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# Analysis of Influenza Cases and Seasonal Index in Thailand

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***Abstract*—**This study investigated the pattern and seasonal index of influenza cases in Thailand. Our results showed that southern Thailand had the highest influenza incidence among the four regions of Thailand (i.e. north, northeast, central and southern Thailand). The influenza pattern in southern Thailand was similar to that of north-eastern Thailand. Seasonal index values of influenza cases in Thailand were higher in the hot season than in the wet season. Influenza cases started to increase at the beginning of the hot season (April), reached a maximum in August, rapidly declined in the middle of the wet season and reached the lowest value in December. Seasonal index values for northern Thailand differed from other regions of Thailand.

***Keywords*—**Influenza, Disease Index, Seasonal index, Thailand.

## I. Introduction

INFLUENZA rapidly spreads around the world in seasonal epidemics and imposes a considerable economic burden in the form of hospital and other health care costs and lost productivity. In annual influenza epidemics, 5-15% of the population is affected with upper respiratory tract infections. Hospitalization and deaths mainly occur in high-risk groups (the elderly, and the chronically ill) [1]. Although difficult to assess, these annual epidemics are thought to result in between three to five million cases of severe illness and between 250,000 and 500,000 deaths every year around the world. Most deaths currently associated with influenza in industrialized countries occur among the elderly that is those over 65 years of age [2]. This disease is also a major health problem in Thailand. It could mutate to a new influenza virus which might spread widely to other areas of the world (i.e. Avian influenza) [3].

The weather in Thailand is tropical and the climate is generally hot and humid. Thailand's weather is ruled by monsoons that produce three seasons in the area of Thailand north of Bangkok and two seasons in the southern peninsular region of Thailand. The major influences on Thailand's climate are its location in the tropical monsoon zone of mainland Southeast Asia and certain topographic features that affect the distribution of precipitation. Beginning in May, the warm, humid air masses of the southwest monsoon flow northeastward over the region from the Indian Ocean, depositing great quantities of precipitation; rainfall reaches a maximum in September. The wind pattern is reversed between November and February, when the northeast monsoon brings cool, relatively dry air masses in a southwesterly flow to create a seasonably cooler climate for much of the country. Stagnant air in March and April is associated with a distinct hot and dry inter-monsoonal period [4].

In the northern, central and northeastern regions of Thailand, the seasons are clearly defined. Between November and June the weather is mostly dry. However, this dry weather is broken up into the periods November to February and March to May, with the dry or hot season in the northern region being shorter than in the other regions. Although the northeast monsoon does not directly affect the northern area of Thailand, it does cause cooling breezes from November to February. During the cool season in the north, it can get quite chilly at night. The hot season is between March and June. The other northern season is from June to November and is dominated by the southwest monsoon, during which time the rainfall in the north is at its heaviest [5].

In southern Thailand the southwest monsoon season, which lasts for 6 months from May to October, brings rain and squalls to the coastal areas of the Andaman Sea. There is another rainy period caused by the northeast monsoon, which brings heavy rain to the coastal areas along the Gulf of Thailand from November to September. The tropical southern region of Thailand has two seasons: wet and dry. The further south you go, the shorter the dry season. These seasons do not occur at the same time on both the east and west sides of the southern peninsular. On the west coast, the southwest monsoon brings rain and storms between April and October, whilst on the east coast, the rainfall is highest from September through to December. Temperatures are more even year-round in the south and do not drop much at night [5].

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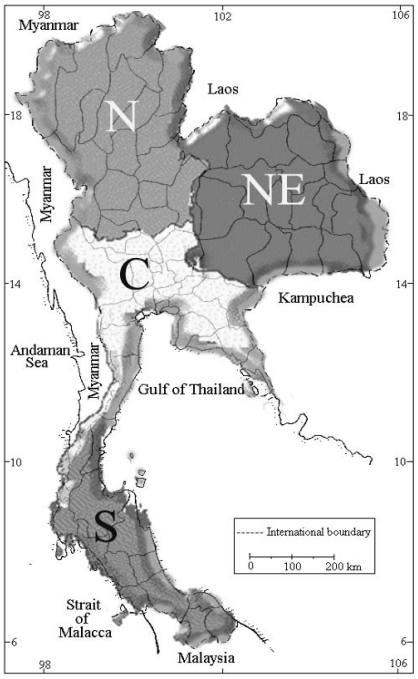


Fig. 1 Map of administrative boundaries of the four regions of Thailand. N, NE, C and S represent Northern, North-eastern, Central and Southern Thailand

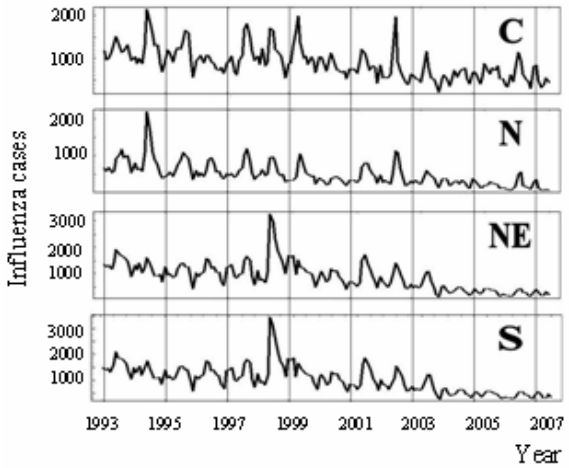


Fig. 2 Pattern of influenza cases in the four regions of Thailand from January 1993 – July 2007. N, NE, C and S represent Northern, North-eastern, Central and Southern Thailand

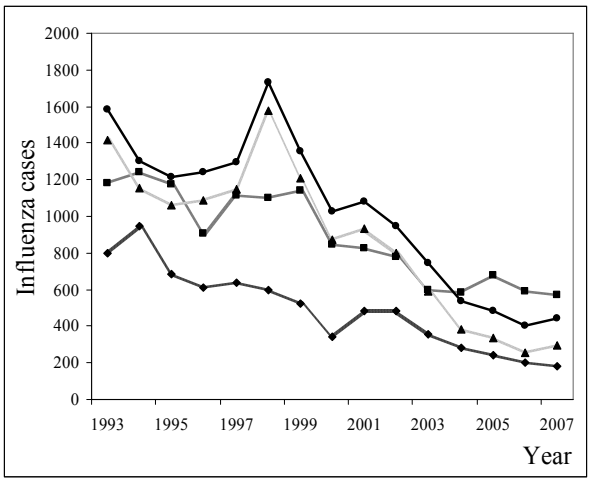


Fig. 3 Influenza cases in the four regions of Thailand from January 1993 – July 2007. Symbols represent Central (), Northern (), North-eastern () and Southern Thailand ()

## II. Materials and Methods

Thailand is located at 15° 00′ N 100° 00′ E in the centre of mainland South East Asia. It is bound by the Andaman Sea to the west, Myanmar to the west and northwest, Laos to the east and northeast, Cambodia to the east and Malaysia and the Gulf of Thailand to the south. Thailand covers 513,115 $Km^2$ (Fig. 1) and comprises four regions: northern, eastern, north-eastern and southern (Fig. 1).

The number of monthly influenza cases from January 1993-July 2007 was collected by the public health service units, the Centre of Epidemiological Information, the Bureau of Epidemiology, and the Ministry of Public Health. This study used *Mathermatica* 5.2 and its Time series package 1.3 for data visualization and analysis.

We used one-way ANOVA tests and post-Hoc tests (i.e. Student Newman Keuls) to test the mean differences of influenza cases among four regions [6,7]. We used the classical time series analysis to separate the seasonal index in each region [8].

## III. Results and Discussion

The pattern of influenza cases in southern region was similar to that of the north-eastern region and the pattern of influenza cases in northern region was similar to that of the central region (Fig. 2 and 3). This could be because the climates of the northern and central regions are very similar to each other.

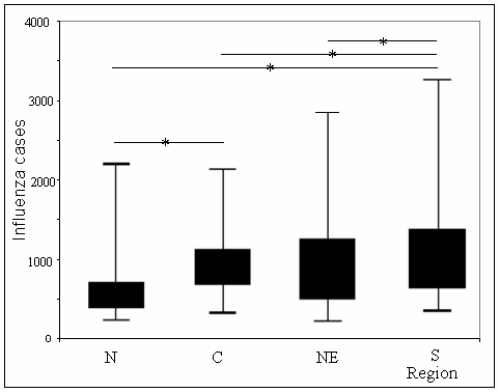


Fig. 4 Influenza cases in the four regions of Thailand from January 1993 – July 2007. N, NE, C and S represent Northern, North-eastern, Central and Southern Thailand

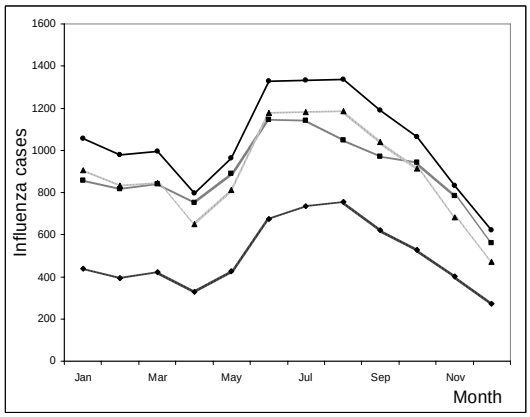


Fig. 5 Mean monthly Influenza cases in the four regions of Thailand from January 1993 – July 2007. Symbols represent Central (▪), Northern (◆), North eastern (▲) and Southern Thailand (●)

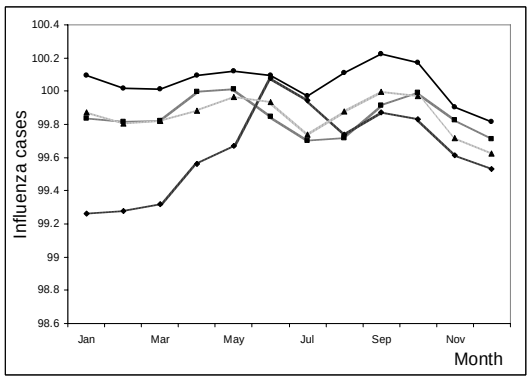


Fig. 6 Mean of seasonal index value of Influenza cases from the four regions in Thailand in each month from January 1993 – July 2007. Symbols represent Central (▪), Northern (◆), North eastern (▲) and Southern Thailand (●)

The number of influenza cases differed among the four regions of Thailand (one-way ANOVA test: $F_{3, 696} = 48.615$, $P<0.001$, Fig. 4). From student Newman Keul's post-hoc test, influenza cases in Southern Thailand differed from the other regions and influenza cases in northern Thailand also differed from the central region (Fig. 4). This showed that southern Thailand has the highest influenza incidence among all four regions of Thailand. This could be because southern Thailand is a peninsula bordering the Andaman Sea and the Gulf of Thailand. The peninsular is under a strong monsoon influence. This results in a high amount of rainfall, strong winds and also a higher percent relative humidity than other regions of Thailand [9].

The mean monthly figured for influenza cases in the four regions of Thailand showed a similar trend (Fig. 5). Influenza cases started to increase at the beginning of the hot season (April), reached a maximum in August, rapidly declined in the middle of the wet season and reached the lowest point in December (Fig. 5). This could suggest that the amount of rainfall has a negative effect on the transmission of influenza in Thailand [10]. This negative effect has been conventionally explained by human behavioral changes, as during the heavy rainfalls, people tend to congregate indoors more often. Thus, there is a less likelihood of influenza infection between houses, districts or provinces because of decreased human interaction [10].

When irregular values were removed from the number of influenza cases, seasonal index values of influenza cases were obtained. Seasonal index values showed that the influenza cases in the northern region differed from the other regions (Fig. 6). This could be because of differences between the northern region and other parts of Thailand, particularly the region's elevation. Northern Thailand has many mountainous areas which may produce a shorter hot or dry season than that of other regions of Thailand [11].

In the dry season, the number of influenza cases was the lowest among all four regions of Thailand. The number of influenza cases decreased continuously until the beginning of the hot season. After the hot or dry season, the number of influenza cases rapidly increased at the beginning of rainy season. The number of influenza cases decreased rapidly in the middle of the rainy season and continued to decrease until the end of the dry season [12]. The results of this study differed from seasonal influenza data reported by The Centre for Infections (CfI) from the UK. The CfI reported that influenza cases occurred most often in winter and usually peaked between December to March. From our study, influenza cases in Thailand occur most often in the hot season and continue to increase until the beginning of the rainy season in May to August, then decreasing in the dry season from November to March. However, November to March is the winter season in the UK [13].

From this study, influenza cases in the northern region followed different patterns from those in most of the other regions. This may be because the wind from the northeast monsoon from China brings the cool air to northern Thailand. The southern, northeastern and central regions could be under the stronger influence of the wind of the southwest monsoon than is northern region. The effect of the wind of the

southwest monsoon may be to provide advantageous conditions for the flu virus and enhance the transmission rate. Southern Thailand is more strongly affected by the wind of the southwest monsoon than other regions [14].

## IV. Acknowledgments

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