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Original Article

Screening behaviors of high-risk individuals for lung cancer: A cross-sectional study

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ABSTRACT

Objective: To investigate current screening behaviors among high-risk individuals and analyse the factors that influence them.

Methods: A cross-sectional of 1652 high-risk individuals were recruited in Fujian Province, China from February to October 2022. Socio-demographic characteristics of participants were collected and other survey measures included a lung cancer and lung cancer screening knowledge questionnaire and a stage of adoption algorithm. Standardized measures on surveys were comprised of the: Lung Cancer Screening Health Belief Scales, Cataldo Lung Cancer Stigma Scale, Generalized Anxiety Disorder Scale-7, Patient Health Questionnaire-9, and the Patient Trust in the Medical Profession Scale. Factors associated with screening behavior were identified using binary logistic regression analysis.

Results: Lung cancer screening behavior stages were largely reported as Stage 1 and Stage 2 (64.4%). The facilitators of lung cancer screening included urban residence (OR = 1.717, 95% CI: 1.224–2.408), holding administrative positions (OR = 16.601, 95% CI: 2.118–130.126), previous lung cancer screening behavior (OR = 10.331, 95% CI: 7.463–14.302), media exposure focused on lung cancer screening (OR = 1.868, 95% CI: 1.344–2.596), a high level of knowledge about lung cancer and lung cancer screening (OR = 1.256, 95% CI: 1.185–1.332), perceived risk of lung cancer (OR = 1.123, 95% CI: 1.029–1.225) and lung cancer screening health beliefs (OR = 1.090, 95% CI: 1.067–1.113). A barrier to lung cancer screening was found to be social influence (influence of friends or family) (OR = 0.669, 95% CI: 0.465–0.964).

Conclusions: This study found a low participation rate in lung cancer screening and identified eight factors that affected lung cancer screening behaviors among high-risk individuals. Findings suggest targeted lung cancer screening programs should be developed based on identified influencing factors in order to effectively promote awareness and uptake of lung cancer screening.

Introduction

Lung cancer ranks as the second most common cancer in the world, with approximately 2.2 million new cases and 1.8 million deaths in 2020.[1] In 2020, lung cancer became the primary cause of death in China, with 0.82 million new cases and 0.72 million fatalities.[2] With most patients diagnosed at an advanced stage, poor prognoses and high recurrence rates have resulted. For those fortunate enough to be diagnosed at an early stage of lung cancer, the 5-year survival rate can be as high as 60%–70%.[3] The key to reducing mortality lies in enhancing early diagnosis and treatment of lung cancer.[3]

Low-dose computed tomography (LDCT) is widely recognized as one of the primary methods for lung cancer screening (LCS).[4] LDCT has proven to be more effective than chest X-rays in detecting lung cancer at an early stage, leading to a remarkable 20% reduction in lung cancer mortality.[5] Similarly, a multicenter prospective cohort study conducted in China confirmed the benefits of LDCT for high-risk individuals, showing that a single LDCT screening could reduce lung cancer mortality

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by 31% during the follow-up period.[6] These findings make it evident that LCS plays a crucial role in improving the health outcomes of individuals at-risk.

Despite its established effectiveness, the global adoption of LCS remains very low. For instance, in the United States, the proportion of eligible individuals receiving LCS has remained consistently low, ranging from 3.3% in 2010 to 3.9% in 2015.[7] A recent study reports that less than 5% of all eligible individuals have undergone LCS.[8]

In China, a cancer screening project in rural and urban areas of China started in 2009 and 2012, respectively, and was designed to offer more than 210,000 individual cost-free baseline LDCT screenings.[9] However, compliance with LDCT screening among high-risk groups for lung cancer has remained poor. An analysis conducted across 38 cities in China between 2017 and 2020 revealed that the majority of participants (21.25%) were high-risk individuals aged between 40 and 74 years, while the overall screening participation rate stood at only 35.32%.[10] Wen Yan et al.,[11] conducted an analysis on the compliance of LDCT screening in three Chinese provinces from 2017 to 2018, indicating an overall screening participation rate of 34.86% among 17,983 high-risk individuals for lung cancer. Additionally, LDCT uptake in China remained stagnant, with an overall participation rate of 33% between 2013 and 2018.[12]

Adhering to the principle of preventing and strengthening early cancer screening and detection is an important measure for cancer prevention and control in China. Considering the goals set forth by the Healthy China Initiative (2019–2030), which aims to achieve an early diagnosis rate of over 55% for key cancer types in high-risk areas,[13] it becomes vital to focus on improving LCS behaviors of high-risk individuals.

Thus, researchers have directed their attention toward finding ways to encourage higher participation rates among those at risk. Over recent years, there has been a surge in national and international efforts dedicated to improving the implementation of LCS programs. A pivotal focus of cancer prevention and control research involves delving into the factors influencing individual screening behaviors. These factors serve as a framework to craft interventions that boost motivation for proactive screening and heighten screening awareness. This understanding not only aids in augmenting screening behaviors among high-risk individuals, but also contributes significantly toward elevating the rates of early lung cancer diagnosis and subsequent treatment.

Previous evidence suggests that the influencing factors of LCS behaviors are determined by several features, including level of health beliefs, knowledge of lung cancer and LCS, health care provider recommendations, demographic and health factors (e.g., age, gender, smoking status and economic level, etc.), as well as psychological and socio-environmental variables (e.g., mistrust, worry, social influence and media exposure, etc.).[14–17] However, these studies differ in key aspects that affect their interpretation, such as large sample size differences (ranging from 23 to 1730),[15–17] inconsistent lung cancer risk (including average-risk individuals),[17] inconsistent study methodology (mixed studies),[14] and different definitions of high-risk individuals for lung cancer (LCS guidelines vary by country),[15–18] and such methodological differences result in inconsistent research outcomes.[13–16] Moreover, while these studies predominantly focus on the United States, it is important to note that culture significantly influences individual preferences regarding health-related decisions. For instance, in China, going to the hospital or discussing illness is considered taboo.

Considering the limitations of previous studies, more studies are needed into the factors that influence LCS behaviors in high-risk individuals in China. Therefore, the aim of this study is to investigate the current status of LCS behaviors and explore the factors that affect them. The selection of influencing factors to examine in this study was based on a literature review and tenets of the Health Belief Model. Factors encompassed psychological, demographic and health factors, cognitive factors, medical staff recommendations, as well as socio-environmental factors.[14,15]

Methods

Study design and participants

From February to October 2022, we conducted a large-scale cross-sectional study in Fuzhou and Putian cities of Fujian Province, China. To ensure a comprehensive approach to recruitment, we employed a variety of community-based methods. In each city, six neighborhoods were randomly selected as investigational sites. Throughout the study, we established strong and trusted relationships with community partners, which included medical clinics, community hospitals, and large, non-governmental organizations. Through a combination of community outreach efforts and engagement with health care providers at each investigational site, we successfully recruited 1652 high-risk individuals for inclusion in the study. Adhering to established guidelines, our study followed the principles outlined in the Strengthening the Reporting of Observational Studies in Epidemiology statement.[19]

The eligibility criteria for this study were based on the China Guideline for the Screening and Early Detection of Lung Cancer (2021, Beijing),[18] and thus, eligible participants met the accepted definition in China of "high-risk" for lung cancer. The following study inclusion criteria were applied to participants: (1) aged between 50 and 74 years (the age range is consistent with the guidelines); (2) had at least one risk factor as defined as a) smoking history of $\geq$ 30 packs per year, including those who had smoked $\geq$ 30 packs per year but quit $\leq$ 15 years, b) second-hand smoke exposure (living or working with smokers for $\geq$ 20 years), c) diagnosis of chronic obstructive pulmonary disease, d) occupational exposure of at least 1 year to substances such as asbestos, radon, beryllium, chromium, cadmium, nickel, silicon, or soot, or e) first-degree relatives (parents, children, or siblings) diagnosed with lung cancer; and (3) willing and able to participate in the study. To limit confounding of study results, those with a previous history of cancer, or those with cognitive or psychological disorders (such as depression and anxiety), were excluded from the study. A flow chart of study enrollment is presented in Fig. 1.

The sample size was calculated using the formula: $N = [\mu^2_{\alpha/2} \times \pi \times (1-\pi)]/\delta^2$, where the value of α represents the type I error (set at 0.05), and δ indicates the admissible error (set at 0.03).[20] As determined by a previous study authored by Chen et al.,[9] the LCS participation rate in China was 35.32% ($\pi = 0.3532$). By substituting each value into the sample size calculation formula, we obtained a required sample size of 975. Accounting for potential non-responses, a conservative estimate of a 20% non-response rate was assumed. Consequently, the minimum sample size for the study was calculated to be at least 1170 participants.

Survey instruments

Socio-demographic characteristics

Socio-demographic variables, including age, gender, body mass index (BMI), residential location, educational level, employment status, occupational exposure history, smoking status, family history of cancer, and other relevant characteristics were collected from participants.

Lung Cancer and Lung Cancer Screening Knowledge Questionnaire (Appendix 1)

The lung cancer and lung cancer screening knowledge questionnaire was adapted using peer-reviewed articles by Carter-Harris et al.,[21,22] and was informed by the implementation plan of the survey of core knowledge of cancer prevention and control in Fujian Province.[23] The questionnaire covered various aspects, including early symptoms of lung cancer, preventive measures, recommended groups for LCS, screening methods and frequency. It consisted of 9 items, including 4 single-item questions and 5 multiple-item questions. For single-answer questions, a correct response was assigned 1 point, while an incorrect answer received 0 points. For multiple-answer questions, a score of 2 points was

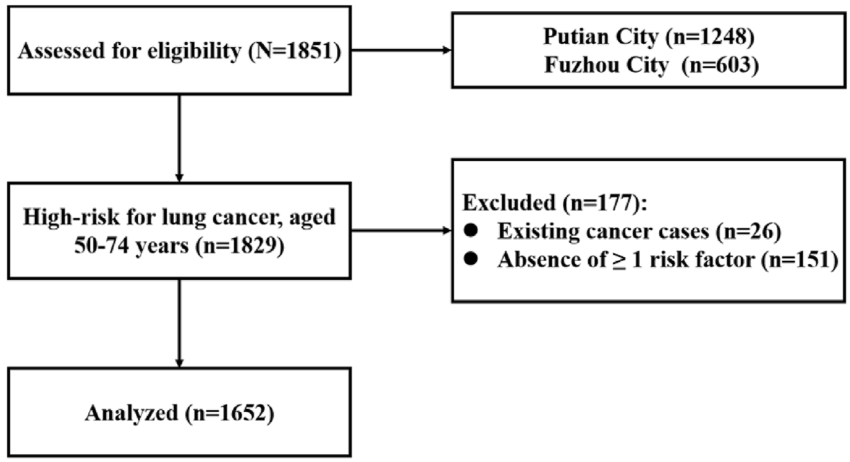

Fig. 1. Study enrollment flow chart.

given for a completely correct answer, and 0 points were assigned if the answer was partially correct or incorrect. A higher total score indicated a greater knowledge about lung cancer and LCS. In this study, the Cronbach's α coefficient for the overall scale was 0.89.

Stage of adoption algorithm: LCS (Appendix 2)

LCS behavior was evaluated using a stage of adoption algorithm adapted from an article by Carter-Harris et al.[15] This algorithm consisted of 5 questions that corresponded to 7 stages of adoption. The 7 stages are, stage 1: unaware, stage 2: unengaged, stage 3: undecided, stage 4: decided not to act, stage 5: decided to act, stage 6: action, stage 7: maintenance. Individuals in stages 1 to 4 were considered as not participating in LCS, while individuals in stages 5 to 7 were considered as LCS participants.[15]

Lung Cancer Screening Health Belief Scales (Appendix 3)

The Lung Cancer Screening Health Belief scales were initially developed by Carter-Harris et al.,[22] and translated and adapted by our research team. The questionnaire consisted of 35 items designed to assess individual health beliefs related to LCS and was organized into 4 subscales: perceived barriers to LCS (17 items), perceived benefits of LCS (6 items), perceived risk of lung cancer (3 items), and self-efficacy for LCS (9 items). Participants rated each item on a 4-point Likert scale. For subscales related to perceived benefits, perceived risks, and self-efficacy, positive items were scored from 1 to 4, while negative items in the perceived barriers subscale were scored from 4 to 1. A higher total score on each individual subscale indicated a stronger LCS health belief. The Cronbach's α coefficient ranged from 0.83 to 0.93 for the 4 subscales.

Cataldo Lung Cancer Stigma Scale (CLCSS) (Appendix 4)

Smoking-related stigma was evaluated using the smoking-related stigma subscale of Cataldo Lung Cancer Stigma Scale, which utilized a rating scale ranging from 1 to 4, where 1 indicated “strongly disagree” and 4 indicated “strongly agree.” Higher scores indicated a greater degree of smoking-related stigma. Others found the subscale demonstrated good internal consistency with a Cronbach's α coefficient of 0.80.[24] The original subscale consisted of five items; however, for this study, the fourth item, “some people act as though it is my fault that I have lung cancer,” was deemed not applicable to high-risk individuals and was therefore excluded from the assessment. Consequently, the subscale used in this study was comprised of 4 items. In this study, the Cronbach's α coefficient for the overall scale was 0.85.

Generalized Anxiety Disorder Scale-7 (GAD-7) (Appendix 5)

The GAD-7 was initially developed by Spitzer et al.,[25] and consists of 7 items that aim to assess the presence and severity of generalized anxiety symptoms experienced over the past two weeks. Participants rated each item on a 4-point Likert scale ranging from 0 to 3, with response options ranging from “not at all” to “nearly every day”. Higher scores indicated higher levels of anxiety. The Chinese version of the GAD-7 has previously demonstrated good internal consistency, with a Cronbach's α coefficient of 0.90.[26]

Patient Health Questionnaire-9 (PHQ-9) (Appendix 6)

The PHQ-9 was developed by Kroenke et al.,[27] and consists of 9 items designed to assess the presence and severity of depressive symptoms experienced over the past two weeks. Participants rated each item on a 4-point Likert scale ranging from 0 to 3, with response options ranging from “not at all” to “nearly every day”. Higher scores indicated a higher level of depression severity. The Chinese version of the PHQ-9 has previously demonstrated good internal consistency, with a Cronbach's α coefficient of 0.83.[28]

Patient trust in the medical profession (Appendix 7)

Medical trust was evaluated using the Patient Trust in the Medical Profession Scale.[29] This scale consisted of 5 items, and participants rated each item on a 5-point Likert scale ranging from 1 to 5. It is important to note that one of the items is negatively worded and is reverse-scored during analysis. The total score on the scale ranged from 5 to 25, with higher scores indicating a higher level of medical trust. The scale has demonstrated acceptable internal consistency, with a Cronbach's α coefficient of 0.77 in the past.[29]

Other indicators

Socio-environmental factors encompassed residential location, social influence, and media exposure. Social influence referred to the influence exerted by friends or family members. Media exposure included exposure to various sources, which may have influenced an individual's decision regarding early LCS, such as newspapers, magazines, television, broadcasts, the Internet, or brochures from the community or health departments. To evaluate the impact of these factors, the question was used “which sources of information would be helpful in making a decision regarding early LCS?” and was designed based on literature reviews.

Data collection

Data was collected through a pen-and-paper version of the questionnaires or online surveys, depending on participant preferences. Online surveys were administered through the Wenjuanxin online platform, a popular survey platform in China (available at https://www.wjx.cn).

Data analysis

Data analysis were conducted using SPSS 27.0 (IBM, Chicago, IL, USA). The significance level was predefined at $P < 0.05$ (2-tailed).

Continuous variables were expressed as means with standard deviations (SD). Categorical variables were expressed as proportions or percentages. LCS behavior was used as the dependent variable (with a value of "0" representing "not participating in screening" and a value of "1" representing "participating in screening"), and statistically significant indicators from the univariate analysis were considered as independent variables. Binary logistic regression was performed to determine which influencing factors were associated with LCS behaviors.

Ethical considerations

The research was approved by the institutional review boards of Fujian Medical University (IRB No. FM2021097) and written informed consent was obtained from all participants.

Results

Participant characteristics

A total of 1652 high-risk individuals for lung cancer were included in this study. Among them, 909 (55.02%) were male and 743 (44.98%) were female, with a mean age of 63.92 years (SD = 6.65). The average BMI was 23.56 kg/m^2 (SD = 2.91). Table 1 presents the socio-demographic characteristics of the participants.

Characteristics of LCS behaviors in high-risk individuals

Among the high-risk individuals, LCS behavior stages were largely reported as stage 1 and stage 2 (64.41%). Specifically, 1094 individuals (66.22%) were categorized as unaware (stage 1; 662), unengaged (stage 2; 402), or undecided (stage 3; 30) regarding LCS behavior. 110 individuals (stage 4; 6.66%) decided not to act, while 448 individuals (stages 5–7; 27.12%) were considered as LCS participants, which were categorized as decided to act (stage 5; 63), action (stage 6; 161), maintenance (stage 7; 224).

Univariate analysis of LCS behaviors in high-risk individuals

The results of the univariate analysis indicated that 20 factors, consisting of 9 continuous variables and 11 categorical variables, were found to be associated with LCS behavior ($P < 0.05$). These factors included age, lung cancer and its screening knowledge, medical trust,

Table 1
Socio-demographic characteristics of participants ($N = 1652$).

Characteristic		*n* (%)
Gender	Male	909 (55.02)
	Female	743 (44.98)
Residential location	Urban	669 (40.50)
	Rural	983 (59.50)
Religious belief	No religion	530 (32.08)
	Christianity	86 (5.21)
	Buddhism	1009 (61.08)
	Taoism	27 (1.63)
Educational level	Primary school degree or below	669 (40.50)
	Middle school degree	540 (32.69)
	High school degree	366 (22.15)
	Bachelor's degree or higher	77 (4.66)
Employment status	Worker	72 (4.36)
	Farmer	721 (43.64)
	Administrative personnel	11 (0.67)
	Science and technology, medical personnel or teacher	17 (1.03)
	Individual, business, enterprise or service personnel	109 (6.60)
	Retired	621 (37.59)
	Homemaker	79 (4.78)
	Other[a]	22 (1.33)
Occupational exposure history[b]	Yes	281 (17.01)
	No	1371 (82.99)
Medical insurance type	Self-paid (uninsured)	20 (1.21)
	Publicly funded, free medical care	17 (1.03)
	Urban employee basic medical insurance	552 (33.41)
	Urban-rural basic medical insurance	1063 (64.35)
Monthly household income (yuan, RMB)	< 1000	137 (8.29)
	1000–3000	722 (43.70)
	3001–5000	560 (33.90)
	> 5000	233 (14.10)
Smoking status	Non-smoker	887 (53.69)
	Current smoker	587 (35.53)
	Former smoker	178 (10.77)
Second-hand smoke exposure	Yes	1171 (70.88)
	No	481 (29.12)
History of COPD	Yes	78 (4.72)
	No	1574 (95.28)
Family history of lung cancer	Yes	13 (0.79)
	No	1639 (99.21)
Previous LCS behavior	Yes	647 (39.16)
	No	1005 (60.84)
Medical staff recommendation	Yes	1386 (83.90)
	No	266 (16.10)
Social influence	Yes	1183 (71.61)
	No	469 (28.39)
Media exposure	Yes	958 (58.00)
	No	694 (42.00)

COPD, chronic obstructive pulmonary disease; LCS, lung cancer screening.
[a] Community service workers.
[b] Such as asbestos, radon, beryllium, chromium, cadmium, nickel, silicon, soot.

smoking-related stigma, LCS health beliefs, perceived barriers, perceived benefits, perceived risks, self-efficacy, residential location, religious beliefs, education level, occupation, medical insurance type, monthly average household income, smoking status, previous LCS behavior, medical staff recommendation, social influence, and media exposure. For detailed information on the univariate analysis results, please refer to Tables 2 and 3.

Binary logistic regression analysis of LCS behaviors in high-risk individuals

As shown in Table 4, several factors acted as facilitators of LCS, including urban residence (OR = 1.717, 95% CI: 1.224–2.408), holding administrative positions (OR = 16.601, 95% CI: 2.118–130.126), previous LCS behavior (OR = 10.331, 95% CI: 7.463–14.302), media exposure focused on LCS (OR = 1.868, 95% CI: 1.344–2.596), high level of knowledge about lung cancer and LCS (OR = 1.256, 95% CI: 1.185–1.332), perceived risks of lung cancer (OR = 1.123, 95% CI: 1.029–1.225), and LCS health beliefs (OR = 1.090, 95% CI: 1.067–1.113). The sole barrier to LCS was identified as social influence (OR = 0.669, 95% CI: 0.465–0.964).

Discussion

This study provides a scientific basis for future development of LCS intervention programs that enhance awareness and beliefs of screening and aim to improve screening behaviors in high-risk groups. It also helps to emphasize the importance of early prevention of cancer, which is clinically and practically important to improve the prognosis of high-risk individuals for lung cancer, as well as reduce the morbidity and mortality rates of lung cancer.

Current status of LCS behaviors among high-risk individuals

The screening behavior stages of 1652 high-risk individuals were predominantly concentrated in Stages 1 and 2, and accounted for 64.4% of the total sample. Findings indicated that over half of the high-risk individuals were either unaware of, or unengaged, with LDCT screenings. This suggested that a significant proportion of these individuals had not heard of LDCT, or lacked the motivation to undergo screening, even if they were aware of its existence.

The number of individuals adhering to annual LDCT screenings was 224, which only represented 13.6% of the total sample. This finding is particularly concerning as lung cancer has the highest reported incidence and mortality rates in malignant tumor registries of Fujian Province.[30] The annual screening participation rate in this study was far below that reported in the United States (45.0% to 55.0%).[31] These findings strongly suggest that a substantial disparity exists in screening behaviors among high-risk individuals when compared to other regions of China. The notably lower screening participation rate observed in this study may be due to insufficient promotion of LCS by the relevant health authorities and lack of proactive awareness of LCS and screening-related health knowledge among high-risk individuals, which emphasizes the need for targeted interventions and awareness campaigns to improve the uptake of LDCT screenings in this particular population. Such interventions may include conducting motivational interviews and lectures, as well as distributing educational brochures and other printed materials. Addressing these disparities is crucial to enhancing early detection and reducing the burden of lung cancer in high-risk individuals across the country.

Factors related to LCS behaviors among high-risk individuals

In line with previous studies,[17,32–35] we found that individuals who had previously undergone LCS, and those who were exposed to media coverage focused on LCS, tended to have higher levels of knowledge about lung cancer and LCS as well as higher perceived risks of lung cancer and stronger LCS health beliefs. Consequently, these individuals were more actively involved in LCS. Regarding previous LCS behaviors, the likely reason for this association is that screened high-risk individuals had a clearer understanding of LDCT screening methods and procedures, which reduced their reluctance to engage in future LCS. Additionally, positive screening experiences could have increased their confidence and motivation to maintain good LCS behaviors.[36]

Unlike previous research,[16,37] this study demonstrated that social influence negatively affected LCS behaviors among high-risk individuals. Advice received from family and friends may be less credible than that from health care providers, and the low cognitive levels of the participants may have hindered the impact of social influence on their beliefs about LCS benefits. However, media exposure through various channels, coupled with higher knowledge levels about lung cancer and LCS, have proved effective in promoting LCS behaviors. Sharing LCS knowledge through social media has subtly influenced attitudes and encouraged individuals to prioritize their health.[37] To improve screening initiatives, medical departments should target individuals with limited knowledge and design tailored publicity programs. Strategic utilization of media exposure can amplify health-centric ideas and drive positive health behavior changes among high-risk individuals.

Our findings demonstrate that higher perceived risks of lung cancer and LCS health beliefs can promote LCS behaviors among high-risk individuals. These results align with the findings of most studies.[23,36] Regarding perceived risks, related research has shown that high-risk individuals with a greater perceived risk of lung cancer tend to have positive beliefs about LDCT and health-related behaviors.[38] This may be attributed to high-risk individuals being more aware of their own risks and wanting to stay informed about their true health status, thereby improving their compliance with screenings. However, the findings of Ali et al.,[39] also revealed that a higher perceived risk of lung cancer may create psychological burden in high-risk individuals, potentially hindering LCS behaviors. Conclusions about perceived risks of lung cancer are inconsistent, possibly due to variations in individuals' understanding of their own risk, leading to different screening outcomes.

Table 2
Univariate analysis of screening behaviors of high-risk individuals for lung cancer by continuous variable.

Variable	LCS non-participant (n = 1204), Mean ± SD	LCS participant (n = 448), Mean ± SD	t/Z value	P value
Age (years)	63.72 ± 6.64	64.47 ± 6.64	–2.024	0.043
Knowledge score	4.98 ± 2.95	7.46 ± 2.48	−17.090	< 0.001
Medical trust score	18.17 ± 3.00	19.26 ± 3.34	−6.359	< 0.001
Smoking-related stigma score	9.07 ± 2.13	8.63 ± 2.19	3.674	< 0.001
LCS health beliefs score	93.42 ± 7.99	102.24 ± 9.39	−17.644	< 0.001
Perceived barriers score	45.04 ± 5.79	48.92 ± 5.66	−12.319	< 0.001
Perceived benefits score	17.74 ± 2.25	19.09 ± 2.82	−9.138	< 0.001
Perceived risks score	5.21 ± 1.93	5.51 ± 1.67	−3.122	0.002
Self-efficacy score	25.43 ± 4.58	28.71 ± 4.68	−12.755	< 0.001

LCS, lung cancer screening.

Table 3
Univariate analysis of screening behavior of high-risk individuals for lung cancer by categorical variable.

Variable		LCS non-participant (n = 1204)	LCS participant (n = 448)	χ^2	P value
Residential location	Urban	420	249	−2.024	0.043
	Rural	784	199		
Religious belief	No religion	341	189	46.497	< 0.001
	Christianity	53	33		
	Buddhism	783	226		
	Taoism	27	0		
Educational level	Primary school degree or below	550	119	97.898	< 0.001
	Middle school degree	406	134		
	High school degree	211	155		
	Bachelor's degree or higher	37	40		
Employment status	Worker	62	10	133.679	< 0.001
	Farmer	608	113		
	Administrative personnel	5	6		
	Science and technology, medical personnel or teacher	7	10		
	Individual, business, enterprise or service personnel	72	37		
	Retired	367	254		
	Homemaker	65	14		
	Other[a]	18	4		
Medical insurance type	Self-paid (uninsured)	14	6	78.955	< 0.001
	Publicly funded, free medical care	11	6		
	Urban employee basic medical insurance	328	224		
	Urban-rural basic medical insurance	851	212		
Monthly household income (yuan, RMB)	< 1000	110	27	104.747	< 0.001
	1000–3000	599	123		
	3001–5000	375	185		
	> 5000	120	113		
Smoking status	Non-smoker	637	250	10.502	0.005
	Current smoker	451	136		
	Former smoker	116	62		
Previous LCS behavior	Yes	278	369	481.512	< 0.001
	No	926	79		
Medical staff recommendation	Yes	986	400	13.207	< 0.001
	No	218	48		
Social influence	Yes	832	351	13.728	< 0.001
	No	372	97		
Media exposure	Yes	135	313	35.586	< 0.001
	No	559	645		

LCS, lung cancer screening.
[a] Community service workers.

LCS health beliefs are an essential factor that influences one's willingness to participate in LCS.[22] High-risk individuals with stronger LCS health beliefs can better understand the susceptibility and seriousness of lung cancer, thus promoting the maintenance of active LCS behaviors.[40] In the future, targeted publicity and educational programs may be formulated based on individuals' LCS health belief levels to enhance the understanding of lung cancer. This, in turn, will promote a conscious adoption of LCS behaviors and improve preventive awareness.

The findings regarding occupation revealed that individuals holding administrative positions were more actively involved in LCS, possibly due to better financial status and access to medical treatment, reducing their health care burden. Their involvement in health-related work and cooperation with the government also played a role in motivating them to participate in LCS.[38] Regarding residential location, urban residents showed higher LCS participation rates due to better transportation and health care resources, as well as increased awareness from stronger publicity in cities.[17] However, conflicting results from other studies showed that the effect of residential location on LCS behavior remains uncertain.[22]

Implications for nursing practice and research

Comprehending the current state of LCS behaviors and their influencing factors has provided scientific evidence to guide the development of targeted interventions. These interventions aim to assist individuals at high risk of lung cancer in making informed decisions about screening, raising awareness and beliefs regarding LCS, and improving their LCS

Table 4
Select logistic regression analysis results of screening behavior of high-risk individuals for lung cancer.

Variable	B	S.E.	Wald	OR (95% CI)	P value
Constant	−13.894	1.288	116.341		< 0.001
Residential location (rural as reference)					
Urban	0.540	0.173	9.810	1.717 (1.224–2.408)	0.002
Employment status (other as reference)					
Administrative personnel	2.809	1.051	7.152	16.601 (2.118–130.126)	0.007
Previous LCS behavior	2.335	0.166	198.020	10.331 (7.463–14.302)	< 0.001
Social influence	−0.402	0.186	4.658	0.669 (0.465–0.964)	0.031
Media exposure	0.625	0.168	13.830	1.868 (1.344–2.596)	< 0.001
Knowledge score	0.228	0.030	58.495	1.256 (1.185–1.332)	< 0.001
Perceived risk score	0.116	0.045	6.805	1.123 (1.029–1.225)	0.009
LCS health beliefs score	0.086	0.011	63.083	1.090 (1.067–1.113)	< 0.001

S.E, standard error; OR, odds ratio; CI, confidence interval; LCS, lung cancer screening. Model χ^2 = 766.339 (P < 0.001), Nagelkerke R^2 = 0.538.

behaviors. Furthermore, identifying the influencing factors of LCS in high-risk individuals informs future research aimed at promoting targeted interventions for LCS behaviors.

Limitations

Several limitations of this study should be considered. First, the study only recruited participants from Fujian Province in China due to constraints in manpower, material resources, and time. Consequently, the generalization of the findings to other regions of China may be influenced. Future research should encompass a more diverse sample throughout China to enhance the study's external validity. Second, this study employed a cross-sectional design with no follow-up data collected. To gain a deeper understanding of the dynamic changes in LCS behaviors among high-risk individuals, multi-center, longitudinal studies are needed. Such studies will provide a stronger theoretical basis for implementing effective LCS interventions. Third, in order to facilitate a larger sample size, data collection was conducted through both a pen-and-paper version of the questionnaires and online version, which may have introduced variability in the study results. For future studies, a single data collection method is recommended.

Conclusions

This study highlights the persistently low participation rate of LCS in Fujian Province in China. Among high-risk individuals, certain factors were found to be associated with a higher willingness to undergo LCS. These factors included urban residence, holding administrative positions, previous LCS behavior, media exposure focused on LCS, higher levels of knowledge about lung cancer and LCS, higher risk perceptions of lung cancer, and stronger LCS health beliefs. However, social influence was identified as a barrier to LCS participation. These findings underscore the need for early interventions targeted at addressing these specific factors to enhance disease prevention efforts and promote the importance of participating in LCS to individuals. Earlier diagnosis and treatment of lung cancer will ultimately lead to reductions in health care burdens to individuals and society.

Ethics statement

The research was approved by the institutional review boards of Fujian Medical University (IRB No. FM2021097) and written informed consent was obtained from all participants.

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CRediT authorship contribution statement

Yu-An Lin: Formal analysis, Writing-Original draft. **Yong Lin Li**: Writing, editing. **Xiu Jing Lin**: Data collection. **Fang Fang Wang**: Writing, editing. **Rachel Arbing**: Writing editing. **Wei-Ti Chen**: Methodology, Writing-Supervision. **Fei Fei Huang**: Conceptualization, Methodology, Writing-Reviewing and Supervision. All authors had full access to all the data in the study, and the corresponding author had final responsibility for the decision to submit for publication. The corresponding author attests that all listed authors meet authorship criteria and that no others meeting the criteria have been omitted.

Declaration of competing interest

All authors have no conflicts of interest to declare. The corresponding author, Professor Feifei Huang, is a member of the editorial board of the *Asia-Pacific Journal of Oncology Nursing*. The article underwent the journal's standard review procedures, with peer review conducted independently of Professor Huang and their research groups.

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Data availability statement

The data that support the findings of this study are available from the corresponding author Feifei Huang, upon reasonable request.

Declaration of Generative AI and AI-assisted technologies in the writing process

No AI tools/services were used during the preparation of this work.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.apjon.2024.100402.

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