

Epidemiology Bulletin

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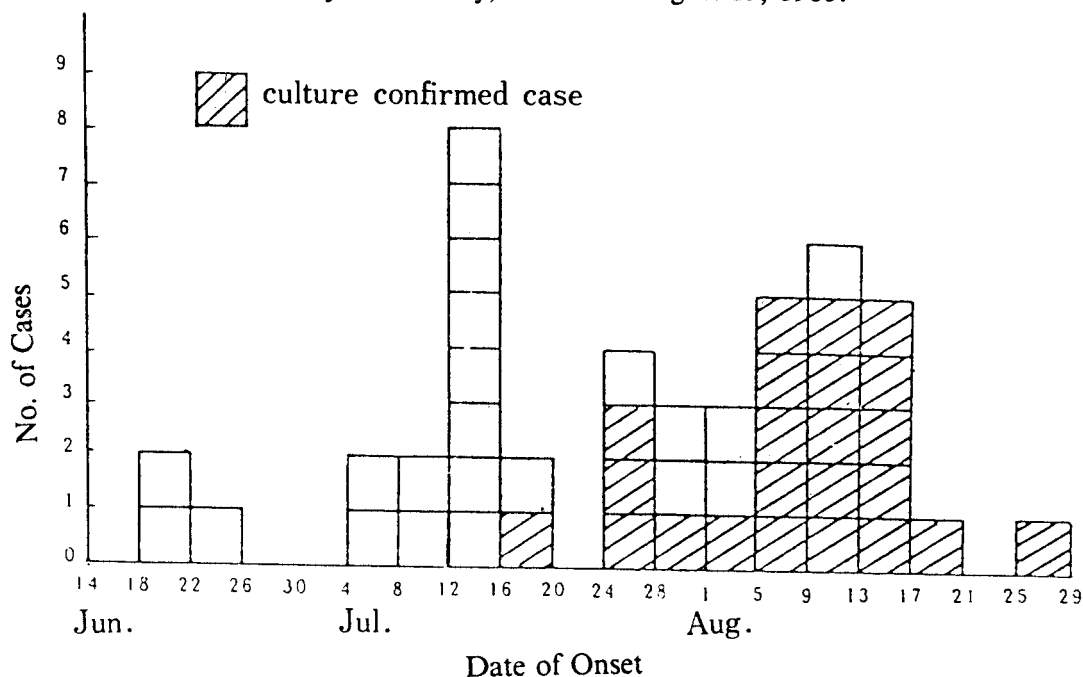
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Typhoid Fever Among Workers in a Shoe Factory – Taoyuan County

During the period July-August 1985, an outbreak of typhoid fever occurred among 230 workers in a shoe factory in Taoyuan County. Twenty-five (11%) workers were culture-positive for *Salmonella typhi*. Of these, 22 had symptoms which included fever $\geq 38^{\circ}\text{C}$ (89%), diarrhea (79%), headache (74%), malaise (60%), and anorexia (60%). All symptomatic culture-positive workers were hospitalized and treated with intravenous chloramphenicol for 2 weeks followed by oral chloramphenicol until stool cultures became negative; there were no fatalities. A questionnaire was administered to all factory employees and an additional 22 workers with symptoms compatible with typhoid fever were identified (a suspect case of typhoid fever was defined as 3 or more of the following symptoms since June: fever, headache, diarrhea, anorexia, malaise, or chills). The dates of onset showed a sharp increase in cases in mid-July followed by a broader peak lasting several weeks in mid-August (Figure 1). Fifteen (60%) of 25 culture-positive cases occurred among students who began summer jobs in the factory in June. The proportion of culture-positive cases among student workers was significantly higher than among regular employees (15 out of 31 compared to 10 out of 199, respectively; $p < 10^{-6}$, chi-square).

A factory cafeteria provided meals for employees three times per day. Student workers received room and board, and ate 2.8 meals per day in the factory cafeteria compared to 1.5 meals per day for regular employees ($p < 0.001$; Student's t-test). Eating in the cafeteria was significantly associated with illness: 39 of 131 employees who ate one or more meals per day were ill compared with 3 of 57 who never ate in the cafeteria ($p < 0.001$, chi-square). A similar association was found between illness and water consumption: students drank more water than regular employees (3.0 compared to 1.8 glasses per day re-

Figure 1. Symptomatic cases of typhoid fever among workers in a shoe factory by four-day intervals, Taoyuan County, June 14 - August 29, 1985.



spectively; $p < 0.004$, Student's t-test), and the rate of illness increased with the number of glasses of water consumed (Table 1). Eating in the cafeteria and water consumption were highly correlated (Table 2).

Inspection of the factory cafeteria showed many deficiencies in food handling practices and in the personal hygiene of foodhandlers; however, none of the four foodhandlers were stool culture-positive for *S. typhi* despite repeat testing with purgatives. Water for drinking and cooking was supplied by a well 11 meters deep located approximately 6-8 meters from a septic tank. Direct inspection of the septic tank was not possible because it was located beneath a concrete floor. Water samples from the well and from taps in the both the kitchen and dining areas were all positive for fecal coliforms. One pound of fluorescein dye was added to the men's and women's toilets, and water was removed from the well for several hours with an electric pump. Dye was detected with a fluorometer in water samples collected immediately after water reaccumulated in the well. A recommendation was made to permanently seal the well and connect the factory to the municipal water supply. After this recommendation was implemented, no further cases of typhoid occurred.

Reported by Taoyuan County Health Bureau; Taoyuan Provincial Hospital; North Mobile Team, National Institute of Preventive Medicine; Bureau of Food and Drug Laboratory, Bureaus of Environmental Protection and Disease Control, Department of Health, Executive Yuan.

Table 1. The dose-response relationship of drinking water consumption to illness among workers in a shoe factory, Taoyuan County, 1985.

Glasses of water	Ill	Total	Percent Ill
0	2	57	4%
1-2	14	72	19%
3-4	18	35	51%
>5	9	23	39%

Chi-square for trend = 24.3, $p < 10^{-6}$

Table 2. Correlation between number of meals eaten in the factory cafeteria and number of glasses of water consumed per day.

Glasses of water	Number of meals				Total
	0	1	2	3	
0	33	4	15	5	57
1-2	18	11	21	22	72
3-4	1	2	6	26	35
>5	4	2	7	10	23
Total	56	19	49	63	187

Pearson's correlation coefficient = 0.44, $t = 6.2$, $p < 10^{-6}$

Editorial note: In addition to this outbreak, two other outbreaks of typhoid fever occurred among factory workers in Taoyuan County during the period 1983-1985. Contaminated well water was also the suspect vehicle in both outbreaks. According to the Labor Health and Safety Law, factories with wells must submit water samples to the local county health bureau at least once per year for testing¹. In practice, however, this law is difficult to enforce; there are more than 50,000 registered factories in Taiwan² and only about 200 Factory and Mine Bureau inspectors.

Another problem concerns sample collection. The first well water sample from the shoe factory collected by the Taoyuan County Health Bureau after the outbreak began was negative for coliform bacteria. This sample had been stored in a refrigerator for two days before being sent to the laboratory for testing. Samples collected one week later and tested immediately were all positive for fecal coliforms. Storing water samples for prolonged periods is dangerous because coliform counts may decline and contaminated wells may go undetected. Samples should be processed within one hour of collection, or