The Relationship Between Air Quality and ISPA: Epidemiology, Etiology, and Prevention Strategies

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ABSTRACT

Background. It can be said that cities are economic, social, and cultural centers with high population density and better infrastructure than rural areas. However, there are several challenges experienced by urban communities, such as air pollution. Air pollution in urban areas contributes to many cases of acute respiratory infections (ARI). Objective. To examine the relationship between air quality and the incidence of ARI and to provide information to the public to be more aware of ARI. Methods. The method used in this literature review is to draw from various sources with publication year limits from 2015 to 2024. Results and discussion. There is a relationship between air quality and the incidence of ARI. In addition to air quality, the incidence of ARI incidence can be influenced by various other factors, such as age (children and the elderly are more exposed), smoking habits, passive smoking, and a weak immune system. Conclusion. Air quality measures the cleanliness of the atmosphere from pollution that harmful to health. The main pollutants include Particulate Matter (PM), Nitrogen Dioxide (NO2), and Carbon Monoxide (CO). Acute Respiratory Tract Infection (ARI) is an infectious disease that often affects infants, children and the elderly, especially in developing countries. The risk of ARI increases due to exposure to pollution and smoking. To prevent ARI, it is important to adopt clean living behaviors, eat nutritiously, exercise, and vaccinate.

Keyword : Air quality; air pollution; ARI; clean living behavior; urban community.

Introduction

A city is a settlement or urban area that has certain characteristics compared to rural areas. Cities are usually economic, social, cultural, and political centers, as well as places where various human activities gather and interact. Cities are characterized by high population density compared to rural areas. City dwellers tend to live in multi-story buildings such as apartments and office buildings, which allows for efficient land utilization. Cities generally have better and more complete infrastructure compared to rural areas. This includes good road networks, public transportation, clean water systems, sewage systems, electricity, and advanced telecommunications technology [1]. Cities are usually the center of economic activity, trade, and industry. Many companies, financial institutions, and technology-based establishments are located in cities. The bustling economy often attracts many residents from surrounding areas in search of better jobs and economic opportunities. Cities provide better access to educational facilities, such as schools, colleges, and universities. In addition, cities also have more complete health facilities, including hospitals and health clinics, which can provide better and more diverse medical services [2].

Despite their many advantages, cities also face a number of challenges and problems, such as pollution, traffic congestion, expensive housing, high population density, and social inequality. Good city management is needed to overcome these problems and create a comfortable environment for its residents, where pollution is one of the things that the city government has not been able to solve, because there are still many vehicles that have not been able to escape greenhouse emissions, resulting in increased air pollution, as well as changing weather conditions to worse conditions, when compared to conditions in rural areas[3].

The problem of pollution in cities is one of the major challenges faced by people in urban society. Pollution can come from a variety of sources and has serious negative impacts on human health and the environment. on human health and the environment, and the impacts of pollution in cities can be devastating. Urban communities exposed to high levels of air and water pollution are more prone to health problems such as respiratory diseases, allergies, asthma, and cardiovascular problems. In addition, pollution can also damage the environment, including forests, rivers, and natural ecosystems, threatening biodiversity and causing climate change [4].

Pollutant particles such as PM2.5 (particles measuring 2.5 micrometers or smaller) and PM10 (particles measuring 10 micrometers) can enter the lungs and even the bloodstream. This can irritate the respiratory tract, leading to coughing, runny nose, and other symptoms.

Air pollution can have adverse effects on public health including respiratory problems for the elderly and children [5]. Long-term exposure can lead to more serious respiratory problems, such as asthma and chronic obstructive pulmonary disease (COPD)[6]. Air pollution can irritate the eyes, nose, and throat. People who suffer from allergies or higher sensitivities may experience more severe reactions to air pollution. Air pollutants such as ozone and fine particles can enter the bloodstream and damage blood vessels. This increases the risk of cardiovascular diseases, including coronary heart disease, heart attack, and stroke [7].The purpose of this literature review is to assess whether there is a correlation between air quality and ARI cases in urban areas. In addition, this literature review will include what causes and how to prevent ARI. With this literature review, it is hoped that it can add insight to the people who read it.

Methods

The method used is a literature review by analyzing various literature from several selected sources. The literature used in this literature review uses a maximum publication limit of the last 9 years (2015-2024). The keywords used to search for literature are air quality, air pollution, and ARI.

Discussion

Air Quality

Air quality is a measure of the extent to which the earth's atmosphere is free from pollution and contaminants that can harm human, animal, and environmental health. According to experts, air quality is measured by the amount and type of pollutants present in the air.8 Environmental and health experts monitor air quality using air monitoring networks and collect data regularly. This data is used to assess air pollution levels and risks to human health and helps in designing policies and measures to reduce air pollution and improve air quality for better health and the environment. Some of the commonly measured pollutants in assessing air quality include : 1). Particulate Matter (PM): A mixture of solid and liquid particles floating in the air. 2). Tropospheric Ozone: Ozone at the Earth's surface is an unwanted pollutant. It is a gas formed from chemical reactions between harmful chemicals and sunlight. 3). Nitrogen Dioxide (NO2) and Nitric Oxide (NOx): These pollutants come from the burning of fossil fuels in motor vehicles and industries. 4). Carbon Monoxide (CO): This toxic gas is formed from incomplete combustion of fuels. High exposure to CO can cause serious health problems, including poisoning and respiratory

problems. 5). Hydrocarbons and Other Hazardous Chemicals: Other pollutants include hydrocarbons, heavy metals, and organic compounds that can contribute to air pollution and negatively impact human health [9,10].

The measure of air quality can be found through the Air Quality Index (AQI), where the general categories of AQI and their meaning and impact on health are as follows: 1). 0-50: Good Air Quality - No or little risk to health. 2). 51-100: Moderate Air Quality - Health risks for sensitive groups such as children, the elderly, and people with respiratory problems may increase. 3). 101-150: 101-150: Unhealthy Air Quality for Sensitive Groups - Higher health risks for sensitive groups, and effects on overall public health may occur. 4). 151 - 200: Unhealthy Air Quality - More people may be affected. Effects on overall public health will increase. 5). 201-300: Very Unhealthy Air Quality - Serious health risks for everyone. 6). 301-500: Hazardous Air Quality - Health emergency due to very serious effects of air pollution[11].

Respiratory Health

Respiratory health refers to the state of health of the human respiratory system. The respiratory system involves organs such as the lungs, bronchi, trachea, and nasal cavity that function to take in oxygen from the air and remove carbon dioxide from the body.12 Respiratory health is a condition in which the respiratory system functions normally and efficiently, allowing the body to obtain an adequate supply of oxygen and properly remove carbon dioxide. This condition is critical to overall health as oxygen is required for normal bodily functions, including blood circulation, metabolism, and energy production [13].

Good respiratory health also includes the prevention of respiratory disorders and diseases that can affect the respiratory system, such as asthma, COPD (chronic obstructive pulmonary disease), respiratory infections, pneumonia, and others. Good air quality and a pollution-free environment are also important factors in maintaining optimal respiratory health[14]. The factors that affect respiratory health include: 1). Smoking Habit: Smoking or exposure to cigarette smoke is a major contributing factor to respiratory disorders and respiratory diseases, such as lung cancer, COPD, and asthma. Cigarette smoke contains harmful substances that can damage lung tissue and cause inflammation in the respiratory tract. 2). Air Pollution: High exposure to air pollution, including PM2.5 and PM10 particles, ozone, nitrogen dioxide (NO2), and carbon monoxide (CO), can cause irritation and inflammation of the respiratory tract. Air pollution can worsen existing respiratory conditions, such as asthma and COPD, and increase the risk of respiratory infections. 3). Respiratory Tract Infections: Viral or bacterial infections of the respiratory tract, such as flu,

colds, bronchitis or pneumonia, can cause respiratory distress and affect respiratory health. 4). Lifestyle and Health Conditions: Lifestyle conditions such as lack of physical activity, being overweight, and consumption of unhealthy food can also affect respiratory health. In addition, other health conditions such as diabetes or heart disease can impact the respiratory system [15].

Definition of ARI

Acute Respiratory Infections (ARI) are diseases that affect the upper and lower respiratory tract. The nose, vocal cords, larynx, and sinuses form the upper respiratory tract, while the trachea, bronchi, bronchioles, and alveoli form the middle and lower respiratory tract. Acute Respiratory Infection, abbreviated as ARI, comes from the English word Acute Respiratory Infections (ARI) [16].

The word ARI is made up of three parts: infection, respiratory tract, and acute which has three definitions as follows: 1). Infection occurs when bacteria or microbes enter the human body and grow to cause symptoms of disease. 2). The respiratory tract includes the sinuses, middle ear cavity, and pleuro, as well as the organs from the nose to the alveolus. The upper respiratory tract, lower respiratory tract (including lung tissue), and adnexal organs of the respiratory system are all included in ARI. Lung tissue is included in the respiratory tract due to this restriction. 3). Acute infection is an infection that lasts 14 days or less limiting even for certain diseases that can be classified as ARI, 14 days is considered to signify an acute course of the disease. This procedure may take up to 14 days [17].

Acute Respiratory Tract Infection (ARI) is a contagious infectious disease of the upper or lower respiratory tract that can cause a variety of diseases ranging from asymptomatic disease to severe and deadly disease depending on the pathogen, etiology, environmental factors, and surroundings. The ARI coordinator on the other hand is often characterized as an acute respiratory infection caused by infectious agents transmitted from person to person[18].

Epidemiology of ARI

ARI, which is an acute respiratory infection, affects both the upper and lower respiratory tract. ARI can attack various age levels, ranging from infants, toddlers, children, adolescents, adults to the elderly. This disease is so easily transmitted, especially in infants and toddlers and also in the elderly who both have immune systems that are vulnerable to viruses and bacteria [19].

The results of WHO research say that approximately 13 million infant deaths each year are caused by ARI infections. The very high percentage of infant and toddler deaths makes

ARI the first rank of the ten diseases that cause the most deaths in infants to toddlers. Infants who have vulnerable immunity are very easily infected by viruses and bacteria. Many factors cause the immunity of infants and toddlers to be very low, one of which is because babies do not get exclusive breastfeeding from their parents, because babies are not immunized and also because the food given by their parents does not meet the standards of child nutrition[20].

ARI is most prevalent in the lower class compared to the upper class. WHO says ARI is most prevalent in developing countries and countries with low economic status. Low income results in lower-class people not being able to meet the needs of the house properly and meet the health standards of a house. In contrast to people who have a middle to upper economy who live in a house that has the right health standards, they are much healthier because in their home environment has many beautiful trees. The distance of houses that are not close together is also an advantage for them because it will inhibit the spread of disease[20].

ARI is a disease that is still a major problem in various countries, especially in developing countries and countries with low economic status. The most cases of ARI in the world occur in India with 43 million cases per year, followed by China with 21 million cases per year, in Pakistan with 10 million cases per year, in Bangladesh and Indonesia with 6 million cases per year. In 2012 WHO predicted ARI cases in developing countries by 0.29% equivalent to 151 million people while in industrialized countries by 0.05% equivalent to 5 million people. Indonesia, as one of the tropical countries in the world, is a country that has the potential to become a spreading area of ARI. This disease threatens the community, especially in densely populated areas and areas with changing weather. Indonesia itself has high ARI casualties every year and continues to increase. In Indonesia, ARI is the first cause of death and has always been the first. In 2013, the first highest number of ARI patients was in NTT with 41.7%, Papua with 31.1%, Aceh with 30.0%, NTB with 28.3%, and East Java with 28.3% [20].

Etiology of ARI

ARI is a disease of the upper or lower respiratory tract that is usually contagious and depending on the causative agent, environmental factors, and host factors, can cause a variety of diseases ranging from asymptomatic to severe and fatal [21]. The causes of ARI are very diverse but can be classified into 2, namely bacteria and viruses [22].

Bacteria that cause ARI include the genus *Streptococcus, Staphylococcus, Pneumococcus, Hemophilus, Bordetella,* and *Corynebacterium*. Viruses that cause ARI include microvirus, adenovirus, coronavirus, picornavirus, mycoplasma, herpesvirus and others [22]. There are 3 types of bacteria species found, namely *Staphylococcus aureus,*

Streptococcus sp, and *Haemophylus influenzae*. Of the three types of bacteria, the most percentage is *Haemophylus influenzae*, then *Staphylococcus aureus*, and finally *Streptococcus* sp [23]. The most common viruses as the etiology of ARI are Human Metapneumovirus A/B, Human Parainfluenza Virus 1, Influenza B, Human Coronavirus OC43, Human Coronavirus-NL63, and Human Parainfluenza Virus 2 [24].

Risk Factor of ARI

ARI stands for Acute Respiratory Infection, this term is adapted from the English term Acute Respiratory Infection (ARI). An acute infectious disease that affects one or more parts of the airway from the nose (upper tract) to the alveoli (lower tract) including adnexal tissues such as the sinuses, middle ear cavity, and pleura[26]. Acute respiratory infection or ARI is an infection in the respiratory tract, which causes symptoms of cough, and runny nose, accompanied by fever. ARI is highly contagious and can be experienced by anyone, especially children and the elderly[26].

Behind the high incidence of ARI, there are various risk factors that contribute to the incidence of ARI. 1). Children and the Elderly: Children and the elderly have low immune systems, making them susceptible to various infections. In addition, the spread of ARI viruses or bacteria among children can occur very quickly because children interact closely and have contact with other children [26]. 2). Air Condition: People often do not realize that pollution will have a direct impact on their health, but people are more focused on wearing masks, and they think that is enough to overcome air pollution that will affect their health. This is quite relevant, given that people underestimate exposure to pollution, as they feel that there are no long-term effects from exposure to pollution. With this in mind, they are the ones who will be exposed to the long-term effects of pollution exposure, such as asthma, ARI, and others.8 Based on research conducted by Situmeang et al, 2021, there is a relationship between air pollution and the incidence of ARI disease. 3). Adults with Weak Immune System: The immune system is very influential in fighting viral and bacterial infections. When immunity is decreased, the risk of infection will increase. One of them is people with AIDS or cancer [26]. 4). Patients with heart and lung disorders: ARI is more common in people who already have heart disease or lung problem [26]. 5). Smoking: Smokers are more at risk of impaired lung and respiratory tract function, making them susceptible to ARI and more likely to have difficulty recovering [26]. In addition, if you live in the same house as someone who smokes, the rate of ARI will be higher [27].

ARI Prevention and Education

Acute Respiratory Infection (ARI) is a disease that affects the upper respiratory tract

and lower respiratory tract in humans starting from the nose to the alveolus and can cause mild to severe infections [28]. However, we can take some measures to prevent ourselves from getting ARI. The main preventive measure for ARI is to adopt a clean and healthy lifestyle. Some ways that can be done, namely: 1). Wash hands regularly, especially after doing activities in public places; 2). Avoid touching the face, especially the mouth, nose, and eyes, to avoid transmission of viruses and bacteria; 3). Use a handkerchief or tissue to cover your mouth when sneezing or coughing. This is done to prevent the spread of disease to others; 4). Eat more vitamin-rich foods, especially vitamin C, to boost your immune system; 5). Exercise regularly; 6). Quit smoking; 7). Get vaccinated, with either MMR, influenza, or pneumonia vaccine. Discuss with your doctor the need, benefits, and risks of these vaccinations[25,26].

Conclusion

Air quality is a measure of the extent to which the Earth's atmosphere is free from pollution and contaminants that can harm human, animal and environmental health. The main pollutants measured in air quality consist of Particulates (PM), Nitrogen Dioxide (NO2), and Carbon Monoxide (CO). The Air Quality Index categorizes air quality from good to hazardous which has an impact on respiratory health. Respiratory health involves the function of the lungs and bronchi. ARI (Acute Respiratory Tract Infection) is an infectious disease that can affect the upper and lower respiratory tract, often caused by viruses or bacteria, and is particularly susceptible to infants, children, and the elderly. The incidence of ARI occurs in many countries, especially developing countries. Without realizing it, sometimes the activities we do every day can be a risk factor for ARI, such as frequent exposure to pollution, having a smoking habit or being a passive smoker. In addition, if someone has a weak immune system, they will be more susceptible to ARI. Therefore, it is important that we all care about our health. There are ways to prevent us from getting ARI, namely implementing clean living behaviors, eating nutritious food, exercising diligently, and exercising. nutritious food, exercise, and vaccination.

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