Shigellosis Outbreak Associated with Swimming

SUE MAKINTUBEE, RN, MPH, JOE MALLONEE, MPH, AND GREGORY R. ISTRE, MD

Abstract: In June 1982, an outbreak of gastrointestinal illness caused by *Shigella sonnei* occurred among residents of two counties in Oklahoma. A case-control study of cases and age and sex-matched controls showed an association with attendance at a southern Oklahoma lake (14/17 cases vs 3/17 controls, matched pair odds ratio [OR] 9/0, confidence interval [CI] 2.4–infinity). A survey of 85 persons who had visited the lake area showed that persons who had swum were more likely to have been ill with a gastrointestinal illness (50 per cent) than persons who had not swum (0 per cent); among those who had swum, illness was more frequent among those who reported having water in their mouths while swimming (62 per cent) than those who did not (19 per cent) (OR = 6.9, 95% CI = 2.2–21.5). No further primary lake-associated cases had onset of symptoms beyond two days of closing the reservoir. Swimming should be considered as a potential source of enteric infections. (*Am J Public Health* 1987; 77:166–168.)

Introduction

Shigellosis is usually transmitted from person-to-person in households or day care centers.[1–3] However, common source outbreaks due to contaminated food,[4–6] and water[4,7] have been reported. Only rarely has *Shigella* been shown to be spread by swimming in contaminated water.[8,9*] We report an investigation of an outbreak of shigellosis that was epidemiologically linked to swimming in a contaminated reservoir.

Background

Konawa Reservoir is a lake located in a rural, sparsely populated area in central Oklahoma. Activities at the lake may include swimming, fishing, picnicking, boating, and waterskiing. Overnight camping is prohibited. Swimming is restricted to one area of the lake (approximately two acres). There are no concessions on the lake property and no potable water outlets. Four portable toilets are located near the swimming beach.

On June 24, 1982, a local hospital infection control nurse reported that six children were hospitalized from June 21 to June 24 with *Shigella sonnei* infections. Isolates from the six children had identical antibiotic susceptibilities by standard Kirby-Bauer susceptibility tests. Each child had visited the lake within three days before onset of illness. They had no other common exposures such as day care centers, food establishments, group meals, or social gatherings.

Methods

Determining the Source

We contacted local physicians, laboratories, and hospitals in the counties near the reservoir. We defined a case as a person who had either a stool culture positive for *Shigella sonnei*, or diarrhea (three or more unformed stools in a day) with fever and/or abdominal cramps during the month of June.

To determine the source, we administered a questionnaire by telephone to each reported case, requesting information about day care center attendance, restaurants patronized, travel, social gatherings, source of home water supply, swimming, and contact with another person with diarrhea in the week before onset of illness. Cases were asked to identify one friend of the same age and sex to serve as a control. A designated control who was found to meet the case criteria was excluded. The same questionnaire was then adminstered to controls by telephone.

We defined a primary lake-associated case as a person who had visited Konawa Reservoir within seven days prior to onset of illness. Cases in a family with onset of symptoms more than 24 hours after an index case and who had no exposure to the lake in the previous one week of their onset were defined as secondary lake-associated cases. Co-primary cases were defined as cases in the same household who had onset of symptoms less than 24 hours apart and who had visited the lake in the previous week.

Stool specimens were collected from individuals identified during the investigation who had had diarrhea in the previous two weeks. The specimens were cultured by standard techniques for *Salmonella, Shigella,* and *Campylobacter.*[10]

On June 26, 28 and 30, water samples were collected from various sites on the reservoir. The specimens were tested for fecal coliforms and fecal streptococci for evidence of human fecal contamination by using standard techniques.[11]

On June 28, we attempted to culture lake water for *Shigella* by filtering a 1,000 milliliter water specimen through 0.45 micron filters, incubating on Hajna's Gram Negative (GN) Broth and plating on MacConkey, xyloselysinedesoxycholate (XLD) and Hektoen agar.[11]

Determining Risk Factors at the Lake

By case interviews, we identified 85 persons who were present at Konawa Reservoir during June. We administered a questionnaire to these individuals to elicit a history of diarrheal illness and activities at the lake.

Results

The Source

We identified 44 persons who fit the case criteria with onsets between June 7 and June 28. Seventeen pairs of cases and controls were successfully contacted and interviewed. Eighty-two per cent of the cases vs 18 per cent of the controls had visited Konawa Reservoir in the week before the onset of illness in the case (matched pair OR = 9/0, CI = 2.4–infinity). No other potential source was implicated. Of the 44 cases identified, 38 (86 per cent) were primary lake-associated cases. No source could be found for the six cases who had not visited the lake.

*Haley CE, *et al:* Centers for Disease Control, unpublished data, EPI-80-92-2.

From Epidemiology Service, Oklahoma State Department of Health. Address reprint requests to Sue Makintubee, RN, MPH, Epidemiology Service, Oklahoma State Department of Health, 1000 NE 10th, Oklahoma City, OK 73152. This paper, submitted to the Journal April 21, 1986, was revised and accepted for publication July 21, 1986.

TABLE 1—Frequency of Symptoms among Cases of Shigellosis, Konawa Reservoir, June 1982

Symptoms	Per Cent of Persons with Symptoms: Stool Culture Shigella + N = 12	Performed Shigella − N = 12	No Stool Culture Performed N = 38
Diarrhea (by definition)	100	100	100
Abdominal Cramps	100	100	88
Fever	92	92	63
Nausea	92	83	53
Vomiting	75	58	40**
Blood, Mucous, or Pus in Stool	67	73*	24

*Information unknown for 1 person.
**Information unknown for 3 persons.

TABLE 2—Attack Rate of Shigellosis among Persons Who Visited Konawa Reservoir by Degree of Water Exposure, June 1982

Exposure	Attack Rate	(%)
Did not swim	0/9	(0)
Waded only	1/6	(17)
Head under water but no water in mouth	3/15	(20)
Water in mouth	34/55	(62)
TOTAL	38/85	(45)

Chi-square for trend as described by Rothman and Boice (12) = 17.3; P = .000016.

Risk Factors at the Lake

A total of 62 lake-associated cases were found. Thirty-eight were primary or co-primary and 24 were secondary lake-associated cases. Nine of the 62 cases were hospitalized. There were no deaths. Of 24 cases with a stool culture performed, 12 (50 per cent) were positive for *Shigella sonnei*. Prevalence of symptoms among ill persons is listed in Table 1.

Questionnaire information from the 85 persons who visited the lake in June revealed that there was no illness among the nine persons who had not swum, while 50 per cent of 76 persons who had swum developed gastrointestional illness. Attack rates for those who had swum increased with the degree of water exposure (Table 2); persons who had lake water in the mouth while swimming had the highest attack rate (62 per cent). No other exposure at the lake (e.g., use of portable toilets, consumption of food items, etc.) was associated with illness. Incubation periods, calculated for 22 persons with single exposure to the lake, ranged from one to six days, with a mean of 2.3 days. The median age of the 38 ill swimmers was 9 years. The overall secondary attack rate for households with a primary lake-associated case was 30 per cent.

Seventy-one per cent of the cases swam during one or both of two weekends (June 12, 13, 19, and 20) when the swimming beach was heavily attended (Figure 1). It was estimated by lake authorities that approximately 30–50 swimmers were present on an average weekday and that as many as 200–300 persons were swimming each day, June 19 and 20. No further primary lake-associated cases had onset of symptoms beyond two days of closing the reservoir.

Water samples collected on June 26, 28, and 30 revealed fecal coliform counts of 20–1500 (mean, 271) per 100 milliliters and fecal streptococci counts of 50–4800 (mean, 619) per 100 milliliters. Cultures for *Shigella* were negative.

Interviews conducted during the second phase of the investigation revealed that at least three children had swum in the lake in June while they were ill with an acute, febrile diarrheal illness. The parents of these children were uncertain whether the children had defecated in the lake. In two of these households, *Shigella sonnei* was cultured from specimens of secondary cases. During the inspection of the lake, a fecally-soiled diaper was found on the swimming beach shore.

Discussion

Epidemiologic investigation implicated Konawa Reservoir as the source of shigellosis in this outbreak. Among persons who had visited the lake, only swimmers became ill, and the attack rate for swimmers increased as the degree of reported water exposure increased.

In 1980, six outbreaks of gastroenteritis related to outdoor swimming were reported to the Centers for Disease Control (CDC).[13] Five of the six outbreaks occurred in fresh-water lakes and *Shigella* was implicated in four. Nevertheless, few reports of these outbreaks exist in the literature.

Shigella is difficult to culture from water and may require a sample of as much as 10 liters of water.[14] We sampled water from the reservoir at least 7–10 days after most cases had been exposed to the water. *Shigella* organisms likely would not survive until the time we collected lake specimens for culture.[15]

DeWailly, *et al*,[16] reported the relative risk of gastroenteritis among windsurfers increased as the amount of water contact increased. Cabelli, *et al*,[17,18] found that swim-

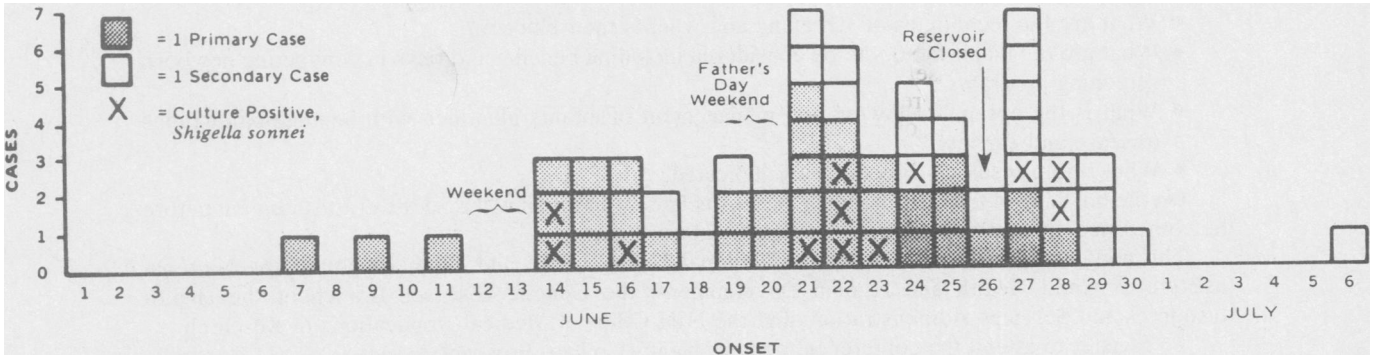

FIGURE 1—Cases of Lake-associated Shigellosis by Date of Onset, Konawa Reservoir, June 1982

ming in sewage-polluted water can be a significant route of transmission of gastrointestinal disease, even at relatively low pollution levels (i.e., lower concentrations of fecal coliforms than the Environmental Protection Agency (EPA) maximum acceptable standard). Persons infected with *Shigella* may shed up to 10^9 bacteria per gram of stool.[19] Other swimmers may ingest the small number (10–100) of organisms necessary to contract the disease,[20] perhaps by allowing contaminated water to enter the mouth without knowingly swallowing the water.

Swimming should be considered a potential source of shigellosis and other enteric diseases. Cases should be reported promptly to public health officials, where recognition of an outbreak may occur and control measures can be implemented.

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NIH Consensus Development Conference on Newborn Screening for Sickle Cell Disease

A Consensus Development Conference on newborn screening for sickle cell disease and other hemoglobinopathies will be held at the National Institutes of Health (NIH), Bethesda, Maryland, April 6–8, 1987. Discussion will center on the need for widespread screening of newborns for sickle cell disease, to facilitate entry into comprehensive care programs and to initiate penicillin prophylaxis to reduce morbidity and mortality from infection.

The consensus conference will bring together biomedical investigators, clinicians, and other health professionals, and representatives of the public. Following two days of presentation by medical experts and discussion by the audience, a Consensus Panel will weigh the scientific evidence and formulate a draft statement in response to several key questions:

- Are programs for screening the newborn for sickle cell disease effective in decreasing morbidity/mortality?
- What are the techniques of screening and what is their efficacy?
- What are the major factors to be considered including benefits and risks in conducting newborn screening programs?
- What is the optimal follow-up and management of infants identified with hemoglobinopathies (disease and carriers)?
- What future research directions are indicated?

On the final day of the meeting, the Consensus Panel Chairman will read the draft statement before the conference audience and invite comments and questions.

The conference is sponsored by the National Heart, Lung, and Blood Institute; the National Institute of Child Health and Human Development; the Genetic Diseases Branch of the Health Resources and Services Administration; and the NIH Office of Medical Applications of Research.

To register to attend the conference, contact Nancy Cowan, Prospect Associates, 1801 Rockville Pike, Suite 500, Rockville, MD 20852, tel: (301) 486–6555.