

BMJ Open Overall quit in triple users of conventional cigarette, e-cigarette and heated tobacco product among healthy adults: a Korea Medical Institute health check-up study

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ABSTRACT

Objective While multiuse patterns of e-cigarettes (EC) or heated tobacco products (HTP) with conventional cigarettes (CC) have been reported, smoking cessation of multiusers is not well known. We aimed to analyse overall quit in triple users of CC, EC and HTP among healthy adults.

Methods A questionnaire was conducted on 89 360 adults who visited the Korea Medical Institute health check-ups in Seoul, Korea, from May 2018 to September 2019. Among 38 812 ever smokers, 9252 were ever triple users of CC, EC and HTP. Frequency and related factors of overall quit were analysed in the cross-sectional study.

Results The average age was 38.8±9.0 years, and 8458 (91.4%) were men. There were 5329 (57.6%) current triple users, 3547 (38.3%) single or dual product quitters and 376 (4.1%) overall quitters. Among the former triple users, the most common tobacco product use pattern was 'dual quit of EC and HTP (eg, current CC use)' both in men (21.3%) and women (26.3%). Age 60s or older (OR 8.5, 95% CI 5.2 to 13.8), women (OR 1.7, 95% CI 1.1 to 2.5), no hyperlipidaemia and married status were significantly related to overall quit.

Conclusion The most common pathway for 'ever triple users' of the three tobacco products was 'current triple users', and the second was 'CC users'. Single or dual product quitters could continue to smoke by EC or HTP instead of quit. Further research on overall quit will be needed to develop effective regulations.

INTRODUCTION

As new tobacco products are released on the market, the pattern of multiuse of various tobacco products rather than exclusive conventional cigarette (CC) use has spread as a general phenomenon.^{1 2} About 40% of smokers used multiple tobacco products similar to both adults and youths in the USA.³ In the Korea National Health and Nutrition Examination Survey (KNHANES), the current use rate of e-cigarettes (EC) within 1 month among adults was 1.1% in 2013 but increased continuously to 2.7% (men 4.4%,

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ The study is considered meaningful as an analysis of the overall quit status and related factors of three major tobacco products, including heated tobacco products.
- ⇒ It is not representative of the entire population because there are many city dwellers, office workers and men, and the age group has a large number of young adults and a small number of elderly people due to the characteristics of data.
- ⇒ It is a cross-sectional study that makes it difficult to identify causality.
- ⇒ This study could not investigate nicotine dependence.

women 0.9%) in 2017.⁴ Dual use rates of EC and CC were 12.0% among adults, 20.4% among university students⁵ and 25.7% in US adults.⁶

In Korea, three types of tobacco, CC, EC and heated tobacco products (HTP), including IQOS, account for most market share. After the launching of IQOS in June 2017 in Korea, triple use of CC, EC and HTP has also increased.² Current use of CC was 34.7% in men and 5.9% in women, EC 8.6%, 3.7% and HTP 10.7%, 2.9%, respectively. When the total tobacco current use rate (TCUR) calculation including CC, EC and HTP is attempted, it is higher than the CC smoking rate. Still, it becomes smaller than the sum of the three use rates by excluding duplication. The calculated TCUR was 38.2% for men and 6.5% for women, which was higher than the CC smoking rate.^{4 7} According to an analysis of the usage status of the three types of tobacco in 2018, among current smokers, 60.3% used only one type of tobacco products (eg, single users), 27.1% used two types (eg, dual users) and 12.7% used all three types of cigarettes (eg, triple users). Exclusive CC users showed

a decreasing trend, but HTP users and triple users had increased.⁸

Although the smoking rate in Korea has been declining, the fact that TCUR is higher than the CC smoking rate suggests that emerging tobacco products are threatening this decline in terms of all types of tobacco product use. One of the reasons can be explained by the possibility that multiple products may interfere with smoking cessation. It was reported that the intention to quit was low when using multiple tobacco products.⁹ Adolescent polyusers who used CC with HTP or EC together showed higher quit attempts, but they had a lower possibility of abstinence from CC. The result implies that the use of HTP has an inverse correlation with the CC smoking cessation rate. From the result, in the field of smoking cessation services, the need for a regulatory policy response to new products as well as CC has been raised.² Therefore, data about smoking cessation, including new products, are required, particularly for 'overall quit'. EC has been positioned to aid conventional tobacco cessation,¹⁰ but it is hard to say that quit with maintaining EC is an appropriate indicator to measure overall quits.

Previous studies have attempted to analyse smoking cessation of dual use of tobacco products, including CC and EC. In a cohort of CC-EC dual users and exclusive CC smokers followed up for 18 months, the 'abstinence from all tobacco product' rate of the dual user group and the exclusive CC user group was not different.¹¹ In another prospective study, the overall quits of exclusive CC users, CC-EC dual users and CC-nicotine replacement therapy (NRT) dual users were not different. However, the quit attempt was slightly higher in CC-EC dual users, and it was significantly higher in CC-NRT dual users.¹²

As above, there were reports on 'dual' overall quits on CC and EC, but it was hard to find studies on overall quit for 'triple' use, including HTP. Therefore, in this study, we aimed to analyse overall quit in triple users of CC, EC and HTP among healthy adults who visited a health check-up through a cross-sectional study.

The long-term health effects of EC have not yet been sufficiently verified by quality studies.^{13 14} The outcome of multiuse of tobacco products, such as the combination of EC and CC, is not even more apparent. In the case of HTP, the marketing period is shorter, and research is also needed. If other types of new tobacco products are introduced, multifaceted investigations such as influence on smoking cessation may be necessary to explore their impact in a short period. As the HTP sales market is expanding, such as being marketed in the USA in September 2019,² this epidemiological case of overall quit following multiple uses will help understand the real-world influence of new products on the market.

METHODS

Sample

The in-depth medical examination questionnaire survey was conducted on 89 360 examiners who agreed to the

survey among those who visited Korea Medical Institute (KMI) Gangnam, Gwanghwamun and Yeouido centres from 3 May 2018 to 11 September 2019. Among the participants, 50 548 without smoking experience were excluded, and finally, 9252 participants who had ever used the three products: CC, EC and HTP.

Measures

For independent variables, gender, age, marital status, educational background, average monthly income, drinking status, body mass index (BMI), cigarette product usage, high blood pressure, diabetes and hyperlipidaemia variables were used for analysis. Monthly income per household was surveyed as Korean won (KRW): less than KRW3.5 million, from KRW3.5 to less than KRW5.5 million, and KRW5.5 million or more. Then, it was converted based on the exchange rate of KRW1130 for US\$1; KRW3.5 million to US\$3077 and KRW5.5 million to US\$4837. BMI was categorised as underweight (BMI <18.5 kg/m²), normal (18.5≤BMI<23 kg/m²), overweight (23≤BMI<25 kg/m²) and obesity (BMI ≥25 kg/m²).

The blood pressure measurement method was measured after resting the arms at the heart level in a seated position with the back against the back for at least 5 min with an automatic blood pressure metre. Hypertension was diagnosed if the systolic blood pressure is 140 mm Hg or if the diastolic blood pressure is more than 90 mm Hg.

Diabetes was defined with fasting blood sugar higher than 126 mg/dL after more than 8 hours of fasting or if the blood sugar is 200 mg/dL more than 2 hours after a meal. Total cholesterol of 230 mg/dL or higher, low-density lipoprotein cholesterol 150 mg/dL or higher and fatty acid of 200 mg/dL or higher were determined to have hyperlipidaemia.

For dependent variables, quit status of triple tobacco product users was classified into single or dual product quit and overall quit, seven patterns in detail: (1) quit CC only, refers to the case with more than 6 months of CC abstinence and the current user of both EC and HTP, (2) quit EC only, (3) quit HTP only, (4) dual quit of CC and EC, (5) dual quit of CC and HTP, (6) dual quit of EC and HTP, and (7) overall quit of all the three tobacco products. 'Overall quit' refers to the case with 6 months or longer duration of CC abstinence, and that they had ever used EC and HTP but did not use them at the time of the survey.

The smoking history questionnaires used to define the quit status of triple tobacco products are as follows. Never CC users were defined as those who answered 'no' to the question: 'Have you ever used CC?'. Current CC users were defined as those who answered 'yes' to the question: 'Have you ever used CC?' and answered 'every day' or 'some days' to the question: 'How often do you smoke CC?' or answered '<6 months' to the question: 'period of quitting smoking?'

Never EC users were defined as those who answered 'no' to the question: 'Have you ever used EC?'. Current

EC users were defined as those who answered ‘yes’ to the question: ‘Have you ever used EC?’ and answered ‘every day’ or ‘some days’ to the question: ‘How often do you smoke EC?’.

Never HTP users were defined as those who answered ‘no’ to the question: ‘Have you ever used HTP?’. Current HTP users were defined as those who answered ‘yes’ to the question: ‘Have you ever used HTP?’ and answered ‘every day’ or ‘some days’ to the question: ‘How often do you smoke HTP?’.

Analyses

Frequency analysis was conducted to identify the general characteristics of a total of 89 360 study participants and 9252 triple users. A χ^2 test was conducted to test for differences in distribution according to quit patterns of participants. Logistic regression analysis was performed to identify the factors related to overall quit. All analyses used SAS V.9.4.

Patient and public involvement

No patient was involved.

RESULTS

The total KMI data participants were 53 608 men and 35 752 women, with an average age of 42.58 years. In the lifetime experience of using tobacco products, 9252 people were triple users of CC, EC and HTP (10.35%), and the final study participants of this study were 9252 people (online supplemental table S1). **Table 1** shows the general characteristics according to smoking cessation patterns of current triple use, single or dual product and overall quit of the three tobacco products including CC, EC and HTP among the ever triple users. The average age of the 9252 ever triple users was 38.8±9.0 years, and 8458 (91.4%) were men. Married participants accounted for 5034 (54.4%), college graduates 5411 (58.5%) and 563 (6.1%) had hypertension.

There were 5329 (57.6%) current triple users, 376 (4.1%) overall quitters and 3547 (38.3%) single or dual product quitters. Women (4.9% vs men 4.0%) and older age groups (50–59 years 6.0%, ≥60 years 29.9% vs 20–29 years 2.7%) showed more overall quitters. Compared with those in their 20s, the overall quit rate in their 30s, 40s, 50s and 60s was higher ($p<0.0001$). Among the former triple smokers, the most common tobacco product use pattern was ‘dual quit of EC and HTP (eg, current CC use)’ both in men (21.3%) and women (26.3%). It was the most common pattern among those in their 20s–50s, while those in their 60s and older had the largest number of overall quits of triple tobacco products ($p<0.0001$) (**table 2**).

In the case of overall quit, it was high at 4.61% for married people, 5.21% of educational level with high school graduation or less, of household members earning less than KRW3.5 million/month on average monthly income.

Table 1 Demographic characteristics of current and former triple users of tobacco products including CC, EC and HTP (n=9252)

		n (%)
Sex	Men	8458 (91.4)
	Women	794 (8.6)
Age (mean±SD)		38.8±9.0
Age group	20–29	1484 (16.0)
	30–39	3758 (40.6)
	40–49	2921 (31.6)
	50–59	922 (10.0)
	≥60	167 (1.8)
Marriage	Unmarried	2720 (29.4)
	Married	5034 (54.4)
	Etc*	396 (4.3)
	Missing	1102 (11.9)
Education	Under high school graduate	1784 (19.3)
	College graduate	5411 (58.5)
	Master’s degree	955 (10.3)
	Missing	1102 (11.9)
Monthly income per household (US\$)	<3077	1690 (20.7)
	3077–4836	2704 (33.2)
	≤4837	3756 (46.1)
Ever drinking	Yes	8736 (94.4)
	No	516 (5.6)
BMI†	Underweight	191 (2.1)
	Normal	2179 (23.6)
	Overweight	2185 (23.6)
	Obesity	4692 (50.7)
Hypertension	Yes	563 (6.1)
	No	8689 (93.9)
Diabetes	Yes	545 (5.9)
	No	8707 (94.1)
Hyperlipidaemia	Yes	340 (3.7)
	No	8912 (96.3)

*Etc: divorced, separation or bereavement.

†Underweight: BMI <18.5 kg/m². Normal: 18.5≤BMI<23 kg/m².

Overweight: 23≤BMI<25 kg/m². Obesity: BMI ≥25 kg/m².

BMI, body mass index; CC, conventional cigarettes; EC, e-cigarettes; HTP, heated tobacco products.

Single or dual product quit was high at 50.7% among those in their 20s, and current triple use was higher among those in their 30s, 40s, 50s and 60+ (55.0%, 65.9%, 63.3% and 35.3%, respectively). In addition, in the case of diabetes, the overall quit was 6.24%. Patients with hypertension and hyperlipidaemia were less likely to be overall quitters ($p<0.0001$) (**table 3**).

Table 2 Demographic characteristics according to smoking cessation patterns of current and former triple users of tobacco products including CC, EC and HTP (N=9252, n (%))

	Single or dual product quit (N=3547; 38.3%)							Overall quit (N=376; 4.1%)	P value
	Current triple use (N=5329; 57.6%)	Quit CC only (N=159)	Quit EC only (N=990)	Quit HTP only (N=327)	Dual quit of CC and EC (N=40)	Dual quit of CC and HTP (N=22)	Dual quit of EC and HTP (N=2009)		
Sex									
Men	4905 (58.0)	148 (1.8)	905 (10.7)	304 (3.6)	39 (0.5)	20 (0.2)	1800 (21.3)	337 (4.0)	<0.0001
Women	424 (53.4)	11 (1.4)	85 (10.7)	23 (2.9)	1 (0.1)	2 (0.3)	209 (26.3)	39 (4.9)	
Age group									
20–29	692 (46.6)	7 (0.5)	180 (12.1)	69 (4.7)	5 (0.3)	4 (0.3)	487 (32.8)	40 (2.7)	<0.0001
30–39	2068 (55.0)	62 (1.7)	472 (12.6)	161 (4.3)	16 (0.4)	13 (0.4)	823 (21.9)	143 (3.8)	
40–49	1926 (65.9)	64 (2.2)	261 (8.9)	73 (2.5)	12 (0.4)	4 (0.1)	493 (16.9)	88 (3.0)	
50–59	584 (63.3)	22 (2.4)	67 (7.3)	21 (2.3)	5 (0.5)	1 (0.1)	167 (18.1)	55 (6.0)	
≥60	59 (35.3)	4 (2.4)	10 (6.0)	3 (1.8)	2 (1.2)	0 (0.0)	39 (23.4)	50 (29.9)	

CC, conventional cigarettes; EC, e-cigarettes; HTP, heated tobacco products.

Table 4 shows the independent association of the overall quit of the three tobacco products with related factors by logistic regression, compared with single or dual product quit. The results showed that sex, age group and marital status variables were significantly related to overall quit. Women showed 1.7 times higher OR for overall quit (95% CI 1.1 to 2.5). Among the age groups, those in their 60s or older showed OR 8.5 (95% CI 5.2 to 13.8) compared with youth in their 20s and 30s. The married had OR 1.7 (95% CI 1.3 to 2.3) compared with the unmarried. Patients with hyperlipidaemia showed low OR (0.3, 95% CI 0.1 to 0.9) for overall quit.

DISCUSSION

Overall quit was the most common among those in their 60s and older (29.9%). Women, older age, non-hyperlipidaemia and married status showed a higher association with overall quit compared with single or dual product quit of the three tobacco products.

In previous reports, characteristics of smokers who successfully quit were old age,¹⁵ higher education,¹⁶ married,¹⁷ higher income,¹⁵ less frequent alcohol intake,¹⁵ low nicotine dependence¹⁸ and having chronic diseases like hypertension or hyperlipidaemia.^{19 20} In this study, old age was the most characteristic feature correlated with overall quit. Although the results of this study were consistent with the existing literature, the factors revealed there were for CC, rather than EC or HTP.

The results of marital status and age were consistent with previous studies. However, in this study, those who had a lower educational level or lower income had a higher proportion for overall quit. It may be explained by the social pattern of new tobacco products such as EC. It has also been reported that EC tends to be used by young, educated, high-income and employed groups, in contrast to CC.²¹ This is because young people are more responsive to new products, and the expense is required to purchase the device and accessories.

If new tobacco product users with these characteristics continue to use new products, it can be inferred that users with opposite features may quit them. However, up to now, EC users' characteristics have been mainly studied, but this study is meaningful as a piece of information reported in terms of characteristics of 'quitters'.

Patients with hypertension and hyperlipidaemia showed decreased association with overall quit. A total of 4353 (4.9%) had hypertension, and 1697 (1.9%) had hyperlipidaemia out of the initial 89 360 participants. However, among triple users, patients with hypertension and hyperlipidaemia were more frequent as 563 (6.1%) and 340 (3.7%), respectively. Participants with hypertension or hyperlipidaemia were more likely to be triple users or single or dual product users and showed fewer overall quit.

Smoking is known to be a risk factor for metabolic syndrome, hypertension and hyperlipidaemia. Nicotine increases blood pressure or pulse rate.²² Smokers have

Table 3 Demographic characteristics according to smoking cessation patterns of current triple use, single or dual product quit and overall quit of tobacco products including CC, EC and HTP (n=9252)

		Current triple use (n=5329)	Single or dual product quit (n=3547)	Overall quit (n=376)	P value
		n (%)	n (%)	n (%)	
Sex	Men	4905 (58.0)	3216 (38.0)	337 (4.0)	<0.0001
	Women	424 (53.4)	331 (41.7)	39 (4.9)	
Age group	20–29	692 (46.6)	752 (50.7)	40 (2.7)	<0.0001
	30–39	2068 (55.0)	1547 (41.2)	143 (3.8)	
	40–49	1926 (65.9)	907 (31.1)	88 (3.0)	
	50–59	584 (63.3)	283 (30.7)	55 (6.0)	
	≥60	59 (35.3)	58 (34.7)	50 (29.9)	
Marriage	Unmarried	1456 (53.5)	1182 (43.5)	82 (3.0)	<0.0001
	Married	3017 (59.9)	1785 (35.5)	232 (4.6)	
	Etc*	220 (55.6)	163 (41.2)	13 (3.3)	
	Missing	636 (57.7)	417 (37.8)	49 (4.5)	
Education	Under high school graduate	924 (51.8)	767 (43.0)	93 (5.2)	<0.0001
	College graduate	3195 (59.1)	2021 (37.4)	195 (3.6)	
	Master's degree	574 (60.1)	342 (35.8)	39 (4.1)	
	Missing	636 (57.7)	417 (37.8)	49 (4.5)	
Monthly income per household (US\$)	<3077	846 (50.1)	759 (44.9)	85 (5.0)	<0.0001
	3077–4836	1584 (58.6)	1021 (37.8)	99 (3.7)	
	≤4837	2263 (60.3)	1350 (35.9)	143 (3.8)	
	Missing	636 (57.7)	417 (37.8)	49 (4.5)	
Ever drinking	Yes	5009 (57.3)	3374 (38.6)	353 (4.0)	<0.0001
	No	320 (62.0)	173 (33.5)	23 (4.5)	

*Etc: divorced, separation or bereavement.

BMI, body mass index; CC, conventional cigarettes; EC, e-cigarettes; HTP, heated tobacco products.

a higher risk of hypertension, with 16.9% for men and 27.6% for women compared with non-smokers.²³ It has also been reported that dual users of CC and EC have a higher prevalence of metabolic syndrome than exclusive CC smokers.²⁴ Therefore, the results of this study can be thought of as reflecting a larger number of smokers in patients with hypertension and hyperlipidaemia because it is a cross-sectional study.

However, in this study, we want to emphasise one more focus that these patients with chronic diseases tried to quit smoking similar to the results of the previous report.¹⁹ Still, they only discontinued CC and continued tobacco use by changing to EC or HTP. The reason can be explained by the misperception of safety that EC or HTP is safer or less harmful than CC, which was reported in Korean adults and young Americans.^{25 26}

These misperceptions may have originated primarily from the tobacco companies' claims. Philip Morris International argued that switching CC to IQOS reduces smoking-related diseases.²⁷ Through this 'harm reduction' marketing, new products including HTP have been suggested as part of the tobacco industry's strategy to

undermine tobacco control policies.²⁸ According to this study, 'complete switching' seems to be difficult, and many became multiusers. Misleading perceptions can hinder overall quit, so accurate information delivery and regulatory policies are needed to overcome them.

Precedent research such as Sweet *et al*'s study has been reported on the dual quit, including smoking cessation of CC and EC. The study showed that in the short term of 6 months, dual users quit CC better than single tobacco product users, but there was no difference in the 12–18 months. Besides, there was no difference in overall quit between the above two groups at any time point.¹¹ As such, the dual use is related to the quit attempt and slightly related to the abstinence of CC, but in the end, it consistently showed the result of failure to overall quit.¹² This can be explained as dual users are aware of the harmfulness of cigarettes, try new tobacco products to quit CC smoking or change to new types of products based on the perception that they are less harmful but eventually fail to quit smoking altogether.

However, their tobacco products are of two types, CC and EC, while this study analyses triple smoking for three

Table 4 Factors related to overall quit compared with single or dual product quit of tobacco products including CC, EC and HTP (n=3923)

		OR for overall quit
		OR (95% CI)
Sex	Men	1.0
	Women	1.7 (1.1 to 2.5)
Age (years)	20–39	1.0
	40–59	1.3 (1.0 to 1.7)
	≥60	8.5 (5.2 to 13.8)
Marriage	Unmarried	1.0
	Married	1.7 (1.3 to 2.3)
	Etc*	0.9 (0.5 to 1.9)
Education	Under high school graduate	1.0
	College graduate	0.9 (0.7 to 1.3)
	Master's degree	1.1 (0.7 to 1.6)
Monthly income per household (US\$)	<3077	1.0
	3077–4836	0.9 (0.7 to 1.3)
	≤4837	1.0 (0.7 to 1.4)
Ever drinking	Yes	1.0
	No	0.9 (0.6 to 1.6)
BMI†	Underweight	1.0
	Normal	1.6 (0.6 to 4.0)
	Overweight	1.6 (0.6 to 4.2)
	Obesity	1.6 (0.6 to 4.2)
Hypertension	No	1.0
	Yes	0.7 (0.4 to 1.2)
Diabetes	No	1.0
	Yes	1.0 (0.6 to 1.6)
Hyperlipidaemia	No	1.0
	Yes	0.3 (0.1 to 0.9)

*Etc: divorced, separation or bereavement.

†Underweight: BMI <18.5 kg/m². Normal: 18.5≤BMI<23 kg/m².

Overweight: 23≤BMI<25 kg/m². Obesity: BMI ≥25 kg/m².

BMI, body mass index; CC, conventional cigarettes; EC, e-cigarettes; HTP, heated tobacco products.

products: CC, EC and HTP. In other words, this study attempted to suggest the necessity of a survey on overall quit, including HTP.

Smoking cessation mainly meant quit CC.²⁹ It has been based on 'six months' in many interventions, and this study used the same definition for CC. For EC or HTP, we asked if they were not using it at the survey time. Since new products were frequently tried or discontinued during the research period after the new product had been marketed, it was thought to be challenging to collect data sufficiently based on 3 or 6 months. Several questionnaires on EC and HTP asked abstinence on a 30-day basis.

The definition came from the current smoking in adolescents,^{2 3} but it was also used in adult studies.²⁵ Further discussion is needed on the question of EC, and HTP quit in adults.

The limitations of this study are, first, the KMI data have limitations in that it is not representative of the entire population because there are many city dwellers, office workers and men, and the age group has a large number of young adults and a small number of elderly people due to the characteristics of these data. However, these data have an advantage in that it was possible to analyse single, double and overall quits through a relatively large number of triple users, including mainly city workers who are known to have quickly accepted HTP. According to Kim and Cho's³⁰ study, as comparative data, out of 8000 people in the KNHANES for 1 year, there was a relatively small number of triple users, about 100 people. Second, it is a cross-sectional study that makes it difficult to identify causality, and design limitations should be considered in interpreting of the results. The operational definition of EC and HTP cessation was 'had ever used EC and HTP, but did not use them at the time of the survey', which may have included situations in which each tobacco product was no longer used after a few attempts, rather than a willingness to quit. It is thought that this could also be considered a quit status, meaning that they have not become a current user who continuously uses the product after the attempt. Also, this study could not investigate nicotine dependence. In future studies, it seems to investigate the nicotine dependence of multiusers.

However, the study is considered meaningful as an analysis of the overall quit status and related factors of three major tobacco products, including HTP. In smoking cessation counselling, it is necessary to develop a counselling strategy tailored to each target among the triple users such as men versus women, young versus senior citizens and married versus unmarried people. Youth group is known to be more active in trying new tobacco products,³¹ so unique approaches are required for the overall quit including emerging ones. In this study, their overall quit is less, so it is necessary to explore the reason and establish effective strategies and policies. In the case of patients with chronic diseases, it was also challenging to expect overall quit. This study has limitations to explain the cause. A prospective study that considers the course of chronic disease progression and nicotine dependence is required.

CONCLUSION

Of the total 89 360 participants in the study, 9252 (10.4%) experienced triple use. Among them, 5329 (57.6%) were current triple users, 3547 (38.3%) were single or dual product quitters and only 376 (4.1%) were overall quitters of the three tobacco products. Among the former triple smokers, the most common tobacco product use pattern was 'dual quit of EC and HTP', for example, current CC use. These results imply that the most common final

pathway for ‘ever triple users’ of the three tobacco products was ‘current triple users’, the second most common was ‘CC users’. Also, the large number of single or dual product quitters suggests that they continue to smoke by transferring them to EC or HTP instead of stopping them. Women, older age, no hyperlipidaemia and married status were associated with overall quit.

These data are meaningful in that it is the first study to analyse the overall quit of triple use of tobacco products, including HTP, as far as the authors know. Further research is needed on smoking cessation after multiple uses of various tobacco products considering nicotine dependence. Detailed research on overall quit with other new emerging tobacco products will be required to develop effective guidelines and regulations.

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Contributors HJK was responsible for the study design, conducted the research study and data analysis and interpreted the study findings. HWY conducted the data analysis, interpreted the study findings and wrote the paper. SHJ and KJJ reviewed the drafts and revisions of the final paper.

Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.

Patient consent for publication Obtained.

Ethics approval This study involves human participants and was approved by the Severance Medical Ethics Committee (4-2011-0444). Participants gave informed consent to participate in the study before taking part.

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Data availability statement Data sharing not applicable as no data sets generated and/or analysed for this study. This is a deidentified participant data from three health check-ups at Korea Medical Institute (KMI) and not an open data.

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