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REVIEW

Trichinosis: Epidemiology in Thailand

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Abstract

Trichinosis is one of the most common food-borne parasitic zoonoses in Thailand and many outbreaks are reported each year. This paper reviews the history, species, and epidemiology of the disease and food habits of the people with an emphasis on the north, northeast, central and south regions of Thailand. The earliest record of trichinosis in Thailand was in 1962 in the Mae Sariang District, Mae Hong Son Province. Since then, about 130 outbreaks have been reported involving 7392 patients and 97 deaths (1962-2005). The highest number of cases, 557, was recorded in 1983. The annual epidemiological surveillance reports of the Bureau of Epidemiology, Department of Disease Control, Ministry of Public Health, Thailand, show that trichinosis cases increased from 61 in 1997 to 351 in 1998. In contrast to these figures, the number of reported cases decreased to 16 in 1999 and 128 cases in 2000. There was no record of trichinosis in 2001, but then the figures for 2002, 2003 and 2004 were 289, 126 and 212 respectively. The infected patients were mostly in the 35-44 years age group and the disease occurred more frequently in men than women at a ratio of 1.7-2.0:1. There were 84 reported cases of trichinosis in Chiang Rai, Nan, Chiang Mai, Si Sa ket, Nakhon Phanom, Kalasin, Nakhon Ratchasima, Nakhon Nayok, Nakhon Pathom and Surat Thani, provinces located in different parts of Thailand in 2005. The outbreaks were more common in the northern areas, especially in rural areas where people ate raw or under-cooked pork and/or wild animals. This indicates the need for health education programs to prevent and control trichinosis as soon as possible in the high-risk areas.

Key words: Trichinosis; Epidemiology; Thailand

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INTRODUCTION

Trichinosis is one of the most widespread helminthic zoonoses. Unlike other parasitic infections, it has been a major public health problem and reported in many Asian countries, including China, Japan, Korea and Thailand[1-7]. Since 1835, controversy has surrounded the discovery and description of *Trichinella*. In that year the organism, *T. spiralis*, was initially observed by a first-year medical student, James Paget, later famous for other medical achievements, but it was named and described by his professor, Richard Owen. Until recently, that species was the only one known[8]. However, seven distinct species of *Trichinella* are now recognized, *T. spiralis, T. pseudospiralis, T. native, T. nelsoni*, *T. britovi*, *T. papuae* and *T.murrelli*[9-16]. In Thailand, human trichinosis was first reported in June 1962. The causative agent of most outbreaks of this disease has been identified as *T. spiralis*[1], but an outbreak in the Ta Sae District, Chumporn Province in 1994 was due to *T. pseudispiralis*[17]. Trichinosis infections in humans are characterized by an initial phase dominated by gastro-intestinal symptoms (vomiting and diarrhea), followed by a stage lasting about 2 mo, of fever, sub-cutaneous edema, muscle pain, cachexy, myocardiosis and weakness. Death occurs in up to 40% of cases either due to anaphylactic shock or the consequences of the myocardiosis[7,18-23]. In eight cases of childhood trichinosis reported in Thailand, major symptoms and signs were fever, myalgia, puffy face and eyelids. Laboratory examinations showed leukocytosis, eosinophilia and elevation of muscle enzymes[24]. The outbreaks of trichinosis in Thailand seem to depend in part on the density of *Trichinella* contamination in domestic and wild animals, but they are also influenced by social and other factors, including people's eating habits[25-30]. This study includes a review of the history, species, epidemiology of trichinosis and food habits of Thai people based on previous studies and the annual epidemiological surveillance reports from 2002-2005 from the Bureau of Epidemiology, Department of Disease Control, Ministry of Public Health, Thailand.

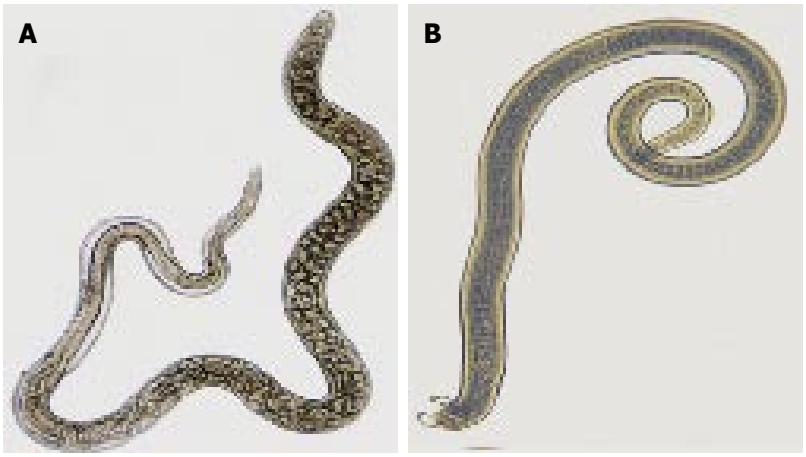

Figure 1 *T. spiralis* in Thailand[50]. **A**: Adult female *T. spiralis* with fully formed larvae in uterus; **B**: Adult male *T. spiralis* claspers on tail (lower end).

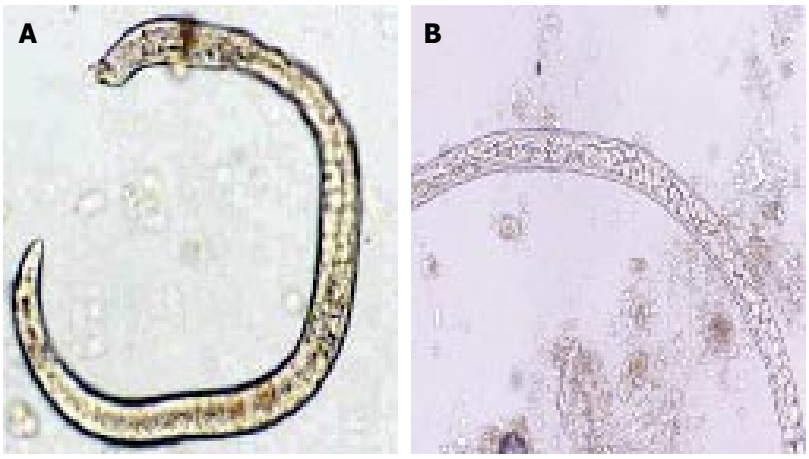

Figure 2 *T. pseudospiralis* in Thailand[51]. **A**: Adult male *T. pseudospiralis*; **B**: Adult female *T. pseudospiralis* containing eggs and larvae.

HISTORICAL REVIEW OF TRICHINOSIS IN THAILAND

The first outbreak of trichinosis in Thailand was in 1962 and involved 56 patients resulting in 11 deaths in the Mae Sariang District, Mae Hong Son Province. Meat from pigs was the source of outbreak[1]. The number of outbreaks has tended to increase in recent years. The annual epidemiological surveillance report dated 15 November 2005 recorded 7392 patients and 97 deaths. The highest annual number of hospital recorded trichinosis cases was 557 in 1983. This figure is considered an underestimation of the actual number of cases involved in the outbreaks[31-36]. In April 1973, an outbreak of trichinosis occurred in the Mae Sruay District, Chiang Rai Province. Thirty-one persons were involved, ranging from 9 to 72 years, and one adult female died[37]. In 1980, trichinosis was reported in the Pluak Dang District of Rayong Province, the infection being caused by the consumption of wild squirrel[38,39]. An epidemic of trichinosis involving 177 patients and 13 deaths occurred in April 1981 in Kok-Ta-Back Village, Nong-Pai District, Petchabun Province, and reported the fourteenth outbreak of human trichinosis in Thailand[40-42]. Khambooruang[43] reported 118 discrete outbreaks of the disease involving 5400 patients and 95 deaths. In the south of Thailand, an outbreak of trichinosis affecting 59 individuals resulting in one death occurred in Chumporn Province during 1994-1995. This was the first report of an epidemic of human infection caused by *T. pseudospiralis*[7]. Takahashi *et al*[35] reported 120 outbreaks from 1962 to 2000 involving nearly 6700 patients and 97 deaths. The highest number of cases was in Chiang Mai, Chiang Rai and Nan provinces, 1776, 1739 and 894 respectively. Chotmongkol *et al*[7] presented the case of a 49-year-old man with progressive generalized muscle hypertrophy and weakness for 3 mo. Histologic findings from muscle biopsy demonstrated a nurse cell-larva complex. Treatment with albendazole resulted in a very favorable outcome. Trichinosis remains a major public health problem in Thailand, often associated with rural people celebrating local and traditional festivals, such as the northern Thai New Year and wedding ceremonies, at which raw and/or under-cooked wild animals are eaten.

SPECIES OF TRICHINOSIS IN THAILAND

Seven species belonging to the *Trichinella* genus, five with encapsulated larvae and two with non-encapsulated larvae in host muscles and three additional genotypes, have been described to date: *T. spiralis*, *T. nativa*, *T. britovi, T. murrelli, T. nelsoni, T. pseudospiralis*, and *T. papuae*. In Southeast Asia, *T. spiralis* and *T. pseudospiralis* have been documented in domestic animals and/or humans in Cambodia, Indonesia (Bali and Sumatra), Lao PDR, Malaysia, Myanmar and Thailand[10,12,14,15,44]. In Thailand, the causative agent of most outbreaks of trichinosis has been identified as *T. spiralis*[1] (Figure 1). Meanwhile, Jongwutiwes *et al*[17] reported human infection by *T. pseudospiralis* (Figure 2). An outbreak

of trichinosis affecting 59 individuals, of whom one died, occurred in south Thailand during 1994-1995. After that, there were no reports of other species of *Trichinella* in this country in either humans or animals[35]. Until recently, *T. spiralis* and *T. pseudospiralis* were the only human- infecting species in Thailand.

EPIDEMIOLOGY OF TRICHINOSIS IN THAILAND

Trichinosis is more common in temperate regions than in tropical regions. The epidemiology of trichinosis was first reported in 1962 in patients who consumed pig meat[1]. The second outbreak was in 1963 at Prao District, Chiang Mai Province. Since then, outbreaks have occurred each year, mostly in the northern part of Thailand where people have eaten raw or under-cooked pork and/or wild animals[45-47]. The annual epidemiological surveillance reports indicated that trichinosis cases increased from 61 in 1997 to 351 in 1998. In 1999 and 2000, the number of reported cases decreased to 16 and 128 respectively. No cases were recorded in 2001, hospital based or by the Bureau of Epidemiology, that clearly showed a human trichinosis case this year, but then 289, 126 and 212 occurred in 2002, 2003 and 2004 respectively. In 2005, 75 cases were reported by the Bureau of Epidemiology, Department of Disease Control, and Ministry of Public Health (Figure 3). Since then, about 130 outbreaks have been reported totaling 7392 patients and 97 deaths.

Since 2002, the distribution of human trichinosis cases by age groups has been considered by the annual epidemiological surveillance reports which data were the hospital based. The youngest patient was about 1 year old. Charkrit[44] reported a patient of the same age. It is not uncommon to see patients in the 10-14 and 65+ age groups, but most patients are in the age 35-44 groups, morbidity rate was 0.04 per 100 000 of people (Figure 4). Infection occurs in men more frequently than women at the ratio of 1.7-2:1 (calculated from trichinosis cases of 2002-2005). This result was similar to the 1.2-2.6:1 found by Charkrit[44].

The epidemiological surveillance reports of trichinosis have been conducted almost every year and data investigation reveals that the outbreaks have occurred predominantly in rural areas. The north part of Thailand is responsible for 96.4% of all cases reported from 1962 to 2000[35]. The annual epidemiological surveillance reports from 2002 to 2005 found consistently high numbers of cases (289, 126, 30 and 60 respectively) in the north region. The figures for 2004 reported 124 in the northeast, the first time that a region other than the north has had the highest number of cases. Only small numbers of trichinosis cases were recorded in the central and south regions in 2005 (Figure 5). In 2005, 75 trichinosis cases were reported, the highest number occurring in October, August, March and September, 36, 16, 7 and 5 respectively. The cases were reported in Chiang Rai, Nan, Chiang Mai, Si Sa ket, Nakon Phanom, Kalasin, Nakhon Ratchasima, Nakhon Nayok and Surat Thani, all provinces located in different parts of Thailand. The main age group was 35-44 years and the youngest patient was 1.

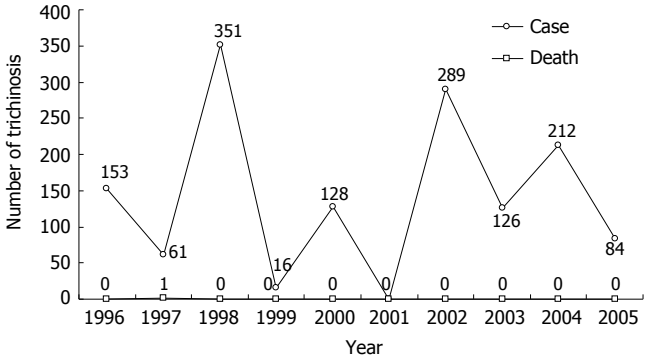

Figure 3 Trichinosis cases in Thailand from 1995-2005.

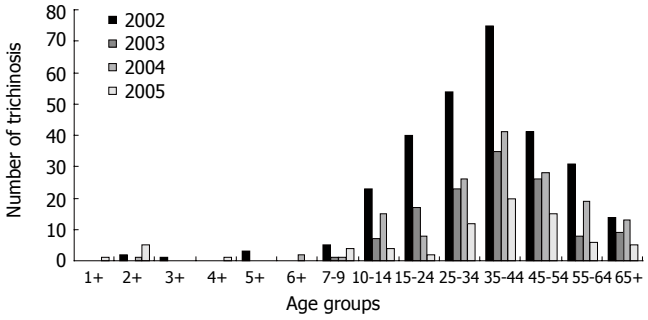

Figure 4 Human trichinosis cases in Thailand from 2002-2005.

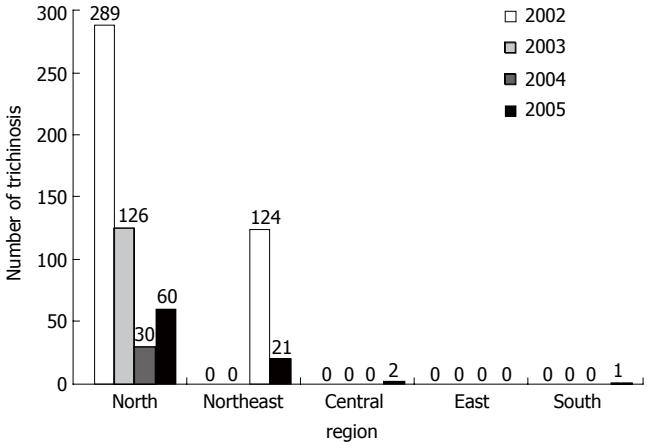

Figure 5 Human trichinosis by region in Thailand from 2002-2005.

Most outbreaks occurred in the north region, including 60.84% of all cases reported from 1962 to 2005. These results were different from those of Takahashi *et al* (2000) that reported the north region was responsible for 96.4% of all cases. The most severely affected areas in the north region were the highland provinces of Chiang Rai, Nan, Chiang Mai, Mae Hong Son and Payao. (Figure 6). The numbers of cases in other parts of Thailand were very few. In the central region, Uthai Thani, Karnchanaburi Nakhon Pathom and Nakhon Nayok provinces reported 0.28% of the total number of cases. Chumporn, Songkla and Surat Thani were the only three provinces of the south region in

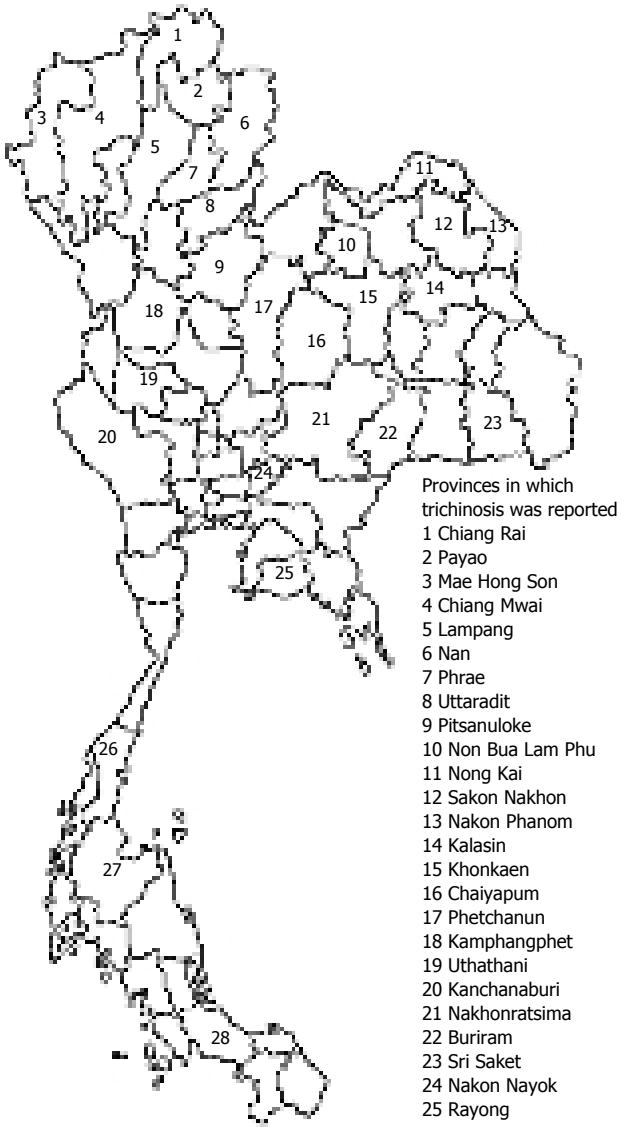

Figure 6 Provinces trichinosis reported in Thailand from 1962-2005.

Table 1 Distribution of trichinosis in humans by province in Thailand from 2002-2005

Region	Province	Total cases (%)
North	Chiang Mai, Chiang Rai, Nan, Phrae, Uttaradit, Payao, Mae Hong Son, Petchabun, Kamphaengpetch, Pitsanuloke, Lampang	60.87
Northeast	Nong Bua Lam Phu, Buri Rum, Kalasin, Sakol Nakorn, Sri Saket, Nong Kai, Khon Kaen, Nakhon Phanom, Nakhon Ratchasima	38.59
East	Rayong	0.18
Central	Uthai Thani, Karnchanaburi, Nakhon Nayok, Nakhon Pathom	0.18
South	Chumporn, Songkla, Surat Thani	0.18

which cases of trichinosis were observed, these accounting for only 0.28% of cases (Table 1). The northeast of Thailand was responsible for the highest number of cases in 2004 and the second highest (38.5%) in 2005. Provinces involved were Nong Bua Lam Phu, Buri Ram, Kalasin, Sakol Nakorn, Sri Saket, Nong Kai, Khon Kaen, Nakhon Phanom and Nakhon Ratchasima. These results showed trichinosis as a serious problem, particularly in the north and northeast regions of Thailand.

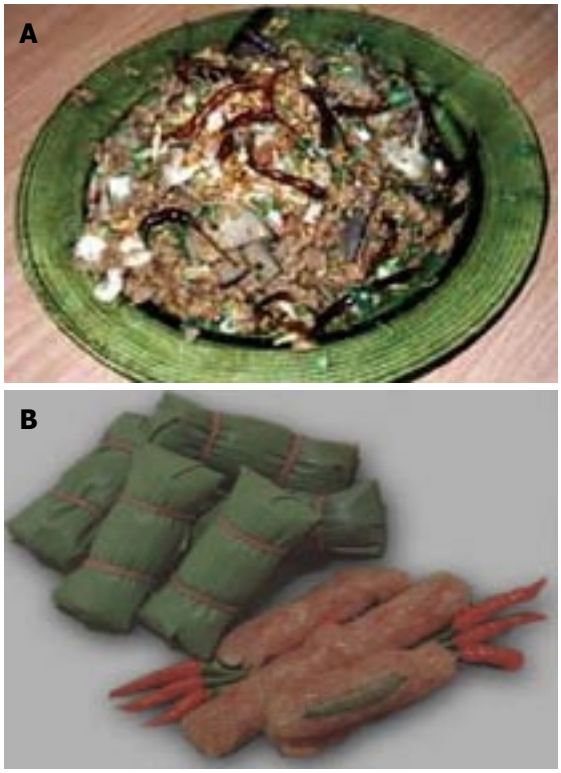

Figure 7 The dishes of raw or under-cooked wild boar are the favorite local foods that are the major sources of infection in Thailand. **A**: Lahb is made from wild pig or reptile; **B**: Nham is also made from wild pig and fermented for a few days.

SOURCE OF THAI HUMAN INFECTION

Trichinosis is a parasitic disease of mammals caused by the nematode parasite Trichinella spp. It has an important zoonosis with humans becoming infected by eating raw or inadequately cooked infected meat. Infection is more common in omnivores (horses, humans, pigs and rats) and carnivores (cats, dogs, and seals). Pigs and rodents seem to play the most important role in the epidemiology of the disease. The main source of infection in Thailand has been pigs, but wild boar, jackal and black bear were also reported as sources of trichinosis[45,46]. All trichinosis cases gave a history of having consumed raw pork in the form of "lahb" and "nahm," favorite dishes of north Thailand[37] (Figure 7). Lahb is made from chopped raw pork mixed with lemon juice, roasted rice powder, finely cut red onion and parsley (Figure 7A). Nahm is also made from chopped raw pork mixed with salt, garlic and chili, tightly wrapped in banana leaves for a few days for fermentation (Figure 7B)[35]. Some Thai dishes are proven as viable *T. spiralis* larvae sources due to cooking procedures[47]. Srikitjakarn *et al*[48] reported *T. spiralis* was found in 1.67% of 421 dogs in Tarae District, Sakonnakon Province**.** Raw dog meat was a source of infection in Kaeng Khlo District, Chaiyaphum Province

in December 1984[49]. The incidence of *T. spiralis* larvae in dog meat in the areas favoring dog meat consumption is a major public health problem in the future. The major source of infection is wild boar, free roaming pigs located in the north, and wild animals from Laos and Myanmar sold in Thailand[2].

In conclusion, various studies of trichinosis in Thailand since the first outbreak up until recent years have shown that most of the outbreaks occurred in the north of the country, an area in which some of the favorite traditional dishes involve meat from pigs and wild boars, often eaten raw or under-cooked. No vaccines have yet been developed. Treatment exists for humans if diagnosis is done promptly. Better prevention and control of trichinosis require health education to stop the consumption of infected and under-cooked meats.

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