

# Air Quality as a Risk Factor for Exacerbation Frequency in Asthma and COPD Patients

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**Abstract**—Obstructive pulmonary diseases often attack humans, one of which is asthma and chronic obstructive pulmonary disease (COPD), these two diseases can cause discomfort and death. Exacerbations of both diseases can be caused by poor air quality. This research is analytical observational research taking place at Airlangga University Hospital, with 126 asthma and COPD patients who met inclusion and exclusion criteria in January - June 2025. Patient data was obtained from medical records and air quality data was obtained from IQAir. Of 126 patients, 28 (22.2%) patients visited the ED. The AQI average at 6 stations in Surabaya is 82. No significant correlation was found between air quality and the incidence of ER visits (correlation coefficient  $-0.096$ )(Sig .283). Negative correlation results that are not significant can occur because the distribution of patients in this study was not very wide., and can also be caused by patient behavior (for example: frequent controls), and/or station air quality data that does not accurately represent patient exposure.

**Keywords**— Asthma, COPD, Air quality, ED.

## I. INTRODUCTION

Asthma and chronic obstructive pulmonary disease (COPD) are obstructive lung diseases that burden health budgets, especially in countries with weak economies. Asthma is a chronic lung disease that attacks all ages. Asthma is caused by inflammation and constriction of the muscles around the airways, making breathing more difficult [1]. Meanwhile, COPD is a common lung disease that causes permanent damage to the lungs and narrows the airways and breathing problems when the disease reaches an advanced stage [2], [3].

Both diseases have a significant global impact. It is estimated asthma affected 262 million people in 2019 and cause 455 thousand deaths [1]. According to the 2018 riskeddas report, the prevalence of asthma in Indonesia was 2.4% [4]. According to world health organization (WHO), COPD is the third cause of death in the world, causing 3.23 million deaths in 2019 [2]. The global initiative for chronic obstructive lung disease (GOLD) estimates the global prevalence of COPD at 10.3% [5]. According to the 2013 riskeddas report, the prevalence of COPD in Indonesia was 3.7% [6].

Asthma symptoms include sleep disturbances, fatigue, poor concentration, shortness of breath, decreased physical activity, anxiety and depression [1]. COPD symptoms include shortness of breath, chronic cough and fatigue [7]. Approximately 20% of asthma sufferers experience exacerbations that require an ER visit or even hospitalization [8]. BPJS Health allocated IDR 431 billion for 1.1 million outpatient cases, and IDR 13.3 trillion for 1.7 million inpatient cases for respiratory diseases [9].

Asthma exacerbations are triggered by exposure to environmental allergens, physical activity, drug hypersensitivity,  $\beta$ -adrenergic receptor blockers, contact with compounds, emotional factors or stress. COPD exacerbations can be caused by bacterial or viral infections, air pollution, and changes in environmental temperature [10] Air pollution can cause inflammation in both of these diseases, which can worsen the patient's condition by causing exacerbations. Air quality is affected by air pollution. According to data from IQAir in 2023, Indonesia is ranked 14th in terms of worst air quality in the world with average PM 2.5 pollution which is 7.4 times higher than the WHO guideline.

The correlation between environmental air quality and the incidence of asthma exacerbations and COPD has not been clearly explored. To answer this problem, research is needed that explores the air quality of asthma and COPD patient in relation to exacerbations of the disease. It is hoped that the results of this research will contribute to knowledge about the correlation between the two so that policies can be taken for the promotion, prevention, therapy and rehabilitation of this disease.

## II. METHODS

This research is analytical observational. This study used data from January - July 2025 using simple random sampling. Data on asthma and COPD patients was obtained from medical records of Airlangga University Hospital (RSUA) Lung Clinic patients with primary diagnoses of asthma (J45) and COPD (J44). Inclusion criteria patients domiciled in the Surabaya area, Age not less than 21 years for asthma patients, Age not less than 40 years for COPD patients. Exclusion criteria incomplete electronic medical record data. The variables taken include name, age, gender, address, disease, visit to the ER. Data on severe exacerbations was obtained using data on emergency room visits from asthma and COPD patients from various age groups with addresses in Surabaya. This research received ethical clearance from The Research Ethics Committee of Rumah Sakit Universitas Airlangga. Air quality data is obtained from the IQAir website, there are 6 air quality monitoring stations. Data analysis used IBM Statistical Package for Social Sciences (SPSS) version 31. Analysis was carried out using Spearman and chi-square to see the relationship between severe exacerbations in patients with asthma and COPD and air quality during the study period. Results were considered significant if  $P < 0.05$ .

III. RESULT

Samples in Table I were divided according to age, gender and frequency of exacerbations. A sample of 126 patients diagnosed with asthma and COPD, located in Surabaya, was taken. Of these patients, 65 (51.58%) were male. The mean age was 60.87 years (standard deviation (SD) 14.23 years) (Table I). No significant correlation was found between age or gender and severe exacerbations (Table III).

TABLE I. Distribution of patients studied during the study period.

Variable	COPD (%)	Asthma (%)	Total (%)
Patient characteristics			
Age (mean (SD))	67,17 (9,37)	54,37 (15,32)	60,87 (14,23)
Patient gender			
Male	55	10	65(51,58)
Female	9	52	61(48,41)
Exacerbations 0x	48(48,98)	50(51,02)	98
Exacerbations ≥1x	16(57)	12(43)	28

TABLE III. Characteristics of the sub-district where the patient lives

Subdistrict	AQI	AQI Category	Exacerbations 0x	Exacerbations ≥1x	Total
Kertajaya	79.3365	Moderate	77	21	98
Benowo	113.8281	High	1	0	1
Keputih	16.12317	Low	1	1	2
Tandes	90.45323	Moderate	4	1	5
Lakarsantri	112.3304	High	0	0	0
Sukolilo	80.11355	Moderate	15	5	20

The highest AQI value in Benowo is 113.8281, this can be caused by the presence of a waste incinerator machine which can worsen the air quality in that area. Surabaya's air quality, based on the average of six air quality stations, is moderate (82.031). No significant correlation was found between severe exacerbations and average air quality over six months (Table III).

TABLE III. Relationship between Age, Gender and Air Quality with Severe Exacerbations of Asthma and COPD

Variable	r	χ2	P
Age	0,053		0,556
Gender		2,324	0,127
Air Quality	-0,096		0,283

r : The Spearman correlation coefficient is significant if P <0,05  
 χ2 : chi-square results are significant if P <0,05

IV. DISCUSSION

The aim of this study was to explore air quality in asthma and COPD patients and its relationship to disease exacerbations. with asthma, studies have provided evidence there's an association between poor air quality and with COPD, many studies show a connection between increased air pollution and hospitalization and exacerbation of COPD [11], [5], [12], [13]. From the data gathered in this research the air quality in Surabaya is classified as moderate. This may be due to vehicle emissions and waste burning, which worsen air quality by releasing various pollutants. units for each quantity in an equation [14]. In addition to air quality, other factors may contribute to the number of exacerbations, such as patient behavior (e.g., medication adherence and smoking status) [14]. Smoking causes an inflammatory reaction which can worsen the patient's condition and can cause exacerbations, while medication compliance can help reduce the risk of exacerbations by using the right medication at the right time.[14]

In this study, the demographics of asthma and COPD patient subjects were dominated by the elderly. According to some studies the incidence of asthma affects children more than adults but according to the 2018 Basic Health Research (Riskesdas) conducted by the Ministry of Health of the Republic of Indonesia, the prevalence and incidence of asthma

exacerbations are higher in the elderly [4][11]. Some studies suggest that the highest prevalence is those above the age of 60[5].

In this study, the demographics of COPD patient subjects were predominantly male. This may be due to differences in population behavior, such as smoking, where males usually start smoking earlier than females [16]. Meanwhile, the demographics of asthma patient subjects are dominated by women. Which align with American Lung Association and the Ministry of Health Republic Indonesia [4], [17]. This can be caused by the hormone estrogen which increases inflammation [18].

This study chose emergency room visits as a marker for severe exacerbations because such data was available in the patient's medical record. Patient behavior was not included in this study because it is difficult to measure adequately. Another limitation of this study is that station air quality data may not accurately represent patient exposure [19]. Station air quality data does not accurately represent patient exposure because individuals may spend more time at home or at work, which can significantly impact the results of this study. The patient distribution in this study was also limited, with many residing in the Kertajaya area. This could be due to the location of RSUD, which causes patients from Kertajaya to seek medical attention there, while patients in other areas tend to seek medical care closer to their homes. These limitations of this study are expected to be considered in future research.

ACKNOWLEDGMENT

The authors would like to express their sincere gratitude to the Dean of the Faculty of Medicine, Universitas Airlangga, teachers and mentors, and also friends and colleagues who have helped in making this research

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