



Outbreak, Surveillance and Investigation Reports

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Investigation of a Countywide Outbreak of Paratyphoid Fever Associated with Consuming Cold and Raw Food

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Abstract

Paratyphoid fever is endemic in Yunnan Province, China. We investigated a countywide outbreak of paratyphoid fever in Yuanjiang County of the province in 2010. From January through October of the year, 469 cases were identified. *Salmonella* Paratyphi A was isolated from 370 (79%) cases. Three hundred eighty (80%) patients were adults aged between 20 to 49 years, 277 (60%) were farmers, and more than half of the cases occurred in the capital township of the county. A case-control study of culture-confirmed cases and controls matched with healthy family members was conducted to detect behavior risk factors. Consuming cold and raw food (matched odds ratio 5.5, 95% confidence interval 2.4-12.3) was associated with the infection. Poor sanitary system in both hospital and the city were observed during the environmental study, and 10 (8%) recovering patients and 2 (8%) healthy relatives of patients were identified as carriers. Improvement on sanitation, cooked food and access to safe water, and appropriate treatment for patients and carriers were suggested in outbreak control and prevention.

Keywords: Paratyphi A, outbreak, case-control study, continual exposure, China

Introduction

Enteric fever is a clinical syndrome caused predominantly by human-restricted *Salmonella enterica* serovar Typhi (typhoid fever) and Paratyphi A (paratyphoid fever), and rarely by *Salmonella* Paratyphi B and C.¹ Globally, in the year of 2000, it was estimated that typhoid fever caused 21.6 million illnesses and 216,510 deaths while 5.4 million were sickened by paratyphoid fever.² Especially across East and South Asia, Paratyphi A is becoming increasingly common.³

In developing countries with low and middle income, enteric fever infection was linked with unsafe drinking water and food, and poor sanitation.^{3,4} However, in developed countries, outbreaks of enteric fever have become relatively rare⁵ and usually associated with travel to endemic regions.⁶

In China during 2010, the leading 3 provinces with highest number of enteric fever cases were Yunnan, Guangdong and Guangxi. In addition, around 34%

(4,860/14,041) of all the cases in China were in Yunnan Province.⁷

This study was based on the investigation of a paratyphoid fever outbreak occurred in Yuanjiang County, Yunnan Province, China during 2010. The reasons that are likely to be the cause of infection spread were discussed.

Methods

Descriptive Epidemiology

All cases of typhoid and paratyphoid fever recorded in a routine surveillance system in Yunnan Province were reviewed from 2005 through 2009. The number of cases in 2010 was compared to the median of last five years by month for outbreak confirmation.

A national standard diagnostic criteria⁸ was used as case definition in this outbreak investigation. A suspected case of paratyphoid fever was a patient who had fever for three days or more, body temperature more than or equal to 38°C, headache,

malaise and bellyache. A probable case of paratyphoid fever was a patient who had fever for five days or more, body temperature more than or equal to 39°C, headache, malaise, relative bradycardia, bellyache and skin rash, with low white blood cell count. A confirmed case of paratyphoid fever was a patient who was confirmed of *Salmonella* paratyphoid fever infection by using blood, bone marrow, urine, or stool culture, or Widal test.

An active case finding was conducted by local public health bureau in May 2010. All township health centers and village administration divisions were asked to search suspected cases for paratyphoid fever according to the above guideline in their own administrative regions. The results were reported to Yuanjiang County Center for Disease Control and Prevention (CDC) for verification. All suspected cases were asked to undergo blood culture test at county CDC for confirmation of infection.

The demographic data of all cases were collected and described in terms of time, place and person distribution through an epidemic curve, attack rate by region and frequency table to formulate etiological hypotheses.

Laboratory Test

Blood samples of current cases, stool samples of recovering cases and patients' relatives, and water samples from environment were collected. *Salmonella* Paratyphi A was isolated by culture of these samples.

Case-control Study

A case-control study was designed for detection of behavior risk factors. A case was defined as a patient confirmed by the above standard diagnosis in Yuanjiang County from August through November 2010. A control was a healthy person living together with a patient during one month before the patient's onset of symptoms. The ratio of case to control was 1:1. Investigation was conducted by face to face interview with a set of structured questionnaire, which included demographic characteristics, signs and symptoms of patients, personal behaviors concerning with drinking water and food, and also food items in daily meals during one month prior to patient's onset. Conditional logistic regression analysis was used to calculate matched odds ratio and 95% confidence interval using R statistical software.

Environmental Investigation

Environmental investigation was carried out at areas around the county hospital, vegetable fields around the hospital, restaurants and city sewage system. The waste water treatment was not implemented in the

county hospital. Specimens of sewage in the hospital were collected for laboratory test to look for fecal contamination. Although other specimens from the environmental survey were asked for laboratory test by the investigation team, these were not collected at that time due to limited local public health service.

Results

Area of Outbreak

Yuanjiang County is located in the central part of Yunnan Province, spanning approximately 2,858 square kilometer and with a population of 200,000. Around 80% of the total population is engaged in farming. Yuanjiang County has hot climate all year; it could be higher than 40°C in summer. The county is made up of the 14 township level administrative divisions as in figure 1. The capital of the county is located in Township A.

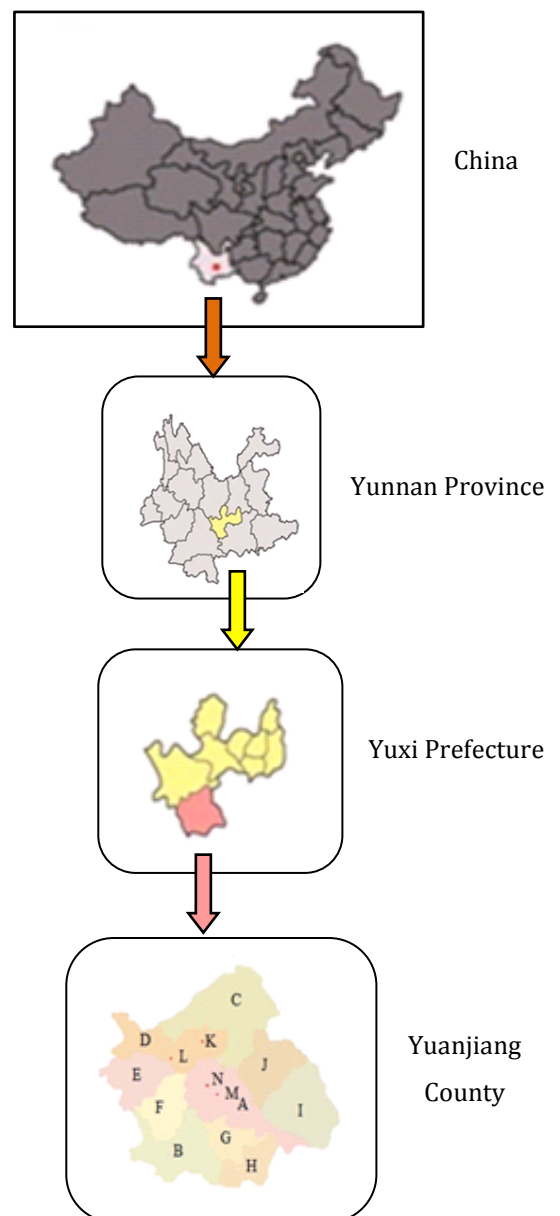


Figure 1. Geography of Yuanjiang County, Yunnan Province, China

Descriptive Epidemiology

From January through October 2010, 469 cases of paratyphoid fever who met the diagnosis categories were identified by health care institutions in Yuanjiang County. The outbreak was confirmed by comparing the cases in 2010 to the median of monthly surveillance data in last five years (2005-2009) (Figure 2). Of these 469 cases of paratyphoid fever, 370 were confirmed cases, 46 were probable cases and 53 were suspected cases.

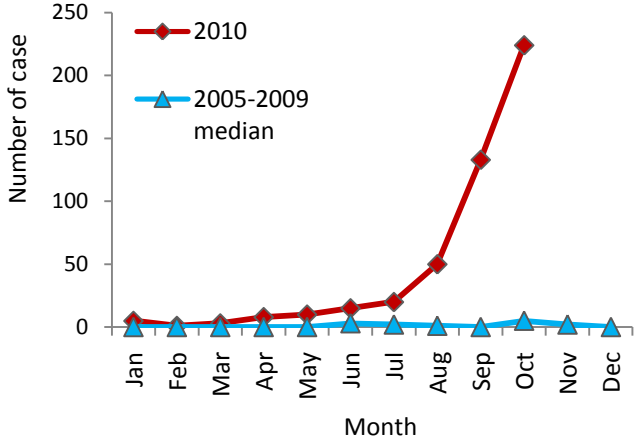


Figure 2. Number of typhoid and paratyphoid fever infection by month in Yuanjiang County, Yunnan Province, 2005-2010

The first case occurred on 8 Jan 2010 in Township A. Most paratyphoid fever patients were reported in August 2010. Over half of the cases were reported in September through October (Figure 3).

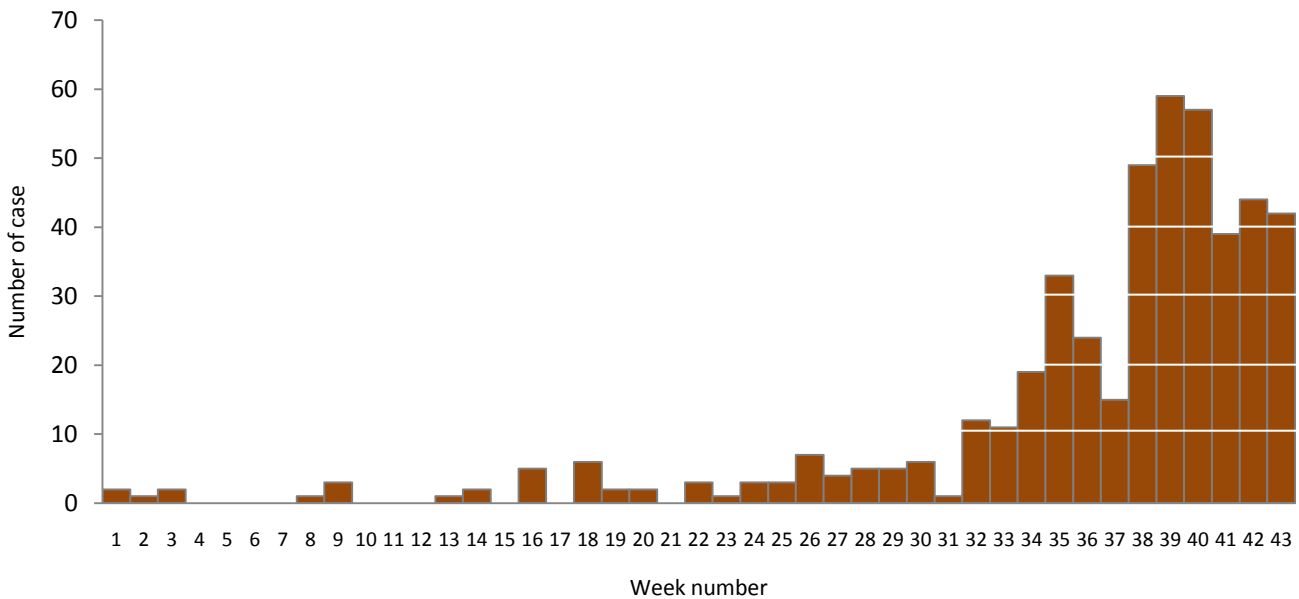


Figure 3. Number of paratyphoid fever cases by week, Yuanjiang County, Yunnan Province, China, January to October 2010 (n=469)

This outbreak spread out countywide. The cases were reported from all 14 townships; attack rates were showed in figure 4. Fifty five percent (259/469) of cases occurred in Township A, the capital of Yuanjiang County, with the highest attack rate of 0.6% (259/45,999). Cluster of cases were not identified by the local health care system.

Among 469 cases of paratyphoid fever, 207 were female, 262 were male and male to female ratio was 1.3:1. Around 80% (380/469) of cases were 20 to 49 years of age. Most of the cases (60%) were farmers, followed by workers, students and government officers. Attack rate by occupation was not calculated because the population of each occupation was not known.

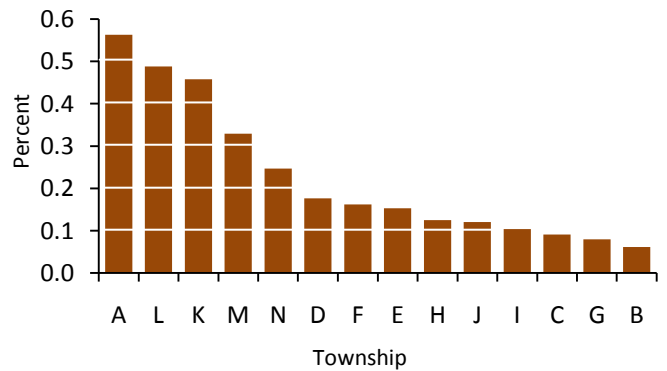


Figure 4. Attack rate of paratyphoid fever by township in Yuanjiang County, Yunnan Province, China, January to October 2010

Table 1. Behavior factors associated with paratyphoid fever infection in Yuanjiang County, Yunnan Province, China, 2010 (n=155)

Behavior	Yes or No	Control (%)	Case (%)	Crude OR (95% CI)	Matched OR (95% CI)
Travel out of the county	No	144 (92.9)	138 (89.0)	1	1
	Yes	11 (7.1)	17 (11.0)	1.61 (0.7,3.6)	2.49 (0.6,10.3)
Contact with paratyphoid fever patients	No	153 (98.7)	150 (96.8)	1	1
	Yes	2 (1.3)	5 (3.2)	2.55 (0.5,13.4)	1.78 (0.2,18.4)
Drink un-boiled water	No	117 (75.5)	114 (73.5)	1	1
	Yes	38 (24.5)	41 (26.5)	1.11 (0.7,1.9)	1.16 (0.5,2.9)
Consume cold and raw food	No	80 (51.6)	46 (29.7)	1	1
	Yes	75 (48.4)	109 (70.3)	2.53 (1.6,4.0)	5.47 (2.4,12.3)

Note: conditional logistic regression adjusted by all variables

Analytic Epidemiology

Information on travel out of the county, contact with paratyphoid fever patients, drinking un-boiled water and consuming cold and raw food was collected from 155 cases and 155 matched controls. We found that consuming cold and raw food was a risk factor (matched OR 5.5; 95% CI 2.4-12.3) for paratyphoid fever infection (Table 1).

Environmental Investigation

Isolation of patients faced a heavy challenge. Yuanjiang County hospital was located in Township A, which was the biggest hospital in the county with 120 beds. Although isolation for paratyphoid fever patients was suggested to all health institutions in China, the current cases were observed by the investigation team to understand the patient management in the hospital. On 8 Nov 2010, records in the county hospital showed that only seven out of 77 current patients stayed in hospital for injection treatment. Patients returned to home soon after illness relieved even though they were asked to stay in hospital for isolation.

Sewage of the county hospital was discarded without any treatment. Patients who had communicable diseases were treated at a separate building in the hospital. A public toilet of the building was used specifically by these patients. However, sewage from clinical treatment and feces of infected patients were mixed with other sewage of the hospital, and discharged out of the hospital directly without any disinfection. *Salmonella* Paratyphi A strain was isolated from waste water at a sump of the hospital by the local CDC on 28 Oct 2010.

A wide area of vegetable fields was polluted by hospital waste water. There were 175 acres of vegetable fields at one side of the hospital. The foul water of the hospital overflowed across the fields and finally ran into the Yuanjiang River. As such, farmers irrigated the fields and washed the vegetables with the hospital sewage prior to being commercially distributed.

The vegetables in the fields were often locally consumed. Coriander, peppermint, green onion and cordate houttuynia were planted in these fields. All of the vegetables were sold in a market of the county. The most typical food preparation was uncooked and cold food dressed with sauce.

Vegetables were eaten raw in local food habits. The investigation team visited some local restaurants where cold and uncooked food was served. This kind of menu was popular among local residents. People like to eat it not only at their own homes, but also at restaurants. Most vegetables were bought from the local market or the vegetable fields directly.

There was no sewage treatment system in the county either. The sewage of the city was discharged into sewers, which then flew into the Yuanjiang River. As some part of city sewers did not have any covers, people poured their home refuse into the open sewers.

Carrier Investigation

Carriers of paratyphoid fever infection were also detected. Stools of 124 recovering patients and 25 healthy relatives of paratyphoid fever patients were collected and tested for *Salmonella* Paratyphi A infection. Of these, 10 recovering patients (8%) and 2 healthy relatives of patients (8%) showed positive result.

Discussion

The findings of this study verified the existence of a paratyphoid fever outbreak in Yuanjiang County. The possible risk factor of the infection was identified as consuming cold and raw food. Loose management of the patients and infected sewage treatment was found in this investigation.

Since isolation was not strictly implemented, the outbreak was propagated. In recent years, Paratyphi A appears to be responsible for a growing proportion of enteric fever in a number of Asian countries.³ The majority of infection result from consuming food or water contaminated by feces of patients or carriers.⁹ In this outbreak, patients went back home soon after convalescence as Paratyphi A seems to be less severe compared to Typhi.¹⁰ Patients did not abide by the isolation requirement. Therefore, the pathogen was thrived with the patients' activities and behavior plus the unhygienic conditions. In the second phase, positive carrier was identified as another important reason for continuation of this outbreak. About 2-5% of persons infected in middle age could become chronic carriers.⁹ Quite high carrier rate, 8% in both recovering patients and healthy relatives of patients, was reported in this outbreak which also indicated inadequate antibiotic treatment and disease containment measures. In the United States, the majority of the foodborne outbreaks are caused by asymptomatic chronic carriers employed as food handlers. Treatment of carriers is also critical to prevent further spread.⁵

This outbreak reflects that consuming of contaminated food is an important transmission route. Generally, the most common modes of enteric fever transmission are through fecal contaminated water or food and person to person transmission.⁹ Family cluster of cases was rarely found in this kind of outbreak. A recent study indicated that typhoid and paratyphoid fever are associated with distinct routes of transmission. Factors in the household were important risk factors for typhoid whereas factors outside the household such as food from street vendors and flooding were major risk factors for paratyphoid fever.¹¹ In recent years, surveillance data of Yunnan Province shows that enteric fever maintains a steady decline, particularly relative to typhoid fever. Furthermore, waterborne outbreaks of enteric fever have become relatively rare. However, paratyphoid fever shows an increasing trend as the incidence of enteric fever remains at a high level in some areas of Yunnan Province. In the neighboring Guangxi province, since Vi polysaccharide typhoid fever vaccine was introduced, more than 80% of

enteric fever outbreaks have been caused by *Salmonella* Paratyphi A.¹² However, there is no licensed vaccine against Paratyphi currently available.¹³ The transmission mode of this outbreak may indicate some current hindrances to control of paratyphoid fever in Yunnan Province.

Poor sanitation maximized exposure risks. Extending benefits of improved sanitation and availability of safe water and food to the public have been achieved in industrialized countries a century ago.³ Historical surveillance data suggest that enteric fever was endemic in Western Europe, North America and Latin American, and the rates declined in parallel with introduction of municipal water treatment, pasteurization of dairy products and exclusion of human feces from food production.^{2,3} In countries with poor resources, lack of sanitation and clean water is still a cause of contamination for long periods of time.¹⁴ In this outbreak, domestic waste water from the hospital and the whole county were untreated, and directly discharged into the vegetable fields and the river respectively. The feco-oral transmission was substantially reflected in this event. As humans are the only reservoir of this pathogen, preventive measures include improvement of water supply and sanitation facilities.

There were a few limitations in this study. Direct evidence of causative bacteria of *Salmonella* Paratyphi A in vegetables and food could not be identified. Microbiological testing of drinking water supply system was not done. These may provide more evidences for outbreak control.

Conclusion

Paratyphi A as a cause of enteric fever is of great concern, particularly due to lack of availability of an effective vaccine. Public health prevention measures include purification of water supplies, sewage control, treatment of chronic carriers, and sanitary and hygiene education especially to food handlers.

Acknowledgement

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Suggested Citation

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