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Seasonal effects on the reported incidence of acute diarrhoeal disease
in Northeast Thailand

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Abstract

This paper examines the seasonal variation in the reported incidence of acute diarrhoea for selected amphurs and changwats in the Northeast of Thailand. Charts are presented which show rainfall, temperature and reported incidence of acute diarrhoea for the period 1982 to 1987. Incidence of diarrhoea appears to be inversely related to a sharp decrease in temperature around January and February each year. Although rainfall does not appear to have a direct effect on the relative incidence of acute diarrhoea, there is always a consistent reduction during July or August, after the rains have begun. Seasonal changes in climate may be indirectly related to other factors which have an important bearing on diarrhoeal disease. Detailed information on factors such as water use and the level of service of water facilities may help to provide a more comprehensive explanation of differences in the reported incidence of diarrhoeal disease.

Key words

Diarrhoea, Diarrhoeal disease control, Seasonality.

INTRODUCTION

Diarrhoeal disease is one of the major causes of morbidity in Thailand and in recent years there has been a concerted effort by the Thai Government to reduce this problem. The burden that this disease imposes on health services has meant that preventative strategies have generally been favoured, with water supply and sanitation interventions proposed as a major component of this approach. However, improved information on the impact of specific and combined levels of water supply and sanitation services is required if an optimal health impact is to be achieved. The reasons for this are twofold. In the first place, planners have to decide how resources should be allocated between water supply and sanitation programs, and other health programs such as oral rehydration and immunisation. Secondly, once the level of resources available to the water supply and sanitation sector is set, planners then have to decide the appropriate allocations to specific water supply, sanitation and hygiene education activities, and the levels of service to be provided.¹

An insight into the mechanisms of the spread of diarrhoea would assist in the design of cost-effective public health strategies. However, such is the complexity of this disease that studies conducted in Thailand and other developing countries, have shown only 50% (or less) of diarrhoeal incidence to result from infection by a known pathogen.²⁻⁴ The most common pathogenic agents found are usually rotavirus and enterotoxigenic *Escherichia coli* (ETEC). Other common agents include *Shigella*, enteropathogenic *E. coli*, *Campylobacter jejuni*, *Salmonella* spp. and *Giardia lamblia*. Rotavirus infections are commonly associated with the cooler months of the year,⁵ and studies in Thailand tend to confirm this, showing for example, a definite peak in the cool winter months.^{6,7} The incidence ETEC has been correlated with higher temperatures² and again this observation is supported from studies⁸ in Thailand. Overall it is observed that enteric bacteria are not as common during the cool months as at other times of the year.

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The aim of this paper was, therefore, to investigate in some detail the relationship between the seasonal climatic pattern and the seasonality of the reported incidence of acute diarrhoea in Northeast Thailand.

MATERIALS AND METHODS

Data on rainfall, temperature and reported incidence of acute diarrhoea for the period 1982-1987 were collated for 10 of the 17 changwats (provinces) in the Northeast region of Thailand and 15 of the 20 amphurs (districts) in Changwat Khon Kaen. Only a few of these charts are presented in this paper as a representative sample of these amphurs and changwats. The data were provided by the Department of Meteorology, Bangkok and Khon Kaen; the Provincial Health Office, Khon Kaen; and the Department of Epidemiology, Ministry of Public Health (MOPH), Bangkok. Data for the incidence of only acute diarrhoea are included in the charts as these are by far the most numerous when compared to other categories of diarrhoea as defined by the MOPH. For example, it has been shown that from 1978-1983 the majority of cases reported were acute diarrhoea (77%), followed by dysentery (12.2%), food poisoning (6.3%), enteric fever (3.5%) and cholera (0.6%).⁹ Diarrhoea without blood or mucus is usually reported as acute diarrhoea, whereas all other diarrhoeal categories require stricter definitions.

No attempt has been made to show the incidence rate of diarrhoeal disease because of expected anomalies between reported incidence and actual incidence. Data on the incidence of the disease are recorded at health centres, district hospitals and general hospitals. There is little information available concerning the relationship between reported incidence and actual incidence or the biases that may occur at the different recording institutions. The level of health service provided in different areas may well affect the proportion of reported to actual incidence of diarrhoea. In addition, the increased attention paid to diarrhoeal disease in recent years may have led to changes in the reporting procedure during the time period chosen. Therefore, the charts should only be read for the relative incidence of acute diarrhoea. It is assumed that the reported incidence is proportional to actual incidence, but this proportion may differ for the selected amphurs and changwats, and may change over time.

Temperature is only recorded at the changwat level, but rainfall data are collected at each of the amphurs included herein. In some months rainfall data are missing and this is indicated on the charts. It should be noted that in the year 1987 acute diarrhoea figures for the changwats do not appear to be as reliable as those obtained for the amphurs.

RESULTS AND DISCUSSION

Amphur charts

There has been a general increase in the reported incidence of acute diarrhoea over the last six years. This may have resulted from improvements in the reporting procedure and/or an increase in the actual incidence of diarrhoea. It is interesting to note that the increase is not so marked in Amphur Muang Khon Kaen (Figure 1) as it is in some of the other amphurs (Figures 2 & 3), which may reflect the better facilities available at the provincial capital and hence a greater consistency in the reporting procedure. Although the reported incidence rates of acute diarrhoea for different amphurs can not reliably indicate the actual incidence rates, calculations have been made for the year 1986. It is interesting that the two amphurs with the lowest reported incidence rate (Amphur Muang and Amphur Chum Phae) have the highest proportion of residents living in municipal areas (Figures 1 & 2). The highest incidence rate for 1986 is found in Amphur Ubon Ratana which has almost four times the rate of Amphur Muang.

The general pattern of seasonality is similar throughout the province although the relative magnitude and the exact months of peaks and troughs vary. It should be noted that an epidemic occurred early in 1987 which is reflected by the high peaks at this time. The epidemic is thought to have started in Ban Phai and appears to have spread, by varying degrees, throughout the province.

The only consistent association between reported incidence of acute diarrhoea and temperature appears to be an inverse relationship during the winter months. Although temperature is only recorded at the provincial capital, such a marked decrease around this time can generally be assumed to effect the whole changwat. From this data alone it is not possible to know which causative agents are predominant at different times of the year, but there is evidence to suggest that rotavirus may be more predominant during these cooler months.⁷

Rain has often been proposed as a major factor in the spread of diarrhoeal disease.^{10,3} However, the relationship between incidence of acute diarrhoea and rainfall is not altogether clear. There is no evidence to suggest that rainfall directly affects the spread of diarrhoeal disease, but it may be expected to have an impact on certain factors which are relevant. For example, rainfall may affect the survival and spread of certain causative agents since it is known that most enteric bacteria survive longer in a moist environment¹¹ and may be physically moved with water. Rainfall may also indirectly affect the spread of disease by changing factors commonly associated with diarrhoeal disease, such as water use and availability. This is particularly relevant to Northeast Thailand as rainwater collection by rural households is a predominant water source for drinking and other domestic uses. There could thus be a number of factors related to rainfall whose combined effect is greater than the sum of their independent parts. Whatever the case, the only consistent seasonal change in the reported incidence of acute diarrhoea is a steep reduction which occurs around the middle of the rainy season during the months of July, August and September. Interestingly, the time of year at which this reduction occurs appears to be fairly constant for each amphur.

The seasonal pattern of diarrhoeal disease caused by enteric pathogens, would be expected to depend on how water is used and its subsequent impact on faeco-oral routes. Information of this kind is not generally available for the areas studied and such is the complexity of faeco-oral transmissions that it would be problematic to make any statistical comparisons. However, the effect of rainwater on the environment, patterns of water use and water-related activities probably show a greater seasonal variability than any other water resources available in Northeast Thailand. Information on the way rainwater is used may provide a more accurate picture of disease transmission.

Changwat charts

The changwat charts also show a general increase in the reported incidence of acute diarrhoea over the same time period. Similar findings have been reported for the period 1978-1982 and it is suggested that this may be partly due to improved surveillance and reporting procedures.⁹ The highest reported incidence rate of acute diarrhoea for the year 1986 occurred in Changwats Loei and Mukdahan and it is almost four times greater than the lowest rate, recorded in Nong Khai. There is, however, a large discrepancy between some of the population figures obtained from different sources. This may be due to the methodological differences in recording demographic data. For example, migrant workers who are absent semi-permanently may still be recorded as residents. The highest and latest population figures (for 1987) are used here, and this may have led to an underestimate of the reported incidence rate of acute diarrhoea (Figures 4 to 6).

The peaks and troughs reflect a similar pattern to those described by the amphur charts, but the similarity between the diarrhoea curves is more striking in changwats than amphurs (Figures 4 to 6). The seasonal pattern appears with a greater regularity and consistency than that found in the amphur charts. This phenomenon cannot be explained by the outbreak of repeated epidemics originating from a common source, for two reasons. First, there are no obvious mechanisms by which diarrhoeal disease could spread so quickly and consistently over such a vast area, given that the peaks and troughs usually occur on the same months in the different changwats. Secondly, in the cases where epidemics of cholera and shigellosis have been closely studied by the MOPH, the spread between changwats has never been instantaneous. It is therefore more likely that the agents causing diarrhoeal disease are endemic in the population and that seasonal changes effect their rate of survival and transmission.

Although the age-specific diarrhoea incidence is not presented in the charts, an example is provided in Figure 7 which compares the reported incidence of diarrhoea for persons above and below five years of age during 1986 in Changwat Khon Kaen. There is a striking difference between the two groups with winter diarrhoea being far more prevalent in infants. As rotavirus is generally more common in children than adults, this supports the suggestion that this agent is more prevalent during the winter months.

The Northeast Region has the greatest seasonal variation in reported diarrhoeal incidence. In the Southern Region for example, the seasonal variation is much less dramatic (Figure 8). Climatic conditions in these two regions are markedly different: the Southern Region has a tropical climate with the greatest rainfall and longest rainy season extending to January or February, whereas the Northeast, in common with most parts of Thailand, has a distinct wet and dry season. Seasonal variation in temperature is only slight in the South, between 2° to 3°C, but the Northeast has a seasonal variation of 12° to 15°C and a daily range of as much as 20°C may be observed during the cool season.

CONCLUSIONS AND RECOMMENDATIONS

The intention of this paper is to provide background information for studies aimed at the prevention of diarrhoeal disease. The charts provide a limited and simplified presentation of what is certainly a complex phenomenon. There is no doubt that a strong seasonal pattern exists and the following are tentative explanations of the seasonal changes in the reported incidence of acute diarrhoea:

- A multitude of pathogenic agents are endemic in the population and climatic selectively affects their survival in the environment.
- Certain environmental factors directly or indirectly affect the faeco-oral transmission of microorganisms.
- Seasonal changes affect the susceptibility of the host to the infestation of disease.

The detection of enteric pathogens is both expensive and time consuming. To measure directly their survival in a dynamic environment would be extremely difficult, if not impossible. Studies of this type are usually limited to the identification of pathogens in diarrhoeal cases, and the season variations of particular pathogens has been discussed earlier. Little is known about the relationship between the ingestion of enteric pathogens and the infestation of disease. That temperature appears to be strongly associated with infant diarrhoea is certainly interesting, but complex biological processes are difficult to measure, let alone control. Studies of this type may practically be limited to crude, indirect measures of biological processes such as seasonal changes in dietary intake.

Although rainfall does not appear to have a direct effect on the relative incidence of acute diarrhoea, the sharp decline of diarrhoea around the middle of the rainy season is highly consistent. Little is known about the changes in social and individual behaviour and the subsequent effect on faeco-oral disease transmission. It would, therefore, be useful to have more information about other related factors which may give a clearer association with this particular phenomenon. Further investigation into the regional differences in the seasonal pattern of diarrhoea may help to select factors which produce the most fruitful areas for research.

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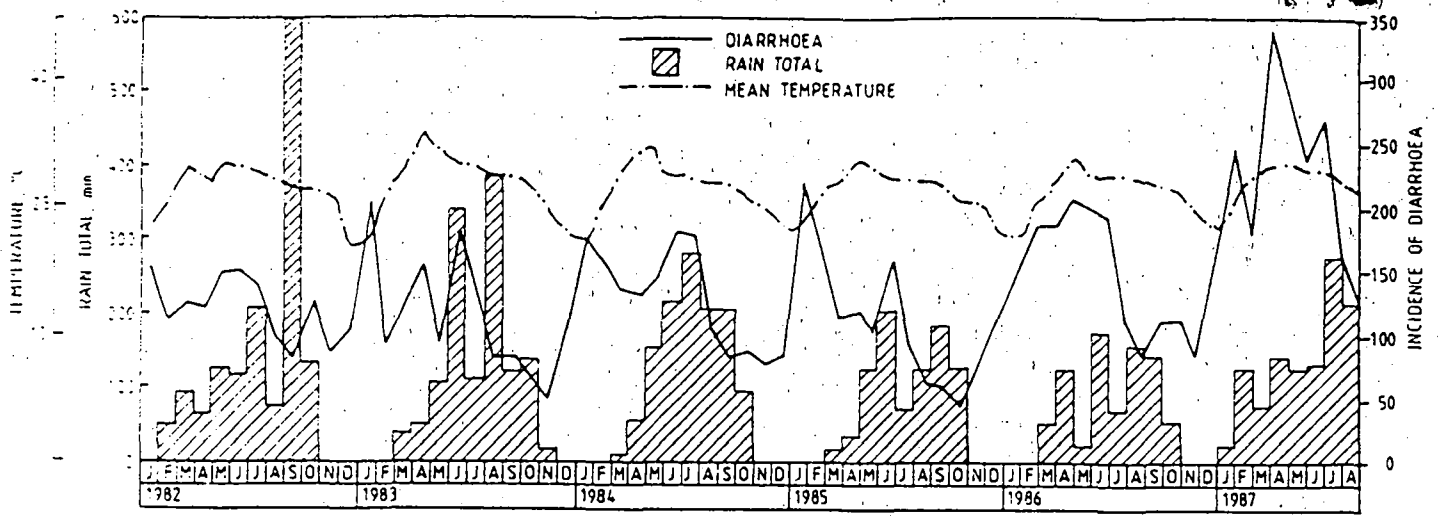


Figure 1 Amphur Muang Khon Kaen: reported cases of diarrhoea and climatic conditions
 Population: Rural - 183,020; Urban - 129,802. Incidence rate: 569 (per 100,000)

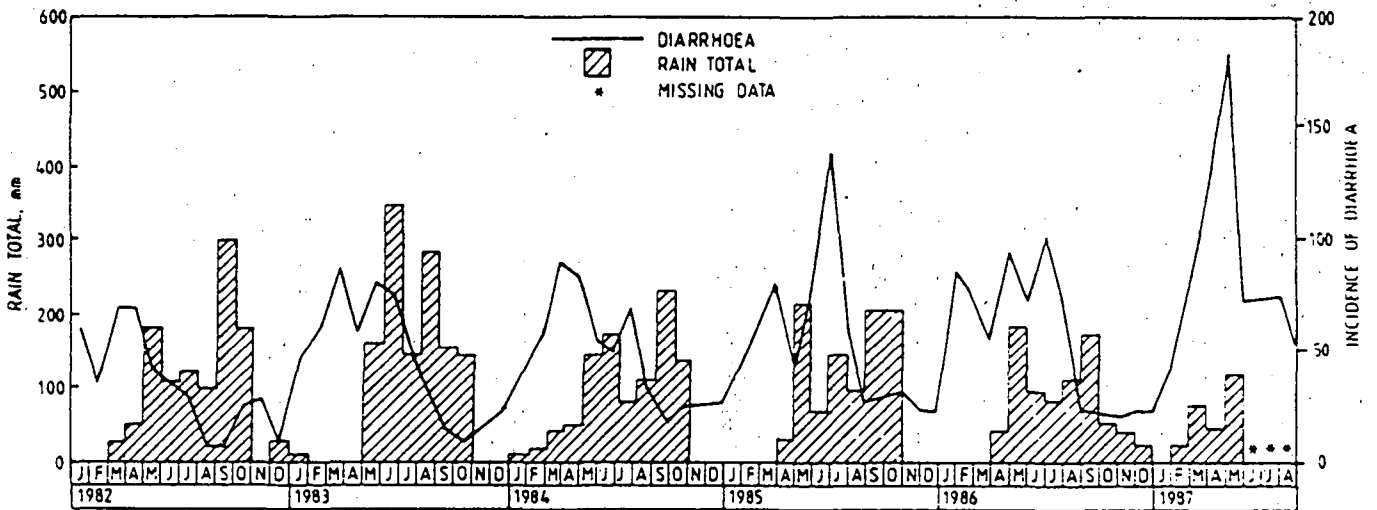


Figure 2 Amphur Chum Phae: reported cases of diarrhoea and climatic conditions
 Population: Rural - 88,263; Urban - 31,238. Incidence rate: 557 (per 100,000)

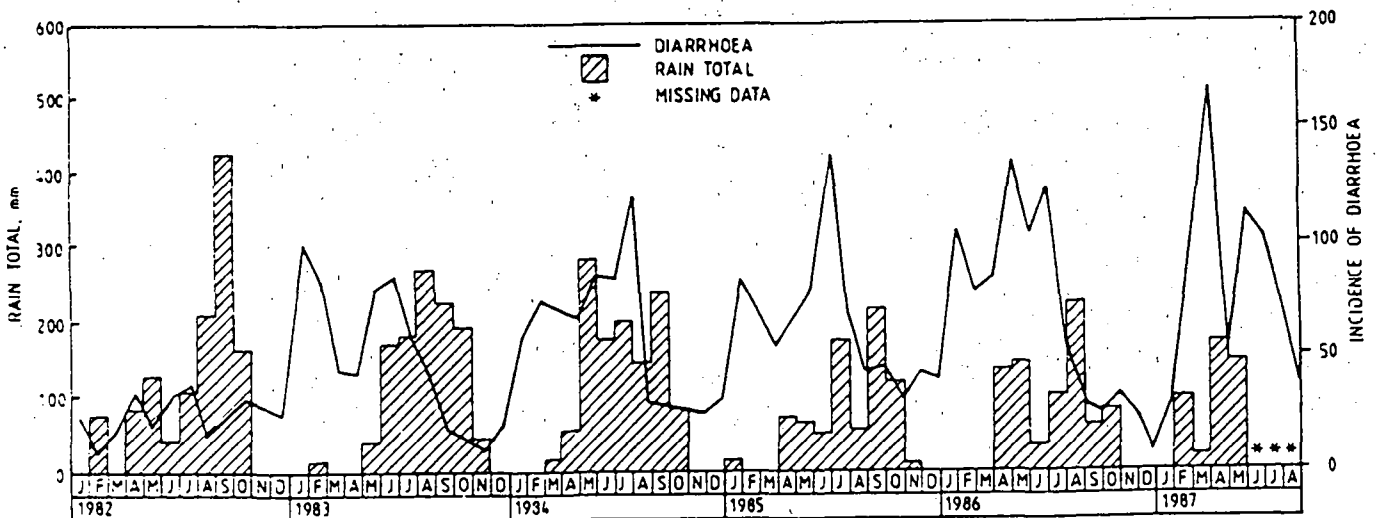


Figure 3 Amphur Phon: reported cases of diarrhoea and climatic conditions
 Population: Rural - 69,526; Urban - 13,689. Incidence rate: 980 (per 100,000)

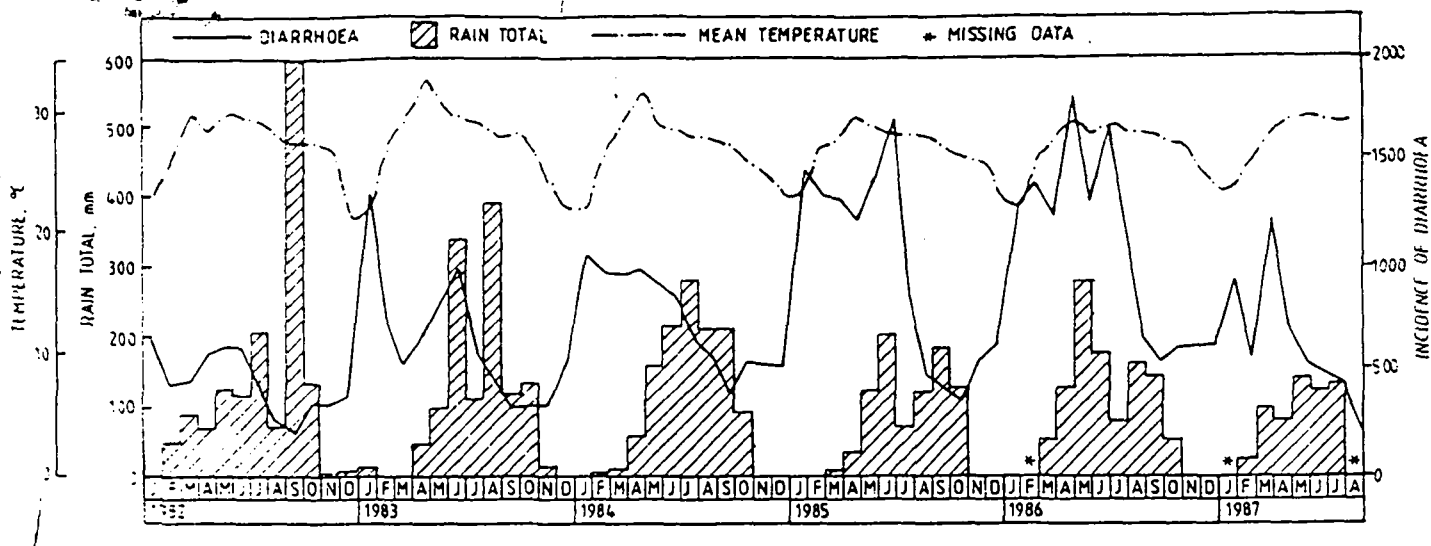


Figure 4 Changwat Khon Kaen: reported cases of diarrhoea and climatic conditions
 Population: 1,633,000. Reported incidence rate of diarrhoea: 788 (per 100,000)

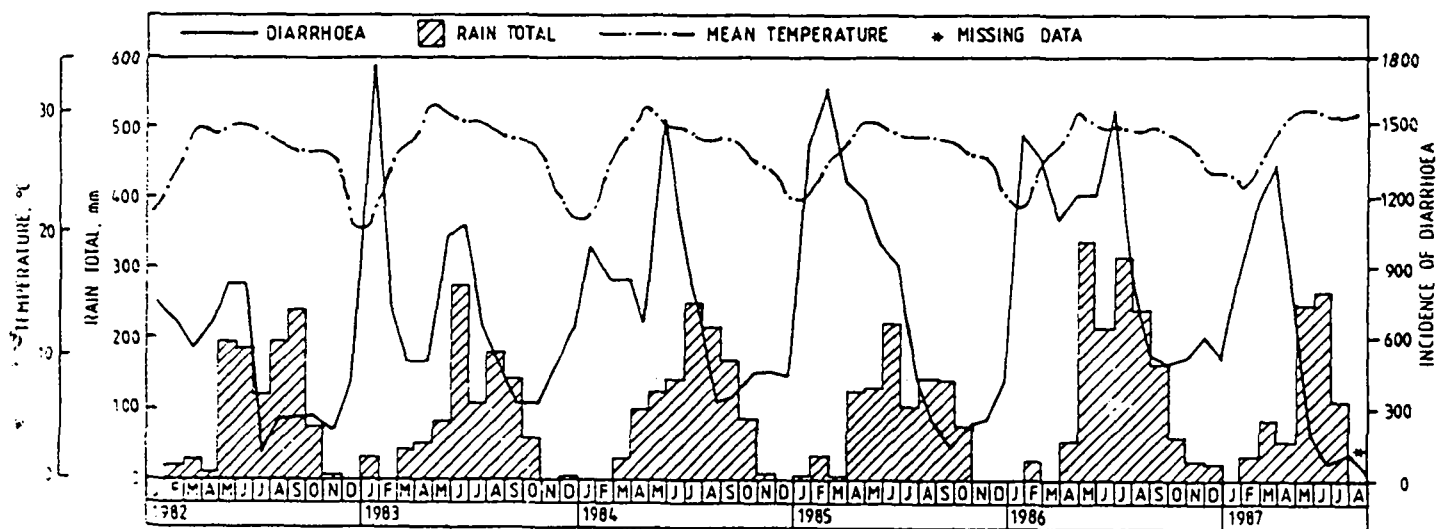


Figure 5 Changwat Udon Thani: reported cases of diarrhoea and climatic conditions
 Population: 1,663,000. Reported incidence rate of diarrhoea: 689 (per 100,000)

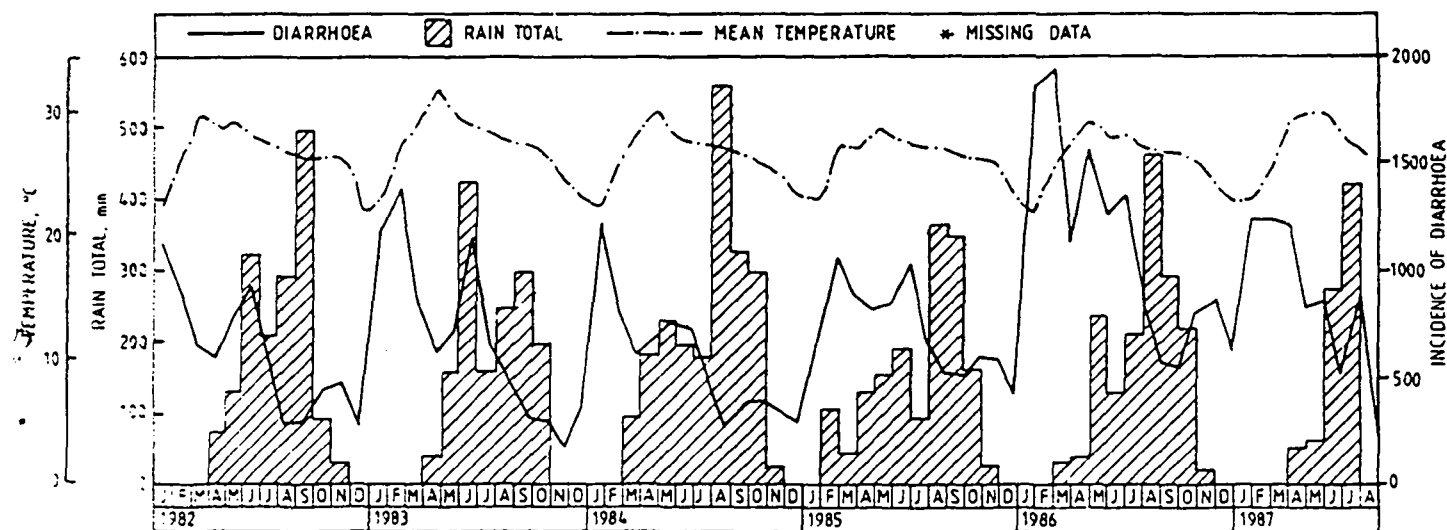


Figure 6 Changwat Ubon Ratchathani: reported cases of diarrhoea and climate
 Population: 1,733,000. Reported incidence rate of diarrhoea: 780 (per 100,000)

Age specific incidence of diarrhoea (Changwat Khon Kaen)

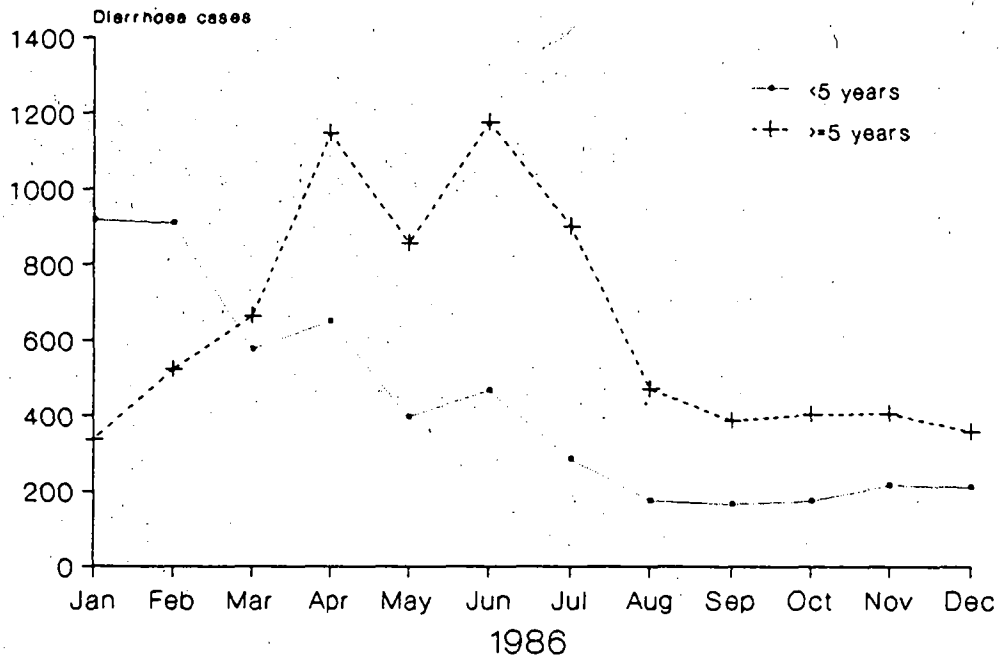


Figure 7

Incidence of acute diarrhoea by region (Northeast and Southern Thailand)

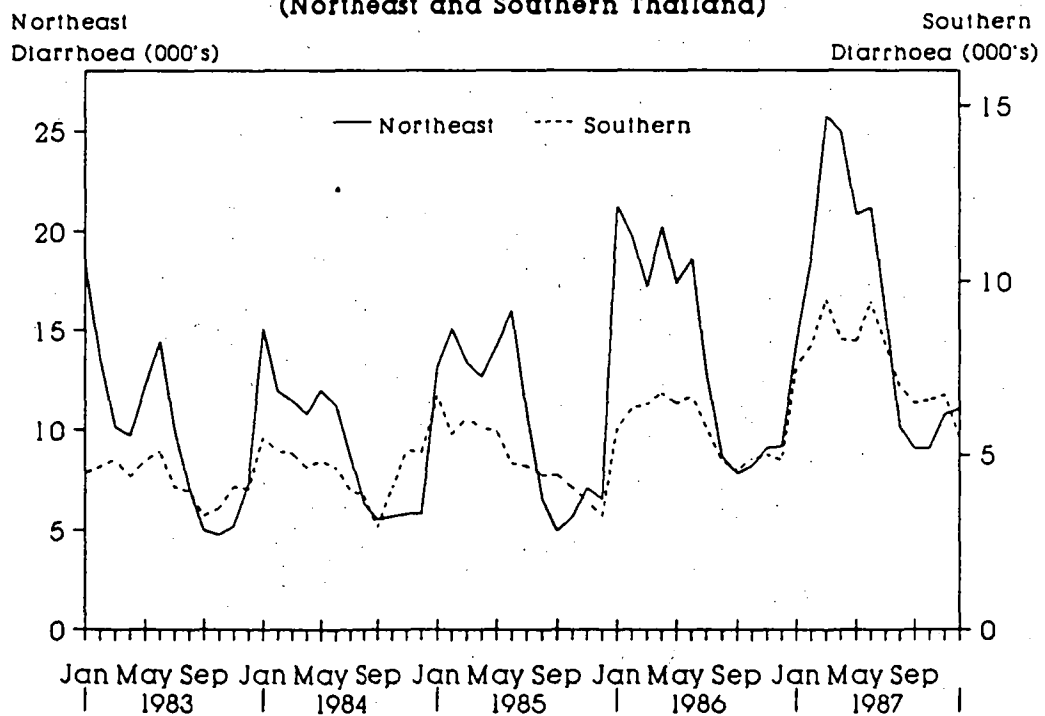


Figure 8