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Prevalence of Chronic Obstructive Pulmonary Disease in the Attecoube Lagune Neighborhood of Abidjan (Cote d'Ivoire)

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Abstract

Introduction: Chronic obstructive pulmonary disease (COPD) is a severe, long-term, life-threatening respiratory illness. The aim of this study was to determine the prevalence of COPD and the factors associated with its prevention in the population of the Attecoube Lagune neighborhood of Abidjan, Côte d'Ivoire. **Material and Methods**: A descriptive and analytical cross-sectional study lasting 2 months was carried out in the Attecoube Lagune neighborhood of Abidjan in 2022. A questionnaire was used to collect information on sociodemographic, clinical and environmental characteristics. Baseline spirometry and a beta mimetic test were performed in all subjects surveyed to explore their respiratory function. Data analysis was performed using stata15.1 software. **Results:** A total of 170 residents were surveyed, including 103 women and 67 men, with a sex ratio (M/F) of 0.65. Mean age was 35.92 ± 15.28 years. The most frequent respiratory symptoms were chest tightness (29.41%), dyspnoea (28.82%) and cough (22.35%). The prevalence of COPD was 5.29% among Attecoube Lagune neighborhood residents. Tobacco smoke was strongly associated with COPD [OR = 7, 06; IC95%: 1.00 - 10.60; P < 0.05]. **Conclusion**: Chronic obstructive pulmonary disease (COPD) was strongly associated with tobacco smoke in Attecoube Lagune neighborhood. Awareness-raising campaigns on the dangers of tobacco and health promotion are needed in this commune.

Keywords

Chronic Obstructive Pulmonary Disease, Air Pollution, Attecoube Lagune Neighborhood, Abidjan, Cote d'Ivoire

1. Introduction

Chronic obstructive pulmonary disease (COPD) is a chronic inflammatory respiratory disease characterized by permanent, progressive and non-reversible bronchial obstruction [1]. It is currently a major global public health issue, affecting approximately 329 million people worldwide, or nearly 5% of the global population [2] [3]. In 2019, COPD was the third leading cause of death globally, with 3.23 million deaths recorded, nearly 90% of which occurred in low- and middle-income countries (LMICs), underscoring its substantial health and economic burden [4].

Beyond its contribution to mortality and morbidity, COPD poses a significant barrier to socio-economic development, particularly in LMICs, due to its impact on productivity, healthcare expenditure, and patients' quality of life [5]. In sub-Saharan Africa, where access to specialized care remains limited [6], the disease is largely under-recognized, underdiagnosed, and often identified at an advanced stage, typically during acute exacerbations [7] [8]. The few available data are mostly hospital-based, with prevalence rates of 6.45% in Burkina Faso, 4.13% in Senegal, and 2.47% in Côte d'Ivoire [9].

In Côte d'Ivoire, the few published studies have focused mainly on hospitalized populations [10] [11], overlooking the potential extent of the disease in community settings. In a precarious urban context such as that of Attecoube Lagune, a sub-neighborhood of the Attecoube commune in Abidjan [12], characterized by high population density, unfavourable living conditions and chronic exposure to risk factors such as air pollution, use of biomass for cooking and smoking, the local impact of COPD could be significant but remains poorly understood.

This study aimed to determine the prevalence of COPD and identify its associated risk factors in the population of Attecoube Lagune, with a view to informing community-level public health interventions.

2. Material and Methods

2.1. Study Framework

Attecoube is one of the thirteen municipalities in the District of Abidjan, located between the municipalities of Adjamé and Yopougon. It has a population of 207,586 and covers an area of 68.2 km^2. Attecoube is divided into right and left banks, and comprises 35 neighborhoods and 5 villages. Economic life in this commune is essentially dominated by trade and craft activities (**Figure 1**).

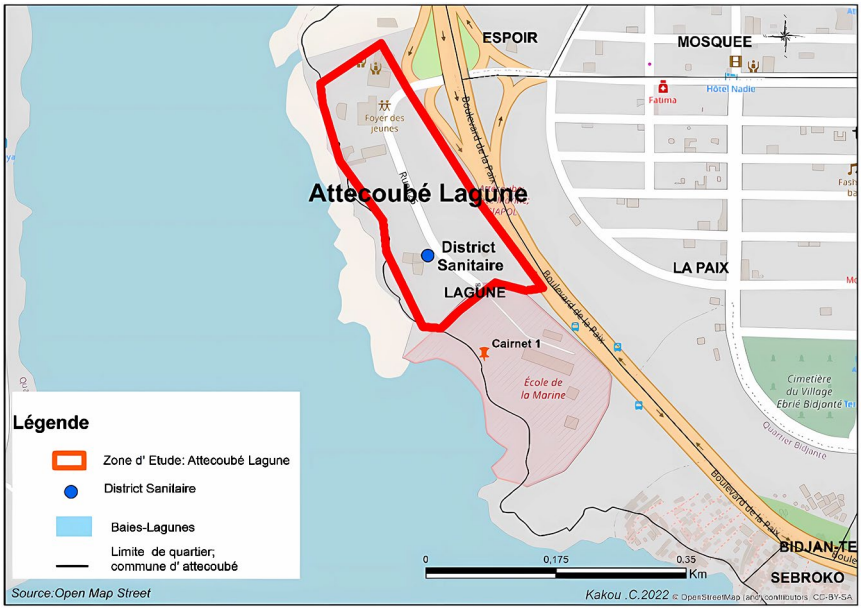

Figure 1. Overview of the study area.

2.2. Type of Study

This was a descriptive and analytical cross-sectional study conducted over a two-month period from February 15, 2022 to April 15, 2022 in the Attecoube Lagune neighborhood.

2.3. Population

The study population was made up of residents of the Attecoube Lagune neighborhood, living between Banco Bay and Peace Boulevard.

Inclusion criteria

Residents aged 18 and over who gave a positive opinion were included in the study.

Non-inclusion criteria

Pregnant women, sick people, non-consenting residents and anyone unable to perform a spirometry test were excluded from the study.

2.4. Sampling and Sample Size

2.4.1. Sample

The study was conducted according to a systematic sampling plan with a random starting point, in order to maximize the representativeness of the Attecoube Lagune population.

Starting from the center of the neighborhood, the right-hand side of the Centre d'Entraînement Naval (CNI) was randomly selected as the starting point for data collection. The aim of this randomization was to eliminate any initial selection bias and ensure fair coverage of the territory.

From this point, a systematic progression was followed in the direction of the interchange. A sampling step of 2 concessions was applied, meaning that every

second concession was selected on either side of the progression axis (right and left). This scheme ensured balanced geographical dispersion and improved the spatial representativeness of the sample.

In each concession visited, all eligible persons (aged 20 or over, resident for at least six months and consenting) were fully enrolled. This method of exhaustive sampling within the selected units reduces the risk of intra-concession bias.

2.4.2. Sample Size

The minimum sample size was calculated using Epi Info's StatCalc software version 7.2.1, taking into account the following parameters:

- Total population of Attecoube Lagune = 2700 (Adjamé-Plateau-Attecoube District Report, 2021).

- Prevalence of respiratory diseases in Attecoube = 12% (District Adjamé-Plateau-Attecoube report, 2021).

- Alpha risk = 5%.

- Confidence interval = 95%.

This calculation resulted in a minimum sample size of 153. In anticipation of potential non-responses and exclusions, a 10% margin was added, bringing the sample size to 168. In the end, 170 individuals were included, ensuring sufficient statistical power for the planned analyses.

2.5. Data Collection

2.5.1. Interviewer Training and Quality Control of Data Collection

For this study, three interviewers, all medical students, were selected to carry out the data collection. To ensure the quality and standardization of the procedure, a two-day face-to-face training session was organized before the actual start of the survey.

The training session took place at the Institut National de Santé Publique (INSP) in Abidjan and was led by the principal investigator and a field epidemiology expert. The training content covered the following elements:

- Presentation of the research protocol (objectives, inclusion/exclusion criteria, sampling plan);

- Procedures for recruiting participants and obtaining informed consent;

- Use of the structured questionnaire, including how to administer it and how to deal with ambiguous responses;

- Awareness of ethical principles in human health research.

At the end of the training, an assessment of the skills acquired was carried out in the form of simulated situations. This phase helped to identify the points to be reinforced before the start of the survey.

In addition, a pre-test of the questionnaire was carried out on February 10, 2022 in the Attecoube Sebroko sub-neighborhood, also in the commune of Attecoube. This pre-test involved 10 households and made it possible to:

- Identify any ambiguities in wording;

- Test the average administration time;

- Validate the logic of the tool and its consistency with field realities.

Following this pre-test, several adjustments were made to the collection medium, notably simplifying certain wordings and clarifying response options.

Finally, throughout the data collection phase, a field supervisor was appointed to make unannounced visits, randomly check completed questionnaires, and assist interviewers in the event of technical or logistical difficulties. The data collected was reviewed daily to identify duplicates, inconsistencies or missing fields. A system of manual double-checking was also put in place before electronic data entry, guaranteeing greater data reliability.

2.5.2. Field Data Collection

As part of this study, three investigators, all students, received two days' classroom training on the research protocol and the various data collection tools and media. This training verified their understanding of research procedures (recruitment, consent and follow-up). In addition, a pre-test of the data collection form was carried out on February 10, 2022 in the Attecoube Sebroko neighborhood, and enabled the various shortcomings to be corrected. In addition, spirometry was carried out by a team consisting of a nurse and a doctor, both specialists in functional exploration and highly experienced.

Data collection took place in two phases.

The first phase involved completing a questionnaire inspired by those of the European Coal and Steel Community (ECSC), the British Medical Research Council (BMRC) and the American Thoracic Society (ATS) [13] with each subject included in the study.

The questionnaire collected information on socio-demographic characteristics, length of residence in the neighborhood, smoking habits, degree of exposure to pollution and health data.

The respiratory symptoms sought were those suggestive of asthma or chronic obstructive pulmonary disease (dry cough, wheezing, dyspnea and chest tightness), and rhino conjunctivitis (rhinorrhea, nasal obstruction, nasal tingling, sneezing, lacrimation, ocular redness).

The second phase consisted in performing pulmonary auscultation and spirometry on each subject included in the study. Spirometry was performed using a Winspiro PRO6.5 MIR portable spirometer, followed by a reversibility test after inhalation of a dose of 400-µg per inhalation chamber. This test was carried out in accordance with the recommendations of the American Thoracic Society (ATS) by two technicians (a nurse and a doctor) duly trained to perform it.

The parameters measured were: forced vital capacity (FVC) in liters, forced expiratory volume in one second (FEV1) in liters per second and the Tiffeneau ratio (FEV1/FVC) expressed as a percentage.

The pathological threshold was defined by a fall of more than 20% in FEV1, FVC, the pathological threshold of the Tiffeneau ratio was defined by a fall of more than 12% (FEV1/FVC < 80% of predicted) according to the ATS/ERS Criteria.

The theoretical standard used is that of the African ethnic group incorporated

into the spirometer software, which takes into account the subjects' sex, age, weight and height.

2.6. Operational Definition

- Obstructive ventilatory disorder (OVD) is defined by a FEV1/FVC ratio of less than 80% of predicted.

The severity of the disorder is assessed on the basis of FEV1:

- FEV1 > 80%: mild;
- FEV1 50-80%: moderate;
- FEV1 30-50%: severe;
- FEV1 < 30%: very severe;
- Reversibility of obstruction: gain in FEV1 of more than 12% (relative value) and 200ml (absolute value).

2.7. Data Analysis

Initially, a univariate analysis was conducted to describe the main sociodemographic, clinical and environmental characteristics of the study population. The variables explored included: age, sex, height, weight, smoking habits, body mass index (BMI), length of residence, occupation, level of education, level of exposure to pollution, presence of respiratory symptoms (cough, dyspnea, wheezing, chest tightness), and family history of asthma.

The dependent variable, the presence of chronic obstructive pulmonary disease (COPD), was defined as a non-reversible obstructive ventilatory disorder after inhalation of a beta-2 mimetic bronchodilator, in accordance with the criteria established by the results of spirometry performed on the inhabitants of Attecoube Lagune.

Secondly, a bivariate analysis was performed to explore potential associations between COPD and a set of independent variables: age, sex, smoking, length of residence, level of pollution exposure, occupational activity and level of education.

Finally, a multivariate analysis was performed. Multiple logistic regression was performed to identify factors associated with the presence of COPD. The top-down stepwise selection method was used, including variables with a p-value ≤ 0.20 in the bivariate analysis.

The following variables were introduced into the final model: gender, smoking status, marital status, age group, level of exposure to air pollution and length of residence (the latter two being considered "strength" variables due to their significant impact on COPD). The threshold of significance retained for the modelling was $p < 0.05$.

2.8. Ethical Considerations

Verbal and informed consent was obtained from the respondents, before proceeding with the interviews. For people with no formal education or illiteracy, consent was translated and obtained in the local language (Dioula).

The questionnaire was only administered once consent had been obtained. An-

onymity and confidentiality were respected, and initials were used instead of names. Interviews were conducted in French or the local language, and in private locations to ensure confidentiality. Approval for the study was granted by the internal ethics committee of the National Institute of Public Health and the District Sanitaire Adjamé - Plateau - Attecoube.

3. Results

3.1. Socio-Demographic Characteristics

The study involved a total of 170 participants. The majority of respondents were female (60.6%) and aged 35 or under (56.5%). In addition, 41.8% of participants had completed secondary school or higher, compared with 35.9% who had never attended school. Over half the participants (65.9%) had lived in the study area for more than 10 years and were non-smokers (94.7%). Analysis of body mass index (BMI) revealed individuals of normal weight (48.8%), overweight (21.2%) and obese (26.5%), while a small proportion (3.5%) were underweighted (Table 1).

The study population comprised 103 women and 67 men, with a sex ratio (M/F) of 0.65. Mean age was 35.92 ± 15.28 years. Over 41% of the population had secondary education or higher. Some 66% of residents had lived in the neighborhood for more than 10 years. Smoking status was found in 5.30% of residents, and obesity in over 26% of the population (Table 1).

Table 1. Socio-demographic characteristics of Attecoube Lagune neighborhood residents in 2022.

Characteristics	Staff (N) = 170	Percentage (%)
Gender		
Man	67	39.40
Woman	103	60.60
Age range		
35 years ≤	96	56.50
35 years >	74	43.50
Study level		
None	61	35.90
Primary	38	22.30
Secondary and higher	71	41.80
Time of residence		
10 years ≤	58	34.10
10 years >	112	65.90
Tobacco status		
No	161	94.70
Yes	9	5.30
Body mass index (BMI)		
underweight	6	3.53
Normal weight	83	48.82
Overweight	36	21.18
Obesity	45	26.47

3.2. Prevalence of Respiratory Symptoms among Residents of Attecoube Lagune Neighborhood in 2022

3.2.1. Respiratory Symptoms

The most frequent respiratory symptoms were, in order of importance, chest tightness (29.41%), dyspnea (28.82%), sneezing (22.94%) and cough (22.35%) (Figure 2).

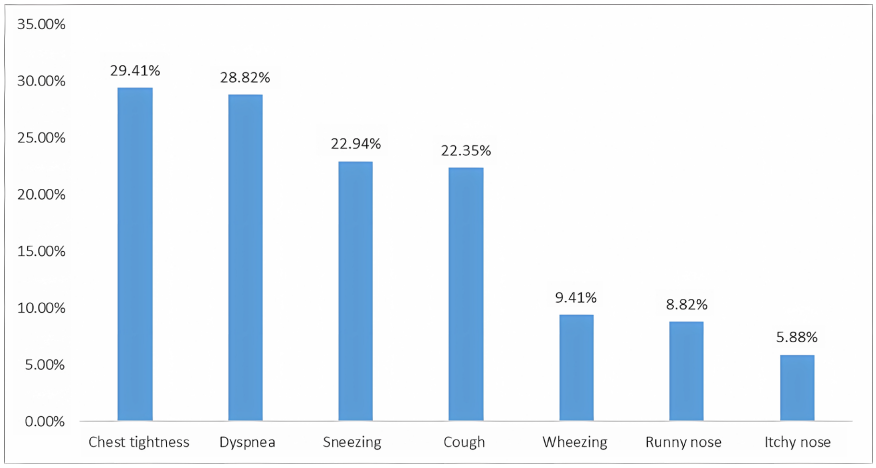

Figure 2. Respiratory symptoms in the Attecoube Lagune neighborhood population.

3.2.2. COPD Prevalence

The prevalence of COPD in the Attecoube Lagune neighborhood population was estimated at 5.29% (Figure 3).

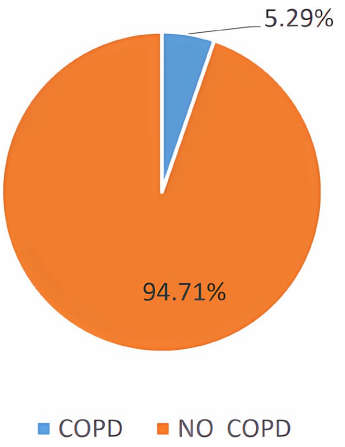

Figure 3. Prevalence of COPD among residents of Attecoube lagune in 2022.

3.3. Factors Associated with COPD in Attecoube Lagune in 2022

Bivariate analysis explored associations between the presence of COPD and several independent variables (Table 2). The results showed that sex, smoking status, marital status and age group appeared to show some tendency towards association with COPD. Although not statistically significant, male sex was more frequently associated with COPD (8.96%), compared with female sex (2.9%) ($p = 0.09$).

Smoking status also showed a trend: 16.7% of COPD sufferers were smokers, compared with only 4.4% of non-smokers (p = 0.13).

Marital status was statistically associated with COPD (p = 0.048), with an increased prevalence in married people (17.7% of COPD cases) than in single people (3.9%). Age showed no statistically significant association, but the proportion of COPD cases was increased in subjects over 45 (9.3%) (p = 0.265). No significant associations were found between COPD and body mass index (p = 0.67), occupation (p = 0.47), length of residence (p = 0.353), level of education (p = 0.215) or exposure to air pollution (p = 0.692) (Table 2).

Table 2. Factors associated with COPD in Attecoube Lagune in 2022.

Caracteristics	COPD (n%)		Total (n%)	P
	No	Yes		
Gender				
Female	100 (62.1)	3 (33.33)	103 (60.59)	0.09
Male	61 (37.89)	6 (66.67)	67 (39.41)	
Occupation				
Others	95 (59.01)	6 (66.67)	101 (59.41)	0.47
Traders	66 (40.99)	3 (33.33)	69 (40.59)	
Level of exposition to air pollution				
weak	37 (22.98)	1 (11.11)	38 (22.35)	0.62
average	64 (39.75)	3 (33.33)	67 (39.41)	
strong	60 (37.27)	5 (55.56)	65 (38.24)	
Smoker				
No	151 (39.79)	7 (77.78)	158 (92.94)	0.13
Yes	10 (6.21)	2 (22.22)	12 (7.06)	
Marital status				
Singles	147 (91.30)	6 (66.67)	153 (90.00)	0.048
Married	14 (8.70)	3 (33.33)	17 (10.00)	
Body mass index (BMI)				
Underweight	6 (3.73)	0 (0.00)	6 (3.53)	
Normal	79 (49.03)	4 (44.44)	83 (48.82)	0.67
Overweight	35 (21.74)	1 (11.11)	36 (21.18)	
Obesity	41 (25.47)	4 (44.44)	45 (26.47)	
Age range (Years)				
18 - 30	77 (47.83)	2 (22.22)	79 (46.47)	
30 - 45	45 (27.95)	3 (33.33)	48 (28.24)	0.265
>45	39 (24.22)	4 (44.44)	43 (25.29)	

3.4. 2022 COPD Risk Factors in Attecoube Lagune

Multivariate logistic regression was used to identify factors associated with COPD in the Attecoube Lagune population. Among the variables studied, only smoking status emerged as being significantly associated with the onset of COPD. Smokers had a significantly increased probability of developing COPD than non-smokers (OR = 7.06; CI95% = 1.00 - 10.60; p < 0.05). Marital status, in particular being married, also appeared to be associated with an increased risk (OR = 5.22; CI95% = 0.96 - 18.43), although this association was not statistically significant (p > 0.05).

In contrast, other variables such as age group, exposure level and length of residence showed no statistically significant association with COPD (Table 3).

Table 3. Risk factors for COPD in Attecoube lagoon neighborhood in 2022.

COPD risk factors	OR	IC95%	P
Age range			
[18 - 30, years]	1		
[30 - 45 years]	1.53	0.22 - 10.7	> 0.67
> 45 ans	2.30	0.33 - 18.2	> 0.37
Level of exposure			
Weak	1		
Average	1.25	0.12 - 13.60	> 0.85
Strong	2.64	0.28 -14.68	> 0.39
Marital status			
Single	1		
Married	5.22	0.96 - 18.43	> 0.05
Time of residence			
> 10 years	1		
≤ 10 years	0.65	0.12 - 3.64	> 0.63
Smoker			
No	1		
Yes	7.06	1.00 - 10.60	< 0.05

4. Discussion

Chronic obstructive pulmonary disease (COPD) is the third leading cause of death worldwide [14]. Almost 90% of COPD deaths occur in low- and middle-income countries [14]. It is often a neglected disease in these countries due to its lack of awareness among patients themselves and medical staff. Moreover, COPD prevalence studies are rare in sub-Saharan Africa in general and specifically in community settings [15]. The aim of this study was to determine the prevalence of COPD and associated factors in order to prevent it in the population of Attecoube Lagune neighborhood in Abidjan. To our knowledge, this community-based study of COPD using spirometry is one of the first of its kind in Côte d'Ivoire.

COPD generally occurs in smokers from the age of 40. However, apart from tobacco, certain factors are likely to induce this condition. In fact, local practices related to COPD may involve a younger population than those in Western contexts [16].

In Africa, for example, exposure to biomass fuels can lead to a high involvement of young subjects in COPD. In fact, just as tobacco smoke is the main risk factor for COPD in developed countries, domestic smoke from biomass combustion is an important risk factor for COPD in developing countries [17].

However, the majority of the population of the Attecoube lagune district lived in precarious conditions and therefore generally used biomass for cooking [11]. In addition, early and prolonged exposure to domestic pollutants, such as biomass smoke from cooking with wood or coal fires, is common from childhood and adolescence in disadvantaged areas like ours. Furthermore, early exposure to harm-

ful agents compromises lung development and accelerates the decline in respiratory function, which naturally decreases after 20 years [18], hence the choice of this age in our study.

The prevalence of COPD was estimated at 5.29% among Attecoube Lagune neighborhood residents. It was decreased, but increased than that obtained in the Cameroon community study, estimated at 2.9% [16], which adopted an age of 19 years, similar to our choice. The difference in prevalence observed could be explained by the definition of COPD adopted in each study. In the present study, the definition of COPD was based on the fixed FEV1/FVC ratio. Whereas in the Cameroon study, COPD was defined as a FEV1/FVC ratio < defined GLI - LLN. In studies using the fixed FEV1/FVC ratio definition, an overestimation of COPD prevalence was observed due to physiological decline with age.

Studies based on the fixed FEV1/FVC ratio carried out in Malawi, Tanzania, Ethiopia and Uganda reported prevalences of 17.8% [15], 17.5% [19], 16.2% [20] and 13.6% [21] respectively. The prevalence of our study was very decreased compared with those of these studies. The difference in prevalence observed between these studies and ours could be due to variations in the study population, sample size and methodology [15].

In our study, the sample size of 170 was very small compared with 734 in Ethiopia [15], 869 in Tanzania [19] and 588 in Uganda [20]. In Uganda, the prevalence of smoking was 36%, well above the prevalence in our study (7.06%). In the Ethiopian, Tanzanian and Malawian studies, the high use of biomass in poorly ventilated dwellings was reported. The combined action of all these factors could explain this marked difference in prevalence.

In contrast, studies based on a defined FEV1/FVC < GLI - LLN ratio revealed decreased prevalences such as those by Pefura.Y et al (4%) in 2016 in Tanzania [20], Kayongo et al (6.22%) in 2017 in Uganda [21].

The prevalence of COPD can vary considerably depending on whether the definition adopted is based on the use of spirometry or not [14].

In some cases, case definitions were based on the British Medical Research Council (BMRC) questionnaire for chronic bronchitis, in which there was an affirmative response to the definition of "daily productive cough for at least three consecutive months for more than two consecutive years", and on a previous diagnosis of COPD by a physician [22]. Two meta-analyses of 13 African studies revealed that prevalences obtained with spirometry were increased than those obtained on the basis of symptoms [14]. The mean prevalence of COPD in symptom-defined cases was estimated at 4%, while those defined by spirometry had a mean prevalence of 13.4% [14]. This could be justified by the fact that only spirometry could objectively diagnose bronchial obstruction. However, some providers did not always position spirometry as first-line treatment, given its non-routine availability [23]. This situation confirms the underestimation of COPD in Africa.

In our study, the prevalence of COPD increased with age. In fact, the preva-

lences were estimated at 2.53%, 6.25% and 9.30% respectively in the age groups [18yrs - 30yrs],]30yrs - 45yrs] and over 45 years. However, this difference was not significant. This variation in COPD with age has been observed in other studies [16] [17]. The prevalence of COPD tended to increase with age, and old age was considered a risk factor for developing COPD [24] [25]. The association of COPD with old age can be attributed to greater exposure to risk factors and a physiological decline in lung function that appears around the age of 30 to 40 [26] [27].

In terms of factors, smoking residents were 7.06 times more likely to develop COPD ($p < 0.05$) than non-smoking residents. Indeed, active smoking is the main risk factor for COPD [28]-[30]. The prevalence of smoking in our study was estimated at 7.06%. This prevalence was increased than that of active smoking (5.66%) obtained in the study by Tetchi *et al.* (2022) carried out in a general population and involving a population ranging in age from 20 to 79 years [30].

Level of exposure to air pollution was not associated with COPD in our study. This could be justified by the fact that air quality was not actually measured. These are subjective data from the questionnaire administered at the surveys.

The main limitation of this study was the absence of air quality measurement. The main strength of this study was the performance of baseline spirometry and beta 2 mimetic testing on all enrolled residents of Attecoube Lagune neighborhood. This is the very first community-based COPD study to use spirometry. Future studies are needed to better characterize this chronic respiratory condition, which appears to be poorly understood and neglected.

5. Conclusions

Chronic obstructive pulmonary disease (COPD) is a chronic, disabling respiratory illness. It is a non-curable but preventable condition. It is strongly associated with tobacco smoke. It would be desirable for the relevant authorities in the commune of Attecoube to undertake concrete anti-tobacco actions in order to offer their residents a better living environment.

At the end of this work and based on our results, we recommend to the competent authorities and environmental program managers to:

1) Adopt a municipal by-law banning smoking in all public buildings, markets, schools and parks within 12 months.

2) Launch an awareness campaign in the Attecoube Lagune neighborhoods, aiming to reach 80% of households within 6 months, through local media, health centers and schools.

3) Put up "smoke-free space" signs in strategic public places over the next 3 months.

4) Train municipal and community workers on COPD and the dangers of smoking to reinforce local communication.

Declarations

Ethical approval

Ethics approval was obtained from the *Comité Scientifique Interne, Institut National de Santé Publique, Abidjan,* Côte d'Ivoire (N˚ 165).

Consent to participate

A written informed consent was obtained from all participants in the study. For people with no formal education or illiteracy, consent was translated and obtained in the local language (Dioula). Participation was voluntary and participants were informed of their right to withdraw from the study when they wished to do so. All the participants were aware of the study's purpose, risks, and benefits.

Data were collected, managed, and analyzed in a way to ensure the confidentiality of study participants. All procedures performed in this study involving human participants were in accordance with the ethical standards of the national ethic review committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Availability of Data and Materials

The datasets used and/or analyzed during the current study are available from the first author on reasonable request.

Authors' Contributions

LLK wrote the study protocol and collected the data. He analyzed and interpreted the data then wrote the manuscript. EMLE made critical revision of the manuscript for important intellectual content. ASW and IT read and approved the final manuscript. Therefore, all the authors mentioned in this article contributed to the production of the work we are submitting, and the contents of the manuscript have never been published. They agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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