Associated Factors of Respiratory Diseases in Community Settings in Attécoubé Lagoon, Côte d'Ivoire, January-February 2022

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ABSTRACT:

Introduction: The work and living environments of the population are two of the main causes of respiratory disease in Côte d'Ivoire. This study determined the prevalence of respiratory diseases and their associated factors in the population of Attécoubé Lagoon, Abidjan district.

Methods: This cross-sectional study was carried out on a total of 170 people in Attécoubé Lagune, Côte d'Ivoire. A questionnaire was used to inquire about socioeconomic characteristics, occupational factors and respiratory symptoms of the respondents. Pulmonary function tests were performed by spirometry, looking for the presence of respiratory diseases such as asthma and chronic obstructive pulmonary disease (COPD). The relationship between our variables of interest and respiratory diseases was determined by logistic regression analysis.

Results: The results of the study showed that 45.45% of residents with respiratory disease reported high exposure to air pollutants. Pulmonary function tests estimated the prevalence of respiratory diseases at 25.88%, including 20.59% asthma and 5.29% chronic obstructive pulmonary disease (COPD). Multivariate analysis revealed that respondents with a history of coughing were 3.2 times more likely to develop respiratory disease [OR: 3.2, 95% CI (1.37 - 7.54)].

Conclusion: The study conducted in Attécoubé Lagoon revealed that most of the people surveyed with clinical signs reported having a respiratory illness. Pulmonary function tests showed a high prevalence of respiratory diseases such as asthma and chronic obstructive pulmonary disease. A history of coughing was the main factor associated with the occurrence of respiratory diseases among people living in Attécoubé Lagoon.

KEYWORDS: Respiratory diseases, Asthma, Chronic obstructive pulmonary disease, Attécoubé Lagoon.

I. INTRODUCTION

Respiratory diseases are one of the major causes of morbidity and mortality in the world [1–3]. They are responsible for around 4.2 million deaths a year worldwide, almost 80% of which occur in low- and middle-income countries. These respiratory diseases include multiple manifestations of the airways and lungs, such as asthma, chronic obstructive pulmonary disease (COPD) and other lung diseases, most of which result from exposure to pollutants in the ambient air or in the workplace [3].

Another risk factor adversely affecting respiratory health is the biomass smoke used in some households. According to a report by the World Health Organization (WHO), low- and middle-income countries (South-East Asia, Africa) account for 64% of the global burden of deaths from respiratory diseases caused mainly by biomass smoke. In addition, the prevalence of respiratory diseases such as COPD, asthma and tuberculosis in adults increases with exposure to biomass smoke in community settings [5].

Previous studies have established a link between the onset of respiratory diseases in children and/or adults and a range of social and environmental factors, including low family income, living in slums [6], household promiscuity[7], proximity to high-traffic roads and increased ambient air pollution [8,9]. In addition, associations between specific respiratory diseases in certain age groups and indoor air pollution have been reported and examined both descriptively and quantitatively [10,11].

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In some West African countries, notably Côte d'Ivoire, Benin, Senegal and Burkina Faso, recent studies have shown a high prevalence of respiratory diseases such as asthma and COPD due to exposure to outdoor and indoor air pollution [12–13].

In Côte d'Ivoire, as in many developing countries, there are many cases of respiratory diseases that remain under-diagnosed and are most often linked to the poor quality of ambient air in the living environment. In addition, most respiratory tract diseases are caused by the negative effects of industrial emissions, heavy vehicle traffic, waste burning, smoking fish with firewood and cooking with charcoal, etc. [14]. Furthermore, in Côte d'Ivoire, studies of factors associated with respiratory health have not yet been carried out in community settings, despite the high level of exposure in Abidjan. This study was therefore initiated in order to obtain scientific data on respiratory diseases in Abidjan, mainly in the Attécoubé Lagoon district.

A. General objective

The general objective is to study the factors associated with the occurrence of chronic respiratory diseases in the population of Attécoubé Lagoon, Côte d'Ivoire, January - February 2022.

B. Specific objectives

1- To determine the prevalence of respiratory diseases in Attécoubé Lagoon population from January to February 2022;
2- To describe the socio-demographic, clinical and environmental characteristics of chronic respiratory diseases;
3- To determine the factors associated with chronic respiratory diseases.

II. METHODS

A. Scope of the study

A1. Attécoubé Municipality

Attecoube is one of the ten (10) communes of the city of Abidjan, the economic capital of Côte d'Ivoire. It is bounded to the north by the commune of Abobo, to the south by the communes of Plateau and Treichville, to the east by the communes of Adjamé and Plateau and to the west by the commune of Yopougon (**Figure 2**). The study site covers an area of 70 km², or 11.2% of the total area of the Abidjan district. However, 40 km² is covered by the Banco forest and 5 km² by the Ébrié Lagoon [15]. Only 25 km² were inhabited by around 300,000 people in 2015, giving an average density of 12,000 inhabitants per km2. It has a tropical climate, with an average annual rainfall of 1,771 mm and 88 mm in September; the central-northern of the municipality has a temperature of between 22.5 and 25°C and the south-west has a temperature of between 21.5 and 22.5°C [16].
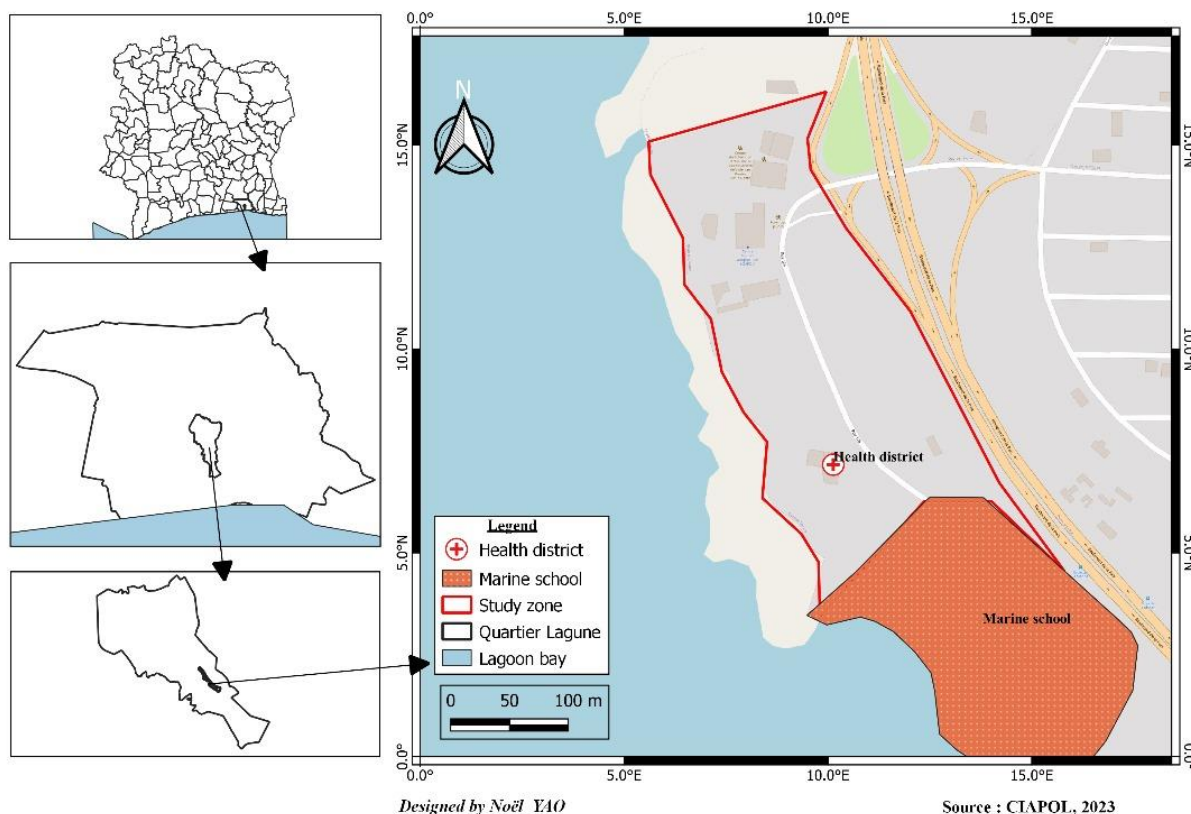

Figure 1: **Presentation of area study (Attécoubé Lagoon)**

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A2. Type and period of study

This is a cross-sectional study with an analytical focus covering a 2-month period from 03 January to 26 February 2022.

A3. Study population and sampling

Study population:

Target population : The entire population of Attécoubé Lagoon, Côte d'Ivoire

Source population: The entire population living and working in Attécoubé Lagoon between January and February 2022.

A4. Inclusion and non-inclusion criteriaInclusion criteria

Any resident aged at least 15 years, living continuously in Attécoubé Lagoon for at least one year and exercising a professional or commercial activity or other in the said locality, who is available and has consented to the study.

Non-inclusion criteria

Any resident of Attécoubé Lagoon who was unavailable or absent during the collection period.

A5. Sample size

The Statcalc function of EPI Info software version 7.2.1 was used to calculate the minimum size of our sample. A minimum sample size of 153 was surveyed.

The minimum sample size was calculated as follows

- Total population Attécoubé Lagoon district= 2700

- Prevalence of respiratory diseases= 12% (Rapport District APA, 2021)

- Alpha risk = 5%.

- Confidence interval= 95%.

With a 10% increase, the final size of our survey sample is 170 people.

Sampling

The Lagoon district of Attécoubé, located between the Banco bay and the Boulevard de la Paix, was chosen for the study. Starting from the center of the neighborhood, the right side of the entrance of the Naval Training Center (NTC) was randomly selected as the starting point for data collection. The progression was made in the direction of the road interchange with a probing pitch equal to 2. We thus proceeded to the right and to the left side to visit the chosen dwellings; all individuals who fulfilled the inclusion criteria were exhaustively enrolled.

A6. Data collection procedure

To mark the occasion, three student investigators were given two days' training in the research protocol and the various data collection tools and media.

This training enabled them to check their understanding of the research procedures (recruitment, consent and follow-up). In addition, a pre-test of the data collection questionnaire was carried out on 27 December 2021 in the Attécoubé Sebroko sub-district.

Sub-district and enabled certain imperfections to be corrected. In addition, spirometry was performed by a team consisting of a doctor and a nurse, both specialists in functional exploration and highly experienced. Data collection was carried out in two phases. The first phase involved completing a questionnaire with each subject included in the study. The questionnaire collected information on socio-demographic characteristics, length of residence in the neighbourhood, smoking status, degree of exposure to pollution and health.

The respiratory symptoms sought were those suggestive of Asthma or chronic obstructive pulmonary disease (dry cough, wheezing, dyspnoea and chest tightness), and rhinoconjunctivitis (rhinorrhoea, nasal obstruction, stinging nose, sneezing, watery eyes, red eyes).

The second phase consisted of performing pulmonary auscultation and spirometry on each subject included in the study. Spirometry was performed using a portable

Winspiro PRO6.5 MIR portable spirometer, followed by the reversibility test, performed after inhalation of a dose of 400 µg through an inhalation chamber. This test was carried out in accordance with the recommendations of the American Thoracic Society (ATS) [17].

The parameters measured were forced vital capacity (FVC) in liters, forced expiratory volume in one second (FEV1) and exhaled air volume. Forced expiratory volume in one second (FEV1) in litres per second, Tiffeneau ratio (FEV1/FVC) expressed as a percentage, forced expiratory flow 25% - 75% (FEF 25% - 75%) and slow vital capacity (SVC) in litres. The pathological threshold was defined by a fall of more than 20% in FEV1, FVC, peak expiratory flow 25% - 75% and slow vital capacity in litres.VC. The pathological threshold for the Tiffeneau ratio was defined by a fall of more than 12% (FEV1/FVC < 80% of the predicted value) according to the ATS/ERS criteria. [18]

The theoretical standard used is the African ethnic standard incorporated into the spirometer software, which takes into account the sex, age, weight and height of the subjects.   Data management and analysis.

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Operational definition

COPD was diagnosed in subjects surveyed presenting an obstructive syndrome that was not reversible after bronchodilator therapy, as determined by spirometry, with a Tiffeneau index (FEV1/FVC) of less than 80%. COPD is classified according to its severity by the GOLD report [19]. Asthma has been defined by the clinical symptoms of the disease, such as cough, wheeze and dyspnoea, and by spirometric tests with a positive reversibility of the obstruction by an increase of at least 12% in the value of FEV1 or FVC [20].

A7. Statistical analysis

Statistical analysis was performed using SAS software version 9.4.

A univariate analysis was carried out for the description of the variables: age, sex,

height, weight, smoking habits, BMI, length of residence, occupation, level of education, level of exposure to pollution, respiratory symptoms (cough,

dyspnoea, wheezing, chest tightness), rhinitis symptoms (sneezing, nasal obstruction, rhinorrhoea, nasal pruritus), conjunctivitis and family history of asthma.

The dependent variable: chronic respiratory disease was obtained from the results of spirometry tests performed on Attécoubé Lagoon residents by the medical team.

A bivariate analysis was used to search for possible associations between the dependent variable (chronic respiratory disease) and the independent variables (age, sex, smoking, length of residence, level of exposure, occupation and level of education). Independent variables with a significance level P ≤ 0.20 were included in the multivariate analysis.

Multiple linear regression models were constructed to investigate the relationship between the dependent variable and the selected independent variables.

The top-down stepwise logistic regression method was adopted with (P < 0.05).

III.   RESULTS

A. Determination of the prevalence of respiratory disease among people surveyed in Attécoubé *Lagoon*

Table I shows the prevalence of chronic respiratory diseases observed during the study period in the Attécoubé Lagoon district. A prevalence of respiratory diseases of 25.88% was observed, of which 20.59% concerned asthma and 5.29% chronic obstructive pulmonary disease (COPD).

Table I. Prevalence of respiratory diseases among people surveyed.

Spirometry results	Frequency (N)	% (IC 95%)
Normal	126	74,12 (66,85-80,52)
Asthma	35	20,59 (14,78-27,45)
COPD	09	5,29 (2,45-9,81)
Total	**170**	

COPD: Chronic Obstructive Pulmonary Disease

B. Socio-demographic, clinical and environmental description of variables for people surveyed in Attécoubé *Lagoon*

B1. Socio-demographic and environmental description

The sex ratio (male/female) was 0.65 for the subjects surveyed in Attécoubé Lagoon. The average age of respondents was 35 ± 15.3 years. The age of respondents with respiratory disease was statistically similar to those without disease (p= 0.31). 72% of surveys with respiratory disease have lived in Attécoubé Lagoon for more than 10 years. Some 45.45% of people with a respiratory illness reported having been heavily exposed to atmospheric pollutants. Also, 84.09% of people suffering from respiratory disease were either single or widowed **(Table IIa).**

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Table II a. Description of socio-demographic and environmental variables of people surveyed in Attécoubé Lagoon

Variables	Total (*n=170*) n(%)	Respiratory diseases		p-value
		Yes (*n=44*) n(%)	No (*n= 126*) n(%)	
Age range (Years)				**0.3146**
≤35	96 (56 47)	22 (50)	74 (58)	
>35 ans	74 (43.53)	22 (50)	52 (41.27)	
Average age =35± 15.3 Years				
Sex				**0.9027**
Female	103 (60.59)	27 (61.36)	76 (60.32)	
Male	67 (39.41)	17 (38.64)	50 (39.68)	
Sex ratio M/F = 0.65				
Employment				**0.6841**
Commercial	69 (40.59)	19 (43.18)	50 (39.68)	
Others*	101 (59.41)	25 (56.82)	76 (60.32)	
Education level				**0.8483**
None	61 (35.88)	16 (36.36)	45 (35.71)	
Primary	38 (22.35)	11 (25)	27 (21.43)	
Secondary and above	71 (41.76)	17 (38.64)	54 (42.86)	
Matrimonial status				**0.1291**
Single/widowed	153 (90)	37 (84.09).	116 (92.06)	
Married	17 (10)	7 (15.91)	10 (7.91)	
Duration of residence (Years)				**0.2660**
≤10	58 (34.12)	12 (27.27)	46 (36.51)	
>10	112 (65.88)	32 (72.73)	80 (63.49)	
Exposure to pollutants				**0.4938**
Low	38 (22.35)	8 (18.18)	30 (23.81)	
Medium	67 (39.41)	16 (40.91)	51 (40.45)	
High	65 (38.24)	20 (45.45)	45 (35.71)	

Others*: Private sector employees, contractors, retired people, housewives, unemployed, etc.

B2. Description of the clinical characteristics of people surveyed in Attécoubé Lagoon

A proportion of 40.91% of people with a history of coughing reported having a respiratory disease. There was a significant difference between people with a history of cough who said they had a respiratory disease and those who did not (p=0.0006). Approximately 52.27% of overweight or obese people reported having a respiratory disease compared with 46.03% who did not. The BMI of overweight or obese people with chronic respiratory disease was statistically similar to those without disease (p=0.304) (Table IIb).

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Table IIb: Description of the clinical characteristics of people surveyed in Attécoubé Lagoon

Variables	Total (n=170) n(%)	Respiratory diseases		p-value
		Yes (n=46) n(%)	No (n=126) n(%)	
History of asthma				0.0283
Yes	8 (4.71)	5 (11.36)	3 (2.38)	
No	162 (95.29)	39 (88.64)	123 (97.62)	
History of cough				0.0006
Yes	38 (22.35)	18 (40.91)	20 (15.87)	
No	132 (77.65)	26 (59.09)	106 (84.13)	
Dyspnea				0.0951
Yes	49 (28.82)	17 (38.64)	32 (25.40)	
No	121 (71.18)	27 (61.36)	94 (74.60)	
Respiratory disorders				0.0484
Yes	33 (19.41)	13 (29.55)	20 (15.87)	
No	137 (80.59)	31 (70.45)	106 (84.13)	
Nose irritation				0.6615
Yes	10 (5.88)	2 (4.55)	8 (6.35)	
No	160 (94.12)	42 (95.45)	118 (93.65)	
Eye irritation				0.7437
Yes	77 (45.29)	19 (43.18)	58 (46.03)	
No	93 (54.41)	25 (56.82)	68 (53.97)	
Smoker				0.5103
Yes	12 (7.06)	4 (9.09)	8 (6.35)	
No	158 (92.94)	40 (90.91)	118 (93.65)	
Tobacco				0.7967
Yes	9 (5.29)	2 (4.55)	7 (5.56)	
No	161 (94.71)	42 (95.5)	119 (94.4)	
Sneezing				0.1975
Yes	39 (22.94)	7 (15.91)	32 (25.40)	
No	131 (77.06)	37 (37)	94 (74.60)	
Nasal runny				0.7620
Yes	15 (8.85)	3 (6.82)	12 (9.52)	
No	155 (91.18)	41 (93.18)	114 (90.48)	
Thoracic oppression				0.4288
Yes	50 (29.41)	15 (34.09)	35 (27.78)	
No	120 (70.59)	29 (65.91)	91 (72.22)	
Wheezing				0.6065
Yes	16 (9.41)	5 (11.36)	11 (8.73)	
No	154 (90.59)	39 (88.64)	115 (91.27)	
BMI				0.3048
Normal subjects	83 (48.82)	21 (47.73)	62 (49.21)	
Underweight	6 (3.53)	0 (00)	6 (4.76)	
Overweight/Obesity	81 (47.65)	23 (52.27)	58 (46.03)	

B3. Identification of socio-demographic and clinical factors associated with respiratory diseases in multivariate analysis
In the univariate analysis, the factors with a p-value of less than 20% and forced into the final model based on the literature review were the socio-demographic and environmental variables (age group, sex, occupation, marital status, length of residence, level of exposure to pollutants) and clinical variables (dyspnoea and breathing difficulties).

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After adjustment, the variable "history of cough" was identified as a factor associated with the occurrence of chronic respiratory disease in Attécoubé Lagoon. Participants with a history of coughing were 3.2 times more likely to develop chronic respiratory disease than those without a history of coughing. This observation is statistically significant with a p-value = 0.0073 **(Table III).**

Table III: Association of socio-demographic and clinical variables with respiratory diseases in multivariate analysis

Variables	ORa	IC95%	p-value
Age range (Years)			**0.1728**
>35	1	-	
≤35	0.574	0.259-1.275	
Sex			**0.8780**
Female	1	-	
Male	1.070	0.451-0.451	
Employment			**0.8699**
Others*	1	-	
Sales person	0.934	0.415-2.103	
Matrimonial status			**0.4874**
Single/widowed	1	-	
Maried	1.517	0.468-4.915	
Duration of residence (years)			**0.5750**
>10	1		
≤10	0.791	0.348-1.796	
History of asthma			**0.1529**
No	1	-	
Yes	3.492	0.629-19.399	
History of cough			**0.0073**
No	1		
Yes	3.215	1.370-7.544	
Dyspnea			**0.4020**
No	1		
Yes	1.447	0.610-3,436	
Respiratory difficulties			**0.7354**
No	1	-	
Yes	1.192	0.430-3.302	

IV.DISCUSSION

A. Prevalence of of respiratory diseases

The study revealed a 25.88% prevalence of respiratory diseases, including 20.59% asthma and 5.29% COPD among the people surveyed. This high prevalence of respiratory disease in Attécoubé Lagoon is thought to be partly linked to the poor air quality in the area. In fact, the people of Attécoubé Lagoon suffer daily from the effects of atmospheric emissions from car traffic, industrial activities (cement factories) and domestic activities such as open-air waste burning, smoking fish with firewood, cooking with charcoal, and so on. Our results differ from those of **Sylla *et al*. (2018)** [19] obtained in bus drivers in Senegal. Indeed, pulmonary function tests performed by these authors revealed prevalences of asthma and COPD respectively of 38.8% and 30.3% among bus drivers in Dakar. This difference in prevalence was attributable to the observation grid used for spirometry. According to these authors, COPD was diagnosed in subjects surveyed presenting an obstructive syndrome that was not reversible after bronchodilator treatment, as determined by spirometry with a Tiffeneau index (FEV1/FVC) of less than 70% [19].

The spirometric tests showed an asthma prevalence of 20.59%, whereas many of the subjects surveyed believed they were free of this respiratory disease. Our results confirm the data in the literature according to which a large proportion of people with asthma are generally under-diagnosed and unaware of their condition [24].

A prevalence of COPD of 5.29% was found among people surveyed in Attécoubé Lagoon. According to **Sylla *et al.* (2018) [19]**, in Africa, the prevalence of COPD varies between 4% and 39% [35]. However, it is higher in workers frequently exposed to air pollution, such as workers in industrial areas and farmers [24].

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In certain African countries, notably Tunisia and Algeria, COPD has been determined to be 4.7% and 4.9% respectively in the non-smoking adult population and in adults who are independentof smoking status [26] . Proximity of residence or workplace to traffic is associated with an increased risk of asthma, with a dose-response relationship. The estimated prevalence of COPD varies between 2.7% and 38.5% [25].

B. Associations of socio-demographic factors with the occurrence of respiratory diseases

In our study, the factor associated with the onset of respiratory disease was the presence of a history of coughing. Our work revealed that patients with a history of cough were 3.2 times more likely to develop respiratory disease [OR: 3.2 (1.37 - 7.54)]. Our results are similar to the work carried out by **Sylla *et al*. (2017) [24]** in Senegal on vendors located near public roads. According to these authors, vendors exposed to air pollution along public roads in Dakar who had a cough were 3.2 times more likely to develop a respiratory disease such as allergic rhinitis [OR: 3.23 (1.28 - 8.15)] [25].

However, our results differ from those of [26] in Benin. The work of these authors on respiratory symptoms associated with workplaces located along a heavily trafficked road in Cotonou, Benin, showed that the risk of "cough" symptoms was 5.15 times higher in a person exercising at the roundabout than in a person exercising along the road [14].

C. Limitations of the Study

This study has certain limitations. Firstly, the study could only be carried out on a limited number of people due to the difficulty of accessing spirometry mouthpieces in Côte d'Ivoire and their high cost. Secondly, exposure to air pollution was not assessed in the people included in the study. Thirdly, it was not possible, for financial reasons, to measure personal exposure to pollutants emitted mainly by occupational activities (fish smoking, open-air burning, car exhaust emissions, etc.). However, this is the first study of its kind to assess community respiratory health in Côte d'Ivoire.

V. CONCLUSION

The community survey carried out in Attécoubé Lagoon revealed that most people surveyed with clinical signs reported having a respiratory illness. Pulmonary function tests showed a high prevalence of chronic respiratory diseases such as asthma and chronic obstructive pulmonary disease. Multivariate analysis showed that the presence of a "History of Cough" was the main factor associated with the occurrence of respiratory diseases among people surveyed in Attécoubé Lagoon. Given the high prevalence and its contribution to morbidity and mortality, a program to combat respiratory diseases in Attécoubé Lagoon could be envisaged.

DECLARATION

Authors' Contributions

Affou Seraphin Wognin wrote the study protocol, collected the data and then drafted the manuscript. LLK assisted with data interpretation. EMLE critically reviewed the manuscript for important intellectual content. JBONO, BY and IT read and approved the final manuscript. Therefore, all authors mentioned in this article contributed to the production of the work we submit, and the manuscript content was never published. They have agreed to be responsible for all aspects of the work, ensuring that questions relating to the accuracy or integrity of any part of the work are investigated and resolved appropriately.

Consent to Participate

A written informed consent was obtained from all participants in the study. Participation was voluntary and participants were informed of their right to with draw 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.

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