RESEARCH ARTICLE

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Knowledge, Attitudes, and Screening Practices for Lung Cancer in Uzbekistan: A Nationwide Cross-Sectional Study

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Abstract

Objective: Lung cancer is among the most lethal cancers worldwide and ranks as the third leading cause of cancer-related deaths in Uzbekistan. Despite its growing burden, public knowledge and participation in early screening remain poorly understood in the region. This study aimed to assess general awareness, attitudes, and practices related to lung cancer and its screening among the adult population of Uzbekistan. **Methods:** A cross-sectional survey was conducted between January 25 and February 3, 2025, involving 561 participants from all 14 regions of Uzbekistan. A structured, validated questionnaire was used to assess socio-demographic data, lung cancer knowledge, risk perception, and willingness to participate in screening. Descriptive statistics, chi-square tests, t-tests, ANOVA, and multivariable analysis, such as linear regression and logistic regression were employed to examine associations between knowledge scores and demographic variables. Knowledge was categorized as poor, moderate, or good. **Results:** Only 4% of participants demonstrated good knowledge, while 79% had poor knowledge about lung cancer and its early detection. Although 73.2% recognized smoking as a major risk factor, only 37.4% were aware of early screening methods such as low-dose computed tomography (LDCT). Higher knowledge scores were significantly associated with older age, higher education, income, and urban residence ($p < 0.05$). Gender and smoking status were not significantly correlated with knowledge levels. **Conclusions:** This nationally representative study reveals substantial gaps in public awareness of lung cancer and its screening in Uzbekistan. Targeted public health interventions focusing on youth, rural populations, and individuals with lower educational backgrounds are urgently needed. Expanding educational outreach and increasing access to early detection services may significantly improve outcomes and reduce mortality in high-risk populations.

Keywords: Public health- early detection- health education- Central Asia- low-dose CT

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Introduction

Lung cancer is the most lethal cancer globally, accounting for nearly 20% of all cancer-related deaths in 2022, with over 1.8 million deaths 100,000 more than in 2018 [1, 2]. Tobacco smoking is the primary risk factor for lung cancer, accounting for approximately 85% of all cases globally [3, 4]. Studies indicate that smokers face up to a 30-fold higher risk of developing lung cancer compared to non-smokers [4-6]. In Uzbekistan, 26.8% of adult men and 1.4% of adult women are current smokers, further emphasizing the role of tobacco use in lung cancer prevalence [7]. There are numerous and diverse risk factors for lung cancer, with smoking being the most significant. Other contributing factors include exposure to secondhand smoke, radon, asbestos as well as prior chest radiation and family history [8, 9].

Common symptoms include chronic cough, chest pain, and shortness of breath [10]. Although survival rates have improved for many cancers, most cases of the disease are diagnosed at an advanced stage, significantly limiting treatment options and reducing five-year-survival rates to as low as 5%. This delayed detection is partly due to a lack of awareness about its symptoms and early detection methods [3, 11]. Recent research suggests that only 15% of lung cancer cases are detected globally in the early stages [12]. However, implementing lung cancer screening, particularly with low-dose computed tomography (LDCT), has been shown to reduce mortality by up to 20% [13, 14].

Despite evidence supporting early detection through low-dose CT, awareness and uptake of screening remain

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low globally. A study in the United States found that 71% of respondents were unaware of lung cancer screening options, although a similar percentage expressed willingness to undergo screening if eligible [15].

In Uzbekistan, lung cancer is the third most common cancer by both incidence (9.0%) and mortality (9.7%), according to the WHO Cancer Country Profile and Global Health Observatory [16, 17]. In 2022 alone, it caused 2,137 deaths, making it the leading cause of cancer-related mortality among males. Men were nearly three times more likely to be diagnosed than women (1,854 vs. 677 new cases) [17].

Lung cancer is estimated to be more prevalent in Uzbekistan's industrial regions, including Navoiy, Bukhara, and Tashkent. However, comprehensive research is still needed to assess the nationwide burden. Healthcare professionals expect a significant rise in lung cancer cases in Tashkent over the next two decades due to worsening air pollution and increasing tobacco use among youth. Given these trends, a nationwide assessment of public awareness and preventive practices regarding lung cancer is essential to promote early detection and reduce mortality. Despite being the third leading cause of cancer-related death in Uzbekistan, there is a lack of a systematic approach to LC prevention, resulting in late-stage diagnoses. In Uzbekistan, organized lung cancer screening programs, such as LDCT for high-risk groups, are not yet systematically implemented. Public awareness about the availability and benefits of early detection remains largely unknown. Understanding the population's knowledge, attitudes, and practices regarding lung cancer screening is therefore critical to inform national strategies, improve uptake of early detection services, and ultimately reduce the burden of late-stage diagnoses and mortality. This study aims to evaluate public knowledge, attitudes, and screening practices related to lung cancer across Uzbekistan.

Materials and Methods

Study Design, Setting, and Participants

This research was a descriptive, cross-sectional survey conducted among the Uzbek population. The study utilized a structured, printed questionnaire designed for ease of comprehension. It was adapted from similar research conducted in Saudi Arabia, with modifications to align with Uzbekistan's cultural and demographic characteristics [18]. The questionnaire was divided into three sections: Socio-Demographic Characteristics of Participants, Knowledge and Awareness of Lung Cancer, and Perception of Prevention, Practices, and Attitudes Towards Cancer Screening.

Due to cultural sensitivities, questions about personal and family histories of cancer were combined, as Uzbek respondents are generally reluctant to disclose personal health conditions. To enhance clarity and ensure the questionnaire's validity, two university researchers one public health professor and an oncology professor reviewed and refined the survey. A pilot study involving 21 randomly selected participants was conducted before full implementation to identify and resolve potential ambiguities. Based on participants' and mentors' feedback, the questionnaire underwent seven revisions. To ensure accessibility, both Latin and Cyrillic Uzbek versions were provided. The study adhered to the principles of the Declaration of Helsinki and received approval from the Ethics Committee of Central Asian University (protocol code CAU-IRB-2025-034).

Sample Size Calculation

The required sample size was estimated using the Raosoft® sample size calculator, considering a 5% margin of error and a 95% confidence level. Given Uzbekistan's projected population of 37.5 million as of January 2025, the minimum required sample size was calculated to be 385 participants.

Data Collection

The primary author, after undergoing training in effective public communication, personally collected the data. The survey was conducted over a 10-day period, from January 25 to February 3, 2025, primarily on trains traveling across Uzbekistan. Train conductors and carriage supervisors were informed in advance about the study, and official documentation, including a formal letter from the university and a pre-approved sample questionnaire, was presented before data collection commenced.

To ensure a diverse and representative sample, participants were selected randomly on trains, beginning from the center of each carriage to maximize engagement. The survey targeted Uzbekistan citizens only, and participation was entirely voluntary, with no coercion. Before responding, each participant provided verbal informed consent and was briefed on the study's purpose, benefits, estimated completion time, and voluntary nature. To expand the participant pool, additional surveys were conducted at two public polyclinics and one national library. Efforts were made to include participants from all 14 regions of Uzbekistan, including Tashkent city, to ensure broad national representation.

Inclusion and Exclusion Criteria

Participants were included in the analysis if they completed at least 80% of the 14 knowledge-measuring questions. Those who missed more than 20% of these questions were excluded. Additionally, the following criteria were applied:

1. If identical responses were detected (e.g., same answers, duplicate timestamps, or identical demographic details), only one response was retained

2. Participants who selected the same answer for nearly all knowledge-related questions (e.g., answering "Yes" to everything) were excluded to minimize random or inattentive responses.

3. Participants who completed only demographic questions but left all knowledge-based questions blank were removed.

4. The smoking-related follow-up question was only applicable to smokers and was not scored separately.

5. Respondents with contradictory answers were excluded. Example: If a participant answered "No" to "Have you heard about cancer screening?" but later listed

specific screening tests, their response was considered inconsistent.

Data Analysis

Data were collected and organized in Excel files, ensuring accuracy and consistency. Data analysis was conducted using multiple statistical software tools, including R (version 4.4.2), Jamovi (version 2.6.25), and JASP (version 0.19.3.0). The analysis involved various statistical tests to assess differences and relationships among categorical and numerical variables. JASP (0.19.3.0) was utilized for conducting independent t-tests and ANOVA tests, and visual data representation. Specifically, an independent t-test was used to analyze gender and place of residence, while ANOVA was applied to the remaining factors.

In this analysis, a P-value of 0.05 is used as the standard threshold for statistical significance. If the P-value is less than 0.05, the factor is considered statistically significant, meaning it has a meaningful impact on knowledge levels. Conversely, if the P-value is greater than 0.05, the result is considered not statistically significant, indicating no strong association between the factor and knowledge level.

Categorical variables were converted into percentages for comparison, while numerical data was summarized using means and standard deviations where applicable. Independent t-tests were conducted to compare means between two groups, with corresponding p-values determined. ANOVA (Analysis of Variance) was used to compare means across multiple groups, followed by Tukey's post-hoc test to identify specific group differences. During data collection period, a total of 682 individuals took part in the survey: however, 121 were excluded for not meeting the inclusion criteria, leaving a final sample of 561 participants.

Knowledge Assessment Methodology

To evaluate the general knowledge of participants regarding cancer screening, we developed a scoring system based on 12 key questions. The total maximum score was 25 points. A score below 13 was classified as poor knowledge, a score between 14 and 20 as moderate knowledge, and a score of 21 or higher as good knowledge (Table 1).

Results

As shown in the Table 2, most respondents were young adults, with the largest group falling into the 18-44 age range (77.18%), while those 45 and older made up a smaller percentage (22.82%).

In terms of gender, 51.52% of participants identified as male, 47.59% as female, and a small fraction (0.89%) preferred not to disclose their gender. Marital status varied more than half (58.29%) were married, while 34.94% were single. The remaining 4.28% were either divorced or widowed.

Most respondents lived in urban areas (62.92%), whereas 35.65% resided in rural regions. When it came to education, about half (50.27%) had earned a bachelor's degree, and around 10% held a master's degree. Another 31.91% had completed technical college or an academic lyceum, while 6.59% had only finished school education.

The participants' occupations varied widely. The largest groups included unemployed individuals or housewives (14.26%), students from non-medical fields (19.07%), and healthcare workers (12.12%). Other professions were distributed across different fields, with military personnel, retirees, and construction workers making up smaller percentages.

As for the monthly income, a substantial portion of participants (35.47%) reported having no income, indicating a significant representation of students, unemployed individuals, or those financially dependent on others. Among those with reported earnings, income distribution was relatively even across lower to middle-income brackets. A similar share of participants (15.33%) reported earning either 1–2.5 million UZS or 2.5–4 million UZS, while 13.37% earned 4–6 million UZS. The highest income group, those earning 6 million UZS or more, made up 20.50% of the respondents.

Table 3 presents the smoking habits of the participants. Among the total respondents, 115 (20.5%) identified as smokers, while the majority, 438 (78.1%), stated they did not smoke, and a small portion, 8 (1.4%), mentioned they had smoked in the past. Looking at the duration of smoking, most smokers (63.5%) had been smoking for less than 10 years, while others had continued the habit for 10–20 years (22.6%), 20–30 years (10.4%), or more than 30 years (3.5%).

When asked about smoking within their social circles, 337 (60%) reported having family members or friends who smoke, whereas 198 (35.3%) said they did not, and 26 (4.6%) were unsure. Among those with smokers in their family or friend groups, 269 (79.8%) said they had advised them to quit, 51 (9.1%) had not, and 17 (3%) preferred not to answer.

Table 1 summarizes participants' understanding of lung cancer, with knowledge scores ranging from 0 to 25 and an average score of 9.98 ± 4.89. While 64.35% of respondents recognized lung cancer as one of the most common cancers, slightly fewer (58.64%) were aware that it is also a leading cause of death.

When it comes to risk factors, a majority correctly identified smoking (73.26%) and electronic cigarettes (62.03%) as contributors to lung cancer. However, awareness of the link between lung cancer and chronic respiratory diseases, such as chronic bronchitis or asthma, was relatively low, with 40.46% stating they were unfamiliar with such conditions.

Participants' knowledge of lung cancer symptoms varied. 45.99% identified chronic cough as a symptom, while 37.08% associated it with chest pain during breathing, and 36.72% recognized shortness of breath as a warning sign.

When it comes to screening tests, nearly half (44.21%) of the respondents stated that they do not know early detection methods of lung cancers. Knowledge was categorized into three groups: Good knowledge (scores 21-25), Moderate knowledge (scores 14-20), and Poor knowledge (scores 13 and below). Among the participants,

Table 1. Assessment of Participants' Knowledge About Lung Cancer (n = 561)

Questions		No	%
Did you know that lung cancer is one of the most common types of cancer?	Yes (correct)	361	64.35%
	No	196	34.94%
	Prefer not to answer	4	0.71%
Did you know that lung cancer is one of the leading causes of death?	Yes (correct)	329	58.64%
	No	225	40.11%
	Prefer not to answer	7	1.25%
Do you think physical activity can reduce the risk of lung cancer?	Yes (correct)	320	57.04%
	No	72	12.84%
	Not sure	169	30.12%
Do you think chronic obstructive pulmonary diseases, such as chronic bronchitis and asthma, are related to lung cancer?	Yes (correct)	178	31.73%
	No	151	26.92%
	I am not aware of such diseases	227	40.46%
	Not sure	5	0.89%
Does smoking cause lung cancer?	Yes (correct)	411	73.26%
	No	29	5.17%
	Not sure	121	21.57%
Does smoking a hookah (shisha) cause lung cancer?	Yes (correct)	294	52.41%
	No	43	7.66%
	Not sure	224	39.93%
Do electronic cigarettes cause lung cancer?	Yes (correct)	348	62.03%
	No	33	5.88%
	Not sure	180	32.09%
Does air pollution cause lung cancer?	Yes (correct)	304	54.19%
	No	52	9.27%
	Not sure	205	36.54%
If someone smokes near you, can secondhand smoke cause lung cancer?	Yes (correct)	274	48.84%
	No	93	16.58%
	Not sure	194	34.58%
What about spicy foods and fried foods? Can they cause lung cancer?	Yes	65	11.59%
	No (correct)	263	46.88%
	Not sure	233	41.53%
What about alcoholic beverages? Can they cause lung cancer?	Yes	181	32.26%
	No (correct)	159	28.34%
	Not sure	221	39.40%
Which of the following can be symptoms of lung cancer? (all answers are correct)	Chronic cough	258	45.99%
	Chest pain while breathing	208	37.08%
	Shortness of breath	206	36.72%
	Coughing up blood	195	34.76%
	Unexplained weight loss	194	34.58%
	Persistent chest pain	179	31.91%
	Fatigue and weakness	172	30.66%
	Pain while coughing	166	29.59%
	Frequent lung infections	165	29.41%
	Loss of appetite	128	22.82%
	Wheezing	97	17.29%
	Changes in the shape of fingers or nails	66	11.76%
	Persistent shoulder pain	65	11.59%
	Do not know	42	7.48%
Do you know that there are methods for early detection of lung cancer?	Yes (correct)	210	37.43%
	No	248	44.21%
	Not sure	103	18.36%

Table 2. Socio-Demographic Characteristics of the Study Participants (n = 561)

Factors		No	%
Age	18-44	433	77.18%
	45+	128	22.82%
Gender	Male	289	51.52%
	Female	267	47.59%
	Prefer not to mention	5	0.89%
Marital Status	Single	196	34.94%
	Married	327	58.29%
	Divorced/Widowed	24	4.28%
	Prefer not to mention	14	2.49%
Place of Redidency	City	353	62.92%
	Outside the city	200	35.65%
	Prefer not to mention	8	1.43%
Education level	School	37	6.59%
	Technical college/Academic lyceum	179	31.91%
	Bachelor's degree	282	50.27%
	Mater's degree	58	10.34%
	Prefer not to mention	5	0.89%
Occupation	Unemployed or Housewife	80	14.26%
	Healthcare worker	68	12.12%
	Medical student	17	3.03%
	Student in another field	107	19.07%
	Retired	33	5.88%
	Construction worker	13	2.32%
	Driver	6	1.07%
	Military	22	3.92%
	Chef	6	1.07%
	Employee in public works (guard, security)	7	1.25%
	Other	198	35.29%
	Preferred not to mention	4	0.72%
Monthly income	No income	199	35.47%
	1-2.5 million UZS	86	15.33%
	2.5-4 million UZS	86	15.33%
	4-6 million+ UZS	75	13.37%
	6 mln + UZS	115	20.50%

only 4% (21 individuals) demonstrated good knowledge, while 17% (97 individuals), had a moderate understanding. A significant portion, 79% (443 individuals), fell into the poor knowledge category, indicating limited awareness of lung cancer-related information.

Participants were also asked about their views on early detection methods for lung cancer. Among those who recognized the existence of such methods, 172 (81.9%) believed they were useful, while 8 (3.81%) did not find them beneficial. When smokers were questioned about their willingness to undergo screening, 61 (51.04%) indicated they would use these methods, whereas 24 (20.87%) stated they would not. Encouragingly, most respondents (72.01%) believed that detecting lung cancer early could help prevent premature death (Table 4).

Table 5 presents an analysis of overall knowledge levels regarding lung cancer across various demographic and lifestyle factors. The data indicate that all factors except gender and smoking status significantly influence individuals' knowledge about lung cancer and its screening methods. Statistical significance was assessed using the Chi-square test in the JASP platform and the Monte Carlo test in R software. A p-value below 0.05 indicates a significant relationship between a factor and knowledge level, suggesting a direct impact.

No significant association was found between lung cancer knowledge and gender or smoking status. However, knowledge levels tend to increase with age, with individuals aged 50 and above being nearly twice as knowledgeable as younger individuals. Higher education levels also correlate with greater awareness, with those holding advanced degrees demonstrating the highest

Table 3. Smoking Behavior of the Study Participants (n = 561)

Survey items		No	%
Are you smoker?	Yes	115	20.50%
	No	438	78.07%
	Previously	8	1.43%
If you smoke, how long have you been smoking? (n=115)	Less than 10 years	73	63.48%
	Between 10-20 years	26	22.61%
	Between 20-30 years	12	10.43%
	More than 30 years	4	3.48%
Do you have family members or friends who smoke?	Yes	337	60.07%
	No	198	35.29%
	Not sure	26	4.64%
If you have family members or friends who smoke, have you advised them to quit smoking?	Yes	269	79.82%
	No	51	9.09%
	Prefer not to answer	17	3.03%

Table 4. Participants' Perceptions of Early Detection Methods for Lung Cancer

Questions	No	%
If you think there are methods for early detection of lung cancer, do you believe they are useful		
Yes	172	81.90%
No	8	3.81%
Not sure	23	10.95%
Prefer not to answer	7	3.34%
If you are a smoker, would you be willing to use these screening methods?		
Yes	61	51.04%
No	24	20.87%
Not sure	25	21.74%
Prefer not to answer	5	6.35%
Do you think early detection of lung cancer can help prevent premature death?		
Yes	404	72.01%
No	45	8.02%
Not sure	107	19.08%
Prefer not to answer	5	0.89%

knowledge. Marital status plays a role, as individuals who have or had a family tend to be more informed about lung cancer and early detection methods. Additionally, both monthly income and place of residency show a positive association with knowledge urban residents exhibit greater awareness (24.36%) compared to rural individuals (14.5%). However, the relationship between higher income and greater knowledge is not strictly linear.

Interestingly, individuals who are uncertain about quitting smoking (41.67%) tend to have more knowledge than other groups. Moreover, those who have advised friends or relatives to quit smoking demonstrate a higher awareness of lung cancer, with 22.68% showing increased knowledge. Despite some unexpected trends, the overall findings confirm that age, education, marital status, income, and residency significantly impact knowledge levels, while gender and smoking status do not.

Table 6 presents the mean knowledge scores and standard deviations across various demographic and lifestyle factors, including age, gender, education level, monthly income, smoking status, and place of residence. A higher mean score indicates greater knowledge of lung cancer and its screening methods. Several variables, such as age, gender, education, monthly income, place of residence, having family members or friends who smoke, and advising them to quit, showed statistically significant associations with knowledge levels ($P < 0.03$ for all).

In terms of age, knowledge scores increased progressively with older age groups. Participants aged 65 years and above demonstrated the highest knowledge scores (12.333), while younger individuals aged 18–24 years had lower scores (9.487). This suggests that awareness of lung cancer increases with age, possibly due to increased exposure to health-related information over time.

Regarding gender, women exhibited a significantly higher mean knowledge score (10.431) compared to men (9.488) ($P = 0.023$). This finding indicates that women may have greater awareness of lung cancer risk factors and screening methods, which could be attributed to differences in health-seeking behaviors and engagement with health education.

Education level played a crucial role in determining lung cancer knowledge. A clear trend was observed where participants with higher educational attainment had significantly greater knowledge. Individuals with a Master's degree or higher had the highest mean score (12.414), while those with only a school-level education had the lowest (7.811) ($P < 0.001$). This emphasizes the importance of education in enhancing awareness about cancer prevention and screening.

Socioeconomic factors also influenced knowledge levels. Participants with higher monthly incomes demonstrated greater awareness, with the highest mean score (11.112) observed in those earning 6 million+ UZS per month ($P = 0.014$). This suggests that financial stability may provide better access to health-related information and preventive healthcare services.

Place of residence was another significant factor, with

Table 5. Factors Influencing Knowledge of Lung Cancer and Screening

Factors		Overall Knowledge Level						P value
		Poor		Moderate		Good		
		No	%	No	%	No	%	
Age in years	18-24	170	85.43%	29	14.58%	0	0	0.004
	25-34	103	80.47%	22	17.19%	3	2.34%	
	35-44	76	71.70%	23	21.70%	7	6.60%	
	45-54	57	78.08%	11	15.07%	5	6.85%	
	55-64	20	71.43%	6	21.43%	2	7.14%	
	65+	17	62.96%	6	22.22%	4	14.82%	
Gender	Male	238	82.35%	42	14.53%	9	3.11%	0.182
	Female	203	76.03%	52	19.48%	12	4.49%	
Education	School	34	80.14%	3	8.11%	0	0%	<0.001
	College/Academic lyceum	146	81.56%	24	13.41%	9	5.03%	
	Bachelor's degree	226	80.14%	50	17.73%	6	2.13%	
	Master's & higher	33	56.90%	19	32.76%	6	10.35%	
Marital status	Single	164	83.67%	32	16.33%	0	0%	0.006
	Married	250	76.45%	57	17.43%	20	6.11%	
	Divorced/Widowed	16	66.67%	7	29.17%	1	4.17%	

individuals living in cities showing higher knowledge scores (10.552) compared to those residing outside the city (8.940) ($P < 0.001$). Urban residents may have better access to healthcare facilities, awareness campaigns, and medical professionals, which could explain the difference.

Additionally, social influences played a role in lung cancer awareness. Participants who had family members or friends who smoked exhibited significantly higher knowledge scores (10.332) compared to those who did not (9.747) ($P = 0.002$). Similarly, individuals who advised their family or friends to quit smoking had higher scores (10.636) compared to those who did not (9.529) ($P = 0.030$). This finding suggests that discussions about smoking and lung cancer within social circles may contribute to increased awareness.

On the other hand, marital status and smoking habits did not show statistically significant associations with knowledge levels ($P > 0.05$), indicating that these factors may have a minimal impact on awareness.

In multivariable linear regression ($R^2 = 0.106$), several predictors were independently associated with knowledge score. Participants aged 65 years and above had significantly higher knowledge scores compared to those aged 18–24 years ($\beta = +2.25$, $p = 0.030$). Female participants scored lower than males ($\beta = -0.98$, $p = 0.035$). Higher education was a strong predictor: those with a Master's degree or higher had higher knowledge scores ($\beta = +1.72$, $p = 0.021$), whereas participants with only school-level education scored significantly lower ($\beta = -2.26$, $p = 0.009$). Rural residents demonstrated lower knowledge scores compared to urban residents ($\beta = -1.40$, $p = 0.002$). Monthly income was not an independent predictor after adjustment ($p > 0.05$).

Discussion

This research aimed to assess the general knowledge, attitudes, and practices of the population of Uzbekistan regarding lung cancer and its screening. Knowledge scores ranged from 0 to 24 (out of a maximum of 25), with a mean score of 9.98.

Overall, knowledge and awareness about lung cancer among the population of Uzbekistan are limited. Alarmingly, only 4% of the population demonstrated good knowledge, while four out of five people had poor or insufficient knowledge. As mentioned earlier, lung cancer is one of the most common cancers and a leading cause of cancer-related deaths. However, the results of this study indicate that not everyone is aware of this fact. While 64.35% of respondents recognized lung cancer as one of the most common cancers, slightly fewer (58.64%) knew that it is also a leading cause of death. When questioned about diagnostic methods for lung cancer, 191 respondents (34.05%) correctly stated that computed tomography can detect the disease. However, exactly 50% (96) of them were unaware that it is also a screening method for lung cancer. Even though the majority strongly believe that early detection methods like low-dose computed tomography are useful, only half of smokers expressed willingness to undergo this test. This suggests that lung cancer is often diagnosed at later stages not only due to its overlapping symptoms with other diseases but also because of the low awareness among the general population, as observed in this study. Therefore, it is crucial to expand awareness campaigns about cancer and screening methods while also identifying the main barriers that prevent individuals from undergoing screening [3, 19]. This can be supported by the fact that smokers in China had a significantly lower lung cancer detection rate (only 4.9%) through screening, likely due to negative attitudes toward screening and socioeconomic

Table 6. Mean Knowledge Scores and Standard Deviations Across Different Factors Related to Lung Cancer Awareness

Factors		Knowledge Score		P value
		Mean	Standard deviation	
Age in years	18-24	9.487	4.001	0.019
	25-34	9.375	5.007	
	35-44	10.236	5.267	
	45-54	10.548	5.431	
	55-64	11.286	5.577	
	65+	12.333	5.704	
Gender	Male	9.488	4.865	0.023
	Female	10.431	4.881	
Education	School	7.811	3.978	<.001
	College/Academic lyceum	9.737	5.101	
	Bachelor's degree	9.879	4.604	
	Master's & higher	12.414	5.325	
Marital status	Single	9.541	4.153	0.257
	Married	10.275	5.294	
	Divorced/Widowed	10	5,485	
Are you smoker?	Yes	9.652	5.159	0.635
	No	10.032	4.803	
	Previously	11	6.118	
If you are smoker, are you planning to quit soon?	Yes	9.312	4.126	0.245
	No	10.462	5.027	
	Not sure	12.083	9.977	
Do you have family members or friends who smoke?	Yes	10.332	4.703	0.002
	No	9,747	5.052	
	Not sure	6.923	5.083	
If you have family members or friends who smoke, have you advised them to quit smoking?	Yes	10.636	4.646	0.03
	No	9.529	4.447	
	Prefer not to answer	7.941	5.607	
Monthly income	Not applicable	9.286	4.448	0.014
	1-2.5 mln UZS	10.407	4.361	
	2.5-4 mln UZS	10.14	5.516	
	4-6 mln UZS	9.307	4.064	
	6 mln + UZS	11.112	5.743	
Place of residence	City	10.552	4.924	<.001
	Outside the city	8.94	4.66	

barriers limiting access to LDCT scans [20]. Studies from China indicate that annual LDCT screening for high-risk individuals significantly improves survival rates and cost-effectiveness [21]. However, research from Australia suggests that such screening may not be economically feasible due to the high costs per quality-adjusted life year (QALY) gained [22]. Meanwhile, a separate study in the same country revealed that current smokers exhibited a notably low interest in screening, with an interest rating score of just 2.1 [23]. Similarly, a survey of Indian software professionals found that while nearly half were aware of lung cancer screening methods, only one in four was willing to undergo screening [24]. In contrast, research in the Jazan region of Saudi Arabia showed a higher willingness, with 78.8% of individuals at risk expressing readiness for screening [18]. Additionally, research in Brazil revealed that 39.5% of high-risk individuals had positive screening results, further supporting the effectiveness of targeted screening programs [25]. Subsequently, increasing awareness of the risks and encouraging early detection can have a significant impact on an individual's prognosis.

In the current study, a total of 115 respondents (20.5%) identified as smokers. Among them, 103 were male. These 103 male smokers accounted for 35.64% of all male respondents, which is significantly higher than the 20.4% reported by the WHO in 2024 for adult male smokers in Uzbekistan in 2022 [26].

However, when compared to the global tobacco use prevalence in 2020, where 22.3% of the world's population

used tobacco including 36.7% of men and 7.8% of women the overall smoking rate in our study (20.5%) appears lower than the global average. Meanwhile, the male smoking prevalence in our study (35.64%) is slightly lower than the global male tobacco use prevalence of 36.7% [27].

Given that smoking is a major risk factor for lung cancer, this higher prevalence of smoking among males may contribute to the fact that, in recent years, lung cancer incidence has been 27% higher among males compared to females [28].

Furthermore, 53.9% (62 individuals) of smokers in our study were between the ages of 18-34, highlighting young adults as a key demographic for tobacco use. This suggests that prevention and intervention efforts should focus on this age group to curb smoking-related health risks. Additionally, considering the strong association between smoking and lung cancer, raising awareness about the critical role of early detection is essential in reducing lung cancer mortality [13, 14].

Regarding age, the findings reveal a positive correlation between age and awareness of lung cancer. Specifically, older individuals (55-64) tend to have higher knowledge scores compared to younger age groups (25-34). However, no significant differences are observed among younger age groups (18-24, 25-34, 35-44). In terms of education, higher levels of formal education are strongly associated with increased knowledge scores. In particular, individuals with a Master's degree or higher demonstrate significantly greater awareness compared to those with lower education levels. Conversely, those with only school-level education exhibit notably lower knowledge scores. Interestingly, there is no substantial difference between Bachelor's and Technical School graduates.

Furthermore, uncertainty about whether close contacts are smokers, as reflected in the 'Not sure' responses, is associated with significantly lower knowledge scores. This suggests that individuals who are unsure about this factor may have lower engagement with health-related information and awareness about lung cancer risks.

When considering gender and place of residence, the results indicate that females possess higher knowledge scores than males. Similarly, individuals residing in urban areas exhibit greater awareness than those in rural settings, emphasizing the role of access to healthcare services and information dissemination in shaping public knowledge.

With regard to smoking status and social environment, whether an individual's family or friends smoke does not significantly impact their knowledge scores. However, having a smoker in one's social circle increases the likelihood of advising them to quit, possibly due to heightened awareness of cancer risks. In contrast, those who do not provide such advice may require further education on smoking-related cancers.

Additionally, there is a statistically significant association between monthly income and lung cancer knowledge scores, as indicated by the P value of 0.014 (which is less than 0.05). Looking at the mean scores, individuals with higher monthly income (6 million+ UZS) had the highest knowledge scores (11.112 ± 5.743), whereas those in the lowest income group (Not applicable) had the lowest (9.286 ± 4.448). This suggests that higher-income individuals tend to have greater knowledge about lung cancer, possibly due to better access to healthcare information and educational resources.

On the other hand, marital status, smoking status, and plans to quit smoking do not demonstrate a statistically significant influence on knowledge scores. There is no notable difference among married, single, divorced, or widowed individuals, nor among smokers, former smokers, and non-smokers.

During data analysis, participants were categorized based on their general knowledge levels (poor, moderate, or good) (Table 5) and their mean scores for different factors (Table 6). The results were then compared by calculating statistical significance. While some findings remained consistent across both analytical methods, others showed significant differences. For example, age, education, monthly income, and place of residence were statistically significant factors, indicating their influence on general awareness of lung cancer.

Interestingly, smoking status did not show any correlation with lung cancer knowledge in both methods of analysis, with p-values of 0.78 and 0.635. While factors such as gender, having smokers among family or friends, and giving advice to smokers were statistically insignificant in the first type of analysis, a second analysis based on mean scores suggested that these factors could influence general knowledge of the disease. Deeper evaluations also released that, females, individuals with smokers in their social circle, and those who advised smokers to quit had better knowledge about lung cancer and early detection. In contrast, married individuals and smokers themselves appeared to have lower knowledge levels. Additionally, those uncertain about quitting smoking seemed to have better knowledge than others. However, deeper analysis showed no positive correlation between these factors and general lung cancer awareness.

The results were quite surprising when compared to those from Saudi Arabia. For instance, while research in Saudi Arabia indicated that younger individuals had greater knowledge than older ones, our study found that older participants had better awareness. Additionally, whereas single individuals in Saudi Arabia demonstrated higher knowledge levels, we did not observe a positive correlation in Uzbekistan. Although the mean scores of married and divorced/widowed individuals were higher than those of single individuals, the difference was not statistically significant. This finding differs from some earlier studies, which indicate that married individuals typically possess greater health knowledge and adopt healthier behaviors, likely due to the supportive influence of their spouses [29].

However, some findings were consistent across both studies. For example, smoking status and the intention to quit did not influence lung cancer knowledge. The Saudi study also reported that factors such as gender, education level, monthly income, having a smoker in the family or social circle, and advising others to quit had no significant impact on lung cancer knowledge. In contrast, our study in Uzbekistan found a positive correlation between these

factors and knowledge levels.

Similar research has been conducted in different continents and countries, examining factors that influence knowledge about lung cancer [30-33]. Studies conducted in Eswatini reported that knowledge increased with age, suggesting that older individuals may have had more exposure to health education [30]. However, research from China and European countries found no significant effect of age, indicating that awareness levels were relatively similar across different age groups [31, 32]. In contrast, findings from Saudi Arabia showed that younger individuals had significantly higher knowledge, which may be due to better access to online information and modern education systems [33].

The role of gender in lung cancer awareness also varies by region. Studies from China, Eswatini, and European countries found no significant difference in knowledge between males and females [30-32]. However, research conducted in Saudi Arabia revealed that males had significantly higher knowledge levels compared to females, which may be influenced by cultural and societal differences in access to health information [33].

The association between marital status and lung cancer knowledge has also been explored in multiple studies. Research from Eswatini and Saudi Arabia indicated that married individuals had higher awareness levels, possibly due to increased responsibility for family health and decision-making [30, 33]. On the other hand, studies in China and European countries found no significant effect of marital status, suggesting that marital status alone may not always be a determining factor in health knowledge [31, 32].

Most studies agree that higher education is associated with better lung cancer knowledge. Research conducted in China, Eswatini, and Saudi Arabia confirmed that individuals with higher education levels had greater awareness of lung cancer risks and screening options [21, 30, 33]. However, studies in European countries reported a weaker correlation in some regions (such as the Czech Republic), indicating that education alone may not always guarantee better awareness [32].

Findings on the relationship between smoking and lung cancer awareness have been inconsistent. Studies in China reported that smokers had better awareness and were more likely to participate in screening [31]. In contrast, research from European countries found that smokers had lower knowledge, possibly due to denial or misinformation [32]. In Saudi Arabia, no significant correlation was found between smoking and awareness levels [33].

Economic factors also play a role in lung cancer awareness. Studies from Europe revealed that higher-income women had better knowledge, highlighting the impact of financial stability on health education access [33]. Research from China indicated that cost concerns affected screening participation, suggesting that economic barriers may limit preventive healthcare measures [31]. However, studies from Eswatini and Saudi Arabia did not provide data on income-related differences in awareness [30, 33].

Additional studies have also explored the influence of employment status and place of residence on lung cancer awareness. Findings suggest that employment plays a role in knowledge levels, with higher-ranking professionals in Eswatini, skilled workers in European countries, and employed individuals in Saudi Arabia demonstrating greater awareness [30, 32, 33]. This indicates that professional experience and workplace education may contribute to better health knowledge. Additionally, place of residence appears to impact awareness in some regions. Research in European countries identified regional differences, while studies in Saudi Arabia found that individuals from central and southern regions had higher knowledge levels [32, 33]. These findings suggest that geographical disparities in healthcare access and educational outreach may influence lung cancer awareness.

There were still some limitations in our study. For instance, unlike the research conducted in Saudi Arabia, we were unable to assess lung cancer knowledge based on occupation, which could be considered a limitation. Additionally, the total number of questions used in our study was slightly higher, which may have impacted participants' willingness to complete the questionnaire fully. Moreover, the number of participants from certain regions, such as Jizzakh, Sirdarya, Navoiy, and Khorazm, was insufficient. However, the total sample size was adequate to represent the country as a whole. Considering these limitations, we encourage future researchers conducting similar studies to take these factors into account and, if possible, explore alternative evaluation methods.

In conclusion, this study highlights a critical gap in public knowledge about lung cancer in Uzbekistan, with only a small fraction of participants demonstrating adequate awareness. Demographic factors such as age, education, and place of residence were significantly associated with knowledge levels, while gender and smoking status had less influence.

These findings underscore the urgent need for targeted educational campaigns, particularly focusing on youth, rural populations, and individuals with lower educational backgrounds. Integrating lung cancer awareness into national public health strategies and expanding access to early screening especially LDCT for high-risk groups can significantly improve early detection rates. Additionally, enhancing tobacco control measures and supporting smoking cessation efforts remain vital in reducing the burden of lung cancer.

Author Contribution Statement

All authors contributed equally in this study. All authors read and approved the final manuscript.

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Ethics approval and consent to participate

This study was approved by the Ethics Committee of Central Asian University (Ethical Approval Code: CAU-IRB-2025-034). All participants provided verbal informed consent prior to data collection. The study was conducted in accordance with the Declaration of Helsinki.

Availability of data and materials

The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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