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Epidemic cholera in rural El Salvador: risk factors in a region covered by a cholera prevention campaign

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SUMMARY

In response to the Latin American cholera epidemic, El Salvador began a prevention programme in April 1991. The first case was confirmed in August, and 700 cases were reported within 3 months. A matched case-control study was conducted in rural La Libertad Department in November 1991. Illness was associated with eating cold cooked or raw seafood (odds ratio [OR] = 7·0; 95% confidence limits [CL] = 1·4, 35·0) and with drinking water outside the home (OR = 8·8; 95% CL = 1·7, 44·6). Assertion of knowledge about how to prevent cholera (OR = 0·2; 95% CL = 0·1, 0·8) and eating rice (OR = 0·2; 95% CL = 0·1, 0·8) were protective. More controls than patients regularly used soap (OR = 0·3; 95% CL = 0·1, 1·0). This study demonstrated three important points for cholera prevention: (1) seafood should be eaten cooked and hot; (2) populations at risk should be taught to treat household drinking water *and* to avoid drinking water outside the home unless it is known to be treated; and (3) education about hygiene can be an important tool in preventing cholera.

INTRODUCTION

The Latin American cholera epidemic that began explosively in late January 1991 in Peru and spread throughout the Americas challenged the public health infrastructure throughout the region. In response to reports of the epidemic, the Ministry of Public Health and Social Assistance (MOPHSA) of El Salvador began a cholera prevention programme in April 1991 before any cases had occurred. Students trained by MOPHSA personnel conducted a nationwide door-to-door education campaign to encourage the population to wash hands with soap, boil or chlorinate drinking water, keep drinking water containers covered, wash produce, and eat cooked food, including seafood, hot. Public health sanitarians distributed sodium hypochlorite solution to households for water disinfection.

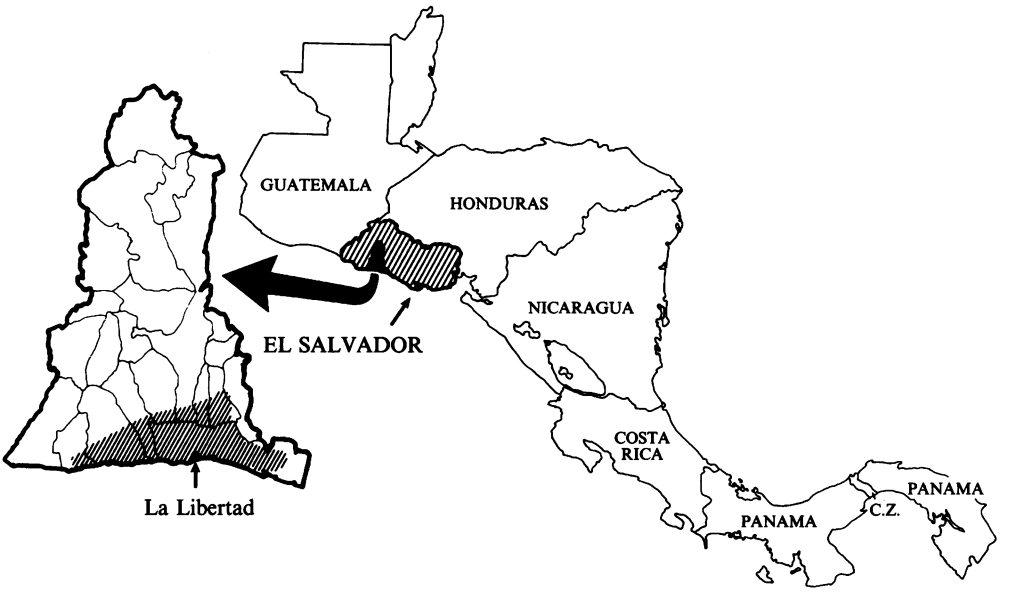

Fig. 1. Map of El Salvador with La Libertad Department indicated and the site of the investigation highlighted.

The first case of epidemic cholera in El Salvador was diagnosed on 16 August 1991. By 27 November 1991, 709 cases had been reported [1]. The epidemic affected a number of villages in La Libertad Department. We conducted a case control study in La Libertad in November 1991 to evaluate risk factors for cholera transmission.

BACKGROUND

La Libertad Department is on the Pacific coast of El Salvador, south of San Salvador (Fig. 1). The southern part of the Department consists of a number of small, rural fishing and agricultural villages whose main source of health care is the hospital in the city of La Libertad (population 33000). Drinking water in these villages is obtained from rivers, wells, or springs. A few communities pipe surface water to communal or household taps; only the departmental capital of La Libertad chlorinates the water. Other communities lack water treatment. Most families store drinking water in jugs or buckets in their homes. The only sewage system in the department is in the city of La Libertad. In other locations, human waste is disposed of on the open ground or in latrines.

METHODS

We selected cases from the registry of cholera patients treated at the La Libertad health centre. We defined a case as diarrhoea with a stool specimen yielding *Vibrio cholerae* 01, biotype El Tor, serotype Inaba, in a person > 5 years old who lived in southern La Libertad Department. We included patients whose illness onset was between 10 and 31 October 1991. Interviews were conducted between 31 October and 13 November 1991. We excluded patients if another

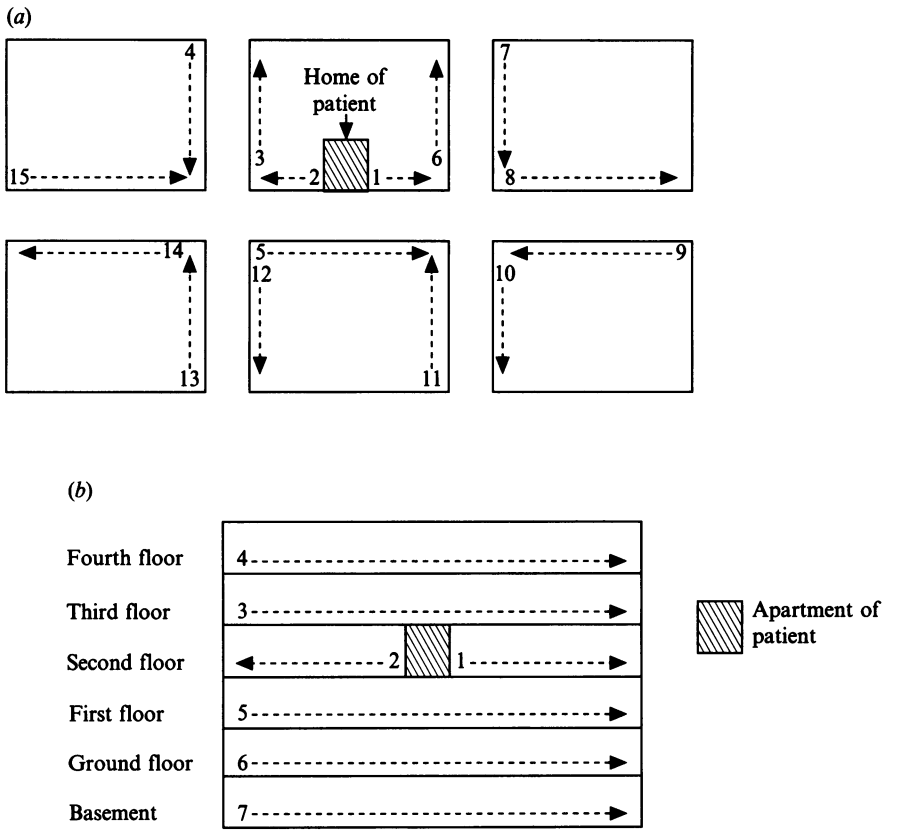

Fig. 2. Maps for finding control subjects. (*a*) For patients who live in houses; (*b*) For patients who live in apartment buildings: if no control is found in the building, proceed to the next building using map (*a*).

member of their household had been ill with diarrhoea since the onset of the cholera epidemic in El Salvador; only one had to be excluded. Two age- and sex-matched neighbourhood controls were systematically selected for each case. The method for identifying homes to recruit controls is shown in Fig. 2. Controls were to be excluded if any household member had diarrhoea since the onset of the Salvadoran cholera epidemic, but none had to be excluded. Patients and controls were interviewed about foods and beverages consumed in the 3 days before onset of the patient's illness, water sources, water handling practices, hygienic habits, and whether they thought they knew how to prevent cholera.

Matched analyses of the data were conducted using Epi-Info version 5.01b software [2]. Statistical significance was tested using the Yates corrected or Fisher's two-tailed exact test.

RESULTS

Twenty-four cholera patients from 5 counties and 48 matched controls were interviewed. The median age of patients was 46·5 years (range 6–65 years). Sixty-three percent of patients were male.

Predominant symptoms among the patients included vomiting (88%), muscle cramps (79%), and abdominal pain (54%). All patients were treated at the health

Table 1. *Comparison of exposures of 24 cholera patients with 48 healthy controls by matched univariate analysis, La Libertad, El Salvador, October, 1991*

Exposure	Patients No. (%)	Controls No. (%)	Odds ratio	95% CL	*P* value
Drank water outside the home	17 (71)	18 (38)	8·8	1·7, 44·6	0·008
Drank untreated water	19 (79)	33 (70)	1·9	0·5, 7·2	0·54
Ate seafood prepared at home and served raw or cold	8 (33)	4 (8)	7·0	1·4, 35·0	0·02
Ate rice prepared at home	10 (42)	35 (73)	0·2	0·1, 0·8	0·01
Ate leftover rice without reheating	0 (0)	3 (6)	0	0·0, 4·7	0·54
Ate street-vended food	6 (26)	7 (15)	2·1	0·5, 8·4	0·32
Drank street-vended beverages	4 (17)	11 (23)	0·7	0·2, 2·7	0·73
Claimed to know how to prevent cholera	10 (43)	34 (72)	0·2	0·1, 0·8	0·02
Used soap always or almost always to wash hands	11 (46)	33 (69)	0·3	0·1, 1·0	0·07
Covered drinking water vessel in home	19 (83)	45 (94)	0·2	0·0, 1·2	0·14

centre; 22 patients (92%) received intravenous fluids. Fourteen (58%) had treated themselves with oral rehydration solution before admission.

Illness was associated with drinking water outside the home (odds ratio [OR] = 8·8, 95% confidence limits [CL] = 1·7, 44·6) (Table 1). Although illness was not associated with eating a specific type of shellfish or finfish, illness was associated with eating any cold cooked or raw seafood (OR = 7·0, 95% CL = 1·4, 35·0). Eating rice was protective against illness (OR = 0·2, 95% CL = 0·1, 0·8). Illness was not associated with eating rice cold after cooking, or with consuming street-vended foods or beverages.

Ten (42%) patients obtained water for their household from a well, 6 (25%) from a river, 3 (13%) from a spring, 3 (13%) from a public tap, and 2 (8%) from a household tap. Of 17 patients who drank water outside the home during the 3-day period referred to in the interviews, 7 (41%) obtained it from a well, 6 (35%) from a river, 2 (12%) from a spring, 2 (12%) from a household tap, and 2 (12%) from a public tap. There were no significant differences in water sources inside and outside the home between patients and controls. Twenty (83%) patients and 42 (88%) controls stored drinking water in household containers. Ten (42%) patients and 26 (54%) controls had treated their drinking water in the 3-day period referred to in the interviews. Household chlorine treatment was used by 6 (25%) patients and 15 (31%) controls.

Assertion of knowledge about how to prevent cholera was protective against illness (OR = 0·2, 95% CL = 0·1, 0·8) (Table 1). A smaller proportion of patients than controls reported that they always or almost always used soap to wash their hands and covered the household drinking water storage container; these differences were not statistically significant.

DISCUSSION

In this investigation, we identified eating improperly prepared seafood and drinking water outside of the home as risk factors for cholera, and eating rice and claiming to know how to prevent cholera as protective factors. Although seafood has been well documented as an important vehicle of cholera transmission outside of Latin America [3–8], this investigation is only the second during the current Latin American cholera epidemic to implicate seafood. The Latin American epidemic began in coastal Peru, where the epidemic strain of *V. cholerae* was isolated from shellfish, finfish, and sea and river water samples [9], and where a raw fish dish, ceviche, is commonly eaten. However, investigations of the cholera epidemic in the coastal cities of Trujillo and Piura found that very few patients or controls had eaten raw seafood [10, 11], possibly because the Peruvian population heeded warnings by the Ministry of Health early in the epidemic to avoid eating raw seafood [12]. Cases occurring before the warnings were not studied. Such warnings were not emphasized in Ecuador; an investigation of the cholera epidemic in Guayaquil revealed that illness was associated with eating raw shellfish or finfish or cooked crab [13]. Outbreaks of cholera also occurred in the United States related to cold salad made with crabs brought from Ecuador [14]. In La Libertad Department there are no sewage treatment facilities, so it is likely that sewage contaminates coastal waters where seafood is harvested, creating environmental conditions that could support the transmission of epidemic cholera.

The association between cholera and water consumed outside the home is noteworthy because cholera prevention campaigns usually stress the importance of boiling or chlorinating household drinking water without making specific recommendations for water consumed outside the home. Most investigations of the Latin American cholera epidemic have found a preponderance of cases in adult males [10, 13, 15–18], who are likely to work outside the home and thus to have increased exposure to untreated water and street-vended foods and beverages. Campaigns to prevent cholera should address this risk.

The finding in this study that eating rice protected against cholera was unexpected since, at room temperature, rice has been shown to be an effective growth medium for *Vibrio cholerae* 01 [19]. This may be explained by the Salvadoran custom of eating cooked food hot, which would kill bacteria contaminating the rice, a custom reinforced by the cholera prevention campaign which stressed the importance of eating cooked food hot.

Control subjects were more likely than patients to claim to know how to prevent cholera. This finding suggested that the cholera prevention campaign in El Salvador had a beneficial impact in these communities. This interpretation is supported by the trend towards protection against cholera associated with regular use of soap. The plausibility of this finding is supported by other investigations that have documented reduced diarrhoea rates among recipients of hygiene education [20].

Despite attempts by the MOPHSA to distribute sodium hypochlorite solution for household water disinfection and to provide instructions about its proper use, only 25% of patients and 31% of controls used it. We did not attempt to

determine the reasons for the low compliance. In a trial of in-home water chlorination in Brazil, 9 (36%) of 25 participants dropped out because they disliked the taste or feared toxic effects of the chlorine [21]. The investigators acknowledged that this disappointing result may have occurred because no community-wide education campaigns were conducted before they introduced the intervention.

This investigation was limited by the small number of cases encountered in this sparsely populated rural area, which limited power to discern statistical associations between illness and exposures. The retrospective nature of this study, which examined exposures that occurred up to 4 weeks before the time of the interviews, had the potential for recall bias. This limitation was mitigated by the relative lack of variation in the diet of residents of La Libertad Department, which permitted them to describe what they had ingested with some confidence.

The results of this investigation underline the high risk of improperly prepared seafood in the setting of a cholera epidemic, and of the need to educate the public to cook seafood thoroughly. This investigation also shows that educational campaigns to improve hygiene and food preparation practices to prevent cholera can be beneficial, but that they need to be tailored to the characteristics of the population being served. In this instance, the recommendation to treat water in the home was not sufficient because contaminated water was being consumed outside the home. A more complete approach would have also included recommendations to drink water only from sources that are known to be treated, and, for persons who work outside the home, to carry treated water from home to work in a clean, lidded container. Finally, the fact that less than a third of study subjects treated their water with the sodium hypochlorite solution distributed by MOPHSA suggests that the use of disinfectant was not adequately promoted. Social marketing techniques may be necessary if this is to be a successful tool for cholera prevention.

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