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Recent trends in COPD prevalence in Spain: a repeated cross-sectional survey 1997–2007

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ABSTRACT: We aimed to describe changes in the prevalence of chronic obstructive pulmonary disease (COPD) in Spain by means of a repeated cross-sectional design comparing two population-based studies conducted 10 yrs apart.

We compared participants from IBERPOC (*Estudio epidemiológico de EPOC en España*) (n=4,030), conducted in 1997, with those of EPI-SCAN (Epidemiologic Study of COPD in Spain) (n=3,802), conducted in 2007. Poorly reversible airflow obstruction compatible with COPD was defined according to the old European Respiratory Society definitions.

COPD prevalence in the population between 40 to 69 yrs of age dropped from 9.1% (95% CI 8.1–10.2%) in 1997 to 4.5% (95% CI 2.4–6.6%), a 50.4% decline. The distribution of COPD prevalence by severity also changed from 38.3% mild, 39.7% moderate and 22.0% severe in 1997, to 85.6% mild, 13.0% moderate and 1.4% severe in 2007, and in the 40–69 yr EPI-SCAN sub-sample to 84.3% mild, 15.0% moderate and 0.7% severe. Overall, underdiagnosis was reduced from 78% to 73% (not a significant difference) and undertreatment from 81% to 54% ($p<0.05$) within this 10-yr frame.

The finding of a substantial reduction in the prevalence of COPD in Spain is unexpected, as were the observed changes in the severity distribution, and highlights the difficulties in comparisons between repeated cross-sectional surveys of spirometry in the population.

KEYWORDS: Chronic obstructive pulmonary disease, EPI-SCAN, IBERPOC, prevalence, Spain

Chronic obstructive pulmonary disease (COPD) is a leading but under-recognised cause of morbidity and mortality worldwide. No other disease that is responsible for comparable burden worldwide is neglected by healthcare providers as much as COPD [1, 2]. The Global Burden of Disease Study from the World Health Organization has been systematically assessing worldwide statistics on mortality and prevalence by disease since 1990 [3], and their 30-yr projections for the global increase in COPD are startling. COPD is projected to move from its current fourth position to third in terms of morbidity, before 2020 [4, 5], mainly owing to the worldwide epidemic of smoking and the changing global demographics, with more people in developed and developing countries living longer and, therefore, being at risk of COPD for longer. Spain is currently experiencing an epidemiological transition. Although smoking prevalence in Spain is decreasing, current estimates still show one of the highest prevalences within Western Europe [6], estimated in 2006 as 30.0% of the adult population, that is 35.8% of males and 24.3% of females [7]. Additionally, the Spanish population is ageing, with a maximal growth expected by 2050 with 53 million inhabitants, and maximal ageing expected by 2060 [7]. Therefore, Spain is a country where the population burden of COPD, and other chronic conditions associated with smoking, are expected to surge in the coming years [8], although the recent reductions in overall smoking warrant a reassessment of these predictions. The available epidemiological data in Spain has been recently reviewed elsewhere [9]. The *Estudio epidemiológico de EPOC en España* (IBERPOC), a landmark prevalence survey conducted in 1997 [10], reported that 9.1% of the general Spanish population aged between 40 and 69 yrs had COPD [11]. IBERPOC was the first

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large population survey to use post-bronchodilator spirometry to ascertain the prevalence of COPD, and its results on underdiagnoses and undertreatment have also been identified in more recent international surveys elsewhere [12, 13]. The Epidemiologic Study of COPD in Spain (EPI-SCAN) is a new, more recent evaluation of the population distribution of COPD in Spain (fig. 1) [14], and recently reported that, currently, 10.2% of the general Spanish population aged between 40 and 80 yrs has COPD [15]. However, the comparison of the results of EPI-SCAN *versus* IBERPOC is not straightforward. By using the individual, patient-level data of these two studies, we report the changes in COPD prevalence in Spain in 1997 and 2007, and illustrate the difficulty of comparing population estimates of COPD measured by spirometry between different surveys.

METHODS

We applied a repeated cross-sectional study design to compare the COPD prevalences in Spain in 1997 and 2007. Both studies [10, 14] have been described in full elsewhere, and their main similarities and differences are compared in table 1. Briefly, on the one hand IBERPOC was a population survey conducted in seven areas of Spain in 1996–1997. The study randomly identified population participants aged 40–69 yrs, and invited them to perform pre- and post-bronchodilator spirometry. Recommendations for lung function and thresholds to define and stage COPD were determined according to the old European Respiratory Society (ERS) guidelines [20], and COPD was defined by a post-bronchodilator forced expiratory volume in 1 s (FEV_1) to forced vital capacity (FVC) ratio <88% predicted in males and <89% pred in females; similarly, COPD severity was staged as mild if FEV_1 was ⩾70% pred, moderate if FEV_1 was 50–69% pred and severe if FEV_1 was <50% pred. On the other hand, EPI-SCAN was another population survey conducted in 11 areas of Spain 10 yrs later [14]. The study randomly identified population participants aged 40–80 yrs, and also invited them to perform pre- and post-bronchodilator spirometry. Recommendations for lung function and thresholds to define and stage COPD were according to current Global Initiative for Chronic Obstructive Lung Disease (GOLD) guidelines [21]. So, COPD was defined by a post-bronchodilator ratio FEV_1/FVC <0.70, and severity was staged as mild if FEV_1 was ⩾80% pred, moderate if FEV_1 was 50–80% pred, severe if FEV_1 was 0–50% pred, and very severe if FEV_1 was <30% pred.

FIGURE 1. Map of Spain displaying the geographical distribution of participating centres for IBERPOC (*Estudio epidemiológico de EPOC en España*), 1997, and EPI-SCAN (Epidemiologic Study of COPD in Spain), 2007. ●: IBERPOC; ○: EPI-SCAN; and ■: both.

For the purpose of these analyses, the old ERS recommendations have been used to define and stage COPD [20], and the predicted reference values were re-calculated according to ROCA *et al.* [18] for the Spanish population. Comparison of IBERPOC results are presented with all, and with the subsample of 40–69-yr-old participants in EPI-SCAN. Participants reporting a previous asthma diagnosis were excluded from the analyses, as per the IBERPOC protocol [10].

Questions on previous medical diagnosis compatible with COPD, and on prescribed respiratory treatments, were the same/similar in both surveys and they were used to determine changes in underdiagnosis and undertreatment.

Both studies received approval by an ethics committee and all subjects provided written informed consent to participate in the studies [10, 14].

Statistical analysis

A descriptive and comparative analysis of sociodemographic and clinical variables between both study samples has been performed. The EPI-SCAN sample has been described including all subjects and defining the same age group (40–69 yrs) as the IBERPOC study. Data is presented as mean±SD for continuous variables, or percentage for qualitative variables, as appropriate. Prevalences are presented as percentages and their 95% confidence interval by sex, age and area. In order to compare the prevalences between studies, data from the EPI-SCAN study have been adjusted by age and sex using indirect standardisation. Differences within groups were compared with Chi-squared tests for categorical variables and unpaired t-tests for continuous variables. A p-value <0.05 was considered statistically significant.

RESULTS

A flowchart of participation according to IBERPOC is presented in figure 2. The demographic and clinical characteristics of both surveys are summarised in table 2. The characteristics of the subgroup of EPI-SCAN participants of age 40–69 yrs are presented as an additional column in table 2. When comparing this EPI-SCAN subgroup with the IBERPOC participants, they had no significant differences in the age and sex distribution. But, 2007 participants were taller (161.8 cm *versus* 164.7 cm) but with an identical mean body mass index of 27 $kg \cdot m^{-2}$, were more often current or ex-smokers, and more often had a higher degree of education (all $p<0.05$). The average smoking history in IBERPOC participants was 27.8±22.9, while in EPI-SCAN participants it was 26.0±21.5 pack-yrs; that is, very similar, although IBERPOC included older participants aged 70–79 yrs. Whenever those aged 70 yrs or older were excluded, smoking history went down to 24.4±19.9 pack-yrs ($p<0.001$; table 2). In the IBERPOC study, the average distribution of pack-yrs by centre ranged from the highest in Caceres (34.1±25.7) to the lowest in Manlleu (25.0±21.2 pack-yrs),

TABLE 1 Comparison of study designs, definitions and thresholds originally used in the 1997 and 2007 surveys

	IBERPOC, 1997 [11]	EPI-SCAN, 2007 [14]
Participating areas	Burgos, Cáceres, Madrid, Manlleu, Oviedo, Sevilla and Vizcaya	Barcelona, Burgos, Córdoba, Huesca, Madrid (two areas), Oviedo, Sevilla, Valencia, Vic and Vigo
Ages	40–69 yrs	40–80 yrs
Fieldwork	October 1996 to April 1997	May 2006 to July 2007
Sampling source	Random sample of the general population *via* census	Random sample of the general population *via* commercially available database
Exclusion criteria	Individuals reporting asthma, and those unable to conduct spirometry	Inability to conduct spirometry
Spirometer	DATOSPIR-200; Sibel S.A., Barcelona, Spain	Master Scope CT; VIASYS Healthcare, Hoechberg, Germany
Spirometry guidelines	ATS 1987 update [16]	ATS/ERS 2005 [17]
Reference values	ROCA *et al.* [18]	QUANJER *et al.* [19]
COPD definition	As per old ERS criteria of SIAFAKAS *et al.* [20]: a post-bronchodilator FEV_1/FVC <88% pred in males or <89% pred in females; or, in the few patients in whom bronchodilator testing had not been performed, an absolute FEV_1/FVC value <81% and FEV_1 <70% pred	As per current GOLD criteria, RABE *et al.* [21]: a post-bronchodilator FEV_1/FVC <0.70
Bronchodilator test	After two inhalations of salbutamol, and using an inhalation chamber, a difference between FEV_1 or FVC was >200 mL a nd its relative increase was >12%	As per PELLEGRINO *et al.* [22]: after two inhalations of salbutamol, an increase in FEV_1 and/or FVC ⩾12% of control and ⩾200 mL
COPD staging	Pre-bronchodilator FEV_1 Mild: ⩾70% Moderate: 50–69% Severe: <50%	Post-bronchodilator FEV_1 Mild: ⩾80% Moderate: 50–80% Severe: 30–50% Very severe: <30%

COPD: chronic obstructive pulmonary disease; IBERPOC: *Estudio epidemiológico de EPOC en España*; EPI-SCAN: Epidemiologic Study of COPD in Spain; ATS: American Thoracic Society; ERS: European Respiratory Society; GOLD: Global Initiative for Chronic Obstructive Lung Disease; FEV_1: forced expiratory volume in 1 s; FVC: forced expiratory volume; % pred: % predicted.

while in EPI-SCAN the average distribution by centre ranged from the highest in Vic (29.2±24.1) to the lowest in Huesca (22.3±18.9 pack-yrs). There were significant differences in all forced spirometry measurements. Mean FEV_1 was 87.8±17.0 *versus* 100.8±17.4% pred, and FVC was 88.4±14.6 *versus* 98.7±15.3% pred, in 1997 *versus* 2007, respectively. From now onwards, all comparisons with IBERPOC are based on the latter subgroup of EPI-SCAN aged 40–69 yr.

The prevalence of COPD according to the old ERS guidelines dropped from 9.1% (95% CI 8.1–10.2%) in 1997 to 4.5% (95% CI 2.4–6.6%) in 2007, that is, a 50.4% decline (fig. 3). The distribution of COPD prevalence by severity according to the old ERS criteria changed to a milder population distribution, from 38.3% mild, 39.7% moderate and 22.0% severe in 1997, to 85.6% mild, 13.0% moderate and 1.4% severe in 2007, and in the age 40–69 yrs EPI-SCAN sub-sample to 84.4% mild, 15.5% moderate and 2.2% severe (all $p<0.05$) (fig. 3). Interestingly, re-calculation of patient-level data, with all combinations of thresholds (old ERS and current GOLD) and restriction to the 40–69 yrs sample or all participants, would have produced a different interpretation of changes in prevalence and severity distribution among both surveys (additional columns in fig. 3).

The decline in COPD prevalence was observed in all age strata and in both sexes, except for a nonsignificant increase from 2.8% to 4.2% in COPD prevalence in 50–59-yr-old females ($p>0.05$) (fig. 4).

As five areas in IBERPOC were also surveyed in EPI-SCAN (Burgos, Madrid, Oviedo, Sevilla and Vic-Manlleu), changes in local COPD prevalence were explored. It can be seen that in all repeated areas there is a substantial decrease in local COPD prevalence, ranging from an 85% to a 94% decrease in Manlleu and Burgos to a 46% decrease in Oviedo, applicable specially to females in Burgos, where a 94.8% decrease was observed (table 3). These standardised observed reductions were of 72.4% in males and 67.9% in females. Similar significant reductions were observed if the current GOLD recommendations were applied to both surveys (data not shown).

Finally, changes in underdiagnosis, undertreatment and smoking among participants with spirometrically confirmed COPD in both IBERPOC and EPI-SCAN were explored. There was a nonsignificant decrease in underdiagnosis, from 78% in 1997 to 73% in 2007. However, there was a significant decrease in undertreatment, from 81% in 1997 to 54% in 2007, which was even greater (50% *versus* 10%) in those with severe COPD (those with FEV_1 <50% pred). Lung function was indeed more frequently tested in 2007 (16.5% *versus* 58.5%), but more smokers reported never trying to quit smoking (34.9% *versus* 88.7%; both $p<0.05$) (table 4).

DISCUSSION

By repeating a cross-sectional survey 10 yrs later, we can report here a substantial decrease of 50.4% in COPD prevalence in Spain in the population aged 40–69 yrs between

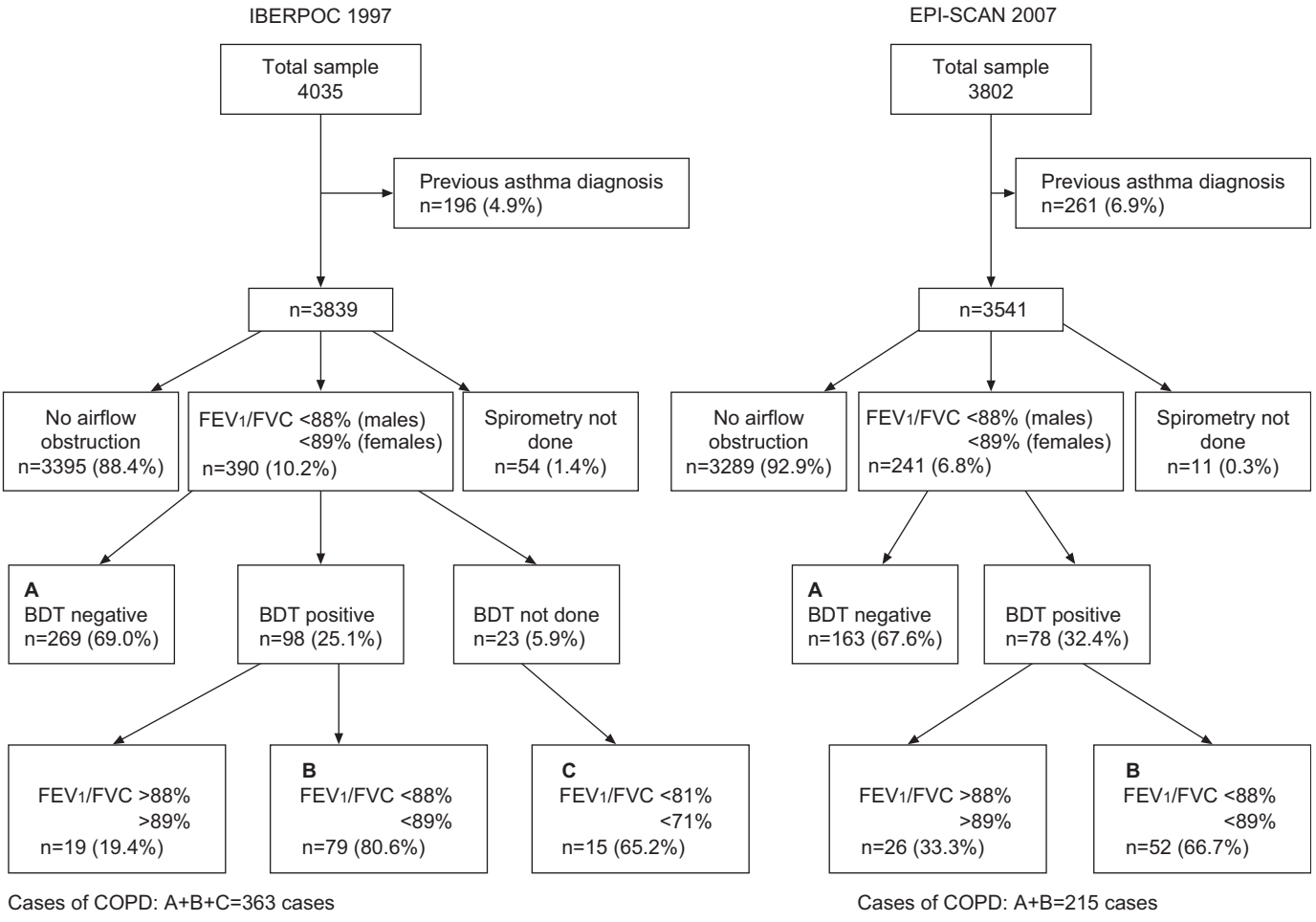

FIGURE 2. Flowchart of participants in a) IBERPOC (*Estudio epidemiológico de EPOC en España*) and b) EPI-SCAN (Epidemiologic Study of COPD in Spain). FEV_1: forced expiratory volume in 1 s; FVC: forced vital capacity; BDT: bronchodilator test; COPD: chronic obstructive pulmonary disease.

the 10 yrs from 1997 to 2007. This is a surprising, unexpected finding. Due to the cumulative history of exposure to cigarette smoking in Spain, we were actually expecting to find an increase in COPD prevalence in Spain [14], particularly in females [9], rather than the current observed decrease. After careful review of all implemented quality control procedures in IBERPOC and EPI-SCAN, and independent re-calculation of all statistics, our conclusion is sustained. To our knowledge, ours is the first repeated survey of COPD using post-bronchodilator spirometry conducted in adults and the elderly from the general population.

Review of previous literature

Numerous indirect assessments concur that the population burden due to COPD, both worldwide and in Spain, are set to increase in the near future. The global estimates of mortality and morbidity for given diseases made in 1990 were recently updated and confirmed a significant upward trend for COPD [5]. In Europe, the COPD mortality rates range from <25 to >75 per 100,000 inhabitants within the various European countries with data, and its prevalence ranges from <2% to >10%, also with an expected increase [6]. Both PLATINO (Latin American Project for the Investigation of Obstructive Lung Diseases) and BOLD (Burden of Obstructive Lung Disease) results identified substantial variability of COPD prevalence within centres. This evidence, together with the instability of results by time reported in here, points to the difficulties of applying current spirometric definitions of COPD [23]. Both the PLATINO and BOLD surveys have identified a significant burden and undetected COPD in most areas, but their cross-sectional nature prevents any conclusion regarding temporal changes regionally or locally [12, 13]. In asthma, repeated cross-sectional studies conducted in the same areas by the same authors, and using an identical/similar protocol, have reported the transition to the current, expanding asthma epidemic [24–27]. Such evidence is scarce in adults from the population with post-bronchodilator forced spirometry and COPD, with repeated surveys only available from Finland [28] and Sweden [29]. Both countries identified increases in the population burden of COPD 30 yrs after initiation, but did not use post-bronchodilator spirometry, a factor that can modify any final COPD assessment [30].

Limitations

Apart from the advantages of similar researchers and areas, and closely similar protocols whose differences were taken into account in our analysis, there are some limitations of our research that deserve further discussion. As mentioned above,

TABLE 2 Demographic and clinical characteristics of participants in 1997 and 2007

	1997	2007	2007 (only ages 40–69 yrs)	p-value#
Subjects n	4030	3802	3191	
Age yrs	53.9±8.6	56.6±10.7	53.3±8.2	0.803
Age band %				0.701
40–49 yrs	37.4	32.7	39.0	
50–59 yrs	32.6	29.3	34.9	
60–69 yrs	35.8	21.9	26.1	
70–79 yrs	0	16.1	0	
Males	1976 (49.0)	1797 (47.3)	1502 (47.1)	0.097
Smoking history pack-yrs	27.8±22.9	26.0±21.5	24.4±19.9	<0.001
Smoking status %				<0.001
Never	50.2	43.1	39.7	
Ex	24.5	30.9	31.3	
Current	25.4	26.0	29.1	
Height cm	161.8±9.0	164.0±9.2	164.7±9.0	<0.001
Weight kg	72.8±12.8	73.9±14.1	73.9±14.4	<0.001
BMI kg·m^{-2}	27.7±4.3	27.4±4.5	27.2±4.5	<0.601
Primary education	2244 (57.6)	1751 (46.1)	1242 (41.7)	<0.001
Symptoms %				
Cough	13.5	13.4	12.4	0.172
Sputum	10.7	11.7	10.9	0.774
Dyspnoea	10.4	9.9	7.2	<0.001
Wheezing	40.0	36.0	31.9	<0.001
Previous diagnoses %				<0.001
Asthma	4.9	6.9		
COPD		1.4	0.8	
Chronic bronchitis	4.8	4.0	3.1	
Emphysema		0.5	0.4	
FEV$_1$ % pred [18]	87.8±17.0	102.1±19.4	100.8±17.4	<0.001
FVC % pred [18]	88.4±14.6	96.8±16.3	98.7±15.3	<0.001

Data are presented as n (%) or mean±SD, unless otherwise stated. BMI: body mass index; COPD: chronic obstructive pulmonary disease; FEV1: forced expiratory volume in 1 s; FVC: forced vital capacity. #: for 1997 *versus* those aged 40–69 yrs in 2007.

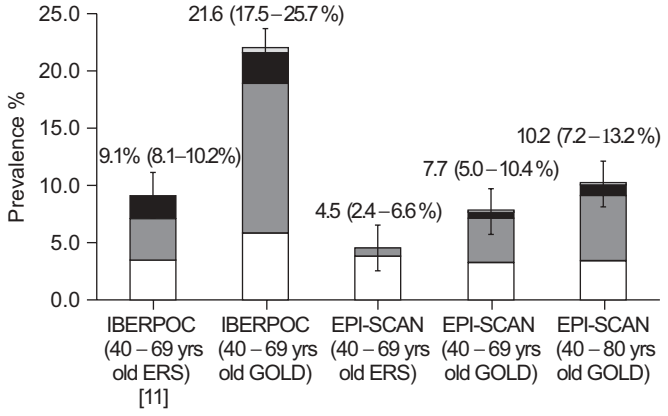

FIGURE 3. Changes in chronic obstructive pulmonary disease (COPD) prevalence and severity from 1997 to 2007. Estimators are presented with 95% confidence intervals. □: mild: ■: moderate; ■: severe; ■: very severe. IBERPOC: *Estudio epidemiológico de EPOC en España*; ERS: European Respiratory Society; GOLD: Global Initiative for Chronic Obstructive Lung Disease; EPI-SCAN: Epidemiologic Study of COPD in Spain.

protocols were not exactly the same and COPD guidelines and forced spirometry recommendations have changed during this relatively short period. We have ensured that re-calculation of individual data from both surveys was conducted consistently, and that similar definitions, thresholds and exclusions were applied. However, the subtle effect of differences in the sampling frame and recruitment, and slight technical changes in spirometry recommendations and/or tools cannot be ruled out to explain, totally or partially, our findings. Without an intention to be cumbersome, a long list of methodological issues are presented as follows. Spirometers used in both surveys differed (table 1). In IBERPOC it was a turbine spirometer, while in EPI-SCAN a pneumotacograph spirometer with high sensitivity was used. It has been reported that turbine spirometers create greater internal resistance to flow, sometimes failing the standards recommended by the American Thoracic Society at high flows [31]. The manufacturer of the pneumotacograph spirometer Datospir-200 reports a maximum resistance of 0.12 kPa·L^{-1}·s^{-1} and the turbine MasterScope 0.05 kPa·L^{-1}·s^{-1}. BUESS *et al.* [32] suggested that the relationship between the internal resistance of a spirometer

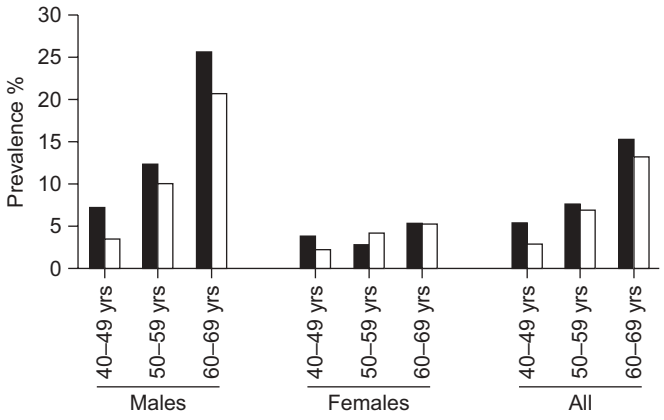

FIGURE 4. Changes in chronic obstructive pulmonary disease (COPD) prevalence from 1997 to 2007, by sex and age. ■: IBERPOC (*Estudio epidemiológico de EPOC en España*); □: EPI-SCAN (Epidemiologic Study of COPD in Spain).

and the resistance of the respiratory system should be between 5–10%. For a range of resistance of the respiratory system of 0.5–1 $kPa \cdot L^{-1} \cdot s^{-1}$ and according to data provided by manufacturers, the pneumotacograph MasterScope meets that criterion, while the turbine spirometer would exceed it by 12–24%. An increase in internal resistance of pneumotacographs can produce an underestimation of expiratory volumes, detecting more COPD, which could have occurred in the IBERPOC study. As this effect occurs early in the expiratory manoeuvre, since most resistance occurs at high flows, it appears that the measure should affect FEV1 more than the FVC, the latter being more dependent on the completion of the manoeuvre. Consequently, an increase of internal resistance of the spirometer could result in an underestimation of the FEV1/FVC ratio. To our knowledge, there is no data in the literature comparing the Datospir 200 spirometer *versus* pneumotacographs. Accordingly, we re-analysed data considering an underestimation by 6% in the FEV1/FVC due to turbine spirometers, producing a prevalence of COPD according to the old ERS criteria in EPI-SCAN of 10.6% (95% CI 9.6–11.5%). In the subgroup of individuals aged 40–69 yrs, the estimated prevalence of COPD would then be 9.2% (95% CI 8.2–10.2%), virtually identical to the 9.1% reported in the IBERPOC study.

A final limitation to consider is the often arbitrary decision when applying reference equations to estimate predicted lung function. We used those defined by ROCA *et al.* [18], as they are preferred to other available equations for being locally produced and therefore more representative, as recommended elsewhere [21]. However, they were obtained in the mid 1980s. As the Spanish population has grown taller and leaner 21 yrs later, their ongoing validity might be debatable, as their application produced an observed mean FEV1 of 87.8% pred in 1997 and 100.8% in 2007 (table 1). Therefore, additional caution in the interpretation of changes in results of any spirometric survey should be granted when repeated, as changing lung reference equations might have a major effect. Only a re-analysis of raw data, as applied here, would identify this problem.

TABLE 3 Changes between 1997 and 2007 chronic obstructive pulmonary disease prevalence in the five repeater areas, total and by sex, crude and adjusted by indirect standardisation, in 40–69-yr-olds according to old European Respiratory Society thresholds [20]

	1997	2007	2007 standardised	% change 1997 to 2007 standardised
All				
Burgos	11.9	1.9	1.9	-84.0
Madrid	11.8	6.0	6.1	-48.3
Oviedo	9.5	5.4	5.1	-46.3
Sevilla	8.7	3.2	2.1	-75.9
Vic-Manlleu	22.3	3.4	3.3	-85.4
Males				
Burgos	16.5	3.3	3.5	-78.8
Madrid	20.2	8.8	9.1	-55.0
Oviedo	12.1	5.1	4.6	-62.0
Sevilla	11.5	5.8	3.7	-67.8
Vic-Manlleu	28.8	4.0	3.9	-86.5
Females				
Burgos	7.7	0.5	0.4	-94.8
Madrid	4.1	3.7	3.6	-12.2
Oviedo	7.0	5.7	5.7	-18.6
Sevilla	5.6	0.9	0.7	-87.5
Vic-Manlleu	17.0	2.7	2.8	-83.5

The use of lower limit of normal (LLN) to define and stage COPD has been postulated as more advantageous than previous and current recommendations, all based on fixed spirometry ratios [33], which may misdiagnose large segments of the very young and the very old [34, 35]. In a way, the old ERS definition of COPD used in this study, with its variable post-bronchodilator ratio FEV1/FVC percentage lower than a

TABLE 4 Changes in determinants and attitudes towards chronic obstructive pulmonary disease (COPD) and smoking among participants with spirometrically confirmed COPD in 1997 and 2007

	1997	2007
Underdiagnosis %	78	73
Undertreatment %	81*	54
Undertreatment in severe COPD %	50*	10
Lung function ever measured previously %	16.5*	58.5
Have you ever tried to quit smoking? %		
Never	34.9*	88.7
Yes	65.1	11.3
1–3 times	43.6	
4 times or more	21.5	
No answer	4.0	

*: $p<0.05$.

predicted value by sex, is already a type of LLN. However, to compare LLN to current thresholds was not the aim of our study, and we doubt our data will help to settle this controversy.

Should the findings be true, some factors can be considered that might explain, albeit partly, this unexpected finding of a COPD prevalence decrease. Changes in tobacco consumption in Spain have been well documented. The prevalence of smokers in adults in Spain significantly dropped in males from 39.9% in 1999 to 32.1% in 2007, while only from 24.6% to 22.1% in females in the same period [36]. The actual point prevalence of smoking at the time of conducting the fieldwork of each study, IBERPOC in 1999 and EPI-SCAN in 2007, should not explain the COPD burden, but the cumulative exposure in this population, so it is hard to understand our finding of a 50.4% decrease in COPD prevalence due to changes in smoking. Although the comparison in pack-years of smoking exposure has to be made with care (table 2), the distribution in smoking exposure among individuals with and without airflow obstruction was 47.2 ± 28.7 *versus* 26.7 ± 19.4 pack-yrs in IBERPOC in 1997 [37], a finding that was largely maintained in EPI-SCAN in 2007: 36.5 ± 18.6 *versus* 25.0 ± 17.2 pack-yrs (data not shown).

Of interest, the prevalences of respiratory symptoms in both periods (table 2) were similar for cough or sputum, and they are only significant for minor decreases in dyspnoea and wheezing; therefore, it is unlikely they help to explain the magnitude of the differences in spirometric values.

The birth cohort of IBERPOC participants in 1996–1997 suffered the consequences of the Spanish Civil War, from 1936 to 1939. During the 1940s, living conditions in Spain were extremely hard, including starvation and virtually universal infections. As the average year of birth of IBERPOC participants was 1942, the Barker hypothesis on the influence of preconception and early childhood factors on attaining full lung development [38], with a population shift on weight and other factors to influence later spirometry findings [39], and even the effect of tuberculosis [40], common in Spain at that time, might explain a significant unhealthy ''cohort effect'' in the IBERPOC participants. Conditions gradually improved in subsequent years, so EPI-SCAN participants (1952 being their average year of birth) were actually taller, leaner, and better educated (table 2). A final, relevant factor might be the existence of an outlier centre in the IBERPOC 1997 study; Manlleu participants had a COPD prevalence of 18.0% (95% CI 14.8–21.2), which was four-fold higher than the lowest participating area, mostly explained at that time by high occupational exposures in actually nonsmoking females, who had the mildest COPD [41]. 10 yrs later in Vic, another rural village in the outskirts of Barcelona, only 10 km (~6 miles) from Manlleu, but without any major local industry, we obtained a 4% COPD prevalence.

Finally, of public health interest, we have to underline from table 4 the nonsignificant drop in COPD underdiagnosis, but the substantial decrease in undertreatment, especially in those with severe COPD. To further reduce underdiagnosis, the implementation and wider use of spirometry screening in all settings, including quality spirometry in primary care [42], pharmacies [43], and elsewhere, require further research and resources [44].

Conclusion

To conclude, we report a substantial reduction of 50.4% in the prevalence of COPD in Spain from 1997 to 2007 in subjects aged 40–69 yrs, with also an unexpected shift to a milder severity in the population distribution. These findings remain unexplained, but highlight the difficulty found in comparing population findings of forced spirometry by time and place. Undertreatment (but not underdiagnosis) was significantly reduced during the same period.

SUPPORT STATEMENT

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STATEMENT OF INTEREST

A statement of interest for G. Sánchez and for the study itself can be found at www.erj.ersjournals.com/misc/statements.dtl

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