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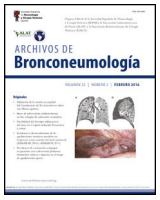

Scientific Letter

Estimate of the Eligible Population for Lung Cancer Screening in Galicia: An Analysis of Potential Scenarios

To the Director,

Lung cancer remains a significant public health challenge due to its high incidence and mortality, and despite advances in diagnosis and treatment, its survival rate remains low compared to other cancers.[1] Low-dose CT screening has been shown to reduce mortality, as demonstrated in studies such as the NLST[2] in the United States (US) and the NELSON study[3] in Europe. However, the effectiveness of the inclusion criteria may vary by context. In Spain, for example, the USPSTF screening criteria (used in the US to establish the eligibility criteria in the US and like those on the NELSON study) would only detect 63.5% of lung cancer cases, with even lower detection rates in women.[4] These disparities suggest the need to evaluate and potentially adapt international screening criteria to fit local contexts, taking also into account how these criteria may impact the feasibility of the program. This study aims to estimate the population eligible for a lung cancer screening program in Galicia (Spain) by applying international eligibility criteria and exploring different scenarios.

To estimate the eligible population, we used data from the 2018 Galician Risk Behavior Data System (SICRI) and the 2022 Municipal Voters Roll from the Instituto Galego de Estatística (IGE). SICRI-2022 is a telephone-based survey conducted on 7853 individuals aged 16 years and older, collecting detailed sociodemographic and smoking information. This dataset enabled us to estimate the prevalence of smokers and ex-smokers by health area, age group, and sex.

Eligibility for lung cancer screening was assessed using the 2013 and 2021 USPSTF guidelines, focusing on smoking in pack-years, the period of smoking abstinence (in ex-smokers). Additionally, three broad age ranges were considered, 50–80 years, 55–80 years and 65–80 years. These factors were combined into twelve scenarios (four for each age range). To determine the number of individuals meeting the smoking criteria by health area, sex, and age group, we estimated the proportion of daily smokers with more than 20 or 30 pack-years using data from the SICRI survey, applying these proportions to the population of Galicia using the Municipal Voters Roll. For ex-smokers, given that the SICRI survey did not collect daily consumption, we used current smokers' data to calculate pack-years. ROC curves were then applied to estimate the minimum number of years of smoking required to meet the 20- or 30-pack-year criteria. This estimate was applied to the Galician population. Three different participation rates (40%, 60%, and 80%) were considered. We also estimated the required number of LDCT scanners to support the program. Each scanner was assumed to operate over 250 working days per year, with a scanning capacity of 40 patients per day (equivalent to 10,000 scans per year). Statistical analyses were conducted using Stata v.17.

The analysis showed significant variability in the number of subjects eligible for lung cancer screening in Galicia depending on the tobacco consumption and smoking cessation criteria applied, as well as the age range. Using the loosest screening criteria—defined as including individuals aged 50–80 years who are current or former smokers with more than 20 pack-years and, in the case of ex-smokers, less than 15 years of abstinence—a total of 249,099 persons across Galicia would be eligible for screening. In contrast, the strictest screening criteria—defined as including individuals aged 65–80 years who are current or former smokers with more than 30 pack-years and, for ex-smokers, less than 10 years of abstinence—reduce the eligible population to 53,931 individuals. These results were detailed by health area in Table 1.

With an assumed participation rate of 60%, the number of screened individuals would be approximately 149,459 under the loosest criteria and 32,358 under the strictest criteria. For example, under the loosest scenario, Vigo and A Coruña are projected to have 32,936 and 30,650 participants, while Pontevedra would have approximately 13,082 participants. Conversely, using the strictest criteria, Vigo and A Coruña would be reduced by 83% and 80% respectively, and Pontevedra by 70% (Table 2).

In terms of the number of low-dose CT scanners necessary to support the screening program, under the scenario using the loosest criteria (i.e., >20 pack-years and <15 years of abstinence for ex-smokers, and an age range of 50–80 years), the screening volume would require over three CT scanners in major regions—for instance, 3.1 scanners in A Coruña and 3.3 in Vigo. However, applying the strictest criteria (i.e., >30 pack-years and <10 years of abstinence for ex-smokers, with an age range of 65–80 years) would significantly reduce the demand for scanners, with estimates of 0.5 scanners for A Coruña and 0.7 for Vigo. Practically, under this strict scenario, A Coruña could manage its screening needs with one CT scanner operating at 20 tests per day over a full year or 40 tests per day over a six-month period. Overall, the total number of dedicated CT scanners needed by the Galician Health Service would vary based on the screening criteria chosen—from an estimated 14.9 scanners under the loosest criteria to 3.2 scanners under the strictest criteria.

This study is the first to estimate the number of lung cancer screening candidates coupled with scanner needs in a specific region using real data and a bottom-up strategy. The findings reveal that the number of eligible individuals varies significantly based

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Table 1
Total Number of Subjects Eligible to Participate in Screening, According to the Loosest, Intermediate and Strictest Criteria, by Age Group, for Galicia as a Whole and by Health Area.

Criteria	Age	Galicia		A Coruña		Ferrol		Lugo		Ourense		Pontevedra		Santiago		Vigo	
		n	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Loosest criterion: <15 years and >20 py	50–80	249,099	22.9%	51,084	22.9%	22,081	27.8%	30,361	22.1%	29,017	22.1%	21,803	18.3%	39,860	22.3%	54,893	24.8%
Intermediate criterion: <10 years and >20 py	50–80	216,767	19.9%	44,970	20.2%	19,369	24.4%	25,603	18.6%	25,161	19.2%	19,132	16.1%	35,635	19.9%	46,897	21.2%
Intermediate criterion: <15 years and >30 py	50–80	215,238	19.7%	42,467	19.1%	18,328	23.1%	27,385	19.9%	24,169	18.4%	19,492	16.4%	35,329	19.8%	48,068	21.7%
Strictest criterion: <10 years and >30 py	50–80	191,116	17.5%	38,454	17.3%	16,246	20.4%	23,488	17.1%	21,509	16.4%	17,971	15.1%	31,860	17.8%	41,587	18.8%
Loosest criterion: <15 years and >20 py	55–80	188,827	21.5%	37,461	21.1%	16,664	25.5%	23,625	21.0%	22,017	20.3%	17,027	18.1%	30,555	21.3%	41,479	23.7%
Intermediate criterion: <10 years and >20 py	55–80	157,986	18.0%	31,308	17.6%	14,157	21.7%	18,748	16.6%	18,701	17.2%	14,357	15.2%	26,505	18.5%	34,211	19.6%
Intermediate criterion: <15 years and >30 py	55–80	171,724	19.6%	32,502	18.3%	14,672	22.4%	22,748	20.2%	19,694	18.1%	15,494	16.5%	28,029	19.5%	38,586	22.1%
Strictest criterion: <10 years and >30 py	55–80	148,167	16.9%	28,461	16.0%	12,735	19.5%	18,748	16.6%	17,147	15.8%	13,973	14.8%	24,700	17.2%	32,402	18.5%
Loosest criterion: <15 years and >20 py	65–80	68,608	14.1%	12,454	12.6%	5868	16.0%	9355	14.9%	8025	12.7%	7923	15.3%	9827	12.5%	15,158	15.9%
Intermediate criterion: <10 years and >20 py	65–80	55,248	11.3%	9873	10.0%	4610	12.6%	6881	11.0%	6390	10.1%	6438	12.5%	8645	11.0%	12,411	13.1%
Intermediate criterion: <15 years and >30 py	65–80	67,040	13.8%	11,220	11.4%	5533	15.1%	9355	14.9%	8025	12.7%	7923	15.3%	9827	12.5%	15,158	15.9%
Strictest criterion: <10 years and >30 py	65–80	53,931	11.1%	8890	9.0%	4275	11.6%	6881	11.0%	6390	10.1%	6438	12.5%	8645	11.0%	12,411	13.1%

[a] py: pack-years. The percentages indicate the proportion of the eligible population out of the total population of the corresponding age group and health care.

Table 2
Number of Subjects Who Would Fulfill the Inclusion Criteria for Participating in Lung Cancer Screening, in the Event of an 80%, 60% or 40% Participation Rate, by Age Group and Health Area.

		A Coruña			Ferrol			Lugo			Ourense			Pontevedra			Santiago			Vigo		
Criteria	Age	80%	60%	40%	80%	60%	40%	80%	60%	40%	80%	60%	40%	80%	60%	40%	80%	60%	40%	80%	60%	40%
Loosest criterion: <15 years and >20 py	50–80	40,867	30,650	20,433	17,665	13,249	8832	24,289	18,217	12,144	23,213	17,410	11,607	17,442	13,082	8721	31,888	23,916	15,944	43.915	32.936	21.957
Intermediate criterion: <10 years and >20 py	50–80	35.976	26,982	17,988	15,495	11,622	7748	20,482	15,362	10,241	20,129	15,096	10,064	15,306	11,479	7653	28,508	21,381	14,254	37,517	28,138	18,759
Intermediate criterion: <15 years and >30 py	50–80	33,974	25,480	16,987	14,662	10,997	7331	21,908	16,431	10,954	19,335	14,501	9668	15,594	11,695	7797	28,263	21,197	14,131	38,455	28,841	19,227
Strictest criterion: <10 years and >30 py	50–80	30,763	23,072	15,381	12,997	9747	6498	18,791	14,093	9395	17,208	12,906	8604	14,377	10,783	7189	25,488	19,116	12,744	33,270	24,952	16,635
Loosest criterion: <15 years and >20 py	55–80	29,969	22,477	14,985	13,331	9998	6665	18,900	14,175	9450	17,613	13,210	8807	13,621	10,216	6811	24,444	18,333	12,222	33,183	24,887	16,591
Intermediate criterion: <10 years and >20 py	55–80	25,046	18,785	12,523	11,325	8494	5663	14,999	11,249	7499	14,961	11,220	7480	11,486	8614	5743	21,204	15,903	10,602	27,368	20,526	13,684
Intermediate criterion: <15 years and >30 py	55–80	26,001	19,501	13,001	11,738	8803	5869	18,198	13,649	9099	15,755	11,816	7878	12,395	9296	6197	22,423	16,817	11,211	30,869	23,152	15,434
Strictest criterion: <10 years and >30 py	55–80	22,768	17,076	11,384	10,188	7641	5094	14,999	11,249	7499	13,718	10,288	6859	11,179	8384	5589	19,760	14,820	9880	25,922	19,441	12,961
Loosest criterion: <15 years and >20 py	65–80	9963	7472	4981	4694	3521	2347	7484	5613	3742	6420	4815	3210	6338	4754	3169	7861	5896	3931	12,126	9095	6063
Intermediate criterion: <10 years and >20 py	65–80	7898	5924	3949	3688	2766	1844	5505	4129	2753	5112	3834	2556	5150	3863	2575	6916	5187	3458	9929	7447	4965
Intermediate criterion: <15 years and >30 py	65–80	8976	6732	4488	4427	3320	2213	7484	5613	3742	6420	4815	3210	6338	4754	3169	7, 861	5896	3931	12,126	9095	6063
Strictest criterion: <10 years and >30 py	65–80	7112	5334	3556	3420	2565	1710	5505	4129	2753	5112	3834	2556	5150	3863	2575	6916	5187	3458	9929	7447	4965

[a] py: pack-years.

on screening criteria such as smoking history and years of abstinence. Stricter criteria improve program effectiveness but reduce the number of detected cases, while looser criteria increase cases but also costs and false positives.[5]

Our results show that shifting from broad to strict criteria can reduce the number of candidates fivefold. These estimates are crucial for planning screening implementation, particularly in countries with universal healthcare, where resource allocation must not disrupt existing services. A key challenge is the availability of CT scanners and radiologists.

Our study benefits from reliable population data in a setting with universal healthcare coverage, ensuring that estimates reflect the entire eligible population. However, there are several limitations. First, the study lacks a detailed analysis on false positives and the subsequent resource implications of incidental findings, which are known to account for 20–50% of screening outcomes.[6–9] Second, the inclusion criteria did not include lung cancer risk factors other than tobacco use and age. Third, although the American Cancer Society recently recommended removing the years-since-quit threshold, aligning with the NELSON trial, which did not set such a limit. In Spain, this change would be relevant, as a national study found that 34.1% of diagnosed lung cancer cases would have been excluded due to quitting more than 15 years ago.[4] However, this study follows the criteria used in major European clinical trials and pilots, assuming Spain would adopt similar guidelines for implementation. Lastly, the estimates for CT scanners were based on clinician-reported data. However, the lack of data on existing scanners makes it not possible to assess the gap between required and available resources.

In conclusion, healthcare authorities should carefully decide on the inclusion criteria and allocate sufficient material and human resources before implementing lung cancer screening programs, while also integrating effective anti-smoking interventions for active smokers within these initiatives. It is worth mentioning that most lung cancer screening research is based on clinical trials rather than real-world data. Assessing real-life outcomes is crucial to refine initial predictions before expanding screening to the entire target population.

Author Contributions

CCP: Methodology, Formal analysis, Visualization, Writing-original draft. ARR: Conceptualization, Methodology, Supervision, Writing-review and editing. MISP: Methodology, Formal analysis, Writing-review and editing. RAO: Conceptualization, Writing-review and editing. AGA: Conceptualization, Writing-review and editing. CDP: Conceptualization, Writing-review and editing. LMG: Conceptualization, Writing-review and editing.

Ethical Considerations

As the data used in this study were drawn from public sources, there was no need for the approval of an ethics committee or the signing of informed consent.

Artificial Intelligence Involvement

The authors declare that no artificial intelligence software or tool was used for this paper.

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Conflicts of Interest

The authors declare that there are no conflicts of interest that are relevant to the publication of this paper.

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Cristina Candal-Pedreira[a,b,c], Alberto Ruano-Ravina[a,b,c,*], Q1
María Isolina Santiago-Pérez[d], Raquel Almazán Ortega[d],
Ángel Gómez-Amorín[d], Carmen Durán-Parrondo[d],
Lucía Martín-Gisbert[a,b]

[a] *Department of Preventive Medicine and Public Health, University of Santiago de Compostela, Santiago de Compostela, Spain*
[b] *Health Research Institute of Santiago de Compostela (Instituto de Investigación Sanitaria de Santiago de Compostela-IDIS), Santiago de Compostela, Spain*
[c] *Consortium for Biomedical Research in Epidemiology and Public Health (CIBER en Epidemiología y Salud Pública/CIBERESP), Madrid, Spain*
[d] *Regional Health Authority, Galician Regional Authority, Santiago de Compostela, Spain*

Corresponding author.
E-mail address: alberto.ruano@usc.es (A. Ruano-Ravina).