

# Cholera in metropolitan Manila: foodborne transmission via street vendors

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*Reported are the results of an unmatched case-control study to determine the risk factors associated with acquisition of cholera in Manila. Cases were patients admitted to the San Lazaro Hospital between July and September 1989 and whose stools yielded *Vibrio cholerae* O1 on culture. Controls were patients admitted to the same hospital and who had no history of diarrhoea or of having taken antibiotics during the 3 days prior to admission.*

*Of the 158 cases and 158 controls who had bought food from street vendors, cases were more likely to have bought the following items: pansit (rice noodles with shrimp, meat, and vegetables), mussel soup, spaghetti, fish balls, pig blood coagulated with vinegar, and salty brine shrimp with vegetables. Cases were also more likely to lack piped water at home. An unconditional logistic regression analysis indicated that only pansit (OR = 2.15, 95% CI = 1.32 – 3.51), mussel soup (OR = 2.29, 95% CI = 1.06 – 4.95), and the absence of piped water at home (OR = 2.70, 95% CI = 1.63–4.46) remained as risk factors.*

*As control measures we recommend stricter implementation of the food sanitation code and the licensing of street food vendors.*

## Introduction

On 22 September 1961, the first cases of cholera for 25 years were identified in the Philippines. The disease spread rapidly in Manila and soon other cities and provinces reported cholera outbreaks (1). Subsequently, cholera has recurred each year in various foci during the rainy season. Use of oral rehydration therapy has greatly decreased mortality from the disease, but less progress has been made towards preventing cholera because it is not clear how it is transmitted in the Philippines.

Cholera can be transmitted by food or water. In recent years, evidence has accumulated which suggests that foodborne transmission is more likely than was previously suspected. Shellfish, especially from contaminated water, have often been responsible for

cholera outbreaks (2–6). A study in Manila in 1988 showed that cholera patients were eight times more likely than controls to report having bought food from street vendors (M.R. Benabaye, unpublished observations, 1988); however, the specific food items that were associated with a higher risk were not identified.

The present study was carried out to identify which specific food items bought from street vendors were more likely to be the vehicles of cholera transmission in Manila.

## Methods

The study was based on an unmatched case-control approach. The inclusion criterion was that all cases and controls had purchased food from street vendors in the week prior to their illness.

### **Definition of cases and controls**

All subjects were interviewed between July and September 1989, the peak diarrhoea season in Manila, at the San Lazaro Hospital, a 900-bed infectious disease hospital in metropolitan Manila. Cases were previously well individuals who had had diarrhoea more than three times per day and positive stool cultures for *Vibrio cholerae* O1. Controls were patients admitted to the hospital for conditions other than diarrhoea, usually respiratory illnesses. Controls who had taken antibiotics in the 3 days prior to admission were excluded from the study since this could

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have prevented them from developing clinical illness had they been infected with *V. cholerae*. Stool cultures were not performed for the controls, and the latter were not matched.

Identical questionnaires were administered to the cases and the controls. For adults, the patients themselves were the respondents; for paediatric patients, the mothers. Included were questions on demographic data, whether food items were bought from vendors, a checklist of specific food items commonly sold by vendors, and information on water sources.

### Determination of the sample size

Using the method described by Fleiss, we estimated a sample size of 148 cases and 148 controls (7). We assumed an alpha error of 0.05 (two-tailed), a beta error of 0.2, an estimated exposure risk among controls of 50%, and accepted a smallest detectable odds ratio of 2. To cover the possibility that individuals whose questionnaires contained errors might have to be excluded, we recruited 10 additional cases and controls. Since all the questionnaires were, however, completed correctly and could be used, the data for all 158 cases and 158 controls were analysed in the study.

### Analysis

The data were analysed using  $\chi^2$  tests; 95% confidence intervals (CI) around the odds ratios (OR) were calculated by means of Cornfield's method using Epi Info 5.0 software (8). Unconditional logistic regression analyses of the data were also performed using EPILOG PLUS software (9).

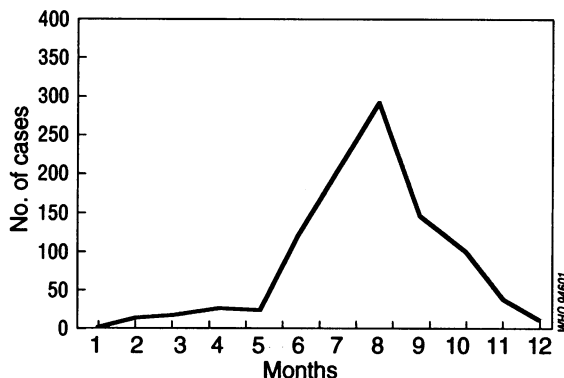
## Results

Fig. 1 shows the number of cases of cholera registered at the San Lazaro Hospital in 1989. The demographic characteristics of the 158 cases and 158 controls in the study are shown in Table 1. The age and sex distributions of the cases and controls were similar. There was no geographical clustering of cases, since both cases and controls were residents of the Manila Bay area.

A total of 33 food items were tested in the study. Of these, the following six items were associated with cholera, as indicated by the results of  $\chi^2$  tests (Table 2):

- *pansit*: rice noodles cooked in chicken or shrimp broth and garnished with vegetables, pre-cooked shrimps, or eggs;
- mussel soup: mussels (*Perna viridis*) sautéed with garlic, onions, ginger, and tomatoes;

Fig. 1. Distribution of cholera cases registered at San Lazaro Hospital, Manila, 1989.



- spaghetti: noodles with tomato sauce and sautéed beef;
- vegetables with salty brine shrimp, containing aubergines, okra, and bitter gourd;
- fishballs: a snack food, composed of fish and flour made into balls, deep fried, and dipped in sweet-and-sour sauce; and
- blood meat (*dinuguan*): coagulated pig blood cooked in vinegar.

The remaining 27 food items were not found to be statistically significantly associated with cholera.

Using a logistic regression analysis, we attempted to fit the following variables to the model: subject's age, presence/absence of tap water in the home, and the six food variables found to be associated with cholera in the bivariate analysis. Only *pansit*, mussel soup, and the absence of tap water at home were significant risk factors for cholera in the best-fitting model (Table 3).

Table 1: Demographic characteristics of cholera cases and controls at the San Lazaro Hospital, Manila, September, 1989

Characteristic	Cases (n = 158)	Controls (n = 158)
<i>Sex</i>		
No. of males	76 (48) <sup>a</sup>	83 (53)
No. of females	82 (52)	75 (47)
Age range	3 months–84 years	6 months–77 years
Mean age	15 years	15 years
Age group most affected	1–4 years	1–4 years

<sup>a</sup> Figures in parentheses are percentages.

Table 2: Food items bought from street vendors and which were associated with the risk of acquiring cholera, Manila, September 1989

Food item	Odds ratio	P-value <sup>a</sup>
Rice noodles with meat, vegetables, and shrimp ( <i>pansit</i> )	2.54 (1.56–4.13) <sup>b</sup>	0.0001
Vegetables with salty brine shrimp	2.01 (1.24–3.27)	0.003
Mussel soup	2.40 (1.11–5.27)	0.02
Spaghetti	1.86 (1.09–3.19)	0.02
Blood meat ( <i>dinuguan</i> )	1.96 (1.08–3.57)	0.02
Fish balls	1.76 (1.04–2.90)	0.03

<sup>a</sup> Statistically significant according to the results of a  $\chi^2$  test with Yates' correction.

<sup>b</sup> Figures in parentheses are the 95% confidence intervals.

## Discussion

Epidemiological studies have shown that both water and food are important vehicles for the transmission of cholera (2–6, 10–13). Our findings suggest that food may play a more important role in cholera transmission in Manila than was previously thought. Because they neutralize gastric acids, certain foods are good vehicles for transmitting cholera. In food the infectious dose of *V. cholerae* is as low as 1000 organisms per gram, compared with  $10^5$ – $10^6$  organisms per gram in water (14, 15). In addition, *V. cholerae* can multiply rapidly in rice or other grains, so there may be a higher dose in contaminated foods than in water. Efforts to control cholera and other enteric diseases in Manila should therefore focus on street food vendors as well as on the provision of safe water.

Interruption of the transmission of foodborne cholera requires identification of those foods that are contaminated, how they became contaminated, and how they support multiplication of vibrios. In our study, *pansit* bought from street vendors and soup made with mussels were the chief food items implicated.

Table 3: Risk factors for cholera morbidity, according to the results of a multivariate analysis, Manila, September, 1989<sup>a</sup>

Risk factor	Odds ratio	P-value
No tap water at home	2.70 (1.63–4.46) <sup>b</sup>	0.0002
<i>Pansit</i>	2.15 (1.32–3.51)	0.003
Mussel soup	2.29 (1.06–4.95)	0.04

<sup>a</sup> The model included the following variables: blood meat (*dinuguan*), vegetables with brine shrimp, spaghetti, fish balls, mussel soup, *pansit*, and no tap water at home.

<sup>b</sup> Figures in parentheses are the 95% confidence intervals.

*Pansit* is the item of food sold most frequently by street vendors in Manila, and the vibrios could have been harboured by any of its ingredients. For example, both the shrimps and vegetables in the *pansit* could have been contaminated with vibrios, and the brief cooking time may not have been sufficient to kill the organisms (17). Shrimps can become contaminated with *V. cholerae* when they ingest copepods that carry vibrios on their chitin (17). These vibrios then attach themselves to the shrimp shells and multiply on the moist chitin. This has been shown for both *V. parahaemolyticus* and *V. cholerae* (16). By adhering to the chitin, the vibrios protect themselves from the lethal effects of hydrochloric acid in the gastric secretions of the shrimps (18). Since the shrimps in *pansit* are usually only lightly steamed and used as garnish, it is possible that they introduce vibrios into the *pansit*, where they can survive and reproduce rapidly. In the Philippines an association between cholera cases and consumption of raw seafood, including small shrimps, has been reported (19).

*V. cholerae* can also be introduced into *pansit* by vegetables (17), since the latter may be contaminated by night soil fertilization, washing and freshening with polluted water, or when handled by a cholera carrier. Like shrimps, these vegetables are not thoroughly cooked when *pansit* is prepared and are used as a garnish.

Because rice noodles are boiled thoroughly when they are prepared, they are unlikely to be a source of vibrios. However, because they are alkaline, such noodles are conducive to vibrio multiplication (17). If the *pansit* is allowed to cool, noodles therefore provide an excellent environment for the growth of any *V. cholerae* that may be present in the other ingredients.

The second most important food item that was associated with cholera was mussel soup. In the preparation of this soup, garlic, onions, and ginger are first sautéed; water is added and the mixture is allowed to boil. The mussels are then put in the mixture, and as soon as they pop open, they are considered "cooked"; however, the meat inside is probably still raw or half-cooked. Since most of the mussels sold in Manila are obtained from Manila Bay, which is heavily polluted with raw sewage, they are a probable source of contamination. Mussels, particularly if they are consumed raw, have frequently been implicated in cholera transmission (2, 6); also, partially cooked mussels can support multiplication of *V. cholerae* (17). Thus, inadequate cooking of contaminated shellfish or their contamination by cholera carriers, following cooking, can lead to transmission of the disease.

Although our study focused largely on the association between cholera and the consumption of

food, we noted that cases were less likely than controls to have piped water in the home. Water drawn directly from the pipes of the Metropolitan Manila Waterworks System is nearly always safe, but becomes contaminated rapidly if handled by water vendors or is piped through rubber hoses (which leak and let in groundwater during periods of low mains pressure). Sprinkling contaminated water on previously prepared food to make it appear fresher ("freshening") or preparing food with contaminated water may provide a link between water- and food-borne cholera transmission.

A limitation of the study was that we did not ask the respondents whether the food they bought from vendors was eaten immediately after cooking or was consumed later. This could explain why some of the food items we thought were probably associated with cholera were not implicated; for example, rice gruel, which has an alkaline pH appropriate for cholera growth, was usually served piping hot. This may have prevented replication of vibrios. Because no stool cultures were performed on controls, some of them may have been infected asymptotically with *V. cholerae*. This would bias the odds ratio towards 1.

Foods sold by street vendors are possible health hazards (20). The roles of vendors who are cholera carriers, of food-handling practices, and of the impact of the availability of clean water need to be elucidated if we want to intervene in the transmission of cholera. In 1983, the Joint FAO/WHO Expert Committee on Food Safety made the following recommendations: personnel involved in the preparation and handling of food must be instructed about hygiene; the environmental conditions in which the trade is practised must be improved; and essential services to assist street-vendors of food to assure the safety of their wares must be provided.

Many of the hygiene requirements of street foods are the same as those for food sold in establishments. In the Philippines, the Food Sanitation Code has requirements for food establishments but none for street vendors; there is no classification for street-sold food. It has been proposed that food vendors in the Philippines be licensed. A prerequisite for such a licence would be to have attended classes in basic food-handling (hand-washing, keeping hot foods hot, and cold foods cold) and that vendors have access to clean water. The medical examination of vendors should not be a prerequisite for obtaining a licence (21), however, since overregulation and too many overhead costs can be deterrents to the food-vending trade and may lessen its capacity to provide nutritious food at affordable prices.

In the Philippines, responsibility for the health services is being devolved to the local chief executives and it is expected that city and municipal

mayors will strongly support the move to license street vendors, because the health of their constituents is at stake. It is therefore likely that transmission of cholera and other food- and waterborne diseases will be reduced in the country.

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## Résumé

### Le choléra à Manille: transmission alimentaire par les vendeurs des rues

Il est courant d'acheter des aliments aux vendeurs des rues à Manille et cette façon de faire constituerait peut-être un facteur de risque de choléra. Pour étudier la question, nous avons effectué une étude cas-témoins non-appariés afin de déterminer les facteurs de risque associés au fait de contracter le choléra.

Les cas retenus ont été des patients admis à l'hôpital San Lazaro entre juillet et septembre 1989 et dont les selles renfermaient *Vibrio cholerae* 01 après mise en culture. Les témoins, eux, ont été des patients admis dans le même hôpital pour des maladies autres que la diarrhée, ou n'ayant pas pris d'antibiotiques pendant les 3 jours ayant précédé leur admission. On a ensuite analysé les données obtenues par le  $\chi^2$  et par régression logistique non conditionnelle.

On n'a observé aucune différence significative dans la répartition par âge, par sexe et selon le lieu de résidence des 158 cas et des 158 témoins recrutés dans l'étude. En revanche, le choléra a été associé à l'achat de l'un des aliments suivants auprès d'un vendeur des rues: *pansit* (nouilles à base de farine de riz avec diverses garnitures), soupe de moules, spaghettis, boulettes de poisson, boudin (*dinuguan*) et légumes. Seuls les *pansits* (odds ratio (OR) = 2,15; intervalle de confiance à 95% = 1,32-3,51), la soupe de moules (OR = 2,29; IC à 95% = 1,06-4,95) et l'absence d'eau courante au domicile (OR = 2,70; IC à 95% = 1,63-4,46) constituent des facteurs de risque de choléra d'après l'analyse de régression logistique. Le *pansit* contient divers ingrédients ayant pu pro-

venir de sources contaminées: crevettes utilisées comme garniture, légumes ayant pu être "rafraîchis" avec de l'eau contaminée; et nouilles à base de farine de riz, dont le pH favorise le développement de *V. cholerae*. De même, des moules contaminées ont pu être employées pour préparer la soupe de moules. Le rôle des vendeurs dans la transmission du choléra, les pratiques de préparation des aliments et l'impact de l'absence d'eau propre à Manille doivent être analysés si l'on veut interrompre la transmission de cette maladie. Il faudrait également que les vendeurs d'aliments soient agréés et aient une autorisation spéciale leur permettant de tenir leur commerce.

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