Mobile Low-Dose Computed Tomographic (LDCT) Scanning combined with Remote Reading: a feasible approach to lung cancer screening among rural population

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Research Article

Abstract

Background

Low-dose computed tomographic (LDCT) screening has been proven to be powerful in detecting lung cancers in early stage. However, it's hard to carry out in less-developed regions in lacking of facilities and professionals. The feasibility and efficacy of mobile LDCT scanning combined with remote reading by experienced radiologists from superior hospital for lung cancer screening in deprived areas was explored in this study.

Methods

A prospective cohort was conducted in rural areas of western China. Residents over 40 years old were invited for lung cancer screening by mobile LDCT scanning combined with remote image reading or local hospital-based LDCT screening. Rates of positive pulmonary nodules and detected lung cancers in the baseline were compared between the two groups.

Results

Among 8073 candidates with preliminary response, 7251 eligibilities were assigned to the mobile LDCT with remote reading ($n = 4527$) and local hospital-based LDCT screening ($n = 2724$) for lung cancer. Basic characteristics of the subjects were almost similar in the two cohorts except that the mean age of participants in mobile group was relatively older than control (61.18 $vs.$ 59.84 years old, $P < 0.001$). 1778 participants with mobile LDCT scans with remote reading (39.3%) revealed 2570 pulmonary nodules or mass, and 352 subjects in the control group (13.0%) were detected 472 ones ($P < 0.001$). Proportions of nodules less than 8 mm or subsolid were both more frequent in the mobile LDCT group (83.3% $vs.$ 76.1%, 32.9% $vs.$ 29.8%, respectively; both $P < 0.05$). In the baseline screening, 26 cases of lung cancer were identified in the mobile LDCT scanning with remote reading cohort, with a lung cancer detection rate of 0.57% (26/4527), which was significantly higher than control (4/2724 = 0.15%, $P = 0.006$). Moreover, 80.8% (21/26) of lung cancer patients detected by mobile CT with remote reading were in stage I, remarkedly higher than that of 25.0% in control (1/4, $P = 0.020$).

Conclusion

Mobile LDCT combined with remote reading is probably a potential mode for lung cancer screening in rural areas.

Trial registration

No. of registration trial was ChiCTR-DDD-15007586 (http://www.chictr.org).

Background

Lung cancer is the leading cause of cancer-related deaths (18% of the total cancer deaths) and the second commonly diagnosed cancer (11.4% of all cancer diagnoses) worldwide (1). During the past decades, the role of low-does computed tomography (LDCT) in reducing lung cancer-related mortality has become an evidence-based reality (2). NLST (National Lung Screening Trial) demonstrated a reduction in the lung-cancer mortality with LDCT screening of about 20% as compared with that in the radiography group; while NELSON (Nederlands-Leuvens Longkanker Screenings Onderzoek) showed a decreasing death cumulative rate ratio from lung cancer by 34% with LDCT screening (3, 4).

Typically, CT scanners are installed in hospitals-based centers with abundant medical resources, which causes part population unable to obtain examinations due to geographic and socioeconomic factors (5). In the rural areas of Western China, the contradiction between lung cancer screening requirements and the present capability-limited technology has become increasingly conspicuous. Mobile low-dose computed tomographic (LDCT), which is transferable, potentially makes the lung cancer screening more convenient (6). The mobile lung cancer screening program in the West London, UK, suggested that although there was no difference in the attendance for participants who were invited to the hospital-fixed or mobile CT sites, the greater distances to the mobile scanner may have deterred some potential participants (7). In addition, the Manchester Lung Health Check program of UK, which delivered mobile lung cancer screening to socioeconomically disadvantaged communities, also emphasized the importance of screening location (8, 9). In another study in the United States, mobile LDCT was used for uninsured individuals and the result showed that the initial cancer detection rate was comparable to that reported in the NLST (10). The mobile CT might provide an opportunity for lung cancer screening in deprived areas.

Beyond scanning by transferable mobile CT, image reading and interpretation was another problem in effective lung cancer screenings. In an investigation to assess the influence of clinical skills to the interreader variability of submillisievert CT for lung cancer screening, six radiologists with different degrees of experience were invited to interpret the CT scans randomly. The overall interobserver agreement between all readers was only moderate, and the reading time for each scan varied from 7 seconds to 7 minutes and 45 seconds, significantly correlated with reader-experience (11). In rural areas, the lack of professional and technical team makes medical security difficult. With the development of telemedicine, remote film reading or consultation based on information technology support extends the superior medical service (12).

A Health Benefit Program for the rural population in Western China, mainly depending on mobile inspections and remote image reading, was launched and funded by West China Hospital of Sichuan University, China in July 2020. This is a prospective cohort study including kinds of chronic diseases, for example, lung cancer, hypertension, osteoarthritis and so on, among natural rural population with long-time follow ups.

Regarding the pulmonary nodule and lung cancer screening cohort, based on the positive results of the famous NLST and NELSON, individuals who are at high risk of lung cancer, such as elderly heavy tobacco consumers, are the common target population (3, 13, 14). However, lung cancer in young never smokers, who are not at high risk of lung cancer, increased notably (15). In another pulmonary nodule real-world study launched by our group in outpatients since 2018, before the current prospective research, 63.07% of all subjects with positive pulmonary nodules were non-high-risk population of lung cancer, and the lung cancer detection rate in this group in the first two and half years was even 19.30%, which was significantly higher than that in the high-risk cohort (15.73%, P = 0.037). Additionally, nearly 90% of the detected lung cancer patients were aged over 40 years old (data is under review for publication).

Therefore, in the current study, volunteers over 40 years old, no matter with smoking or other risk factors or not, were included. The aim of this study was to explore the feasibility and efficacy of the operation mode, mobile CT scanning combined with remote reading by experienced radiologists from superior hospital, in lung cancer screening in rural regions. Here, the initial result in one pilot site, Mianzhu in Sichuan Province of China, was reported.

Materials And Methods

Participants Enrollment

The ethical approval of this Health Benefit Program was obtained from the ethics committee of West China Hospital, Sichuan University, China (No. 2018 – 491) and the number of clinical registration trial was ChiCTR-DDD-15007586 (http://www.chictr.org). The first phase of this program was carried out in Mianzhu, Sichuan, between July 2020 and September 2020. Mianzhu is a representative of rural area in western China; and other pilot sites include Longquan, Ganzi and Guangan, where the screenings are being or will be ongoing.

Ever rural residents in Mianzhu over 40 years old were invited for the current lung cancer screening by the local government. Candidates should be in a relatively fine condition to undergo further examinations when necessary. Anyone who had received a thoracic CT in the previous six months or had suffered from a pneumonectomy for lung cancer or any other lung diseases was excluded. Eligible participants were invited to a check appointment at the Mianzhu people's Hospital, Sichuan, China, which is the largest public hospital in this area. Subjects, whose informed consents had been obtained, were assigned to the mobile LDCT with remote image reading or local hospital-based LDCT screening according to the real-time situation of the hospital, and the hospital-based LDCT scanning was conducted after the routine medical work of the hospital.

Health Check, LDCT Scan and Management Protocol

The Health Benefit Program comprised a brief consultation covering basic demographic information, complications, smoking status and family history of lung cancer. Current smokers were defined as adults who had smoked more than 100 cigarettes without smoking cessation within three months. Former smokers were those smoking over 100 cigarettes but had given up smoking at least three months. Never smokers indicated individuals never smoking or had smoked fewer than 100 cigarettes in their lifetime (16).

After finishing the questionnaire, participants were invited for chest CT scanning. The mobile LDCT was donated by Neusoft Corporation with 128 slices; and the local hospital-based LDCT was SIEMENS SOMATOM Definition. Scanning mode and parameters were unified in both of the two groups, with the voltage of 120 kv and radiation dose as low as udder 1 mSv. Chest images included the whole lung, from apices to bases, at the maximum inspiration without contrast medium administration. The slice thickness was 5 mm for lung windows (window width 1200, level – 600) and mediastinal window (window width 350, level 50). There were also high-resolution images in 1 mm of slice thickness (window width 1800, level – 400). Images were sent to Picture Archiving and Communication Systems (PACS) for interpretating. The mobile LDCT scanning and image remote reading were managed by doctors with at least five years' clinical experience from West China Hospital of Sichuan University, one of the top hospitals national wide in China; whereas the local hospital-based screening and image interpretation was operated by doctors in the local hospital.

Positive findings indicated: 1) non-calcified solid pulmonary nodules no less than 5 mm in diameter (If the diameter over 30 mm, mass was named); 2) Subsolid pulmonary nodule no less than 2 mm, which were divided into pure ground glass nodules (pGGN) and mixed ground glass nodules (mGGN) according to the Fleischner guideline (17). 3) Other abnormalities of clinical significance, such as atelectasis, pleural effusion, consolidation, endotracheal lesions, mediastinal lesions, and even extrathoracic lesions, were also collected. The maximum diameter, location, lobulation, spiculation of pulmonary nodules or mass were recorded, and subjects were stratified based on the evaluation with the widely accepted Mayo model (18). If the malignant probability was over 65%, the participant was classified as high risk; anyone with the malignant probability between 5% and 65% was moderate; and the rest less than 5% was low (19). Other abnormalities of clinical significance were all in high risk; while the negative results were regarded as low risk.

The management protocol was in accordance with the lung cancer guideline of China, which was also consistent with National Comprehensive Cancer Network (NCCN) guideline of lung cancer (19, 20). Participants with high risk scans were required to the lung cancer specialists for assessing further invasive investigations. Individuals with moderate risk were referred to the regular LDCT scans at three months, six months or other intervals based on the guideline. The remaining low-risk subjects were recommended annual follow-up. An electronic database was developed for all of the clinical and radiologic data collection and storage based on cloud computing.

In case of lung cancer diagnosed, the histopathological diagnosis was in line with the World Health Organization (WHO) criterion, and the TNM stage classification was according to the Eighth Edition of International Association for the Study of Lung Cancer (IASLC) International Staging Project (21).

The primary endpoint of this study in the baseline screening was the lung cancer detection rate; while rate of positive pulmonary nodules and the clinical stage of lung cancer cases were the second endpoints.

Statistical analysis

Characteristics distribution, such as age, sex and smoking status, between the mobile LDCT with combined remote reading and local hospital-based LDCT screening cohorts was compared by Chi square test categorical factors (Fisher's exact tests when necessary). The comparison of the mean age was tested by Student's t test. Differences were regarded as statistically significant when P value was less than 0.05 in the SPSS version 22.0 (SPSS Inc., USA).

Results

Characteristics of the Study Participants

A total of 8073 residents preliminarily agreed to join in this program, with 389 ones abandoning later. For the 7684 participants, 359 under 40 years old and 15 ones receiving pneumonectomy were excluded. 7310 were eligible, but 59 failed in completing questionnaires. Among the 7251 eligibilities, 4527 were assigned to the mobile LDCT scanning, while the rest 2724 were screened by local hospital-based LDCT screening. The follow-up of participants in this trial was shown in Fig. 1. Females were predominant in both cohorts (63.8% vs. 85.8%, $P = 0.079$), and more than 75% were never smokers without significant difference in tobacco consumption ($P = 0.558$). However, the mean age of subjects having mobile LDCT scanning was older than that of control (61.18 vs. 59.84 years old, $P < 0.001$) and the proportion of cases over 60 years were also higher (54.8% vs. 48.3%, $P < 0.001$). Distribution of harmful occupational exposure, complications with chronic lung diseases and family history of lung cancer were all similar in the two groups (all $P > 0.05$). More details were displayed in Table 1.

Table 1
Baseline Characteristics of the Study Participants

Variables	Mobile LDCT with remote reading (n = 4527)		Local hospital-based LDCT screening (n = 2724)		P
	n	%	n	%	
Gender					
Male	1641	36.2	932	34.2	0.079
Female	2886	63.8	1792	65.8	
Age/years					
Mean	61.18		59.84		< 0.001*
40–49	614	13.6	440	16.2	< 0.001*
50–59	1432	31.6	968	35.5	
60–69	1511	33.4	845	31	
70–79	948	20.9	455	16.7	
≥ 80	22	0.5	16	0.6	
Smoking status					
Current smoker	770	17	453	16.6	0.558
Former smoker	346	7.6	192	7	
Never smoker	3411	75.3	2079	76.3	
Harmful Occupational Exposure					
Yes	332	7.3	196	7.2	0.826
No	4195	92.7	2528	92.8	
Chronic Lung Diseases, such as COPD					
Yes	41	0.9	17	0.6	0.425
No	4435	98	2677	98.3	
NA	51	1.1	30	1.1	
Family History of Lung Cancer					
Yes	84	1.9	41	1.5	0.267
No	4443	98.1	2683	98.5	
*: significant difference.					
COPD: chronic obstructive pulmonary disease.					
NA: not available.					

Positive Findings in the Study Participants

As shown in Table 2, at the baseline screening, positive findings were detected in 1786 cases in the mobile LDCT with remote reading group, with a proportion of 39.5%; whereas only 13.0% (355/2724) controls were found to have clinically significant abnormalities. The positive finding rate in mobile scanning with remote reading was much higher than that of local hospital-based LDCT screening (P < 0.001).

Table 2
Positive Detections in the Study Participants

Variables	Mobile LDCT with remote reading (n = 4527)		Local hospital-based LDCT screening (n = 2724)		P
	n	%	n	%	
Cases with positive findings					
	1786	39.5	355	13.0	< 0.001*
Positive Pulmonary Nodules or Mass					
Individuals	1778	39.3	352	13.0	< 0.001*
No. of nodules or mass	2570	-	472	-	
Diameter					
≤ 7 mm	2140	83.3	359	76.1	0.003*
8−20 mm	353	13.7	93	19.7	
21−30 mm	43	1.7	11	2.3	
≥ 31 mm	34	1.3	9	1.9	
Density					
pGGN	765	29.7	108	22.9	< 0.001*
mGGN	81	3.2	6	1.3	
Solid	1724	67.1	358	75.8	
Other positive findings					
Atelectasis	4	50.0	0	0	0.030*
Endotracheal Lesions	3	37.5	0	0	
Mediastinal Lesions	0	0	2	66.7	
Extrathoracic Lesions	1	12.5	1	33.3	
*: significant difference.					

For the pulmonary nodule or mass detection, 1778 participants with mobile LDCT scans with remote reading (39.3%) revealed 2570 nodules or mass, and 352 subjects in the control group (13.0%) were detected 472 nodules or mass ($P < 0.001$). In the study group, 83.3% (2140/2570) of positive nodule or mass were less than 8 mm, much more frequent than 76.1% (359/472) of control. Accordingly, constituent ratio of mass over 30 mm was relatively lower in the mobile group (1.3% vs. 1.9%, $P = 0.003$). With the density, 32.9% of mobile LDCT detected nodules or masses were subsolid, including 29.8% (765/2570) pGGNs. This was noticeably more than that of control (subsolid 24.2% and pGGN 22.9%; $P < 0.001$).

Other positive detections, such as atelectasis, endotracheal lesions and even extrathoracic lesions, were also different ($P = 0.030$).

Risk Stratification of Participants and Lung Cancer Detected in the Baseline Screening

As shown in Table 3, depending on artificial interpretation with exceeding 65% chance of malignancy, 207 participants in the mobile LDCT with remote reading were identified to be at high risk (4.6% out of 4527). Meanwhile, only 27 subjects (1.0% out of 2724) in the local hospital-based LDCT scanning were regarded as high risky, with a significant difference ($P < 0.001$).

Table 3
Risk Stratification of Participants and Detected lung cancer in the Study Participants

Variables	Mobile LDCT with remote reading (n = 4527)		Local hospital-based LDCT screening (n = 2724)		P
	n	%	n	%	
Risk stratification of participants					
High risk	207	4.6	27	1.0	< 0.001*
Moderate risk	547	12.1	269	9.9	
Low risk	3773	83.3	2428	89.1	
Detected lung cancer					
	26	0.57	4	0.15	0.006*
Gender					
Male	7	26.9	2	50.0	0.348
Female	19	73.1	2	50.0	
Age/years					
Mean	63.96		66.75		0.551
40−49	1	3.8	0	0.0	0.433
50−59	7	26.9	0	0.0	
60−69	9	34.6	3	75.0	
70−79	9	34.6	1	25.0	
Clinical Stage					
I	21	80.8	1	25.0	0.020*
II	1	3.8	1	25.0	
III	2	7.7	0	0.0	
IV	0	0.0	1	25.0	
NA	2	7.7	1	25.0	
Histopathological types					
ADC	22	84.6	3	75.0	0.500
SCC	2	7.7	1	25.0	
SCLC	0	0.0	0	0.0	
Others	2	7.7	0	0.0	
*: significant difference.					
ADC: Adenocarcinoma.					
SCC: Squamous cell carcinoma.					
SCLC: small cell lung cancer.					

All high-risk individuals were referred to lung cancer specialists. A total of 26 cases of lung cancer were identified in the mobile group, with a detected lung cancer rate of 0.57% (26/4527). Meanwhile, only four participants (0.15%, 4/2724) were diagnosed with lung cancer in control. The lung cancer detection rate of mobile LDCT scanning with remote reading was significantly higher than that of control group (P< 0.001). 30.7% (8/26) of detected lung cancer patients in the mobile cohort was younger than 60 years old, even though there was no statistical significance in age (P = 0.433). Moreover, 80.8% (21/26) of lung cancer patients detected by mobile scanning with remote reading were in stage I; however, there was only one patient (1/4 = 25.0%) in stage I in control. Mobile LDCT scanning, combined with remote reading, might be powerful in detecting early stage of lung cancer (P = 0.020). Additionally, most detected lung cancers were adenocarcinoma (84.6% vs. 75.0%, P = 0.500) without

statistical significance of histopathological types, as well as sex distribution (*P* = 0.348). Detailed information of detected lung cancer patients was summarized in Table 4.

Table 4
Clinical and Pathological Details of the Participants with Lung Cancer Detected

ID	Group (M or H)#	Sex	Age	Smoking	Occupational Exposure	Chronic Lung Diseases	Family History of Lung Cancer	TNM	Clinical Stage	Histopatholo-gical Types	Treatment
1	M	Female	75	Never	No	No	No	T3N3M0	IIIC	SCC	Chemotherapy
2	M	Male	78	Never	No	No	No	T1bN0M0	IA2	ADC	Surgery
3	M	Female	55	Never	No	No	Yes	T3N2M0	IIIB	SCC	Surgery + Chemotherapy
4	M	Female	62	Never	No	No	No	T2N0M0	IB	ADC	Surgery
5	M	Female	63	Never	No	No	No	T1cN0M0	IA3	Sarcomatoid carcinoma	Surgery
6	M	Female	55	Never	No	No	No	T1aN0M0	IA1	ADC	Surgery
7	M	Female	66	Never	No	No	No	T2aN1M0	IIA	ADC	Surgery
8	M	Female	71	Never	Yes	No	No	T1bN0M0	IA2	ADC	Surgery
9	M	Female	70	Never	No	No	No	T1cN0M0	IA3	ADC	Surgery
10	M	Female	70	Never	No	No	No	T1cN0M0	IA3	ADC	Surgery
11	M	Male	78	Current	No	No	No	NA	NA	ADC	NA
12	M	Female	71	Never	No	No	No	T1cN0M0	IA3	ADC	Surgery
13	M	Male	69	Current	No	No	No	T1cN0M0	IA3	ADC	Surgery
14	M	Male	66	Former	No	No	No	T2N0M0	IB	ADC	Surgery
15	M	Female	56	Never	No	No	No	T1bN0M0	IA2	ADC	Surgery
16	M	Female	51	Never	No	No	No	T1bN0M0	IA2	ADC	Surgery
17	M	Female	58	Never	No	No	No	T1bN0M0	IA2	ADC	Surgery
18	M	Female	66	Never	No	No	No	NA	NA	NA	Surgery + Chemotherapy
19	M	Male	71	Never	No	No	No	T1bN0M0	IA2	ADC	Surgery
20	M	Female	65	Never	No	No	No	T1aN0M0	IA1	ADC	Surgery
21	M	Male	75	Current	No	No	No	T1bN0M0	IA2	ADC	Surgery
22	M	Female	52	Never	No	No	No	T2aN0M0	IB	ADC	Surgery
23	M	Female	62	Never	No	No	No	T1aN0M0	IA1	ADC	Surgery
24	M	Female	63	Never	No	No	Yes	T1aN0M0	IA1	ADC	Surgery
25	M	Female	51	Never	No	No	No	T1cN0M0	IA3	ADC	Surgery
26	M	Male	44	Current	No	No	No	T1bN0M0	IA2	ADC	Surgery
27	H	Female	67	Never	No	No	No	T2aN0M0	IB	ADC	Surgery
28	H	Male	71	Current	No	No	No	T3N0M0	IIB	ADC	Surgery
29	H	Male	65	Former	No	No	No	NA	IV	SCC	Chemotherapy
30	H	Female	64	Never	No	No	No	NA	NA	ADC	Targeted therapy

M: mobile LDCT with remote reading; H: Local hospital-based LDCT screening.

NA: not available.

Discussion

Annual LDCT screening has been identified to be helpful in detecting lung cancer in early stage (4, 22, 23) and is widely performed in developed countries or regions (2, 24–26). However, it is hard to carry out in less-developing rural areas due to the lack of equipment and professional technicians. Mobile LDCT breaks the limitation that conventional CT scanners must be fixed in hospital and it offers a probability to conduct screening trial in rural areas. However, image reading and interpretation was also a key step in lung cancer screening. Clinical skill for image interpretation has been proven to be an important factor affecting the results of lung cancer screening (11). The initial results of lung cancer screening by mobile LDCT combined with remote reading by experienced radiologist, compared with local hospital-based LDCT scanning and interpretation in Mianzhu, a rural area of western China, were reported. As far as we know, this is the first prospective cohort study to explore the feasibility and availability about mobile LDCT with remote reading in lung cancer screening in rural areas. Detection rates of positive pulmonary nodules or mass and lung cancer cases in the baseline in mobile cohort were both much higher, suggesting that mobile and remote unit might be a novel approach for lung cancer screening among rural population.

Volunteers permanently resided in Mianzhu and over 40 years old were invited, which were remarkably different from other lung cancer screening trials (4, 13, 24, 27). Several studies had revealed that lung cancer incidence increases with advancing age. People beyond 40 years old seemed to be more likely to develop lung cancer (28, 29), which prompted us to recruit participants over 40 years in the current study. In addition, it is generally believed that smoking is the main cause of lung cancer. However, more and more lung cancer patients without tobacco consumption have been identified (30, 31). Among 12176 Korean nonsmokers, 55 cases of lung cancer were detected by LDCT scanning. Although the lung cancer detection rate in nonsmokers was lower than smokers (0.45% $vs.$ 0.86%, $P < 0.05$), their survival was estimated much better. LDCT screening in the never-smoking population was recommended (16). Accordingly, subjects in this investigation were not constrained to smoking. Voluntary participants over 40 years old, smoking or not, were invited.

Regarding the screening result, 39.5% of all individuals receiving mobile LDCT showed positive findings. This was slightly higher than the positive rate of 27.3% in NLST (13). For the Dutch-Belgian randomized lung cancer screening trial NELSON, only 2.6% of participants had a positive result in the first round of screening (32), which were remarkably lower than ours. In this study, only non-calcified solid nodules with a volume of > 500 mm^3 were regarded as positive. However, in our study, subsolid pulmonary nodule, including pGGN and mGGN, no less than 2 mm were also classified as positive. GGN has aroused more and more attentions recently. The malignant probability of GGN were even higher than solid nodules in spite of very small diameter (33, 34). The broad-spectrum criteria probably caused more positive results in the current research. Additionally, high-resolution images in 1 mm of slice thickness were obtained, which were supplemented based on the regular lung windows and mediastinal window in 5 mm of slice thickness. This might be another reason that the positive findings of the current investigation were more frequent than those reported.

The primary endpoint of the baseline screening was the detected lung cancer rate. In the mobile LDCT scanning with remote reading group, 26 cases of lung cancer (0.57%) were diagnosed. This was relatively lower than reported results. For NLST and NELSON, the lung cancer detection rate in the first screening was 1.1% and 0.9% respectively (13, 32). The recruited participants in these two trials were heavy smokers, while more than 75% of the population in our study never smoked. Subjects had fewer lung cancer risk factors might decline the detection rate of lung cancer to certain extent. However, the proportions of lung cancer in stage I (80.8%) and adenocarcinoma (84.6%) were higher than the baseline results in NLST (58.3% of patients in stage I, 44% of lung cancer were adenocarcinoma). These differences were probably attributed to the different screening criteria as well.

Compared with local hospital-based LDCT, the finding rate of positive nodules in mobile LDCT with remote reading was exceeding. General characteristics of the two groups were almost similar except that participants undergoing mobile LDCT screening were a bit older. Age is considered to be an important factor involved in the number of nodules (35, 36). The probability of developing lung cancer also increased with aging (37). Moreover, the abundant clinical experience of radiologists from West China Hospital Sichuan University in pulmonary nodule interpretation might be another explanation for the difference of the screening results in the two cohorts.

Conclusion

In view of the initial results with significant demonstration of both positive detections and lung cancer diagnosis, mobile LDCT scanning with remote reading is probably a potential option for lung cancer screening in rural areas. This might be helpful in alleviating the weakness of facilities and experience in distant regions for lung cancer screening.

Declarations

- **Ethics approval and consent to participate:** This study conformed to the Declaration of Helsinki and was approved by the Ethics Committee of West China Hospital, Sichuan University, China.

Abbreviations

LDCT
Low-Dose Computed Tomographic;
NLST
National Lung Screening Trial;
NELSON
Nederlands-Leuvens Longkanker Screenings Onderzoek;
PACS
Picture Archiving and Communication Systems;
pGGN
pure ground glass nodules;
mGGN
mixed ground glass nodules;
NCCN
National Comprehensive Cancer Network;
WHO
World Health Organization;
IASLC
International Association for the Study of Lung Cancer.

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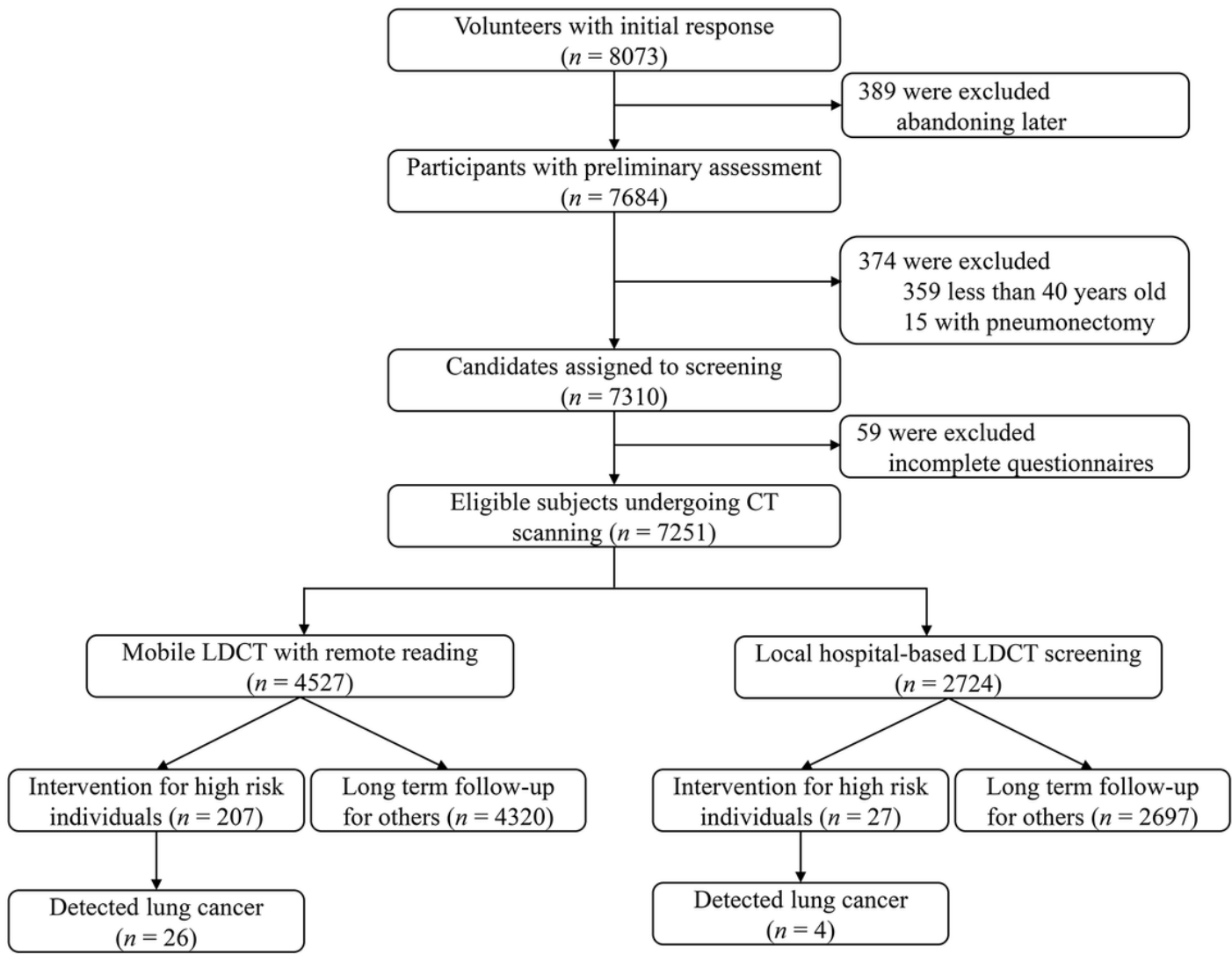
Figures

Figure 1

Participants flow of the screening cohort.