BMC Public Health

RESEARCH

Open Access

Longitudinal assessment of smoking-related knowledge, attitude, and practice for cancer prevention: an analysis of data from the Korean National Cancer Prevention Awareness and Practice Survey

Jeoung A Kwon[1†], Naeun Kim[1†], Jin-Kyoung Oh[1,2], Bohyun Park[1,3], Yoon-Jung Choi[1,2], Yoonjoo Choi[1*] and Byungmi Kim[1,2*]

Abstract

Background This study examined the influence of knowledge and attitudes on smoking cessation behaviors among Koreans—including both individuals who have quit smoking and those who continue to smoke—using an extended KAP (knowledge, attitude, and practice) model.

Methods Data for this study were drawn from the Korean National Cancer Prevention Awareness and Practice Survey conducted between 2014 and 2023, encompassing 12,400 participants. After excluding responses lacking data on KAP questions and individuals who had never smoked, the final analytic sample comprised 4,794 participants. To evaluate the associations among knowledge (that smoking causes cancer), attitudes (regarding smoking cessation for cancer prevention), and practice (the decision to stop smoking), we employed multiple logistic regression and mediation analyses to assess both the direct and indirect effects of these variables on smoking behavior.

Results Most participants demonstrated awareness that smoking causes cancer. In assessing the associations among knowledge, attitude, and practice, a decline in odds ratios was observed in 2023 compared with 2021. Attitudes toward smoking cessation for cancer prevention exerted a direct influence on the decision to quit smoking, with effect sizes of 0.23 in 2014, −0.10 in 2016, 0.50 in 2018, 0.42 in 2021, and 0.40 in 2023. Furthermore, knowledge about smoking indirectly influenced the decision to quit smoking via its effect on attitudes toward cessation, with indirect effects of 0.12 in 2018, 0.10 in 2021, and 0.09 in 2023. Notably, knowledge did not directly affect practice; thus, attitudes toward smoking cessation emerged as the primary mediator between knowledge and the decision to quit smoking.

Conclusions Our findings indicate that the decision to quit smoking is significantly influenced by individuals' attitudes toward smoking. Consequently, smoking cessation policies and interventions should integrate strategies

[†]Jeoung A. Kwon and Naeun Kim contributed equally to this work.

*Correspondence:
Yoonjoo Choi
yj_choi@ncc.re.kr
Byungmi Kim
kbm5369@ncc.re.kr
Full list of author information is available at the end of the article

that address attitudes in tandem with knowledge and practice components among Koreans. Moreover, the gradual weakening of the relationships among knowledge, attitudes, and practices over time underscores the need to reinforce these associations through innovative smoking cessation policies.

Keywords Attitude, Knowledge, Practice, Smoking, Cancer, South Korea

What the study adds

What is already known on this topic?

- Growing awareness of the detrimental health impacts of smoking has contributed to a global decline in smoking prevalence, a trend that is also evident in South Korea.
- Examining factors that influence smoking cessation is essential for the implementation of effective smoking cessation policies and for addressing the emergence of new tobacco products.

What this study adds

- The associations among smoking-related knowledge, attitudes, and practices (S-KAP) have exhibited a declining trend over time in South Korea.
- Our findings reveal that the decision to quit smoking is predominantly driven by individuals' attitudes toward smoking, suggesting that smoking cessation policies and interventions should prioritize these attitudes in conjunction with knowledge and practice components.

How this study might affect research, practice, or policy

- By elucidating the mediating role of attitudes toward smoking in the relationship between knowledge and practice, this study has provided valuable guidance for the formulation of smoking cessation policies and the monitoring of national smoking cessation programs in South Korea, drawing on nationwide population-based data.

Background

Smoking is a major global public health challenge, contributing to the premature deaths and illnesses of tens of thousands of people each year [1, 2]. In 2017, more than 8 million people lost their lives to smoking-related diseases [2, 3]. In 2000, an estimated one-third of the global population aged 15 years and older were smokers [2].

Numerous studies have explored the associations between smoking and a range of diseases [4]. A review of the literature reveals that, in addition to cancer-related conditions, smoking is strongly linked to cerebrovascular diseases, lung-related disorders, chronic illnesses, and other conditions [5–10]. Notably, Wynder et al. in the 1950s elucidated the relationship between smoking and bronchogenic carcinoma [5, 6]. Subsequently, in the 1960s, the first Surgeon General's report, authored by Terry, established a causal link between smoking, liver cancer, and chronic bronchitis [7, 8]. Since that time, research has demonstrated associations between smoking and cancers of the lung, larynx, esophagus, oral cavity, pharynx, bladder, liver, uterine cervix, kidney, stomach, colorectum, pancreas, and even myeloid leukemia [8, 9]. Moreover, robust evidence supports a causal relationship between smoking and chronic conditions such as stroke, chronic obstructive pulmonary disease, and atherosclerotic peripheral vascular disease [8, 10].

In addition to its profound health impacts, smoking imposes a substantial economic burden. The annual global economic costs attributable to tobacco use exceed US $1 trillion [11–13]. These considerable health and economic consequences underscore the urgent need to implement robust public health measures aimed at controlling tobacco use [13, 14]. Effective implementation and enforcement of tobacco control policies and interventions have the potential to enhance life expectancy while reducing healthcare expenditures [13, 15–18]. Consequently, in 2003, World Health Organization member states adopted the FCTC (Framework Convention on Tobacco Control), thereby launching a series of evidence-based interventions designed to curtail smoking rates [2, 19]. To date, reductions in tobacco use have been reported in 150 countries, with 60 achieving or surpassing a 30% decrease [2].

The knowledge, attitude, and practice (KAP) model provides a valuable framework for evaluating the effectiveness of these evidence-based interventions in reducing smoking rates. This model posits that individual behaviors are fundamentally shaped by one's knowledge and attitudes [20] and is among the most widely used frameworks in medicine [20]. Originating in the 1950s as a tool for studying population and family planning [21], the KAP survey has since been extensively employed to investigate a broad range of health behaviors [21]. In particular, the KAP model proves especially useful in the context of smoking cessation, as it offers a comprehensive

framework for understanding the cognitive and behavioral factors that shape smoking habits [22]. By examining the interrelated effects of knowledge, attitude, and behavior, the model facilitates the identification of critical barriers to quitting and informs the development of targeted interventions [22]. Given its proven success in addressing diverse health behaviors, the KAP model serves as a valuable tool for refining smoking cessation strategies [20].

This study hypothesized that the KAP model can effectively inform smoking cessation efforts, with attitudes toward smoking mediating the relationship between smoking knowledge and smoking practices. Therefore, this study aimed to examine the relationship between knowledge (awareness that smoking causes cancer), attitude (regarding cessation of smoking for cancer prevention), and practice (the decision to quit smoking) by applying the KAP model to individuals who currently smoke or have smoked in South Korea.

Methods

Settings, sampling, and participants

To establish a foundation for effective cancer prevention policies, this study analyzed data from the National Cancer Prevention Awareness and Practice Survey conducted by the National Cancer Center in South Korea. The initial survey was conducted in 2007 and has been repeated biennially since then. Each survey was designed as a cross-sectional study, with sample sizes allocated based on the population proportions of region, gender, and age groups, followed by random sampling. In 2014, the questionnaire was updated to emphasize the importance of KAP in smoking cessation. Data collected from 2014 through 2023 ($N=12,400$) were analyzed for this study.

Data collection was conducted via face-to-face interviews administered by a professional research agency. The sample size for each survey ranged from 1,000 to 2,000 participants between 2014 and 2018. The most recent survey, conducted from 2021 through 2023, included a random sample of 4,000 men and women, aged 20–74 years, residing in 17 provinces of South Korea. Following informed consent procedures, face-to-face interviews using a structured questionnaire were conducted with participants who voluntarily agreed to participate after reviewing a recruitment guide that detailed the study's purpose and content. In total, 12,400 participants were enrolled across all data collection sites. Only participants who had ever smoked ($N=4,794$) were included in the analysis, as they represented the target population for assessing smoking-related knowledge, attitudes, and practices in cancer prevention. The final analytic sample for this study consisted of 4,794 participants ($N=467$ in 2014, $N=458$ in 2016, $N=783$ in 2018, $N=1,552$ in 2021, and $N=1,534$ in 2023), aged 20–74 years, drawn from the combined datasets across all survey periods.

The study was approved by the National Cancer Center Institutional Review Board (NCCNCS-07–102, NCC2016-0153, and NCC2022-0012). All participants provided written informed consent to participate in the study.

Measures

A structured questionnaire was used to evaluate public awareness and practices associated with the Korean National Codes Against Cancer, as established by the National Cancer Center. The survey instrument was developed by updating the version created in 2007. The original questionnaire was based on the Precaution Adoption Process Model (PAPM), a theory designed to understand how individuals take action to prevent diseases, injuries, or other forms of harm. The fundamental assumption of this theory is that individuals progress through six qualitatively distinct stages as they move from ignorance to action. The PAPM posits that preventive health behaviors can be categorized into six nominal stages of intention: (1) unaware of the health behavior, (2) unengaged in the decision, (3) undecided, (4) decided not to act, (5) decided to act, and (6) acting [9]. For the purposes of this study, the PAPM stages were grouped into three categories: (1) pre-adoption (stages 1–3), (2) refusal (stage 4), and (3) adoption (stages 5 and 6). Accordingly, the questionnaire was designed to reassess S-KAP (smoking-related knowledge, attitude, and practice) for cancer prevention.

The specific S-KAP measures used to assess smoking awareness for cancer prevention were as follows: knowledge was evaluated by assessing whether individuals were aware of the no-smoking guidelines (i.e., do not smoke and avoid secondhand smoke) outlined in the Korean National Codes Against Cancer and whether they understood that smoking causes cancer. To assess awareness, the following questions were posed: "Do you think smoking causes cancer?" and "Do you think that not smoking (i.e., avoiding smoking and secondhand smoke) prevents cancer?" Knowledge of the link between smoking and cancer was determined by considering only those respondents who answered "yes" to these questions. Attitudes were assessed by asking, "Do you think about the recommendation to quit smoking for cancer prevention?" with the following response categories: "I do not think about it," "I have not decided to quit smoking yet," "I do not try to quit smoking," and "I will quit smoking." For the purposes of this study, a positive attitude toward smoking cessation was operationally defined as responding "I will quit smoking." Practices were assessed by asking, "Have you ever smoked?" with the following

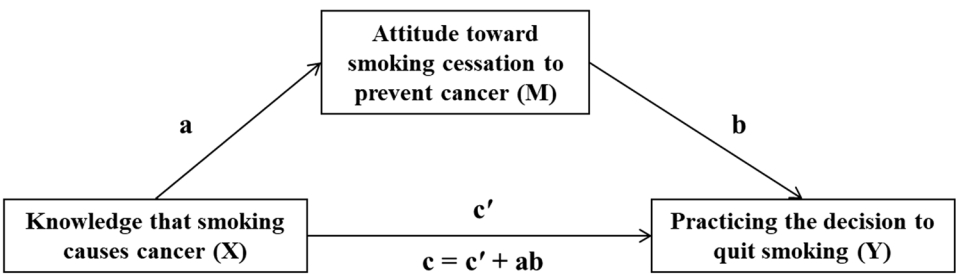
response categories: "non-smoker," "ex-smoker," and "current smoker." This study included only individuals with a history of smoking, thereby excluding those who had never smoked. Smoking cessation was operationalized by classifying respondents as "ex-smokers," thereby indicating their previous engagement in smoking.

Statistical analysis

The analysis considered several factors as potentially relevant, including age (categorized as 20–29, 30–39, 40–49, 50–59, and 60–74 years), gender, residential area (metropolitan areas [referring to metropolitan cities], small and medium cities [referring to urban districts], and rural areas [referring to the countryside]), region (Seoul, Busan, Daegu, Incheon, Gwangju, Daejeon, Ulsan, Sejong, Gyeonggi, Gangwon, Chungbuk, Chungnam, Jeonbuk, Jeonnam, Gyeongbuk, Gyeongnam, and Jeju), marital status (married, single, and widowed/separated/divorced), educational level (middle school or lower, high school, and college or higher), and monthly income (categorized as less than 3 million Korean Won [KRW, less than US $3,900], 3–6 million KRW [US $3,900–7,800], and 6 million KRW or more [US $7,800 or more]) [23]. Age was treated as a continuous variable and entered into the models in 10-year increments.

Data were collected between November 2014 and October 2023. For the time-trend analysis, the period was divided into segments corresponding to the survey cycles: November 2014–December 2014, July 2016–August 2016, August 2018–September 2018, November 2021–February 2022, and September 2023–October 2023. General demographic characteristics and the distributions of KAP among the survey participants, stratified by time period, are presented as frequencies and percentages. Multiple logistic regression analysis was used to assess the interrelated effects of smoking-related knowledge, attitudes, and practices. This method was chosen because the outcome variable was binary, and odds ratios (ORs) were estimated to assess how each independent variable influenced outcomes. The model was adjusted for potential confounding factors, including gender, age, region, marital status, education level, and monthly income. ORs and 95% confidence intervals (CIs) were calculated with the significance level set at 0.05. To further explore the relationships between variables, Pearson correlation analysis was performed to identify correlation coefficients and determine statistical significance (Figures S1–S6 of Additional File 1). Collinearity was assessed using VIF (variance inflation factor) analysis.

In this analysis, smoking knowledge was treated as the independent variable (X), smoking cessation practice as the dependent variable (Y), and attitude toward smoking as the mediating variable (M). This framework facilitated the investigation of the indirect effects of smoking knowledge on smoking cessation practice through attitudes toward smoking. We hypothesized that attitude toward smoking mediates the relationship between smoking knowledge and smoking behavior (Fig. 1). Mediation analysis was conducted to evaluate the indirect effect of smoking knowledge on smoking cessation practice via attitude. The indirect effect was estimated by calculating the product of the path coefficients from smoking knowledge to attitude and from attitude to smoking cessation practice. The significance of the mediation effect was assessed using bootstrapping methods to generate CIs and evaluate the robustness of the findings, alongside conducting the Sobel test. The Sobel test evaluates the indirect effect of the independent variable on the



H: Smoking attitude mediates the relationship between smoking knowledge and smoking cessation practice

Fig. 1 Proposed model of smoking knowledge, attitude, and practice**.** *Knowledge: awareness that smoking causes cancer; attitude: attitude toward smoking cessation to prevent cancer; practice: implementing the decision to quit smoking. Path (a) denotes the effect of knowledge on attitude toward smoking, whereas path (b) denotes the effect of attitude on practice to stop smoking. The direct effect (c′) refers to the effect of knowledge on practice after adjusting for attitude. The total effect (c) is the sum of the direct effect of knowledge on practice and the indirect effect (ab) of knowledge on practice via attitude. **H* denotes the hypothesis proposed in this study

dependent variable through the mediating variable, with significance determined by whether the z-value exceeded the critical threshold (e.g., $|z| > 1.96$ for a 95% confidence level). All statistical analyses were conducted using R, version 4.4.1 (R Core Team, Vienna, Austria), and statistical significance was set at $p < 0.05$.

Results

Table 1 presents the characteristics of study participants by time period with respect to smoking. Most participants were men (90.6%), married (73.2%), and aged between 40 and 74 years—with the proportion of older participants increasing over time. Approximately half of the participants belonged to the middle-income group (i.e., with a monthly income of 3–6 million KRW) and had higher levels of education.

Table 2 displays the proportions of participants who demonstrated knowledge, positive attitudes, and engagement in practices associated with smoking cessation. Overall, 93.1% of participants exhibited knowledge about smoking, 42.3% displayed positive attitudes toward quitting, and 35.7% were actively practicing smoking cessation. Knowledge peaked in 2014 and reached its lowest point in 2018. Positive attitudes were highest in 2014, dropped below 40% in 2015, but subsequently recovered and have remained above this level since. In contrast, cessation practices were relatively low in 2014 and 2016, remaining below 30%; however, since 2018, the practice rate has consistently exceeded 30%.

Table 3 shows the associations between knowledge, attitude, and practice over time. All independent variables exhibited VIF values less than 10, indicating no significant collinearity issues (Table S1–S6 of Additional File 2). Knowledge that smoking causes cancer was associated with a higher likelihood of having a positive attitude toward quitting smoking to prevent cancer (adjusted aOR = 2.95; 95% CI = 2.25, 3.94). The influence of knowledge on attitudes peaked in 2016 but showed a downward trend from 2018 onward. Similarly, knowledge was associated with a higher likelihood of practicing

Table 1 Sociodemographic characteristics of participants by survey time period

Characteristics	Overall, n (%)	Time period, n (%)				
		2014	2016	2018	2021	2023
All	**4,794**	**467**	**458**	**783**	**1,552**	**1,534**
Gender						
Men	4,341 (90.6)	412 (94.6)	418 (91.3)	751 (95.9)	1,377 (88.7)	1,353 (88.2)
Women	453 (9.4)	25 (5.4)	40 (8.7)	32 (4.1)	175 (11.3)	181 (11.8)
Age (year)						
Mean ± SD	48.0 ± 13.5	45.4 ± 13	46.6 ± 13.9	46.9 ± 12.8	48.7 ± 13.4	49.1 ± 13.6
20–29	642 (13.4)	72 (15.4)	61 (13.3)	106 (13.5)	207 (13.3)	196 (12.8)
30–39	797 (16.6)	106 (22.7)	96 (21.0)	151 (19.3)	228 (14.7)	216 (14.1)
40–49	1,069 (22.3)	112 (24.0)	116 (25.3)	178 (22.7)	341 (22.0)	322 (21.0)
50–59	1,170 (24.4)	92 (19.7)	101 (22.1)	195 (24.9)	384 (24.7)	398 (25.9)
60–74	1,116 (23.3)	85 (18.2)	84 (18.3)	153 (19.5)	392 (25.3)	402 (26.2)
Region						
Metropolis	2,254 (47.0)	221 (47.3)	216 (45.0)	352 (45.0)	811 (52.3)	654 (42.6)
Small and medium cities	2,198 (45.8)	232 (49.7)	200 (43.7)	394 (50.3)	615 (39.6)	757 (49.3)
Countryside	342 (7.1)	14 (3.0)	42 (9.2)	37 (4.7)	126 (8.1)	123 (8.0)
Marital status						
Single	1,152 (47.0)	114 (24.4)	87 (19.0)	155 (19.8)	385 (24.8)	411 (26.8)
Married	3,511 (73.2)	342 (73.2)	359 (78.4)	618 (78.9)	1,128 (72.7)	1,064 (69.4)
Widowed/separated/divorced	131 (2.7)	11 (2.4)	12 (2.6)	10 (1.3)	39 (2.5)	59 (3.8)
Education level						
Middle school or less	184 (3.8)	23 (4.9)	21 (4.6)	34 (4.3)	51 (3.3)	55 (3.6)
High school	1,767 (36.9)	184 (39.4)	192 (41.9)	323 (41.3)	587 (37.8)	481 (31.4)
College or more	2,843 (59.3)	260 (55.7)	245 (53.5)	426 (54.4)	914 (58.9)	998 (65.1)
Monthly income (million KRW)						
< 3	825 (17.2)	129 (27.6)	87 (19.0)	99 (12.6)	258 (16.6)	252 (16.4)
3–6	6,065 (63.9)	295 (63.2)	343 (74.9)	570 (72.8)	941 (60.6)	916 (59.7)
6 ≤	904 (18.9)	43 (9.2)	28 (6.1)	114 (14.6)	353 (22.7)	366 (23.9)

Table 2 Evaluation of knowledge, attitude, and practice regarding smoking by time period

Characteristics	Overall, n (%)	Time period, n (%)				
		2014	2016	2018	2021	2023
Knowledge						
No	329 (6.9)	14 (3.0)	39 (8.5)	71 (9.1)	86 (5.5)	119 (7.8)
Yes	4465 (93.1)	453 (97.0)	419 (91.5)	712 (90.9)	1,466 (94.5)	1,415 (92.2)
Attitude						
No	2,766 (57.7)	247 (55.0)	298 (65.1)	458 (58.5)	959 (55.3)	894 (58.3)
Yes	2028 (42.3)	210 (45.0)	160 (34.9)	325 (41.5)	593 (44.7)	640 (41.7)
Practices						
No	3083 (64.3)	331 (70.9)	338 (73.8)	484 (61.8)	975 (62.8)	955 (62.2)
Yes	1711 (35.7)	136 (29.1)	120 (26.2)	299 (38.2)	577 (37.2)	579 (37.7)

* Knowledge: knowledge about smoking causing cancer; attitude: attitude toward quitting smoking to prevent cancer; practice: implementing the decision to quit smoking

smoking cessation (aOR = 1.50; 95% CI = 1.16, 1.95), with this influence peaking in 2021 before declining in 2023. Attitude was also associated with a higher likelihood of practicing smoking cessation (aOR = 4.82; 95% CI = 4.22, 5.51). The effect of attitude on practice was most pronounced in 2018 (aOR = 9.56; 95% CI = 6.77 to 13.67) but has decreased over time, with an aOR of 6.63 (95% CI = 5.22, 8.47) in 2021 and 5.21 (95% CI = 4.11, 6.62) in 2023.

The results of the mediation analyses are presented in Table 4. For the overall period, the indirect effects were significant, as zero was not included in the 95% CI of the estimate. Similar findings were observed for 2018, 2021, and 2023 in Table 5. According to the Sobel test (Table 6), the indirect effects for these years were also significant. These results indicate that attitude toward smoking cessation for cancer prevention mediated the relationship between knowledge of smoking's role in causing cancer and the practice of smoking cessation. However, the direct effects were not significant, as zero was included in the 95% CI, indicating that no direct relationship was found between the knowledge that smoking causes cancer and the practice of smoking cessation.

Discussion

Smoking adversely affects health while simultaneously imposing a substantial economic burden. In response, numerous studies and policies targeting smoking cessation have been implemented worldwide. Prioritizing the identification of factors that influence smoking cessation behaviors—such as socioeconomic conditions and social support—is essential for the development and implementation of effective policies, as these factors may serve as mediating variables in smoking cessation practices. In this context, the KAP model is particularly valuable, offering a comprehensive framework for understanding the mediators that shape smoking habits.

Therefore, this study applied the KAP model to examine the relationship between knowledge of smoking's link to cancer, attitudes toward smoking cessation for cancer prevention, and the practice of smoking cessation in the Korean population over time. Our study sample predominantly comprised men, married individuals, members of middle-income groups, and those with higher levels of education; however, only approximately 35% of participants reported engaging in smoking cessation behavior. Moreover, the associations among smoking-related knowledge, attitudes, and practices exhibited a decreasing trend over time. This trend may be attributable to South Korea's tobacco cessation policies. In 2014, the Korean government announced the "Comprehensive Smoking Cessation Plan," which involved significant cigarette tax increases in 2015 and the expansion of tobacco control policies and smoking cessation support services through a secured National Health Promotion Fund [24]. Although these measures effectively raised awareness regarding the benefits of quitting smoking from 2015 onward, our findings suggest that their impact has diminished over time. This diminished impact may be further explained by the recent surge in new tobacco products, such as electronic and flavored cigarettes, which are marketed with novel flavors, scents, and forms [25]. Additionally, mixed messages regarding unverified claims that these new products are less dangerous [25], coupled with the diverse marketing strategies employed across various media platforms, have created regulatory blind spots [25]. Data from the OECD (Organization for Economic Cooperation and Development) indicate that the cost of a pack of cigarettes in South Korea, at KRW 4,500 (US $4.00), is among the lowest compared with other member nations [26]. Therefore, it may be time to

Table 3 Adjusted odds ratios (aORs) and 95% confidence intervals (CIs) of association between knowledge, attitude, and practice by time period*

		Overall		2014		2016		2018		2021		2023	
		aOR (95%CI)	***P*-value**	**aOR (95%CI)**	***P*-value**	**aOR (95%CI)**	***P*-value**	**aOR (95%CI)**	***P*-value**	**aOR (95%CI)**	***P*-value**	**aOR (95%CI)**	***P*-value**
Knowledge → Attitude													
Knowledge	No	Ref	**< 0.001**	Ref	0.602	Ref	0.001	Ref	< 0.001	Ref	< 0.001	Ref	< 0.001
	Yes	2.95 (2.25, 3.94)		1.35 (0.45, 4.56)		**7.40 (2.56, 31.37)**		**3.18 (1.76, 6.12)**		**2.91 (1.74, 5.09)**		**2.79 (1.78, 4.52)**	
Knowledge → Practice													
Knowledge	No	Ref	< 0.001	Ref	**0.531**	Ref	**0.341**	Ref	**0.0396**	Ref	**0.005**	Ref	**0.006**
	Yes	1.50 (1.16, 1.95)		1.53 (0.45, 7.09)		0.69 (0.33, 1.51)		1.27 (0.74, 2.21)		**2.13 (1.28, 3.69)**		**1.84 (1.20, 2.91)**	
Attitude → Practice													
Attitude	No	Ref	0.002	Ref	< 0.001	Ref	**0.051**	Ref	< 0.001	Ref	< 0.001	Ref	< 0.001
	Yes	**4.82 (4.22, 5.51)**		**3.09 (2.01, 4.83)**		0.60 (0.35, 1.00)		**9.56 (6.77, 13.67)**		**6.63 (5.22, 8.47)**		**5.21 (4.11, 6.62)**	

* Knowledge: knowledge that smoking causes cancer; attitude: attitude toward quitting smoking to prevent cancer; practice: implementing the decision to quit smoking

* Adjusted odds ratios (aORs) were adjusted for gender, age, region, marital status, education level, and monthly income

Table 4 Direct and indirect interrelated effects of smoking knowledge, attitude, and practice

Year	Total effect	Direct effect K → P	Indirect effect K → A → P	K → A	A → P
2014	0.08 (−0.16, 0.32)	0.06 (−0.18, 0.30)	0.02 (−0.04, 0.08)	0.10 (−0.17, 0.37)	**0.23 (0.15, 0.31)**
2016	−0.11 (−0.25, 0.03)	−0.08 (−0.22, 0.06)	−0.03 (−0.06, 0.00)	**0.30 (0.14, 0.46)**	**−0.10 (−0.18, −0.02)**
2018	0.06 (−0.06, 0.18)	−0.06 (−0.16, 0.04)	**0.12 (0.06, 0.18)**	**0.24 (0.12, 0.36)**	**0.50 (0.44, 0.56)**
2021	**0.15 (0.05, 0.25)**	0.05 (0.05, 0.15)	**0.10 (0.06, 0.14)**	**0.24 (0.14, 0.34)**	**0.42 (0.38, 0.46)**
2023	**0.13 (0.03. 0.23)**	0.04 (−0.04, 0.12)	**0.09 (0.05, 0.12)**	**0.22 (0.12, 0.32)**	**0.40 (0.36, 0.44)**
Overall	**0.09 (0.03, 0.15)**	0.00 (−0.06, 0.06)	**0.09 (0.07, 0.10)**	**0.24 (0.18, 0.30)**	**0.36 (0.34, 0.38)**

* A bootstrap sample of 1,000 was used to calculate effect sizes (with 95% confidence intervals in parentheses). The K-to-A path denotes the effect of knowledge that smoking causes cancer on attitude toward smoking. The A-to-P path denotes the effect of attitude on practicing the decision to quit smoking. The direct effect refers to the effect of knowledge that smoking causes cancer on implementing the decision to quit smoking after adjusting for attitude. The total effect is the sum of the direct effect and the indirect effect of knowledge on practice via attitude

Table 5 Direct and indirect interrelated effects of smoking knowledge, attitude, and practice

Year	Total effect	Direct effect K → P	Indirect effect K → A → P	K → A	A → P
2014	0.06 (−0.18, 0.30)	0.04 (−0.20, 0.28)	0.02 (−0.04, 0.08)	0.09 (−0.16, 0.34)	**0.21 (0.13, 0.29)**
2016	−0.07 (−0.21, 0.07)	−0.05(−0.16, 0.00)	−0.02 (−0.04, 0.00)	**0.27 (0.11, 0.43)**	−0.08 (−0.16, 0.00)
2018	0.05 (−0.07, 1.17)	−0.06 (−0.16, 0.04)	**0.11 (0.05, 1.17)**	**0.23 (0.11, 0.35)**	**0.48 (0.42, 0.54)**
2021	**0.15 (0.05, 0.25)**	0.06 (−0.04, 0.16)	**0.09 (0.05, 0.13)**	**0.23 (0.13, 0.33)**	**0.40 (0.36, 0.44)**
2023	**0.12 (0.04, 0.20)**	0.04 (−0.04, 0.12)	**0.07 (0.04, 0.10)**	**0.20 (0.10, 0.30)**	**0.36 (0.32, 0.40)**
Overall	**0.08 (0.02, 0.14)**	0.01 (−0.01, 0.03)	**0.08 (0.06, 0.10)**	**0.22 (0.20, 0.24)**	**0.34 (0.32, 0.36)**

* A bootstrap sample of 1,000 was used to calculate effect sizes (with 95% confidence intervals in parentheses). The K-to-A path denotes the effect of knowledge that smoking causes cancer on attitude toward smoking. The A-to-P path denotes the effect of attitude on practicing the decision to quit smoking. The direct effect refers to the effect of knowledge that smoking causes cancer on implementing the decision to quit smoking after adjusting for attitude. The total effect is the sum of the direct effect and the indirect effect of knowledge on practice via attitude

* Gender, age, region, marital status, education level, and monthly income were included as control variables

Table 6 Results of Sobel test and bootstrap test for mediation effect

Year	Sobel test statistic	p − value	Bootstrap 95% CIs	Mediation ratio (%)
2014	1.28	0.20	**(− 0.04, 0.08)**	**33.33**
2016	−0.95	0.34	(−0.05, 0.00)	28.57
2018	**5.42**	**< 0.001**	**(0.05, 0.16)**	**220.00**
2021	**5.95**	**< 0.001**	**(0.05, 0.13)**	**60.00**
2023	**5.77**	**< 0.001**	**(0.04, 0.10)**	**58.33**
Overall	**9.95**	**< 0.001**	**(0.06, 0.09)**	**100.00**

* Gender, age, region, marital status, education level, and monthly income were included as control variables

* Bootstrap iteration was performed 1,000 times

re-emphasize both economic and non-economic strategies within smoking cessation policies.

Our mediation analysis revealed significant indirect effects, demonstrating that attitudes toward smoking cessation for cancer prevention mediate the association between knowledge of smoking's role in causing cancer and the practice of smoking cessation. In line with KAP theory, individuals' behaviors toward disease prevention are shaped by their knowledge and attitudes regarding the disease [27]. Knowledge provides the foundation for developing positive attitudes and fostering healthy behaviors, while attitudes sustain the commitment to these behaviors [27, 28]. Moreover, the association between sufficient knowledge and more appropriate practices suggests that health education programs—such as those aimed at increasing awareness of pulmonary nodules—could effectively promote better attitudes and support healthy behaviors [27].

Previous studies have shown that smokers generally possess less knowledge about the detrimental effects of smoking compared to non-smokers [29–32]. This discrepancy may be attributable to smokers' tendencies to partially deny or significantly underestimate the risks of future health complications and mortality associated with smoking [29–32]. Based on these findings, if current tobacco control policies have predominantly focused on "cigarettes" and reducing tobacco consumption among smokers, future policies should pivot toward "comprehensive regulation" and smoking prevention, emphasizing the importance of "attitudes" and "knowledge" among both smokers and non-smokers [25]. In a rapidly evolving tobacco market, it is imperative that tobacco control policies and smoking cessation support services be refined into a system capable of rapid response, incorporating

measures designed to deter new smokers from entering the market and facilitating the proactive implementation of policies [25]. By establishing and enforcing targeted smoking-related policies, public attitudes, awareness, and behaviors regarding smoking can be transformed. For instance, the implementation of a smoking ban in Malaysian universities fostered the development of new social norms that rendered smoking less acceptable [33, 34]. Furthermore, although gender-based differences were not examined in our study, previous research has reported varied outcomes by gender, indicating that future investigations should incorporate gender analyses [33].

This study is significant as the first to examine knowledge, attitudes, and practices related to smoking cessation by applying the KAP model using the Korean National Cancer Prevention Awareness and Practice Survey. However, a notable limitation was that the KAP survey was administered exclusively to individuals with a history of smoking or those who currently smoke; future research should also include individuals affected by secondhand and thirdhand smoke. Additionally, as the data were collected via self-reporting, there was a potential for bias. Moreover, although no direct effect was observed between the knowledge that smoking causes cancer and the practice of smoking cessation, caution is warranted in interpreting these findings, as there may be unaccounted-for factors influencing this relationship.

Conclusions

This study investigated the knowledge, attitudes, and practices associated with smoking cessation by applying the KAP model to identify factors influencing smoking cessation behavior. The findings underscore the importance of shaping policies by considering the critical roles of both attitudes and knowledge in influencing smoking cessation behavior.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12889-025-22258-6.

Supplementary Material 1.

Supplementary Material 2.

Acknowledgements
None.

Authors' contributions
JK worte the original draft. NK conducted the methodology and formal analysis. JO, BP, and YC2 were responsible for reviewing and editing. YC1 and BK contributed to conceptualization, supervision, methodology, writing, review, and editing. All authors read and approved the final manuscript.* YC1: Yoonjoo Choi, YC2: Yoon-Jung Choi.

Funding
This research was supported by the National Cancer Center Research Grant (NCC2460150-1, 24H1051-2).

Data availability
The datasets used in this study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate
This study was conducted in accordance with the principles of the Declaration of Helsinki. This study was approved by the National Cancer Center Institutional Review Board (NCCNCS-07–102, NCC2016-0153, and NCC2022-0012). All participants provided informed consent to participate in this study.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

Author details
[1]Division of Cancer Prevention, National Cancer Control Institute, National Cancer Center, Goyang, Gyeonggi-Do, Republic of Korea. [2]Department of Cancer Control and Population Health, Graduate School of Cancer Science and Policy, National Cancer Center, Gyeonggi-Do, Republic of Korea. [3]Division of Cancer Control and Policy, National Cancer Control Institute, National Cancer Center, Goyang, Gyeonggi-Do, Republic of Korea.

Received: 31 July 2024 Accepted: 10 March 2025
Published online: 25 March 2025

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