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ORIGINAL RESEARCH

Prevalence and Risk Factors of Chronic Obstructive Pulmonary Disease Among Users of Primary Health Care Facilities in Morocco

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Background: Chronic obstructive pulmonary disease (COPD) is a major public health problem. In Morocco, few studies have focused on COPD in primary health care facilities, whose main mission is prevention. The aim of our work is thus to assess the prevalence of COPD and to study the factors associated with this silent disease among users of health care facilities in Morocco.

Methods: This is a cross-sectional observational study of participants aged 40 and over. Data were collected by questionnaire. Pulmonary function testing was conducted using a spirometer before and after administration of a bronchodilator. COPD was defined as fixed ratio of the post-bronchodilator forced expiratory volume in 1 second / forced vital capacity less than 0.7. Logistic regression models were applied to define factors associated with COPD.

Results: From 550 participants aged 40 and over, we selected only 477 patients with exploitable spirometry results for inclusion in the final analysis. The mean age of participants was 54.91±11.92 years, and the female/male ratio was 1.59. The prevalence of COPD was 6.7% (95% CI; 4.6 to 9.3%), and was higher in men than in women (11.4% vs 3.8%, p=0.002). The prevalence of COPD increased significantly with age, from 3.3% in those aged 40 to 49 to 16.9% in those aged 70 and over (p=0.001). Current smokers had a higher prevalence of COPD than former and never smokers. Age, smoking, asthma diagnosis and childhood hospitalization for lung disease were risk factors associated with the development of COPD. Only 6.25% of participants identified as having COPD had previously been diagnosed with COPD.

Conclusion: COPD remains largely under-diagnosed among primary care consultants in Morocco. Efforts for early detection and promotion of prevention of the main risk factors need to be intensified in order to reduce the burden of this silent pathology on a national scale.

Keywords: chronic obstructive pulmonary disease, Morocco, network of primary health care facilities, prevalence, risk factors, spirometry

Introduction

Chronic obstructive pulmonary disease (COPD) is a heterogeneous lung disorder characterized by chronic respiratory symptoms caused primarily by airway and/or alveolar abnormalities, leading to progressive airflow limitation.[1] It is considered a major public health problem and a leading cause of morbidity and mortality.[2] Data from the GBD (Global Burden of the Disease) study stipulate that 213 million cases of COPD were recorded worldwide in 2016.[3] Furthermore, in 2017, 3.2% of people worldwide died from COPD.[4] COPD negatively impacts quality of life due to exacerbations and associated comorbidities, and is responsible for a significant economic burden.[5,6] Previous

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systematic reviews and meta-analyses have shown a high prevalence of COPD worldwide, ranging from 10.3% to 12.16%.[7,8] Thus, these estimates are likely to increase in the coming years due to continued exposure to risk factors and an ageing population.[9]

COPD is a heterogeneous, complex and multifactorial condition.[1] Cigarette smoke is considered an important cause implicated in the development of an obstructive disorder.[10] However, non-smokers can also develop COPD.[11,12] Exposure to dust in the workplace, outdoor or indoor air pollution, asthma and low body mass index are among the risk factors associated with COPD in non-smokers.[1]

The diagnosis of COPD is based on a pulmonary function test called spirometry. Indeed, spirometry is considered the gold standard for diagnosing irreversible airway limitation and monitoring the progression of the disease.[1,13] The best-known diagnostic criteria is that of the Global Initiative for Obstructive Lung Disease (GOLD), which confirms the diagnosis if the ratio of mean expiratory volume in one second to forced vital capacity is less than 0.7. Other societies suggest comparing measured values with so-called reference values measured from the healthy non-smoking population.[1] Worldwide, COPD remains an under-diagnosed disease.[7,8,14] The main reason for under-diagnosis is the under-use of spirometry.[15] Indeed, the unavailability of spirometry in care units, the high costs of the test, the absence of trained personnel to conduct a quality test and the difficulty of interpreting the results are all factors that limit the use of spirometry in clinical practice to confirm COPD cases and promote early diagnosis.[16]

COPD is a major health problem in Morocco, with prevalence estimates reaching 12.6%.[17] However, it remains under-studied and under-diagnosed.[17] Factors associated with the development of obstructive disorders are on the increase. The prevalence of smoking is increasing in Morocco.[18] Moreover, Moroccan customs favor exposure to biomass smoke, recognized as a major contributor to COPD, particularly among women who continue to use biofuels for cooking and heating.[19] Studies on the spirometry-based prevalence of this lung condition in Morocco are scarce. Moreover, understanding of the factors involved in its development is limited. Consequently, work to study COPD through spirometric measurements is needed to develop appropriate prevention and management strategies on a national scale. Thus, the aim of this study is to estimate the prevalence of COPD based on spirometry, and to identify the risk factors associated with this disease among users of health centers in Morocco. These health centers are part of the network of primary healthcare establishments, which constitute the first interface between the population and the healthcare system. It is also through this network that the various prevention strategies are implemented.

Materials and Methods

Study Type and Period, Sampling, Inclusion and Exclusion Criteria of Participants

This was a cross-sectional observational study conducted from January to July 2023 in primary care facilities in the province of Settat. The sample size was calculated based on the known prevalence of COPD in Morocco (12.6%),[17] an alpha risk of 0.05 and a desired precision on either side of the proportion or width of the 5% confidence interval, and by applying the following formula ($N= (Z\alpha)^2 \times (P.\ Q)/d^2$). Where: N= sample size; P=COPD prevalence; Q =1-P; d= estimate precision.

Thus, the minimum number of participants required for the study is 167.

Inclusion criteria were primary care users aged 40 and over, who agreed to answer a questionnaire and to perform a spirometry test before and after administration of a bronchodilator. Exclusion criteria included age under 40, presence of one or more contraindications to spirometry, inability to perform a spirometry test, and refusal to participate in the study.

Data Collection

All study participants completed a face-to-face questionnaire. The questionnaire covered socio-demographic characteristics (age, sex, marital status, residence area, education level, insurance status), respiratory symptoms (cough, phlegm, wheezing and dyspnoea), potential COPD risk factors (smoking, including passive smoking, exposure to biomass smoke, workplace exposures, history of respiratory disease and family history of respiratory disease), as well as comorbidities.

Participants' height was measured with a stadiometer from the head (vertex) to the soles of the feet and recorded in cm. Weight was measured on a scale and recorded in Kg. Body mass index (BMI) was categorized according to the

following World Health Organization (WHO) classification: Underweight = BMI <18.5 Kg/m^2; Normal weight = BMI: 18.5–24.9 Kg/m^2; Overweight = BMI: 25 −29.9 Kg/m^2; Obese = BMI ≥ 30 Kg/m^2.[20]

For greater objectivity, dyspnea was assessed using the modified Medical Research Council scale (Mmrc). Participants were asked to select the statement that best described their perception of breathlessness, from among the five statements in the scale.[21] Smoking status was categorized into current smokers, former smokers and never-smokers. Participants were considered current smokers if they were smoking at the time of the survey or had quit smoking less than three months prior to the survey and smoked more than 100 cigarettes in their lifetime. Former smokers were defined as those who had quit smoking more than three months before the survey and smoked more than 100 cigarettes in their lifetime. Never-smokers were defined as those who had never smoked or who had smoked fewer than 100 cigarettes in their lifetime.[22] Tobacco consumption is converted into pack-years for current and former smokers. Exposure to passive smoking was defined by an affirmative response to the question of whether the participant was exposed to cigarette smoke at home. Occupational exposure was identified by asking participants whether they were exposed to dusts, gases, smoke and fumes at work. Biomass exposure was defined as home exposure to biomass smoke used in cooking/and or heating. Family history of respiratory disease was defined by an affirmative response to the question "Has a doctor or health professional ever told your father, mother, brother or sister that they had emphysema, chronic bronchitis, COPD or asthma?". The diagnosis of asthma was defined by an affirmative response to the question "Has a doctor or other health professional ever told you that you have asthma?".

Pulmonary function testing is carried out by personnel trained in the use of spirometers (Spirolab MIR® model, Rome, Italy) in accordance with American Thoracic Society (ATS) recommendations on pulmonary function normalization.[23,24]

COPD was defined as a post-bronchodilator forced expiratory volume ratio in 1 second to forced vital capacity less than 0.7.[1,24] In the absence of national reference data, percentage predicted values were estimated based on the National Health and Nutrition Examination Survey (NHANES) III reference equation.[25]

Statistical Analysis

Measurement data were summarized as percentages for qualitative variables, and as means ± standard deviation for quantitative variables. Statistical significance was assessed using the Chi-squared test for qualitative variables. Logistic regression models were constructed to assess the relationship between potential risk factors and COPD. All analyses were performed using SPSS software (IBM SPSS Statistics 21). Values of $P<0.05$ were considered statistically significant.

Ethical Considerations

The study was conducted in accordance with the Declaration of Helsinki. Participants were fully informed of the purpose of the study. The study protocol was approved by the Moroccan Association for Research and Ethics (approval number IRB00012973). All participants gave verbal informed consent to participate.

Results

Study Sample Characteristics

A total of 477 participants had met the inclusion criteria set by the present study (Figure 1).

The mean age of participants was 54.91± 11.9 years, and mean body mass index was 28.28 ± 5.26 kg / m^2. Over half the participants were women (61.4%). Almost half (47.6%) were illiterate. The vast majority (86%) of patients were unemployed, and just over half (54.1%) lived in urban areas. With regard to tobacco consumption, 13.8% of respondents were former smokers and 7.3% were current smokers. The average number of packs smoked per year was 4.97 ±15.13. In addition, 36.7% of respondents had been exposed to biomass smoke and 12.2% had reported exposure to dusty jobs. Of the 477 participants, only three reported having undergone pulmonary function testing. Table 1 summarizes the general characteristics of the study participants.

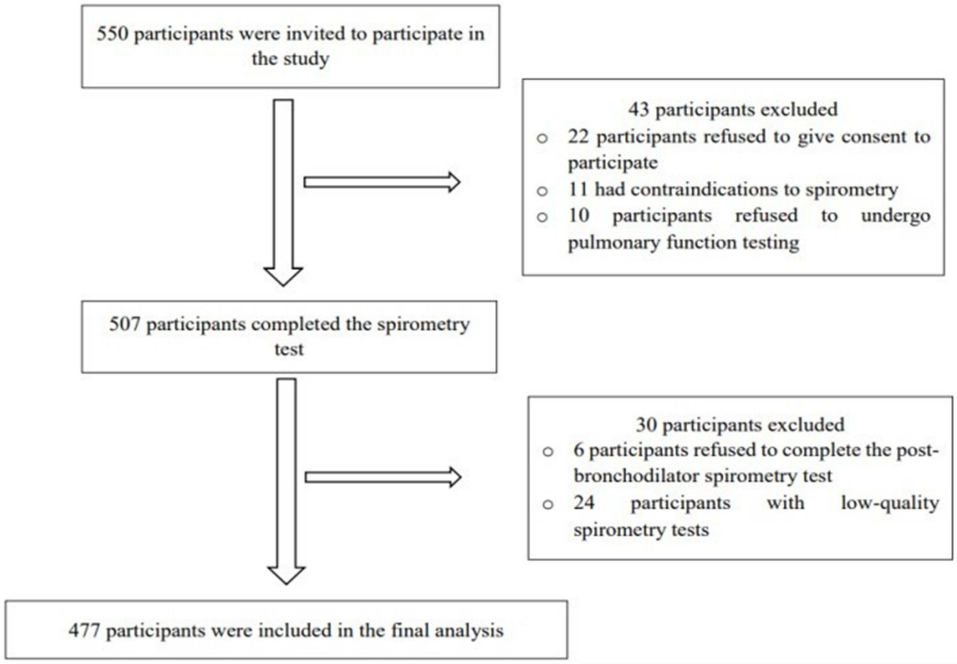

Figure 1 Participant retention criteria over the course of the study.

Pulmonary Function

In this study, spirometry before and after bronchodilator administration was performed for all 477 study participants. The following parameters were recorded: forced expiratory volume in six seconds (FEV6), forced

Table 1 General Characteristics of the Study Sample

	Number	Percentage
Gender		
Men	184	38.6
Female	293	61.4
Age categories		
40–49 years	184	38.6
50–59 years	119	24.9
60–69 years	103	21.6
≥70 years	71	14.9
BMI		
Underweight	6	1.3
Normal weight	127	26.6
Overweight	175	36.7
Obese	169	35.4

(*Continued*)

Table 1 (Continued).

	Number	Percentage
Education level		
Illiterate	227	47.6
Primary	121	25.4
College	62	13
Secondary	45	9.4
Higher education	22	4.6
Residence		
Urban	258	54.1
Rural	219	45.9
Marital status		
Single	43	9
Married	381	79.9
Divorced	22	4.6
Widowed	31	6.5
Employment		
Yes	67	14
No	410	86
Health coverage		
Yes	413	86.6
No	64	13.4
Smoking status		
Never smokers	376	78.8
Former smokers Current smokers	66 35	13.8 7.3
Passive smoking		
Yes	61	12.8
No	416	87.2
Cough		
Yes	91	19.1
No	386	80.9
Phlegm		
Yes	69	14.5
No	408	85.5

(*Continued*)

Table 1 (Continued).

	Number	Percentage
Wheezing		
Yes	58	12.2
No	419	87.8
Dyspnea		
Degree 0	237	49.7
Degree 1	187	39.2
Degree 2	30	6.3
Degree 3	22	4.6
Degree 4	1	0.2
Occupational exposure to dust		
Yes	58	12.2
No	419	87.8
Exposure to biomass		
Yes	175	36.7
No	302	63.3
Diagnosis of asthma		
Yes	24	5
No	453	95
Family history of respiratory disease		
Yes	51	10.7
No	426	89.3
Childhood hospitalization for lung disease		
Yes	16	3.4
No	461	96.6
Comorbidities		
Yes No	211 266	44.2 55.8
Spirometry test already performed		
Yes	3	0.6
No	474	99.4

Abbreviation: BMI, Body mass index.

expiratory volume in one second (FEV1), FEV6/FVC, peak expiratory flow (PEF), expiratory flow between 25% and 75% of forced vital capacity (DEM25-75), forced vital capacity (FVC) and FEV1/FVC. The mean distribution of pulmonary function values for study participants is shown in Table 2.

Table 2 Mean ± Standard Deviation Distribution of Spirometric Parameters of Study Participants

	Pre-Bronchodilator Spirometry Parameters	Post-Bronchodilator Spirometry Parameters
FEV6 (mean ± standard deviation) (L)	2.74 ±0.61	2.81 ±0.60
FEV1 (mean ± standard deviation) (L)	2.23 ±0.51	2.35 ±0.50
FEV6/FVC (mean ± standard deviation) (%)	81.73 ±8.04	83.91 ±7.33
PEF (mean ± standard deviation) (L/min)	4.83 ±1.37	5.67 ±1.35
DEM 25–75 (mean ± standard deviation) (L/min)	2.37 ±0.85	2.82 ±0.94
FVC (mean ± standard deviation) (L)	2.75 ±0.61	2.82 ±0.60
FEV1/FVC (mean ± standard deviation) (%)	81.47 ±8.22	83.69 ±7.46

Abbreviations: FEV6, Forced expiratory volume in six seconds; FEV1, Forced expiratory volume in one second; PEF, Peak expiratory flow; PEF25-75, Forced expiratory flow between 25% and 75% of forced vital capacity; FVC, Forced vital capacity.

Prevalence of Chronic Obstructive Pulmonary Disease

Among the 477 study participants, there were 32 with COPD, generating a prevalence of 6.7% (95% CI; 4.6–9.3%). According to gender, the prevalence of COPD was higher in men than in women (11.4% vs 3.8%; p=0.002). The prevalence of irreversible airway obstruction increases significantly with age. The total prevalence of COPD in the 40–49 age group was 3.3%, and reached 16.9% among people aged 70 and over (p=0.001). The prevalence of COPD differed significantly according to smoking status, and was 3.7%, 15.2% and 22.9% (p=0.000) respectively among never-smokers, former smokers and current smokers. A previous diagnosis of asthma, a family history of respiratory disease, childhood hospitalization for lung disease and a low level of education were significantly correlated with the increased prevalence of COPD (P<0.05). Analyses according to area of residence, passive smoking, childhood exposure to tobacco smoke, body mass index, occupational exposure, biomass smoke exposure and comorbidities revealed no differences in COPD prevalence among the subgroups (differences were not statistically significant P>0.05). Of the 32 patients identified as affected, only two had been previously diagnosed with COPD, resulting in an under-diagnosis rate of 93.75% in primary care units in Settat province. The prevalence of COPD according to the studied factor is presented in Table 3.

Table 3 Prevalence of COPD According to Studied Factors (N=477)

	COPD		Prevalence (%)	Univariate Analysis		Multivariate Analysis	
	Yes Number (%)	No Number (%)		Crude OR (95% CI)	P-value	Adjusted OR (95% CI)	P-value
Total sample	32 (6.7)	445 (93.3)	6.7	–	–	–	–
Gender							
Female	11 (3.8)	282 (96.2)	3.8	Reference group	0.002	Reference group	0.4
Men	21 (11.4)	163 (88.6)	11.4	0.3 (0.14–0.64)		0.54 (0.13–2.24)	
Age categories							
40–49 years	6 (3.3)	178 (96.7)	3.3	Reference group		Reference group	
50–59 years	6 (5)	113 (95)	5	6.03 (2.16–16.78)	0.001	5.19 (1.27–21.10)	0.02
60–69 years	8 (7.8)	95 (92.2)	7.8	2.49 (0.84–7.41)	0.09	3.06 (0.78–11.93)	0.1
≥ 70 years	12 (16.9)	59 (83.1)	16.9	1.57 (0.49–5.00)	0.44	1.48 (0.38–5.73)	0.56

(*Continued*)

Table 3 (Continued).

	COPD		Prevalence (%)	Univariate Analysis		Multivariate Analysis	
	Yes Number (%)	No Number (%)		Crude OR (95% CI)	P-value	Adjusted OR (95% CI)	P-value
Residence							
Urban	14 (5.4)	244 (94.6)	5.4	Reference group	0.22		
Rural	18 (8.2)	201 (91.8)	8.2	0.64 (0.31–1.32)			
Education level							
Higher education	0 (0)	22 (100)	0	Reference group		Reference group	
Secondary	0 (0)	45 (100)	0	0.00 (0.00)	0.99	0.00 (0.00)	0.99
College	4 (6.5)	58 (93.5)	6.5	0.00 (0.00)	0.99	0.00 (0.00)	0.99
Primary	4 (3.3)	117 (96.7)	3.3	0.58 (0.19–1.74)	0.33	0.55 (0.11–2.67)	0.46
Illiterate	24 (10.6)	203 (89.4)	10.6	0.28 (0.09–0.85)	0.02	0.49 (0.14–1.7)	0.26
BMI classification							
Obese	7 (4.1)	162 (95.9)	4.1	Reference group		Reference group	
Overweight	8 (4.6)	167 (95.4)	4.6	0.21 (0.02–2.10)	0.18	0.99 (0.03–32.25)	0.99
Normal weight	16 (12.6)	111 (87.4)	12.6	0.24 (0.02–2.29)	0.21	0.94 (0.03–29.24)	0.97
Underweight	1 (16.7)	5 (83.3)	16.7	0.72 (0.07–6.57)	0.77	1.99 (0.06–63)	0.69
Smoking status							
Never -smokers	14 (3.7)	362 (96.3)	3.7	Reference group		Reference group	
Former smokers	10 (15.2)	56 (84.8)	15.2	7.66 (2.95–19.86)	0.000	8.57 (1.81–40.48)	0.007
Current smokers	8 (22.9)	27 (77.1)	22.9	4.61 (1.95–10.90)	0.000	2.56 (0.61–10.72)	0.19
Passive smoking							
No	28 (6.7)	388 (93.3)	6.7	Reference group	0.96		
Yes	4 (6.6)	57 (93.4)	6.6	1.02 (0.34–3.04)			
Childhood exposure to tobacco smoke							
No	20 (5.5)	342 (94.5)	5.5	Reference group	0.07	Reference group	0.96
Yes	12 (10.4)	103 (89.6)	10.4	0.50 (0.23–1.06)		0.97 (0.36–2.63)	
Occupational exposure to dust							
No	28 (6.3)	414 (93.7)	6.3	Reference group	0.25		
Yes	4 (11.4)	31 (88.6)	11.4	0.52 (0.17–1.59)			
Exposure to biomass							
No	20 (6.6)	282 (93.4)	6.6	Reference group	0.92		
Yes	12 (6.9)	163 (93.1)	6.9	0.96 (0.45–2.02)			
Family history of respiratory disease							
No	25 (5.9)	401 (94.1)	5.9	Reference group	0.04	Reference group	0.26
Yes	7 (13.7)	44 (86.3)	13.7	2.55 (1.04–6.23)		2.10 (0.56–7.84)	

(*Continued*)

Table 3 (Continued).

	COPD		Prevalence (%)	Univariate Analysis		Multivariate Analysis	
	Yes Number (%)	No Number (%)		Crude OR (95% CI)	P-value	Adjusted OR (95% CI)	P-value
Diagnosis of asthma							
No	21 (4.6)	432 (95.4)	4.6	Reference group	0.000	Reference group	0.000
Yes	11 (45.8)	13 (54.2)	45.8	17.4 (6.97–43.44)		24.53 (5.87–102.41)	
Childhood hospitalization for lung disease							
No	26 (5.6)	435 (94.4)	5.6	Reference group	0.000	Reference group	0.03
Yes	6 (37.5)	10 (62.5)	37.5	10.03(3.38–29.75)		8.68 (1.20–62.85)	
Comorbidities							
No	15 (5.6)	251 (94.4)	5.6	Reference group	0.29		
Yes	17 (8.1)	194 (91.9)	8.1	0.68 (0.33–1.40)			

Abbreviations: COPD, Chronic obstructive pulmonary disease; BMI, Body mass index.

Factors Associated with Chronic Obstructive Pulmonary Disease

In univariate analysis, we observed that gender, age, low level of education, body mass index, smoking, childhood exposure to tobacco smoke, family history of respiratory disease, previous diagnosis of asthma and childhood hospitalization for lung disease were significantly associated with COPD (Table 3), and were used as independent variables in multivariate analysis.

Multivariate logistic regression analyses showed that age, smoking, a previous diagnosis of asthma and childhood hospitalization for lung disease were factors significantly associated with COPD (Table 3).

Clinical Features of Chronic Obstructive Pulmonary Disease

The prevalence of COPD was significantly increased in people with symptoms of cough, phlegm, wheezing and in those with advanced stages of dyspnoea as measured by the modified Medical Research Council. The prevalence of COPD according to participants' clinical characteristics is shown in Table 4.

Discussion

The aim of this study is to determine the prevalence of COPD based on spirometry in the network of primary care facilities in the province of Settat, Morocco, and to identify the factors associated with this pathology. To our knowledge, this is the first study to be carried out at this site.

The spirometry-confirmed prevalence of COPD among people aged 40 and over attending the network of primary care facilities was around 6.7%. This estimate is lower than that found by Rhazi et al,[17] who revealed a COPD prevalence of 12.6% among people in the same age group in the city of Fez. The discrepancy observed could be attributed to the different context in which the study was carried out. Our study was conducted in primary care units attended mainly by patients with fewer respiratory symptoms. Another possible explanation for the lower COPD prevalence observed in our study is the low proportion of smokers and elderly people in the study sample, known to be high-risk categories for developing COPD.

Estimation of COPD prevalence by gender indicates that men were more affected than women (11.4% vs 3.8%; p=0.002). This result is similar to that reported by Varmaghani et al, who reported a prevalence of 15.70% in men and 9.93% in women.[8] In another study conducted in China, the prevalence of COPD was 18.6% and 6.6% in men and women respectively.[26] Similarly, Leung et al reported that 18.3% of men in Canada had COPD, compared with 10.9% of

Table 4 Clinical Features of COPD

Respiratory Symptoms	No COPD (n=445) Number (%)	COPD (n=32) Number (%)	p-value
Cough			
No	380 (98.4)	6 (1.6)	0.000
Yes	65 (71.4)	26 (28.6)	
Phlegm			
No	397 (97.3)	11 (2.7)	0.000
Yes	48 (69.6)	21 (30.4)	
Wheezing			
No	406 (96.9)	13 (3.1)	0.000
Yes	39 (67.2)	19 (32.8)	
Dyspnea			
Degree 0	234 (98.7)	3 (1.3)	0.000
Degree 1	176 (94.1)	11 (5.9)	
Degree 2	22 (73.3)	8 (26.7)	
Degree 3	13 (59.1)	9 (40.9)	
Degree 4	0 (0)	1 (100)	

Abbreviation: COPD, Chronic obstructive pulmonary disease.

women.[27] The difference observed is largely explained by the higher prevalence of tobacco consumption in men compared with women.[28] In our study, the vast majority of participants with a history of smoking were male.

In line with national and international studies, age was identified as a risk factor for COPD in our study. The prevalence of COPD jumped from 3.3% among people aged 40 to 49 to 16.9% among those aged 70 and over (p=0.001). It is now well established from various studies that age is an important risk factor for COPD.[9,29] Indeed, lung function parameters tend to decline with age. A cohort study by Kim and his team revealed a significant decline in forced expiratory volume in one second among people aged over 67.[30] Thus, in the elderly, several changes that are responsible for the development of an obstructive disorder set in.[31] Consequently, COPD must be actively and early sought in the elderly for effective disease management.

Smoking has been identified as an independent risk factor for COPD. This finding is consistent with data from several studies which have suggested that tobacco consumption is an important cause of the development of permanent airway obstruction.[32,33] Indeed, contact of cigarette smoke with the airways induces the release of inflammatory mediators that are responsible for the development of COPD.[34] Consequently, combating the smoking epidemic must be a national health priority for public authorities, in order to reduce smoking prevalence, protect public health and encourage smokers to quit.

In the present work, we found that asthma is a risk factor associated with the development of spirometry-confirmed COPD. A similar result was found by Leung et al, who showed that Canadian participants with a history of physician-diagnosed asthma were at high risk of developing COPD (OR=3.03; 95% CI 2.24–4.49).[27] Similarly, in Tunisia, it has been reported that participants with a history of asthma are 10.62 times more likely to develop COPD.[35] Other researchers have referred to the asthma-COPD overlap syndrome known by the acronym (ACO), which indicates the presence of both asthma and COPD. Evidence to date shows that ACO is highly responsive and poses a significant burden. Indeed, studies have shown that participants with ACO syndrome have more respiratory symptoms, a high risk of

exacerbations and reduced quality of life.[36] These data highlight the importance of looking for the presence of an obstructive disorder in patients with asthma, in order, on the one hand, to establish the differential diagnosis with COPD and, on the other, to search for any possible association. The role of childhood hospitalization for lung disease in the development of COPD was confirmed by our study. A similar finding has been suggested by previous evidence showing that childhood hospitalization for lung disease increases the risk of COPD morbidity.[27,37] Other nationwide studies have identified other risk factors associated with the development of COPD. Benslimane et al observed a 25% reduction in the prevalence of COPD in obese individuals.[38] In addition, Atassi et al found a statistically significant association between low socio-economic status and the development of COPD.[39] Taken together, these data demonstrate the importance of other risk factors in the development of COPD among non-smokers.

Another finding of our study is that COPD is largely underdiagnosed in patients attending the network of primary care facilities in Morocco. Only two participants out of the 32 cases identified as affected had ever been diagnosed with COPD. On close examination of the scientific literature, COPD remains an under-diagnosed disease worldwide.[14,40] A possible reason for the high rate of under-diagnosis is the under-utilization of spirometry, considered the key element in confirming the diagnosis of an obstructive disorder. In our study, only three participants had ever undergone pulmonary function testing by spirometry. Its absence in facilities dependent on the primary care network, the lack of staff trained to perform a quality test, and the difficulty of interpreting results, are among the factors that limit the use of spirometry to make the diagnosis of non-permanent airflow limitation, leading to erroneous and delayed diagnosis of the disease.[14,15,40,41] We therefore suggest that the use of spirometers should be integrated into daily practice in order to effectively detect COPD at an early stage and thus reduce its impact on a national and even international scale.

Our results reported that the prevalence of COPD was significantly increased in people with symptoms of cough, phlegm production, wheezing and dyspnoea (p=0.000). Therefore, the presence of respiratory symptoms should raise the possibility of COPD and be confirmed by spirometry in people with such symptoms.

The present study has a number of limitations. Firstly, the success of spirometry tests depends on the willingness and cooperation of participants, so measured values may not reflect actual measurements. However, this limitation was largely resolved by excluding low-quality spirometry tests. Secondly, several investigated factors in this study were self-reported and the answers provided may be biased since they depend on the memory quality of the respondents, especially among the elderly. Finally, the small number of participants among certain subgroups may reduce the statistical power needed to establish significant associations. On the other hand, our study has a number of strengths. To our knowledge, it is the first study to assess the prevalence and risk factors of COPD in a primary care setting in Morocco. In addition, the prevalence of COPD was estimated according to the GOLD criteria (fixed ratio), considered to be the most widely used and effective criteria for defining permanent airway obstruction.[1] Also, our study, in contrast to many studies in this area,[42–45] included post-bronchodilator assessments for all participants, which increases the accuracy and reliability of the documented results.

Conclusion

This study showed that the prevalence of COPD among people aged 40 and over attending primary care facilities in Morocco is 6.7%. Age, smoking, a previous diagnosis of asthma and childhood hospitalization for lung disease were independently associated with the development of COPD. Moreover, due to a lack of resources, COPD remains largely under-diagnosed. The promotion of early detection, through the creation of questionnaire-based tests to replace spirometry, remains a good alternative that will remedy the lack of material resources needed to screen for this disease in primary care establishments. Promoting prevention of the main risk factors associated with the development of COPD must also be a national priority, in order to reduce the prevalence of this silent disease, which constitutes a public health problem in Morocco.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically

reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors report no conflicts of interest in this work.

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