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Climate Change and Pneumonia Disease: An Ecological Study

Kusuma S. Lestari[a*], Agung Budijono[b], Ajeng Pramayu[c], Ansyori Ansyori[d]

[a] *Department of Environmental Health, Airlangga University, Surabaya, Indonesia*

[b,c,d] *Graduates Study of Public Health Science, School of Public Health, University of Indonesia,*

[a]*Email address: kusumalestari@gmail.com*

Abstract

Since in the mid of 1970 climate change occurred causing 150,000 deaths and 5 million life disabilities every year in developing countries. ARI (Acute Respiratory Infection) is one of the most common diseases in Indonesia and contributing to baby and infant mortality. Pneumonia is one of transmitted disease cause the 2nd death in infant after diarrhea in Indonesia. ARI in Central Jakarta in 2009 recorded 1,213 people. August 2011 ARI cases was 16,750 and 248,168 in North Jakarta, West Jakarta, respectively. The aim of this research was to get a model of climate change and pneumonia in Jakarta. It was an observational research with ecological design. Data obtained from Ministry of Health and Meteorology, Climatology, and Geophysics in Jakarta from 1990 to 2010. Variables were temperature, humidity, rainfall, wind speed, and pneumonia. The results of multiple linear regression analysis known that one variable significantly associated with the incidence of pneumonia in Jakarta were the wind speed. Based on the p value = 0.007. The increase in wind speed of 1 knot can lead to an increase in 2142 of pneumonia 40.6 % of the variation of wind speed can explain the incidence of pneumonia. It is needed to build cooperation with other sector programs with relevant agencies such as Local Government, Department of Education, community organizations, community leaders and community participation for the anticipated increase in the incidence of pneumonia.

Keywords: climate change; pneumonia; model

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* Corresponding author.

E-mail address: kusumalestari@gmail.com.

1. Introduction

Climate change occurred since the mid of 1970 had a huge impact to human. It is leading to 150,000 deaths and 5 million life disabilities every year in developing countries. The effects of climate are morbidity and mortality due to air pollution related to disease, infectious disease contaminated by water, vector, rodent, and refugees migration as well [1].

Climate change affect to infection disease pattern in the world. Infectious disease caused by viral, bacteria, protozoa, and others links to extremely climate change. Higher temperature, higher air pollution and glass house effects such carbon monoxide, ozone, nitrogen dioxide, and hydrocarbon impact to respiratory system. Climate change as a result of global warming affects to infection disease pattern in the world.

Air pollution can lead infection disease especially respiratory diseases. The immunity decreases due to mucosa damage of upper respiratory tract that result of air pollutant. Acute respiratory disease such pneumonia (*Streptococcus pneumonia*), influenza, *Respiratory Syntitial Virus* (RSV) mostly occurred. Climate change in North America has affected respiratory disease by extremely increasing rainfall [2]. In United State, the increase hantavirus pulmonary syndrome related to climate change [3].

In Indonesia, baby and infant mortality are caused by Acute Respiratory Infection (ARI). Based on Ministry of Health survey, mortality caused by acute respiratory infection in 2005 and 2006 was 22.30 % and 23.60 % respectively in 10 provinces in Indonesia.. Pneumonia is one of transmitted disease cause the 2nd death in infant after diarrhea in Indonesia [4]. The objective of this research was to identify the relation of climate change and pneumonia disease in Jakarta in 1990 – 2010.

2. Materials and Methods

Data on pneumonia from year 1990 - 2010 obtained from Ministry of Health in Jakarta. It included record from public health center and hospital. Data on climate variables such rainfall, temperature, humidity, and wind speed were obtained from Meteorology, Climatology, and Geophysics in Jakarta from January 1990 to December 2010.

Data on pneumonia were annual report issued by Ministry of Health while data on climate were daily measurement. Daily data on climate were averaged to monthly then averaged to an annual. Analysis data using linier regression test.

3. Results

The figures showed fluctuated trends between pneumonia and climate variables. The upward trends on both of pneumonia and climate variables were humidity and wind speed (Figure 3-4). Pneumonia trend in 21 years tends inversely with temperature, rainfall, and humidity (Figure 1-3) while wind speed tends to directly proportional (Figure 4).

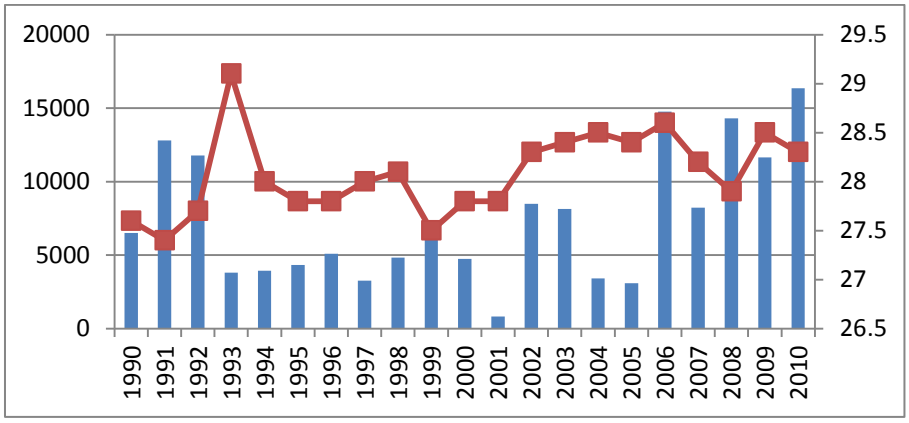

Figure 1: Temperature and Pneumonia Disease in Jakarta 1990 – 2010

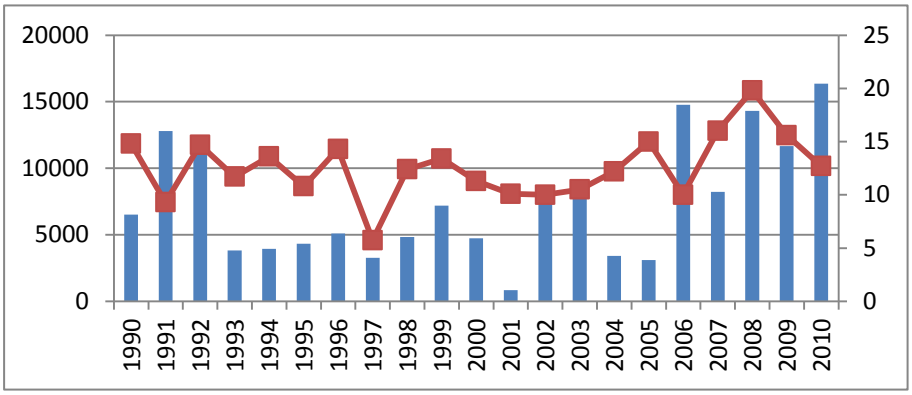

Figure 2: Rainfall and Pneumonia Disease in Jakarta 1990 – 2010

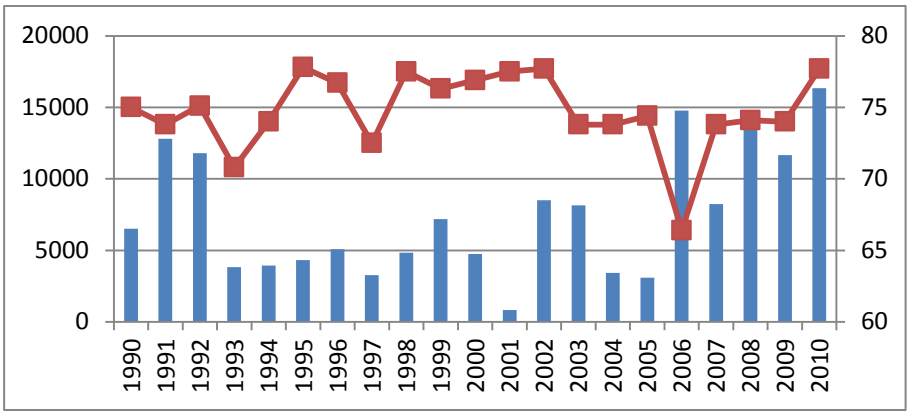

Figure 3: Humidity and Pneumonia Disease in Jakarta 1990 – 2010

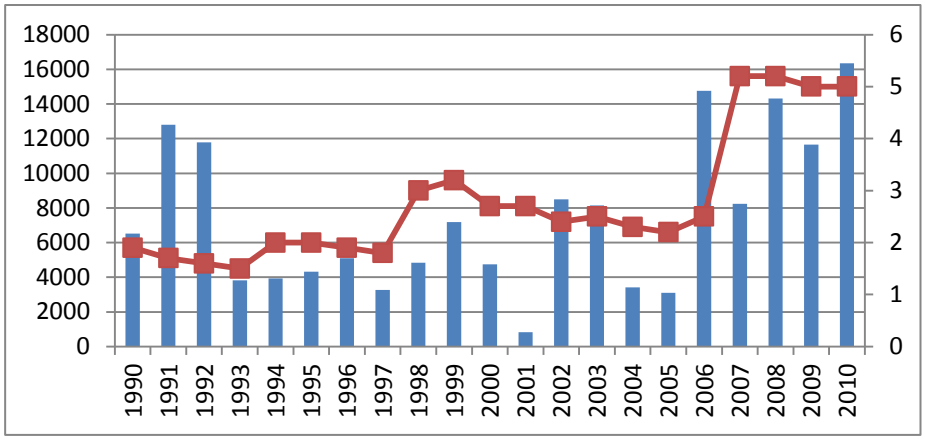

Figure 4: Wind Speed and Pneumonia Disease in Jakarta 1990 – 2010

Table 1 shows the climate variables, correlation coefficient, prediction, equation, and p value. There was only wind speed had significant relationship (p value ≤ 0.05) with positively average linier relationship (r = +0.501).

Table 1: Linier Regression of Temperature, Rainfall, Humidity, and Wind Speed to Pneumonia Disease in Jakarta 1990 -2010

Variables	r	R^2	Equation	p value
Temperature	0.002	0.000	Y = 6908.82 + 21.253* Temperature	0.993
Rainfall	0.274	0.075	Y = 2383.072 + 407.568* Rainfall	0.230
Humidity	0.241	0.058	Y = 37004.861 – 397.676* Humidity	0.293
Wind Speed	0.501	0.251	Y = 2479.16 + 1810.56* Wind Speed	0.021

Multivariate analysis using linier regression to determine major and closeness relationship between climate variables and pneumonia after controlled with others. Bivariate analysis showed significant relationship (p value = 0.021) was wind speed. Multivariate candidates (p value ≤ 0.25) are rainfall and wind speed.

In the first analyzed 4 variables, after obtained results which the variable has the p value > 0.05 excluded in subsequent analyzes one by one starting from the p variables that have the greatest value until obtain the results of the analysis in which all study variables have p value ≤ 0.05. From the results of multiple logistic regression obtained p value ≤ 0.05 was wind speed. The last model is used after calculating the coefficient β are as follows:

Pneumonia= 145871,361+2142,009*Wind Speed

It means an increase of 1 knot wind can lead to an increase of respiratory pneumonia by 2142. As much as 40.6 % of the variation of wind speed to explain the prevalence of pneumonia.

Coefficients[a]

Model	Un-standardized Coefficients		Standardized Coefficients	t	Sig.	Co linearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
1(Constant)	146858.928	85680.654		1.714	.106		
Temperature	-3169.510	2429.189	-.297	-1.305	.210	.715	1.398
Rainfall	-28.178	345.092	-.019	-.082	.936	.692	1.446
Humidity	-749.898	370.699	-.457	-2.023	.060	.726	1.377
Wind Speed	2180.409	857.802	.603	2.542	.022	.658	1.519

a. Dependent Variable: Pneu

bCoefficients[a]

Model	Un-standardized Coefficients		Standardized Coefficients	t	Sig.	Co-linearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
1(Constant)	145871.361	82307.266		1.772	.094		
Temperature	-3144.996	2339.079	-.295	-1.345	.196	.726	1.377
Humidity	-749.207	359.612	-.457	-2.083	.053	.727	1.376
Wind Speed	2142.009	696.122	.593	3.077	.007	.941	1.062

a. Dependent Variable: Pneu

4. Discussion

Climate change contributing the risk factor of respiratory disease indirectly. The higher temperature the higher incidence of respiratory disease related to environment, nutrition, immunity system, and microorganism. There were several evidence based the increase of influenza in rainy season especially in tropical area in the world [5].

From 1999 to 2007 the number of pneumonia caused by Mycoplasma pneumonia rise significantly by increasing of average temperature and humidity in Fukuoka which is 16.9 % for 1˚C average temperature increase and 4.1 % for humidity [6]. The increasing of pneumonia occurred in April – May when rainfall decreasing and in December when rainfall increasing while in Palembang the rainfall has significant relationship with acute respiratory infection [7].

Wind Speed is one of related factor in incidence pneumonia because it blows particles and pollutant around human environment. Air pollution in Jakarta not only known of transportation pollution but population density as well. Indoor air pollutant is risk factor of increasing pneumonia [1].

The study has a prediction to prevent the pneumonia regarding of climate variables. It also describes the trends both of pneumonia and climate variables. Furthermore, it requires explore the variables much further in future studies. The weakness of this study is bias in exposure and outcome due to aggregate data.

5. Conclusion

There is a significant relationship between pneumonia and wind speed in Jakarta. The increase in wind speed of 1 knot can lead to an increase in 2142 of pneumonia 40.6 % of the variation of wind speed can explain the incidence of pneumonia.

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