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Original Article

Factors influencing the intention for lung cancer screening in high-risk populations for lung cancer

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ABSTRACT

Objective: Utilizing low-dose computed tomography for lung cancer screening has proven effective in reducing lung cancer mortality among high-risk individuals. This study aimed to investigate the health beliefs, knowledge of lung cancer, and cancer prevention behaviors in adults at high risk for lung cancer, with the goal of identifying predictors influencing their intention to undergo lung cancer screening.

Methods: The study utilized a descriptive cross-sectional design. Online questionnaires, including assessments of lung cancer screening health beliefs, knowledge of lung cancer, cancer prevention behaviors, intention to undergo lung cancer screening, and participant characteristics, were distributed to 186 individuals at high risk of lung cancer through a survey link. The data collection period spanned from April 26 to May 3, 2023. Analytical procedures encompassed descriptive statistics, independent t-test, one-way ANOVA, Pearson's correlations, and hierarchical multiple regression.

Results: The mean score for the intention to undergo lung cancer screening in our study was 3.66 out of 5. The regression model explaining the intention to undergo lung cancer screening accounted for 34.7% of the variance. Significant factors identified included stress level ($\beta = 0.20$, $P = 0.002$), perceived risk ($\beta = 0.13$, $P = 0.040$), self-efficacy ($\beta = 0.35$, $P < 0.001$), and engagement in cancer prevention behavior ($\beta = 0.26$, $P < 0.001$).

Conclusions: Healthcare providers should implement psychological interventions and provide education about cancer screening for high-risk individuals, aiming to enhance their perceived risk and self-efficacy, thus promoting a higher likelihood of undergoing screening.

Introduction

Cancer is the leading cause of death worldwide, and lung cancer is one of the most fatal cancers regardless of sex and ethnicity.[1] It is the most common cancer among men and the fifth-most common cancer among women.[2] According to Korea's 2019 National Cancer Registry Annual Report,[2] of the 254,718 newly diagnosed cancer cases in 2019, there were 29,960 cases of lung cancer (11.8%). Furthermore, lung cancer has the highest mortality rate in both sexes and is continually rising.[3]

Early detection of cancer and advances in treatment modalities have substantially reduced the mortality rates and improved the survival rates for most types of cancers. However, marked improvements in these parameters have not been reported for lung cancer, primarily because it is diagnosed at an advanced stage with little chance of survival.[4] In other words, early detection of lung cancer would increase the five-year survival rate.[5] Therefore, effective screening during the asymptomatic period is critical to diagnosing, treating, and surviving lung cancer. Given that screening with low-dose computed tomography (LDCT) is helpful in detecting early-stage lung cancer,[6] it is recommended in many countries.[7,8]

Heavy smoking is the primary cause of lung cancer.[4] The United States Preventive Services Task Force recommends annual lung cancer screening with LDCT for adults aged 50–80 years with a 20-pack-year smoking history who currently smoke or have quit within the past 15 years.[7] Despite the established benefits in terms of morbidity and mortality rates, lung cancer screening with LDCT is still not widely utilized around the globe.[5] South Korea has also been conducting a national lung cancer screening project every two years since 2019 using LDCT for patients at high risk for lung cancer.[9] The Korean government subsidizes the cost of this project. However, the participation rate in lung cancer screening has not been high enough.[10] In 2020, the average participation rate in Korea's entire national cancer screening program was 55.1%. In contrast, the average participation in the lung cancer screening program was 36.6%, which was lower than

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that for liver cancer (68.4%) and breast cancer (58.5%) screenings in 2020. Of the various factors that predict the participation rate of Koreans in national cancer screening, awareness of the program and knowledge of lung cancer are important.[11] However, in contrast to screening projects for other cancer types, lung cancer screening with LDCT was started recently,[10] and therefore, despite various campaigns, the project awareness and knowledge of lung cancer is not high. Therefore, the intention to participate in lung cancer screening is also expected to be low.

For an individual to take steps for good health, he or she must have the intention to become healthy and act accordingly.[12] A study on the intention of Koreans to participate in the national cancer screening program found that low intention may lower the actual participation rate or delay participation.[11] Therefore, individuals need to develop a strong intention to be healthy and act upon that intention.[12] In other words, intention is a direct antecedent of health behaviors. Thus, it is crucial to ensure that individuals at high risk for lung cancer possess the intention to undergo screening to promote cancer screening with LDCT. Effective interventions to encourage their participation in lung cancer screening require a comprehensive examination of their intention to undergo the screening and the identification of its predictors.

Previous studies on factors that affect individuals' decision and intention to undergo lung cancer screening have shown that health beliefs, including the perceived risk, perceived benefit, perceived barrier, and self-efficacy, are important determinants of lung cancer screening.[13] Hence, individuals with a higher perceived risk of lung cancer, higher belief in their risk for lung cancer, higher perceived benefits of lung cancer screening, and lower perceived barrier to lung cancer screening are expected to have strong intentions to undergo lung cancer screening. In addition, the intention to undergo lung cancer screening increases with increasing self-efficacy.[5] An individual's knowledge of health and health behaviors plays a pivotal role in shaping their practice of these behaviors. Carter-Harris et al. reported that knowledge of lung cancer and its screening affects screening behaviors through the mediation of lung cancer screening health beliefs.[13] Individuals who possess knowledge of lung cancer screening demonstrate a stronger intention to undergo the screening compared to those without this knowledge.[14] This correlation is attributed to the fact that having more knowledge increases the likelihood of accepting health behaviors related to lung cancer screening.[15] Therefore, it is crucial to examine the level of knowledge on lung cancer and its screening among high-risk smokers and their intention to undergo lung cancer screening. Pender et al.[16] explained that prior behavior can help understand current health-promoting behavior. In other words, preventive behaviors to protect oneself against cancer and promote health are expected to be associated with lung cancer screening behaviors. In addition to lung cancer screening, health beliefs, knowledge of lung cancer, and relevant behaviors, general health-related characteristics such as health status, health history, and smoking history also impact lung cancer screening.[15,17] In a previous study that examined predictors of lung cancer screening utilization using the 2017 Behavioral Risk Factors Surveillance System survey data in the US, the participation rate in lung cancer screenings depended on age, chronic respiratory conditions, previous cancer diagnoses, and general health.[17]

Lung cancer screening is an effective means to lower lung cancer mortality among high-risk individuals. Therefore, examining their intention to undergo lung cancer screening and identifying its predictors will present valuable data for developing and implementing effective strategies to facilitate lung cancer screening among the at-risk population.

Study aim

This study aimed to examine lung cancer screening health beliefs, knowledge of the disease, and prevention behaviors in adults at high risk for lung cancer to identify the predictors of their intention to undergo screening.

Methods

Research design

Descriptive cross-sectional study.

Participants

The participants were selected comprehensively based on the eligibility criteria for lung cancer screening recommended by the National Comprehensive Cancer Network (NCCN) Clinical Practice Guidelines in Oncology.[18] The inclusion criteria were as follows: age 50–74 years, smoking history of $\geq$ 20 packs/year, if not a current smoker, had quit smoking within the past 15 years, no diagnosis of lung cancer, able to access the questionnaire link using a smartphone or computer without assistance, voluntarily provided informed consent to participate, and completed the online questionnaire. Patients diagnosed with lung cancer or those who underwent surgery for lung cancer were excluded. The sample size was determined using the G*Power version 3.1.9.4 software. For hierarchical regression modeling, specifically multiple linear regression, using the fixed model R^2 increase method with a medium effect size (f^2) of 0.15, α of 0.05, 1-β of 0.90, and 18 predictor variables (12 in model 1, 6 in model 2), the recommended sample size was 157. With 15% potential dropout in online surveys considered, the targeted sample size was 184. We collected data from 186 participants.[19]

Tools

Lung cancer screening health belief

Lung cancer screening health belief consists of four domains: perceived risk, perceived benefit, perceived barrier, and self-efficacy for lung cancer.[1] Perceived risk of lung cancer screening refers to an individual's belief regarding their possibility of developing the disease, and perceived benefit refers to the belief in the positive outcomes of the screening to lower the risk for lung cancer. Perceived barrier refers to the barriers to receiving lung cancer screening, such as the screening process and cost, and self-efficacy refers to one's confidence in their ability to undertake all processes related to the screening. In this study, we used an instrument developed by Carter-Harris et al.[1] and validated in Korean by Cho & Cho[20] after obtaining permission from the developers. The scale consists of 35 items, including three items for perceived risk, six for perceived benefit, 17 for perceived barrier, and nine for self-efficacy. Each item is rated on a four-point Likert scale from 1 (strongly disagree) to 4 (strongly agree). A higher score for each domain indicates a stronger lung cancer screening health belief in that domain. The Cronbach's α was 0.80–0.92 for the original tool,[1] 0.80–0.93 for the Korean version,[20] and 0.81–0.94 in this study.

Knowledge of lung cancer

Knowledge of lung cancer was assessed using the instrument developed by Suh et al.[21] and based on the Cancer Screening Project of Korea's National Cancer Information Center. The tool consists of five yes-or-no questions, covering topics such as the at-risk group for lung cancer, risk factors, early symptoms, early screening methods, and early screening frequency. Each correct answer is scored 1, while a wrong answer receives a 0. The total possible score ranges from 0 to 5, with a higher score indicating a greater knowledge of lung cancer. The reliability (KR-21) of the tool was 0.83 in a study by Suh et al.[21] and 0.55 in this study, primarily due to the low correct answer rate among the participants.

Cancer prevention behavior

Cancer prevention behavior involves acting to help prevent the disease and protect and promote health.[21] In this study, cancer prevention behavior refers to the actions and behaviors to prevent cancer based on known causes and factors related to carcinogenesis performed on a daily basis. Cancer prevention behavior was evaluated using an instrument

developed by Suh et al.[21] and based on the cancer prevention tips proposed by the American Cancer Society. This instrument comprises 20 items designed to assess adherence to various lifestyle tips, including diet, healthy living, and exercises for the prevention and detection of lung cancer. Each item is rated on a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree), with the total score ranging from 20 to 100. A higher total score reflects stronger adherence to cancer prevention behaviors. The Cronbach's α coefficient was 0.78 in a study by Suh et al.[21] and 0.83 in this study, indicating good internal consistency reliability.

Intention to undergo lung cancer screening

Intention to undergo lung cancer screening refers to an individual's proactive actions taken for the early detection or prevention of lung cancer, even without symptoms.[22] This tool was selected because it has been used in various studies on the intention to participate in early screening for women's cancer,[23] to prevent tuberculosis,[24] cervical cancer,[25] and influenza A (H1N1)[26] in Korea. The tool is highly reliable and has the advantage of having a small number of items. In this study, the scales for the intention to undergo women's cancer screening were replaced with lung cancer screening scales.[23] In the context of this study, it specifically pertains to one's willingness to undergo lung cancer screening.[24] We utilized four items to measure this intention: (a) "I am willing to search for information about lung cancer screening in the future," (b) "I am willing to consult health care providers regarding lung cancer screening," (c)"I am willing to undergo regular lung cancer screening to prevent lung cancer," and (d) "I am willing to recommend lung cancer screening to people around me." Each item is rated on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The total score ranges from 0 to 20, with a higher total score indicating a higher intention to undergo lung cancer screening. The Cronbach's α coefficient was 0.88 and 0.79 in studies by Ko[24] and Han,[23] while it was 0.91 in our current study, indicating high internal consistency reliability.

Lung cancer screening experiences and demographics

The following parameters were surveyed to identify the predictors of intention to undergo lung cancer screening: demographic factors, including gender, age, education level, marital status, economic status, health status, and stress level, and lung cancer risk-related factors, including smoking status, smoking history, average daily tobacco consumption, and family history of lung diseases. Economic status was measured on a 5-point scale from 1 for 'very low' to 5 for 'very high'. Health status and stress level were measured using a VAS scale ranging from 0 for 'not healthy at all' or 'not at all stressful' to 10 for 'very healthy' or 'very stressful.'

Data collection

The Hankook Research is an online survey company established in 1978 that has been investigating data from government-run panels (such as the Adolescent Health Panel, Korea Labor Panel, Housing Panel for the Disabled, and Aging Employment Panel). Hankook Research has a master dataset including approximately 900,000 individuals representing the entire nation in terms of region, gender, age, occupation, education, and income distribution. The dataset has been managed in accordance with international standards. For this study, Hankook Research identified approximately 200 Korean individuals who were at high risk for developing lung cancer and met the selection and exclusion criteria for our study. Hankook Research sent out an online study information sheet and informed consent form to the selected subjects. The researchers' contact information was provided in the information sheet so the participants could contact them for information about the study. When the participants consented to participate, Hankook Research sent a link to the online questionnaire, and data were collected from April 26 to May 3, 2023. After an anonymization process, we received data from 186 subjects.

Data analysis

The collected data were analyzed using the SPSS 27.0 software (IBM, New York, NY, USA). Participant characteristics, lung cancer screening health beliefs, knowledge of lung cancer, cancer prevention behavior, and intention to undergo lung cancer screening were analyzed using descriptive statistics (frequency, percent, mean, standard deviation, range), and the normality of the variables was analyzed using the Kolmogorov–Smirnov test. Differences in intention to undergo lung cancer screening according to participant characteristics were analyzed using the independent *t*-test and one-way ANOVA. The correlations between lung cancer screening health beliefs, knowledge of lung cancer, cancer prevention behavior, and intention to undergo lung cancer screening were analyzed using Pearson's correlation. The predictors of intention to undergo lung cancer screening were identified using hierarchical multiple regression, and statistical significance was set at $P < 0.05$.

Ethical considerations

This study was approved by the Institutional Review Board at the Chungbuk National University (IRB No. CBNU-202306-HR-0150). The participants were recruited from the panels of an online survey company. The study information sheet presented a clear and easily understandable explanation of the study, including the potential risks and benefits of participation. It was explicitly stated that the participants faced minimal risks and were free to discontinue the questionnaire at any point without facing any disadvantages. Only those who voluntarily consented to participate were provided with the link to the online questionnaire. Additionally, demographic information such as gender, age, and education level were collected as part of the survey. The company ensured that the data provided to the researchers remained deidentified to maintain confidentiality. All participants provided written informed consent.

Results

Participant characteristics

The mean age of the participants was 60.08 ± 6.07 years. The majority (n = 180, 96.8%) were men, had a bachelor's degree (n = 129, 69.4%), and were married (n = 150, 80.6%). The mean economic status score was 2.75 ± 0.88, and the mean health status score was 5.58 ± 1.73. The mean stress score was 5.82 ± 2.11. While 160 cases (86.0%) were current smokers, 26 (14.0%) had quit smoking within the past 15 years. The mean smoking history was 33.78 ± 8.52 years, with a daily average of 21.23 ± 3.44 cigarettes. Eighty-two (44.1%) had a family history of lung disease, and 79 (42.5%) had a history of lung cancer screening CT scan (Table 1).

Descriptive statistics of study variables

The mean intention to undergo lung cancer screening score was 14.65 ± 2.58 (scale standardized score: 3.66 ± 0.64, range: 2.00–5.00). The mean scores for the different domains of lung cancer screening health beliefs were: 6.44 ± 1.50 (scale standardized score: 2.15 ± 0.50, range: 1.00–3.67) for perceived risk, 19.01 ± 2.96 (scale standardized score: 3.17 ± 0.49, range: 1.67–4.00) for perceived benefit, 35.16 ± 8.57 (scale standardized score: 2.07 ± 0.50, range: 1.00–3.40) for perceived barrier, and 26.68 ± 3.29 (scale standardized score: 2.96 ± 0.37, range: 2.11–4.00) for self-efficacy. The mean knowledge of lung cancer score was 2.97 ± 0.80 (range: 0–5), and the mean cancer prevention behavior

Table 1
Characteristics of the participants ($N = 186$).

Characteristics		*n*	%	Mean ± SD
Age (years)	50-59	86	46.2	60.08 ± 6.07
	60-69	80	43.0	
	70-74	20	10.8	
Gender	Male	180	96.8	
	Female	6	3.2	
Education	High school graduate	37	19.9	
	College graduate	129	69.4	
	Master's degree or higher	20	10.8	
Marriage status	Yes	150	80.6	
	No	36	19.4	
Economic status	Below average	70	37.6	2.75 ± 0.88
	Above average	116	62.4	
Health status	Below average	91	48.9	5.58 ± 1.73
	Above average	95	51.1	
Stress level	Below average	81	43.5	5.82 ± 2.11
	Above average	105	56.5	
Smoking	Present	160	86.0	
	Past (quit < 15 years)	26	14.0	
Smoking period (years)	< 33.78	92	49.5	33.78 ± 8.52
	≥ 33.78	94	50.5	
Smoking amount (cigarettes/day)	< 21.23	157	84.4	21.23 ± 3.44
	≥ 21.23	29	15.6	
Familial history of pulmonary disease	Yes	82	44.1	
	No	104	55.9	
Experience with Lung cancer screening CT scan	Yes	79	42.5	
	No	107	57.5	

n, frequency; SD, standard deviation; CT, computed tomography.

score was 67.06 ± 8.13 (scale standardized score: 3.35 ± 0.41, range: 2.20–4.80) (Table 2).

Knowledge of lung cancer score

In the knowledge of lung cancer quiz, the statement "Low-dose chest computed tomography (CT) should be done to detect lung cancer" had the highest correct response rate (94.6%, 176/186 participants). The correct response rates to "For early detection of lung cancer, screening should be done every 6 months" and "Smokers do not care how much they smoke, but the longer they smoke, the more likely they are to develop lung cancer" were only 37.1% ($n = 69$) and 23.1% ($n = 43$), respectively (Table 3).

Differences in intention to undergo lung cancer screening according to participant characteristics

Intention to undergo lung cancer screening was significantly higher in individuals with better-than-average health status ($t = -2.85$, $P = 0.005$) and better-than-average stress level ($t = -2.06$, $P = 0.040$ (Table 4).

Correlations among study variables

Intention to undergo lung cancer screening showed a significant positive correlation with the perceived benefit ($r = 0.34$, $P < 0.001$) and self-efficacy ($r = 0.48$, $P < 0.001$) domains of the lung cancer screening health belief scale. In contrast, it showed a significant negative correlation with the perceived barrier domain of the scale ($r = -0.31$, $P < 0.001$). It was also significantly positively correlated with cancer prevention behavior ($r = 0.35$, $P < 0.001$) (Table 5).

Predictors of intention to undergo lung cancer screening

Factors with a significance level < 0.05 were identified as predictors of intention to undergo lung cancer screening, while those with significance ≥ 0.10 were excluded. In model 1, participant characteristics that showed significance in the univariate analysis were included as predictors. In model 2, hierarchical multiple regression analysis incorporated all four domains of the lung cancer screening health belief scale (perceived risk, perceived benefit, perceived barrier, self-efficacy), knowledge of lung cancer, and cancer prevention behavior (Table 6). In the intention to undergo the lung cancer screening model, tolerance was above 0.1, and the variance inflation factor was below 10, indicating no multicollinearity issues. The Durbin–Watson statistic was 1.85 (close to 2), confirming no autocorrelation of residuals.

In model 1, the intention to undergo lung cancer screening was higher with better health status ($\beta = -0.26$, $t = 3.56$, $P < 0.001$) and higher stress level ($\beta = 0.16$, $t = 2.19$, $P = 0.030$). These two variables explained 6.3 % of the variance in the intention to undergo lung cancer screening ($F = 7.18$, $P < 0.001$). In model 2, the intention to undergo lung cancer screening was higher with higher perceived risk ($\beta = 0.13$, $t = 2.07$, $P = 0.040$), higher self-efficacy ($\beta = 0.35$, $t = 4.57$, $P < 0.001$), and more frequent cancer prevention behaviors ($\beta = 0.26$, $t = 3.59$, $P < 0.001$). Model 2 explained 34.7% of the variance in the intention to undergo lung cancer screening ($F = 13.27$, $P < 0.001$) (Table 6).

Discussion

Lung cancer is the leading cause of cancer-related deaths and has the highest mortality rate among cancers in Korea.[3] Lung cancer screening with LDCT is effective in reducing lung cancer mortality among those at high risk. However, although many countries recommend screening,[7] LDCT is still not widely used.[5,27] Therefore, it would be beneficial to assess the intention to undergo screening among individuals at high risk for lung cancer and predict their intention based on relevant factors.

In our study, the mean intention to undergo lung cancer screening using LDCT was 3.66 out of 5. This cannot be compared directly with the literature due to the lack of studies that used the same instrument on Koreans at high risk for lung cancer. However, the score is considered low compared to the percentage of current or past smokers willing to undergo LDCT (84.3%) in Belgium[28] and to 86% of high-risk Americans indicating an intention to undergo LDCT in a previous study.[29] In addition to the low intention, the actual screening rate is also low in the Korean population. Korea has a national health insurance system for the entire population, through which the government pays 90% of the cancer screening cost for individuals at high risk for six cancer types, including

Table 2
Descriptive statistics of the variables ($N = 186$).

Variables	Items	Mean ± SD	Range	Scale standardized score	
				Mean ± SD	Range
Intention to lung cancer screening	4	14.65 ± 2.58	8-20	3.66 ± 0.64	2.00–5.00
I am willing to search for information about lung cancer screening in the future.					
I am willing to consult health care providers regarding lung cancer screening.					
I am willing to undergo regular lung cancer screening to prevent lung cancer.					
I am willing to recommend lung cancer screening to people around me.					
Lung cancer screening health belief scale.					
Perceived risk	3	6.44 ± 1.50	3-11	2.15 ± 0.50	1.00–3.67
It is likely that I will get lung cancer sometime in my lifetime.					
It is likely that I will get lung cancer in the next ten years.					
It is likely that I will get lung cancer in the next five years.					
Perceived benefit	6	19.01 ± 2.96	10-24	3.17 ± 0.49	1.67–4.00
Having a lung scan will help find lung cancer early.					
Having a lung scan will lower my chances of dying from lung cancer.					
Having a lung scan will help me not to worry as much about lung cancer.					
Having a lung scan will help me plan for the future.					
Having a lung scan will help my family not worry as much.					
Having a lung scan will give me peace of mind.					
Perceived barrier	17	35.16 ± 8.57	17-58	2.07 ± 0.50	1.00–3.41
I might put off having a lung scan because I worry about finding something wrong.					
I might put off having a lung scan because I do not have the time.					
I might put off having a lung scan because I do not have a regular health care provider.					
I might put off having a lung scan because no one in my family had lung cancer.					
I might put off having a lung scan because the cost would be a problem.					
I might put off having a lung scan because I do not have any lung problems or symptoms.					
I might put off having a lung scan because transportation would be a problem.					
I might put off having a lung scan because I am afraid the lung scan will damage my lungs.					
I might put off having a lung scan because I have had a bad experience with a hospital or health care provider.					
I might put off having a lung scan because I do not know enough about the test.					
I might put off having a lung scan because I think I am too old to benefit from screening for lung cancer.					
I might put off having a lung scan because I am a smoker.					
I might put off having a lung scan because I would rather not know if I have any lung problems.					
I might put off having a lung scan because I worry about feeling like a social outcast for smoking.					
I might put off having a lung scan because I worry about being blamed for having smoked.					
I might put off having a lung scan because it is not worth the effort.					
I might put off having a lung scan because I do not trust the health care system.					
Self-efficacy	9	26.68 ± 3.29	19-36	2.96 ± 0.37	2.11–4.00
How confident are you that you can make an appointment to have a lung scan?					
How confident are you that you can find the time to have a lung scan?					
How confident are you that you can find transportation to get to and from the clinic/hospital to have a lung scan?					
How confident are you that you can get enough information about having a lung scan?					
How confident are you that you can cover the cost of a lung scan, if needed?					
How confident are you that you can get a lung scan even if you are worried about the results?					
How confident are you that you can have a lung scan even if you do not know what to expect about the procedure?					
How confident are you that you can even if you are anxious about the process?					
How confident are you that you can even if you are anxious about the results?					
Knowledge of lung cancer	5	2.97 ± 0.80	0-5		
Smokers do not care how much they smoke, but the longer they smoke, the more likely they are to develop lung cancer.					
More than 80 % of all lung cancers are caused by smoking.					
Coughing with blood is the most common symptom in the early stages of lung cancer.					
Low-dose chest computed tomography (CT) should be done to detect lung cancer					
For early detection of lung cancer, screening should be done every 6 months.					
Cancer prevention behavior	20	67.06 ± 8.13	44-96	3.35 ± 0.41	2.20–4.80
I try to maintain a normal weight.					
I am not a picky eater and consume balanced nutrition.					
I avoid overeating.					
I mainly eat green vegetables, fruits, grains, and other high-fiber foods.					
I don't eat anything moldy.					
I don't eat heavily burnt food.					
I take adequate amounts of vitamins A, C, and E.					
I don't eat instant food.					
I don't eat fatty foods.					
I don't eat spicy and salty foods.					
I don't drink too much.					
I don't smoke.					
I avoid overwork.					
I keep my body clean.					
I exercise regularly.					
I try to avoid stress and have fun.					
I use mass media and the Internet for cancer prevention and early detection.					
I check to see if antibodies have formed after being vaccinated against hepatitis B.					
I do not share personal items that may be infected, such as razors, toothbrushes, or syringes, with others.					
I clean my genital area.					

SD, standard deviation.

Table 3
Correct answer rate for knowledge of lung cancer screening ($N = 186$).

	Correct answer	
	n	%
1. Smokers do not care how much they smoke, but the longer they smoke, the more likely they are to develop lung cancer.	43	23.1
2. More than 80 % of all lung cancers are caused by smoking.	119	64.0
3. Coughing with blood is the most common symptom in the early stages of lung cancer.	145	78.0
4. Low-dose chest computed tomography (CT) should be done to detect lung cancer	176	94.6
5. For early detection of lung cancer, screening should be done every 6 months.	69	37.1

n, frequency.

Table 4
The difference in the Intention for Lung Cancer Screening According to Participant's Characteristics ($N = 186$).

Characteristics		Mean ± SD	*t* or *F*	*P*
Age (years)	50-59	14.60 ± 2.39	0.04	0.961
	60-69	14.71 ± 2.86		
	70-74	14.60 ± 2.28		
Gender	Male	14.70 ± 2.55	1.44	0.152
	Female	13.17 ± 3.37		
Education	High school graduate	13.97 ± 2.53	1.80	0.168
	College graduate	14.77 ± 2.48		
	Master's degree or higher	15.15 ± 3.13		
Marriage status	Yes	14.82 ± 2.58	1.84	0.067
	No	13.94 ± 2.47		
Economic status	< 2.75	14.19 ± 2.28	−1.92	0.056
	≥ 2.75	14.93 ± 2.71		
Health status	< 5.58	14.11 ± 2.44	−2.85	0.005
	≥ 5.58	15.17 ± 2.62		
Stress level	< 5.82	14.21 ± 2.52	−2.06	0.040
	≥ 5.82	14.99 ± 2.58		
Smoking	Present	14.63 ± 2.60	−0.33	0.739
	Past (quit < 15 years)	14.81 ± 2.48		
Smoking period (years)	< 33.78	14.83 ± 2.68	0.92	0.360
	≥ 33.78	14.48 ± 2.48		
Smoking amount (cigarettes)	< 21.23	14.66 ± 2.57	0.07	0.946
	≥ 21.23	14.62 ± 2.65		
Familial history of pulmonary disease	Yes	14.70 ± 2.64	0.31	0.760
	No	14.59 ± 2.51		
Experience with Lung cancer screening CT scan	Yes	14.95 ± 2.55	1.36	0.175
	No	14.43 ± 2.59		

SD, standard deviation; *t*, independent *t*-test; *F*, one-way ANOVA; CT, computed tomography.

lung cancer, and the full screening cost for low-income individuals.[30] However, screening rates for lung and colorectal cancers remain among the lowest compared to other cancer types.[10] This suggests a low intention to undergo lung cancer screening among Koreans, accounting for the low screening rate. Therefore, exploring the underlying reasons and barriers to lung cancer screening in this population is imperative. Understanding these factors can pave the way for targeted interventions to improve lung cancer screening rates and enhance early detection efforts. In the univariate analysis, health status and stress level were significantly associated with intention to undergo lung cancer screening. Hence, the intention to undergo lung cancer screening was higher among people with better-than-average health status and higher-than-average stress levels. However, these two factors only explained 6.3% of the variance in the intention to undergo lung cancer screening (model 1), while model 2, which included lung cancer screening health belief-related variables reported in previous studies, accounted for 34.7% of the variance. In model 2, stress level, perceived risk, self-efficacy, and cancer prevention behavior were identified as factors impacting the intention to undergo lung cancer screening.

Individuals' perceived stress affects their health behaviors and health outcomes.[31–33] Individuals with high stress levels tend to have an unhealthy lifestyle, such as smoking, compared to those with low stress levels.[33] However, unlike stress generally being associated with negative health behaviors,[31–33] we found that higher stress levels were associated with a higher intention for lung cancer screening. This discrepancy could be due to two reasons. First, in contrast to the general population evaluated in the previous studies, the participants of this study had been smoking for a long time and were recommended to undergo lung cancer screening using LDCT. Second, the stress measurement methods and tools used in this survey were different from those used in the previous studies.

Our results are consistent with those of a previous study on 1730 Korean men aged 40–74 years, wherein the intention to undergo lung cancer screening was higher among high-risk individuals living in a metropolitan area, undergoing regular health check-ups, and with high perceived susceptibility or low perceived barrier.[34] However, the specific study variables differed, and participants living in non-Seoul metropolitan areas probably would have had poorer access to lung cancer screening, which might have acted as a barrier to lung cancer screening.[34] This previous study identified “perceived susceptibility” but not “perceived severity” and “perceived benefits” as significant predictors for the intention to undergo lung cancer screening.[34] The perceived susceptibility reported by Bui et al.[34] refers to one's belief in their likelihood of developing lung cancer, which aligns with the perceived risk construct used in our study. The participants' intention to undergo lung cancer screening increases when they believe they may develop lung cancer. Therefore, health care providers should ensure that patients accurately understand their relative risk for lung cancer and provide psychological interventions to improve their perceived susceptibility and perceived risk. A previous study has shown that the health advisor's suggestion is a critical factor influencing individuals' decision to initiate lung cancer screening.[35] Hence, hospitals or community health

Table 5
Correlation among the variables.

Variables	Lung cancer screening health belief scale				Knowledge of lung cancer	Cancer prevention behavior
	Perceived risk	Perceived benefit	Perceived barrier	Self-efficacy		
	r (*P*)					
Intention to lung cancer screening	0.07 (0.340)	0.34 (< 0.001)	−0.31 (< 0.001)	0.48 (< 0.001)	0.09 (0.213)	0.35 (< 0.001)
Lung cancer screening health belief scale						
Perceived risk	1	−0.01 (0.936)	0.12 (0.102)	0.01 (0.921)	0.02 (0.778)	−0.09 (0.200)
Perceived benefit		1	−0.27 (< 0.001)	0.38 (< 0.001)	0.01 (0.949)	0.26 (< 0.001)
Perceived barrier			1	−0.55 (< 0.001)	−0.11 (0.141)	−0.04 (0.606)
Self-efficacy				1	0.12 (0.110)	0.16 (0.031)
Knowledge of lung cancer					1	0.08 (0.286)
Cancer prevention behavior						1

Notes. r: Pearson's correlation.

Table 6
Factors affecting intention to lung cancer screening.

Variables	Model 1				Model 2			
	B	SE	*β*	*t* (*P*)	B	SE	*β*	*t* (*P*)
Intercept	11.31	0.93		12.19 (< 0.001)	−2.65	2.49		−1.06 (0.289)
Health status	0.39	0.11	0.26	3.56 (< 0.001)	0.20	0.11	0.13	1.83 (0.069)
Stress level	0.20	0.09	0.16	2.19 (0.030)	0.24	0.08	0.20	3.16 (0.002)
Perceived risk					0.22	0.11	0.13	2.07 (0.040)
Perceived benefit					0.08	0.06	0.10	1.45 (0.149)
Perceived barrier					−0.03	0.02	−0.10	−1.32 (0.188)
Self-efficacy					0.27	0.06	0.35	4.57 (< 0.001)
Knowledge of lung cancer					0.03	0.20	0.01	0.17 (0.863)
Cancer prevention behavior					0.08	0.02	0.26	3.59 (< 0.001)
F (*P*)	7.18 (< 0.001)				13.27 (< 0.001)			
Adjusted R^2 (%)	6.3				34.7			
Tolerance	0.93				0.62–0.97			
Variance inflation factor	1.08				1.03–1.62			
Durbin–Watson					1.85			

B, Unstandardized coefficient; SE, standard error; β, Standardized coefficient; *t*, independent *t*-test; *F*, Ratio of mean squares treatment and mean squares error; *R*, Coefficient of determination.

providers should provide interventions to increase the individuals' perceived risk to increase the LDCT participation rate in Korea.

We found that cancer prevention behavior was a predictor of lung cancer screening, consistent with previous reports showing regular health checkups affect individuals' intention to undergo lung cancer screening. In other words, health checkups and usual cancer prevention behaviors are health-promoting behaviors, which are, in turn, influenced by prior health-related behaviors. Information on the individuals' prior health-related behaviors allows the prediction of behaviors in the present,[36] including their intention to undergo lung cancer screening.

Additionally, although participants' knowledge of lung cancer was not identified as a predictor of lung cancer screening, the mean knowledge score among our participants was low (2.97/5). In particular, the correct answer rate was especially low for questions on individuals at high risk for lung cancer (23.1%) and early detection (37.1%). In other words, the participants seemed to know that lung cancer screening using LDCT is useful for early detection of the disease, but they lacked knowledge about who should be screened and how frequently they should undergo screening. These findings differ from those of a previous study wherein the willing-to-be-screened group exhibited higher knowledge and belief in the efficacy of lung cancer screening than the unwilling-to-be-screened group.[14] Furthermore, a qualitative study that aimed to explain the reasons why current and former long-term smokers undergo LDCT revealed that people with no intention to undergo screening considered it as a waste of time or money and believed that their health care providers, including physicians, did not recommend it because of this reason.[37] Thus, health care providers should provide the details of lung cancer screening, including the method, process, and time taken, to people at high risk for lung cancer to boost their self-efficacy for undergoing screening.

Limitations

This study has some limitations that should be acknowledged. First, recruiting participants online might have introduced bias in the study results. The exclusion of individuals who are less familiar with or lack access to smartphones or computers could have impacted the average age and knowledge level of the participants. For future investigations, it is essential to include a more diverse range of participants, encompassing those excluded from our study. Second, as a cross-sectional study, the aim was to identify factors influencing the intention to undergo lung cancer screening. While this design provides valuable insights, caution must be exercised in drawing causal relationships between the variables and screening intention since we did not observe two groups over an extended period, as in a cohort study. Third, the participants in this study differed in gender ratio. Since there were fewer women than men, the findings may not be representative of all adults in Korea. Fourth, although the tools used in this study have been validated in Korea, they were still general tools and had limitations in assessing lung cancer knowledge. Future studies should develop and use lung cancer-related validated tools specialized in assessing knowledge and prevention behaviors.

Conclusions

Lung cancer screening using LDCT is an effective means of lowering the lung cancer mortality rate. Therefore, this study aimed to identify the

predictors of intention to undergo lung cancer screening by evaluating lung cancer screening health beliefs, knowledge of lung cancer, and cancer prevention behavior among adults at high risk for lung cancer. The mean intention to undergo lung cancer screening score was 3.66/5. The regression model for intention to undergo lung cancer screening explained 34.7% of the variance, and stress level, perceived risk, self-efficacy, and cancer prevention behavior were identified as significant factors. These results highlight the necessity for interventions by health care providers to alter individuals' behaviors and facilitate their participation in lung cancer screening. Health care providers should provide psychological interventions and education about cancer screening to high-risk individuals to increase their perceived risk and self-efficacy to undergo screening. Quality patient-provider communication during such interventions will help increase the number of individuals undergoing screening.

Declaration of competing interest

All authors have none to declare.

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CRediT author statement

Mi-Kyoung Cho: Conceptualization, Methodology, Data curation, Formal analysis, Writing - Original draft preparation, Writing - Revised draft preparation. Yoon Hee Cho: Conceptualization, Data collection, Writing - Original draft preparation, Writing - Revised draft preparation. All authors had full access to all the data in the study, and the corresponding author had final responsibility for the decision to submit for publication. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

Ethics statement

The study was approved by the Institutional Review Board at Chungbuk National University (IRB No. CBNU-202306-HR-0150). All participants provided written informed consent.

Data availability statement

The data that support the findings of this study are available on request from the corresponding author.

Declaration of Generative AI and AI-assisted technologies in the writing process

No AI tools/services were used during the preparation of this work.

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