 (85.06)	676 (7.00)	271 (2.81)	30 (0.31)	75 (0.78)	197 (2.04)	194 (2.01)	
Population size (%)	7,506,073 (83.05)	727,938 (8.05)	296,345 (3.28)	28,353 (0.31)	84,120 (0.93)	192,778 (2.13)	202,938 (2.25)	
	Weighted %	Weighted %	Weighted %	Weighted %	Weighted %	Weighted %	Weighted %	
Sex								
Male	86.46	86.44	86.50	93.44	84.56	84.06	81.83	0.540
Female	13.54	13.56	13.50	6.56	15.44	15.94	18.17	
Age								
Mean (±SD)	44.54 (±0.20)	35.69 (±0.48)	36.82 (±0.67)	36.74 (±1.61)	33.89 (±1.37)	36.64 (±0.92)	40.78 (±0.72)	<0.0001
19–29	18.07	36.09	28.53	19.61	45.36	29.60	14.56	
30–39	20.95	29.28	34.40	49.93	23.45	40.09	28.26	
40–49	24.30	21.47	23.84	24.00	24.33	15.98	41.25	
50–59	20.94	10.22	11.96	3.24	4.34	5.70	14.10	
≥60	15.74	2.94	1.26	3.22	2.52	8.63	1.83	
Household income								
Lower	14.72	7.58	5.60	6.24	14.42	8.06	3.80	<0.0001
Middle lower	25.27	21.55	20.31	18.25	19.60	19.63	20.01	
Upper middle	31.55	35.25	36.80	18.08	31.44	38.00	31.44	
Upper	28.47	35.61	37.28	57.42	34.53	34.31	44.76	
Education								
Middle school or less	19.04	7.71	4.47	1.01	3.98	8.83	1.96	<0.0001
High school	44.50	50.04	41.51	32.01	54.69	34.59	34.83	
College graduate or more	36.46	42.25	54.01	66.98	41.33	56.58	63.21	
Drinking frequency^b								
None at all	8.00	6.38	4.80	3.92	4.85	7.45	11.19	0.024
Less than 4 days per month	47.14	51.57	54.03	65.86	52.50	59.06	47.56	
2–3 days per week	29.06	29.67	29.60	22.17	27.12	25.69	28.80	
4 or more days per week	15.80	12.37	11.57	8.05	15.53	7.81	12.45	
Aerobic exercise^c per week								
None	54.02	45.31	42.00	54.93	44.62	46.52	57.81	<0.0001
1 or more days per week	45.98	54.69	58.00	45.07	55.38	53.48	42.19	
Strength exercise^d per week								
None	73.01	69.10	59.80	62.59	68.43	59.98	68.18	<0.0001
1–2 days per week	10.30	11.72	15.02	26.50	18.33	15.10	15.16	
3–4 days per week	9.10	11.43	13.74	4.30	3.08	14.00	6.62	
5 or more days per week	7.59	7.75	11.44	6.60	10.16	10.92	10.04	
Dietary supplements use								
No	58.12	58.59	35.95	29.34	43.66	37.27	33.18	<0.0001
Yes	41.88	41.41	64.05	70.66	56.34	62.73	66.82	
Body mass index (kg/m²)								
Mean (±SD)	24.22 (±0.05)	24.84 (±0.18)	25.38 (±0.27)	25.12 (±0.83)	24.82 (±0.47)	24.49 (±0.25)	25.05 (±0.31)	0.012
<23	38.95	32.23	31.20	31.66	32.34	35.93	31.34	
23.1–24.9	22.29	22.16	19.88	22.89	20.04	21.93	22.74	
≥25	38.76	45.61	48.93	45.44	47.61	42.14	45.92	
Willingness to quit smoking within 1 month								
No	80.04	77.99	86.48	85.98	85.98	85.36	88.02	0.019
Yes	19.96	22.01	13.52	14.02	14.02	14.64	11.98	
Number of combustible cigarettes smoked per day								
Mean (±SD)	13.70 (±0.10)	13.38 (±0.31)	10.99 (±0.46)^e	–	11.95 (±1.00)	–	–	<0.0001
Number of heated tobaccos smoked per day								
Mean (±SD)	–	–	8.80 (±0.45)^f	11.45 (±1.26)	6.73 (±0.67)^f	–	11.93 (±0.58)	<0.0001

CC, combustible cigarette; CE, combustible cigarettes and e-cigarettes; CEH, combustible cigarettes and e-cigarettes and heated tobacco; CH, combustible cigarettes and heated tobacco; CI, confidence interval; EH, e-cigarettes and heated tobacco; KNHANES, Korean National Health and Nutrition Examination Survey; SE, sole e-cigarettes; SH, sole heated tobacco.

^a Categorical data were analyzed using the Chi-squared test, and continuous data were analyzed using analysis of variance. The analysis of variance post-hoc test was performed using Scheffé's test.

^b Drinking frequency was defined as the average number of drinking days per week over the past year.

^c Aerobic exercise was defined as ≥2.5 h of moderate-intensity physical activity or ≥1.25 h of high-intensity physical activity.

^d Strength exercise was defined as the number of days during the last week with strength exercises, such as push-ups, sit-ups, dumbbells, weights, and barbells.

^e $P < 0.05$, relative to combustible cigarettes (Scheffé's test).

^f $P < 0.05$, relative to sole heated tobacco (Scheffé's test).

of new tobacco users was less than 1% until 2018 and has increased rapidly since then. Exclusive use of new cigarettes remained low at less than 1% through 2018 but increased to 5.45% in 2021, a trend consistently observed for both men and women (Fig. 2 and Supplementary Table 2). Supplementary Table 3 shows the annual prevalence of CC, CE, CH, CEH, EH, SE, and SH users from 2013 to 2021. Table 2 presents the primary motivation for using new types of tobacco products. Of the HTPs users, 46.68% selected 'no cigarette smell' as the main reason of HTPs use, followed by 'It seems less

harmful than cigarette' (19.19%), and 'It seems to be helpful for quitting smoking' (15.04%). Of the e-cigarette users, 45.19% responded 'It seems to be helpful for quitting smoking' as the main reason for e-cigarette use, followed by 'It is less harmful than cigarettes' (19.98%), and 'no cigarette smell' (16.65%).

Table 3 presents the factors associated with the use of new types of tobacco products alone or use in combination with conventional cigarettes. Based on multiple polynomial logistic regression analysis. Compared with CC, those who use both conventional cigarette

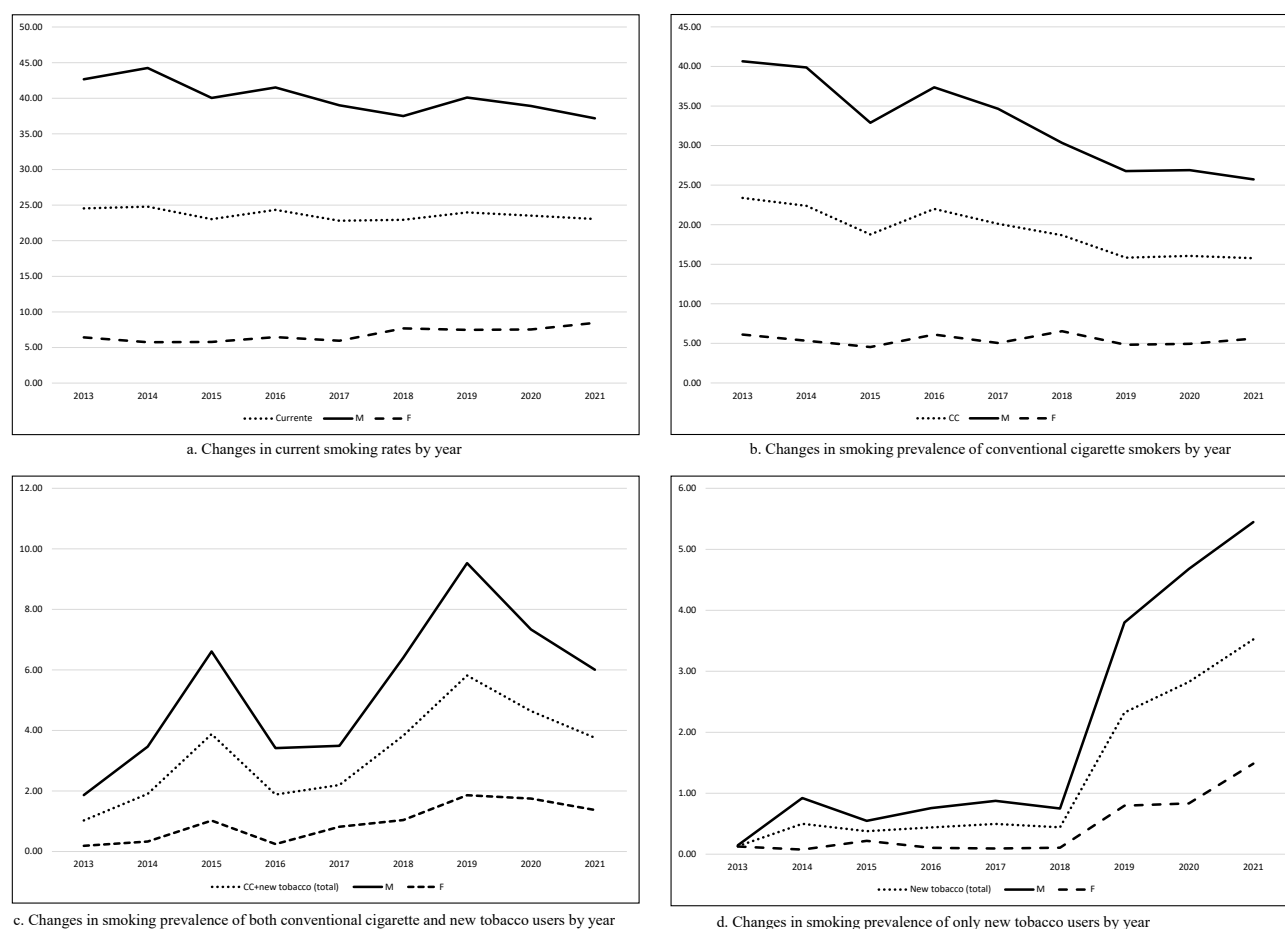


Fig. 2. Yearly prevalence of current smoking, conventional cigarette users, both conventional cigarette and new tobacco users, and solely new tobacco users from 2013 to 2021. Yearly prevalence was age standardized based on mid-year population in Korea, with the population in 2006 as a standard reference. New tobacco included electronic cigarette and heated tobacco product.

Table 2

Reasons for using new types of tobacco products.

Heated tobacco products (n = 170)	%
No cigarette smell	46.68
Less harmful than cigarettes	19.19
I think it will help quit smoking	15.04
Curiosity	10.76
Indoor smoking allowed	6.21
Others	0.84
The scent is better.	0.50
Can be easily obtained	0.49
Because it tastes good	0.29
Electronic cigarette (n = 238)	%
I think it will help quit smoking	45.19
Less harmful than cigarettes	19.98
No cigarette smell	16.65
The scent is better	8.81
Curiosity	4.61
Indoor smoking allowed	3.64
Because it tastes good	0.48
Can be easily obtained	0.33
Others	0.31

The reasons for using heated tobacco were surveyed in 2020, and those for electronic cigarettes were surveyed in 2015 and 2016. The heated tobacco products group included current heated tobacco smokers, irrespective of their combination use of combustible cigarettes or electronic cigarettes. The electronic cigarette group included current electronic cigarette users, irrespective of their combination use of combustible cigarettes or heated tobacco products.

and new tobacco were younger (OR = 7.95, 95% CI = 4.63–13.67 in age 19–29 years compared with age ≥ 60 years, P -trend <0.001); had higher income (OR of upper middle = 1.62 [95% CI = 1.12–2.35] and OR of upper = 1.56 [95% CI = 1.05–2.31] compared with lower income group, P -trend 0.067); and higher dietary supplement usage (OR = 1.45, 95% CI = 1.20–1.75). Compared with CC, only new tobacco users were more likely to be women (OR = 1.62, 95% CI = 1.12–2.34); younger (OR = 3.98, 95% CI = 1.98–8.02 in age 19–29 years compared with age ≥ 60 years, P -trend <0.001); had a higher level of education (OR of high school = 2.10 [95% CI = 1.11–4.00] and OR of college or higher = 3.67 [95% CI = 1.92–7.04] compared with middle school or less, P -trend <0.001); had higher income (OR of upper = 2.38 [95% CI = 1.12–5.05] compared with lower income group, P -trend 0.015); and higher dietary supplement usage (OR = 2.32, 95% CI = 1.74–3.09). Although not statistically significant, compared with CC, those who used both conventional cigarettes and new tobacco or exclusively used new types of tobacco were less likely to be willing to quit smoking.

Discussion

In this study, we investigated the trends in CC and new cigarette use in Korea from 2013 to 2021, explored the reasons for new

Table 3

Factors associated with using new types of tobacco in combination with conventional cigarettes or alone based on the multiple polynomial logistic regression.

Classification	Both new tobacco and conventional cigarette users vs CC		Only new tobacco users vs CC	
	OR	95% CI	OR	95% CI
Sex				
Male	1.00		1.00	
Female	1.06	0.82–1.38	1.62	1.12–2.34
Age				
19–29	7.95	4.63–13.67	3.98	1.98–8.02
30–39	5.87	3.57–9.67	3.40	1.78–6.48
40–49	4.01	2.45–6.56	3.05	1.68–5.53
50–59	2.30	1.38–3.82	1.00	0.50–1.98
≥60	1.00		1.00	
<i>P-trend</i>	<0.001		<0.001	
BMI				
Normal	1.00		1.00	
Underweight	0.89	0.69–1.15	0.82	0.55–1.24
Obesity	1.20	0.95–1.51	1.00	0.68–1.47
<i>P-trend</i>	0.029		0.506	
Education				
Middle school or less	1.00		1.00	
High school	1.33	0.89–2.00	2.10	1.11–4.00
College graduate or more	1.44	0.97–2.15	3.67	1.92–7.04
<i>P-trend</i>	0.161		<0.001	
Household income				
Lower	1.00		1.00	
Middle lower	1.42	0.95–2.11	1.29	0.60–2.74
Upper middle	1.62	1.12–2.35	1.59	0.77–3.27
Upper	1.56	1.05–2.31	2.38	1.12–5.05
<i>P-trend</i>	0.067		0.015	
Dietary supplements				
No	1.00		1.00	
Yes	1.45	1.20–1.75	2.32	1.74–3.09
Strength training				
None at all	1.00		1.00	
1–2 days per week	1.12	0.84–1.49	1.35	0.85–2.16
3–4 days per week	0.81	0.58–1.14	1.00	0.59–1.71
5 or more days per week	1.13	0.80–1.59	1.63	0.94–2.82
<i>P-trend</i>	0.453		0.225	
Will to quit smoking				
No	1.00		1.00	
Yes	0.85	0.69–1.04	0.76	0.55–1.06

cigarette use, and identified the factors affecting changes in smoking rates and the use of new cigarettes.

The study found that while the overall prevalence of CC usage has declined in Korea, particularly among men, the use of new tobacco products such as E-cigarettes and HTPs has increased across both sexes. This shift occurs in the context of various anti-smoking policies aimed at reducing smoking rates.¹⁶ However, within these antismoking environments, new types of tobacco have been suggested as alternatives to conventional cigarettes or as assistant tools for smoking cessation.¹⁷ E-cigarettes are more popular in Western countries, whereas HTPs are more common in Asian countries.¹⁸ In the Korean population, despite the late introduction of HTPs compared with e-cigarettes, the prevalence of CH or SH users (3.37% and 1.42%, respectively) was higher than that of CE or SE users (1.25% and 0.59%, respectively) in 2019, 1 year after the introduction of HTPs (Supplementary Table 3). A meta-analysis of HTPs use showed that Japan and South Korea had the highest prevalence of current HTP use.¹⁹ Although a direct comparison between the studies included in the meta-analysis would be difficult due to differences in participants, this study showed a rapid and sustained increase in new tobacco product use after 2018, coinciding with the introduction of HTPs in Korea. In 2019, the prevalence of current HTP use in Korea was 6.31% (Supplementary Table 3; sum of CH, EH, CEH, and SH), 10.5% in men and 1.9% in women, comparable to the studies included in the meta-analysis. This increase highlights the need for ongoing monitoring and

intervention strategies to prevent the adoption of new tobacco products and to promote effective cessation methods.^{23–26}

This study also explored the reasons behind the use of these new tobacco products. Many e-cigarette users expect these devices to aid in smoking cessation, whereas HTPs users primarily seek to avoid the smell associated with CC. Approximately 20% of the users believed these new products to be less harmful than CC. According to a previous online survey in Korea, HTP users perceived HTPs to be less odorous, with less smoke and less secondhand smoke exposure, and more helpful for smoking cessation compared with the perception of other cigarette product users regarding HTP.²⁰ These results are comparable to the reasons for HTP use in the present study population. In European countries and Japan, the most common reason for HTPs use is the perception that it is less harmful than CC.^{21,22} HTP marketing focuses on defining HTPs as having fewer harmful effects on health and less odor than CC.²³ In Korea, the desire to mitigate the unpleasant smell associated with smoking is considered important in light of the public awareness of the detrimental effects of secondhand smoke.^{24,25} This study suggests that the marketing of HTPs, which emphasizes reduced health risks and less odor, may influence their popularity.

The most common reason for e-cigarette use in Western countries was the intention to quit CC by switching to e-cigarettes,^{26,27} which is the same as that in our study. In our study, despite the perception of e-cigarettes as a smoking cessation tool, the average number of cigarettes smoked daily was similar between the CC and

e-cigarette users. E-cigarettes consist of a battery-powered device that heats a liquid that typically contains nicotine, the amount of which can be modified according to user preferences. HTPs heat tobacco without combustion, allowing it to be used in a manner similar to smoking CC.¹⁸ This finding indicates that switching to new tobacco products may not effectively reduce tobacco consumption in terms of the number of cigarettes smoked per day. Moreover, the study highlighted a lower willingness to quit smoking among new tobacco product users, except for those using both CC and e-cigarettes.³⁵

New tobacco product users tended to be younger, have higher household incomes and educational levels, and were more likely to use dietary supplements. This reflects a greater health consciousness among these individuals. Although adults may use e-cigarettes to quit or reduce smoking, young adults are more susceptible to the initiation of new types of tobacco through the media²⁸ and use them for novelty and curiosity.^{29,30} In addition, surrounding sanctions have been reported to significantly influence smoking choices at young age.³¹ Because new types of tobacco are perceived as less harmful than CC,²⁹ health conscious smokers typically prefer new types of tobacco. In Korea, the low smoking prevalence among Korean women is attributed to the negative social stigma toward female smoking.³² However, the higher odds of women using new types of tobacco alone compared with CC could be attributed to the increased social acceptability of new types of tobacco as well as the marketing of new types of tobacco as attractive elements.^{33,34}

This study has several limitations. First, smoking status and the use of new tobacco products were measured using a questionnaire. Thus, information bias may have occurred, particularly in women with a more negative social attitude toward smoking.³⁵ Second, owing to the characteristics of this cross-sectional study, the reasons for new types of tobacco use and the factors related to the choice of smoking type and temporality could not be identified. Third, owing to the different years of inquiry about new types of tobacco (from 2013 for e-cigarettes and from 2019 for HTPs), only a small number of CEH and EH users could be identified. Thus, we divided the participants into new types of tobacco users in combination with conventional cigarettes, new types of tobacco users alone, and CC users. Considering the different characteristics of e-cigarettes and HTPs, combining these two types of new tobacco usage is not desirable. However, the factors associated with the use of new tobacco types separated by CE, CH, EH, CEH, SE, and SH showed comparable associations with CC (data not shown).

Conclusion

In Korea, the regulatory approach toward HTPs and e-cigarettes is comparatively lenient, treating them similarly or less stringently than CC. Increased HTP or e-cigarettes use based on misconceptions, such as being less harmful than conventional cigarettes or helpful in quitting smoking underscores the need for increased vigilance and proactive intervention to stem the rising tide of new tobacco product usage. To rectify these misconceptions and enhance consumer awareness of the potential risks of new types of tobacco, it is essential to mandate the detailed disclosure of their contents, including nicotine, hazardous substances, and heavy metals. The urgency of these recommendations arises from the unique characteristics of new tobacco products, which are often wrongly perceived as safer alternatives to CC despite a lack of substantial evidence to support these claims. Consequently, the establishment and enforcement of comprehensive and specific control policies tailored to each new type of tobacco product are imperative to safeguard public health.

Author statements

Ethics approval

This study was approved by the Institutional Review Board of Hanyang University, Korea (Approval no: HYUIRB-202307-006). We obtained permission to analyze the pseudonymized data from all data sources. Thus, the requirement for informed consent was waived.

Funding

This study was not supported.

Competing interests

The authors have no conflicts of interest to disclose.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.puhe.2023.12.017>.

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