NON-COMUNICABLE DISEASE

Awareness of Lung Cancer Among the Lebanese General Population: a Cross-Sectional Study

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Summary

Background. *Lung cancer is a significant contributor to mortality worldwide. The aim of this study was to assess the level of lung cancer awareness among the Lebanese general population.*

Methods. *An online-based questionnaire was completed by 410 participants all over Lebanon. A validated Lung Cancer Awareness Measurement tool was used. Multivariate analysis using Generalized Linear model and post-hoc analysis were performed after assessing validity and reliability of the scale.*

Results. *Only 13.7% correctly identified age-related lung cancer risk, while 60.7% thought age was unrelated. Warning signs were poorly recalled, with persistent cough being the most remembered (58%), and coughing up blood being highly recognized (87.8%). Participants struggled to recognize persistent shoulder pain (28.7%) and finger/nail changes (29.51%) as possible warning signs of lung cancer. Multivariate analysis showed that gover-*

norates, educational level, and occupation significantly affected warning sign-scores. Post-hoc analysis revealed that people residing in Bekaa scored lower warning sign recognition scales compared with participants residing in Beirut, Mount Lebanon, and North. Postgraduates and medical field workers showed higher symptom recognition, with the latter scoring higher recall scales as well. Smoking was the most recalled and recognized risk factor (82% and 95.6%). Females, postgraduates, and medical workers showed higher risk factor recognition. While 75% were willing to seek medical attention for lung cancer suspicion, 58% lacked confidence in identifying warning signs.

Conclusion. *Extensive awareness campaigns focusing on age-related misconceptions, warning signs, and risk factors hold immense promise for improved therapeutic outcomes.*

Introduction

Despite ongoing research advancements in the field of oncology worldwide, the cancer burden remains high. According to the International Agency for Research on Cancer (IARC), the global incidence of cancer increased to 19.3 million new cases and resulted in 10 million deaths by the year 2020 [1].

As for specific cancer types, lung cancer ranked second after breast cancer in terms of worldwide incidence and accounted for 11.4% of total new cancers in 2020 [1]. It is also the leading cause of mortality among all types of cancer worldwide in men and ranks second after breast cancer in women (18% of the total cancer deaths), highlighting the substantial impact of lung cancer incidence on the healthcare system [1].

Additionally, a descriptive study assessing the expected global burden of lung cancer between the years 2020 and 2040 anticipated a further increase in its incidence, particularly in low and middle-income countries, thus potentially posing an additional burden on the healthcare systems and resources, especially in such regions [2].

In Lebanon, a recent epidemiological study also showed that lung cancer incidence comes right after breast cancer, accounting for approximately 9.2% of

all reported cancer cases during the period from 2005 to 2015 [3]. The majority of patients are aged 50 years or older, with approximately 89.2% of cases occurring within this age group [3].

High rates of mortality and morbidity caused by lung cancer were linked to several barriers in a systematic review conducted in 2021, all of which can result in delayed diagnosis and hence poorer treatment outcomes [4]. The barriers include lack of symptom awareness, underestimation or misinterpretation of warning signs, poor doctor-patient relationships, and limited access to healthcare services, including financial hindrance, geographic distance, and inadequate access to specialized healthcare professionals [4].

The American Cancer Society categorizes lung cancer risk factors as modifiable or non-modifiable [5]. Modifiable risk factors include smoking, both direct and indirect as well as exposure to cancer-causing chemicals such as radon and asbestos. Non-modifiable risk factors encompass past chest radiation for treating different cancers, especially breast cancer, along with air pollution and a family history of lung cancer [5].

In that regard, assessing awareness levels among the Lebanese population regarding lung cancer is considered crucial to identify gaps in knowledge

and attitudes within the general population. Using validated and effective measurement tools can aid in the fulfillment of the targeted outcome. The Cancer Awareness Measurement Tool (CAM) was developed by University College London and Cancer Research UK. It is based on a generic CAM developed by Cancer Research UK, University College London, Kings College London, and Oxford University in 2007-08. The CAM tool was initially validated in 2008 [6] and has undergone continuous updates, including adaptations to incorporate the impact of the COVID-19 pandemic. As for lung cancer awareness measurement, scale validation was fulfilled in the UK in 2012 [7]. The most recent version of the CAM tool was available online in February 2023.

Despite the lack of updated validation, embracing the use of this scale still holds importance for knowledge assessment. Given the limited number of cancer research studies in the Arab World, including Lebanon, which accounted for only 1.52% of total cancer publications between 2005 and 2019 [8], the lack of epidemiological studies in Lebanon that have assessed the general population's awareness of lung cancer using a validated scale, combined with the increasing burden of lung cancer, makes conducting an awareness assessment among the Lebanese population critical. CAM was used in several observational studies aiming to assess knowledge in the general population, including Colombia, Australia, and Gaza [9-11]. As for Lebanon, CAM was not used for assessing lung cancer awareness, yet it was applied to colorectal cancer [12].

Therefore, the aim of this study is to assess the level of lung cancer awareness among the Lebanese general population using the Lung Cancer Awareness Measurement (LCAM) tool. The importance of this study is to gain insights into the level of knowledge, attitudes, and perceptions related to lung cancer in Lebanon.

Materials and methods

Study design

A cross-sectional study was conducted over a one-month period to assess the knowledge and awareness of the Lebanese general population towards lung cancer.

Population and sampling

Lebanese individuals aged 18 years or older, speaking either Arabic or English (no need to be bilingual), were eligible to take part in the study after providing their agreement to participate through an informed consent form. Participants need to have access to the internet or be able to receive delegate assistance to fill out the survey. Patients with a personal or family history of lung cancer will not be excluded from the study; they will be identified throughout the socio-demographic section after being questioned about the presence of a personal or family history of lung cancer. The study participants were approached randomly in different community settings such as restaurants, universities, pharmacies, and

online groups all over Lebanon to ensure that the sample was representative of the Lebanese general population. This approach helped increase the likelihood of obtaining a diverse sample that reflects the population's characteristics.

Ethical Consideration

Prior to conducting the study, ethical approval was obtained for the study protocol. The protocol, which outlined the study design, procedures, and objectives, was submitted to the Research and Ethics Committee (REC) at the Institut National de Santé Publique d'Epidémiologie Clinique et de Toxicologie-Liban (INSPECT-LB) and was granted approval (IRB ID: 2023REC-011-INSPECT-07-11).

Sample size Calculation

The sample size calculation was performed using Epi Info 7. Because no comparable studies have been done on the Lebanese population, the sample size was calculated using the single population proportion formula by considering 50% proportion, a 95% CI (Confidence Interval), and a 5% margin of error.

$$N = \frac{Z\alpha^2 \times P\,(1-P)}{d^2} = \frac{1.96^2 \times 0.05(1-0.05)}{0.05^2} = 384.16$$

The minimum final sample size required was 384.16.

Data collection methods

An online-based questionnaire preceded by informed consent approval was utilized as the assessment tool to collect data from the participants. Before being able to access the survey, participants were informed about the nature of the study and were required to provide agreement to take part in it. The questionnaire was composed of two sections: the first section included sociodemographic questions, which aim to gather information about the participants' demographic characteristics, such as age, sex, governorate, marital status, educational level, living arrangement, medical coverage, regular physical check-ups, occupation, personal or family history of lung cancer, and smoking habits (yes/no, frequency). The second section of the questionnaire focused on the participants' knowledge and awareness of lung cancer using the LCAM (Lung CAM). The LCAM questions were designed and used to assess the knowledge of general populations regarding lung cancer via recall and recognition questions. Detailed questionnaire is presented in the supplementary section (Appendix 1).

To ensure the appropriateness of the questionnaire, questions were translated into Arabic, back-translated into English, and validated before being used in our study. The validation process demonstrated a high overall percent agreement between the Arabic and English CAM questionnaires as per 95% Kappa agreement, thus confirming the reliability of the translated questions. Refer to the supplementary section (Appendix 2) for validation test results.

The LCAM questions consisted of a set of open-ended

and closed-ended questions targeting different aspects of awareness. For the lung cancer warning signs awareness assessment, participants were asked to answer an open-ended question at first, followed by a closed-ended question comprising a set of 14 questions related to lung cancer warning signs to compare the difference between participants' ability to recall and recognize lung cancer warning signs. Participants were asked to choose between "yes," "no," and "I don't know" for each warning sign. A total score of 14 was granted to participants who answered all questions correctly, with 1 point for each correct answer (yes being the correct answer). Similarly, awareness of lung cancer risk factors included an open-ended question followed by a closed-ended one. Answers were "strongly disagree," "disagree," "not sure," "agree," or "strongly agree." Each correct question grants the participant 1 point, for a total score of 9 (strongly agree and agree being the correct answers). The remaining parts covered health seeking behavior, age-related risk of lung cancer development, and self-rated confidence level of noticing lung cancer (4 Likert score: not at all confident to very confident). Correct answers were identified as per LCAM Toolkit version 2.1 [13].

STATISTICAL ANALYSIS

The data were analysed using SPSS version 26. Descriptive statistics were used to describe the socio-demographic characteristics of the study participants, age at risk, health-seeking behavior, and confidence levels in terms of percentages and frequencies. A cumulative knowledge score for warning signs of lung cancer (range 0-14) was obtained by summing up the total correct answers to the 14-item questionnaire. The same applies to the knowledge score for the risk factors (range 0-9). Afterwards, mean recognition scores were obtained to assess the extent of awareness regarding warning signs and risk factors. An average warning sign recognition score of 11 and above was considered an indication of awareness, whereas a score below 11 was considered unaware. Similarly, a mean score of 7 or higher on the risk factor recognition scale signified awareness, while a score below 7 indicated unawareness. To ensure construct validity of the recognition scales, factor analysis was conducted for both warning signs and risk factor-recognition scales. Cronbach alpha was obtained to ensure the reliability of the scales mentioned. Moreover, to determine the association between the different covariates and the level of awareness, multivariate analysis using a generalized linear model was conducted to handle varying types of error distributions. The covariates considered in our study were age, sex, district, marital status, educational level, living arrangement, medical coverage, regular physician check-ups, occupation, personal/family history of lung cancer, and smoking (yes/no, frequency). A p-value of < 0.05 is considered statistically significant. Further Post-Hoc analysis was performed using Bonferroni correction for the significant categorical variables.

Results

DESCRIPTIVE ANALYSIS

Socio-Demographics of Study Participants

A sample comprising 410 Lebanese individuals was collected during the month of August from various governorates across Lebanon. The majority of the study participants were female (66.1%), with a mean age of 38 years (SD ± 15) for the entire study population. The socio-demographic attributes of the study population are presented in Table I. Approximately 53% of participants were bachelor degree holders and currently employed, with nearly equal distribution between medical (40.5%) and non-medical (42.7%) fields. Forty-one percent of participants lacked medical insurance coverage, and a significant portion did not undergo regular physician check-ups, accounting for 66.3% of the total sample size. Furthermore, a notable 78.5% reported no known personal or family history of lung cancer, while the majority abstained from both cigarette and waterpipe smoking (73.2 and 74.9%, respectively).

Awareness of age-related risk of developing lung cancer

As per the LCAM, participants were asked to identify the age at risk for developing lung cancer. Options included: a 30-year-old, 50-year-old, 70-year-old (correct answer), and lung cancer was unrelated to age. Results showed that only 13.7% of the study population were able to identify an age-related risk of developing lung cancer, whereas the majority of the population assumed no relationship between age and the risk of developing lung cancer (60.7%). The remaining participants chose 30-year-old (6.3%), and 50-year-old (19.3%) as ages at risk for lung cancer development.

Health Seeking Behavior

Seventy-five percent of the study population stated their immediate willingness to seek medical attention when having concerns regarding lung cancer development, suggesting a positive proactive attitude of the study population. The remaining 25% of answers were divided between either waiting weeks before seeking medical attention (9%), months (4%), or won't consider medical attention at all or when symptoms become very severe and disabling (12%).

Knowledge of warning signs of Lung Cancer

Study participants displayed a mean average recall of two symptoms, with a standard deviation of 1.68, ranging from 0-9 recalled symptoms. However, symptom recognition yielded a higher mean of 8.9 (SD ± 3.54, range 0-14), indicating unawareness. Among the recalled symptoms, persistent cough and shortness of breath were the most commonly reported (58 and 54.65%), respectively. In terms of symptom recognition, coughing blood and shortness of breath emerged as the most widely recognized warning signs, acknowledged by 87.8% and 81.7%, respectively. Study

Tab. I. Socio-Demographic Characteristics of Study Participants.

Characteristics	N = 410	%
Sex		
Male	139	33.9
Female	271	66.1
Age		
18-24	100	24.4
25-34	113	27.6
35-44	60	14.6
45-54	57	13.9
55-64	59	14.4
65 and over	21	5.1
Governorate		
Mount Lebanon	130	31.7
North	80	19.5
South	74	18
Bekaa	56	13.7
Beirut	44	10.7
Nabatieh	26	6.3
Living Arrangement		
Urban	219	53.4
Rural	191	46.6
Educational level		
Not educated	19	4.6
School Degree	68	16.6
Bachelor Degree	218	53.2
Post-graduate Degree	105	25.6
Marital Status		
Single	189	46.1
Married	199	48.5
Divorced	11	2.7
Widowed	11	2.7
Medical Coverage		
NSSF	85	20.7
Insurance	120	29.3
COOP	31	7.6
None	167	40.7
Others	7	1.7
Occupation		
Medical	166	40.5
Non-medical	175	42.7
Unemployed/ Retired	69	16.8
Regular Physician Check-Ups		
No	272	66.3
Yes	138	33.7
Personal or Family History of Lung Cancer		
No	322	78.5
Yes	88	21.5
Cigarette Smoker		
No	300	73.2
Yes	110	26.8
Waterpipe Smoker		
No	307	74.9
Yes	103	25.1

NSSF: National Social Security Fund; COOP: Co-operative insurance companies.

participants showed lower recall percentages for the remaining warning signs, whereas the majority were not able to recognize persistent shoulder pain (28.7%) and changes in the shape of a finger or nails (29.51%) as

possible warning signs of lung cancer. Table II provides a comparative summary of recall and recognition-warning sign knowledge.

Knowledge of Lung Cancer Risk Factors

On average, participants were able to recall one risk factor (mean = 1.59, SD ± 0.94, range 0-6). As expected, participants demonstrated a higher ability to recognize risk factors, with an average of 7.1 recognized risk factors per participant (SD ± 1.9, range 0-9) implying risk factor awareness. Among the recalled risk factors, smoking was the most commonly identified (82%), while other risk factors received lower recall percentages. Similarly, smoking was the most recognized lung cancer risk factor (95.60%). Additionally, both air pollution and exposure to chemicals showed high recognition percentages (94.63 and 89.75%, respectively). Overall, more than half of the study participants were able to recognize all lung cancer risk factors. Details are presented in Table III.

Self-rated confidence level of noticing Lung cancer

Forty-eight percent of study participants were identified as not very confident when it comes to noticing lung cancer, according to the self-rating question, and 10% were not at all confident, which gives a total of 58% of the Lebanese population lacked confidence in identifying lung cancer warning signs. Thirty-six percent reported being fairly confident, while a lower percentage reported being very confident (6%).

Reliability and Validation of the Scale

For the warning signs recognition scale, factor analysis suggested that variables were able to explain 52% of total variances of the hidden variable, the Kaiser-Meyer-Olkin measure was 0.87, and Bartlett's test of sphericity was significant ($p < 0.001$), suggesting sample adequacy. The Cronbach alpha of all scale items was equal to 0.84. The same was applied to risk factor recognition scales, where the variables were able to explain 56.5% of the hidden variable, the Kaiser-Meyer-Olkin measure was 0.81, and Bartlett's test of sphericity was significant ($p < 0.001$), suggesting sample adequacy. The Cronbach alpha of all scale items was equal to 0.8.

MULTIVARIATE ANALYSIS OF WARNING SIGNS KNOWLEDGE SCORES

Multivariate Analysis Results

Multivariate associations between socio-demographics and total symptom awareness scores are presented in Table IV. For each level of socio-demographic predictors, means and a 95% CI are found. There was no difference in symptom awareness by age, sex, living arrangement, marital status, medical coverage, regular physician checkups, cigarette or waterpipe smoking, or familiarity with cancer. However, there was a significant difference when it came to the governorate for recognition scale only (recognition: $F_{(5,404)} = 3.270$,

Tab. II. Knowledge of warning signs of lung cancer.

Symptom	Recall (Open-ended)		Recognition (closed-ended)	
	N = 410	%	N = 410	%
Unexplained weight loss	52	12.7	241	58.7
Persistent chest infection	11	2.7	276	67.3
Persistent cough	238	58	286	69.75
Shortness of breath	224	54.6	335	81.7
Persistent tiredness or lack of energy	50	12.2	250	60.97
Persistent chest pain	117	28.5	298	72.68
Persistent shoulder pain	0	--	118	28.7
Coughing blood	120	29.3	360	87.8
Ache or pain when breathing	3	0.7	303	73.9
Loss of appetite	9	2.2	206	50.24
Painful cough	0	--	332	80.97
Changes in shape of fingers or nails	2	0.5	121	29.51
Developing unexplained loud, high pitched sound when breathing	23	5.6	251	61.21
Worsening or change in existing cough	4	1	319	77.80

Tab. III. Knowledge of risk factors of Lung Cancer.

Risk Factors	Recall (Open-ended)		Recognition (closed-ended)	
	N = 410	%	N = 410	%
Exposure to Radon	3	0.7	329	80.24
Exposure to another persons' cigarette smoke	18	4.4	334	81.46
Previous cancer treatment	6	1.5	233	56.82
Having close relative with Lung Cancer	105	25.5	295	71.90
Exposure to chemicals such as Asbestos	27	6.6	368	89.75
Personal history of cancer such as head and neck cancer	4	1	271	66.09
Air Pollution	139	33.8	388	94.63
Being a smoker	338	82	392	95.60
Previous history of Lung disease such as COPD	13	3.2	311	75.85

COPD: Chronic Obstructive Pulmonary Disease.

p = 0.007, $\eta_p^2 = 0.041$). Similarly, education showed a significant effect on the recognition scale but not recall (recognition: F (3,406) = 5.543, p = 0.001, $\eta_p^2 = 0.041$). As for occupation, results showed significant differences for both recall and recognition scales (recall: F (2,407) = 12.808, p < 0.001, $\eta_p^2 = 0.073$; recognition: F (2,407) = 15.147, p < 0.001, $\eta_p^2 = 0.062$).

Post-hoc Analysis Results

Further Post Hoc analysis was conducted using Bonferroni correction to examine pairwise group differences among significant variables. Results showed that people residing in Bekaa scored approximately two times lower warning sign recognition scales compared with participants residing in Beirut, Mount Lebanon, and North Lebanon. As for education, participants with postgraduate degrees showed higher recognition scales compared to others, while less educated individuals showed the lowest level of awareness. Finally, medical-field workers were able to both recall and recognize a higher average of warning signs when compared to other field workers or their unemployed or retired counterparts. Non-medical field workers and retired/unemployed individuals showed 30% lower recall compared to medical field workers, where the latter were able to recognize warning signs two times higher. Details of the Hoc pairwise comparison are presented in Table V.

MULTIVARIATE ANALYSIS OF RISK FACTORS RESULTS

Multivariate Analysis Results

There was a significant difference in recognition of risk factors total scores by sex for the recognition scale only (recognition: F (1,408) = 11.411, p = 0.001, $\eta_p^2 = 0.029$) (Tab. IV). Educational level was associated with higher risk factor recognition scores (recognition: F (3,406) = 21.85, p < 0.001, $\eta_p^2 = 0.058$), but there was no significant difference by level of education in recall. Additionally, occupation showed no significant difference for recall but for recognition scale only (recognition: F (2,407) = 30.52, p < 0.001, $\eta_p^2 = 0.054$). Females scored higher when it came to risk factor recognition compared to males.

Tab. IV. Multivariate associations between socio-demographic factors and awareness of Lung Cancer performed on total study participants (N=410).

	Symptom Awareness		Risk Factor Awareness	
	Recall (open)	Recognition (closed)	Recall (open)	Recognition (closed)
	Mean (95% CI)	Mean (95% CI)	Mean (95% CI)	Mean (95% CI)
Sex				
Male	1.69 (1.42 to 1.97)	8.00 (7.42 to 8.58)	1.51 (1.36 to 1.67)	6.35 (6.04 to 6.65)
Female	2.28 (2.08 to 2.47)	9.49 (9.08 to 9.91)	1.63 (1.51 to 1.74)	7.52* (7.30 to 7.73)
Age				
Under 40	2.44 (2.23 to 2.64)	9.48 (9.04 to 9.92)	1.72 (1.60 to 1.84)	7.48 (7.24 to 7.71)
40 and above	1.55 (1.30 to 1.80)	8.25 (7.71 to 8.79)	1.39 (1.25 to 1.53)	6.59 (6.31 to 6.87)
Governorate				
Beirut	2.43 (1.93 to 2.93)	9.79 (8.75 to 10.83)	1.65 (1.37 to 1.94)	7.61 (7.05 to 8.17)
Mount Lebanon	2.07 (1.78 to 2.36)	9.32 (8.71 to 9.92)	1.52 (1.36 to 1.68)	7.19 (6.86 to 7.51)
South Lebanon	2.25 (1.87 to 2.64)	8.82 (8.02 to 9.62)	1.67 (1.45 to 1.89)	7.31 (6.88 to 7.74)
North Lebanon	2.12 (1.75 to 2.49)	9.32 (8.55 to 10.09)	1.71 (1.50 to 1.92)	6.88 (6.47 to 7.30)
Bekaa	1.55 (1.11 to 1.99)	7.41* (6.49 to 8.33)	1.35 (1.10 to 1.60)	6.48 (5.98 to 6.97)
Nabatieh	2.03 (1.39 to 2.68)	8.80 (7.45 to 10.15)	1.73 (1.36 to 2.09)	7.53 (6.81 to 8.26)
Living Arrangement				
Urban	2.25 (2.03 to 2.47)	9.27 (8.80 to 9.74)	1.63 (1.50 to 1.76)	7.27 (7.02 to 7.52)
Rural	1.88 (1.64 to 2.12)	8.66 (8.15 to 9.16)	1.54 (1.40 to 1.68)	6.95 (6.68 to 7.22)
Education				
Not Educated	1.26 (0.53 to 1.99)	6.42 (4.87 to 7.96)	1.31 (0.89 to 1.73)	4.05 (3.26 to 4.84)
School Degree	1.17 (0.79 to 1.56)	8.82 (8.00 to 9.64)	1.23 (1.01 to 1.45)	6.73 (6.31 to 7.15)
Bachelor Degree	2.22 (2.00 to 2.44)	8.56 (8.10 to 9.02)	1.61 (1.48 to 1.73)	7.16 (6.92 to 7.39)
Post-grad Degree	2.52 (2.21 to 2.83)	10.44* (9.79 to 11.10)	1.83 (1.65 to 2.01)	7.85* (7.52 to 8.19)
Marital Status				
Single	2.56 (2.32 to 2.79)	9.39 (8.89 to 9.90)	1.76 (1.62 to 1.89)	7.45 (7.18 to 7.72)
Married	1.66 (1.44 to 1.89)	8.72 (8.23 to 9.22)	1.46 (1.33 to 1.59)	6.91 (6.64 to 7.17)
Divorced	1.81 (0.85 to 2.78)	9.00 (6.91 to 11.09)	1.36 (0.80 to 1.92)	7.00 (5.89 to 8.10)
Widowed	1.63 (0.66 to 2.60)	6.72 (4.63 to 8.81)	1.18 (0.62 to 1.73)	5.45 (4.35 to 6.56)
Medical Coverage				
NSSF	2.23 (1.87 to 2.59)	8.95 (8.19 to 9.70)	1.61 (1.40 to 1.81)	7.31 (6.91 to 7.72)
Insurance	2.10 (1.79 to 2.40)	9.44 (8.80 to 10.07)	1.60 (1.42 to 1.77)	7.30 (6.96 to 7.64)
COOP	1.74 (1.14 to 2.33)	8.03 (6.78 to 9.28)	1.61 (1.27 to 1.94)	6.96 (6.29 to 7.63)
None	2.03 (1.77 to 2.29)	8.85 (8.31 to 9.39)	1.55 (1.41 to 1.70)	6.87 (6.58 to 7.16)
Others	2.57 (1.31 to 3.82)	9.28 (6.65 to 11.92)	2.00 (1.29 to 2.70)	8.42 (7.02 to 9.83)
Occupation				
Medical	2.87* (2.63 to 3.11)	10.39* (9.88 to 10.91)	1.83 (1.68 to 1.97)	7.94* (7.67 to 8.21)
Non-medical	1.54 (1.31 to 1.77)	8.00 (7.50 to 8.49)	1.46 (1.32 to 1.60)	6.63 (6.37 to 6.89)
Unemployed-retired	1.55 (1.18 to 1.92)	8.11 (7.32 to 8.91)	1.34 (1.12 to 1.56)	6.39 (5.97 to 6.81)
Regular physician check-ups				
No	2.02 (1.82 to 2.22)	8.63 (8.21 to 9.05)	1.56 (1.44 to 1.67)	6.98 (6.75 to 7.20)
Yes	2.20 (1.92 to 2.48)	9.68 (9.10 to 10.27)	1.65 (1.49 to 1.81)	7.40 (7.08 to 7.72)
Personal or Family History of Lung Cancer				
No	2.11 (1.93 to 2.30)	8.92 (8.54 to 9.31)	1.58 (1.48 to 1.69)	7.18 (6.98 to 7.39)
Yes	1.96 (1.61 to 2.32)	9.21 (8.47 to 9.96)	1.61 (1.41 to 1.81)	6.88 (6.48 to 7.28)
Smoker				
No	2.25 (2.06 to 2.44)	9.24 (8.84 to 9.64)	1.68 (1.58 to 1.79)	7.38 (7.17 to 7.59)
Yes	1.60 (1.29 to 1.92)	8.30 (7.63 to 8.96)	1.33 (1.16 to 1.51)	6.40 (6.06 to 6.75)
Waterpipe				
No	2.16 (1.98 to 2.35)	9.17 (8.78 to 9.57)	1.64 (1.53 to 1.74)	7.20 (6.99 to 7.41)
Yes	1.82 (1.49 to 2.15)	8.42 (7.74 to 9.11)	1.44 (1.26 to 1.63)	6.88 (6.51 to 7.25)

* P-value < 0.05.

Post-hoc Analysis Results

In conformity with warning signs results, Post hoc analysis showed that not-educated participants were able to recognize risk factors three times lower compared to other levels of education. Postgraduates showed the highest level of awareness. Additionally, non-medical field workers and unemployed or retired individuals showed lower level of risk factor recognition compared to medical field workers (31 and 55%, respectively). Detailed results are presented in Table V.

Tab. V. Post-Hoc Analysis using Bonferroni correction.

Dependent Variable	Independent Variable		Mean	P-value	95% CI (Upper and Lower Bounds)
Warning Signs-Recognition Scale	Governorate Bekaa	Beirut	-2.38	0.004	-4.30 to -0.46
		Mount Lebanon	-1.91	0.004	-3.43 to -0.39
		South Lebanon	-1.41	0.205	-3.09 to 0.27
		North Lebanon	-1.91	0.011	-3.57 to -0.25
		Nabatieh	-1.39	1.00	-3.65 to 0.86
Warning Signs-Recognition Scale	Education Not Educated	School Degree	-2.40	0.021	-4.56 to -0.23
		Bachelor Degree	-2.12	0.028	-4.13 to -0.14
		Post-Graduate Degree	-4.02	< 0.001	-6.10 to -1.94
	School Degree	Post-Graduate	-1.62	0.006	-2.92 to -0.32
	Bachelor Degree	Post-Graduate	-1.88	< 0.001	-2.87 to -0.89
Warning Signs-Recall Scale	Occupation Unemployed/Retired	Medical	-1.32	< 0.001	-1.85 to -0.787
		Non-medical	0.0079	1.00	-0.52 to 0.53
	Non-medical	Medical	-1.33	< 0.001	-1.73 to -0.92
Warning Signs-Recognition Scale	Occupation Medical	Non-medical	2.39	< 0.001	1.57 to 3.21
		Unemployed/Retired	2.28	< 0.001	1.19 to 3.36
Risk Factor-Recognition Scale	Education Not Educated	School Degree	-2.68	< 0.001	-3.88 to -1.47
		Bachelor Degree	-3.10	< 0.001	-4.21 to -1.99
		Post-Graduate Degree	-3.80	< 0.001	-4.96 to -2.64
	School Degree	Post-Graduate	-1.12	< 0.001	-1.84 to -0.39
	Bachelor Degree	Post-Graduate	-0.69	0.005	-1.24 to -0.11
Risk Factor-Recognition Scale	Occupation Non-Medical	Medical	-1.31	< 0.001	-1.76 to -0.85
	Unemployed/Retired	Medical	-1.55	< 0.001	-2.15 to -0.95

Discussion

For the purpose of identifying levels of awareness in the Lebanese general population towards lung cancer warning signs and risk factors, the Lung Cancer Awareness Measurement Tool (LCAM) was used. The survey revealed that a significant portion of the Lebanese population exhibited unawareness regarding lung cancer warning signs. More specifically, the majority of the respondents held the belief that there is no correlation between age and the likelihood of developing lung cancer.

In parallel, the findings from this study were mirrored in another study conducted in Gaza [11]. The study was employed to assess cancer awareness among the general population in Gaza using the CAM Tool, and its results uncovered similar beliefs when it comes to the relationship between age and the development of different types of cancer, including lung cancer [11]. Additionally, a separate Lebanese study on awareness related to colorectal cancer using the Bowel Cancer Awareness Measurement (Bowel CAM) displayed similar findings [12]. Just as with lung cancer, awareness of the relationship between age and colorectal cancer risk

was inadequate among the Lebanese population [12]. Such consistency across different studies focusing on different types of cancer indicates the presence of misconceptions regarding the role of age in the development of lung cancer.

For risk factor awareness, participants showed an average recall of only one risk factor and two possible warning signs of lung cancer. A very low percentage of the study population managed to identify persistent shoulder pain and changes in the shape of fingers or nails as possible warning signs of lung cancer development. Similarly, nearly half of the study population couldn't link loss of appetite and unexplained weight loss to the possibility of lung cancer development. As for lung cancer risk factors, as expected, the Lebanese population was alert about smoking being one of the major risk factors for lung cancer development, as shown in both recall and recognition risk factor awareness questions. In contrast, awareness of the relationship between previous cancer treatment or personal history of cancer, such as head and neck cancer, and lung cancer development was low. The above-mentioned results come in conformity with a population-based study on the people of the UK using the LCAM tool [7], along with a study assessing

knowledge of Lebanese populations' knowledge of cancer-related environmental risk factors a using literature-based questionnaire that has highlighted both smoking and air pollution as the most recognized factors [14].

The study findings highlight differences in awareness of lung cancer warning signs across various socio-demographic backgrounds. This suggests that factors such as location, education, and occupation play a crucial role in shaping the level of awareness among the population. One striking observation is the regional variation in awareness. People residing in Bekaa governorate displayed lower levels of risk factor awareness compared to Beirut, Mount Lebanon, and North Lebanon, guiding stakeholders towards the main regions of interest while developing educational campaigns. Education, on the other hand, appears to be a key determinant of awareness. Postgraduates showed higher levels of awareness, as expected in parallel to Chinese study findings aiming to assess knowledge of lung cancer in community residents and medical field workers [15]. This positive correlation can be justified by the fact that individuals with higher levels of education often have access to more resources and are likely to engage in more health-related information-seeking behavior. Moreover, and as anticipated, individuals working in the medical field demonstrated a deeper understanding of lung cancer warning signs. This heightened awareness among medical professionals is likely attributed to their daily exposure to healthcare-related information and patients, resulting in more comprehensive disease-related knowledge.

When it comes to risk factor awareness in relation to socio-demographic factors, there was no significant difference in risk factor recall among the whole population. However, females, postgraduates, and medical field workers demonstrated a higher level of risk-factor recognition compared to the rest of the population. The sex-related difference in the level of risk factor awareness could be attributed to various factors, including greater health awareness and more proactive health-seeking behavior. Those results come in parallel with a study conducted in Australia using a convergent parallel mixed-method design [10]. The higher level of awareness among educated individuals and medical professionals is justified by their educational background [15], along with their daily scientific and disease-related learning and experience.

There was no difference in symptom or risk factor awareness among smoking categories (cigarette or waterpipe). Although a population-based study conducted in the UK using the LCAM tool [7] and a survey-based cross-sectional study assessing knowledge differences in lung cancer knowledge and prevention across different ethnic and socioeconomic statuses conducted in the USA [16] studies demonstrated lower recall, studies in Australia and a cross-sectional study in Nepal using a structured questionnaire to assess lung cancer risk factor awareness demonstrated no difference in awareness

among smoking groups [10, 17]. Such a result can be justified by the fact that smokers could be aware of the harmful and devastating effects of smoking and still choose to smoke. This knowledge could stem from the extensive presence of awareness campaigns that extensively highlight the health-related consequences of smoking. The concept of cognitive dissonance may provide insight into this result. Cognitive dissonance refers to the psychological discomfort that arises when an individual holds conflicting beliefs or engages in actions that are contrary to their beliefs [18]. In the context of smoking, individuals may be fully aware of the health risks, such as the development of lung cancer or heart diseases associated with smoking. However, the addictive nature and other factors may lead them to continue their smoking habit despite this knowledge.

Moreover, the majority of the study population expressed their intent to seek medical attention directly when having concerns about the development of lung cancer. This initial willingness is a positive indication of a proactive approach to health care. However, this seemingly positive indication is countered by the study findings regarding the low level of awareness among the participants. Specifically, their response to the question addressing their confidence in identifying lung cancer warning signs revealed that they had low to fair levels of confidence. This implies that, despite their willingness to consult a healthcare professional, their ability to recognize early signs might be limited. Meanwhile, such findings come in parallel to an international benchmarking partnership study conducted in different countries using Awareness and Beliefs about Cancer Measures (ABC) [19]. The combination of the low level of awareness and limited confidence in identifying warning signs of lung cancer suggests that individuals might delay seeking medical attention until the emergence of more severe symptoms, such as coughing up blood, which might lead to a delayed surgical resection procedure. Notably, these findings align with a study conducted in Australia [10] along with a meta-analysis performed examining delay in seeking medical attention [20], suggesting that this phenomenon might not be unique to the Lebanese population. Public health campaigns and awareness initiatives can play a crucial role in addressing such issues by disseminating information about lung cancer warning signs and encouraging individuals to seek medical attention as soon as they have concerns. These initiatives can help promote earlier detection of lung cancer and, hence, earlier resection when needed, especially in cases of non-small-cell lung cancer, potentially saving more lives, as shown by a cohort study investigating opportunities to reduce lung cancer mortality [21].

This study was the first to assess the level of awareness of the Lebanese general population using an LCAM-validated tool. The tool was properly translated and validated in a pilot study ahead of the study and was representative of the Lebanese population as per

governorates, along with an appropriate sample size. Factorial and reliability analyses confirmed the validity of the used tool (the Cronbach alpha of all scale items was equal to 0.84 and 0.81 for the warning signs and recognition scales, respectively). Using such a tool allowed us to highlight the most frequently recalled warning signs and risk factors for lung cancer in comparison to guided questions, as the latter showed a higher level of awareness. The results will enable the development of educational campaigns targeting misconceptions for the purpose of increasing the likelihood of early diagnosis and thus better treatment outcomes, as shown by a population-based study using Awareness and Beliefs about Cancer Measure (ABC) in the UK [22]. Moreover, similar findings were stated by comparative studies assessing cancer educational campaign impacts in England [23, 24], a systematic review examining the association between time to diagnosis and treatment outcomes [25], in addition to a study assessing the 5-year impact of the National Awareness and Early Diagnosis Initiative in England [26]. Our findings highlight the importance of developing a multidisciplinary lung cancer program for the sake of reducing the delay in seeking medical attention, as such programs have proven efficacy, as shown in a retrospective study assessing the impact of a multidisciplinary lung cancer program in reducing the delay between diagnosis and treatment in the USA [27], as well as in India assessing the impact of an educational campaign in increasing awareness and adopting safer practices [28].

The limitation of this study is that the LCAM survey was conducted online. Such a method for data collection allowed study participants to access the internet or other sources to aid their responses, which might lead to misclassification bias. Although participants were able to navigate backward and forward during the survey, it didn't affect the expected pattern of answers when comparing recalled and recognition questions. The difference between those questions was significantly high, suggesting that such biases were non-differential. To minimize the effects of such limitations, a face-to-face survey will ensure that the responses are representative of the real level of knowledge of the study participants. Additionally, older people were less likely to participate in the study, resulting in selection bias. However, the study protocol allowed elderly participants who received proper aid in filling out the survey to be included in the study so that we could enhance the representativeness of the study results. Moreover, although multivariate analyses were conducted to decrease the chance of false-positive results, there is always a risk of residual confounding. Further studies are recommended to overcome such limitations.

Conclusions

Employing the LCAM survey tool played a crucial role in obtaining a comprehensive insight into the level of awareness among the Lebanese population concerning various facets of lung cancer. One of the most significant takeaways from this study is the identification of specific areas that require attention and improvement. By pinpointing the weak links in public awareness, this research has paved the way for a targeted approach. Properly targeted campaigns hold importance in enhancing public knowledge and consequently fostering early diagnosis and more effective therapeutic outcomes in the context of lung cancer, and hence can make a substantial difference in the health and well-being of the Lebanese population.

Ethics approval and informed consent to participate

Ethical approval was granted by Research and Ethics Committee (REC) at Institut National de Santé Publique d'Epidémiologie Clinique et de Toxicologie-Liban (INSPECTLB) ethical review board (IRB ID: 2023REC-011-INSPECT-07-11). Prior to accessing the survey, participants agreed to participate through an informed consent form.

Consent for publication

Not Applicable.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Conflict of interest statement

The authors declare that they have no competing interests.

Authors' contributions

Concept and design aspects were led by MH and RA. Data acquisition and statistical analysis were conducted by MH under supervision of RA. Analysis and interpretation of the data were performed collectively by MH, PS, SA, and RA. MH was responsible for drafting the manuscript, which was critically revised for

important intellectual content by PS, SA, and RA. All authors reviewed and approved the final manuscript.

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Appendix 1: Questionnaire

Lung Cancer Awareness among the Lebanese General Population: a cross-sectional study

You are Kindly Invited to take part in this study conducted by Master Candidate at Lebanese University. This study aims to determine knowledge of general Lebanese population regarding Lung Cancer risk factors and warning signs in which the results can identify gaps of knowledge.

You are eligible to participate if you are:
Lebanese Living in Lebanon
Age 18 years or above.
Speaks English/ Arabic.

Your participation is voluntary with the right to withdraw at any time is reserved. It won't take more than 5 minutes and all the information will be handled confidentially throughout the study and used for research purpose only.

Thank You

أنت مدعو إلى المشاركة في استطلاع لطالب ماجيستير في الجامعة اللبنانية.

تهدف هذه الدراسة إلى تحديد معرفة اللبنانيين عامة فيما يتعلق بعوامل خطر الإصابة بسرطان الرئة وعلامات التحذير التي يمكن أن تحدد النتائج من خلالها ثغرات المعرفة.

أنت مؤهل للمشاركة إذا كنت:

لبناني الجنسية ومقيم في لبنان.

18 سنة وما فوق.

تتحدث اللغة العربية أو الإنكليزية.

أدعوكم للمشاركة في الاستبيان، والمشاركة طوعية، والحق في الانسحاب في أي وقت محفوظ. لن يستغرق الأمر أكثر من خمسة دقائق وسيتم التعامل مع جميع المعلومات بسرية طوال فترة الدراسة واستخدامها لأغراض البحث فقط.

شكرا لك

Please check all the boxes below to proceed to the survey/ يرجى تعبئة جميع المربعات أدناه لمتابعة الاستبيان:
- ☐ I have read and understood the above information/لقد قرأت وفهمت المعلومات الواردة أعلاه
- ☐ I understand that my participation is voluntary /أفهم أن مشاركتي تطوعية
- ☐ I understand that my data will be kept confidential/أفهم أن بياناتي ستبقى سرية
- ☐ I agree to participate in the study/أوافق على المشاركة في الدراسة

Part 1: Sociodemographic Characteristics/الخصائص الاجتماعية والديموغرافية:
- ▪ Sex/الجنس:

- □ Male/ ذكر
  □ Female/ أنثى
- Age (years)/ :العمر (بالسنوات)/ _____
- Governorate/ :المحافظة
  - □ Beirut / بيروت
  - □ Mount Lebanon / جبل لبنان
  - □ Bekaa / البقاع
  - □ North Lebanon / الشمال
  - □ South Lebanon/ الجنوب
  - □ Nabatieh / النبطية
- Living Arrangement/ :السكن
  - □ Urban / مدينة
  - □ Rural / قرية
- Educational level/ :مرحلة التعلم
  - □ Not educated/ غير متعلم
  - □ School degree / درجة مدرسية
  - □ Bachelor's degree/ درجة جامعية
  - □ Post grad degree / دراسات عليا
- Marital Status/ الوضع العائلي :
  - □ Single/ أعزب
  - □ Married / متزوج
  - □ Divorced / مطلق
  - □ Widowed / أرمل
- Medical Coverage/ تغطية طبية
  - □ None/ لا يوجد
  - □ NSSF / الصندوق الوطني للضمان الاجتماعي
  - □ Insurance/ تأمين
  - □ COOP / تعاونية موظفي الدولة
  - □ Others / غير ذلك
- Occupation/ المهنة
  - □ Medical / في المجال الطبي
  - □ Non-medical / خارج الجال الطبي
  - □ Unemployed/ retired / متقاعد لا أعمل
- Regular Physician checkups/ هل تخضع لفحص طبي منتظم
  - □ No/ كلا
  - □ Yes / نعم
- Personal or Family History of Lung Cancer/ وجود سابقة شخصية أو عائلية للإصابة بسرطان الرئة
  - □ No / كلا
  - □ Yes / نعم
- Do you smoke cigarette/ هل تدخن السجائر ؟
  - □ No / كلا
  - □ Yes / نعم
- Do you smoke waterpipe/ هل تدخن الأركيلة؟
  - □ No/ كلا
  - □ Yes / نعم

Part 2: LCAM Questionnaire:

- There are many warning signs and symptoms of lung cancer. Please name as many as you can think of /هنالك العديد من العلامات والأعراض التحذيرية لسرطان الرئة، أذكر حسب رأيك الشخصي العدد الأكبر منها:
- The following may or may not be signs for lung cancer. We are interested in your opinion/ قد تكون العلامات التالية علامات تحذيرية لسرطان الرئة و قد لا تكون كذلك, و نحن مهتمون برأيك

	Yes /نعم	No/ لا	I don't know/ لا أعرف
Do you think that unexplained weight loss could be a sign of lung cancer/ هل تعتقد أن فقدان الوزن غير المبرر علامة على الإصابة بسرطان الرئة	□	□	□
Do you think that a persistent (3 weeks or longer) chest infection could be a sign of lung cancer/ هل تعتقد أن التهابات أوعدوى الصدر المستمرة لمدة 3 أسابيع أو أكثر قد تكون علامة على الإصابة بسرطان الرئة	□	□	□
Do you think that a cough that does not go away for two or three weeks could be a sign of lung cancer/ هل تعتقد أن السعال الذي يستمر لمدة أسبوعين أو ثلاثة أسابيع قد يكون علامة على الإصابة بسرطان الرئة	□	□	□
Do you think that persistent shortness of breath could be a sign of lung cancer/ هل تعتقد أن ضيق التنفس المستمر قد يكون علامة على الإصابة بسرطان الرئة	□	□	□
Do you think that persistent tiredness or lack of energy could be a sign of lung cancer/ هل تعتقد أن التعب المستمر أو نقص الطاقة يمكن أن يكون علامة على الإصابة بسرطان الرئة	□	□	□
Do you think that persistent chest pain could be a sign of lung cancer/ هل تعتقد أن ألم الصدر المستمر قد يكون علامة على الإصابة بسرطان الرئة	□	□	□
Do you think that persistent shoulder pain could be a sign of lung cancer/ هل تعتقد أن آلام الكتف المستمرة قد تكون علامة على الإصابة بسرطان الرئة	□	□	□
Do you think that coughing up blood could be a sign of lung cancer/ هل تعتقد أن خروج الدم عند السعال قد يكون علامة على الإصابة بسرطان الرئة	□	□	□
Do you think that an ache or pain when breathing could be a sign of lung cancer/ هل تعتقد أن الألم عند التنفس يمكن أن يكون علامة على سرطان الرئة	□	□	□
Do you think that loss of appetite could be a sign of lung cancer/ هل تعتقد أن فقدان الشهية يمكن أن يكون علامة على الإصابة بسرطان الرئة	□	□	□
Do you think that a painful cough could be a sign of lung cancer/ هل تعتقد أن السعال المؤلم يمكن أن يكون علامة على سرطان الرئة	□	□	□
Do you think that changes in the shape of your fingers or nails could be a sign of lung cancer/ هل تعتقد أن التغييرات في شكل أصابعك أو أظافرك يمكن أن تكون علامة على الإصابة بسرطان الرئة	□	□	□
Do you think that developing an unexplained loud, high pitched sound when breathing could be a sign of lung cancer/ هل تعتقد أن صدور صوت غير مفسّر أو الصوت العالي النبرة عند التنفس علامة على الإصابة بسرطان الرئة	□	□	□
Do you think that worsening or change in an existing cough could be a sign of lung cancer/ هل تعتقد أن تفاقم أو تغيير السعال الموجود يمكن أن يكون علامة على سرطان الرئة	□	□	□

- If you had a symptom that you thought might be a sign of lung cancer how soon would you contact your doctor to make an appointment to discuss it/ إذا كانت لديك أعراض تعتقد أنها قد تكون علامة على الإصابة بسرطان الرئة ، فمتى ستتصل بطبيبك لتحديد موعد لمناقشتها

- In the next Year, who is more likely to develop Lung Cancer/ في العام المقبل ، من هو الأكثر عرضة للإصابة بسرطان الرئة

    ☐   A 30-year-old/ شخص يبلغ من العمر 30 سنة

    ☐   A 50-Year-old/ شخص يبلغ من العمر 50 سنة

    ☐   A 70-year-old/ شخص يبلغ من العمر 70 سنة

    ☐   Lung Cancer is unrelated to age/ لا يوجد علاقة بين العمر وخطر الإصابة بسرطان الرئة

▪ What things do you think affect a person's chance of developing lung cancer/ ما هي الأشياء التي تعتقد أنها تؤثر على فرصة إصابة الشخص بسرطان الرئة

▪ 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/ ما يلي قد يزيد أو لا يزيد من فرصة إصابة الشخص بسرطان الرئة. إلى أي مدى توافق على أن كل واحدة من هذه يمكن أن تزيد من فرصة إصابة الشخص بسرطان الرئة

	Strongly Agree / أوافق بشدة	Agree / أوافق	Not sure / لا أعلم	Disagree / لا أوافق	Strongly Disagree / لا أوافق بشدة
Exposure to radon gas (a naturally occurring radioactive gas)/ التعرض لغاز الرادون (غاز مشع طبيعي)	☐	☐	☐	☐	☐
Exposure to another person's cigarette smoke/ التعرض لدخان سجائر شخص آخر	☐	☐	☐	☐	☐
Having had treatment for any cancer in the past/ تلقي علاجًا من أي سرطان في الماضي	☐	☐	☐	☐	☐
Having a close relative with lung cancer/ وجود قريب مصاب بسرطان الرئة	☐	☐	☐	☐	☐
Exposure to chemicals (such as asbestos)/ التعرض للمواد الكيميائية (مثل الأسبستوس)	☐	☐	☐	☐	☐
Having a previous history of cancer such as head and neck cancer/ التعرّض سابقاً للإصابة بالسرطان مثل سرطان الرأس والعنق	☐	☐	☐	☐	☐
Air pollution/ تلوث الهواء	☐	☐	☐	☐	☐
Being a smoker/ أن تكون مدخنا	☐	☐	☐	☐	☐
Having a previous history of lung disease, such as, Chronic Obstructive Pulmonary Disease (COPD)/ التعرّض سابقاً لأمراض الرئة، مثل مرض الانسداد الرئوي المزمن	☐	☐	☐	☐	☐

▪ How Confident are you that you would notice a symptom of Lung Cancer/ ما مدى ثقتك في أنك ستلاحظ أحد أعراض سرطان الرئة

Not at all confident/ غير واثق على الإطلاق	Not very confident/ لست واثقا جدا	Fairly confident/ واثق	Very Confident/ واثق جدا
☐	☐	☐	☐

Appendix 2: Scale Validation Results

Tab. S1. Proportion of answer per categories of warning signs awareness variables and Kappa agreement with 95% confidence interval between the Arabic and English reference questionnaires.

Warning signs	English questionnaire (reference)		Arabic questionnaire		Kappa Agreement	95% CI of Kappa Agreement	p-value
	N	%	N	%			
Unexplained weight loss					0.879	(0.66,1.00)	< 0.001
Yes	16	76.19	16	76.19			
No	2	9.52	3	14.28			
Don't Know	3	14.28	2	9.52			
Persistent (3 weeks or longer) chest infection					1	--	< 0.001
Yes	16	76.19	16	76.19			
No	3	14.28	3	14.28			
Don't Know	2	9.52	2	9.52			
Cough that doesn't go away for two to three weeks					1	--	< 0.001
Yes	20	95.23	20	95.23			
No	1	4.76	1	4.76			
Don't Know	0	0.00	0	0.00			
Persistent shortness of breath					1	--	< 0.001
Yes	20	95.23	20	95.23			
No	0	0.00	0	0.00			
Don't Know	1	4.76	1	4.76			
Persistent tiredness or lack of energy					0.790	(0.51,1.00)	< 0.001
Yes	16	76.19	15	66.66			
No	2	9.52	3	14.28			
Don't Know	3	14.28	3	14.28			
Persistent chest pain					1	--	< 0.001
Yes	21	100	21	100			
No	0	0.00	0	0.00			
Don't Know	0	0.00	0	0.00			
Persistent shoulder pain					0.921	(0.771,1.00)	< 0.001
Yes	7	33.33	8	38.09			
No	11	52.38	10	47.61			
Don't Know	3	14.28	3	14.28			
Coughing up blood					1	--	< 0.001
Yes	20	95.23	20	95.23			
No	0	0.00	0	0.00			
Don't Know	1	4.76	1	4.76			
Ache or pain when breathing					1	--	< 0.001
Yes	20	100	20	95.23			
No	0	0.00	0	0.00			
Don't Know	1	0.00	1	4.76			
Loss of appetite					0.913	(0.75,1.00)	< 0.001
Yes	13	61.90	13	61.90			
No	3	14.28	4	19.04			
Don't Know	5	23.80	4	19.04			
Painful Cough					1	--	< 0.001
Yes	20	90.47	20	90.47			
No	1	4.76	1	4.76			
Don't Know	0	0.00	0	0.00			
Changes in the shape of fingers or nails					0.927	(0.797,1.00)	< 0.001
Yes	8	38.09	9	42.85			
No	8	38.09	7	33.33			
Don't Know	5	23.80	5	23.80			

▶

Tab. S1 *(follows).* Proportion of answer per categories of warning signs awareness variables and Kappa agreement with 95% confidence interval between the Arabic and English reference questionnaires.

Warning signs	English questionnaire (reference)		Arabic questionnaire		Kappa Agreement	95% CI of Kappa Agreement	p-value
	N	%	N	%			
Developing unexplained loud, high pitched sound when breathing					0.877	(0.687, 1.00)	<0.001
Yes	16	76.19	16	76.19			
No	3	14.28	4	19.04			
Don't Know	2	9.52	1	4.76			
Worsening or change in an existing cough					1	--	<0.001
Yes	20	95.23	20	95.23			
No	1	4.76	1	4.76			
Don't Know	0	0.00	0	0.00			

Tab. S2 *(follows).* Proportion of answers per categories of age at risk variable and Kappa agreement with 95% confidence interval between Arabic and English reference questionnaire

Risk factors	English questionnaire (reference)		Arabic questionnaire		Kappa Agreement	95% CI of Kappa Agreement	p-value
	N	%	N	%			
Age					1	--	< 0.001
1,058	0	0.00	0	0.00			
50-year-old	1	4.76	1	4.76			
70-year-old	11	52.38	11	52.38			
Unrelated to age	9	42.85	9	42.85			

Tab. S3. Proportion of answer per categories of risk factors awareness variables and Kappa agreement with 95% confidence interval between the Arabic and English reference questionnaires.

Risk factors	English questionnaire (reference)		Arabic questionnaire		Kappa Agreement	95% CI of Kappa Agreement	p-value
	N	%	N	%			
Exposure to radon gas					0.913	(0.753,1.00)	< 0.001
Strongly agree	13	61.90	13	61.90			
Agree	4	19.04	5	23.80			
Not sure	4	19.04	3	14.28			
Disagree	0	0.00	0	0.00			
Strongly Disagree	0	0.00	0	0.00			
Exposure to another persons' cigarette smoke					0.90	(0.73,1.00)	< 0.001
Strongly agree	13	61.90	14	66.66			
Agree	6	28.57	5	23.80			
Not sure	2	9.52	2	9.52			
Disagree	0	0.00	0	0.00			
Strongly Disagree	0	0.00	0	0.00			
Having had treatment for any cancer in the past					1	--	< 0.001
Strongly agree	11	52.38	11	52.38			
Agree	6	28.56	6	28.56			
Not sure	3	14.28	3	14.28			
Disagree	1	4.76	1	4.76			
Strongly Disagree	0	0.00	0	0.00			

▶

Tab. S3 *(follows)*. Proportion of answer per categories of risk factors awareness variables and Kappa agreement with 95% confidence interval between the Arabic and English reference questionnaires.

Risk factors	English questionnaire (reference)		Arabic questionnaire		Kappa Agreement	95% CI of Kappa Agreement	p-value
	N	%	N	%			
Having a close relative with lung cancer					0.911	(0.75,1.00)	<0.001
Strongly agree	13	61.90	13	61.90			
Agree	6	28.56	5	23.80			
Not sure	2	9.52	3	14.28			
Disagree	0	0.00	0	0.00			
Strongly Disagree	0	0.00	0	0.00			
Exposure to chemicals such as asbestos					0.892	(0.7,1.00)	<0.001
Strongly agree	15	71.42	15	71.42			
Agree	4	19.04	5	23.80			
Not sure	2	9.52	1	4.76			
Disagree	0	0.00	0	0.00			
Strongly Disagree	0	0.00	0	0.00			
Having previous history of cancer such as head and neck cancer					1	--	<0.001
Strongly agree	11	52.38	11	52.38			
Agree	4	19.04	4	19.04			
Not sure	5	23.80	5	23.80			
Disagree	1	4.76	1	4.76			
Strongly Disagree	0	0.00	0	0.00			
Air pollution					1	--	<0.001
Strongly agree	18	85.71	18	85.71			
Agree	3	14.28	3	14.28			
Not sure	0	0.00	0	0.00			
Disagree	0	0.00	0	0.00			
Strongly Disagree	0	0.00	0	0.00			
Being a smoker					1	--	<0.001
Strongly agree	19	90.47	19	90.47			
Agree	2	9.52	2	9.52			
Not sure	0	0.00	0	0.00			
Disagree	0	0.00	0	0.00			
Strongly Disagree	0	0.00	0	0.00			
Having a previous history of lung disease, such as Chronic Obstructive Pulmonary Disease (COPD)					1	--	<0.001
Strongly agree	18	85.71	18	85.71			
Agree	2	9.52	2	9.52			
Not sure	1	4.76	1	4.76			
Disagree	0	0.00	0	0.00			
Strongly Disagree	0	0.00	0	0.00			

Tab. S4. Proportion of answers per categories of confidence variable and Kappa agreement with 95% confidence interval between Arabic and English reference questionnaire

Risk factors	English questionnaire (reference)		Arabic questionnaire		Kappa Agreement	95% CI of Kappa Agreement	p-value
	N	%	N	%			
Confidence					1	--	< 0.001
Not at all confident	0	0.00	0	0.00			
Not very confident	7	33.33	7	33.33			
Fairly confident	9	42.9	9	42.9			
Very confident	5	23.8	5	23.8			

Reference: Handbook of Parametric and Nonparametric Statistical Procedures, Third Edition-2004.