นิพนธ์ต้นฉบับ . Original Article

ความสัมพันธ์ระหว่างข้อมูลทางอุตุนิยมวิทยากับอุบัติการณ์การเกิดโรคหลอดเลือดหัวใจ

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Association of Meteorological Data to Incident of Cardiovascular Disease

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หลักการและวัตถุประสงค์: โรคหัวใจและหลอดเลือดเป็นสาเหตุของการเสียชีวิตทั่วโลก ความเสี่ยงของการเกิดโรคเรื้อรังนั้นมีสาเหตุมาจากปัจจัยทางพันธุกรรมและสิ่งแวดล้อม การวิจัยครั้งนี้มีวัตถุประสงค์เพื่อประเมินและรายงานความสัมพันธ์ระหว่างโรคหลอดเลือดหัวใจและสิ่งแวดล้อม

วิธีการศึกษา: เป็นการศึกษาย้อนหลังจากข้อมูลอุตุนิยมวิทยาจาก the Modern-Era Retrospective Analysis for Research and Applications, version 2 (MERRA-2) และจำนวนผู้ป่วยนอกรายใหม่ในประเทศไทยจากศูนย์ข้อมูลสนับสนุนการจัดบริการสุขภาพที่ได้รับอนุมัติจากกระทรวงสาธารณสุขระหว่างวันที่ 1 มกราคม 2556 ถึงวันที่ 31 ธันวาคม 2560

ผลการศึกษา: จำนวนผู้ป่วยโรคหัวใจและหลอดเลือดรายใหม่ในประเทศไทยตั้งแต่วันที่ 1 มกราคม 2556 ถึงวันที่ 31 ธันวาคม 2560 แสดงแนวโน้มที่เพิ่มสูงขึ้นอย่างต่อเนื่อง โดยมีค่าเฉลี่ย 1,990 รายต่อเดือน จากโมเดลอนุกรมเวลามีเพียง 3 ปัจจัยที่เกี่ยวข้องกับการมีผู้ป่วยโรคหัวใจและหลอดเลือดรายใหม่อย่างมีนัยสำคัญ คือ อุณหภูมิ ความดันพื้นผิว และความชื้น

สรุป: ข้อมูลอุตุนิยมวิทยาได้แก่ อุณหภูมิ ความดันบรรยากาศและความชื้นที่มีผลกับการมีผู้ป่วยโรคหัวใจและหลอดเลือดรายใหม่

คำสำคัญ: โรคหัวใจและหลอดเลือด; ข้อมูลอุตุนิยมวิทยา; อุณหภูมิ; ความดันบรรยากาศ; ความชื้น

Background and Objectives: Cardiovascular disease (CVDs) is the leading cause of death worldwide. The risks of developing chronic diseases are attributed to both genetic and environmental factors. The aim of this research was to assess and report on correlation between cardiovascular disease and environment.

Methods: This retrospective study evaluated meteorological data from the Modern-Era Retrospective Analysis for Research and Applications, version 2 (MERRA-2) along with monthly new CVDs cases in Thailand from Health Data Center (HDC) v 4.0 approved by the Ministry of Public Health (MOPH) during January 1, 2013 to December 31,2017.

Results: Monthly mean values of new CVDs cases in Thailand from January 1, 2013 through December 31, 2017 display increasing trends over time with mean 1990 cases/month. By the time series model, only 3 factors related with new CVDs cases significantly including temperature, surface pressure, and humidity.

Conclusion: Meteorological data like temperature, atmosphere pressure and humidity has effect to CVDs event.

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Keywords: Cardiovascular disease; Meteorological data; Temperature; Atmosphere pressure; Humidity

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Introduction

Cardiovascular disease (CVDs) is the leading cause of death worldwide. It is estimated that 17.9 million people died from CVDs in 2016, representing 31% of all global death[1]. The causes of CVDs are multifactorial such as: age, gender, ethnicity, family history of heart disease, type 2 diabetes, hypertension, dyslipidemias, obesity, tobacco smoking, alcohol abuse, lack of physical activity and dietary habits[2,3]. To prevent and regression CVDs, it is essential to identify the risk factors of atherosclerotic lesions and need to be managed and treated[4]. The risks of developing chronic diseases are attributed to both genetic and environmental factors, 70 to 90% of disease risks are probably due to differences in environments[5].

Accumulating evidence supports that ecological features are important determinants of cardiovascular health. As has previously been reported, Seasonal variation in sudden cardiac death (SCD) has been documented by several epidemiological studies with controversial outcome[6,7]. Variations of outdoor temperature were associated with variations in the majority of CVDs risk factors such as lower outdoor temperatures were significantly associated with higher levels of systolic blood pressure (SBP) and increased total cholesterol and LDL-cholesterol [8,9]. The synergistic effect between low temperature and high humidity had the greatest impact on the CVDs death burden over a lag of 0–21 days[10].

The aim of this research was to assess and report on correlation between cardiovascular disease and environment such as temperature and air pollution in Thailand, potentially leading to improved understanding of climate vulnerability in the health sector, and more informed risk management and adaptation decisions.

Materials and Methods

This retrospective study evaluated meteorological data along with monthly new CVDs cases in Thailand during January 1, 2013 to December 31,2017, were collected from Health Data Center (HDC) v 4.0 approved by the Ministry of Public Health (MOPH). The classification of the disease in new case, hospital admission and death cases were coded according to the International Classification of Diseases (ICD-10). For the present study, ICD-10 codes associated with cardiovascular disease (I00-I09, I20-I28, and I30-I52) were included. We obtained monthly mean temperature, surface pressure, humidity and amount of rain from January 2013 to December 2017 by the Modern-Era Retrospective Analysis for Research and Applications, version 2 (MERRA-2), that is the latest atmospheric reanalysis of the modern satellite era produced by NASA's Global Modeling and Assimilation Office (GMAO). The study was approved by Khon Kaen University Ethics Committee (KKU-EC) (Project identification code HE606166).

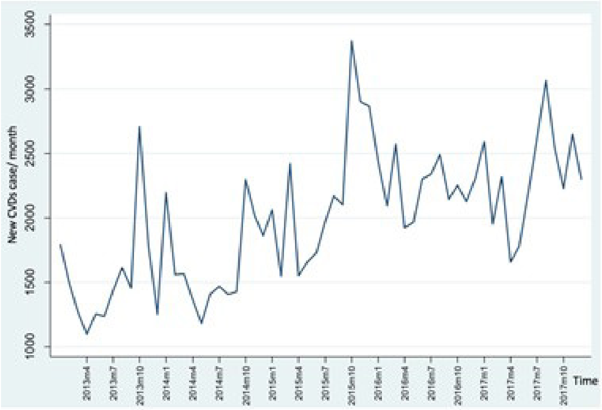
Data analysis was performed using Stata version 10.1. Meteorological data and CVDs cases were presented as frequency, median with standard deviation with percentile, respectively. A Spearman correlation was used to explore the relationship between CVDs and weather variables with its 95% confidence interval (CI).This study used a time-stratified case-crossover design to conventional time series regression for analysing associations between time series of environmental exposures (air pollution, weather) and counts of health outcomes and later in the same month in the same year. Monthly CVDs counts approximately followed Poison distribution.

Results

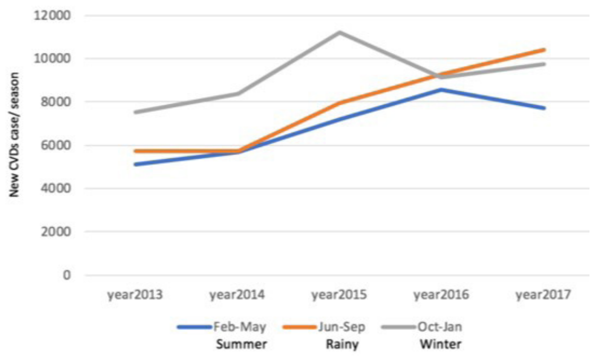
Monthly mean values of new CVDs cases in Thailand were plotted for the entire period from January 1, 2013 through December 31, 2017 to graphically display increasing trends over time with mean 1990 cases/month. Highest peak of new case is on October 2015 with 3372 cases and Lowest is on April 2013 (Graph 1). As expected, a distinctive seasonal pattern was seen, with highest new cases occurring in the winter period (Graph 2).

The distribution of monthly meteorological data is shown in wax and wane pattern of all meteorological factors as seasonal throughout study period (Graph 3). Rain and humidity exhibited the same patterns.

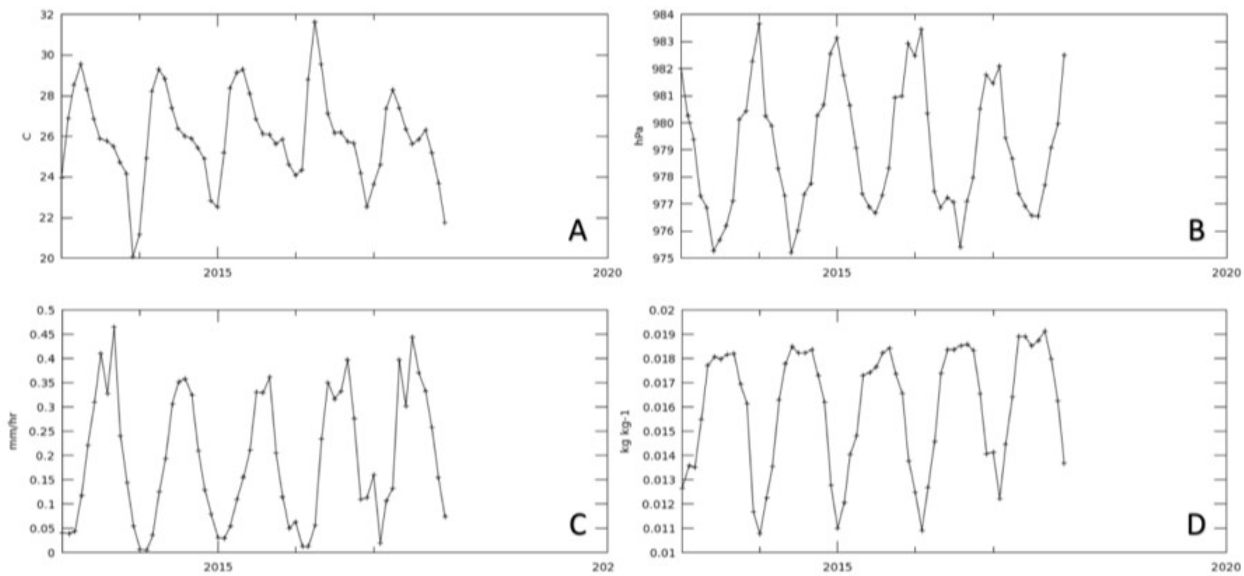
Monthly mean values of meteorological data in Thailand describe with average temperature 26.023



Graph 1 New CVDs cases each month from 2013-2017.



Graph 2 New CVDs cases distributed follow seasonal.



Graph 3 Meteorological variables in Thailand from 2013 to 2017 including temperature (A), surface pressure (B), rain (C) and humidity (D).

°C, surface pressure 979.069 hPa, rain 0.193 mm/hr and humidity 0.016 % (Table1).

Correlation between meteorological data and new CVDs cases by Spearman method found positive correlation in pressure, rain and humidity, with the highest coefficient for surface pressure (0.2876) as shown in Table 2. While, the temperature had negative coefficient with new CVDs cases at -0.2825.

By the time series model, only 3 factors related with new CVDs cases significantly including temperature, surface pressure, and humidity (Table 3). The highest incidence rate ratio (IRR) was found in temperature at 0.97 (95%CI 0.97,0.98) and lowest in humidity.

Discussion

This present study showed that in a population exposed to wide fluctuations in meteorology, was associated with a markedly resemble to wax and wane pattern of new CVDs cases during study period and also increase numbers of this disease, which is similar to the results of previous studies. In Hiroshima, Okayama, Yamaguchi and Matsue City, daily average events of acute myocardial infarction were 30- 40% higher in winter than in summer ($p < 0.05$). Daily average events increased as atmospheric temperature decreased[11]. Early ST occurred with seasonal variation; in 31 (36%) in winter, in 29 (34%) in spring, in 17 (20%) in autumn, in 9 (10%) in the summer ($p = 0.002$), was more likely to occur in the winter months 12. Compatible with our study that higher new cases in winter period with lower temperature associated with higher incidence rate ration (IRR 0.97) after adjusting other meteorology.

Table 1 Meteorological characteristics in Thailand during 2013-2017.

Meteorological data	mean values	SD	p25	p50	p75
Temperature (°C)	26.023	2.239	24.686	25.898	27.414
Surface pressure (hPa)	979.069	2.367	977.113	978.86	980.809
Rain (mm/hr)	0.193	0.135	0.06	0.157	0.326
Humidity (%)	0.016	0.003	0.014	0.017	0.018

Table 2 Correlations between meteorological data and new CVDs cases by Spearman correlation.

	CVDs	Temperature	Surface pressure	Rain	Humidity
CVDs	1	-	-	-	-
Temperature	-0.2825*	1	-	-	-
Surface pressure	0.2876*	-0.6096**	1	-	-
Rain	0.0243	0.1544	-0.7911**	1	-
Humidity	0.0356	0.3722**	-0.843**	0.8977**	1

* p < 0.05. ** p < 0.01

Table 3 Analysis of time-stratified case-crossover studies in environmental epidemiology

	IRR	[95% Conf.	Interval]	P>z
Temperature	0.97	0.97	0.98	<0.01
Surface pressure	1.07	1.06	1.08	<0.01
Rain	0.96	0.75	1.21	0.71
Humidity	7.78E+25	6.10E+20	9.91E+30	<0.01

Note: Incidence Rate Ratio (IRR)

For atmospheric pressure, a V-shaped relationship, with a minimum of daily event rates at 1016 hPa. A 10-hPa decrease in atmospheric pressure < 1016 mbar was associated with a 12% increase in total coronary event rates, a 13% increase in coronary deaths, an 8% increase in incidence rates, and a 30% increase in recurrent event rates, but atmospheric pressure levels > 1016 hPa, a 10-hPa increase was associated with an 11% increase in total coronary event rates, an 18% increase in coronary deaths, a 7% increase in incidence rates, and a 30% increase in recurrent event rates[13]. These effects were independent and influenced both coronary morbidity and mortality rates. The fall and winter seasons had the highest variability in atmospheric pressure, there was a significant correlation (p = 0.0083) between a decrease in atmospheric pressure and the occurrence of Acute Myocardial Infarction (AMI) the day after a pressure decrease, especially during the fall and winter seasons[14]. Contrast to our study that demonstrate increase atmospheric pressure increase CVDs cases.

High humidity may lead to increased thrombotic risk, a positive correlation between daily CVD death and relative humidity (r = 0.035, p < 0.05). Similar to our study that humidity impact to new CVDs case even little effect.

Strength of this study lies in the data from a national registry approved by MOPH, and our limitation is that we used exposure data that are measured directly by the Modern-Era Retrospective Analysis for Research and Applications, version 2 (MERRA-2), that is the latest atmospheric reanalysis of the modern satellite era produced by NASA's Global Modeling and Assimilation Office (GMAO), but no correlation to ground station limited to developing process.

Conclusion

Meteorology like temperature, atmosphere pressure and humidity has effect to CVDs event.

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