Chapter 5

Conclusion and Discussion

The purpose of this study is to investigate and model the geographical distribution of the annual incidences of dengue hemorrhagic fever and other fever-symptomatic diseases in Yala province of southern Thailand in 2002 and 2003, with a view to identifying locations associated with an unusually high risk of disease. The other diseases considered are dengue fever, hemorrhagic conjunctivitis, diarrhoea, pyrexia of unknown origin, pneumonia and malaria. In this chapter we summarise the statistical methods and the findings, and discuss their implications. We also list some of the limitations of our study.

5.1 Conclusion

The method for preliminary analysis involves first investigating the correlations between the observed disease incidences in the 58 subdistricts of Yala Province in 2002. The incidence rates for each disease in each subdistrict are computed by dividing the number of reported hospital cases by the subdistrict population (in 1000s). Skewness is reduced by taking the natural logarithms of these incidence rates (after adding 1.0 to take care of 0s), and Pearson's correlation coefficient is used to measure the associations between the disease rates.

The highest correlations between the disease incidence rates in 2002 are 0.805 for diarrhoea and conjunctivitis, and 0.798 for diarrhoea and pneumonia, with a lower, but still relatively high, correlation (0.580) found between conjunctivitis and pneumonia. A high correlation (0.61) is also found between diarrhoea and DHF in 2002. This

correlation is difficult to explain, because diarrhoea is associated with dirty water but the mosquito carrier for DHF lays its eggs in clean water.

It is of interest to see if these correlations are found in the data for 2003. Table 5.1 shows this comparison, from which we conclude that the correlations are generally lower in 2003 than in 2002.

Disease	2002	2003
Diarrhoea and Haemorrhagic conjunctivitis	0.81	0.66
Diarrhoea and Pneumonia	0.80	0.39
Diarrhoea and Dengue Haemorrhagic Fever	0.61	0.46
Haemorrhagic conjunctivitis and Pneumonia	0.58	0.26

Table 5.1 Correlations between logarithms of disease incidence rates

As shown in Table 4.1, the incidence rates for the three diseases Dengue Haemorrhagic Fever, Dengue Fever and Haemorrhagic conjunctivitis decreased in Yala province from 2002 to 2003, whereas those for the three diseases Diarrhoea, Pneumonia and Malaria increased. Pyrexia of unknown origin has similar incidence rates in the two years.

We use schematic range maps to show how the morbidity rates vary over the 58 subdistricts in Yala province in 2002 and 2003. The statistical method involves first using the Poisson distribution to model the incidences for each disease in each year, and examining the residual deviance and normal scores plots of the standardized residuals for the subdistricts in each year. Finding excessive deviance (overdispersion) in this model, we find that the negative binomial distribution, which includes an additional parameter, provides satisfactory fits to the data for each disease and each year. In this case the appropriate scores are based on a gamma distribution instead of the normal distribution.

Finally, we calculate a multiplicity-adjusted p-value for each subdistrict based on the negative binomial model, and thus show risk alert maps where subdistricts having unusually small p-values are shaded in red (p-value < 0.01; high risk alert) or orange (p-value < 0.05; moderate risk alert). For all diseases in the two years, five risk alerts occurred. For Dengue fever, in 2002 there were two subdistrict with moderate risk alerts, namely Ka Yu Bo Ko (p = 0.0296) and Ku Ta Ba Ru (p = 0.0422), whereas in 2003 there was just one subdistrict with a high risk alert, namely Ka Yu Bo Ko (p = 0.0032). For pyrexia, in 2003 there were two subdistricts with moderate risk alerts, namely Kerikat (p = 0.0172) and Than To (p = 0.0358).

5.2 Discussion

Our map region is the subdistrict, so we cannot compare disease rates in villages. For example, there was high Dengue haemorrhagic fever incidence in BaLa subdistrict in 2002. This could be due to a single village having many cases of DHF or several villages each having a smaller number of cases. Also, the volatility of incidence rates with time suggests that there might be a cycle of disease incidence, or possibly environmental factors that wax and wane in the subdistricts. A study of Fenn (2005) found that diarrhoea and pneumonia co-exist among children less than five year of age and increased severity of disease has higher comorbility. Possible or probable results of Adenovirus infections include respiratory illness, pneumonia and diarrhoea (Jong, 2003). Adenoviruses are associated with disease cases and the diseases resulting for infection include conjunctivitis and pneumonia (Crabtree, 1997).

Spatial geographical patterns are associated with the distribution of the incidence of Dengue haemorrhagic fever and other diseases. This is consistent with results reported by Luemoh (1998).

Small area maps of disease incidence and growth incidence are important because they facilitate possible explanations and hypotheses of spatially varying risk factors, including environmental factors such as swamps, chicken farms, industrial waste dumps, and population density, and socio-economic and demographic factors associated with the residents (Kleinschmidt el al, 2002).

Strickman (2000) also found that the incidence of dengue fever increases in small areas. Gubler (2002) reported that Dengue epidemic might be caused by secondary infections.

However, using statistical method alone to analyse epidemics and their possible risk factors is not sufficient since important geographic information would be missed. GIS methods are also needed to help researchers to visualize spatial pattens (Keola el al, 2002).

It is important to note that the risk alert concept we have introduced is not related to the overall incidence rate in any given year, because it increases the statistical significant of unusually high disease incidences relative to the overall mean. Future studies need to develop similar models for data increasing periods of longer duration than one or two years. The statistical modelling also needs to take other important disease risk factors, such as age and season, into account.

5.3 Limitations and Future Research

While we have developed a useful statistical method for assessing excess disease in the community, our study was limited, due to time constraints, as follows.

(a) The information for this study was only collected for the incidence cases, and no risk factors were examined.

(b) The physical geographic details (villages, rivers, mountains, etc) were not considered.

(c) The time period of the study was not long enough.

(d) Age distributions of disease were not taken into account.

(e) Seasonal patterns were not considered.

(f) Data for several provinces should be compared.

Future studies should and can address these limitations.