

## LUNG CANCER

# Attitudes towards screening for lung cancer among smokers and their non-smoking counterparts

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Appendix is available online at <http://www.thorax.bmjournals.com/supplementary>

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**Background:** There has been resurgence of interest in lung cancer screening using low-dose computed tomography. The implications of directing a screening programme at smokers has been little explored.

**Methods:** A nationwide telephone survey was conducted. Demographics, certain clinical characteristics and attitudes about screening for lung cancer were ascertained. Responses of current, former and never smokers were compared.

**Results:** 2001 people from the US were interviewed. Smokers were significantly ( $p < 0.05$ ) more likely than never smokers to be male, non-white, less educated, and to report poor health status or having had cancer, and less likely to be able to identify a usual source of healthcare. Compared with never smokers, current smokers were less likely to believe that early detection would result in a good chance of survival ( $p < 0.05$ ). Smokers were less likely to be willing to consider computed tomography screening for lung cancer (71.2% (current smokers) v 87.6% (never smokers) odds ratio (OR) 0.48; 95% confidence interval (CI) 0.32 to 0.71). More never smokers as opposed to current smokers believed that the risk of disease (88% v 56%) and the accuracy of the test (92% v 71%) were important determinants in deciding whether to be screened ( $p < 0.05$ ). Only half of the current smokers would opt for surgery for a screen-diagnosed cancer.

**Conclusion:** The findings suggest that there may be substantial obstacles to the successful implementation of a mass-screening programme for lung cancer that will target cigarette smokers.

Lung cancer is the leading cause of cancer death worldwide. The number of deaths from breast, colon and prostate cancer combined would not equal the approximately 150 000 patients who will die of lung cancer in the USA this year.<sup>1</sup> The 5-year survival for this disease remains a dismal 14%.<sup>1</sup> In contrast with breast, colon and prostate cancer, there is no recommended screening programme for lung cancer.<sup>2</sup> Previous trials using chest radiography and sputum cytology as screening tools in heavy smokers failed to show a reduction in mortality.<sup>3–5</sup> Recently, there has been resurgence of interest in lung cancer screening using low-dose computed tomography, which can detect lesions smaller than can be visualised using plain chest radiography. Several large case series have shown that computed tomography of the chest detects more early-stage lung cancers than would be expected in a non-screened group.<sup>5–11</sup> The findings have prompted the National Cancer Institute in the USA to sponsor a randomised controlled trial of 50 000 patients to either annual chest radiography or low-dose computed tomography scan for three consecutive years, with another 5 years of follow-up planned. Certain regions such as Japan have already accepted computed tomography screening for lung cancer as reasonable. While the randomised trial is progressing in the USA, private entrepreneurs are providing screening for those willing to pay. Countries with a national health system such as Ireland have taken a much more conservative approach and are not providing coverage for screening, but are reporting data from non-randomised trials.<sup>12</sup>

Although there is optimism regarding computed tomography screening for lung cancer, the societal implications of a mass-screening programme has been little explored. Unlike screening

programmes for the other common cancers, lung cancer screening could be the first screening programme of its size that targets a population with a specific poor health habit—namely, cigarette smoking. One aspect of the screening debate which lacks information is whether or not the target group for screening (smokers) has different attitudes about the value of screening. There has been no comparison of smokers and non-smokers regarding their self-assessment of risk for development of lung cancer, their acceptance of the various treatments for the disease, their willingness to pay for the test and, most importantly, their willingness to consider screening for lung cancer. We undertook this study to compare the demographics, certain clinical characteristics and attitudes about screening for lung cancer among current, former and never smokers. The results may help to better understand the implications of targeting smokers to participate in a screening programme for lung cancer.

### METHODS

From 1 October 2002 to 13 January 2004, a telephone survey was administered to a nationwide sample of people at least 40 years old. Random telephone numbers were generated using the Genesys Sampling System's in-house Random Digit Dial telephone sampling system. The "last birthday" method was used for respondent selection within the household.<sup>13</sup>

The survey instrument contained questions about demographics, smoking status, and health status, which were obtained from the 2000 Behavior and Risk Factor Surveillance System. In addition, the instrument included questions developed by the investigators about the respondent's knowledge

**Table 1** Demographics of never, former and current smokers

Characteristic	Never smokers (n = 925)	Former smokers (n = 517)	Current smokers (n = 559)	All subjects (n = 2001)
Age (years), mean (SD)	55.7 (12.9)	58.3 (12.9)*	52.1 (10.0)*†	55.4 (12.4)
Gender (% male)	27.9	45.7*	66.7*††	43.3
Race (% white)	79.0	76.5	66.6*††	74.1
Marital status (% married)	62.0	60.9	61.5	61.4
Education (% beyond high school)	53.6	54.4	49.0‡	52.5
Health insurance provided by employer (%)	46.7	40.2*	57.1*††	47.9
Employed (%)	66.3	52.2*	70.5*†	63.8
The subject is the family's primary income source (%)	55.6	63.0*	76.1*††	62.6
Income (% <\$40 000 per year)	40.9	48.2*	39.2†	42.3
Very good or excellent health (%)	68.6	61.9*	55.7*††	63.3
Ever had cancer (%)	4.6	8.4*	8.8*†	6.7
Pack-years	–	–	–	–
Mean (SD)			15.6 (17.7)	
Median (interquartile range)			10.0 (3.4 to 22.5)	
Usual source of healthcare (%)	95.8	96.5	84.6*††	92.8
Doctor's office as usual source of healthcare (%)	85.8	81.3*	77.2*†	82.4
Distance from usual source of healthcare (miles), mean (SD)	9.7 (29.6)	11.1 (28.9)	14.6 (30.3)*†	11.3 (29.7)
Time to usual source of healthcare (min), mean (SD)	19.7 (46.4)	20.8 (50.6)	24.9 (42.3)*†	21.3 (46.6)
Able to work (%)	90.5	83.1*	83.3*†	86.6
Type of work limited by health impairment (%)	12.5	21.2*	21.4*†	17.2

\*p<0.05 compared with non-smokers by t test or  $\chi^2$  test, as appropriate.

†p<0.05 compared with former smokers by t test or  $\chi^2$  test, as appropriate.

‡p<0.05 compared with non-smokers, after adjusting for age in analysis of covariance or logistic regression models, as appropriate.

about lung cancer and willingness to be screened for lung cancer. Subjects' willingness to pay for the screening procedure was ascertained using two separate questions that included randomly assigned costs. Firstly, each person was asked by the interviewer if he/she would be willing to pay X dollars, where X ranged from \$50 to \$400. If he/she was willing to pay X dollars, then he/she was asked if he/she would be willing to pay Y dollars, where Y was a randomly selected value greater than X. If the person was not willing to pay X dollars, then he/she was asked if he/she would be willing to pay Z dollars, where Z was a randomly selected value less than X. Subjects' responses to these questions allowed us to estimate the proportion from each group that would be willing to spend \$200 and the proportion from each group that would be willing to spend \$300 out-of-pocket on this screening procedure.

Cognitive pre-testing was conducted on a pilot group recruited using the same methodology as the study participants. Appropriate changes were made on the basis of their responses. The interviewers were experienced in telephone survey research and were trained by a co-investigator to follow a written script for each participant. Survey respondents were informed that their participation was regarded as voluntary, anonymous and without compensation. Survey responses were entered into an electronic database using appropriate range and logic checks. This research project was approved by the Institutional Review Board of the Medical University of South Carolina (see the appendix available online at <http://www.thorax.bmjournals.com/supplementary> for a copy of the survey).

Each respondent was classified as one of the following: a current smoker, a former smoker or a never smoker, as defined by the Behavior and Risk Factor Surveillance System. Comparisons of the respondents demographic characteristics by smoking status were performed using t tests and  $\chi^2$  tests, as appropriate. Because some comparisons were associated with age and because there were significant (p<0.05) age differences across the three smoking groups, age-adjusted comparisons in

the demographic characteristics were also performed using analysis of covariance methods. The odds of being willing to consider screening for lung cancer were compared across current smokers, former smokers and never smokers using a multivariate logistic regression model adjusting for respondent's age, race, sex, marital status, education, employment status, having health insurance through employer, income and whether or not the subject was the primary source of household income. Using a  $\chi^2$  test, willingness to be screened for lung cancer via a computed tomography scan was also compared between current smokers with <20 pack-years and smokers with  $\geq$ 20 pack-years.

## RESULTS

The survey was completed by 2001 respondents. To obtain this sample, 21 000 random phone numbers were selected. Of these numbers, 17 225 calls were ineligible for the study because the recipient of the call did not fulfil the inclusion criteria (no person in the household was aged >40 years), did not answer the telephone or because the telephone line was not in service. Of the 3775 eligible respondents contacted, 2001 (53%) agreed to participate and 1774 (47%) declined.

Table 1 shows the demographics of the study group by smoking status. There are striking differences between the groups, including current smokers (mean (standard deviation (SD)) age 52.1 (10) years) being significantly younger than never smokers (mean (SD) age 55.7 (12.9) years) and former smokers (mean (SD) age 58.3 (12.9) years). Significant differences between at least two of the three groups were noted in all of the demographic characteristics except marital status. After adjusting for age, current smokers were significantly (p<0.05) more likely than never smokers to be male, non-white, less educated, to have employer-based health insurance, to be their family's primary income source, and for their type of work to be limited by a health impairment. Likewise, after age adjustment, current smokers were less likely than never smokers to have a usual source of healthcare, to

have a doctor's office as their usual source of care and to be able to work. Despite their younger age, smokers were less likely to rate their health as good or excellent when compared with never smokers or former smokers, and almost twice as likely to report having been diagnosed with cancer when compared with never smokers. Despite better health insurance, current smokers were less likely than former smokers or never smokers to be able to identify any usual source of healthcare or claim a specific doctors' office as their usual source of healthcare. Smokers were located further away from their healthcare resources, both in travel time and distance to the nearest healthcare facility.

Table 2 explores the beliefs regarding cancer and willingness to consider screening for lung cancer among the three groups. Again, marked differences are apparent among the groups. In general, the responses of former smokers were somewhere between those of never and current smokers, but most closely resembled those of never smokers. As expected, smokers stated that they were much more likely to have been told that they are at risk for lung cancer than non-smokers; however, the percentage was still low, with only 21% of the group stating that they had been told by a doctor that they were at high risk of developing lung cancer. Less than a quarter of the smokers believed that they were at risk for lung cancer, and that decreased to 7.7% and 2.8% in former smokers and never smokers, respectively. The risk of a current smoker for developing lung cancer is 33 times higher than that of a never smoker, with the risk of former smokers being between 7 and 22 times the risk depending on when they quit. Smokers were less likely to believe that early detection of cancer led to a better outcome, were less willing to be screened for lung cancer, and were less likely to undergo surgery (the treatment of choice for early-stage disease) than their former or never smoker counterparts. When assessing the attributes of the screening test for lung cancer, the accuracy of the test and the risk of disease were less important to smokers than the other subsets, but cost of the test was more important. Only 27% of smokers were willing to pay \$200 for a screening test for lung cancer, whereas half of the never smokers would pay \$200 for the test. Similarly, only 10.9% of smokers were willing to pay \$300 for a screening test for lung cancer, whereas 26.9% of the never smokers would pay \$300 for the test. Again, these differences remained significant between smokers and never smokers, even after adjusting for age. The separate multivariate model adjusting for the previously mentioned subject characteristics (age, race, sex, etc) source showed that the odds among current smokers of being willing to be screened for lung cancer with computed tomography was half that of never smokers and former smokers, should that test be recommended by a doctor (adjusted OR 0.48 (95% CI 0.32 to 0.71);  $p < 0.001$ ). An analysis of heavy smokers ( $>20$  pack-years) showed no significant difference in responses when compared with those smoking for  $<20$  pack-years.

## DISCUSSION

This study has several important findings. Firstly, the demographic characteristics of smokers are different from those of former or never smokers. Secondly, smokers have markedly different beliefs about their risk of cancer, their understanding of screening test characteristics, and the benefits of treatment when the cancer is detected earlier. Thirdly, smokers are less willing to pay for this screening test and to undergo the appropriate treatment (in this case surgery) for a screen-diagnosed cancer. Finally, smokers seem significantly less likely than former or never smokers to be willing to consider computed tomography screening for lung cancer than their non-smoking counterparts. The combination of findings in our

study suggest that there may be substantial obstacles to the successful implementation of a mass-screening programme for lung cancer that is directed towards cigarette smokers.

That the demographics of smokers in this study are different from those of former or never smokers should not really come as a surprise. Data compiled from the 2001 National Health Information Survey documented that 22.8% of the adult population (46 million) of the US smoked.<sup>14</sup> However, smoking rates within different subgroups of the population were vastly different. For example, the prevalence of smoking among those with a 9th–11th grade education (those aged 15–17 years or without a high school degree) was nearly 5 times higher (47%) than those with a graduate or doctoral degree (10%). A similar dichotomy held true when smoking rates were compared between those at or below the poverty level (31%) as opposed to those at or above the poverty level (23%). Lastly, African American men had higher smoking rates than their white counterparts.<sup>14</sup> These data are important because they suggest that those with the highest smoking rates reside in that stratum of the population who have historically had poorer participation in screening programmes for various reasons.<sup>15–19</sup> Smokers in this study were less likely to be able to identify any usual source of healthcare or claim a specific doctors' office as their usual source of healthcare. This has implications for screening because lack of an identifiable primary care provider is associated with a lower likelihood of participation in a screening programme.<sup>20–22</sup>

Our results show important differences between smokers and former or never smokers with regard to their attitudes about their risk of cancer and knowledge about the benefits of screening tests. Firstly, it seems that only about a quarter of the smokers believe that they are at risk for lung cancer, and about the same proportion say that a doctor told them they were at risk. Although this proportion was higher than that of former or never smokers, it is much lower than expected given the barrage of information available to smokers about cancer risk. The accuracy of the screening test and their risk of having the disease are less important to smokers when deciding whether or not to be screened than non-smokers. In other established screening programmes, both of these factors have been shown to influence a person's willingness to be screened and have follow-up treatment.<sup>23</sup> It is troublesome that the only test characteristic regarding screening that is more important to smokers than their non-smoking counterparts is the cost of the test.

Theoretical models exploring screening behaviour or health-care beliefs for other commonly screened cancers have given some insight into why certain at-risk groups (minorities, the poor, those without health insurance and the less educated) are less likely to be screened.<sup>24</sup>

A positive finding from this study pertains to former smokers. Although our data were not longitudinal in nature, it seems that when smokers quit, their attitudes towards screening become as or more favourable than those who have never smoked. Thus, if a mass campaign for lung cancer screening manages to screen large numbers of former smokers or if large numbers of smokers can be encouraged to quit during this process, we can expect to see significant health benefits among the population of former smokers.

These findings have implications that need to be considered. Should a public policy of screening for lung cancer with low-dose computed tomography be undertaken? An analysis of cost-effectiveness performed by Mahadevia *et al*<sup>25</sup> suggested that periodic screening of about half of the 50 million smokers in the USA could cost approximately 116 billion dollars per year. Many of these patients would be of Medicare age and thus would have health coverage similar to those in countries that

**Table 2** Cancer beliefs and willingness to be screened for lung cancer

Characteristic	Never smokers (n = 925)	Former smokers (n = 517)	Current smokers (n = 559)	All subjects (n = 2001)	Smokers v non-smokers Odds ratio* (95% confidence interval)
Told by doctor that he/she is at high risk of developing lung cancer (%)	0.9	4.9 <sup>†</sup>	21.7 <sup>†,‡,§</sup>	7.7	14.7 (9.6 to 22.5)
Belief that he/she is at risk for lung cancer (%)					
Yes	2.8	7.7 <sup>†</sup>	23.1 <sup>†,‡,§</sup>	9.5	6.95 (4.99 to 9.67)
No	90.8	77.4 <sup>†</sup>	36.2 <sup>†,‡,§</sup>		0.08 (0.06 to 0.10)
Not sure	6.9	14.9 <sup>†</sup>	40.8 <sup>†,‡,§</sup>		7.21 (5.59 to 9.30)
Belief that early detection of lung cancer results in a good chance of surviving (%)	58.8	54.0	48.7 <sup>†,§</sup>	54.7	0.65 (0.53 to 0.79)
In making decision to be screened:					
Screening convenience is important (%)	28.9	32.3	29.4	30.0	1.06 (0.85 to 1.32)
Risk of disease is important (%)	87.7	80.9 <sup>†</sup>	56.4 <sup>†,‡,§</sup>	77.2	0.21 (0.17 to 0.27)
Screening accuracy is important (%)	92.4	86.9 <sup>†</sup>	70.9 <sup>†,‡,§</sup>	85.0	0.24 (0.19 to 0.32)
Screening cost is important (%)	36.1	38.3	51.5 <sup>†,‡,§</sup>	41.0	1.98 (1.61 to 2.42)
Willingness to consider for cancer/pay for test/undertake follow-up					
Willingness to consider screening for lung cancer (%)	87.6	86.1	71.7 <sup>†,‡,§</sup>	82.8	0.30 (0.23 to 0.39)
Willing to pay \$200 for lung cancer screening test (%)	51.3	45.6 <sup>†</sup>	27.5 <sup>†,‡,§</sup>	43.2	0.26 (0.20 to 0.33)
Willing to pay \$300 for lung cancer screening test (%)	26.9	20.3 <sup>†</sup>	10.9 <sup>†,‡,§</sup>	19.5	0.29 (0.20 to 0.42)
Willing to have surgery for lung cancer (%)	69.2	62.5 <sup>†</sup>	50.5 <sup>†,‡,§</sup>	62.2	0.39 (0.31 to 0.48)

<sup>†</sup>p<0.05 compared with non-smokers by t test or  $\chi^2$  test, as appropriate.

<sup>‡</sup>p<0.05 compared with former smokers by t test or  $\chi^2$  test, as appropriate.

<sup>§</sup>p<0.05 compared with non-smokers, after adjusting for age in a logistic regression model.

\*Odds ratios reflect comparisons between smokers and non-smokers, and are adjusted for age in a logistic regression model.

have a national health insurance system. Any estimates of the potential yield in terms of reduction in mortality in such a screening programme will have to consider smokers' reduced willingness to be screened, and previous estimates of the benefits of a screening programme based on high compliance rates may need to be revised. For example, Mahadevia *et al* estimated the incremental cost-effectiveness to be \$116 300 (2001 US\$) per quality-adjusted life year for smokers, and \$2 322 700 per quality-adjusted life year for former smokers, with the assumption that 93.5% of smokers would be adherent to lung cancer screening. This assumption was heavily weighted by adherent rates in a lung cancer screening study conducted in Olmsted County, Minnesota, in which 97% of patients were compliant with computed tomography cancer screening. However, this compliance rate was based on a population that had already consented to participate in a cancer screening study that included annual computed tomography scans for 4 years. Our survey suggests that current smokers' willingness to be screened may have been substantially over-estimated. Such a revision in the adherence rate would result in significantly increased cost-effectiveness estimates.<sup>25</sup> Further, from this study, it seems that, in a population setting, more former smokers than current smokers would opt for screening. Although the cost-effectiveness estimates for detecting a cancer in a former smoker are much higher than in a current smoker, the overall cost to the healthcare system could be substantially higher. Policy makers, whether in privately insured markets or within a national health system, may need to weigh the costs associated with a screening programme against the costs of programmes directed towards primary prevention of cigarette smoking, smoking cessation programmes or investments in the treatment for lung cancer.

This study has several limitations. Firstly, the findings may not be generalisable to other nations or healthcare systems. Although this study assesses attitudes towards screening, there is really no way of calculating the percentage of the population who would actually undertake screening. Secondly, we have no way of knowing whether self-reported telephone surveys translate into actual practice. In at least one study, it seems that patients' self-report, either by telephone or by mailing, of

testing for other commonly screened cancers is higher than what can be documented in chart audits.<sup>26</sup> This suggests that we can expect even less compliance with screening for lung cancer than reported here.

In summary, to realise major reductions in mortality, any screening programme must have the population comply with the screening test. This study shows that the health behaviours of smokers make them less likely to be interested in lung cancer screening. Nearly all of their responses suggest that their belief about this preventive health intervention is different from those of non-smokers and will negatively affect their participation in a screening programme. As a lung cancer screening programme will be directed at current smokers and those with a smoking history, the overall reduction in lung cancer mortality that a mass screening effort can expect may be substantially diminished. Other already established screening programmes face a myriad of challenges in promoting widespread use. Lung cancer screening would face all of those challenges and now "reaching smokers" can be added to the list. Although a randomised controlled trial is necessary to establish a benefit to screening with low-dose computed tomography, the results of this study suggest that innovative approaches to reach this difficult population should be developed and tested now if the promise of reducing the burden of lung cancer death is to be realised.

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## LUNG ALERT

**Patients with severe allergic rhinitis are more often affected by sleep disorders.**

▲ Allergic rhinitis and its consequences on quality of sleep: an unexplored area. Léger D, Annesi-Maesano I, Carat F, et al. *Arch Intern Med* 2006;**166**:1744–8.

Allergic rhinitis is common in the general population and impairs sleep and social life. This French study seems to be the first attempt to assess the impact of duration and severity of allergic rhinitis on the quality of sleep and consequently on everyday living.

From a nationwide controlled cross sectional epidemiological study, 591 patients with allergic rhinitis (>1 year) were selected. Those with nasal polyps and/or major nasal septum deviation were excluded. Sleepiness was assessed by self administered questionnaires: sleep disorders questionnaire and Epworth sleepiness scale score.

Sleep impairment was significantly worse ( $p < 0.001$ ) with increased severity of allergic rhinitis. Patients with allergic rhinitis reported significantly more use of sedative drugs ( $p = 0.003$ ) and alcohol ( $p < 0.001$ ). Snoring and sleep apnoea were also reported significantly more often in patients with allergic rhinitis ( $p < 0.001$ ). Poor quality of sleep induced by allergic rhinitis had an adverse impact on everyday living.

There may have been an unavoidable element of bias in the study as patients with allergic rhinitis would expectedly have better recall about their sleep quality than the control group interviewed in the general population. The effect of cofactors such as anxiety and depression or comorbidities such as asthma on sleep quality was not evaluated.

The authors conclude that early detection and treatment of sleep disorders in patients with allergic rhinitis would have a positive impact on their social and general well being. Further studies focusing on the mechanisms that link allergic rhinitis with altered sleep are needed.

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