RESEARCH ARTICLE

Intentions to Undergo Lung Cancer Screening among Korean Men

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Abstract

Opportunistic screening for lung cancer is commonly conducted in Korea in accordance with physician recommendations and screenee's preferences. However, studies have yet to thoroughly examine the public's understanding of the risks posed by lung cancer screening. This study was conducted to assess changes in intentions to undergo lung cancer screening in response to being informed about exposure to radiation during low-dose computed tomography (LDCT) tests and to identify factors with the greatest influence thereon among Korean men. We conducted sub-group interviews among men chosen from the 2013 Korea National Cancer Screening Survey (KNCSS), a nationwide, population-based, cross-sectional survey of men aged 40 to 74 years and women aged 30 to 74 years. From 4100 participants in the KNCSS, 414 men who underwent any cancer screening test within the last 2 years were randomly selected for inclusion in this study. Via face-to-face interviews, their intentions to undergo lung cancer screening were assessed before and after being informed about exposure to radiation during LDCT testing. Of the 414 participants, 50% were current smokers. After receiving information on the benefits of the test, 95.1% stated an intention to undergo screening; this decreased to 81.6% after they received information on the harms of the test. The average decrease in intention rate was 35.3%. Smoking status, household income, and education level were not associated with lowered intentions to undergo lung cancer screening. Participants who were older than 60 years old (OR=0.56; 95% CI= 0.33-0.96) and those with less concern for radiation exposure (OR=0.56; 95% CI=0.36-0.89) were less likely to lower their screening intentions. The results of this study suggest that there is a need to educate both non-smokers and former smokers on the harms of lung cancer screening.

Keywords: Lung cancer screening-screening intention-low-dose computed tomography-smoking history

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Introduction

Lung cancer is the most common cancer worldwide and the third most common cancer in the Republic of Korea. Further, lung cancer is the leading cause of death among all cancers in men from Korea and worldwide (Ferlay, 2012). Reportedly, the burden of lung cancer according to disability-adjusted life years and a single measure of cancer burden is greatest in Korea (Cho et al., 2013). While most lung cancer patients are usually diagnosed at an advanced stage and have a very poor prognosis (Kasenda et al., 2013), the effectiveness of lung cancer screening by low-dose computed tomography (LDCT) in reducing mortality remains controversial: Many European clinical trials have been conducted to ascertain an effective manner for lung cancer screening, although none have shown positive results (Infante et al., 2009; Saghir et al., 2012). Recently, in 2011, the National Lung Screening Trial (NLST), conducted by the US National Cancer Institute, showed reductions in lung cancer mortality (20.3%) and in all-cause mortality (7%) with LDCT in comparison to subjects who underwent single-view, posteroanterior chest radiography (Aberle et al., 2011). Of three randomized studies that have provided evidences on the effectiveness of LDCT screening on lung cancer mortality, the NLST, which was the most informative, studied the largest sample size (53,454 participants) (Bach et al., 2012).

In March 2014, the US Preventive Service Task Force published their recommendations for annual lung cancer screening for asymptomatic adults of ages 55 to 80 years with a 30 pack-year smoking history and who currently smoke or have quit within the past 15 years. According to their recommendations, screening should be discontinued once a person has quit smoking for 15 years or develops a health problem that substantially limits their life expectancy or ability and/or willingness to undergo curative lung surgery (B recommendation: the USPSTF recommends screening if there is high certainty of moderate net benefit or if there is moderate certainty of moderate to substantial net benefit.) (Moyer, 2014).

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Never-smokers are not to be screened. Building on these recommendations, an additional study suggested that smokers of ages 65 to 80 years are at high risk for lung cancer and may benefit from screening (Slatore et al., 2014).

Nevertheless, the harms of LDCT screening, including the potential for radiation-induced carcinogenesis, high false-positivity rates, and overdiagnosis, are major concerns (Bach et al., 2012; Berg et al., 2012). In fact, one study determined that more than 18% of all of the lung cancers detected by LDCT in the NLST were likely an overdiagnosis (Patz et al., 2014). Additionally, a comparison of the radiation risks posed by lung cancer screening estimated that if a 55-year-old lung screening participant undergoes LDCT periodically for the next 20-30 years, the cumulative radiation dose over that period (280-420 mSv) would amount to as much as those noted in nuclear workers and atomic bomb survivors (McCunney and Li, 2014).

In Korea, lung cancer screening is commonly conducted as part of opportunistic screening programs, based on physician recommendations and individual preferences. However, the public's understanding and awareness of the risks posed by lung cancer screening have not been thoroughly examined. In this study, we aimed to examine intentions to undergo lung cancer screening among Korean men before and after they received information on the benefits and harms of LDCT for lung cancer screening; we assessed changes in intention and factors associated with lowered intentions to undergo screening. Specifically, we focused on how information on radiation exposure from LDCT affects lung cancer screening intentions.

Materials and Methods

Sample and sampling

Data were acquired from subjects included in the 2013 Korean National Cancer Screening Survey (KNCSS). The KNCSS is a an annual cross-sectional survey performed to investigate screening rates among Koreans for five common cancers (gastric, liver, colorectal, breast, and cervix) through nationally representative random sampling. Men of ages from 40 to 74 years and women of ages from 30 to 74 years were selected based on Resident of Registration Population data for July 2013 compiled by Statistics Korea, using multistage random sampling according to sex, age, geographic area, and size of population per area. The survey was conducted from September 26 to October 18, 2013, at which time investigators from a professional research agency went door-to-door to recruit residents. The 2013 KNCSS included 4,100 participants (response rate 69.3%).

From the 4,100 participants in the 2013 KNCSS, we randomly sub-sampled men who had previously undergone cancer screening within the past 2 years. We then conducted an additional face-to-face interview to investigate how men integrated information on the benefits and harms of lung cancer screening with their existing understanding of lung cancer screening and how they might use the information when making their personal decisions to undergo screening. Finally, among 1,135 men who underwent cancer screening within the past 2 years, 414 men completed the KNCSS interview and the additional face-to-face interview survey (response rate: 36.5%). This study was approved by the Institutional Review Board of the National Cancer Center, Korea (approval number: NCCNCS-08-129), and written informed consent was obtained from all study participants.

Study instruments

Each participant was asked to complete a questionnaire designed to collect information on socio-demographic characteristics, smoking status, experience with lung cancer screening within the past 2 years, concerns about radiation exposure during the screening procedure, and lung cancer screening intentions. Smoking status was categorized as non-smokers (never smoked), former smokers (previously smoked but had quit within the last 15 years), and current smokers. Before discussing radiation exposure information, we briefly explained to participants the benefits of lung cancer screening via face-to-face interviews and in writing, which stated, "*For individuals who have smoked a pack of cigarettes every day for the past 30 years or two packs per day for the past 15 years, LDCT examination may reduce lung cancer mortality by 20%.*"

The participants were then asked to describe their intentions to undergo lung cancer screening. Thereafter, information about radiation exposure during lung cancer screening with LDCT was introduced as, "*Whenever you undergo LDCT for lung cancer screening, you are exposed to 1 - 2 mSv of radiation. However, for the common person, the recommended limitation for radiation exposure is 1 mSv. Radiation exposure due to the Fukushima Daiichi nuclear disaster was 8.2 mSv (more than four times that with LDCT).*" We then reassessed lung cancer screening intentions. Participants were asked to describe their intentions to undergo screening via the following four responses: "*I will definitely undergo lung cancer screening*"; "*I will probably undergo lung cancer screening*"; "*I will probably not undergo lung cancer screening*"; and "*I definitely will not undergo lung cancer screening*." Change in intention to undergo screening was assessed as follows: lowered intentions by at least one level were coded as a "*decrease*"; all others (increase or no change) were coded as "*no decrease*."

Statistical analysis

Chi square and Fisher's exact test were conducted to assess differences between non-smokers, former smokers, and current smokers. Unconditional univariate and multivariate logistic regression was conducted to examine factors associated with lowered intentions to undergo screening for lung cancer. To avoid over adjustment by including an excessive number of variables, we performed a stepwise procedure to select variables. Nonparametric test for trends across ordered groups was conducted. All statistical analyses were performed using STATA software, version 12 (version 12 Stata Corp. L.P., College Station, TX), and all P-values <0.05 were considered statistically significant.

Results

Table 1 shows the baseline characteristics of respondents according to smoking status. Of the 414 males who participated in this study, 50% were current smokers (n=207). Overall, 10.6% of men reported having undergone lung cancer screening within the previous 2 years. Although not statistically significant, the percentage of men who had undergone lung cancer screening was slightly higher in current smokers than non-smokers.

Table 2 lists the participants' intentions to undergo lung cancer screening after being told about the benefits of lung cancer screening using LDCT. Thereafter, 95.1% of respondents were willing to undergo lung cancer screening.

Table 1. Baseline Characteristics of Respondents According to Smoking Status

	Non-smokers	Former smokers	Current smokers	Total	P-value
Total	73 (17.6)	134 (32.4)	207 (50.0)	414 (100.0)	
Age (years)					
40 - 49	27 (37.0)	54 (40.3)	64 (30.9)	145 (35.0)	0.374
50-59	25 (34.2)	47 (35.1)	85 (41.1)	157 (37.9)	
60 - 74	21 (28.8)	33 (24.6)	58 (28.0)	112 (27.1)	
Marital status					
With spouse	70 (95.9)	127 (94.8)	193 (93.2)	390 (94.2)	0.751
Without spouse	3 (4.1)	7 (5.2)	14 (6.8)	24 (5.8)	
Highest education level					
High school graduate	44 (60.3)	78 (58.2)	125 (60.4)	247 (59.7)	0.917
College or higher	29 (39.7)	56 (41.8)	82 (39.6)	167 (40.3)	
Monthly household income (US $)					
≤2,999	16 (21.9)	39 (22.4)	46 (22.2)	92 (22.2)	0.546
3,000 - 4,999	31 (42.5)	71 (53.9)	101 (48.8)	203 (49.0)	
≥5,000	26 (35.6)	33 (24.6)	60 (29.0)	119 (28.7)	
Type of health insurance					
National health insurance	70 (95.9)	127 (94.8)	203 (98.1)	400 (96.6)	0.248
Medical aid	3 (4.1)	7 (5.2)	4 (1.9)	14 (3.4)	
Lung cancer screening history within the past 2 years					
Yes	6 (8.2)	12 (9.0)	26 (12.6)	44 (10.6)	0.437
No/Do not know	67 (91.8)	122 (91.0)	181 (87.4)	370 (89.4)	
Concerns about radiation exposure					
High	30 (41.1)	45 (33.6)	83 (40.1)	158 (38.2)	0.452
Medium	18 (24.7)	27 (20.2)	39 (18.8)	84 (20.3)	
Low	25 (34.3)	62 (46.3)	85(41.1)	172 (41.6)	

Table 2. Intentions to Undergo Lung Cancer Screening by LDCT Prior to Exposure to Information on Radiation Exposure

	Definitely Yes	Probably Yes	Probably Not	Definitely Not	P-value
Total	186 (44.9)	208 (50.2)	17 (4.1)	3 (0.7)	
Smoking status					
Non-smokers	27 (37.0)	43 (58.9)	2 (2.7)	1 (1.4)	0.104
Former smokers	52 (38.8)	75 (56.0)	6 (4.5)	1 (0.8)	
Current smokers	107 (51.7)	90 (43.5)	9 (4.4)	1 (0.5)	
Age (years)					
40-49	66 (45.5)	73 (50.3)	5 (3.5)	1 (0.7)	0.498
50-59	75 (47.8)	77 (49.0)	5 (3.2)	0 (0.0)	
60-74	45 (40.2)	58 (51.8)	7 (6.3)	2 (1.8)	
Highest education level					
High school graduate	117 (47.4)	117 (47.4)	10 (4.1)	3 (1.2)	0.320
College or higher	69 (41.3)	91 (54.5)	7 (4.2)	0 (0.0)	
Monthly household income (US $)					
≤2,999	39 (42.4)	50 (54.4)	2 (2.2)	1 (1.1)	0.165
3,000 – 4,999	102 (50.3)	89 (43.8)	10 (4.9)	2 (1.0)	
≥5,000	45 (37.8)	69 (58.0)	5 (4.2)	0 (0.0)	
Lung cancer screening history within the past 2 years					
Yes	22 (50.0)	22 (50.0)	0 (0.0)	0 (0.0)	0.563
No	164 (44.3)	186 (50.3)	17 (4.6)	3 (0.8)	
Concerns about radiation expose in cancer screening					
High	74 (46.8)	75 (47.5)	8 (5.1)	1 (0.6)	0.859
Medium	35 (41.7)	45 (53.6)	4 (4.8)	0 (0.0)	
Low	77 (44.8)	88 (51.2)	5 (2.9)	2 (1.2)	

Table 3. Intentions to Undergo Lung Cancer Screening by LDCT after Exposure to Information On Radiation Exposure

	Definitely Yes	Probably Yes	Probably Not	Definitely Not	P-value
Total	100 (24.1)	238 (57.5)	65 (15.7)	11 (2.7)	
Smoking status					
Non-smokers	11 (15.1)	50 (68.5)	10 (13.7)	2 (2.7)	0.383
Former smokers	34 (25.3)	76 (56.7)	22 (16.4)	2 (1.5)	
Current smokers	55 (26.6)	112 (54.1)	33 (15.9)	7 (3.4)	
Age (years)					
40-49	30 (20.7)	92 (63.5)	19 (13.1)	4 (2.8)	0.636
50-59	42 (26.8)	86 (54.8)	26 (16.6)	3 (1.9)	
60-74	28 (25.0)	60 (53.6)	20 (17.9)	4 (3.6)	
Highest education level					
High school graduate	64 (25.9)	140 (56.7)	35 (14.2)	8 (3.2)	0.467
College or higher	36 (21.6)	98 (58.7)	30 (18.0)	3 (1.8)	
Monthly household income (US $)					
≤2,999	29 (31.5)	46 (50.0)	14 (15.2)	3 (3.3)	0.431
3,000 – 4,999	49 (24.1)	117 (57.6)	31 (15.3)	6 (3.0)	
≥5,000	22 (18.5)	75 (63.0)	20 (16.8)	2 (1.7)	
Lung cancer screening history within the past 2 years					
Yes	18 (40.9)	21 (47.7)	5(11.4)	0 (0.0)	0.038
No	82 (22.2)	217 (58.7)	60 (16.2)	11 (3.0)	
Concerns about radiation expose in cancer screening					
High	35 (22.2)	90 (57.0)	28 (17.7)	5 (3.2)	0.115
Medium	15 (17.9)	49 (58.3)	19 (22.6)	1 (1.2)	
Low	50 (29.1)	99 (57.6)	18 (10.5)	5 (2.9)	

Table 4. Factors Associated with a Decrease in Intention to Undergo Lung Cancer Screening

	Decrease	OR (95% CI)	aOR (95% CI)	P for trend
Total	146 (35.3)	-	-	
Smoking status				
Non-smokers	26 (35.6)	1 (ref)	1 (ref)	0.037
Former smokers	46 (34.3)	0.94 (0.52 - 1.71)	0.98 (0.53 - 1.80)	
Current smokers	74 (35.8)	1.00 (0.57 - 1.75)	1.04 (0.59 – 1.84)	
Age (years)				
40-49	59 (40.7)	1 (ref)	1 (ref)	0.001
50-59	56 (35.7)	0.81 (0.51 - 1.29)	0.78 (0.49 - 1.25)	
60-74	31(27.7)	0.56 (0.33 - 1.94)	0.56 (0.33 – 0.96)	
Highest education level				
High school graduate	84 (34.0)	1 (ref)	-	-
College or higher	62 (37.1)	1.26 (0.97 – 1.63)	-	
Monthly household income (US $)				
≤2,999	27 (29.4)	1 (ref)	-	-
3,000 – 4,999	77 (37.9)	1.47 (0.86 – 2.50)	-	-
≥5,000	42 (35.3)	1.31 (0.73 – 2.36)	-	-
Lung cancer screening history within the past 2 years				
Yes	11 (25.0)	0.58 (0.28-1.18)	-	-
No	135 (36.5)	1 (ref)	-	-
Concerns about radiation expose in cancer screening				
High	67 (42.4)	1 (ref)	1 (ref)	0.001
Medium	29 (34.5)	0.71 (0.41 - 1.24)	0.74 (0.42 – 1.28)	
Low	50 (29.1)	0.94 (0.35 - 0.87)	0.56 (0.36 – 0.89)	

According to smoking status, 95.2% of current smokers were willing to undergo lung cancer screening, which was similar to non-smokers (95.9%) and former smokers (94.8%). However, non-smokers and former smokers showed less certainty in their intentions to undergo lung cancer screening: a larger percentage of current smokers (51.7%) reported that they would "*definitely*" undergo lung cancer screening, compared to non-smokers (37.0%) and former smokers (38.8%). There were no significant differences in lung cancer screening intention according to education level, monthly household income, age group, previous history of lung cancer screening, and concerns about radiation exposure.

After being informed about radiation exposure with LDCT, the percentage of men who intended to undergo lung cancer screening decreased by about 13.4% from

95.1% to 81.6% (Table 3). Further, the percentage of men who reported negative intentions ("*probably not*" and "*definitely not*") also increased. Although there were no statistically significantly differences in intentions to undergo lung cancer screening according to smoking status, non-smokers (83.6%) and former smokers (82.0%) showed greater intentions to undergo lung cancer screening than current smokers (80.7%). Interestingly, we noted a significant difference in lung cancer screening intention according to previous history of lung cancer screening: men who had undergone lung cancer screening within the previous 2 years reported greater intention to undergo lung cancer screening than those who had not.

Finally, univariate and multivariate logistic regression models were used to analyze predictors of a lower intention to undergo screening (Table 4). Overall, 35.3% of men reported lower intentions to undergo LDCT after being informed about radiation exposure with the test. Smoking status, household income, education level, and history of lung cancer screening within the past 2 years were not associated with lowered intentions in univariate regression. In multivariate analysis, men who were older than 60 years were less likely to lower their intentions to undergo LDCT (aOR=0.56, 95% CI= 0.33 - 0.96), compared with men aged 40-49 years. Older age was less likely to decrease their intention to undergo lung cancer screening (p-trend 0.011). Further, men with lower concerns for radiation exposure from the screening test were less likely to lower their intentions to undergo lung cancer screening (OR=0.56, 95% CI=0.36 - 0.89; p-trend<0.001). Smoking status was not statistically significantly associated with a decrease in intention to undergo screening. This multivariate regression model was statistically significant at a confidence level of 90% (Prob >chi2=0.089).

Discussion

In anticipation of the accepted use of LDCT for early detection of lung cancer in Korea, this study evaluated intentions to undergo LDCT for lung cancer screening. In particular, we assessed intentions to undergo LDCT for lung cancer screening before and after exposure to information on radiation exposure during LDCT. In the current study, we discovered that a large majority of men aged 40-74 years intended to undergo lung cancer screening. Almost 95% of these individuals indicated that they would seek to undergo screening (definitely or probably undergo screening) after we explained testing procedures and the benefits of lung cancer screening. Specifically, screening intentions were stronger among current smokers; about 52% of current smokers indicated that they would definitely undergo LDCT for the early detection of lung cancer, compared to 37% of non-smokers and 39% of former smokers. Although, generally, screening intentions were lower after receiving information on exposure to radiation during LDCT, still, more than 80% of men reported that they would be willing to undergo lung cancer screening. This result seems to be consistent with previous studies that have shown high enthusiasm among patients willing to undergo LDCT for lung cancer screening (Schnoll et al., 2003; Schwartz et al., 2004; Delmerico et al., 2014). Notwithstanding, the percentage of men who intended to undergo lung cancer screening in the current study was much higher than those of previous studies. Schnoll et al. assessed interest in lung cancer screening using spiral CT and reported that 62% of current and former smoker expressed strong interest in screening (Schnoll et al., 2003). One of the possible explanations for the higher intentions to undergo LDCT in the current study is that the study participants comprised men who had undergone cancer screening at least once within the previous 2 years. Thus, the participants in the current study may have been more willing to adhere to healthy behavior patterns, more likely to have positive beliefs and attitudes on cancer screening, and show greater willingness to undergo screening than the general population.

After receiving information on exposure to radiation during LDCT, intentions to undergo lung cancer screening decreased in the present study. Overall, 35.3% of men described lower intentions to undergo screening than they had initially reported. However, despite emphasizing who would be likely targets for lung cancer screening and the risks associated with the test, intentions to undergo screening among never-smokers and former-smokers remained high and did not change much. This result is worrisome considering that lung cancer screening using LCDT is recommended for only adults who have a 30-pack year smoking history and currently smoke or have quit within the past 15 years (Moyer, 2014). Consistent with currently available theories and evidence, greater interest in screening was related to smoking history in the current study. However, this variable was not associated with interest in lung cancer screening in the multivariable prediction models. Further, monthly household income and education levels were also not significantly associated with lowered intentions.

In the current study, men aged 60 years or older were less likely to lower their screening intentions, compared to men aged 40-49 years. This could be explained by the fact that elderly people may have had difficulties in understanding the brief explanations we provided on the benefits and harms of LDCT for lung cancer screening. Thus, clear and concise methods of delivering information about both the benefits and harms of LDCT are needed. Also, concerns about radiation exposure were significantly associated with lowering screening intention. This result stresses the importance of providing information on the harmfulness of screening methods,. Even lung cancer screening provides LDCT, a 55-year-old who participates in lung screening may experience cumulative radiation doses of up to 280 to 420 mSv over the next 20-30 years, exceeding those in nuclear workers and atomic bomb survivors (McCunney and Li, 2014). Accordingly, individuals who are deciding on whether or not to undergo screening should seek a thorough understanding of the risks of radiation exposure in order to better weigh the advantages and disadvantages of lung cancer screening.

There are several limitations to the present study. First, as the number of cigarettes packs per year were

not assessed in the questionnaire, we could not classify high-risk populations based on US Preventive Task Force recommendations (Moyer, 2014). Further, this study was conducted in only men who had previous experiences with cancer screening within the past 2 years. Thus, future studies are needed to investigate lung cancer screening intentions within the entire general population. Finally, albeit there are many harms in lung cancer screening, only radiation expose was examined in this study. As well, the small amount of information that was written on the questionnaire form and verbally explained by a professional interviewer may not have been enough to facilitate making an informed choice, and therefore, may have had an impact on our findings. Thus, future studies are needed to investigate awareness of LDCT for lung cancer screening and intentions to undergo screening in general and high-risk populations.

As research on the efficacy of LDCT for early detection of lung cancer progresses, more and more screening guidelines will be established. In the meantime, information on the benefits and harms of lung cancer screening should be provided to individuals so that they can make an informed choice. Further research into the effect of increased public education on the availability, risks, benefits, and barriers to lung cancer screening, as well as the effects of risk perception on rates of screening in eligible populations, is needed. The results of this pilot study suggest that there is a need to educate both non-smokers and former smokers on the harms of lung cancer screening

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