British Journal of Healthcare and Medical Research - Vol. 11, No. 06
Publication Date: December 25, 2024
DOI:10.14738/bjhr.1106.18014.
Flores Uzcanga, M. A., Narvaez Anzures, E. O., & Durán Nah, J. J. (2024). Demographic and Clinical Characteristics Differentiating Patients Referred for Diagnostic Spirometry and Diagnosed with or without Chronic Obstructive Pulmonary Disease. British Journal of Healthcare and Medical Research, Vol - 11(06). 252-263.

Demographic and Clinical Characteristics Differentiating Patients Referred for Diagnostic Spirometry and Diagnosed with or without Chronic Obstructive Pulmonary Disease

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ABSTRACT

Introduction: Patients who, from the perspective of the family physician, require spirometry to confirm or rule out Chronic Obstructive Pulmonary Disease (COPD) must meet clinical criteria that differentiate them from those who do not appear to need it. Objective: To identify the demographic and clinical characteristics that differentiate patients referred for spirometry during 2022–2023 who were diagnosed with or without COPD. Materials and Methods: This was an observational, retrospective, cross-sectional, and comparative study including 455 patients who underwent spirometry for suspected COPD. This suspicion was based on respiratory data, including three variables—cough, dyspnea, and expectoration—combined into an algorithm. These variables, along with other clinical and demographic data, were compared between patients diagnosed with and without COPD using a logistic regression model (LRM). This model identified, through odds ratios (OR) and 95% confidence intervals (95% CI), the differences between both groups and assessed whether the algorithm influenced the indication to perform spirometry. Results: 29.2% of the patients were diagnosed with COPD through spirometry. The final logistic regression model identified the smoking index as a significant factor, with categories moderate (10 to 20 packs/year, OR 3.88, 95% CI 2.16–6.95), intense (21 to 40, OR 1.95, 95% CI 1.03–3.65), and high (≥ 41, OR 11.54, 95% CI 4.55–29.23). Additionally, the presence of cough (OR 2.18, 95% CI 1.36–3.46) also showed significant differences between patients with and without COPD and influenced the indication to perform spirometry. Conclusions: The smoking index and cough were significantly different factors between patients with and without COPD and influenced the indication to perform pre-diagnostic spirometry. The algorithm, however, did not have a significant impact on this indication.

Keywords: Cough, dyspnea, expectoration, COPD, emphysema, family medicine unit.

INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD), as defined by the Global Initiative for Chronic Obstructive Lung Disease (GOLD), is a preventable and treatable condition characterized by

persistent abnormalities in the airways and alveoli. It is one of the leading causes of morbidity and mortality worldwide. This condition, induced by exposure to harmful particles or gases, results in progressive airflow limitation and significantly impacts the quality of life of affected patients [1]. The prevalence of COPD varies significantly depending on factors such as the diagnostic technique employed, age group, and exposure to risk factors. International and national studies estimate that the prevalence ranges from 7.8% to 10% among the population over 40 years old in Mexico [2][3]. However, these figures underestimate the real burden of the disease due to underdiagnosis, which could reach up to 90% [4]. This underdiagnosis reflects the lack of use of essential tools such as spirometry, particularly in primary care, where family physicians play a crucial role in the early detection of the disease [5][6].

This research focuses on identifying the demographic and clinical characteristics that differentiate patients referred for diagnostic spirometry, who were diagnosed with or without COPD, aiming to improve referral criteria and contribute to the timely diagnosis of this disease.

MATERIALS AND METHODS

This was an observational, retrospective, cross-sectional, and comparative study that included patients over 40 years old with a clinical presentation of chronic respiratory disease, treated for suspected Chronic Obstructive Pulmonary Disease (COPD) at the Family Medicine Unit (UMF), and referred for spirometry at the Pulmonology outpatient clinic of the Instituto Mexicano del Seguro Social (IMSS), in the city of San Luis Potosí (SLP).

To include the largest possible number of patients referred by the UMF, it was decided not to calculate a sample size but to include all those whose studies were conducted between January 2022 and December 2023. The sample was therefore considered non-probabilistic, convenience-based, adhering to the specified time period and selection criteria. This strategy was also applied to the consecutive inclusion of patients based on the time they were attended by the family physician.

Patients over 40 years old, both men and women, presenting with cough, dyspnea, or expectoration (included in the algorithm) lasting at least three months were included, regardless of whether they met other criteria from the Questionnaire for Case Detection of COPD (COPD-PS) [5]. Also included were those referred for diagnostic spirometry during the analysis period, regardless of whether spirometry confirmed or ruled out COPD. Patients with a history of asthma, pulmonary neoplasia, thoracic vertebral malformations, neuromuscular or autoimmune disease affecting the pulmonary parenchyma were excluded, even if they had been referred for spirometry. Likewise, patients meeting the clinical algorithm's data but lacking spirometry results or having inconclusive spirometry were excluded.

Dependent Variable

- **COPD confirmed by spirometry**: Chronic pulmonary disease diagnosed through spirometry in a patient with a suggestive clinical presentation and risk factors for COPD.

Independent Variables

- **Sex**: Presence of reproductive organs that characterize, differentiate, and complement mammals.
- **Age**: Completed years at the time of the study.

URL: http://dx.doi.org/10.14738/bjhr.1106.18014.

- **Occupational or biomass exposure**: Prolonged exposure to various substances present or produced by occupational or domestic activities.
- **Current or former smoking**: Current or past exposure to tobacco smoke.
- **Intensity of tobacco smoke exposure**: Smoking index (SI) in packs/year.
- **Referral algorithm**: Respiratory clinical data (cough, dyspnea, and expectoration) structured in a referral algorithm, obtained from the medical history.
- **Cough**: Voluntary or spontaneous effort involving ventilatory mechanics to clear the airways.
- **Dyspnea**: Identifiable and quantifiable difficulty in performing pulmonary inspiration.
- **Wheezing**: Whistling respiratory sound detected during pulmonary inspiration or expiration.
- **Expectoration**: Act of expelling abnormal bronchopulmonary secretions in response to airway inflammation.
- **Eosinophils >300**: Absolute eosinophil count per deciliter of venous blood.
- **Radiographic abnormalities suggestive of emphysema**: Hyperlucency in retrosternal spaces, lung fields, diaphragm flattening, rib horizontalization, increased anteroposterior chest diameter.

Patient Identification and Data Collection

Since the study is observational and retrospective, informed consent was naturally unnecessary. However, the protocol was reviewed and approved by the Ethics Committee of the hospital before its implementation. The included patients had already undergone spirometry, and the information was obtained from the medical-administrative records in the clinical files of the UMF where the researchers officially work. These records were also used at the time to gather the necessary data to prepare the referral requests for patients with clinical suspicion of COPD to the secondary-level medical hospital for evaluation by the pulmonology specialist. The specialist determined whether the clinical algorithm was sufficient to perform spirometry, whose results were considered by the authors to confirm whether the referred patient did or did not have COPD. Since this is a cross-sectional, comparative study between two groups, they were naturally formed based on the spirometric diagnosis: one group with COPD and the other without. Various demographic and clinical data were compared between the groups, including those that comprised what, for research purposes, was referred to as the "referral algorithm," structured with three clinical variables—cough, dyspnea, and expectoration (represented as C+D+E)—as proposed by the corresponding guideline for identifying COPD patients as referral criteria [7]. These are usually recorded in clinical notes, although this was not always the case for criteria such as "intensity of physical activity," chest X-ray, or total eosinophil count, both complementary criteria also proposed by the guideline [7]. The data were collected on a specially designed form with the compared variables.

Data Analysis

The variables were analyzed using descriptive and inferential statistics. For the former, the median and interquartile ranges (IQR) were used as measures of central tendency and dispersion to describe numerical data with skewed distribution, and percentages were used to describe qualitative data.

Inferential statistics were initially used to perform bivariate comparisons between patients with and without COPD. Continuous variables with skewed distributions were analyzed using the nonparametric Mann-Whitney U test, while the Student's t-test was applied for normally distributed quantitative data from two independent samples. For nominal and ordinal dichotomous and polytomous qualitative variables, the nonparametric chi-square (χ^2) test was used. Since the number of patients with COPD was sufficient to apply the rule of ten cases per variable—applicable to studies using logistic regression models (LRM)[8]—the decision was made to include in the models those variables found to be statistically significant in the bivariate comparison (p-value ≤ 0.05). Odds ratios (OR) and their respective 95% confidence intervals (95% CI) were obtained to identify statistically and clinically significant differences between patients with and without COPD.

The population prevalence was calculated by dividing its frequency by the total number of patients covered by the UMF and multiplying the quotient by 100 and then by 1,000. Sample prevalence was calculated by dividing the number of COPD patients by the total number of patients referred for diagnostic spirometry during the analysis period and multiplying the quotient by 100. SPSS 22 (IBM Corp., Armonk, NY, USA) software was used for the comparisons.

RESULTS

During the analyzed period, 455 patients with spirometry were identified. These represented between 0.9% and 1.3% of a population of 47,868 beneficiaries covered by the UMF/HGZ2. Those with a spirometric diagnosis of COPD represented 0.3% to 0.4%, based on the assumption that the adult population accounts for 70% of the total beneficiaries of the aforementioned clinic-hospital. The sample age range (44 to 94) had a median of 65 years (IQR 58 to 72) and a mean of 65.3 ± 10.5 years. Stratified by age, 91 (20%) were between 41 and 55 years, 217 (47.7%) between 56 and 70, and 147 (32.3%) were 71 or older. Regarding sex, 287 (63.1%) were female, whose mean age (64.5 ± 9.1) was significantly lower (p= 0.02) than that of the male group (66.8 ± 12.5). Among non-respiratory clinical data, comorbidities were identified in 83% of the sample, with systemic arterial hypertension and tobacco use being the most prevalent. Obstructive sleep apnea and hypothyroidism were less frequent. Regarding the smoking index (SI), tobacco consumption of <10 packs per year was predominant.

Regarding respiratory clinical data, dyspnea and cough were the most prevalent symptoms, while wheezing was the least frequent. All patients were referred with chest X-rays and eosinophil counts. The referral algorithm was only completed in 23% of the sample. Additional sample data are presented to the left of Table 1.

Of the 455 patients, 133 (29.2%) met the spirometric criterion for COPD, while 322 (70.8%) did not. Although COPD was more prevalent in women (8% higher), while in men it was 8% lower, these differences were not significant (OR 1.39, 95% CI 0.90 to 2.13, p= 0.12). The same was observed with age distribution, comorbidities such as diabetes mellitus (DM), heart disease, sleep apnea, or other circumstances like occupational risk exposure or passive exposure to tobacco smoke. Similarly, eosinophilia >300/mm^3, the only laboratory variable, was not significant (p>0.05 for each variable). Significant differences were observed for the presence of comorbidities, which was less frequent in the COPD group (OR 0.42, 95% CI 0.25

URL: http://dx.doi.org/10.14738/bjhr.1106.18014.

to 0.69). Systemic arterial hypertension was 24% less frequent in COPD patients (OR 0.31, 95% CI 0.20 to 0.48), while hypothyroidism was 9% more frequent in the COPD group (OR 2.68, 95% CI 1.41 to 5.11). Current or former tobacco use was 17% more frequent in this group (OR 2.18, 95% CI 1.40 to 3.38), with the most severe SI category predominating in COPD patients (p< 0.001).

Among clinical data, the presence of cough was 21% more frequent in COPD patients (OR 2.56, 95% CI 1.64 to 4.0), as was expectoration, 24% more frequent (OR 2.66, 95% CI 1.75 to 4.04), and wheezing, 9% more frequent (OR 2.68, 95% CI 1.41 to 5.11). Dyspnea, however, was 11% less frequent in these patients (OR 0.65, 95% CI 0.43 to 0.98). Abnormal chest X-rays suggestive of COPD were only found in this patient group (OR 0.13, 95% CI 0.10 to 0.17). Combined in the algorithm, C+D+E was 11% more frequent in COPD patients (OR 1.89, 95% CI 1.20 to 3.0) (p <0.05 for each variable). Additional sample data and comparisons between patients with and without COPD are presented in Table 1.

Table 1: Demographic and Clinical Characteristics of 455 Patients Referred by Family Physicians for Spirometry Diagnosed with or Without Chronic Obstructive Pulmonary Disease (COPD)

Variable	Sample N=455, (100%)	No COPD N=322, (100%)	COPD N=133, (100%)	P*
Stratified Age				0.08
41 to 55	91 (20.0)	56 (17.4)	35 (26.3)	
56 to 70	217 (47.7)	161 (50.0)	56 (42.1)	
≥71	147 (32.3)	105 (32.6)	42 (31.6)	
Age (continuous variable)	65 (58 to 72)	63.5 (58 to 75)	67 (55 to 72)	0.43†
Positive Responses:				
Comorbidity	378 (83.1)	280 (87.0)	98 (73.7)	0.001
Hypertension	301 (66.2)	238 (73.9)	63 (47.4)	<0.001
Diabetes Mellitus	112 (24.6)	84 (26.1)	28 (28.1)	0.25
Heart Disease	63 (13.8)	49 (15.2)	14 (10.5)	0.18
Hypothyroidism	42 (9.2)	21 (6.5)	21 (15.8)	0.002
Obstructive Sleep Apnea	21 (4.6)	14 (4.3)	7 (5.3)	0.67
Biomass Exposure	287 (63.1)	203 (63.0)	84 (63.2)	0.9
Occupational Risk Exposure	161 (35.4)	119 (37.0)	42 (31.6)	0.27
Tobacco Use	275 (60.4)	178 (55.3)	97 (72.9)	<0.001
Passive Tobacco Smoke Exposure	42 (9.2)	28 (8.7)	14 (10.5)	0.53
Smoking Index (packs/year)				<0.001
<10	294 (64.6)	238 (73.9)	56 (42.1)	
10 to 20	70 (15.4)	35 (10.9)	35 (26.3)	
21 to 40	63 (13.8)	42 (13.0)	21 (15.8)	
≥41	28 (6.2)	7 (2.2)	21 (15.8)	
Smoking Index (continuous variable)	1 (<1 to 16)	1 (<1 to 10)	10 (<1 to 31)	<0.001†
Clinical Symptoms:				
Cough	266 (58.5)	168 (52.2)	98 (73.7)	<0.001
Dyspnea	273 (60.0)	203 (63.0)	70 (52.6)	0.03
Wheezing	42 (9.2)	21 (6.5)	21 (15.8)	0.002
Expectoration	210 (46.2)	126 (39.1)	84 (63.2)	<0.001
Eosinophilia >300	84 (18.5)	56 (17.4)	28 (21.1)	0.36
Chest X-ray Abnormalities	84 (18.5)	0	84 (63.2)	<0.001
Algorithm T+D+E				0.006
Absent	350 (76.9)	259 (80.4)	91 (68.4)	

Present	105 (23.1)	63 (19.6)	42 (31.6)	
* Chi-square test. † Mann-Whitney U test. Rx: Chest X-ray. T+D+E: Cough, Dyspnea, and Expectoration.				

Even though bivariate comparison identified both non-directly related clinical variables and respiratory-type variables as significantly different—potentially associated with the likelihood of performing spirometry and obtaining a positive COPD result—it was decided to include in the trial logistic regression models (LRMs) only those variables that, according to clinical common sense, had some causal relationship with COPD or could be part of its clinical manifestations. This decision aimed to justify spirometry to the pulmonologist. The exception was the exclusion of the chest X-ray variable because, in this type of comparison, no patients without COPD had radiographic abnormalities, leaving the 2x2 χ^2 table with an empty cell. It is important to note that including all variables with a p-value < 0.05 in the bivariate comparison resulted in Hosmer-Lemeshow p-values rejecting the null hypothesis. This indicated differences between observed and predicted values. Consequently, after a process of inclusion and exclusion in trial models, the final LRM—using a stepwise conditional forward method with a χ^2 value of p= 0.51 and a classification table accuracy of 75.4%—identified the smoking index and cough as the variables significantly differing between patients with and without COPD. For the smoking index, the odds ratios (ORs) showed a progressively increasing trend as the number of cigarette packs rose, taking smoking <1 pack per year as the reference category. Regarding the cough variable, it was the only variable per se, and not as part of the referral algorithm to the pulmonologist, that proved statistically significant. Both variables increased the probability of undergoing spirometry, and more so, diagnostic spirometry for COPD, by three to eleven times. Complementary data are presented in Table 2.

Table 2: Binary logistic regression analysis identifying significant differences in the distribution of various variables between patients with and without Chronic Obstructive Pulmonary Disease (COPD), which also influenced the prior performance of spirometry for patients referred from their Family Medicine Unit.

	B*	SE†	Wald‡	p §	OR‖	95% CI¶
Data						
Smoking Index**						
<1		1				
1 to <10	0.01	0.35	0.01	0.97	1.01	0.50 to 2.03
10 to 20	1.35	0.29	20.76	<0.001	3.88	2.16 to 6.95
21 to 40	0.66	0.32	4.32	0.03	1.95	1.03 to 3.65
41 or more	2.44	0.47	26.62	<0.001	11.54	4.55 to 29.23
Cough						
No		1				
Yes	0.78	0.24	10.62	0.001	2.18	1.36 to 3.49
*B coefficient. † Standard error for the B coefficient. ‡ χ^2 test for the Wald statistic. § p-value for the Wald statistic. ‖ Odds Ratio (OR) or exponent β. ¶ 95% Confidence Intervals for the OR. The "1" represents the reference or comparison variable. **Number of cigarette packs smoked per year.						

DISCUSSION

Use of Spirometry

The relevance of the work of physicians in primary care is undeniable, primarily because they are responsible for addressing the healthcare needs of up to 85% of patients. Preventing, diagnosing, treating pharmacologically, monitoring for feedback, and determining when to

URL: http://dx.doi.org/10.14738/bjhr.1106.18014.

refer to a specialist are part of the tasks for which they must be prepared and generally adhere to their fulfillment [9].

This is put into practice when they identify that certain patients come to the consultation complaining of prolonged respiratory symptoms, regardless of whether or not they have a history of being a smoker. Physicians may request blood tests, if pertinent, a chest X-ray, or initiate treatment while considering the probability of COPD and thus propose the specialized evaluation by a pulmonologist. Spirometry is a diagnostic tool that, for various reasons, some of which depend on the primary care physician (PCP) [10] [11], appears to be performed at a frequency that could be considered low and insufficient [11] [12] [13], as seen in the frequency gathered in the present study, 0.9% or 9/1000 beneficiaries over two years. Whether this low frequency is because COPD is rare among beneficiaries of the IMSS primary care clinics is questionable if one considers that COPD is underdiagnosed in Mexico [14] and that PCPs might be contributing to this [15].

This assertion seems to be supported by Blain and Craig [12], whose research finds that pediatricians use spirometry in 66% of their asthmatic patients' consultations, internists in 60%, and PCPs in 47% of consultations under similar clinical contexts. Part of the differences is explained, Blain and Craig note, by the fact that 94% of physicians, when faced with a patient requiring spirometry, prefer to refer the patient to a hospital, while only 6% refer them to a specialist. The researchers also state that 10% of pediatricians use spirometry in every visit for an asthmatic patient, internists do not perform it in such patients but use it in 22% of patients with COPD.

For PCPs, they report that only 14% use spirometry in asthmatic patients, and none use it in patients with COPD [12]. It is known that they do not perform it because it “slips their mind,” among other reasons such as focusing more medical attention on more frequent comorbid syndromes [10] [16] or deciding to refer patients to pulmonologists when spirometry is deemed necessary [17]. The first argument is plausible [12], and the second would be questionable if one considers the underdiagnosis of COPD in the country, which Mexican researchers report is 86% [18], to which PCPs and internists might contribute by not referring as many patients as possible or referring them, but patients do not attend for various hospital or medical reasons, especially when appointments are rescheduled multiple times, as often happens in public hospitals. Regarding the role physicians might play in the high underdiagnosis rate of COPD in Mexico, it appears to be confirmed by pulmonology experts who point out the “little and poor use” of spirometry in the country [15].

COPD Prevalence

One of the specific objectives proposed to respond to the general objective of the research was to estimate the prevalence of COPD in a population of beneficiaries from a city-based primary care clinic, which was found to be 0.3% or three cases per 1000 beneficiaries assigned, or 29.2% considering only patients with spirometry. These frequencies contrast significantly with those reported in other studies as they depend on various factors such as the spirometry technique used, sex and age group of patients, exposure to risk factors, the geographic region analyzed [3] [19], the population analyzed (open or hospital-based), and again, underdiagnosis [10,11,14,16], [15]. It is estimated that up to 10% of the Mexican population over 40 years old suffers from COPD [2], while others propose a prevalence of 7.8% [3]. Ramírez-Venegas et al.

[19] identified a 2.5% prevalence in a national sample. Some of the data mentioned earlier are shared by the Fourth Mexican Consensus for the Diagnosis and Treatment of COPD, which, citing data from the Latin American Project for Research in Pulmonary Obstruction (PLATINO), using GOLD criteria, refers to a calculated prevalence for Mexico of 7.8% in individuals over 40 years old, decreasing to 5.3% when using the <LLN as the obstruction criterion [15].

When analyzed in a hospital population, Romero-López et al. [21] identified COPD in 7.1% of the sample. In outpatient populations, prevalence is also variable. López-Varela et al. [22], analyzing data from four Latin American countries, report an average prevalence of 20.1%, with variability ranging from 11% to 29.6% or 14.7% with variability from 8.3% to 21.8% depending on the spirometry technique used in the respective country.

Distribution of COPD by Sex and Age Groups

In the present study, COPD was slightly more frequent in women, although its distribution by gender was not statistically significant. By age groups, it predominated in the 41–55 years group, being 9% higher, although this difference was also not statistically significant. These results are consistent yet diverge from frequencies documented in other studies. In Zaniku et al.'s [23] sample, 58% were female, and 62.2% were between 40 and 49 years old, with a median age of 46 years. The population prevalence was 10%, higher in men than women (15% vs. 6.4%). Al Wachami et al. [24] report a prevalence of 15.5% in men and 8.8% in women; by age groups, it was 4.4% in individuals under 50 years old, 9.5% in those under 60, 15.8% in those under 70, and 24% in patients 70 years and older. In Mexico, the Fourth Mexican Consensus for the Diagnosis and Treatment of COPD states that the national prevalence by sex and age groups is much higher in men (11%) than in women (5.6%), increasing with age from 4.5% in the 50–59 years group to 18.4% in individuals over 60 years [15]. When the analysis is conducted in hospital populations, Romero-López et al. [21] reported 97% were male, with high prevalence skewed by including only patients with HIV.

Algorithms or Scores

One strategy to make diagnostic approaches more efficient or predict clinical evolution of diseases is by structuring scores or algorithms using demographic, clinical, imaging, or laboratory data. It is estimated that there are at least 250,000 such algorithms, although their utility, efficiency, and accuracy have been questioned [25]. López-Varela et al. [22] structured one with seven interrelated variables predictive of COPD—age, sex, IT, cough, dyspnea, expectoration, and spirometry—to identify in populations with a history of tobacco use which patients in primary care require spirometry. In Mexico, the IMSS proposes the COPD-PS [5] structured with six predictive variables and two "auxiliary" variables. However, its daily application by PCPs does not appear to be the norm, as observed in the review of medical records in which the variable "exercise tolerance" was not found, while the terms cough, expectoration, and dyspnea were more consistently noted. Hence, in the search for differences between patients with and without COPD that influenced the completion (and not rejection) of spirometry requests that led to the diagnosis, these were grouped into a referral algorithm for specialists and compared as a variable.

As such, it was found in 23% of the sample, while each of its components was observed in 46% to 60% of the sample. This variable, when compared bivariately, was significantly different between patients with and without COPD, maintaining its significance when included in several

URL: http://dx.doi.org/10.14738/bjhr.1106.18014.

tested MRLs. One of these assigned it an OR of 1.90 with a 95% CI of 1.19 to 3.04, which clinically translates to patients with the clinical triad being nearly twice as likely to undergo spirometry. The reason for not considering it as a predictor was that including it in the tested MRLs did not allow the inclusion of other variables—it disrupted the models' goodness of fit—except for age, whose strata were ultimately rejected as predictor variables. This is relevant considering that age is one of the criteria variables included in the IMSS's COPD-PS algorithm [5]. The same statistical behavior was observed with IT, a variable that, when included in the MRLs, prevented the inclusion of others, except for the variable cough. Despite its statistical trend to disrupt the used MRLs, from our clinical perspective, it should be accepted as a significantly different variable between patients with and without COPD and predictive of spirometry performance because its three severity categories, according to the MRL, showed a statistical increment effect. Notably, a low IT (10 to 20 packs per year) predicted nearly four times the likelihood of undergoing spirometry. Based on these premises, one could deduce that if a PCP referred a patient with a note indicating only that they have an IT of 20 or more, there would be no doubt that spirometry would be performed.

These observations are consistent with those found in other studies where the variable is analyzed as a risk factor associated with COPD, not spirometry. In populations with a history of tobacco use, López-Varela et al. [22] report that the risk of developing COPD is high in those with an IT > 30, a figure documented in almost 32% of COPD patients. They also note that, to define which primary care patients require spirometry, the referral algorithm includes IT as one of its components. In the study by De Miguel-Diez et al. [17], 63.5% versus 36.2% of patients with and without COPD smoked.

In Malawies et al.'s study [26], having smoked increased the probability of COPD by 6.17 times, while being an active smoker increased it by 17 times. Chinese researchers [27] identified COPD in 12.2% of a sample of 456 people from the general population. In these, tobacco use increased the risk by 10.77. In Mexico, the IMSS's prevention protocol proposes risk factors such as occupational exposure to smoke and tobacco smoke exposure but not active or past tobacco use [6]. From the data referred to so far, it can be argued that IT alone is clinically sufficient to justify spirometry in the referral note. On the other hand, a significant limitation of the findings of the present study is that if IT were used as the sole clinical factor or argument for referring a patient for spirometry, and this were not challenged, it would exclude those with certain demographic and clinical profiles who have never been exposed to active or past tobacco consumption (prevalence of 25% to 45%) [28]. This subgroup represented 40% of the sample and 27.1% of COPD cases in this study. In this subpopulation, the algorithm, along with other criteria from the COPD-PS, provides the basis for requesting spirometry.

Cough as a Predictor of COPD

"Chronic, intermittent, or not, with chronic productive expectoration for three or more months over two consecutive years…" [29] [30] is one of the clinical symptoms found in COPD patients that the Global Strategy for the Diagnosis, Management, and Prevention of COPD proposes as one of several clinical indicators of its presence prior to spirometry [29]. In Mexico, the 2021 COPD Clinical Practice Guideline (GPC) [6] states that to suspect COPD in an adult, the physician must identify the components of the algorithm, which, as seen, are inconsistent in their presentation and frequency [29], as occurred in this study, where 58% of the sample reported

cough. When compared between patients with and without COPD, 73% versus 52% had it, with a 21% difference that was statistically significant.

For this reason, with the referral algorithm—of which it was a part—excluded as a statistically significant variable, a decision was made to analyze it separately, along with dyspnea and expectoration. It resulted as statistically significant, with an OR of 2.18 determining its difference between patients with and without COPD. Clinically, we interpreted this in the context of the patient with some IT category as a variable that influenced spirometry performance. López-Varela et al. [22] include it as one of the criteria structuring an algorithm applicable to patients with a history of tobacco use seen in primary care who require spirometry. Zaniku et al. [23] report that 48.8% of their sample experienced cough, identifying it as a pivotal symptom in 72.5% and 46% of patients with and without COPD.

CONCLUSION

The estimated population prevalence of spirometry and COPD patients in the UMF hosting the research was 0.9% and 0.3%, respectively; the prevalence of COPD among patients with spirometry was 29.2%. Among the compared variables, the referral algorithm was one that, in the bivariate analysis, showed significant differences between patients with and without COPD. However, in the logistic regression analysis, it was excluded, being considered a variable that did not influence the performance of pre-diagnostic spirometry. The IT and the variable cough were significantly different between patients with and without COPD, both—particularly the former with each of its categories—also influencing the performance of spirometry and increasing its likelihood. It is concluded that IT and the variable cough, in the context of a patient who is or has been smoking, were significantly different between patients with and without COPD and influenced the performance of pre-diagnostic spirometry. The algorithm did not influence its performance.

The research has limitations, such as the exclusion from the logistic analysis of the variables "exercise tolerance," considered a referral criterion, and chest X-rays, which required restructuring the referral algorithm. Another limitation would be the acceptance of the COPD diagnosis without considering potential false positives and false negatives produced by the spirometry technique used, which could bias its prevalence.

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