

REVIEW ARTICLE

# Lung Cancer Screening in Asians and Asian Americans Who Have Never Smoked: A Scoping Review

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**Introduction:** A growing trend of lung cancer diagnoses is occurring among Asians and Asian Americans who have never smoked, driving increased interest in implementing lung cancer screening (LCS) in this population. Current data, however, remain insufficient to support such efforts. This scoping review summarizes studies evaluating LCS using low dose computed tomography (LDCT) among Asians and Asian American nonsmokers, reporting lung cancer detection rates and highlighting the heterogeneity across studies that limits the generalizability of results.

**Method:** A scoping review was conducted of studies from East Asia and the United States that utilized LDCT to screen for lung cancer among Asians and Asian Americans or a subset of these populations. Data on study design, screening eligibility criteria, screening protocols, and primary outcomes, including lung cancer detection rates and stages, were extracted and summarized descriptively.

**Results:** A total of 1,334 studies published during 2003–2025 were identified. Of these, 28 met inclusion criteria and originated from Taiwan, Korea, Japan, China, and the United States. Among eight studies that included only Asian and Asian American individuals, four were prospective and four were retrospective. Twenty studies which included both smokers and Asian and Asian American participants were comprised of one randomized control trial, nine prospective, and ten retrospective studies. Substantial variation was observed in definitions of smoking status, screening eligibility criteria (including age thresholds), LDCT protocols, and nodule reporting and follow-up practices. Among the 28 studies, 24 reported lung cancer detection rates in the range of 0.05–4.1% among Asians and Asian Americans who had never smoked.

**Conclusions:** Although several studies have evaluated LCS using LDCT in Asians and Asian Americans who have never smoked, marked heterogeneity across study designs and protocols limits the ability to synthesize findings or draw meaningful conclusions. This review underscores these gaps and may inform the design and focus of future studies to guide evidence-based LCS recommendations for this population.

**Key Words:** lung cancer ■ small cell lung carcinoma ■ non-small cell lung carcinoma ■ diagnosis ■ screening, low dose computed tomography ■ Asian ■ Asian American ■ literature review

While cigarette smoking remains the leading risk factor for lung cancer, approximately 20% of lung cancer deaths in the United States occur in individuals who have never smoked.<sup>1</sup> This proportion is even higher in Asia, especially among women.<sup>2</sup> Lung cancer is increasingly recognized to disproportionately impact Asian and Asian American women who have never

smoked.<sup>3</sup> One study suggests that Asians who have never smoked may face a risk of developing lung cancer comparable to that of high-risk smokers.<sup>4</sup> However, these findings are difficult to interpret as the true incidence of lung cancer in individuals who have never smoked remains unclear due to the lack of smoking status data in most cancer registries.

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### POPULAR SCIENTIFIC SUMMARY

- Lung cancer diagnoses are increasing among Asian and Asian American nonsmokers, but screening rates remain low because clear guidelines for early detection are lacking. This scoping review of literature published across East Asia and the United States during 2003–2025 sought to track trends in lung cancer detection rates among Asian and Asian American nonsmokers who were screened with low-dose computed tomography.
- In the 28 studies that included both of these populations, results varied widely with detection rates ranging from 0.05 to 4.1%. Each study differed in the use of standardized terminology, study protocols, and screening frequency, highlighting the need for clear guidelines to support screening in Asian and Asian American nonsmokers.

Moreover, no established guidelines exist in Asia or the U.S. for lung cancer screening (LCS) using low dose computed tomography (LDCT) for Asians and Asian Americans who have never smoked. This gap largely stems from the fact that although LDCT screening has demonstrated survival benefits among populations with a significant smoking history,<sup>5</sup> similar benefits have yet to be shown in Asians and Asian Americans who have never smoked. In addition, although race and sex are associated with lung cancer risk in Asians and Asian Americans who have never smoked, other contributing risk factors remain poorly understood.<sup>3</sup> As a result, identifying the best candidates for screening continues to be a major challenge.

This challenge is evident in the differing approaches to screening taken by several Asian countries and in the U.S. In Asia, LDCT is both affordable and commonly used for routine health screening, allowing for opportunistic screening. However, broad inclusion is known to lead to over screening and overdiagnosis.<sup>6</sup> In contrast, current U.S. guidelines from the United States Preventive Services Task Force (USPSTF) are more conservative. Studies indicate that over 75% of lung cancers in Asian populations in the U.S. are missed.<sup>7,8</sup> Given that Asians and Asian Americans are among the largest and most diverse racial populations both in the U.S. and globally, there is a need for LCS guidelines tailored to Asians and Asian Americans who have never smoked.<sup>9,10</sup>

The first step in achieving this goal is to understand the patterns and gaps in the existing literature. In this scoping review, studies on LCS using LDCT in Asians and Asian Americans who have never smoked were assessed to detect trends in lung cancer detection rates, report study findings as related to the study populations, and to offer recommendations for future research.

## METHODS

### Systematic literature search

Comprehensive searches of PubMed, Embase, Web of Science, and Scopus databases were iteratively developed using defined search terms and tested prior to conducting final searches (Supplemental Table 1). Inclusion and exclusion criteria were developed and tested prior to final article selection. Title and abstract screening followed by full text screening were performed by two independent reviewers. Included studies were those with primary data in either abstract form or full-text manuscripts that reported lung cancer detection rates in Asian and Asian American populations receiving LDCT (Table 1). Selected literature was limited to studies conducted in the U.S. and East Asia as several East Asian countries have implemented opportunistic screening programs and provide available data on never smoking populations.<sup>4</sup> When overlapping study populations were identified, only the larger or more comprehensive study was included.

Once a data extraction form was developed and tested, two independent reviewers extracted data. Dispute resolution during screening and data extraction was achieved by discussion between reviewers prior to final data extraction. Literature was collected with Zotero (version 7.0, open source) reference management software and imported into Covidence systematic review software for article selection and data extraction. During data extraction, the following information was recorded: (1) details of publication (first author, year, region, study period, and study design); (2) screening eligibility and interval; (3) details of smoking (smoking status included and percentage of never or non-smokers); (4) demographics (mean age and gender); (5) family history of lung cancer; and (6) outcomes (positive screen, total lung cancer, or invasive cancer and stage 0–4).

**Table 1. Study Inclusion and Exclusion Criteria**

Inclusion criteria
Screening performed by CT or low-dose CT
A non-smoking population must be identified in the population studied
Must include a defined Asian population
Exclusion criteria
Screening performed by chest x-ray or other non-CT imaging modality
Non-smoker or never smokers were not identified within the population
Not in English
Editorials, review articles, case reports, perspectives, editorials, and commentaries

**Abbreviations:** CT = computed tomography.

## RESULTS

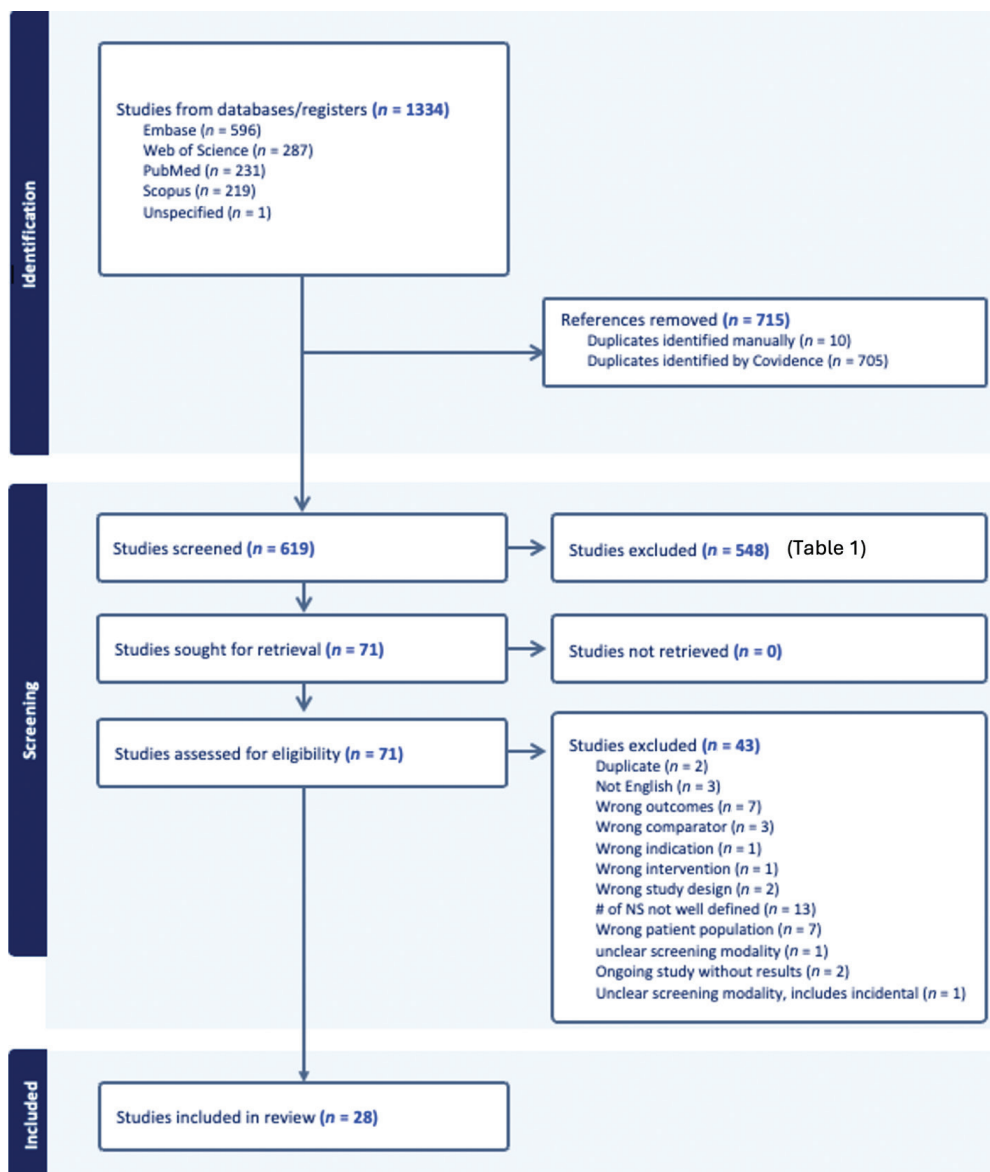
Based on the search criteria, a total of 1,334 studies published during 2003–2025 were identified of which 71 articles were reviewed in detail and 28 studies selected for the final analysis in accordance with the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines<sup>11</sup> (Figure 1). Of the final included studies, most were conducted in East Asia, including the countries of Taiwan, Korea, Japan, and China, with only one originating from the U.S. Notably, the U.S. study enrolled participants of Asian descent without specifying their regional origins.<sup>12</sup> Among the eight studies that focused exclusively on individuals who have never smoked,<sup>12–19</sup> four were

prospective and four were retrospective (Table 2). Of the 20 studies that included both smokers and Asian and Asian American non-smokers in their screening populations,<sup>20–39</sup> one was a randomized controlled trial, nine were prospective studies, and 10 were retrospective studies (Table 3).

### Smoking status

In most of the studies, never-smoking status was not clearly defined,<sup>14–17,20,21,23–33,36,38,39</sup> although some studies defined never-smokers as having never smoked or having smoked fewer than 100 cigarettes in a lifetime.<sup>12,13,18,19,22,34,35,37</sup>

**Figure 1. Literature Selection Flow Diagram.**



**Abbreviations:** NS = never smokers.

\*Table 1 lists inclusion and exclusion criteria.

**Table 2. Scoping Review Data from Studies Including Only Never-Smokers**

Inclusion criteria and protocol		Demographics				Results									
Author	Region	Study period	Age, yrs	LDCT interval	N	Age, mean	Male/Female (%)	FHx LC (%)	Positive screen (%)	Total lung cancer (%)	Invasive cancer (%)	Stage 0-1 (%)	Stage 2 (%)	Stage 3 (%)	Stage 4 (%)
<b>Study design: Prospective</b>															
Li <sup>13</sup> 2025	Hong Kong	2024	50-75	Once	273	62	181/273 (66.3)	273 (100)	NA	NA	3/273 (1.1)	NA	NA	NA	NA
Liu <sup>14</sup> 2024	Taiwan	2023	40-74	Once every 3 years	13,446	NA	NA	NA	949/13,446 (7.1)	74/13,446 (0.6)	NA	NA	NA	NA	NA
Shum <sup>12</sup> 2023	USA	2021-2023	40-74	Annual	201	56.8	201/201 (100)	83/201 (41.3)	13/201 (6.5)	NA	3/201 (1.5)	0/3 (0)	2/3 (66)	1/3 (33)	0/3 (0)
Yang <sup>15</sup> 2018	Taiwan	2014-2018	55-75	Annual	10,397	61.2	7,703/10,397 (74.1)	4,449/10,397 (42.8)	NA	243/10,397 (2.3)	198/10,397 (1.9)	231/243 (stage I only) (95.1)	4/243 (1.6)	3/243 (1.2)	5/243 (2.1)
<b>Study design: Retrospective</b>															
Kim <sup>16</sup> 2018	Korea	2002-2007	40-79	Initial only	4,365	51.1	4,365/4,365 (100)	NA	NA	22/4,365 (0.5)	NA	18/22 (81.8)	0/22 (0)	0/22 (0)	2/22 (9.0)
Kim <sup>18</sup> 2025	Korea	2009-2021	50-80	Once	21,062	59.8	16,133/21,062 (76.6)	2,423/21,062 (11.5)	1,291/21,062 (6.1)	176,21,062(0.8)	NA	164/176 (93.2)	4/176 (2.3)	5/176 (2.8)	3/176 (1.7)
Lee <sup>19</sup> 2024	Korea	2002-2022	NA	At least once	216,618	NA	NA	NA	203/216,618 (0.09)	With FH 31/14,156 (0.2) No FH 172/202,462 (0.08)	NA	NA	NA	NA	NA
Kim <sup>17</sup> 2023	Korea	2009-2021	50-80	Opportunistic	13,084	NA	9,849/13,084 (75.3)	NA	2,513/13,084 (19.2)	128/13,084 (1.0)	NA	111/128 (86.7)	NA	NA	NA

**Abbreviations:** FHx LC = family history of lung cancer; FH = family history; MIA = minimally invasive adenocarcinoma; NS = never smokers; py = pack years; LDCT = low dose computed tomography.

**Table 3. Scoping Review Data from Studies Including Never-Smokers and Smokers**

Inclusion criteria and protocol				Demographics				Results								
Author	Region	Study Period	Age, yrs	LDCT interval	N, total	Age, yrs	Female (%)	Never smoker (%)	FHxLC (%)	Positive screen (%)	Total lung cancer (%)	Invasive cancer (%)	Stage 0-1 (%)	Stage 2 (%)	Stage 3 (%)	Stage 4 (%)
<b>Study design: Randomized control trial</b>																
<b>Rong<sup>39</sup> 2022</b>	China	2019	50-74	3 total LDCT at varying time intervals	600	59.1	189/600 (31.5)	185/600 (30.8)	11/600 (1.8)	131/600 (21.8)	11/600 (1.8)	MIA 2/600 (0.3) Invasive adenocarcinoma 4/600 (0.7)	10/11 (90.9)	0/11 (0)	1/11 (9.1)	0/11 (0)
											Female NS 7/170 (4.1) Smokers 4/415 (1.0)	NS MIA 1/600 (0.2) Invasive adenocarcinoma 2/600 (0.3)	NS 7/11 (63.6)			
<b>Study design: Prospective</b>																
<b>Chang<sup>30</sup> 2024</b>	Taiwan	2015-2019	55-75	Annual for 2 years, biannual for 6 years	12,011	61.2	8,868/12,011 (73.8)	11,201/12,011 (93.3)	6,009/12,011 (50.0)	2,094/12,011 (17.4)	318/12,011 (2.6)	257/12,011 (2.1) MIA 79/12,011 (0.7) Invasive adenocarcinoma 177/12,011 (1.5) Adenosquamous 1/12,011 (0.008)	307/318 (96.5)	3/318 (0.9)	3/318 (0.9)	5/318 (1.6)
<b>Li<sup>23</sup> 2022</b>	China	2013-2018	High risk score 40-74	Once	79,581	56.1	40,295/79,581 (50.6)	31,991/79,581 (40.2)	43,659/77,111 (56.6)	NA	531/79,581 (0.7) NS 161/31,991 (0.5)	NA	244/389 (62.7)	27/389 (6.9)	59/389 (15.2)	59/389 (15.2)
<b>Shao<sup>26</sup> 2022</b>	China	2021	NA	Once	12,360	58.1	8,169/12,360 (66.1)	9,784/12,360 (79.2)	329/12,360 (2.7)	9,511/12,360 (77.0)	86/12,360 (0.7) NS 66/9,784 (0.7)	NA	73/86 (84.9)	6/86 (7.0)	5/86 (5.8)	2/86 (2.3)

**Table 3. (Continued) Scoping Review Data from Studies Including Never-Smokers and Smokers**

Inclusion criteria and protocol			Demographics					Results								
Author	Region	Study Period	Age, yrs	LDCT interval	N, total	Age, yrs	Female (%)	Never smoker (%)	FHxLC (%)	Positive screen (%)	Total lung cancer (%)	Invasive cancer (%)	Stage 0-1 (%)	Stage 2 (%)	Stage 3 (%)	Stage 4 (%)
<b>Kakinuma<sup>22</sup> 2020</b>	Japan	2004- 2012	≥40	Annual	12,114	NS 57.9	4,820/ 12,114 (39.8)	6,021/ 12,114 (49.7)	NA	5,155/ 12,114 (42.6)	133/ 12,114 (1.1)	45/ 12,114 (0.4)	NA	NA	NA	NA
			Smoking 58.2				NS 66/ 6,021 (1.1)	NS-MIA 22/6,021 (0.4)	Invasive adenocarcinoma 23/6,021 (0.4)	Smokers- MIA 19/6,090 (0.3)	Invasive adenocarcinoma 25/6,090 (0.4)	53/54 (stage I-II) (98.1)	1/54 (1.9)	0/54 (0)	0/54 (0)	
<b>Shan<sup>25</sup> 2020</b>	China	2014- 2017	≥40	Once	9,084	55	3,885/ 9,084 (42.8)	4,102/ 9,084 (45.2)	157/ 9,084 (1.7)	NA	54/ 9,084 (0.6)	NA	53/54 (stage I-II) (98.1)	1/54 (1.9)	0/54 (0)	0/54 (0)
						NS 1,912/ 4,102 (46.6)	NS 97/ 4,102 (2.4)	NS 20/ 4,102 (0.5)	NS 179/ 8,392 (2.1)	NS 167/ 7,509 (2.2)	131/ 8,392 (1.6)	174/ 179 (97.2)	2/179 (1.1)	2/179 (1.1)	1/179 (0.6)	
<b>Zhang<sup>29</sup> 2020</b>	China	2012- 2018	All ages	Once	8,392	NA	5,908/ 8,392 (70.4)	7,509/ 8,392 (89.5)	NA	NA	179/ 8,392 (2.1)	131/ 8,392 (1.6)	174/ 179 (97.2)	2/179 (1.1)	2/179 (1.1)	1/179 (0.6)
<b>Wu<sup>28</sup> 2016</b>	Taiwan	2013- 2014	>40	Once	1,763	Male 55.5	734/ 1,763 (41.6)	1,074/ 1,763 (60.9)	297/ 1,763 (16.8)	64/ 1,763 (3.6)	25/ 1,763 (1.4)	NA	22/25 (88.0)	2/25 (8.0)	0/25 (0)	1/25 (4.0)
			Female: 57									NS 23/ 1,515 (1.5)	NS 13/28,687 (0.05)	NS 5/9,405 (0.05)	11/13 (84.6)	0/13 (0)
<b>Nojo<sup>24</sup> 2009</b>	Japan	2000- 2007	40-59	Annual	28,687	NA	NA	9,405/ 28,687 (32.8)	NA	NA	13/28,687 (0.05)	NA	11/13 (84.6)	0/13 (0)	1/13 (7.7)	0/13 (0)

**Table 3. (Continued) Scoping Review Data from Studies Including Never-Smokers and Smokers**

Inclusion criteria and protocol				Demographics						Results							
Author	Region	Study Period	Age, yrs	LDCT interval	M, total	Age, yrs	Female (%)	Never smoker (%)	FHXLC (%)	Positive screen (%)	Total lung cancer (%)	Invasive cancer (%)	Stage 0–1 (%)	Stage 2 (%)	Stage 3 (%)	Stage 4 (%)	
<b>Chong<sup>21</sup> 2005</b>	Korea	1999–2003	≥45	At least once	6,406	55	876/ 6,406 (13.7)	1,472/ 6,406 (23.0)	NA	2,255/ 6,406 (35.2)	23/ 6,406 (0.4)	NA	13/23 (56.5)	1/23 (4.3)	5/23 (21.7)	2/23 (8.7)	
<b>Study design: Retrospective</b>																	
<b>Tang<sup>37</sup> 2024</b>	China	2006–2022	≥ 18	Opportunistic	30,468	48.9	13,864/30,468 (45.5)	21,426/ 30,468 (70.3)	4,936/3 0,468 (16.2)	11,749/ 30,468 (38.6)	289/ 30,468 (0.9)	NA	NA	Ever 73.8%	NA	Ever 8.8% (Stage III or IV)	
<b>Wang<sup>38</sup> 2024</b>	China	2017–2020	20–80	Once	42,028	NA	17,437/42,018 (41.5)	32,595/ 42,018 (77.6)	NA	1,119/ 42,018 (2.7)	258/ 42,018 (0.6)	NA	NA	225/ 258 (87.2)	9/258 (3.5)	11/ 258 (4.3)	
<b>Im<sup>32</sup> 2023</b>	Korea	2008–2018	NA	NA	59,094	NA	NA	23,089/ 59,094 (39.1)	NA	NA	763/ 59,094 (1.3)	NA	NA	NA	NA	NA	
<b>Wang<sup>37</sup> 2023</b>	China	2013–2019	High risk- score40–74	Once	11,521	NA	3,997/ 11,521 (34.7)	3,636/ 11,521 (31.6)	4,560/1 1,521 (39.6)	NA	197/ 11,521 (1.7)	NA	NA	114/ 197 (57.9)	NA	NA	
<b>Hamaguchi<sup>30</sup> 2021</b>	Japan	2009–2019	≥40	At least once	25,189	NA	NS 3,636/ 3,636 (100)	NA	NA	82/ 25,189 (0.3)	NA	NA	NA	60/82 (73.2)	8/82 (9.8)	Ever 3/82 (3.7)	
																NS 37/41 (90.2)	NS 1/41 (2.4)
																	NS 0/41 (0)

**Table 3. (Continued) Scoping Review Data from Studies Including Never-Smokers and Smokers**

Inclusion criteria and protocol		Demographics						Results								
Author	Region	Study Period	Age, yrs	LDCT interval	M, total	Age, yrs	Female (%)	Never smoker (%)	FHxLC (%)	Positive screen (%)	Total lung cancer (%)	Invasive cancer (%)	Stage 0-1 (%)	Stage 2 (%)	Stage 3 (%)	Stage 4 (%)
<b>Kim<sup>35</sup> 2020</b>	Korea	2009-2018	≥ 18	Opportunistic	37,436	49.5	13,609/37,436 (36.4)	17,968/ 37,436 (48.0)	NA	6,066/ 37,436 (16.2)	207/ 37,436 (0.6)	NA	159/ 207 (76.8)	Ever 8/123 (6.5)	Ever 11/123 (8.9)	Ever 16/123 (13.0)
							NS 2,908/ 17,968 (16.2)	NS 84/ 17,968 (0.5)	NS 75/84 (89.3)	NS 3/84 (3.6)	NS 3/84 (3.6)	NS 3/84 (3.6)				
<b>Hsu<sup>31</sup> 2018</b>	Taiwan	2013-2014	40-80	Once	1,978	56.6	894/ 1,978 (45.2)	1,440/ 1,978 (72.8)	404/ 1,978 (20.4)	74/ 1,978 (3.7)	32/ 1,978 (1.6)	26/1,978 8 (1.3)	29/32 (90.6)	2/32 (6.3)	0/32 (0%)	1/32 (3.1)
							NS 30/ 1,440 (2.1)	MIA 6/1,978 (0.3)	Invasive adenocarcinoma 20/1,978 8 (1.0)	NS 135/ 28,807 (0.5)	NS 142/ 198 (71.7)	Ever 12/ 143 (8.4)	Ever 15/ 143 (10.5)	Ever 25/ 143 (17.5)		
<b>Kang<sup>24</sup> 2018</b>	Korea	2003-2016	NA	Once	28,807	52.1	29.5	12,176 (42.2)	NA	NA	198/ 28,807 (0.7)	135/ 28,807 (0.5)	142/ 198 (71.7)	Ever 12/ 143 (8.4)	Ever 15/ 143 (10.5)	Ever 25/ 143 (17.5)
							NS 55/ 12,176 (0.5)	Invasive adenocarcinoma 11/ 12,176 (0.09)	NS 51/55 (92.7)	NS 2/55 (3.6)	NS 0/55 (0)	NS 2/55 (3.6)				

**Table 3. (Continued) Scoping Review Data from Studies Including Never-Smokers and Smokers**

Inclusion criteria and protocol			Demographics					Results								
Author	Region	Study Period	Age, yrs	LDCT interval	N, total	Age, yrs	Female (%)	Never smoker (%)	FHxLC (%)	Positive screen (%)	Total lung cancer (%)	Invasive cancer (%)	Stage 0-1 (%)	Stage 2 (%)	Stage 3 (%)	Stage 4 (%)
Ju <sup>33</sup> 2013	Korea	2006-2011	>55	Once	1,587	62.7	495/ 1,587 (31.2)	1,092/ 1,587 (68.8)	NA	336/ 1,587 (21.1)	8/336 (2.3)	NA	5/8 (62.5)	0/8 (0)	1/8 (12.5)	1/8 (12.5)
Li <sup>36</sup> 2003	Japan	1996-1999	NA	At least once LDCT in 3 years (some had annual scans)	7,847	NS 64.2	3,559/ 7,847 (45.4)	4,251/ 7,847 (54.2)	NA	NS 218/ 1,092 (20.0)	NS 4/218 (1.8)	NA	NS 3/4 (75.0)	NA	NA	NA

**Abbreviations:** FHxLC = family history of lung cancer; F/U = Follow up; MIA = minimally invasive adenocarcinoma; NS = never smokers; py = pack-years; LDCT = low dose computed tomography.

### Age

The age range for screening eligibility varied across studies; most included individuals aged 40-74 years, though some did not specify age criteria.<sup>19,26,32,34,36</sup> Notably, one study offered screening to participants of all ages,<sup>29</sup> and three studies included individuals aged 18 years.<sup>35,37,38</sup>

### Risk factors

Risk factors used to determine screening eligibility also differed across studies. Two studies recruited only women of Asian descent.<sup>12,16</sup> A family history of any cancer or specifically lung cancer<sup>13-15,20,23,25,26,28,37,39</sup> as well as a personal history of breast cancer,<sup>14</sup> were considered in some studies. A history of chronic lung diseases, particularly pulmonary tuberculosis or chronic obstructive pulmonary disease was used as a qualifying factor in several studies.<sup>15,20,23,26,28,37</sup>

Information on occupational exposures, including asbestos, rubber, dust, pesticides, radiation, beryllium, uranium, and radon, were also collected to estimate their impact on lung cancer risk.<sup>23,37,39</sup> Long-term exposure to workplace pollution<sup>14,37</sup> and self-reported exposure to particulate matter<sup>23</sup> were also included in some risk profiles. Several studies assessed cooking index or considered cooking without ventilation.<sup>14,15,20,39</sup> One study used a specific risk score developed for participant Asians and Asian Americans who have never smoked to determine eligibility. The risk score uniquely considered not only environmental exposures but also lifestyle choices as well as family history.<sup>23</sup> Three studies incorporated serum biomarkers alongside screening.<sup>12,15,22</sup>

### Low-dose computed tomography protocol protocol

Screening interval varied across studies and was largely dependent on the duration of the study period. Most studies implemented a one-time LDCT or conducted screening at least once during the study period<sup>13,14,16,18-21,23,25-31,33,34,36,38,39</sup> while others performed annual screening throughout the study<sup>12,15,22,24</sup> or offered opportunistic screening.<sup>17,35,37</sup> One study implemented annual screening for 2 years, followed by biannual screening for 6 years.<sup>20</sup> Variability in screening interval led to inconsistent follow-up definitions across the studies, which prevented determining time from screening to diagnosis.<sup>12,21</sup> While some studies reported a mean or median follow-up duration, the corresponding endpoints were unclear<sup>16-18,23,24,27,28,31-33,37</sup> and others did not specify any followup.<sup>13,14,15,22,29,30,34-36,38,39</sup> Importantly, imaging protocols varied widely; some studies reported both collimation and slice thickness parameters,<sup>21,30,33</sup> whereas several did not specify any imaging parameters.<sup>20,34</sup>

## Screening outcomes

Positive screening results were often defined as the presence of a non-calcified nodule measuring equal to or greater than 4 mm in diameter, consistent with criteria from the U.S. based multi-center National Lung Cancer Screening Trial (NLST), funded by the National Cancer Institute/National Institutes of Health<sup>2,12,14,18,28,31,35,38,39</sup> However, definitions of positive scans varied across studies including varying nodule size thresholds;<sup>1,15,22,25,33,34,37</sup> some studies did not specify or report rates of positive scans.<sup>13,16,19,23,24,29,30,32,36</sup>

Pulmonary nodules detected through screening were generally classified and managed according to the Lung Imaging Reporting and Data System (Lung-RADS), a standardized classification system recognized internationally, using the most current version at the time of publication in each study;<sup>16–18,20,31,33–35</sup> other studies did not specify classification methods<sup>12,14,15,19,21–26,28,29,32,36–39</sup> one study applied the guidelines from the Japanese Society of computed tomography (CT) Screening,<sup>30</sup> and two studies used artificial intelligence–based software for nodule evaluation.<sup>13,26</sup>

Among the 28 studies, 24 reported lung cancer detection rates among Asians and Asian Americans who have never smoked, which ranged from 0.05 to 4.1%.<sup>24,39</sup> Twelve of these studies<sup>15,20,22,25,27,29,31–33,36,39</sup> reported rates comparable to or higher than those observed in the NLST trial.<sup>5</sup> Most detected cases were Stage 0–1 lung cancers, with only a few diagnosed at stage 3 or 4 (Tables 2 and 3). Studies included varying subtypes of invasive adenocarcinomas across studies, with only some studies considering minimally invasive adenocarcinoma as its own classification,<sup>15,18,20,22,29,31,34,39</sup> whereas others did not specify invasive cancer rates.<sup>14,23–28,37,38</sup> None of the included studies reported mortality rates.

## DISCUSSION

This scoping review included 28 studies of LCS with low-dose computed tomography (LDCT) in Asians and Asian Americans who have never smoked. The existing literature is marked by substantial heterogeneity, including variations in screening inclusion criteria, use and reporting of terminology (e.g. a consistent definition of never-smoker), utilization of varying screening LDCT protocols and screening intervals, follow-up reporting, and histologic stratification and staging, all of which limit meaningful comparisons and data pooling. Despite these limitations, this review of the literature highlights the comparable lung cancer detection rates among Asians and Asian Americans who have never smoked as compared with smokers,<sup>5</sup> reinforcing the clinical relevance.

The Taiwan Lung Cancer Screening in Never-Smoker Trial (TALENT) was the largest to demonstrate high lung cancer detection rates among Asians who have never smoked.<sup>20</sup> The results of 1-year follow up after the LDCT screening revealed a lung cancer detection rate of 2.6% in Asians who have never smoked, which is notably higher than the 1.1% observed in the U.S.-based NLST in high-risk individuals who smoked.<sup>5,20</sup> A 2024 meta-analysis further contextualized and expanded upon the TALENT findings by comparing lung cancer risk between Asians and Asian American who have never smoked and those with a history of smoking. The analysis revealed that female individuals who have never smoked had comparable pooled-lung cancer incidence compared with individuals with a history of smoking.<sup>4</sup>

Despite elevated lung cancer detection rates, the mortality benefits (i.e. reduction in death rates through detection and intervention) of LCS among Asians and Asian Americans who have never smoked remain unclear. Current decision-making relies largely on population-based observational studies that are not sufficiently designed or powered to demonstrate mortality benefit. However, of the 28 studies, we identified one randomized controlled trial,<sup>39</sup> which evaluated LCS in Asians and Asian Americans who have never smoked. Participants aged 50–75 years with at least one risk factor, including  $\geq 30$  pack-years of smoking with  $< 15$  years since quitting,  $\geq 20$  years of passive smoking exposure, or a family history of lung cancer in never-smokers, were randomized into three groups: no intervention; LDCT at baseline, 1 year, and 2 years; and LDCT at baseline, 1 year, and 3 years. The study reported a lung cancer detection rate of 4.1% among never-smoking females with passive smoke exposure compared with 1.0% in current smokers.<sup>39</sup> While notable as the only apparent published RCT to date focused on Asians and Asian Americans who have never smoked, its small sample size and lack of defined follow-up limit the ability to assess mortality benefit. In the absence of demonstrated mortality benefit, advocating for screening in a historically low-risk population continues to be a major challenge. However, recent evidence has shown that an absolute reduction in late-stage cancers correlates with reduced lung cancer mortality, suggesting that stage distribution may serve as a surrogate endpoint for future studies.<sup>40</sup>

Additional concerns regarding LCS in Asians and Asian Americans who have never smoked are overdiagnosis and lead time bias (i.e. the perception that screening may have prolonged survival). A study using data from the Taiwan Cancer Registry found that after the implementation of screening in never-smoking Asian women, the incidence of early-stage lung cancer increased more than sixfold, while the rate of advanced-stage cancers remained unchanged.<sup>6</sup> This pattern is consistent with this review's findings that most screen-

detected cancers were diagnosed at early stages (Tables 2 and 3), which suggests that LCS in this population may not have a mortality benefit. However, the prevalence of minimally invasive and invasive adenocarcinomas remains a concern and will require longer follow-up to better understand the natural history. The indolent nature of early-stage adenocarcinoma has raised the possibility of lead-time bias. Yet, emerging evidence suggests that adenocarcinoma may not always follow a predictable, stepwise progression; some lesions may behave more aggressively and unpredictably.<sup>41</sup> In addition, the wide variability in invasive cancer detection rates across studies highlights the potential value of refining risk stratification among individuals who have never smoked. For example, one study enrolled Asians and Asian Americans who have never smoked with at least one of the following risk factors: family history of lung cancer, passive smoke exposure, history of tuberculosis or chronic obstructive pulmonary disease, a cooking index  $\geq 110$  (i.e. prolonged exposure to cooking fumes), or cooking without ventilation. This group demonstrated an invasive lung cancer detection rate of 1.9%.<sup>15</sup>

Studies underway are beginning to investigate the unique biology, genetics, and clinical behavior of lung cancer in the never smoking population.<sup>4</sup> In parallel, several prediction models tailored for screening individuals who have never smoked are being developed and validated.<sup>42–47</sup> These ongoing efforts can strengthen the rationale for screening the never smoking population. In the U.S., the Female Asian Never Smokers (FANS) Study seeks to identify risk factors for lung cancer among Asian American women who have never smoked.<sup>48</sup> Complementing this effort, the Female Asian Never Smokers Screening Study (FANSS) is assessing lung cancer detection rates in Asian and Asian American women who have never smoked and has reported a 1.5% invasive cancer detection rate in preliminary findings.<sup>12</sup> These initiatives may help refine screening strategies and inform future guidelines for this understudied population.

## Recommendations

To enhance the generalizability of future studies, consensus is needed on the definitions of never-smokers, screening eligibility criteria, and LDCT protocols and frequency. Incorporating smoking status into large cancer registries will also be essential for accurately estimating lung cancer incidence among never-smokers and for providing more robust evidence to support current findings. Finally, large randomized controlled trials remain the gold standard for assessing mortality benefit, although their implementation is challenging due to substantial cost and time requirements.

## CONCLUSION

With growing evidence of lung cancer among Asians and Asian Americans who have never smoked, concerns have emerged regarding the adequacy of current LCS paradigms, which primarily target individuals with a history of smoking. This scoping review of the current literature on screening in Asians and Asian Americans who have never smoked highlights the considerable heterogeneity across these studies, which hinders our ability to accurately assess specific screening needs of these populations. Ongoing efforts to standardize terminology, LDCT protocols, and screening frequency are critical and represent an essential first step toward generating robust evidence to support screening in these populations.

## ARTICLE INFORMATION

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