Epidemiology of shigellosis in Teknaf, a coastal area of Bangladesh: a 10-year survey

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SUMMARY

The epidemiological data on shigellosis in Teknaf, a coastal area of Bangladesh, were reviewed for a 10-year period (1975–84). Certain similarities and differences were observed in the epidemiology of the disease in Teknaf when compared with urban Dhaka and rural Matlab. Similarities included: round-the-year infection with two peaks, one in the monsoon period and the other in the winter period; high male to female attendance ratio at the treatment centre; the predominance of infection in the under-15-year age group; high mortality rate in the under-5-year age group of both sexes and in females of all age groups; the multiple drug resistance of organisms. Differences included the higher isolation rate of organisms in Teknaf (42·1 % as against 11–12 % in Dhaka and Matlab) and the preponderance of *Shigella dysenteriae* 1 infection in females in Teknaf. The unusually high isolation rate of shigella makes Teknaf the area with the highest incidence of shigellosis in Bangladesh.

INTRODUCTION

Shigellosis is a disease which is recognized as a global problem [1–3] with high morbidity and mortality, particularly in developing countries [4]. It is highly endemic in Bangladesh, and occasionally flares into epidemics [5]. The epidemiology of shigellosis in urban Dhaka and rural Matlab in Bangladesh has previously been reported [6,7]. Teknaf, a coastal town 500 km south-east of Dhaka is recognized as a hyperendemic region for shigellosis [8]. In this paper the epidemiology of shigellosis in Teknaf between 1975 and 1984 has been compared with that in Dhaka and Matlab in order to determine intracountry variation in the epidemiology of the disease.

MATERIALS AND METHODS

Study area and population

Following a severe outbreak of dysentery due to *Shigella dysenteriae* type 1 in St Martin Island in 1973 in the Bay of Bengal near Teknaf [9], the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B) established a small diarrhoeal treatment centre (DTC) with microbiological facilities at Teknaf. The population of Teknaf was approximately 75000 in whom the observations
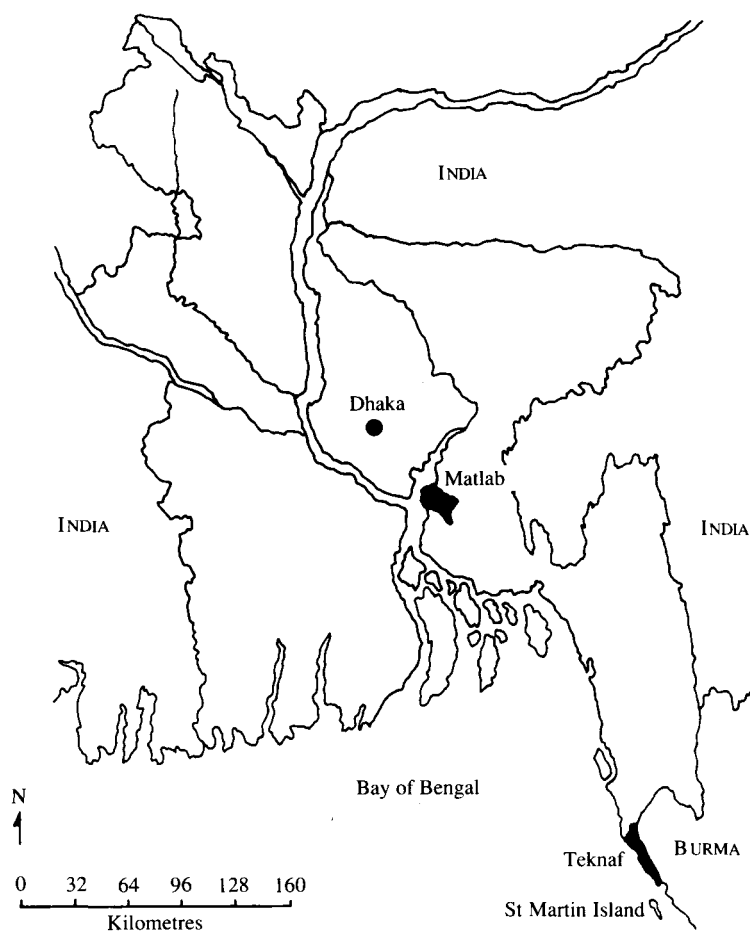
Fig. 1. Geographical locations of Teknaf. Matlab and Dhaka.

were made. Approximately 5000 people received medical treatment at the Centre annually. The study area is flanked by the Naf river bordering Burma in the east and the Bay of Bengal in the southwest (Fig. 1), and is about 40 km long and 5 km wide with mostly hilly deep forest area. Movement within the villages depends on muddy roads and by boats through the Naf river or sea, although an 80 km road was opened between Teknaf and Cox's Bazar in 1974. The villagers live in the coastal area and are mostly extremely conservative Muslims with poor hygienic practices.

Laboratory methods

Faecal specimens or rectal swabs from patients attending the DTC were examined by direct microscopy and cultured for enteric pathogens by standard methods [10]. Colonies resembling *Shigella* spp. on MacConkey agar and Salmonella–Shigella agar were screened biochemically and typed using commercially available antisera (Wellcome Laboratories, England). Every isolate of *S. dysenteriae* 1 and every tenth isolate of *S. flexneri* was tested for sensitivity to

sulphathiazole, streptomycin, tetracycline, chloramphenicol, ampicillin and co-trimoxazole by the disk diffusion method of Bauer and colleagues [11] using commercial disks (BBL).

Death record

Death records due to confirmed shigellosis were obtained from Teknaf DTC; notification of deaths in the community due to symptomatic bacillary dysentery was taken from the Demographic Surveillance System (DSS) records maintained at Teknaf by ICDDR,B since 1976. DSS records describing events preceding death were reviewed for analysis.

Statistical method

Comparison of data were made by chi-square test.

RESULTS

Culture

The isolation rate of *Shigella* spp. from all diarrhoeal cases seeking treatment at the DTC between 1975 and 1984 is shown in Fig. 2 and varied between 19·3 % for 1976 and 42·12 % for 1984. The distribution of shigella serogroups is presented in Fig. 3. *S. flexneri* was the dominant species from 1975 to 1983 and accounted for between 73·5 and 90·5 % of all shigella isolates. In 1984; *S. dysenteriae* 1 surpassed *S. flexneri* (56·6 *v.* 36·1 %). There was also a small peak in the isolation of *S. dysenteriae* 1 in 1979. The isolation rates of *S. sonnei* and *S. boydii* were negligible.

Seasonality

The seasonality of shigella infection for the study period is shown in Fig. 4. Distinct peaks were observed in July–August in all years, followed by smaller peaks in November–December.

Age and sex distribution

Age- and sex-specific morbidity from all shigellae in Teknaf for 1984 is shown in Fig. 5. This was in general higher for females of all age groups than for males, except for the age group 5–9 years; the differences were statistically significant for the 15–44-year-age group ($P < 0.02$) and females as a whole ($P < 0.008$).

Age- and sex-specific morbidity in relation to *S. dysenteriae* 1 and *S. flexneri* is given in Table 1. The infection rate with *S. dysenteriae* 1 of both males and females was high. The infection rate for females was significantly higher than that for males ($P < 0.001$), and for the age categories of 1–4 years and 15–44 years. The differences in infection rate between females and males were statistically significant ($P < 0.001$ and 0.05 respectively). The proportion of males and females in all age groups infected with *S. flexneri* was similar. In all age groups, the attendance rate at the DTC for males was higher than that for females (65·5 compared to 34·5 %).
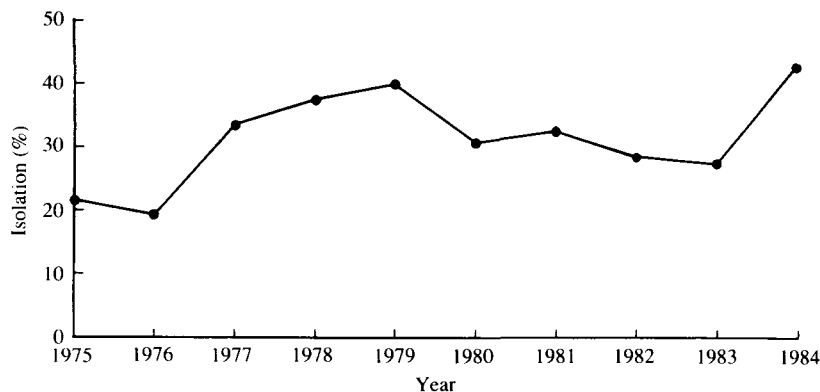
Fig. 2. Isolation of shigellae from all diarrhoeal cases seen at the treatment Centre in Taknaf by year.
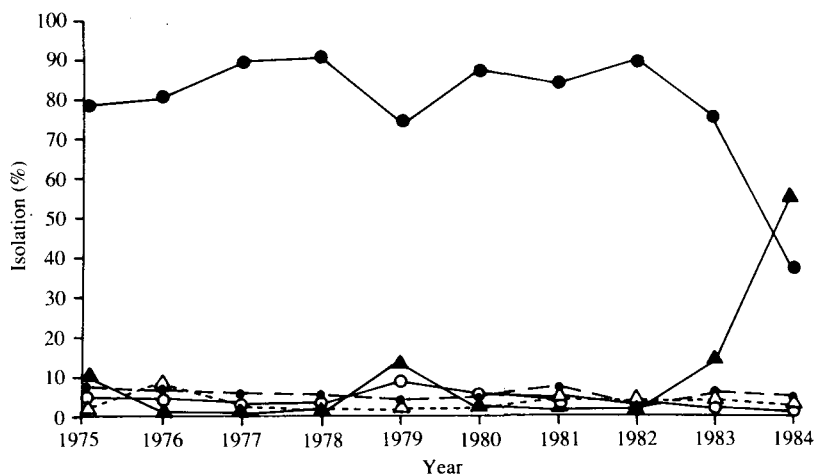

Fig. 3. Distribution of *Shigella* species in relation to one another in Teknaf by year. ▲—▲, *S. dysenteriae* 1; △---△, *S. dysenteriae* (2–10); ●—●, *S. flexineri*; ○—○, *S. boydii*; ●- - -●, *S. sonnei*.

Susceptibility to antimicrobial agents

Sensitivity patterns of *S. dysenteriae* 1 and *S. flexneri* isolates for 1976, 1980 and 1984 are shown in Table 2. In 1980, 100 % of *S. dysenteriae* 1 strains were sensitive to co-trimoxazole, but in 1984 almost all strains were resistant to this drug and approximately 19 % of strains had acquired resistance to ampicillin. The sensitivity pattern of *S. flexneri* to co-trimoxazole for 1980 was not available but in 1984, the majority of strains of this serotype were sensitive to this drug. Between 1980 and 1984, there was a 10 % increase in resistance of *S. flexneri* to ampicillin. There was also a dramatic increase in resistance to chloramphenicol (> 35 %) between 1980 and 1984 in both species.

Mortality trend

Mortality trends for the community as a whole from 1977 to 1984 due to dysentery are shown in Fig. 6. The crude death rate was around 3·4 per 10000
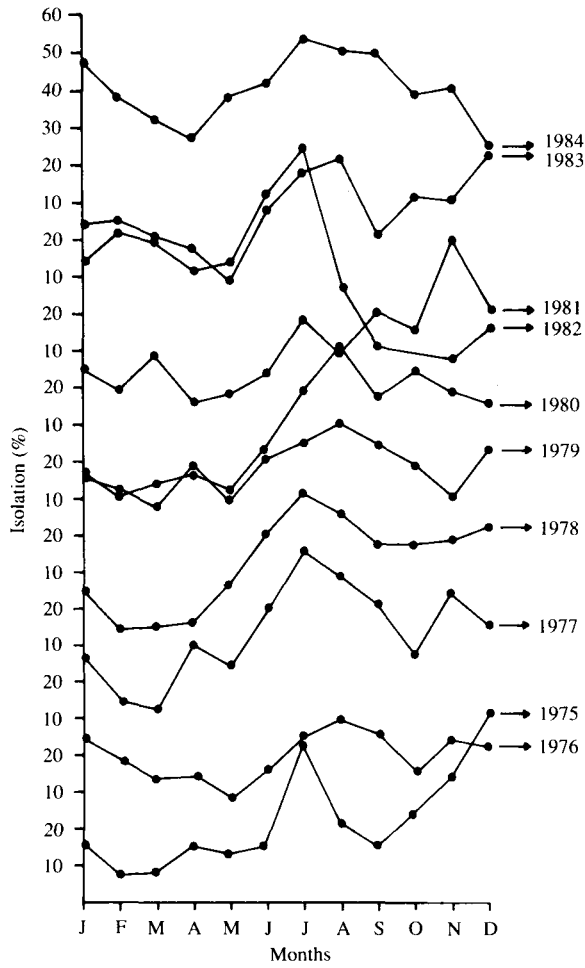
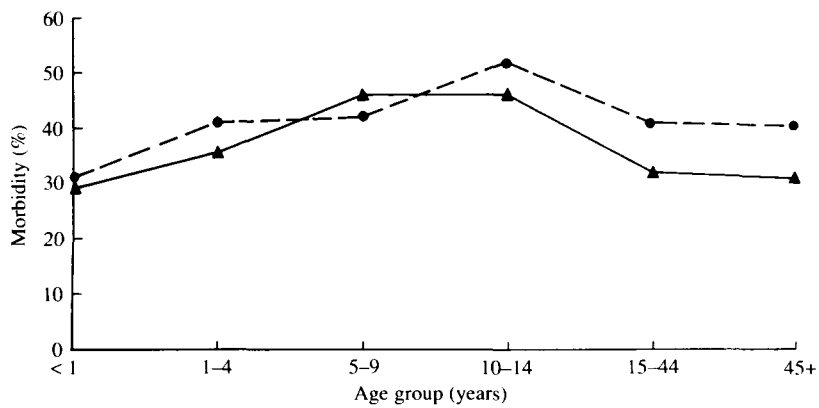Fig. 4. Seasonal variation of shigellae in Teknaf by month and year.

Fig. 5. Age- and sex-specific morbidity due to shigellae in hospitalized patients in Teknaf treatment Centre in 1984. ▲—▲. male; ●---●. female.

Table 1. *Age- and sex-specific morbidity due to* S. dysenteriae 1 *and* S. flexneri *in Teknaf*

Age (years)	Male			Female		
	No. studied	No. (%) infected with		No. studied	No. (%) infected with	
		S. dyst. 1*	S. flexneri		S. dyst. 1	S. flexneri
< 1	90	9 (10)	17 (18·9)	72	11 (15·3)	12 (16·7)
1–4	428	90 (21)	63 (14·7)	312	89 (28·5)	43 (13·8)
5–9	268	93 (34·7)	32 (11·9)	134	50 (37·3)	10 (7·5)
10–14	132	46 (34·8)	15 (11·4)	54	24 (44·4)	5 (9·3)
15–44	540	93 (17·2)	92 (17)	231	54 (23·4)	45 (19·5)
⩾ 45	171	25 (14·6)	30 (17·5)	56	9 (16·1)	14 (25)
Total	1629	356 (21·9)	249 (15·3)	859	237 (27·6)	129 (15)

* *S. dysenteriae* type 1.

Table 2. *Antibiogram of shigellae tested in 1976, 1980 and 1984*

Shigella species	Antibiotics tested	No. tested and percent sensitive					
		1976		1980		1984	
		No. tested	%	No. tested	%	No. tested	%
S. dysenteriae 1	Sulphathiazole	—	—	18	0	334	0·9
	Streptomycin	5	0	18	11·1	334	2·7
	Tetracycline	5	0	18	11·1	334	1·2
	Chloramphenicol	—	—	18	55·5	334	4·2
	Co-trimoxazole	—	—	18	100	334	6·9
	Ampicillin	5	100	18	100	334	81·7
S. flexneri	Sulphathiazole	50	14	80	6·3	38	2·6
	Streptomycin	50	12	80	6·3	38	15·8
	Tetracycline	50	16	80	11·3	38	13·2
	Chloramphenicol	50	88	80	100	38	63·2
	Co-trimoxazole	—	—	—	—	38	71·1
	Ampicillin	50	82	80	95	38	84·7

* %, percentage of strains sensitive to the respective antimicrobial drugs.

Table 3. *Case-fatality rates due to shigellae by age and sex in Teknaf in 1984*

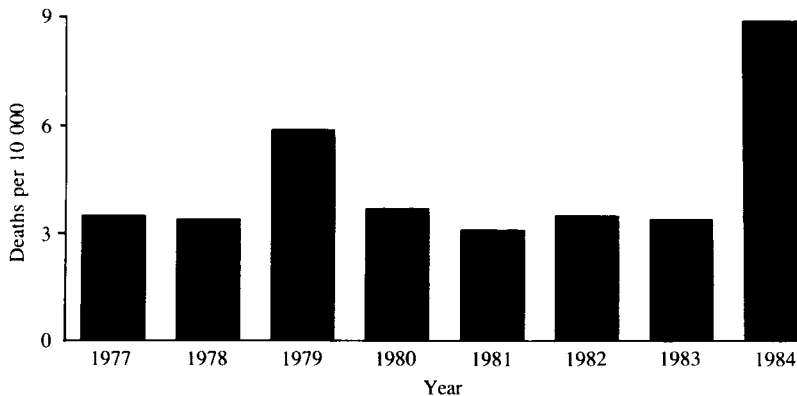| Age (years)	Shigella positive admitted cases		Deaths		% of all male deaths	% of all female deaths
	Male	Female	Male	Female		
< 1	26	23	4	7	26·7	38·9
1–4	153	132	6	9	40	50
5–9	125	60	0	2	0	11·1
10–14	61	29	1	0	6·7	0
15–44	185	99	1	0	6·7	0
⩾ 45	55	23	3	0	20	0
Total	605	366	15 (2·5)	18 (4·9)	100	100

Fig. 6. Mortality due to dysentery by year in Teknaf community.

people in all years except 1979 and 1984, when it rose to 5·9 and 9 per 10000 people respectively. Age- and sex-specific death rates in 1984 for the hospitalized patients are shown in Table 3. The death rate was highest in the under-5-year-old group. Females under 10 years had higher mortality than males. In the above-10-year age group, deaths in males were recorded but there were no deaths in females.

DISCUSSION

Similarities and differences were observed in the epidemiology of shigellosis among urban Dhaka, rural Matlab and coastal Teknaf. In Dhaka and Matlab, *S. flexneri* was the predominant shigella pathogen from 1969 to 1972 and from 1974–1983; in 1973 and 1984, *S. dysenteriae* 1 predominated [6, 7]. A similar pattern was obtained for Teknaf, where *S. flexneri* predominated from 1975 to 1983 but in 1984, the isolation rate of *S. dysenteriae* 1 exceeded that of *S. flexneri*. The predominance of *S. dysenteriae* 1 in Teknaf in 1984 might be indicative of an epidemic of *S. dysenteriae* 1, perhaps encompassing the entire country, as a similar increase was also reported in Dhaka and Matlab. The isolation rate of shigellae in Matlab and Dhaka had varied between 11 and 12 % [6, 7] but was between 19·3 and 42·1 % for Teknaf (Fig. 2). This isolation rate makes Teknaf the area of the highest prevalence of shigellosis in Bangladesh. The unusually high isolation rate may reflect a high prevalence of shigellosis in the community or may be due to the selective reporting of patients presenting for treatment with watery diarrhoea and dysentery at the three centres: in this respect, the Dhaka and Matlab centres were initially established for acute watery diarrhoea (cholera), whereas the Teknaf centre was established following a severe epidemic of shigellosis in the nearby St Martin Island in the Bay of Bengal in 1973 [8]. Another reason could be the poor accessibility of the Teknaf DTC which would limit the number of patients to those severely ill with dysentery.

Shigellosis is reported throughout the year in Bangladesh, although two peaks have been observed in Dhaka covering the premonsoon period of April to May and the winter period of November to January [6]. Two peaks have been reported in Matlab [7], although the first peak coincides with the middle of the monsoon (June

to September). Results presented here indicate that the seasonal distribution of shigellosis in Teknaf is similar to that in Matlab. Since open-air defaecation is the norm, the peak incidence in the monsoon season might be due to faecal pollution of drinking-water sources. The second peak in the winter season might be due to concentration of pathogens in the receding water level [6].

Age- and sex-specific morbidity due to shigellae suggested that children under 15 years of age were the most susceptible. This is consistent with earlier results obtained from Dhaka [6] and Matlab [7]. The highest incidence of shigellosis in children is attributed to their poor resistance, lack of previous exposure, poor hygiene and higher exposure to a contaminated environment, possibly due to their play-related activities. In studies in Matlab and Dhaka, the isolation rates of both S. dysenteriae 1 and S. flexneri were higher in males than in females [6, 7]. In Teknaf, this trend was found only with S. flexneri in children under the age of 15 years; with S. dysenteriae 1, for all age groups, the isolation rate was higher in females. With regard to S. dysenteriae 1 isolation in Teknaf, the reversal of sex ratio could be due to only females with relatively severe symptoms seeking treatment. The higher male attendance for treatment in Teknaf is consistent with that observed in studies in Dhaka and Matlab and is probably a reflection of the society's greater concern for the health of males.

Analysis of antibiotic resistance patterns showed that S. dysenteriae 1 but not S. flexneri had developed a high incidence of resistance to co-trimoxazole. This resistance, which was also observed in Dhaka and Matlab, is thought to be due to widespread use of this drug because of its lower cost, long shelf-life and long action [12].

Mortality trends in the community for 1979 and 1984 corresponded with increased shigella isolation, particularly of S. dysenteriae 1. Surprisingly, in 1983 the mortality trend was lower than expected and the possibility of under-reporting of deaths cannot be ruled out. Age and sex patterns of fatalities among hospitalized patients in 1984 showed that children under 5 years old and females were the most vulnerable groups; the death rate was also higher in female children than in males. The former finding is similar to that reported for Dhaka but the latter is at variance, since the death rate in Dhaka was equal in both sexes [6]. The higher death rate in children may be related to malnutrition and poor resistance and in females, may be due to the late reporting of severe cases and the inadequate care dispensed by family members [13]. The high isolation rate and high death rate observed in 1979 might be due to a refugee influx from neighbouring Burma, since it has been reported that an unsettled population suffers from severe shigellosis [5, 6]. The high isolation rate and high death rate of 1984 might be due to the introduction of a new multiresistant strain into the community or an existing strain finding a favourable environment for an outbreak.

Future studies should be aimed at discovering the true prevalence of infection in the community in order to rule out the selection bias, if any, of dysentery cases in the Teknaf DTC. Factors responsible for the unusually high rate of shigellosis could then be investigated.

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