

## Outbreak of *Salmonella enteritidis* B in a family in southern Taiwan

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**Background and purpose:** This study describes a *Salmonella* outbreak in a 9-member family in Southern Taiwan, and emphasizes the risk of *Salmonella* infection in extreme age.

**Methods:** *Salmonella* infection was identified by blood culture, stool swab, and Widal test. A questionnaire was designed for the family to ascertain the underlying disease, symptoms, and history of untreated water and food exposure.

**Results:** Of 9 members in the family, 4 had symptoms of fever, abdominal pain, and watery diarrhea. There was a relationship between *Salmonella* infection and age, and associated symptoms included fever, nausea, diarrhea, abdominal pain, and weakness.

**Conclusion:** *Salmonella* infection tends to occur more frequently in very young or very old people, especially elderly patients with chronic pre-existing comorbidities. Therefore, age is a significant risk factor for this symptomatic disease.

**Key words:** Age of onset; Disease outbreaks; Risk factors; *Salmonella*

### Introduction

Salmonellosis is an important food-borne disease. Sporadic outbreaks are related to raw eggs, poultry, beef, milk, contaminated vegetables, and food processing. Outbreaks can have a duration of days to months and case numbers ranging from tens to hundreds [1-8]. Despite advances in hygiene and infection control, *Salmonella* infection remains an important public health problem worldwide.

Salmonellosis causes gastroenteritis, bacteremia, localized infections (septic arthritis, meningitis, osteomyelitis), and cardiovascular infections. *Salmonella* gastroenteritis is usually a self-limiting disease. About 5% of patients with *Salmonella* gastroenteritis develop bacteremia [9]. Certain patients such as neonates, those

older than 50 years, or those using steroids or other immunosuppressive agents are at high risk for the disease. In addition, 17% of patients older than 50 years have a tendency to develop a mycotic aneurysm [10]. Antibiotic treatment is important for high-risk patients. However, *Salmonella enterica* serotype *choleraesuis*, which is resistant to extended-spectrum cephalosporins and fluoroquinolones, has increased in incidence in Taiwan, as in the rest of the world [3,11,12]. Until alternative treatment is discovered, prevention of this food-borne disease remains important, especially among high-risk people.

This study describes an outbreak of *Salmonella* in 1 family and highlights the relationship between age and infection.

### Methods

The study included 9 members of 1 family, with 4 symptomatic patients and 5 asymptomatic family

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members. Two of the symptomatic patients were admitted to the gastrointestinal ward and pediatric ward at Kaohsiung Veterans General Hospital, Kaohsiung, Taiwan, where blood cultures and stool cultures were done. The other two symptomatic patients visited the local clinic and no specimens were collected. Rectal swabs and paired Widal tests were performed for the other 7 family members, including 2 symptomatic patients and 5 asymptomatic family members.

A questionnaire was designed to assess details of occupation, age, underlying disease, history of surgery, hospital admission within 3 months, history of untreated water use, and symptoms of fever, chills, diarrhea, nausea, vomiting, abdominal pain, and general malaise. Each person's food history, including their consumption of eggs, poultry, pork, beef, raw-meat, processed meat, salad, or raw vegetables was noted. The date of onset of illness was recorded. The relationship between age, sex, symptoms, and asymptomatic patients were studied.

## Results

### Patient history

A 57-year-old woman was the index case (patient 1; Fig. 1). She described the onset of symptoms on the morning of June 1, 2006, when she had fever, abdomi-

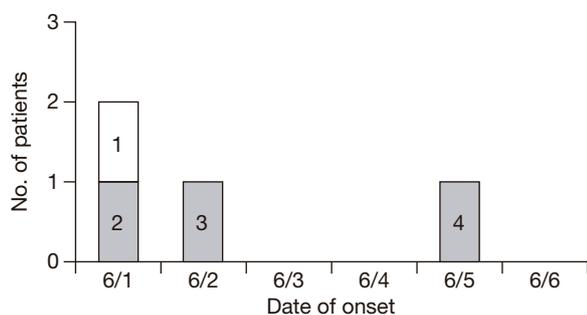


Fig. 1. Patients with *Salmonella* infection from 1 family.

Table 1. Laboratory results of a family with *Salmonella* infection.

Patient No.	Age (years)	Sex	Symptoms	Stool culture	Blood culture	Widal test
1	57	Female	Yes	Negative	Not done	Negative
2	3	Female	Yes	Negative	Not done	Positive
3	2	Male	Yes	Positive	Negative	Negative
4	60	Male	Yes	Positive	Positive	Not done
5	51	Male	No	Negative	Not done	Negative
6	28	Male	No	Negative	Not done	Negative
7	25	Female	No	Negative	Not done	Negative
8	32	Male	No	Negative	Not done	Negative
9	27	Female	No	Negative	Not done	Negative

nal pain, and diarrhea. Her 3-year-old granddaughter (patient 2) had the same symptoms in the afternoon of the same day. They visited a local clinic and were given an unknown medication, which relieved their symptoms. On the next day, patient 1's 2-year-old grandson (patient 3) had symptoms of high fever, chills, severe abdominal pain, and watery diarrhea. He was admitted to the pediatric ward, where infectious diarrhea was diagnosed and ceftriaxone was given. A stool culture was taken, which grew *Salmonella enteritidis* B. Four days later, the woman's 60-year-old husband (patient 4), with a past history of coronary artery bypass graft (CABG) surgery and diabetes mellitus with nephropathy and end-stage renal disease, had fever, chills, diarrhea, and sepsis. He was admitted to the gastrointestinal ward and prescribed ceftriaxone 2 g per day. His blood and stool culture grew *Salmonella enteritidis* B. His fever subsided gradually.

Abdominal computed tomography (CT) was performed for patient 4 to exclude intra-abdominal aneurysm formation. None of the other family members, aged from 25 to 32 years had symptoms (Table 1). The clinical symptoms of the infected patients included fever ( $p = 0.012$ ), nausea ( $p = 0.048$ ), diarrhea ( $p = 0.048$ ), abdominal pain ( $p = 0.048$ ), and weakness ( $p = 0.048$ ). After 3 weeks, each member of the family underwent paired Widal test. There were no further episodes of the illness.

### Microbiology

Among the 4 symptomatic patients, 3 had positive results in their microbiological or serological tests (Table 1). Two patients had positive stool cultures, 1 of whom also had a positive blood culture, and 1 had a positive Widal test. The initial result of the Widal test (*S. paratyphi* B) of patient 2 was  $\geq 1:2560$ ; this titer decreased to 1:320 after 3 weeks (Table 1). The susceptibility test showed that patients were susceptible to ampicillin,

chloramphenicol, extended-spectrum cephalosporin, fluoroquinolones, and trimethoprim-sulfamethoxazole.

### Epidemiology

The outbreak occurred in a town in rural southern Taiwan, where many pig farmers work, mostly with poor standards of hygiene. Since the outbreak, surveillance was done 2 weeks after the symptoms of the index patient, but no further specimens were collected. No likely source of the *Salmonella* outbreak was identified from the data gathered from the questionnaire. The index case worked part-time in a meat bun store but refused a store visit by the outbreak surveillance team on the grounds that no customers or colleagues had the same symptoms and signs. The family was followed up after 2 months and no further outbreaks had developed.

### Discussion

That no further outbreaks developed in the following 2 months suggested that the meat bun store and the water in the town were unlikely to be the outbreak source. However, the family did not record any possible food or other intake during this episode. Therefore, the source of outbreak could be related to food storage processing during hot weather. For many food-borne outbreaks, the pathogens and transmission vehicles

are not usually identified due to delay in collecting epidemiologic and microbiologic information [13].

In adults, advanced age (older than 60 years) is one of the major risk factors for non-typhoid *Salmonella* infection. The incidence of bacteremia is 5% of individuals with gastrointestinal illness caused by non-typhoidal *Salmonella* [14]. Other risk factors include human immunodeficiency virus infection, use of corticosteroids, systemic lupus erythematosus, liver cirrhosis, and solid organ cancer [11]. Approximately 16% of patients with *Salmonella* bacteremia develop localized infections [14]. In 1996, Wang et al reported that 16 (17%) of 94 patients with salmonellosis had mycotic aneurysms and, if only patients older than 65 years were considered, the incidence rose to 35% [10]. The mortality rate was 40% (7 of 16 patients). The independent positive predictor for endovascular infection is arteriosclerosis, which is related to age, diabetes mellitus, and hypertension [11]. In this report, patient 4 had diabetes mellitus with nephropathy and end-stage renal disease, as well as previous CABG surgery. He was therefore predisposed to bacteremia and focal infection. CT was arranged to exclude the possibility of aortic aneurysm and prolonged antibiotic treatment was administered.

Sirinavin et al described extraintestinal non-typhoidal *Salmonella* infection in 172 children and

**Table 2.** Patients with *Salmonella* infection by age.

Study	Age (years) Mean (range)	Sex	No. of patients	Pathogen	Duration of illness	Source of infection	Place
Liu et al, <sup>2</sup> 2006	Not stated (17-50)	Not stated	197	<i>Salmonella enterica</i> serotype <i>Enteritidis</i>	3 days	Cake, bread, congee	Factory workers
Werber et al, <sup>4</sup> 2005	15 (0-92)	52% women	462	<i>Salmonella</i> <i>oranienburg</i>	27 weeks	Chocolate	International
Cherry et al, <sup>5</sup> 2004	Not stated (2-93)	6/7 women	7 patients and 4 pets	<i>Salmonella enterica</i> serovar <i>Typhimurium</i>	4 weeks	Pets (cats and dogs)	Veterinary clinic
Guallar et al, <sup>1</sup> 2004	71 (26-85)	M:F 18:4	22	<i>Salmonella enteritidis</i>	7 months	Not identified	Nosocomial
Olsen et al, <sup>3</sup> 2001	85 (64-90)	M:F 4:7	11	<i>Salmonella enterica</i> serotype <i>Schwarzengrund</i>	34 months	Not identified	Nosocomial
Molbak et al, <sup>8</sup> 1999	45 (<1 month to 88 years)	M:F 9:18	27	Quinolone/multidrug- resistant <i>Salmonella</i> <i>enterica</i> serotype <i>Typhimurium</i> DT 104	6 months	Swine	Slaughter- house
Hennessy et al, <sup>6</sup> 1996	13 (5 months to 84 years)	6 men (2%)	150	<i>Salmonella enteritidis</i>	2 months	Ice cream	Nationwide
L'Ecuyer et al, <sup>7</sup> 1996	35 (21-78)	62% women	22	<i>Salmonella senftenberg</i>	8 months	Turkey	Nosocomial
Telzak et al, <sup>16</sup> 1990	66.3 (1-79)	50% women	Confirmed, 274; probable, 13	<i>Salmonella enteritidis</i>	17 days	Raw eggs	Nosocomial

infants in Thailand [14]. 163 patients (94%) had positive blood culture, 34 (20%) had localized infections, and the overall mortality rate was 10%. However, 70% of the patients were immunocompromised. These authors concluded that infants with *Salmonella* younger than 12 months had a tendency to develop localized infections. Furthermore, risk factors for death were age younger than 12 months, inappropriate antimicrobial therapy, meningitis or culture-proven pneumonia, and immunocompromised status. In this report, both children were older than 12 months, and they recovered well without complications.

A study of an outbreak of *Salmonella* in central Taiwan reported 96 symptomatic patients with *Salmonella* infection, with symptoms of diarrhea (88.5%), fever (71.9%), dizziness/headache (70.8%), abdominal pain (68.8%), chills (68.8%), weakness (52.1%), nausea (37.5%), abdominal distension (36.5%), body soreness (29.2%), and vomiting (26.%) [15]. Physicians should be alert to patients with these symptoms, especially debilitated individuals or those in the high-risk population. Early detection of the infectious source may prevent a secondary outbreak. The duration of illness can be up to 34 months [3].

In a literature review, these authors found that most patients affected by *Salmonella* were at the extremes of age (the youngest was younger than 1 month and the oldest was 93 years; Table 2) [1-8,16]. Case numbers also vary, from 10 people in a family outbreak [8] to 439 in an international outbreak, as was the case with infected German chocolate [4]. In addition, 1 nationwide outbreak and 4 nosocomial outbreaks have been reported (Table 2). The sources of infection include cake, ice cream, pork, raw eggs, turkey, and pets. Most infection is caused by poor temperature control and contamination during preparation, cooking, and storage of food. Given the increasing resistance of *Salmonella* spp. to extended-spectrum cephalosporins and fluoroquinolones in Taiwan [3,8,12], prevention and control in the agriculture and food industries is needed, with monitoring of outbreaks in animals and humans. People should be taught good hygienic practices for handling raw meats and avoid recontamination of cooked food and cross-contamination with other food. In addition, an alert of an outbreak of diarrhea in a family or community is important for the prevention of further outbreaks.

The most common sources of *Salmonella* infection are raw eggs, poultry, beef, and contaminated vegetables. However, it is difficult to identify the source of

an outbreak, especially within a family [13]. People often ignore food-borne disease and do not collect specimens. The long incubation time (48 to 72 h) may be one reason why families cannot recall which meals or food might be the source. *Salmonella* infection tends to occur in people at the extremes of age. Bacteremia and focal infection are more common among elderly people and those with comorbidities, resulting in high mortality rates. An insidious outbreak will increase the number of affected people, making it more harmful. Good hygiene habits of hand washing, avoiding raw food, and appropriate processing of food is important. Prevention, monitoring, and control of an outbreak is the best way to eliminate food-borne disease.

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