Original Article

Dust, Cigarette Smoke, and Cold Air are the Main Risk Factors for Asthma Attacks

Wiwik Agustina

Faculty of Science and Technology, Universitas Islam Negeri Maulana Malik Ibrahim Malang, Indonesia

Abstract

Background: The prevalence of asthma has increased worldwide over the past few decades, with an estimated incidence reaching 400 million people by 2025. By the end of 2020, the prevalence of asthma in Indonesia was 4.5% of the total population, exceeding 12 million individuals.

Methods: This study aimed to analyze the most frequent risk factors for asthma attacks. A correlative descriptive design was employed, with a population consisting of all asthma patients. The sample was selected using purposive sampling, resulting in 30 respondents. This research was conducted in Malang and included respondents with a history of asthma who were not hospitalized.

Results: Logistic regression analysis revealed that 72% of asthma recurrences were attributed to dust, cigarette smoke, cold air, family/hereditary history of disease, obesity, pollen, animal dander, seafood, eggs/nuts, fungi, and cow's milk. The remaining 28% were linked to other risk factors, including pregnancy, stress, excessive emotions, physical fatigue, weather changes, and more. The three primary risk factors for asthma attacks were dust (87%), cigarette smoke (83%), and cold air (73%).

Conclusion: Asthma recurrence is primarily caused by hypersensitivity, with allergens triggering elevated IgE levels, leading to bronchoconstriction and subsequent asthma attacks. The findings of this study identified dust, cigarette smoke, and cold air as the main risk factors for asthma recurrence. Asthma patients need to recognize their allergens to facilitate preventive measures and reduce the likelihood of asthma attacks.

Keywords: allergens, asthma, risk factors

Corresponding Author:
Wiwik Agustina, Faculty of Science and Technology, Universitas Islam Negeri Maulana Malik Ibrahim Malang, Indonesia | nerswika@gmail.com

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INTRODUCTION

Asthma is a major non-communicable disease (NCD) that can attack children and adults, asthma is the most common chronic disease in children. Asthma cases worldwide have risen sharply, affecting 262 million people in 2019 and causing 455,000 deaths, it is estimated that the incidence will increase to 400,000,000 people in 2025. According to data from the Ministry of Health in 2020, asthma is one of the non-communicable diseases most suffered by Indonesian people.[1–5]

Until the end of 2020, the number of asthma sufferers in Indonesia was 4.5 percent of the entire population of Indonesia, or more than 12 million people. According to the results of the 2018 *Survei Kesehatan Rumah Tangga* (SKRT), asthma is the fourth cause of death (mortality) in Indonesia or 5.6%. It is reported that the prevalence of asthma throughout Indonesia is 13 per 1,000 population.[1–5]

Asthma is a respiratory disease characterized by airway constriction and inflammation which results in asthma symptoms, which can include a combination of coughing, wheezing, shortness of breath, tightness in the chest, and coughing that varies from time to time, frequency and intensity. Apart from having physical, psychological or functional impacts, asthma also affects the sufferer's quality of life and even increases morbidity rates. Most asthma-related deaths occur in low- and lower-middle-income countries, where lack of diagnosis and treatment is a challenge.[3,5,6]

Asthma is a long-term inflammatory disease of the airways of the lungs, so it requires good therapeutic management. The long-term target of asthma therapy management is to control the symptoms that appear and reduce the risks. The aim is to reduce the burden of pain on sufferers and the risk of expanding the disease/symptoms (exacerbations), damage to blood flow, and side

effects from medications. Inhaler use is a key self-management strategy for controlling asthma symptoms. Apart from that, there are also various pharmacological drugs as asthma treatments, where this group of asthma drugs apart from having an effect. Therapies to improve asthma symptoms and prevent exacerbations also have undesirable side effects.[7]

Apart from medication, avoiding asthma triggers can also help reduce asthma symptoms, in addition to reducing the side effects of asthma medications used long-term. Risk factors for asthma include genetics, obesity, clinical conditions (low birth weight, prematurity, exposure to tobacco smoke and other sources of air pollution, and respiratory viral infections), exposure to allergens (indoor or outdoor air pollution, animal dander and dust inside or outside the home, and exposure to chemicals, cigarette smoke, or dust in the workplace).[5,8]

Even though these factors can be determined, it is often difficult to determine the cause directly. In general, asthma patients experience excessive bronchospasm which can cause stimulation from smells, cold air, air pollution, upper or lower respiratory infections, and stress.[5,8] This research aimed to analyze the most frequent risk factors for asthma attacks.

METHODS

This research is quantitative research using non-experimental methods in the form of a descriptive survey. The population in the study were subjects (humans) who met the established criteria, all asthma sufferers in Indonesia. The sample is part of the population, and the technique used for sampling is quota sampling, with 30 respondents. This research was conducted in Malang on respondents who had a history of asthma who were not treated in the hospital.

Data was taken using an Asthma Control Test (ACT) questionnaire to determine asthma control and to identify risk factors for asthma. The International Study of Asthma and Allergies in Childhood (ISAAC) questionnaire was used. The data obtained will be processed using univariate analysis aimed at describing or explaining each research variable. This analysis produces the frequency and percentage distribution of each variable.

RESULTS

Table 1 explains the characteristics of the respondents based on age, half of them were 17-25 years old, 15 respondents (50%), were based on island origin, most of them were from Java, 20 respondents (67%), while based on gender, the majority were 12 respondents (60%) is a woman.

Table 1. Characteristics of Respondents

Variable	N	%
Age		
17-25 years	15	50
26-35 years	8	27
36-45 years	4	13
46-55 years	3	10
Ethnic		
Jawa	20	67
Kalimantan	9	30
Papua	1	3
Gender		
Man	12	40
Woman	18	60

Table 2 explains the characteristics of respondents based on the severity of asthma. 16 respondents (53%) were at the partially controlled level.

Table 2. Degree of asthma

Degree of asthma	N	%
Uncontrol	13	43
Partially control	16	53
Well control	1	3

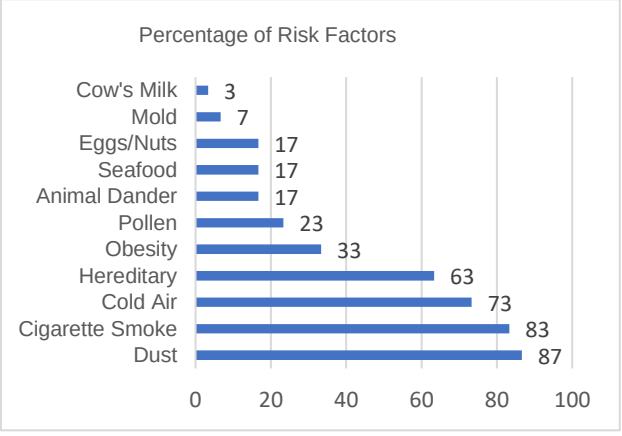

Figure 1. Risk factors for asthma attacks

Based on Figure 1, almost all respondents will experience an asthma recurrence due to exposure to dust, cigarette smoke and cold air, only a small number of respondents will experience an asthma recurrence due to exposure to cow's milk, mold and eggs/nuts.

Table 3. Regresi logistic test result

Details	Result
Sig. Goodness of Fit	0.95
Pseudo R^2 Nagelkerke	0.72

Based on Table 3, the significant Goodness of Fit results are more than 0.9, which means there is descriptive suitability of the model. Furthermore, Pseudo R^2 Nagelkerke was obtained at 0.72, which means that 72% risk factors for asthma recurrence were dust, cigarette smoke, cold air, family/hereditary disease history, obesity, pollen, animal dander, seafood, eggs/nuts, mushrooms and cow's milk.

DISCUSSION

Regresi logistic analysis showed that 72% of risk factors for asthma recurrence are dust, cigarette smoke, cold air, family history of disease/hereditary, obesity, pollen, animal dander, seafood, eggs/nuts, mushrooms and cow's milk. The remaining 28% are risk factors for asthma recurrence caused by other than the 11 factors studied, including pregnancy, stress, excessive emotions, physical fatigue, weather changes, etc.

The results of this study showed that 87% of respondents experienced asthma recurrence due to exposure to dust. Dust is an allergen that can be found anywhere. This figure is in line with the results of Anasis 2021 research showing that around 50–80% of asthma incidents in the world are caused by exposure to house dust. Ninety percent of asthma patients in Indonesia are susceptible to exposure to house dust and house dust mites. This allergen is not only a risk factor for asthma but can trigger various other allergic conditions such as allergic rhinoconjunctivitis, atopic dermatitis, and other skin diseases.[1]

The interaction of genes with environmental triggers (allergens) causes chronic airway inflammation in asthma patients. This interaction can occur with various environmental factors, the main ones being air pollution and mite allergens. Asthma sufferers experience exacerbation of asthma symptoms due to exposure to house dust. This is associated with an immune response in the form of increased production of specific IgE against allergens.[1]

Apart from house dust, dust produced by other materials can also induce asthma recurrence, for example, 4.3% of textile workers in Nam Dinh, Vietnam were diagnosed with allergic asthma. Regarding cotton dust, exposure to cotton dust in the work environment for more than one hour per day is confirmed to be the main predictor of allergic asthma related to cotton dust in people with allergic asthma.[9]

Exposure to cigarette smoke was the second largest risk factor for asthma attacks in this study at 83%. Embuai in 2020 showed that there was a relationship between cigarette smoke and the incidence of asthma, from the statistical test results obtained a *P*=0.02 and 73% of respondents experienced asthma recurrence due to exposure to cigarette smoke. Various pollutants contained in cigarette smoke include nicotine, arsenic, cadmium, azane, benzol, butane, formonitrile, CO (Carbon Monoxide), and tar (tobacco residue) which have a role as triggers for the arousal of various mediators in asthma sufferers.[10,11] Likewise, using shisha will also worsen lung health, one of which is a decrease in lung function, which will worsen the condition of asthma sufferers.[12]

The third cause of asthma recurrence in this study was cold air at 73%. Based on Henna's 2016 research, asthma sufferers who are not well-controlled are more susceptible to experiencing recurrence due to exposure to cold air. When cold air is inhaled while breathing, the respiratory organs react by narrowing the airways. When the weather is cold, the air becomes drier than air at normal temperatures, so the respiratory organs will be irritated more easily.[13,14]

As a result, asthma sufferers will more easily experience attacks that may be accompanied by coughing. This is in line with the results of a study

from China in 2014, from this study it was explained that there was an increase in the number of asthma patients in hospitals who experienced attacks during the winter.[13,14]

In fourth place, the risk factor for asthma is a family history of the disease (hereditary) at 63%. A family history of the disease means that the risk of parents with asthma having a child with asthma is three times higher if the family history of asthma is accompanied by atopy.[15] Asthma is not caused by a single mutation in one gene, so the disease is inherited from generation to generation. does not follow the simple Mendelian inheritance typical of classic monogenic diseases, such as Huntington's disease (autosomal dominant) or sickle cell disease (autosomal dominant).[16]

In contrast, asthma is a polygenic and multifactorial disorder, meaning that many factors contribute to its development. These factors are genetic and environmental, therefore the combination of several genes interacting with each other with environmental factors can cause the transmission of asthma to the next generation.[16]

Obesity was the fifth risk factor for asthma recurrence in this study, a number 33%. Obesity induces an increase in TNF-α, leptin, and IL-6, which stimulates the pro-inflammatory action of non-eosinophils.[7] Obesity is a systemic metabolic disorder that is the cause of various kinds of morbidity and is a complication that has effects on health.[17]

Obesity is often associated with an increased incidence of asthma through several mechanisms, including the role of leptin as a pro-inflammatory cytokine which causes an increased risk of inflammation in the respiratory tract, triggers asthma attacks, and is a critical mediator of lipofibroblast differentiation to normal fibroblasts and the synthesis of lung surfactant phospholipids. Obesity can affect lung function, including decreasing lung compliance, lung volume, and peripheral airway diameter, which in turn affects blood volume in the lungs and ventilation-perfusion. Apart from that, genetic factors, sex hormones and micronutrient intake also play a role in the mechanism of asthma in obesity.[17]

Five other risk factors for asthma in this study were: pollen 23%, animal dander 17%, seafood 17%, eggs/nuts 17%, mold 7%, and cow's milk 3%. Pollen allergy is still considered a trivial disease and has not received much attention, especially in low- and middle-income countries. Various studies show that climate change and air pollution can change pollen production, allergenicity, morphology, seasonality and distribution, which can increase the incidence of allergic diseases in humans.[18]

The prevalence of pollen-related allergies has increased in the last three decades and is likely to increase in 2017. Pollen is large, so it cannot enter the thoracic area of the respiratory tract but can hit the mucous membranes of the nasopharynx. At the same time, submicronic pollen particles can be inhaled and reach deeper into the upper airways, causing exacerbations of asthma, chronic obstructive pulmonary disease (COPD), and other allergic reactions.[18]

Animal dander such as cats, dogs, birds, rabbits, and hamsters can be a source of inhalant allergens. The source of asthma is an allergic protein found on the surface of animal dander (protein from hair and skin flakes) and which is excreted in the form of urine, feces and saliva. These allergens are very small (around 3-4 microns) and can fly in the air, triggering asthma attacks, especially from birds and mammals.[19]

Apart from that, animal dander also contains endotoxins, which are chemicals that cause dangerous physical reactions. This stimulates immune cells and proteins, especially immunoglobulin E (IgE).[19] Hamdan and Musniati's 2020 research shows that there was a relationship between the incidence of bronchial asthma in children aged 5-12 years in BKPM Salatiga City and pet ownership (P=0.043).[15]

Allergens in food that enter the body can induce allergic reactions. The digestive system will absorb protein particles that trigger allergies in large quantities. Types of food that can induce asthma attacks include seafood, milk, eggs, nuts, wheat, soybeans and food additives, of which seafood has a greater risk. According to Kurniasari 2015, his

research showed that there was a significant relationship between dietary factors and the incidence of asthma recurrence (*P*=0.014).[20]

Food-induced allergic disorders are adverse and potentially life-threatening immunological reactions that occur when exposed to food. This immunological reaction is called a hypersensitivity reaction which is categorized into two types, namely mechanisms mediated by immunoglobulin-E (IgE) and mechanisms mediated by non-IgE. In the first type, the onset of symptoms occurs quickly about two hours after consumption and may cause disturbances in other body systems including the respiratory, skin, gastrointestinal and cardiovascular systems. In the second type, symptoms appear around 12-24 hours after consumption, the disorders that occur mainly occur in the skin and digestive tract. With increasing age, the incidence of food allergies decreases, this is in accordance with this research where the trigger factors for asthma caused by food allergies show a small percentage.[21]

Mold are complex eukaryotes, Mold allergies have the potential to cause an allergic immune response, the main clinical response being asthma and rhinitis caused by Alternaria alternata and mediated by immunoglobulin E (Ig)E/Th 2. Mold exposure is an everyday reality in humans that rarely triggers disease. However, mold allergies trigger asthma severity in many people with severe asthma. Statements from various medical associations unequivocally state that mold is a substance that can trigger and worsen allergic asthma.[22]

Many airborne molds are involved, including Alternaria, Aspergillus, Cladosporium, and Penicillium species, and exposure may occur indoors, outdoors, or both. The potential therapeutic role of antifungal agents for patients with severe asthma and fungal sensitization was also explored. Much evidence suggests that atopy (especially mold allergens) is associated with asthma severity. Of persistent asthma sufferers who require specialist referral, 20–25% have skin test reactivity to Aspergillus or other mold.[23]

Thus, the concentration of several molds, especially Aspergillus fumigatus, Alternaria alternata, Aureobasidium pullulans, Cladosporium cladosporioides, Cladosporium herbarum, Epicoccum nigrum, and Stachybotrys chartarum, was negatively related to asthma control parameters in male respondents, but not in female respondents.[24]

Based on linear logistic analysis, there are still 28% other factors besides the 11 factors studied, according to researchers, these other factors include: stress and pregnancy. According to Agustina and Sumiatun 2017, their research showed that there was a significant difference in the frequency of asthma recurrence between pregnant women in the first, second and third trimesters (*P*=0.03), pregnancy had a 3.6% influence on the frequency of asthma recurrence.[25]

The difference that occurs is that the highest frequency of recurrence occurs during the third trimester. This occurs due to physical, emotional and biochemical changes including hormonal ones during pregnancy, especially stress in the third trimester.[25] Changes in immunity during pregnancy, especially a decrease in cell-mediated immunity, are thought to predispose to infection in people with asthma and can cause worsening of asthma.[26]

LIMITATION

This research has limitations, namely that the population size according to the inclusion criteria is not yet known with certainty and the sample was taken using the quota sampling method so that the results of this research cannot be generalized to the general population. Further research with a larger sample and longer research duration is needed.

CONCLUSION

Asthma triggers are highly individualized. The three main risk factors for asthma attacks are dust (87%), cigarette smoke (83%), and cold air (73%).

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CONFLICT OF INTEREST

There is no conflict of interest.

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