

The eltor cholera epidemic in Dhaka in 1974 and 1975*

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Surveillance of hospitalized cholera cases from 1970 to 1977 in Dhaka, a matched control study in 1974, and a neighbourhood control study in 1975 were carried out and show a change from classical cholera to the eltor biotype during this period. Of all the hospitalized cholera cases, 9.1% in 1972 and 99.9% in 1973 were due to the eltor biotype. In 1974 and 1975 the distribution of eltor cholera cases in the city was uniform, except for areas with modern sanitation whose residents were spared. The incidence rates of cholera per 1000 infants (under the age of 1 year) were 1.16 and 0.93 for 1974 and 1975, respectively. On the whole, children below 10 years and females between 15 and 44 years of age were the ones most affected with eltor cholera. Higher rates of diarrhoea and hospitalization were noted among the contacts with cholera cases, compared with non-cholera controls. Contracting cholera was significantly associated with eating in places away from home, especially at charitable feeding centres.

In India, the classical *Vibrio cholerae* biotype *cholerae* was replaced by biotype *eltor* by 1966 (1). In Bangladesh, however, the eltor biotype first appeared in Chittagong in 1963 and in Dhaka in 1964; it then disappeared, but returned in 1968 (2, 3). In 1972 and 1973, there was a shift in *Vibrio cholerae* from the classical Inaba serotype to the eltor Ogawa serotype. By 1973 all cholera cases were due to the eltor biotype, and the biggest eltor cholera epidemic ever recorded in Dhaka occurred in 1974.

After the war of liberation in December 1971, a number of unemployed and homeless rural people flocked to Dhaka for government assistance in 1972 and 1973. Heavy floods and a food crisis affected the country during 1974 (4, 5). The homeless and jobless people constructed thousands of huts near the markets, railway stations, outskirts of the city, industrial parks and on unused government land. Their maximum concentration was in Ramna and Mohamadpur police zones. These settlements had no waste disposal facilities and the few handpump tubewells available were not enough to provide safe drinking water. People were therefore forced to use water from nearby rivers, ponds and canals, as well as from the city supply and the handpump tubewells, for bathing, washing, and drinking.

The vehicles of cholera transmission in urban epidemics in Bahrain, Italy, Malaysia, the Philippines,

and Portugal have been identified (6–10). But although several studies (11–16) have been conducted in Dhaka, few specific suggestions have been made to define the factors relating to the occurrence of cholera epidemics in this urban area. During the epidemic of 1974, a study was planned in order to (1) characterize the epidemiology of this first eltor cholera epidemic in Dhaka city, and (2) carry out a matched control study using hospitalized cholera and non-cholera diarrhoea cases in order to look for factors favouring the transmission of cholera. Since eating in wayside places was identified as an important factor in 1974, a study of the foods responsible and of food stalls connected with cholera outbreaks, based on cases and neighbourhood healthy controls, was carried out in 1975.

MATERIALS AND METHODS

The former Cholera Research Laboratory (now the International Centre for Diarrhoeal Disease Research, Bangladesh) has been the main centre for treatment of diarrhoea cases in Dhaka. This research centre with its hospital serves the entire city, the suburbs and surrounding rural areas. Patients with diarrhoea from other hospitals are also referred to this hospital. For the epidemiological study, the population of Dhaka city was given by the 1974 census (17). But in the absence of figures for the population by age (single years), population figures based on estimated percentages of children aged 0, 1, 2, 3 and 4 years old in the total population of Dhaka (urban districts) were used. All hospitalized, confirmed cholera cases from 1970 to 1973 were analysed for

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serotype and biotype and for comparing seasonal differences. The epidemic was defined by analysing all confirmed and hospitalized eltor cholera cases from the urban area for the years 1974 and 1975, with matched controls employing a randomized sample. All patients seeking treatment, on arrival, had either stool or rectal swabs taken for culture on Monsur's medium and bile peptone broth (18). On receipt of the results on the following morning, a team of trained field-workers interviewed these patients because to be included in the study, they had to have a family, had to be staying in the city, and had to be cooperative. A total of 203 cholera cases were selected (alternately with controls) in 1974. The information sought included the patient's name, age, sex, place of residence, number of family members, sources of water, sanitary facilities, history of eating in places away from home within 5 days of the onset of cholera, and history of any diarrhoea occurring in family members within 5 days of the onset of illness in the index case. Identical data were collected from 203 patients hospitalized with non-cholera diarrhoea. These controls were matched according to place of residence, water and sanitation facilities and age groups (0-4, 5-9, 10-14, and over 14 years). The first non-cholera case matching the study case was taken as the control. Both cases and controls were selected from the city areas only.

During the 1975 epidemic, 168 cholera cases and 168 neighbourhood controls were selected alternately and interviewed. The same criteria and study design were used as in 1974. The type of food consumed away from home and the type of eating place frequented were also recorded. For significance testing, the χ^2 test was used.

RESULTS

Table 1 shows the change from the classical Inaba serotype to the classical Ogawa serotype between 1970 and 1972, and that in 1973 the eltor Ogawa serotype

displaced all other types. The highest number of cholera cases recorded by the Cholera Research Laboratory was in 1974 (incidence of 1.73 per 1000 population); this outbreak was caused mainly by *V. cholerae* eltor Ogawa. An epidemic of lesser intensity due to both eltor Inaba and Ogawa serotypes occurred in 1975 (incidence of 1.37 per 1000).

The monthly variations in the frequency of hospitalized cholera cases in 1971, 1974 and 1975 are shown in Fig. 1. The distribution for 1971 is typical of classical cholera and shows a small rise in May/June, and a post-monsoon peak in November. In 1974, the distribution of eltor cases reached a peak in October, about 6 weeks earlier than with classical cholera. The usual fall in the number of classical cholera cases

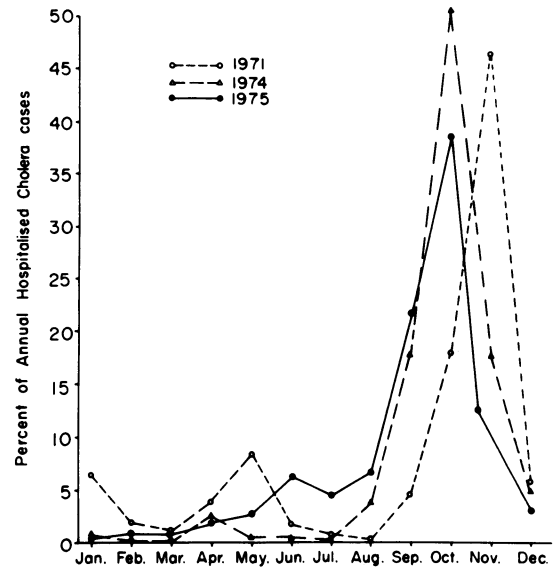


Fig. 1. Percentage incidence of hospitalized cholera cases in 1971, 1974 and 1975.

Table 1. Change from classical cholera to eltor cholera (hospitalized cases), 1970-75

Year	Classical Inaba	Classical Ogawa	Eltor Inaba	Eltor Ogawa	Total	% eltor
1970	2792	38	—	138	2968	4.6
1971	1042	1426	—	185	2653	7.0
1972	40	598	1	63	702	9.1
1973	1	—	10	1265	1276	99.9
1974	—	2	552	4496	5050	100.0
1975	—	—	1827	1530	3357	100.0

during July and August and the high peak between November and December were not observed during the eltor epidemics (13). This type of seasonal variation has continued in Dhaka city even after 1974 and 1975.

Within the municipal areas the incidence of hospitalized cholera cases was 1.73 per 1000 population in 1974 and 1.37 in 1975, except in Ramna district where the rate was reduced from 1.75 in 1974 to 0.88 in 1975, and in Mohammadpur district from 1.37 in 1974 to 0.81 in 1975. This significant reduction ($P < 0.001$) occurred after the demolition of most of the slums in these districts. There were no cholera cases, however, in both these years among persons from the higher socioeconomic groups who were living in houses with a clean water supply and sewage systems.

A total of 993 cholera cases occurred in children under 5 years old in 1974 and 1975. Table 2 shows the distribution of cholera cases by age (single years till 4) per 1000 population. For infants under the age of one year, the incidence rate per 1000 was 1.16 in 1974 and 0.93 in 1975. The rates in children aged 1 year were 1.95 and 1.75 respectively for 1974 and 1975, and they then increased with increase in age.

The distribution of hospitalized eltor cholera cases (rate per 10 000 population) for 1974 and 1975 is shown for males and females and for all ages in Fig. 2. The pattern of distribution was similar in both years, during which a total of 4131 cholera cases from the Dhaka municipal areas were treated. In children aged 14 years and under, the rate for males was higher than that for females ($P < 0.05$). Between the ages of 15 and 44 years, females had a much higher rate of cholera than males ($P < 0.001$). This type of distribution by age and sex, was found with classical cholera also. Nearly 49% of all the cases occurred in

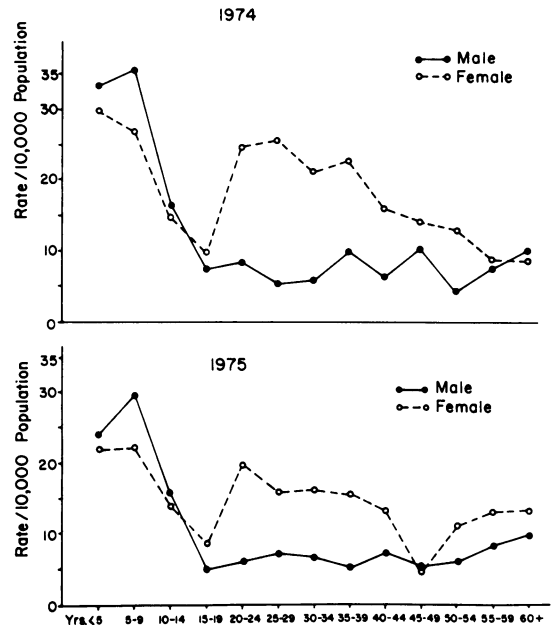


Fig. 2. Rate of hospitalized cholera cases per 10 000 population, by age group and sex, during 1974 and 1975.

children up to the age of 9 years and the highest rate was in children 5-9 years old.

The case-control studies showed the extent to which the contacts of cholera patients and of control subjects had diarrhoea (Table 3). In both 1974 and 1975, there were higher rates of diarrhoea and hospitalization among the contacts of cholera cases, which might explain the occurrence of multiple cases in cholera-affected families. The differences of the rates of diarrhoea and hospitalization between contacts of cholera patients and of control subjects were highly significant ($P < 0.001$) in both years.

Table 2. Cholera in children in Dhaka city, 1974-75^a

Age (years)	1974		1975	
	Cases	Rate/1000	Cases	Rate/1000
0	35	1.16	28	0.93
1	69	1.95	62	1.75
2	107	2.75	113	2.90
3	166	3.66	113	2.49
4	179	4.33	121	2.93
≥ 5	1750	0.91	1389	0.72
Total	2305	1.73	1826	1.37

^a Population by single years was estimated from the percentage of Dhaka district urban population.

Table 3. The eltor cholera epidemic in 1974 and 1975, showing diarrhoea occurring among family contacts of cases and controls

	No. of families	No. of members	No. of diarrhoea cases	No. of hospitalized cases
1974: cases	203	1388	214	69
controls	203	1301	81	0
1975: cases	168	1149	70	24
controls	168	1077	20	3

The effect of eating in places away from home by cholera cases, within 5 days of the onset of illness, and by matched controls is shown in Table 4. There were 203 paired samples for this purpose in 1974. Those who ate away from home contracted cholera significantly more often ($\chi^2 = 44.3$, $P < 0.001$). In all age groups, the relative risks were high and the differences between those who ate and did not eat in places outside the home were statistically significant, except for persons in the 0-4-year age group who do not usually go to restaurants or food stalls for meals.

Table 4. Matched pair analysis of cases and matched controls, by history of eating in places outside the home during the 5 days prior to the onset of cholera in 1974

	Cases		
	Ate out	Did not eat out	Total
Controls: ate out	7	11	18
did not eat out	73	112	185
Total	80	123	203

The effect of eating out by cholera cases and healthy controls from the same neighbourhood in 1975 is shown in Table 5. Here too, the frequency of eating away from home by cases was significantly higher than among the controls ($P < 0.01$).

The types of eating places frequented by cholera cases and controls outside their homes are shown in Table 6. Overall, 52.3% of cases and 29.6% of controls ate away from home. In instances of charity feeding, or meals taken at roadside food stalls or with families where there was a case of diarrhoea (which

Table 5. Matched pair analysis of cases and matched controls, by history of eating in places outside the home during the 5 days prior to the onset of cholera in 1975

	Cases		
	Ate out	Did not eat out	Total
Controls: ate out	113	55	168
did not eat out	92	76	168
Total	205	131	336

might have been cholera), the differences compared with the controls were quite significant. Eating at charitable feeding centres was significantly associated with contracting cholera ($P < 0.001$).

DISCUSSION

This study reports the displacement of classical *Vibrio cholerae* by the eltor biotype in Dhaka. Although the classical biotype had disappeared earlier from other countries, it was still predominant (91%) in Dhaka until 1972.

The epidemiology of eltor cholera differs in some respects from that of classical cholera. The peak incidence of eltor cholera, for example, has been reported to occur over one month earlier than classical cholera (2, 3). Though the peaks of eltor epidemics in the present study were still close to those of classical cholera (in October/November) in Dhaka, small peaks in April/May during the monsoon were noted during the eltor outbreaks. Other workers (16) reported a concentration of classical cholera cases in small urban communities, but the present study shows that eltor cholera was widespread in the urban areas of Dhaka in 1974 and 1975. Those in the highest socioeconomic groups were, however, always spared.

The decrease in attack rates in Ramna and Mohamadpur zones during 1975 was probably due to demolition of most of the slums and open latrines, as a result of which a part of the population at risk was reduced.

Many authors have found that cholera was a disease of young adult males (19). The findings reported here and also in our previous studies (14, 20, 21), however, show that cholera in Dhaka is mainly a disease of children up to the age of 9 years (49% of all cases). In 1974 and 1975, the rates in infants (under 1 year) were 67% of the average, and in children aged 1-4 years they were much higher than the total case rates. This shows the high susceptibility of infants and young children to cholera. We are not sure, however, whether the higher rates in children are related to low vibriocidal titres (22), or frequent exposure to infected surface water while playing. Although adult females in Bangladesh usually avoid having to go to hospital, the rate per 1000 population of hospitalized female cases (aged 15-44 years) was higher (34.9) than the rate for adult males (13.3; $P = < 0.001$). The higher incidence among women may be because they usually nurse and clean the sick and launder their soiled clothes, and also wash the faeces from children after defecation.

The occurrence of diarrhoea was more frequent among persons who had contacts with cholera cases (within 5 days of hospitalization of the index case)

Table 6. Types of eating places outside the home that were frequented by cholera cases and controls, 1974-75

Eating places	Cholera cases		Controls		χ^2	P values
	Ate out (No.)	Ate out (%)	Ate out (No.)	Ate out (%)		
Ordinary restaurants	46	12.4	37	10.0	0.9	> 0.5
Charitable feeding centres	33	8.9	3	0.8	24.5	< 0.001
Roadside hawkers	85	22.9	59	15.9	4.9	< 0.05
Relatives' houses	17	4.6	8	2.1	2.6	< 0.10
Family with a cholera/diarrhoea case	13	3.5	3	0.8	5.2	< 0.01
Total: ate out	194	52.3	110	29.6	38.4	< 0.001
Total: did not eat out	177	47.7	261	70.4		

than among non-cholera controls. Many of these diarrhoea cases could have been cholera, multiple cases of cholera in some families being the result of contamination of food or water.

During 1974 and 1975, free meals were distributed by both voluntary and government agencies from special feeding centres (23, 24). As the price of food in Dhaka was high, thousands of people depended on these charitable feeding centres. The association between consumption of these meals and contracting cholera might be due to unhygienic preparation and handling of food or contamination of the cooked food or drink with *Vibrio cholerae* during prolonged storage before serving. The attack rate was higher for adult males who ate these meals than for adult females, but exactly how many (of all who ate)

contracted cholera could not be ascertained. This finding was consistent in both years.

It is a custom for people in Bangladesh to drink a glass of water after every meal or snack, but in our studies it was not possible to ascertain whether it was the food or the water that was the vehicle of transmission of *Vibrio cholerae*. It is suspected that multiplication of *Vibrio cholerae* can take place in either food or water before consumption.

Several factors may be responsible for the spread of urban cholera. This study has shown that eating away from home during floods or in a food crisis, especially in places where free meals were served, was an important determinant of the cholera epidemics in Dhaka in 1974 and 1975.

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RÉSUMÉ

ÉPIDÉMIE DE CHOLÉRA ELTOR À DHAKA EN 1974-1975

Tous les cas de choléra classique étaient remplacés en 1974 par des cas de choléra eltor et c'est en 1974 que s'est produite la plus grande épidémie de choléra eltor.

Bien que plusieurs études aient été faites, peu de facteurs spécifiques intéressant la transmission du choléra urbain avaient été définis. Au cours de cette première épidémie de

choléra eltor en 1974, nous avons donc cherché 1) à caractériser l'épidémiologie de l'épidémie de choléra eltor dans la ville de Dhaka et 2) à faire une étude avec témoins appariés en nous servant des cas hospitalisés de diarrhée cholérique ou non cholérique pour dégager les facteurs de transmission du choléra. En 1975, nous avons recherché quels types d'aliments avaient été consommés et dans quels genres d'établissements par les malades et par les témoins sains.

Les patients étudiés étaient tous des cas pris au laboratoire de recherche sur le choléra (ICDDR,B). Nous avons pris comme dénominateur la population urbaine recensée à Dhaka en 1974. L'épidémie de choléra eltor a été caractérisée sur la base d'une analyse de tous les cas hospitalisés à Dhaka en 1974 et 1975. Des échantillons de selles ou des frottis rectaux ont été mis en culture sur milieu Monsur et bouillon bilité peptoné. Au total, 203 cas de choléra et 203 témoins appariés ont été étudiés en 1974 et, en 1975, 168 cas de choléra et 168 témoins sains du voisinage.

Les données concernant les années 1970 à 1973 font apparaître un passage du choléra Inaba classique au choléra Ogawa classique, puis au choléra Ogawa eltor. Pour la période classique, l'incidence accusait un pic important

après la mousson. La saison de la mousson ne s'accompagnait pas de choléra classique. Le choléra eltor, par contre, a continué pendant la mousson et son incidence pendant la période post-mousson atteignait son maximum environ six semaines avant les pics de choléra classique. L'incidence des cas hospitalisés, pour 1000 habitants, était de 1,73 en 1974 et de 1,37 en 1975. Les taux étaient nettement plus bas en 1975 dans les districts de Ramna et de Mohammadpur après la destruction des camps de réfugiés. Les cas nouveaux étaient largement disséminés dans la ville à l'exception des quartiers disposant d'installations sanitaires modernes, qui étaient épargnés. Les incidences les plus fortes étaient observées chez les enfants et les femmes adultes.

Il y a eu de multiples cas de diarrhée parmi les contacts des cas de choléra mais peu parmi les contacts des diarrhéiques témoins. Les risques de contracter le choléra étaient nettement plus élevés parmi les gens qui avaient mangé hors de chez eux. La consommation d'aliments à des éventaires extérieurs et plus particulièrement dans des centres caritatifs s'accompagnait d'un risque accru de contracter le choléra.

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