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Gender and tobacco epidemic in South Korea: implications from age-period-cohort analysis and the DPSEEA framework

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ABSTRACT

Objectives To understand a 20-year trend of gender-specific smoking prevalence among adults in South Korea.
Design Age-period-cohort analysis using the intrinsic estimator method was applied to examine the separate contribution of age, period and cohort effect on smoking prevalence. The Driving Force-Pressure-State-Exposure-Effect-Action (DPSEEA) framework was used to explain the observed smoking trends by mapping potential determinants and to address policy implications.
Setting General adult population in South Korea.
Participants 34 828 men and 43 632 women who aged 19–78 years, were not currently pregnant and were without a prior diagnosis of cardiovascular disease or cancer.
Outcome measures Gender-specific current smoking prevalence using the 1998–2017 Korea National Health and Nutrition Examination Survey.
Results Our results showed gender-specific age and birth cohort effects. More specifically, the smoking prevalence peaked at their mid-20s (prevalence rate ratio (PRR): 1.54, 95% CI: 1.49 to 1.59) and cohort born in 1959–1963 (PRR: 1.63, 95% CI: 1.57 to 1.70) and then decreased in men. On the other hand, in women, the smoking prevalence consistently increased until their mid-40s (PRR: 1.53, 95% CI: 1.27 to 1.84) and in recent birth cohort groups (PRR in 1994–1998 cohort: 1.55, 95% CI: 1.13 to 2.13). The period effects declined from 1998–2002 to 2003–2007, following increasing fluctuations in both genders. The smoking-DPSEEA framework showed the absence of policy actions to target female smokers and emphasised a proactive approach that tackles the upstream causes for smoking in women.
Conclusions Men and women are clearly in different phases of the smoking epidemic in Korean population, and gender-tailored policies should be implemented.

BACKGROUND

Smoking is the leading preventable cause of death worldwide, with 8.2 million premature deaths annually.[1] Since the publication of the 1964 Report of the Advisory Committee to the US Surgeon General, a landmark report

Strengths and limitations of this study

► This study examined a 20-year trend of gender-specific smoking prevalence using the age-period-cohort (APC) method and the Driving Force-Pressure-State-Exposure-Effect-Action (DPSEEA) framework, which allows policymakers to understand long-term trends of smoking prevalence and to address policy implications.
► Our APC-DPSEEA method could potentially be applied to various health behaviours and health outcomes in examining the temporal trends and organising potential determinants of the observed trends.
► The casual inference from this study is limited due to the ecological and descriptive characteristics inherent in the APC method.

on the adverse health effects of smoking,[2] tobacco prevention activities have been widely accepted and made a substantial contribution to reduce smoking-related deaths.[3] However, the number of adolescents and women who smoke continues to increase, and smoking and relevant health problems remain unresolved in many countries.[1 4 5]

South Korea is worth studying due to its gender-specific rise and fall of smoking prevalence. Through the 1990s, with the smoking rate reaching the epidemic level (73.0% in 1995[6]), smoking prevalence among men has steadily declined over the last 20 years.[7] Despite the substantial reduction in tobacco use, smoking in men remains high among organization for economic co-operation and development (OECD) countries.[8] In contrast, the smoking prevalence among women was lowest (6.0% in 1995 to 7.7% in 2018), which was notable given the high smoking rate among Korean men and that in other countries.[8] However, a recent national

survey indicates an upward trend in women's smoking prevalence, especially among the younger generation.[7] Moreover, the average age at which people start smoking has decreased in men and women, but the magnitude of decline was greater in women. From 1998 to 2018, the average age of smoking initiation decreased by 2.0 and 5.9 years in men and women, with a mean age of 18.8 and 23.5 years.[9] It is generally accepted that women's smoking differs from men's smoking in terms of the motivation for smoking initiation and cessation,[10 11] smoking habits[12] and biological susceptibility to the health effects of smoking.[12–14] Additionally, social, cultural and environmental factors differently affect smoking behaviour in men and women.[15–17] Therefore, this gender-specific pattern in smoking rates indicates the need to understand the past smoking trends and their underlying determinants by gender.

Age-period-cohort (APC) analysis is a useful method to describe a secular trend of a given risk factor. The APC analysis decomposes the observed trend into three dimensions: age, period and cohort.[18] It attributes changes to (1) age effect reflecting biological, psychological and behavioural changes associated with ageing, (2) period effect reflecting social and cultural changes due to events or policy implemented during the specific period and (3) cohort effect reflecting changes across different cohort groups who experience the same physical and social events/environments in the same year. Previous studies have examined the effects of each APC variable on smoking prevalence and found significant age and birth cohort effects.[19–22] Furthermore, these studies have shown different patterns on age, period and cohort effect according to gender and socioeconomic status, which resulted in social inequality in smoking. Several studies were conducted in Korea but they were only based on adolescents[23 24] or young adults aged 19–30.[25] While these studies have discussed potential explanations for the trends in smoking prevalence, there is limited information organised systematically based on the whole chain of causes that contribute to smoking. The APC analysis describes secular trends in terms of age, period and cohort, thus, mapping the underlying determinants is needed to better understand the changing smoking patterns at the population level and address policy implications.

The WHO developed the Driving Force-Pressure-State-Exposure-Effect-Action (DPSEEA) framework to describe cause-and-effect linkages of health problems and identify policy targets.[26 27] This framework consists of the following steps: Driving force, Pressure, State, Exposure, Effect and Action (online supplemental figure 1). In this study, we took the DPSEEA framework to organise potential determinants of smoking prevalence. The DPSEEA framework has its strengths in organising and visualising proximal causes and underlying social, economic and cultural conditions that create health problems in their chain of causes. It also allows the 'Action' to be taken at every step and gives better insight into pinpointing a practical policy option in the chain. In this regard, the DPSEEA framework has been widely used to understand the root causes of diverse environmental health problems[28–30] and also general public health problems.[9]

In this study, we examined a 20-year trend of gender-specific smoking prevalence among adults in South Korea using the APC method, and tried to explain the observed secular trends by mapping potential determinants using the DPSEEA framework.

METHODS

Data source

Data were taken from the 1998–2017 Korea National Health and Nutrition Examination Survey (KNHANES), a nationwide repeated cross-sectional survey by the Korea Centers for Disease Control and Prevention. The KNHANES used a multistage clustered probability design to monitor the health and nutritional status in the representatives of non-institutionalised civilians in Korea. Further details can be found elsewhere.[31] The overall response rate was 76.5% in the 1998–2017 KNHANES. This study included individuals aged 19–78 years, who were not currently pregnant and were without a prior diagnosis of cardiovascular disease or cancer. A total of 78 460 participants (34 828 men; 43 632 women) were eligible for the analysis. Data used in this study are available in a public, open access repository (https://knhanes.kdca.go.kr/knhanes/main.do).

Measures

To estimate the smoking prevalence, the following questions were used to ascertain the current smoking status: 'How many cigarettes have you smoked in total?' and 'Do you currently smoke?'. The measures of current smoking status were consistent over the study period. For example, if the individual self-reported that they have smoked 100 cigarettes or more in their lifetime and are currently smoking, they were classified as a current smoker. We then calculated the annual age-specific smoking rates using survey sample weights that account for the complex survey design and survey non-response.[31] All measures were estimated separately for men and women.

APC analysis

We first conducted a descriptive analysis using graphics and then used APC analysis to examine the separate contribution of age, period and cohort effect on the smoking prevalence. In this study, a period referred to the calendar year at which the smoking status was measured. A cohort referred to the time when an individual was born, namely birth cohort.

It is important to consider the APC identification problem, which results from the exact collinearity among variables (Cohort=Period − Age), but there is no complete solution to the problem.[18] Therefore, one main concern in fitting the APC model is to select the way to impose constraints. As a conventional method, a constrained generalised linear model, strongly suffer

from the investigator's arbitrary and subjective choice on identifying constraints,[18 32] alternative methods using mechanical constraints, such as intrinsic estimator (IE),[33] maximum entropy estimator[32] and hierarchical APC cross-classified random effects model,[34–36] were widely used as alternatives. The IE model adopts a principal component analysis that uses a Moore-Penrose generalised inverse to the singular design matrix in Age × Period data. The IE model has strengths in yielding estimates that are simple to interpret, like conventional regression coefficients, but also estimates with smaller variance than that from other alternative methods.[33] Therefore, we applied the IE model in this study. We grouped age, period and birth cohort into 5-year intervals in the APC analysis. As a result, we created 12 age groups (19–23, 24–28, …, 74–78 years), 4 periods (1998–2002, 2003–2007, 2008–2012, 2013–2017) and 15 cohort groups (1924–1928, 1929–1933, …, 1994–1998). Data in 1999, 2000, 2002–2004 and 2006 were not available since the KNHANES was conducted every 3–4 years between 1998 and 2006. Thus, the smoking rates for the remaining years were used to calculate the average smoking rates in 1998–2002 and 2003–2007, respectively. We compared the possible combinations of age, period and cohort effects to select the best fitness of the APC model based on the Akaike information criteria, which resulted in selecting the full APC model. All statistical analyses were conducted using SAS V.9.4 software (SAS Institute) and Stata V.16.1 software (StataCorp).

Construction of the smoking-DPSEEA framework

We conducted a non-systematic literature review to determine what factors might contribute to smoking prevalence in Korea. Details of the literature search are presented in Appendix 1. Starting with 'Exposure', we categorised the proposed factors from various fields into 'Driving force,' 'Pressure,' 'State' or 'Action'. When constructing the smoking-DPSEEA framework, we omitted the 'Effect' part because evaluating the link between smoking and its health effects was beyond the scope of this study.

Patient and public involvement

No patient involved.

RESULTS

Table 1 shows the demographic and socioeconomic characteristics of the study subjects. The average age was 41.95 and 43.75 in men and women, respectively. The proportion of those who completed at least high school education in men was 77.4%, while the proportion in women was 63.0%. The highest percentage of occupations among men were craft and related workers, plant and machine operators and assemblers (21.8%), unemployed (21.3%) and general managers and professionals (18.3%), respectively. Among women, unemployed (46.7%), service/sales workers (15.9%) and general managers and professionals (12.7%) accounted for the highest percentage.

Figure 1 shows the age-standardised smoking prevalence of the study subjects during the study period. Between 1998 and 2017, the age-standardised smoking prevalence for men declined from 70.1% to 40.2%, especially with a significant decrease during 1998–2007. For women, the overall age-standardised smoking prevalence fluctuated between 4.0% and 11.0% during the study period. Figure 2 gives a crude description of gender-specific smoking prevalence by age, period and birth cohort. Figure 2A showed the smoking rates in men reaching a peak at age between mid-20s and early-30s and dramatically decreasing between 1998–2002 and 2003–2007. The smoking rates in women showed different age patterns by period, but women in mid-40s had the highest smoking rates on average over the years. Figure 2B showed the smoking rates by birth cohort with a decreasing pattern in recent birth cohorts among men, while the smoking rates in women showed the opposite trends.

Figure 3 shows the prevalence rate ratios (PRRs) in men and women from the APC analysis. First, we observed the evident but gender-specific age effects. When adjusting for the period and cohort effect, the age effect in men peaked between 24 and 28 years (PRR: 1.54, 95% CI: 1.49 to 1.59) and then rapidly decreased. In contrast, the age effect in women consistently increased until 44–48 years (PRR: 1.53, 95% CI: 1.27 to 1.84) and then reduced. Second, similar patterns of the period effects were found in both genders. The period effects adjusted for the impact of age and cohort declined from 1998–2002 to 2003–2007 with the following increasing fluctuations. Lastly, the cohort effects showed opposite trends between men and women. In men, the PRRs of smoking increased and rose to a peak in the cohort born in 1959–1963 (PRR: 1.63, 95% CI: 1.57 to 1.70) and then decreased in recent birth cohorts. However, in women, the pattern of the cohort effect suggested an elevated risk of smoking in the oldest and recent birth cohorts (PRR in 1924–1928 cohort: 2.34, 95% CI: 1.66 to 3.30, PRR in 1994–1998 cohort: 1.55, 95% CI: 1.13 to 2.13).

Figure 4 represents the smoking-DPSEEA framework to describe a series of potential determinants of the observed smoking prevalence. As mentioned in the Methods section, all the proposed factors were based on the peer-reviewed literature and policies implemented in Korea during the study period (see references list in Appendix 1). The 'Chain 1' described the D-P-S-E link regarding the interplay between the tobacco industry's expansion and government restrictions to explain the smoking patterns among men. The economic growth and globalisation of the tobacco industry ('Driving Force') made the conditions where the tobacco industry and its marketing were greatly expanded ('Pressure'). However, the implementation of tobacco control policies ('Action-P'), such as raising cigarette prices and anti-smoking campaigns, might regulate the tobacco industry. These two factors, in turn, influenced the accessibility to tobacco products ('State'). In this step, policy interventions ('Action-S') may also work to restrict accessibility.

Table 1 Demographic and socioeconomic characteristics of the study subject

Characteristics	Total		Men		Women	
	N	Weighted %*	N	Weighted %*	N	Weighted %*
Total	78460	100.0	34828	100.0	43632	100.0
Age (years)						
19–23	4865	9.4	2059	9.3	2806	9.4
24–28	7208	13.2	3404	14.3	3804	12.0
29–33	7425	11.1	3440	11.8	3985	10.4
34–38	9047	11.9	4084	12.2	4963	11.5
39–43	8893	11.7	4035	11.7	4858	11.7
44–48	7819	10.7	3541	10.9	4278	10.5
49–53	7394	9.1	3137	9.0	4257	9.1
54–58	6901	7.6	3093	7.4	3808	7.7
59–63	6199	5.6	2710	5.3	3489	6.0
64–68	5501	4.4	2398	3.9	3103	4.9
69–73	4542	3.3	1887	2.7	2655	3.9
74–78	2666	2.2	1040	1.5	1626	2.9
Household income						
Low	13938	15.7	5526	14.0	8412	17.5
Lower–middle	19349	24.9	8533	24.6	10816	25.2
Upper–middle	21649	29.3	9943	30.3	11706	28.3
High	22380	30.1	10339	31.2	12041	29.0
Education level†						
≤Elementary school	16889	18.4	5073	11.9	11816	25.0
Middle school	8547	11.3	3816	10.7	4731	12.0
High school	23827	36.3	10966	37.1	12861	35.6
≥College	21926	33.9	11743	40.3	10183	27.4
Occupation						
General managers and professionals	7311	15.5	3910	18.3	3401	12.7
Office workers	5050	10.8	2735	12.7	2315	8.9
Service/sales workers	7219	14.5	2736	13.1	4483	15.9
Agricultural/forestry/fishery workers	3785	4.4	2031	5.3	1754	3.5
Craft and related workers, plant and machine operators and assemblers	5539	12.5	4685	21.8	854	3.0
Elementary workers	4851	8.4	1888	7.5	2963	9.3
Unemployed (housewife, student, etc)	20104	33.9	5296	21.3	14808	46.7

*Weighted per cent was calculated based on the complex survey design and weights.
†Education level completed by persons aged 25 and above.

Finally, the interplay in the chain of actions eventually led to change the smoking prevalence ('Exposure'). The 'Chain 2' described the D-P-S-E link resulted from the transitions in social norms associated with smoking in women. The change of social and cultural environment ('Driving Force') which encouraged more women to enter the labour market, led to the growth of the tobacco industry targeting women ('Pressure'). And this created a smoking-friendly environment for women ('State') with increased accessibility to various women-targeted tobacco products, which may be related to the increase in the smoking prevalence in women ('Exposure'). It is also worth noting that, in contrast to Chain 1, there has been no policy actions intervening in any steps encouraging women to smoke in Chain 2.

DISCUSSION
This study examined a 20-year trend of gender-specific smoking prevalence among adults in South Korea. We
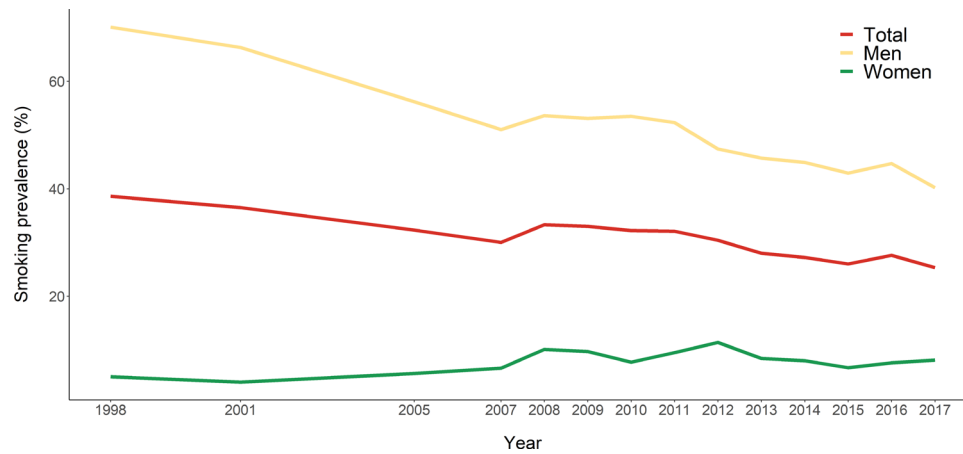
Figure 1 Age-standardised smoking prevalence in study subjects, 1998–2017.

found that men and women are currently in different phases of the smoking epidemic, with contrasting results in age and cohort effects. Specifically, in men, the smoking prevalence peaked at their mid-20s and cohort born in 1959–1963. On the other hand, in women, the smoking prevalence consistently increased until their mid-40s and recent birth cohorts. We also constructed the smoking-DPSEEA framework to understand the observed trends and address the spectrum of factors contributing to smoking behaviour at multiple levels.

The age effect in men peaked at age between 24 and 28 years and then decreased, which is consistent with the previous literature.[4] This results can be interpreted as a combined result of smoking initiation and cessation. Most Korean men start to smoke during adolescence and early adulthood when they do compulsory military service and start their career. Traditionally, both military and work culture in Korea have a unique vertical hierarchy, making young men more vulnerable to either voluntarily or involuntarily start smoking and increase their smoking intensity.[37–39] The previous result from APC analysis

among Korean young adults also identified the peak of the age effect at the age of 25–26.[25] However, as they age, men tend to quit smoking because they become more conscious of adverse health effects of smoking.[40–42] This is also supported by differential tobacco policy effects by age. When the first national tobacco control policies were implemented in 1995, the smoking prevalence was reduced initially among older men and then younger men later.[43] When the cigarette price vastly increased in 2015, smokers aged 45 and older were more responsive to smoking cessation than smokers aged 19–44 years.[44]

The age effect in women increased until their mid-40s and then decreased. A higher smoking rate in older women has been reported in Asian countries,[45 46] different from Western countries with a higher smoking rate in younger women.[47] In countries where sociocultural and religious norms discourage women from smoking, women's smoking, particularly in childbearing age and married women, are highly restricted.[48] However, when women pass childbirth/childcare periods and get older, they get 'liberated' from such social pressure and
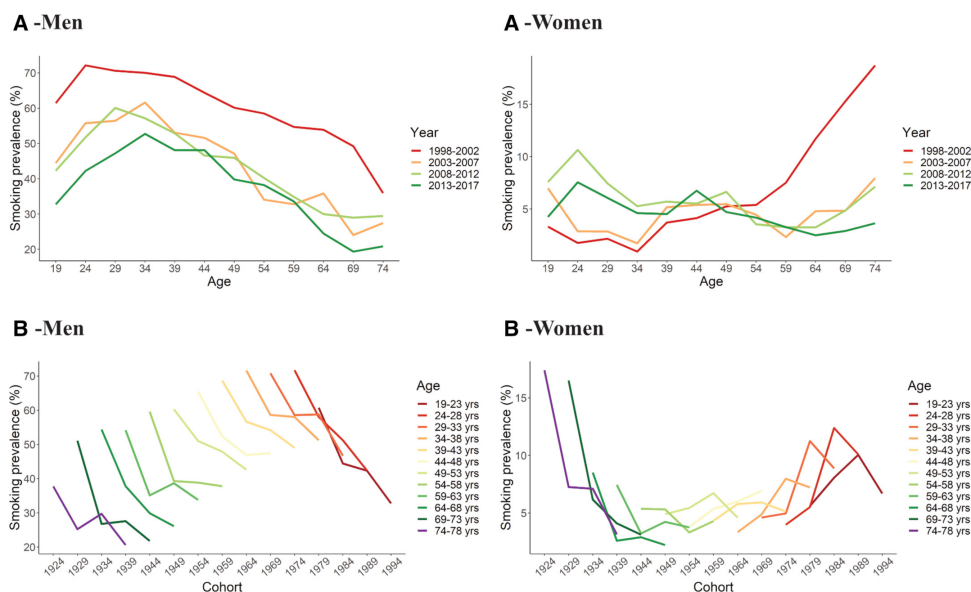

Figure 2 Smoking prevalence among Korean adult men and women, by (A) period and age and (B) age and birth cohort.
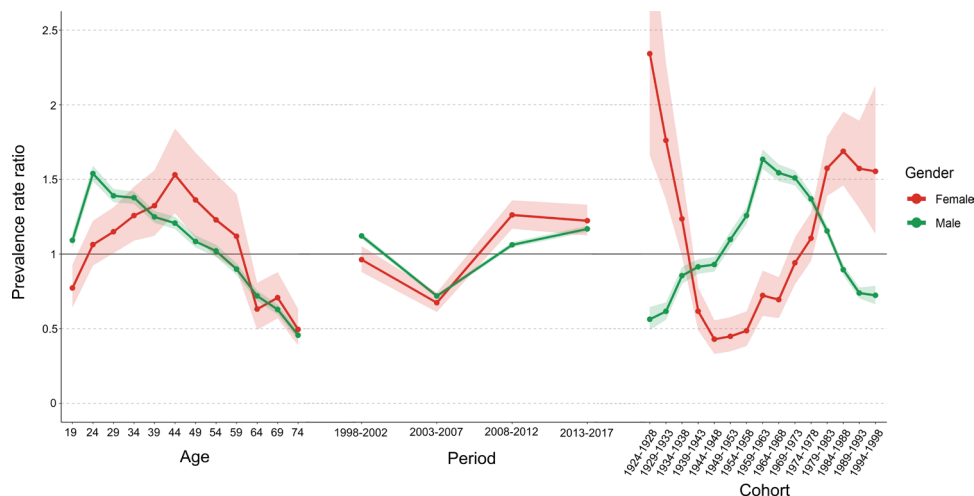
Figure 3 Estimated age, period, cohort effects in Korean adult men and women.

may find it easier to smoke. Moreover, marital disruption due to divorce or widowhood is most common in this age group.[49] The financial difficulties and caring household responsibilities resulting from being a head of household negatively affect their mental health, both of which are well-known risk factors of smoking.[50]

The period effects first decreased and then increased in both genders. The decrease in PRRs between 1998–2002 and 2003–2007 may be associated with rigorous tobacco control policies implemented since the late-1990s. With the enactment of the Health Promotion Act in 1995, comprehensive anti-smoking interventions were implemented.[51] Additionally, a famous Korean comedian, Ju-il Lee, starred in the anti-smoking campaign after he was diagnosed with lung cancer, which received national attention and recognition for smoking cessation.[52] Previous research also reported that the national

tobacco control policies during the late-1990s and early-2000s resulted in reduced prevalence in smoking among men, although the study did not cover women smokers.[43] On the other hand, the increasing trend of period effects after 2003 is unclear. When South Korea ratified the Framework Convention on Tobacco Control (FCTC) in 2005, the government has continued to strengthen anti-smoking measures.[51] Details of the national tobacco control policies are presented in online supplemental table 1). Despite this substantial expansion of tobacco control, our results showed that the PRR of smoking had been gradually increasing since 2003–2007. These findings may suggest that those policy efforts were insufficient to change smoking behaviour during the peroid. A study examining the effect of smoking bans at open public places found that the policy was not able to reduce smoking prevalence, and most smokers who had quit
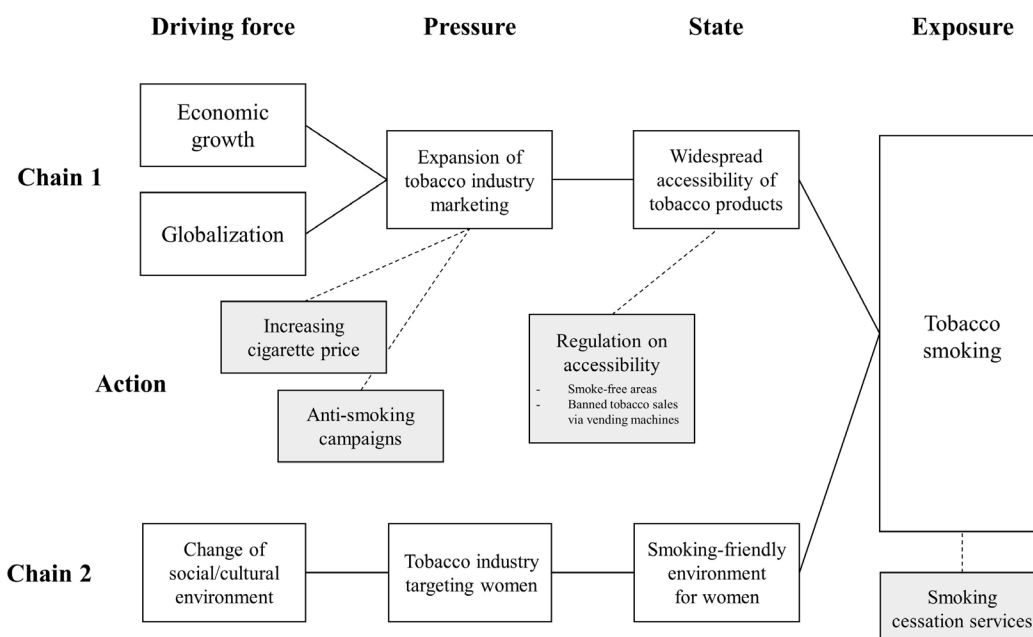

Figure 4 Smoking-Driving Force-Pressure-State-Exposure-Effect-Action framework.

due to smoking restriction relapsed to smoking.[53] Moreover, the increasing trend in the 2010s may reflect the introduction of electronic cigarettes (e-cigarettes) into the market since 2008. The use of e-cigarettes has been growing rapidly, with the widespread misconception that e-cigarettes are less harmful (or harmless) and can aid tobacco cessation in Korea.[54] The questionnaire we used to ascertain the current smoking status in this study did not explicitly distinguish cigarette tobacco and e-cigarette. Thus, it is possible that the inclusion of e-cigarette users as well as typical tobacco smokers in our analysis may have inflated the estimated smoking prevalence. The potential gateway effect of e-cigarettes[55] could also explain the observed patterns.

We observed the opposite trends in smoking prevalence between men and women in terms of the cohort effects. In men, the increasing trend in PRRs was reversed since the 1964–1968 birth cohort. Persons born in the 1960s–1970s were in their 20–30s when the government began implementing various smoking interventions and strong anti-smoking movements caused by the 'Ju-il Lee syndrome' in the mid-1990s and early-2000s. Therefore, people who were in the initial stage of smoking and exposed to an anti-smoking atmosphere may accept harmful social norms on tobacco, which protected them from starting to smoke or/and helped them quit smoking. The sharper decrease in persons born in the 1980s also suggests a significant transition in social norms in younger generations. These generations were 10–20s in the post-FCTC period. This finding implies that the exposure to rigorous tobacco control efforts during adolescence and young adulthood may have prevented the younger generations from smoking onset and persistence. In the APC analysis among Korean adolescents, birth cohorts born in the 1980s also showed a lower level of smoking prevalence than others,[23] which shows the shift to tobacco-free norms had already affected this generation when they were adolescents. Studies in the USA also found that exposure to tobacco control in adolescents may have protected them from smoking.[19 21] The APC analysis among Korean young adults also showed a consistent decrease in smoking prevalence among 1980–1990s birth cohorts.[25] Considering the possibility of including e-cigarettes users in the prevalence and the fact that the largest population of e-cigarette users are younger generations, the actual prevalence of cigarette smoking in this younger cohort may be much lower than we observed.

The cohort effect in women is remarkably different from that in men. In women, the PRRs rapidly decreased but reversed and then consistently increased in birth cohorts born after the 1950s. Historically, the smoking rate was similar in men and women when tobacco was first introduced in Korea.[56 57] In this period, tobacco was regarded as medicine and even used to treat morning sickness for pregnant women.[57] Passing through the colonial period of Japan, however, tobacco became one of the essential colonial finances, which later engendered the anti-smoking movement in 1907–1908.[58 59]

Furthermore, through the 1920s–1930s, the norms of 'a good wife and wise mother' and issues on the adverse reproductive health of smoking generated sociocultural prohibitions against women smokers.[56 60] These collective historical backgrounds made smoking a men's exclusive habit, which explains the sharp decrease of PRRs in older cohorts. However, this decreasing pattern was reversed at the cohorts born in the 1950s and then consistently increased. This could be due to the changing social role of women. Rapid economic growth and urbanisation since the 1960s have expanded opportunities for women in education and employment, changing the traditional perception of women smokers.[56] Moreover, marketing strategies made smoking a symbol of freedom and liberation to target women.[61 62] Flavoured tobacco products, e-cigarettes, and heated tobacco products have also appealed to women and may influence tobacco initiation.[63 64] A decrease in under-reporting of smoking status in women would be another explanation. A cross-sectional study comparing self-reported and cotinine-verified smoking prevalence in Korea reported that the number of cotinine-verified female smokers was twice that of self-reported smokers.[65] This study also noted that female smokers who live with their spouse or parents were more likely to under-report their smoking than those who live alone. That is, there is a possible tendency for women to under-report their cigarette use due to the strong stigmatisation of female smokers, and we speculate that the level of under-reporting may be reduced in recent birth cohort groups.

The above potential explanations on the results from the APC analysis were summarised in the smoking-DPSEEA framework. Based on the framework, we can address two policy strategies. First, a proactive approach that tackles the upstream causes (eg, Driving force, Pressure, State) would be more effective than a reactive approach targeting the exposure itself. As smoking is a multidimensional behaviour influenced by social, cultural and environmental factors, individual-focused interventions (eg, smoking cessation services) would have a limited impact on reducing smoking. This perspective is also in line with the WHO FCTC that focuses on intervening in the upstream part of the supply chain. Thus, policies targeting the upstream determinants, including a rigorous control of the sale and use of tobacco, should be strengthened. Second, a gender-tailored approach is needed in Korea. As the smoking-DPSEEA framework showed the absence of policy targeting women, additional efforts to shift social norms around smoking, such as interventions against woman-targeted tobacco marketing and smoking cessation campaigns targeting workplaces with a high percentage of female smokers, are necessary. Anti-smoking policies toward men are also required. Although the smoking trend in men is in slow decline, men still smoke more than women and other OECD countries. Thus, additional efforts should be taken to further reduce the smoking level as low as possible.

This study has strengths and limitations. To the best of our knowledge, this is the first to investigate the trend of smoking prevalence among general adults in South Korea using the APC method. Combined the innovative tool, the DPSEEA framework, with APC analysis, the study attempted to interpret the temporal dynamics of smoking prevalence and address policy implications. Although the DPSEEA framework has been widely used in the environmental health field, this study is distinct in that it expanded its utility by applying the framework to systematise the chain of cause-and-effect of the general public health problem. The main limitation is that the causal inference from this study is limited due to the ecological and descriptive characteristics inherent in the APC analysis. Thus, our results are not able to describe any causal mechanism but are still valuable in providing insight to describe population-level smoking patterns and potential determinants for the observed changes. Second, the small sample size of women smokers requires a cautious interpretation of the results. Lastly, as the data of the smoking prevalence in 1999, 2000, 2002–2004 and 2006 were not available and the remaining years in 2003–2007 were not proportionally distributed, there is the possibility of underestimating the smoking rates in the given period, which suggests a cautious interpretation of the findings on the period effects.

CONCLUSIONS

This study showed a gender difference in smoking prevalence over the last 20 years in South Korea. To conclude, gender characteristics are important to understand how smoking patterns are shaped in the population, and gender-specific tobacco control should be developed.

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