

# **Epidemiology Bulletin**

- 71 Investigations of Food-Poisoning Outbreaks in Two Primary Schools, Kaohsiung City
- 76 Cases of Notifiable and Reportable Diseases, Taiwan-Fukien Area
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## **Investigations of Food-Poisoning Outbreaks in Two Primary Schools, Kaohsiung City**

### **1. Introduction**

Upon receiving a FAX report on 5 October 1992 from the Kaohsiung City Health Department, a team from the Department of Health (DOH) was dispatched to investigate two suspected outbreaks of food-poisoning in two primary schools in Ling-Ya and Hsin-Hsing districts of the City. This involved some 200 teachers and students who had developed gastrointestinal symptoms such as abdominal pain and diarrhea after taking lunch in the schools on 30 September. The team applied the cohort study method to analyze the risk factors.

Some students of the Ling-Ya Primary School either brought their home-prepared lunch or bought from nearby food stands. Most of them had lunch supplied by the food factories through the arrangement of the school. Lunch for students of different grades had been supplied by different food factories. The teachers and students infected were in the 6th grade. They had the lunch supplied by a food factory in Kaohsiung City on 30 September. Those having had home-prepared lunch or bought from nearby food stands, and those in other grades were not affected. The same food factory had also supplied lunch to teachers and students of 4th grades and above of the Hsin-Hsing Primary School and the kindergarten, and they had also developed some gastrointestinal symptoms such as abdominal pain and diarrhea. The foods supplied by this particular food factory on 30 September seemed to be associated with these food poisoning outbreaks.

### **2. Materials and Methods**

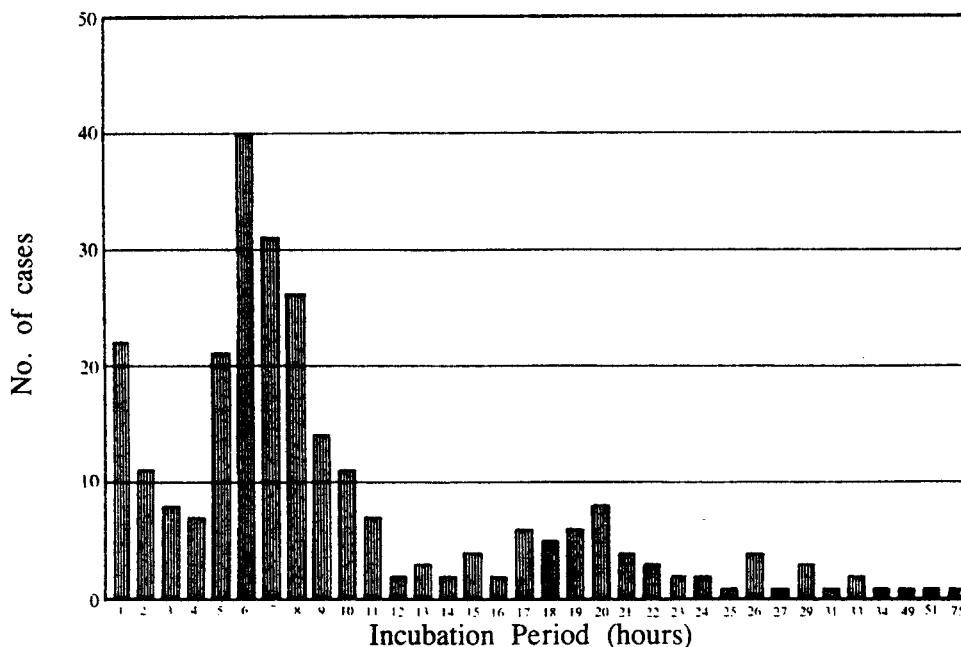
A questionnaire was distributed to teachers and students of the two primary schools who had consumed the lunch supplied by this food factory. The questionnaire included items on personal back-ground information, food items consumed, time of consumption and onset of illness, symptoms and medical treatment. The questionnaire was filled out by each of the above-mentioned teachers and students. Information thus collected

was later analyzed with the Epi-Info.

### 3. Findings

Altogether, 1,222 questionnaires were returned, and 1,133 (92.72%) were valid. Of them, 402 persons complained of symptoms such as: abdominal pain (85.57%), diarrhea (73.38%), weakness and tiredness (24.13%), nausea (21.14%), mucus in stool (13.43%), and vomiting (10.70%). The operational definition for a case was: a person who had lunch in school on 30 September supplied by this particular food factory, and developed later one of the two major symptoms, diarrhea or vomiting, and one of the minor symptoms, abdominal pain, weakness, nausea or fever. 264 persons met the definition, giving an attack rate of 23.3%, a median incubation period of 7 hours, and a disease duration of 18 hours. Most patients recovered within three days. The distribution of incubation periods is shown in Figure 1.

Figure 1. Distribution of Incubation Period



The lunch of the day contained five food items. By Chi-square test comparing each food item and onset of symptoms, both the fried egg and the curry potato were found to be significantly related to the illness ( $RR=1.68$ ,  $p=0.01$ ;  $RR=1.54$ ,  $p=0.03$ ) (see Table 1). A further logarithmic analysis by SAS/PC gave a model of  $\text{logit}(p) = 1.17 + 0.21(\text{curry potato}) + 0.07(\text{fried chicken}) + 0.19(\text{fried egg}) - 0.17(\text{hot dog})$ . The relation between curry potato and the illness was further indicated ( $\text{Chi-square}=3.77$ ,  $p=0.05$ ).

The food factory, a licensed factory for manufacturing boxed lunch, is in Kaohsiung

City. This steel-constructed factory of 280m<sup>2</sup> is located at a land of 600m<sup>2</sup>, with a regular staff of 10 persons, producing 10,000 boxes of lunch and children's lunch in buckets a day to supply to 20 to 30 schools and companies. On each average day, 30 some part-timers are employed to help in production and packing. Occasionally, some ready-cooked food items are purchased from outside. On 30 September, the fried eggs and a part of the rice were brought in from other factories at 7 am. The curry potato contained potato, carrot, and green soybean boiled and stir-fried. The site where foods were prepared was close to where the children's lunch in buckets were placed. The lunch had been delivered under normal temperature at around 10:30 am.

Two of the spare boxed lunch kept by the schools were taken for laboratory test by the Kaohsiung City Health Department for: *Bacillus cereus*, *Staphylococcus aureus*, *Vibrio parahaemolyticus*, *Salmonella* and pathogenic *Escherichia coli*.  $1.4 \times 10^4$  cfu/gm of *Bacillus cereus* were identified.

#### 4. Discussion

These two food poisoning outbreaks gave an incubation period ranging from 1 to 75 hours, with a median of 7 hours. The symptoms were primarily gastrointestinal and not neurological. Food poisoning outbreaks in Taiwan are mostly associated with *Vibrio parahaemolyticus*, *Staphylococcus aureus*, *Bacillus cereus*, *Salmonella* and pathogenic *Escherichia coli*<sup>(1,2)</sup>.

*Vibrio parahaemolyticus* is one of the salt-loving marine bacteria. It may induce food poisoning through contaminated sea foods or foods contaminated by chop board or fingers<sup>(3)</sup>. The lunch of the day was found not to contain any sea food and foods well-cooked were placed directly into clean containers without being sliced on chop board. The possibility of this contamination was eliminated.

*Staphylococcus aureus* is often found in abscesses and nasal secretions. Foods contaminated by food handlers are always the cause of food poisoning<sup>(3)</sup>. The health conditions of the employees of the said factory were found satisfactory. However, the fried eggs were brought in at 7 a.m., and their sanitary conditions could pose a problem. However, the incubation period of *Staphylococcus aureus* is relatively short (1-6 hours, normally 3 hours), and the symptoms are primarily of upper gastrointestinal disorders (nausea, vomiting)<sup>(2,3)</sup>, so they do not correspond with the findings of these outbreaks. It is, therefore, unlikely that these out-breaks were associated with *Staphylococcus aureus*.

The sources of infection of *Salmonella* are poultry, domestic animals and man<sup>(4)</sup>. The infection may begin as acute gastroenteritis and develop into enteric fever or septicemia. Persistent high fever is the major symptom of the typhoid type<sup>(5)</sup>. The gastroenteric type of *Salmonella* can be destroyed by heat at 60°C for 20 minutes. No animals were kept around the factory, the foods had all been heated, and no patient had shown any persistent high fever. The likelihood of *Salmonella* infection was also eliminated.

*Escherichia coli* are normal and harmless bacteria in the intestinal tracts of man and warm-blood animals. There are, however, four pathogenic types that can cause diarrhea in man: enterophogenic *E. coli* (EPEC), enteroinvasive *E. coli* (EIEC), enterotoxigenic *E. coli* (ETEC), and enterohaemorrhagic *E. coli* (EHEC)<sup>(6)</sup>. These pathogenic agents could infect intestinal tracts to induce cholera-like watery diarrhea or dysentery-like mucous stools mixed with pus and blood lasting for several days<sup>(3)</sup>. Most patients of these outbreaks complained of diarrhea and abdominal pain, and though five of them had blood stools, they lasted only less than one day. The chances of pathogenic *Escherichia coli* infection were slim.

*Bacillus cereus* are spore-bearing bacilli existing in the environment, particularly in soil. They multiply at 10-45°C, the spores are resistant to heat at 100°C for 30 minutes, and the optimal temperature for spore-formation is 30°C.<sup>(3)</sup> The curry potato item for the lunch contained potato, carrot and green soybean, boiled first and stir-fried with flavor later. The time and temperature might not be enough to destroy the spores, and the interval until the lunch being served and the temperature during this period seemed to be optimal for the spores to multiply. The site where foods were prepared (contaminated area) and the site where foods were packed and stored (not contaminated area) were not separated, so cross contamination is likely.

Food specimens collected from the schools for laboratory test by the Kaohsiung City Health Department were mixed into one pool for each school, and not every food item was tested. Thus, it was not able to corroborated the epidemiological findings by the laboratory tests.

DOH was informed only a week after the outbreaks. The questionnaires were distributed to the school children only, but the amount of foods consumed was not specified. In the analysis of disease onset and suspected food items, the 1,113 questionnaires were grouped into confirmed cases (264, 23.3%), suspected cases (138, 12.2%) and non-patients (731, 64.5%). Only the confirmed cases and the non-patients, 81.42% of the total, were used in the analysis. Investigation of the rice and soup was made later by random sampling, so the recall bias because of the lapse of time could be considerable. In the end, only 43.63% of valid questionnaires were studied. The validity and reliability in the analysis of the relationship between the outbreaks and suspected food items could have been seriously affected.

## 5. Conclusions and Recommendations

Some recommendations are made as follows:

1. Though the outbreaks, from epidemiological data, were inferred to be bacterial poisoning, the lapse of time between the outbreaks and investigation was long, and also specimens were not available for corroboration, it was not able to pinpoint what type of bacterial poisoning the outbreaks were. Timing is most important in the investigation of food poisoning outbreaks. It is, therefore, recommended that, upon food poisoning outbreaks, health bureaus should inform DOH immediately.

2. Mass food supply has been a trend. To prevent food poisoning, food manufacturers should be supervised to be more alert to the concept of Hazard Analysis Critical Control Point (HACCP). The productivity and supply of a manufacturer, the separation of contaminated and non-contaminated areas, and the use of gloves in food preparation should be legislated.

3. To identify problems of manufacturers through epidemiological procedures for supervision, each food item should be tested separately in the laboratory.

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**Table 1. Analysis of Suspected Food Items**

Food item	Eaten			Not Eaten			Relative Risk 95% C I	p value
	Sick	Not Sick	AR (%)	Sick	Not Sick	AR (%)		
Fried chicken	228	600	28	20	62	24	0.67 < 1.18 < 2.08	0.54
Fried egg	213	512	29	33	133	20	1.08 < 1.68 < 2.60	0.01*
Hot dog	227	608	27	22	61	26	0.60 < 1.03 < 1.79	0.89
Curry potato	119	481	29	42	156	21	1.03 < 1.54 < 2.29	0.03*
Soft drink	213	537	28	33	109	23	0.84 < 1.31 < 2.05	0.21
Rice	32	153	17	17	33	34	0.19 < 0.41 < 0.87**	0.01
Soup	30	141	18	19	44	30	0.24 < 0.49 < 1.02**	0.04

\*p < 0.05.

\*\* RR value.

AR = Attack Rate