ORIGINAL ARTICLE

Knowledge of lung cancer symptoms and risk factors in the UK: development of a measure and results from a population-based survey

Alice E Simon,[1] Dorota Juszczyk,[1] Nina Smyth,[1] Emily Power,[1] Sara Hiom,[2] Michael D Peake,[3] Jane Wardle[1]

[1]Cancer Research UK Health Behaviour Research Centre, Department of Epidemiology and Public Health, UCL, London, UK
[2]Director of Information, Cancer Research UK, London, UK
[3]Department of Respiratory Medicine, University Hospitals of Leicester, Glenfield Hospital, Leicester, UK

Correspondence to
Dr Alice E Simon, Cancer Research UK Health Behaviour Research Centre, Department of Epidemiology and Public Health, 1-19 Torrington Place, London WC1E 6BT, UK;
alice.simon@ucl.ac.uk

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ABSTRACT

Objectives To develop and validate a Lung Cancer Awareness Measure (Lung CAM) and explore the demographical and social predictors of lung cancer awareness in the general population.

Methods study 1 Symptoms and risk factors for lung cancer were identified from the medical literature and health professional expertise in an iterative process. Test–retest reliability, internal reliability, item analyses, construct validity and sensitivity to changes in awareness of the Lung CAM were assessed in three samples (total N=191).

Results study 1 The Lung CAM demonstrated good internal (Cronbach's α=0.88) and test–retest reliability (r=0.81, $p<0.001$). Validity was supported by lung cancer experts scoring higher than equally educated controls ($t(106)$=8.7, $p<0.001$), and volunteers randomised to read lung cancer information scoring higher than those reading a control leaflet ($t(81)$=3.66, $p<0.001$).

Methods study 2 A population-based sample of 1484 adults completed the Lung CAM in a face-to-face, computer-assisted interview.

Results study 2 Symptom awareness was low (average recall of one symptom) and there was little awareness of risk factors other than smoking. Familiarity with cancer, and being from a higher socioeconomic group, were associated with greater awareness.

Conclusions Using a valid and reliable tool for assessing awareness showed the UK population to have low awareness of lung cancer symptoms and risk factors. Interventions to increase lung cancer awareness are needed to improve early detection behaviour.

Key messsages

What is the key question?

- How much does the UK public know about lung cancer symptoms and risk factors?

What is the bottom line?

- Lung cancer could potentially be diagnosed at an earlier stage if patients had better symptom and risk factor awareness that led them to present more promptly in primary care.

Why read on?

- The National Awareness and Early Diagnosis Initiative (NAEDI) has supported the systematic development of validated measures of cancer awareness for several cancers, including lung cancer.
- These measures are now being used across the NAEDI to monitor changes in levels of awareness over time, and assess the impact of interventions designed to increase knowledge and early presentation.
- This paper describes the development of the Lung Cancer Awareness Measure (Lung CAM) (study 1) and presents results from a population-representative survey using the Lung CAM (study 2).

INTRODUCTION

Lung cancer is often diagnosed at a late stage when curative options are limited and survival rates are poor.[1] One-year survival in the UK is lower than the rest of Europe, suggesting delays in diagnosis.[2] Recent data indicate that differences in survival occur during the first 3 months, suggesting that either late presentation by patients or poor access to care are the main causes of the discrepancy.[3] One factor contributing to late presentation may be poor awareness of lung cancer symptoms or risk factors. Recent research has explored awareness of symptoms and risk factors more generally,[4–7] but a more in-depth investigation of lung cancer specifically is warranted.

Cough, dyspnoea, haemoptysis and chest discomfort are potentially associated with a primary lung tumour.[8] Cough is found more frequently in patients with earlier than later stage disease.[9] Haemoptysis and dyspnoea can be present at least 180 days before diagnosis.[10] Earlier diagnosis could be made on the basis of these symptoms, and therefore possibly earlier on in the development of the disease. Knowing that a symptom is associated with cancer is associated with an intention to seek medical help promptly.[6 11] However, a recent survey found that the UK public had little awareness of persistent cough as a cancer symptom.[6] The value of raising symptom awareness has been supported by results from a recent social marketing intervention including symptom information which indicated an increase in the numbers of people presenting at primary care with persistent coughs and being given a chest x-ray; and increases in lung cancer diagnoses.[12 13]

Earlier presentation could also be stimulated by better understanding of personal risk. The

relationship between smoking and lung cancer risk is almost universally acknowledged (90% being aware of this association in a recent study),[7] but public awareness of other lung cancer risk factors, such as family history, or past history of other lung diseases, particularly chronic obstructive pulmonary disease (COPD), have not been investigated. These factors are not amenable to change, but may be important for risk perception. For example, breast cancer risk factor awareness has been associated with mammography uptake[14] and bowel cancer risk factor awareness with intention to undergo colorectal screening.[15] Other evidence suggests that people who think that they are not 'at risk' of getting cancer are more likely to misinterpret symptoms.[16] Knowledge of risk factors may be an important element in developing an informed perception of personal risk, and indirectly influence the ability to recognise and act on relevant symptoms.[17]

Research into public awareness of cancers in the UK has been stimulated by the strategic input of the National Awareness and Early Diagnosis Initiative (NAEDI).[18] NAEDI has supported the systematic development of validated measures of cancer awareness for cancer generally (ie, the CR-UK Cancer Awareness Measure (CAM))[19] and for specific disease sites (eg, Bowel CAM,[20] Ovarian CAM[21]). The aim is to establish a set of standardised measures that can be used to monitor changes in awareness over time and assess the impact of interventions designed to increase knowledge and early presentation; improving comparability across studies.[22] A validated measure of lung cancer awareness would make it possible to identify gaps in public awareness that need to be addressed to improve prompt presentation in primary care. This paper describes the development of the Lung Cancer Awareness Measure (Lung CAM) (study 1) and presents results from a population survey using the Lung CAM (study 2).

STUDY 1

Materials and methods

Item generation

Symptoms and risk factors for lung cancer were identified from the research literature,[23 24] cancer websites,[25 26] National Health Service key messages[27] and NICE guidelines for lung cancer urgent referrals.[28] The format for the Lung CAM followed the original generic CAM[19] using first 'open' and then 'closed' questions to assess symptoms and risk factors. The barriers to help-seeking scale[19] validated in the original CAM remained the same and was not part of the current validation process.

Expert review (N=7 experts) and cognitive interviews (N=17 members of the public) were used to ensure that the Lung CAM represented all facets of lung cancer awareness (content validity) and to select the best items in terms of wording, terminology and comprehensiveness. This resulted in minor adjustments to the items to improve clarity. The version tested in the validation process consisted of 30 items: 15 on symptom awareness (1 open and 14 closed; closed items scoring 'yes'=1, 'no/don't know'=0), 10 on risk factors (1 open and 9 closed; closed items scoring 0–5 on a Likert scale from 'strongly disagree' to 'strongly agree'), one on anticipated delay for presentation of lung cancer symptoms, one on age associated with the risk of lung cancer, two on lifetime risk of lung cancer, and one on confidence detecting a lung cancer symptom (the final version of the Lung CAM can be accessed at http://www.naedi.org.uk).

Validation procedures

Test–retest reliability (repeating administration over 10 days), internal reliability (Cronbach's α), item discrimination (item-to-total correlations), item difficulty (% correct), construct validity ('known groups' method), and sensitivity to changes in

Table 1 Demographical characteristics of the validation samples

	Sample 1		Sample 2				Sample 3	
	Test–retest (N=73)		Control (N=43)		Intervention (N=40)		Experts (N=35)	
Demographical groups	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Age								
18–24	8	11	0	0	0	0	0	0
25–34	24	32.9	0	0	0	0	1	3.2
35–44	11	15.1	0	0	0	0	17	54.8
45–54	16	21.9	3	7	2	5	11	35.5
55–64	12	16.4	10	23.3	10	25	2	6.5
65 and over	2	1.4	24	55.8	12	30	0	0
75–84	0	0	5	11.6	14	35	0	0
85+	1	1.4	1	1.2	2	5	0	0
Gender								
Men	27	37	20	46.5	16	40	2	5.7
Women	46	63	23	53.2	24	60	31	88.6
Missing	0	0	0	0	0	0	2	5.7
Ethnic origin								
White	69	94.5	28	65.1	32	80	32	91.4
Other ethnic backgrounds	4	5.5	15	34.9	8	20	3	8.6
Marital status								
Married/civil partnership	47	64.4	19	44.2	15	37.5	26	74.3
Other	26	35.6	24	55.8	35	62.5	9	25.7
Education								
Degree or above	58	79.5	12	27.9	13	32.5	31	88.6
Below degree	15	20.5	19	44.2	12	30	4	11.4
No formal qualifications	0	0	12	27.9	15	37.5	0	0

knowledge (effect of exposure to lung cancer information), were assessed.

Participants

Three samples of adults (total N=191) took part in the validation. The demographical characteristics of the samples are shown in table 1.

Sample 1

Seventy-three adults (35 office-based workers from companies in London, Birmingham and Swansea, and 38 individuals recruited from the Wandsworth Friends of Cancer Research UK Christmas Fair) completed an online version of the Lung CAM on two occasions.

Sample 2

Eighty-three older men and women were recruited from a health fair, a centre for people aged 50 and over, and a rotary club in London. An older sample was selected (mean=69 years, range 48–99 years) because of the association with lung cancer risk. Participants were randomised to read one of two leaflets and then completed a paper and pencil version of the measure. The lung cancer education group (N=40) received a leaflet called *Lung Cancer: The Facts* and the control group (N=43) received a leaflet called *Recycle to Save the Environment*. There were no significant differences in demographical characteristics between the groups.

Sample 3

Thirty-five lung cancer experts (clinicians and nurse specialists) completed an online Lung CAM. Results from experts were compared with sample 1 results (using data from the first questionnaire) to establish construct validity.

RESULTS

Test–retest and internal reliability

Initial testing with office-based workers (N=45), using an online Lung CAM on two occasions, demonstrated high test–retest reliability for warning signs (r=0.69, p<0.001), but low reliability for risk factors (r=0.33, p=0.03). As a result, wording of the risk factor questions was changed and the item ordering adjusted. In a second sample (N=38), test–retest correlation for risk factors was high (r=0.73, p<0.001). The final analyses are based on the maximum useful sample of 73 (sample 1, see table 1) (ie, excluding 10 participants with contradictory results in the first round) and demonstrated high test–retest reliability over a 10-day interval (mean=10.9 days): warning signs: r=0.74, p<0.001; confidence detecting a lung cancer symptom: r=0.71, p<0.001; anticipated delay: r=0.85, p<0.001; lifetime lung cancer risk: men, r=0.77, p<0.001; women, r=0.86, p<0.001; age at risk: r=0.74, p<0.001; and total awareness score: r=0.81, p<0.001. Satisfactory correlations were also obtained for risk factors: r=0.70, p<0.001.

Internal reliability was established using data from all three samples (N=191). The Lung CAM had good internal reliability with a Cronbach's α of 0.88 for the whole questionnaire, 0.91 for the warning signs subscale and 0.74 for the risk factors subscale.

Item discrimination and difficulty

Item discrimination analyses explore how well items differentiate between respondents who have higher overall scores compared with those with lower overall scores. Data from all three samples (N=191) were used in these analyses. The majority of items showed item-to-total correlations >0.2,[29] with the exception of changes in the shape of finger (nails), smoking, lifetime risk and age at risk. Lifetime risk questions were ultimately removed as they also underperformed in other tests and were not considered essential. The 'age at risk' item was retained as it performed well in other tests. The other items are important for content validity (eg, it would look odd to have a risk factor scale for lung cancer that did not include smoking) and so were retained.

Item difficulty analyses were applied for items where there was a 'correct' answer. Data from sample 1 and the control group from sample 2 (N=116) were used in these analyses (excluding participants exposed to the information leaflet and the expert group). Five items were answered correctly by more than 80%[30]: shortness of breath; coughing up blood, smoking, exposure to chemicals and passive smoking. This indicated that these were well known items, with possible ceiling effects, but again they were retained for content validity. The ability of the Lung CAM to distinguish between more and less knowledgeable groups could potentially be limited due to these item issues and this was systematically tested in the subsequent analyses.

Construct validity

Construct validity was established using the 'known-groups' method.[31] Data from lung cancer experts (sample 3, N=35) were compared with data from sample 1 (time 1, N=73) who were the best matched to the experts in terms of educational

Table 2 Construct validity and sensitivity to change

	Construct validity				Sensitivity to change			
	Control (sample 1, N=73)	Experts (sample 3, N=35)	t Test		Control (sample 2, N=43)	Intervention (sample 2, N=40)	t Test	
Awareness section	Mean (SD)	Mean (SD)	t (106)	p Value	Mean (SD)	Mean (SD)	t (81)	p Value
Symptoms (recall)	2.41 (1.30)	6.34 (1.32)	14.61	<0.001	1.55 (1.50)	3.85 (2.08)	5.78	<0.001
Symptoms (recognition)	8.78 (2.81)	13.48 (1.42)	9.32	<0.001	8.65 (3.46)	11.67 (2.66)	4.43	<0.001
Risk factors (recall)	2.21 (1.19)	3.45 (1.17)	5.14	<0.001	1.60 (1.09)	2.50 (1.41)	3.24	0.01
Risk factors (recognition)	35.60 (3.42)	38.94 (2.89)	4.98	<0.001	36.50 (4.63)	39.00 (5.81)	2.12	0.04
	N (%)	N (%)	χ^2	p Value	N (%)	N (%)	χ^2	p Value
Age at risk*	11 (31.43)	24 (68.57)	13.22	0.01	6 (13.95)	10 (25.00)	1.63	0.20
Lifetime risk men*	3 (4.11)	4 (11.43)	0.15	0.21	1 (2.33)	4 (10.00)	2.16	0.14
Lifetime risk women*	13 (17.81)	7 (20.00)	0.78	0.79	4 (9.30)	7 (17.50)	1.21	0.27
	Mean (SD)	Mean (SD)	t (106)	p Value	Mean (SD)	Mean (SD)	t (81)	p Value
Total knowledge†	44.92 (5.08)	53.42 (3.83)	8.78	<0.001	45.46 (6.66)	51.20 (7.60)	3.66	<0.001

*Shows those responding 'correctly' (ie, 'a 70-year-old', 7 or 8 out of 100 men, 4 or 5 out of 100 women).
†Total knowledge = warning signs + risk factors + age at risk + lifetime risk men + lifetime risk women.

achievement (see table 1). Table 2 shows the average (mean) scores for each section of the Lung CAM and differences between the 'control' and 'expert' groups. Lung cancer experts scored higher than office workers on all of the 'knowledge' sections (table 2), apart from the 'lifetime risk' questions which were subsequently removed from the questionnaire.

Sensitivity to change

Sensitivity of the measure to change in levels of lung cancer knowledge was assessed using sample 2 by comparing scores post exposure to either lung cancer information or control (recycling) information. The lung cancer education group scored significantly higher than the control group on all sections of the Lung CAM apart from age at risk (table 2).

STUDY 2

Materials and methods

A total of 1484 participants were recruited as part of the British Market Research Bureau's (BMRB) Omnibus survey in March 2010. The survey is completed weekly by a nationally representative sample of adults (aged 15+ years) across the UK. The survey uses random location quota sampling based on neighbourhoods classified according to census characteristics. Quotas are set for gender, age and employment status. Additional controls correct for variation in the likelihood of being at home at the time of the interview. Data are weighted using a rim weighting technique which targets demographical variables so that the sample profiles match those of people aged over 16 in the UK. The number of people who declined to participate was not recorded and there are no data available on the characteristics of decliners. Participants completed the Lung CAM in a computer-assisted interview in the presence of a trained interviewer.

Socio-demographical characteristics

The BMRB Omnibus includes several socio-demographical questions. The following were used in these analyses: gender, age (participants dichotomised by age at risk into those older (≥40) and younger than 40),[32] ethnicity (categorised as 'white' vs 'non-white'), and social grade based on occupation (AB managerial/professional, C1/C2 supervisory/skilled manual, and D/E semi-skilled/unskilled manual, state pensioners, casual/lowest grade workers). We included two additional items: smoking status (current, ex-smoker, and non-smoker) and familiarity with cancer (personal experience of cancer and knowing 'someone close' who has cancer).

Awareness of symptoms and risk factors

Initially participants responded to an open format, relying on recall of symptoms or risk factors (eg, 'There are many warning signs and symptoms of lung cancer. Please name as many as you can think of.'). The second question was a recognition task using a prompted list of symptoms or risk factors (eg, 'The following may or may not increase a person's chance of developing lung cancer. How much do you agree that each of these can increase a person's chance of developing lung cancer?'). In the recognition task, only 'true' symptoms and risk factors were presented, and there were no distracter items. Correct responses to the recall and recognition questions were each coded and summed to form scales from 0 to 14 for symptoms and 0 to 9 for risk factors. Our previous work demonstrated that recall items produce lower scores than recognition questions[33] and this is what we expected to see in these data.

Analysis

Data were analysed using SPSS V.18.0. Results are based on weighted data. Descriptive statistics described levels of symptom and risk factor awareness. Multivariate analyses using general linear models explored levels of awareness in relation to smoking status, familiarity with cancer, age, gender, ethnicity and social grade.

Results

The (unweighted) sample demographics are shown in table 3. The sample was largely representative of the UK population, with a slight over-representation of women (54% vs census data of 51.6%[34]) and non-white ethnic groups (15.2% vs census data of 7.9%[35]) and a slightly higher proportion of current smokers (26%) compared with other sources (eg, 22% in an Office of National Statistics survey[36]).

Symptom awareness

Thirty-eight per cent of the sample were unable to recall any symptoms. The average number recalled was one symptom (SD=1, range 0–5). Symptom recognition was higher (mean=9.27, SD=3.21, range 0–14), as predicted. The two most highly recalled and recognised symptoms were 'shortness of breath' (dyspnoea) (recall=37%, recognition=83%) and 'coughing up blood' (haemoptysis) (recall=21% and recognition=91%) (table 4). A number of items had very low levels of recall, and the two that were also the least endorsed in the recognition list were 'persistent shoulder pain' (32%) and 'changes in shape of finger (nail)' (ie, finger clubbing) (21%).

Multivariate associations between social or demographic factors and total symptom awareness scores were explored (table 5). Average (mean) scores and 95% CIs are shown for each level of the socio-demographical predictors. There were no differences in symptom awareness by age, gender or smoking status. People in the highest (AB) social grade had higher

Table 3 Demographical characteristic of the survey sample (N= 1484)

Demographical groups	N	%*
Gender		
Men	675	45.5
Women	809	54.5
Age		
16–24	191	12.9
25–34	260	17.5
35–44	269	18.1
45–54	226	15.2
55–64	213	14.2
65 and over	325	21.9
Ethnicity		
White	1257	84.7
Other ethnic backgrounds	226	15.2
Social grade		
AB (high)	266	17.9
C1	383	25.8
C2	317	21.4
D	226	15.2
E (low)	292	19.7
Smoking status		
Current smoker	391	26.3
Ex-smoker	267	18.0
Non-smoker	825	55.6
Familiarity with cancer		
No	413	27.8
Yes (someone close)	1067	72.1

*Some variables do not add up to 100% due to missing data.

Table 4 Knowledge of warning signs for lung cancer

Symptom	Recall (open question)		Recognition (prompted list)	
	N	%	N	%
Unexplained weight loss	104	7.0	1084	73.0
Persistent chest infection	35	2.4	1097	73.9
Cough that does not go away	77	5.2	936	63.0
Shortness of breath	549	37.0	1233	83.1
Persistent tiredness	92	6.2	969	65.3
Persistent chest pain	200	13.8	1109	74.7
Persistent shoulder pain	2	0.1	474	31.9
Coughing up blood	310	20.9	1357	91.5
Ache or pain when breathing	3	0.2	1131	76.2
Loss of appetite	22	1.5	812	54.7
Painful cough	2	0.1	1176	79.3
Changes in shape of finger (nail)	0	0	308	20.7
High-pitched sound when breathing	94	6.4	916	61.7
Change in existing cough	3	0.2	1147	77.3

symptom awareness than those in the lower grades (recall: $F(2,1445)=30.10$, $p<0.001$; recognition: $F(2,1444)=24.56$, $p<0.001$). People from a non-white ethnic group had lower symptom awareness than those from a white ethnic background (recall: $F(1,1445)=8.36$, $p<0.01$; recognition: $F(1,1444)=4.55$, $p<0.05$). Finally, familiarity with cancer was associated with increased symptom awareness (recall: $F(1,1445)=12.18$, $p<0.001$; recognition: $F(1,1444)=13.87$, $p<0.001$).

Risk factor awareness

As expected, the most well known risk factor for lung cancer was smoking (recall: 85%; recognition: 94%) (table 5). The next best known risk factors were exposure to another person's cigarette smoke and exposure to chemicals. On average people recalled only one risk factor (mean=1.22, SD=0.76, range 0–5). In contrast, the mean number of risk factors endorsed in the recognition list was 6.77 (SD=2.04, range 0–9) (table 6).

There were significant differences in recognition of risk factors (total score) by smoking status ($F(2,1297)=5.36$, $p<0.01$), with smokers having the lowest levels of awareness (table 4), but no significant differences by smoking status in recall. Familiarity with cancer was associated with higher recognition of risk factors ($F(1,1297)=4.54$, $p<0.05$), but not recall. Older age ($F(1,1445)=5.18$, $p<0.05$), being a woman ($F(1,1445)=6.17$, $p<0.05$), and being from a white ethnic background ($F(1,1445)=6.85$, $p<0.01$) were associated with higher recall of risk factors, but there were no differences in recognition. People categorised in the highest social grade (AB) had greater risk factor awareness than those in the lowest social grade (DE) for both recall ($F(2,1445)=15.31$, $p<0.001$) and recognition ($F(2,1297)=3.82$, $p<0.05$).

DISCUSSION

The development studies indicated that the Lung CAM is a psychometrically valid and reliable tool for assessing awareness of lung cancer. Test–retest reliability and internal reliability met established standards, and construct validity was demonstrated by lung cancer experts scoring significantly higher than educated non-experts. Validity was further supported by the results of the brief intervention study, where participants receiving lung cancer information scored significantly higher than those given control information on recycling, demonstrating that the Lung CAM is sensitive to increases in awareness. However, it would be useful in future studies to measure information decay following an intervention over a longer period of time.

The Lung CAM can be used in face-to-face interviews or as an online survey. When used in an online format, researchers should ensure that participants cannot return to previous questions, because closed questions may act as a prompt for subsequent open-ended questions. The Lung CAM could also be used as a postal survey using either open or closed questions, but not both. Reductions in length can be achieved by excluding questions with low item-to-total correlation.

There were some limitations in the design of the development studies. Different modes of administration were used (pen and paper vs online), although all participants from the same

Table 5 Multivariate associations between social and demographical factors and awareness of lung cancer

	Symptom awareness		Risk factor awareness	
	Recall (open) Mean (95% CI)	Recognition (closed)	Recall (open) Mean (95% CI)	Recognition (closed)
Gender				
Men	0.81 (0.72 to 0.91)	8.77 (8.46 to 9.08)	1.06 (0.98 to 1.12)	6.55 (6.34 to 6.76)
Women	0.89 (0.78 to 0.99)	9.01 (8.67 to 9.35)	1.15 (1.07 to 1.24)	6.43 (6.20 to 6.66)
Age				
Under 40	0.81 (0.71 to 0.91)	9.00 (8.67 to 9.33)	1.06 (0.98 to 1.14)	6.52 (6.30 to 6.74)
40 and above	0.89 (0.79 to 0.99)	8.78 (8.45 to 9.11)	1.15 (1.07 to 1.23)	6.45 (6.23 to 6.68)
Social grade				
AB (high)	1.15 (1.03 to 1.28)	9.78 (9.38 to 10.18)	1.24 (1.14 to 1.33)	6.66 (6.39 to 6.93)
C1/C2	0.83 (0.73 to 0.93)	8.81 (8.51 to 9.11)	1.15 (1.08 to 1.23)	6.58 (6.37 to 6.78)
D/E (low)	0.57 (0.44 to 0.69)	8.08 (7.67 to 8.50)	0.93 (0.83 to 1.02)	6.22 (5.94 to 6.50)
Ethnicity				
White	0.97 (0.90 to 1.04)	9.17 (8.94 to 9.40)	1.18 (1.13 to 1.24)	6.62 (6.47 to 6.78)
Non-white	0.73 (0.58 to 0.88)	8.61 (8.12 to 9.09)	1.02 (0.91 to 1.14)	6.35 (6.02 to 6.67)
Smoking status				
Current smoker	0.83 (0.71 to 0.96)	8.87 (8.57 to 9.26)	1.04 (0.94 to 1.13)	6.36 (6.09 to 6.63)
Ex-smoker	0.90 (0.76 to 1.04)	8.85 (8.40 to 9.30)	1.16 (1.05 to 1.26)	6.36 (6.06 to 6.67)
Non-smoker	0.81 (0.73 to 0.90)	8.95 (8.67 to 9.24)	1.12 (1.05 to 1.19)	6.74 (6.54 to 6.93)
Familiarity with cancer				
Yes	0.96 (0.86 to 1.06)	9.26 (8.95 to 9.57)	1.15 (1.07 to 1.22)	6.63 (6.42 to 6.84)
No	0.74 (0.63 to 0.85)	8.52 (8.15 to 8.89)	1.06 (0.98 to 1.15)	6.34 (6.09 to 6.59)

Table 6 Knowledge of risk factors of lung cancer

Risk factor	Recall (open question)		Recognition (prompted list)	
	N	%	N	%
Exposure to radon gas	0	0	881	59.4
Cigarette smoke exposure	191	12.8	1271	85.6
Past cancer treatment	0	0	937	63.2
Close relative with lung cancer	6	0.4	875	59.0
Exposure to chemicals for example asbestos	243	16.4	1324	89.2
Past history of cancer, for example head and neck	2	0.1	970	65.3
Air pollution	106	7.2	1114	75.1
Being a smoker	1256	84.6	1387	93.5
History of lung disease, for example COPD	6	0.4	1055	71.1

COPD, chronic obstructive pulmonary disease.

samples completed the same version of the questionnaire (ie, all participants in the test–retest sample completed an online version). Participants who completed the online version could conceivably have consulted the internet or other sources about their responses. However, the system prevented them from returning to previous answers.

The first use of the Lung CAM in the population-based survey demonstrated low levels of awareness with an average recall of only one symptom or risk factor. The notable exception was the high awareness of smoking as a risk factor, confirming results from previous studies for example.[7] Awareness of family history and prior medical history of lung disease was low. While smoking is by far the most relevant risk factor for lung cancer, it may still be useful to explore whether changing perceptions of risk derived from other risk factors can influence secondary prevention behaviour. In relation to the key symptoms (persistent cough, dyspnoea and haemoptysis), the least well known was persistent cough, indicating that this may be a good target for awareness-raising initiatives.

There were a number of differences in awareness by social or demographical background. Lower SES was associated with lower levels of symptom and risk factor awareness. 'Familiarity with cancer' was associated with symptom awareness and future research might usefully expand this by specifically exploring the impact of knowing someone with a *lung* cancer diagnosis. The predictors of risk factor awareness were less consistent across the 'recall' and 'recognition' questions, but higher risk factor 'recall' was associated with older age, being a woman, and being from a white ethnic background. These results mirror associations found for awareness of cancer in general.[6]

Current smokers did not have higher symptom awareness and so may not be in a good position to notice lung cancer symptoms. The understandable focus on smoking cessation has meant that few interventions address symptom awareness, despite potential gains that could be made through timely investigation of symptoms. Smokers also showed no better awareness of risk factors than either ex-smokers or non-smokers. Other research on this topic has had mixed results. One study from the USA demonstrated that smokers had lower overall cancer knowledge,[37] while an Australian study demonstrated no differences.[38] It is difficult to make direct comparisons because measures of 'knowledge' vary greatly among studies. A validated measure of lung cancer awareness will make it possible to have greater consistency and enable better cross-study comparisons.

Although the Lung CAM includes a single item exploring anticipated time to medical help seeking (for 'a symptom that you thought might be a sign of lung cancer'), the analyses in this paper do not explore this topic. Future research could focus on exploring the relationships between lung cancer knowledge and both intended and actual help-seeking behaviour. The Lung CAM also does not include any items exploring beliefs about lung cancer treatments and outcomes. Beliefs about cancer have been implicated in the help-seeking process,[39] and developing a measure exploring lung cancer beliefs could be another useful avenue for research.

In conclusion, the development of the Lung CAM presents an opportunity to use a validated tool to assess lung cancer awareness. Initial results in this population-representative survey demonstrated low levels of awareness of symptoms and risk factors for lung cancer. The Lung CAM can be used to develop public information campaigns by identifying gaps in awareness and to assess the impact of campaigns by monitoring changes over time. The Lung CAM should be of use to researchers working in health education and promoting the early presentation of lung cancer.

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