THE ASSOCIATION BETWEEN AIR POLLUTIONS AND RESPIRATORY DISEASES : STUDY IN THAILAND

Anongsin Danpaiboon[1]*, Phongtape Wiwatthadate[2], ChannarongChaisuwan[2],Warungarn Kosawang[3] and Petsawat Kankum[4]

[1] Office of Diseases prevention and control region 10th ,Chiang Mai,Thailand
[2] Department of Community Medicine, Faculty of Medicine, Chiang Mai University, Chiang Mai, Thailand
[3] Mae Moh Hospital, Lampang, Thailand
[4] Chiangrai Rajabhat University, Ching Rai, Thailand

*e-mail: anongsind@gmail.com

Abstract

The open burnings, coal mines, traffics, and forest fires have been recognized as the major sources of severe air pollution in the upper north of Thailand. However, there have been no clear evidences to show the associations between the air pollution and respiratory diseases in the area. We assessed the effects of air pollutants on the respiratory diseases in Maemoh District, Lampang Province, Thailand. The numbers of all 3,817 Sob-pad Sub district patients with respiratory diseases were recorded daily, for365 days , from January,1 to December31, 2007. The daily air pollutants, including particulate matter less than 10 μm (PM_{10}), carbon monoxide (CO), ozone (O_3), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2), and the meteorological parameters, including pressure, average temperature, relative humidity, rain quantity, sunshine duration, air quality index and the day of week were monitored. The air pollution and respiratory diseases were analyzed with the generalized linear model with Poisson regression. There were positive associations of SO_2 at lag 4($P=0.006$) and NO_2 at lag1 ($P=0.012$) and respiratory diseases, but negative associations of PM_{10} at lag 2($P<0.001$), Relative humidity at lag 2 ($P<0.001$), temperature at lag 6($P<0.001$), pressure at lag 5($P<0.001$) and air quality index at lag 4 ($P=0.006$) and respiratory diseases. To support this finding, future studies in the other areas and other populations of Thailand are needed.

Keywords: Air pollution, Respiratory diseases

Introduction

The effects of particulate air pollution on respiratory health are universally acknowledged, .The short-term effects of particulate matter with a 50% cut-off aerodynamic diameter 10 μm (PM_{10}) on daily mortality have been estimated to be in the range of 0.3–1.5% per 10 mg/m^3 (Pope and Dockery 2006). Short-term increases in outdoor air pollution have been associated with respiratory symptoms (Heinrich J et al; Kramer, 1999). The impact of long-term exposure to outdoor air pollution on prevalence of respiratory symptoms (Peters, 1999; Gauderman, 2004) . Results concerning symptoms have been mixed, with more evidence for significant effects of outdoor air pollution on bronchitis or symptoms such as cough and phlegm than on asthma (Gotschi, 2008).The World Health Organization reports that 3 million people now die each year from the effects of air pollution. The air pollution in northern Thailand is the cause respiratory health problems every year. The severe air pollution data of the Pollution Control Department's monitoring stations in the northern of Thailand showing in March 2007, the levels of particulate matter less than 10 μm in aerodynamic diameter (PM_{10}) exceeded the 24-h average standard level of 120 micrograms per cubic meter (μg/m3) nearly every day. The levels were as high as more than 2 times of the standard level. The highest level was on 14 March 2007, at 383 μg/m3, which is the all-time record (Pollution Control Department, Thailand, 2007). The sources of hazes were forest fires, open burning sin the agricultural settings followed by garbage and dry leave and stick burnings, traffic, and constructions. There has been no study to show the contribution of each pollution source to the smog crisis. The aggravating factors were abnormally dry weather, standstill wind, and high air pressure covering entire northern region causing (Wiwatanadate and Trakultivak 2011). The open burnings, the coal mines, the traffics, and forest fires have been recognized as the major sources of severe air pollution in the upper north of Thailand. However, there have been no clear evidences to show the associations between the air pollution and respiratory diseases.

Definition:

The respiratory diseases are Diseases of the respiratory system by International Statistical Classification of Diseases and Related Health Problems 10th Revision.

(ICD-10) Version for 2010: follow as

J00-J06 Acute upper respiratory infections

J09-J18 Influenza and pneumonia

J20-J22 Other acute lower respiratory infections

J30-J39 Other diseases of upper respiratory tract

J40-J47 Chronic lower respiratory diseases

J 60- J70 Lung diseases due to external agents
J 80-J 84 Other respiratory diseases principally affecting the inters titium

J85-J86 Suppurative and necrotic conditions of lower respiratory tract

J90-J 94 Other diseases of pleura

J 95-J99 Other diseases of the respiratory system

Methodology

Here, we used the Cross sectional Study. The study was carried out in Sob-pad Sub district , Mae Moh District, Lampang Province, Thailand as following :

1. The numbers of all 3,817 Sob-pad Sub district patients with respiratory diseases were recorded daily, for 365 days from January1 to December 31,2007.
2. Sob-pad air quality measurement station daily air pollutants, including particulate matter less than 10 μm (PM_{10}), (NO_2), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2) from January 1 to December 31, 2007
3. Lampang meteorology station daily meteorological parameters, including pressure, average temperature, relative humidity, rain quantity, sunshine duration, air quality index

Data analysis

ARIMA Models and Generalized Linear Models with Poisson regression were used to analyzed data.First, ARIMA Model excluding the air pollution variables, the basic model were builted with time trends,weather conditions, and day of weeks ,To control the time trends, graphical assessments and formal statistical approached were used for selection of model estimation and diagnostics. We plotted the model fit, partial autocorrelation function, residual deviance, and periodograms for graphical assessments. The partial autocorrelation functions below 1-7 lag day were regarded as a sufficiency condition. The weather condition, such as humidity and Models. Next, the relative risks of daily respiratory diseases cases were generated by with Poisson regression generalized linear model with polynomial distributed lag models to investigate the unconstrained time lag effect. The adopted level of statistical significance was alpha = 5% in all analyses.

Results

We reported that demographic and respiratory diseases cases characteristics were shown as below.

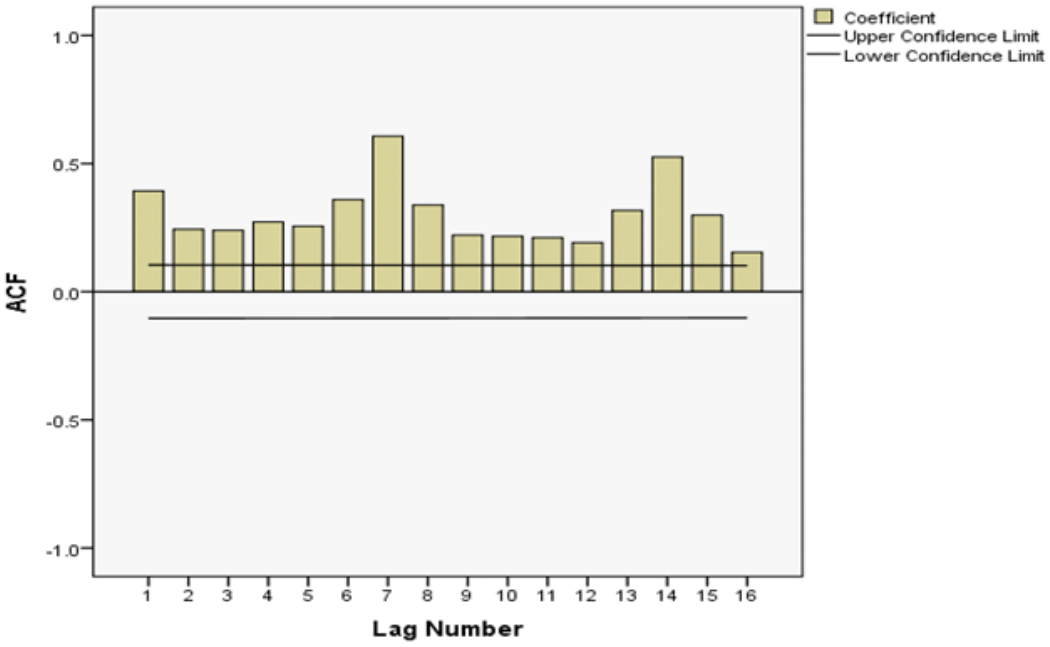

Figure 1 Autocorrelation function plot of 3,817 respiratory diseases cases patients in Sob-pad Sub district, MaeMoh District , Lampang, Thailand (from January 1 to December 31, 2007)

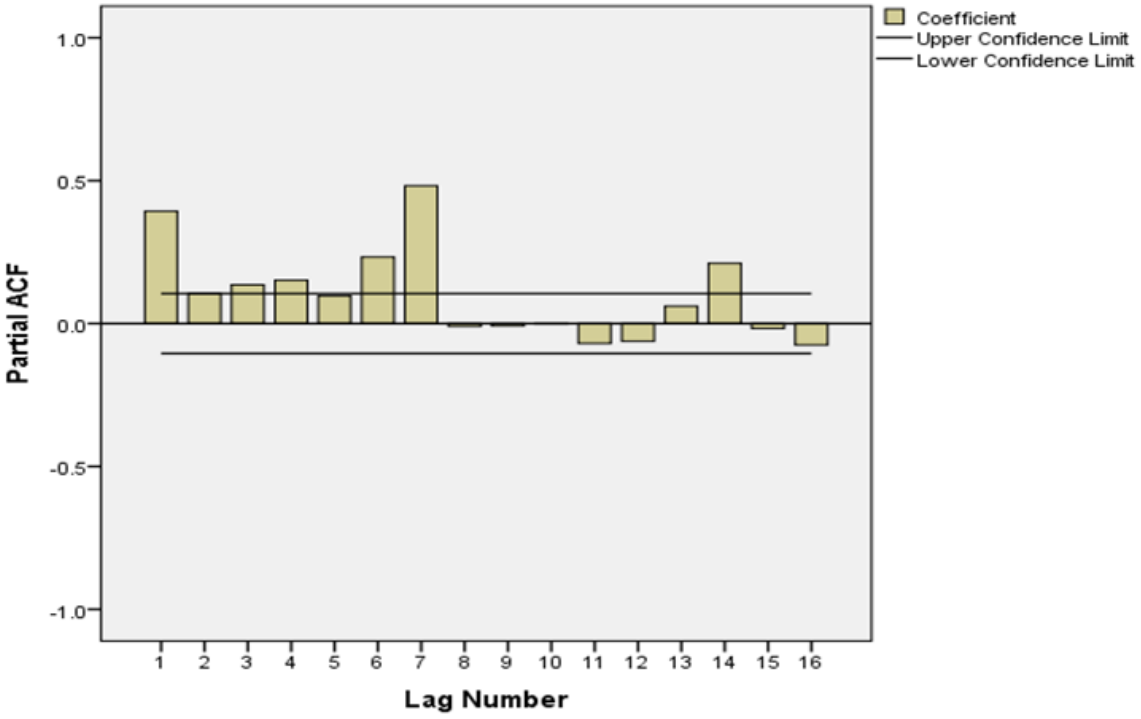

Figure 2 Partial autocorrelation function plot of 3,817 respiratory diseases cases patients in Sob-pad Subdistrict, MaeMoh District , Lampang, Thailand (from January1 to December 31, 2007)

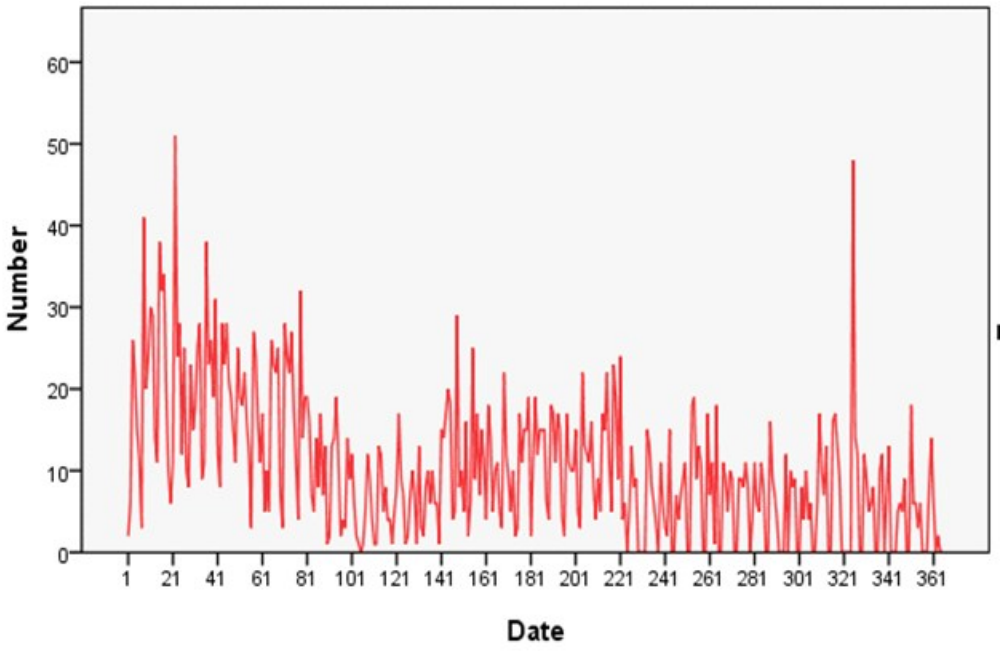

Figure 3 Daily respiratory diseases cases patients in Sob-pad Subdistrict, Mae Moh District, Lampang, Thailand (from January1 to December 31,2007)

Table 1 Descriptive statistics for daily respiratory diseases cases patients in Sob-pad Sub district, Mae Moh District , Lampang, Thailand. (from January1 to December 31, 2007)

Subject characteristic	**respiratory diseases cases**
mean maximum	9.9 51
minimum	0
SD Numbers of cases	8.2 3,817

Table 2 Daily meteorological measurements in Lampang Province , Thailand, (from January1 to December 31, 2007)

Exposure (24 h average)	No. observations	mean	max	min	SD
Highest Pressure (hPa)	365	1010.8	1022.3	1000.8	4.3
Lowest Pressure(hPa)	365	1005.6	1017.2	996.1	3.9
Average pressure(hPa)	365	1008.4	1019.2	999.2	4.0
Highest Temperature (˚C)	365	32.0	40.5	23.3	3.1
Lowest Temperature(˚C)	365	21.1	25.7	11.8	3.7
Average Temperature(˚C)	365	25.8	32.7	18.1	2.8
Highest Relative humidity (%)	365	91.7	99	66	8.9
Lowest Relative humidity (%)	365	53	95	17	16.3
Average Relative humidity (%)	365	75	98	42	13.4
Rain quantity (mm)[a]	346	3.4	103.3	0	10.7
Sunshine duration (h) [a]	361	6.3	10.9	0	3.1
Wind speed (kms/hr)	365	31	67	9	9.3

[a]Missing because of equipment malfunction.

Table 3 The daily air pollutants and air quality at Sob-pad Subdistrict , MaeMoh District, Lampang Province, Thailand, (from January1 to December 31,2007)

Exposure	SO2 [a]	NO_2 [a]	CO [a]	O_3 [a]	PM_{10} [a]	AQI [a]
Mean	0.7	4.0	0.3	16.6	45.3	50.5
Maximum	10	18.6	1.8	57.6	177.1	125
Minimum	0	0	0	1.8	11.6	9
SD	01.0	03.5	00.3	12.4	30.2	24.0
Days exceeded standards	120 ppb (24 h average)	170 ppb (1 h average)	9 ppb (8 h average)	100 ppb (1 h average)	PM_{10} 120 µg./m^3 (24 h average)	100 (24 h average)
No. observations	320	310	306	274	320	302

[a]Missing because of equipment malfunction.

Table 4 The multi-pollutant GLM s of daily average PM10 (lags 2), O_3 (lag 6), NO_2 (lags 5, 6), SO_2 (lags 4) and respiratory diseases [regression coefficient (95% CI)].

Variables		Wald	Significance
SO_2 lag 4	.051	7.685	.006
PM_{10} lag 2	-.002	19.735	.000
NO_2 lag 1	.015	6.317	.012
Relative humidity lag 2	-.017	61.756	.000
Temperature lag 6	-.103	120.277	.000
Pressure lag 5	-.026	16.014	.000
AQI lag 4	-005	7.539	.006

a Adjusted for day of week, o_3 lag 0 , SO_2 lag 4, PM_{10}_2, NO_2 lag 1, PW lag 3, Ash lag 2, a lag 6, sun lag 4, rain lag 2, ap lag 5, AQI lag 4, co lag 3 * $p < 0.05$

There were positive associations of SO_2 at lag 4(P=0.006) and NO_2 at lag1 (P=0.012) and respiratory diseases, but negative associations of PM_{10} at lag 2(P<0.001), Relative humidity at lag 2 (P<0.001), temperature at lag 6(P<0.001), pressure at lag 5(P<0.001) and air quality index at lag 4 (P=0.006) and respiratory diseases.

Discussion and Conclusions

There were positive associations of SO_2 at lag 4(P=0.006) and NO_2 at lag1 (P=0.012) and respiratory diseases, but negative associations of PM_{10} at lag 2(P<0.001), Relative humidity at lag 2 (P<0.001), temperature at lag 6(P<0.001), pressure at lag 5(P<0.001) and air quality index at lag 4 (P=0.006) and respiratory diseases. We found an effect of SO_2 at lag 4 NO_2 at lag1 on respiratory diseases cases more than the others risks, in spite of SO2 and NO_2 are low than Days exceeded standards. This study report has been used for further epidemiological analysis and policy implement for the local area and at national level to determine agents that effect health, set up surveillances systems for health effects, set up air quality warning system, and reconsidering air quality standard level in Thailand. To support this finding, future studies in the other areas and other populations of Thailand are needed.

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