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PATTERN OF DIARRHOEAL DEATHS DURING 1966 - 1987 IN A DEMOGRAPHIC SURVEILLANCE AREA IN RURAL BANGLADESH

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Abstract

Death pattern was analysed in relation to age, sex, seasonality and yearly variation during 1966 - 1987 in Matlab upazila of Chandpur district, Bangladesh. The overall death rate due to diarrhoeal diseases and other causes fluctuated during the period. Diarrhoeal death rate varied between 2.0 and 4.0 per 1,000 population except during the war and famine periods of 1971 and 1974 - 1975 respectively when it was two times higher over the preceding period of five years' average. On an average, more than 20% of all deaths appeared to be related to diarrhoea. The relative importance of diarrhoea as the cause of death did not diminish over time. Persistent diarrhoea caused more deaths than acute diarrhoea. At all times the highest diarrhoeal mortality rate was shown in children aged 1 - 4 years, specially in girls. Women aged under 20 years had a higher rate of diarrhoeal deaths than the men of similar age. November was the peak month of diarrhoeal deaths in this rural area. Introduction of the Maternity, Child Health - Family Planning (MCH - FP) services had significant impact of reducing diarrhoeal deaths as well as deaths from other causes.

Key words: Data interpretation, statistical; Diarrhoea; Mortality.

Introduction

Knowledge of age, sex, seasonality and causes of death is essential for planning health services. In Bangladesh, there have been only a few studies with limited scope to achieve this kind of knowledge. Using data collected for the period of 1975 - 1977 from the Matlab Demographic Surveillance System (DSS) conducted by the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B), Chen found that diarrhoea was the most frequent cause of death in children aged under five years (1). The other causes of death in descending order were: tetanus, measles, fever, and respiratory infections. Using preceding three years' data from the same area, Becker found that the diarrhoeal death has a significant seasonal pattern with its peak occurrence in December (2).

The purpose of this analysis is to examine the pattern of diarrhoeal and other deaths in relation to age, sex, seasonality and yearly variation in Matlab, a rural area of Bangladesh, during the 22 years beginning at 1966 when more detailed information was available on diarrhoeal deaths than was previously the case.

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Materials and methods

Since 1963, the ICDDR,B has been conducting research programmes mainly on diarrhoeal diseases and has been providing limited health services in Matlab upazila of Chandpur district, Bangladesh. The Demographic Surveillance System (DSS) is one of the components of these field programmes. Since 1966, it has been recording births, deaths and migrations of people, in addition to periodic censuses. In 1975, the data collection was extended to include events of marriage and divorce in the study population. In late 1977, a Family Planning Health Services Project (FPHSP), and Family Welfare Centres were established over half of the DSS area - 'the intervention area', the other half

being the comparison area'. The FPHSP was a village-based programme which provided family planning, health education and distribution of drugs for minor ailments. The programme has been described in details elsewhere (3). The Welfare Centres provided treatment of diarrhoeal diseases in children aged under 5 years. Since early 1979, packets of oral rehydration salts have been distributed free of cost to the people of both the areas. The people of the intervention area were also trained to prepare home-made rehydration solution using common salt and brown sugar (*labon-gur*) for the treatment of diarrhoea. In addition to the diarrhoea treatment centre of the Matlab Field Station Hospital, three sub-centres were established - one in 1978 and the other two in 1982. The services of Matlab diarrhoea treatment centres were equally available to the people of both the areas. In 1978, the area was reduced comprising 149 villages and the total population covered by the surveillance system was estimated to be 174,860. Since 1982, the Maternal & Child Health and Family Planning (MCH-FP) programme (3) was introduced in 70 villages, and the remaining villages were treated as the 'comparison area' as was done earlier.

At the village level of the DSS, a female Community Health Worker (CHW), previously designated as Field Worker (FW), visits each household once a fortnight in the MCH-FP area and once a week in the comparison area (this system has been in use from the inception of MCH-FP since late 1977) to record the vital events mentioned earlier. Her work is checked by an experienced male Health Assistant (HA) who visits each household monthly. He accompanies the CHW during the visit and records the vital events on standard registration forms. The Health Assistants have achieved on-the-job experience in demographic data collection, and a number of them have paramedical training and diplomas from a government paramedical institution. They have practical experience in the diagnosis of diarrhoeal diseases and a limited number of commonly encountered infectious diseases. Further details of the data collection system of the DSS have been described elsewhere (4,5).

The data on death due to diarrhoeal and other diseases were collected from mothers or close relatives of deceased persons using retrospective open-ended interview carried out by the Community Health Workers. Diarrhoeal diseases were classified as acute and persistent. Initially, an acute diarrhoea was defined if an individual suffered from diarrhoea or dysentery for less than four weeks: since 1984 this time limit was set at two weeks. If the diarrhoea or dysentery (passage of mucoid or bloody-mucoid stools) was prolonged on most of the days for two weeks or more before deaths, the disease was identified as persistent diarrhoea. In this data analysis, acute diarrhoea and dysentery were combined, and similarly, persistent diarrhoea and dysentery were also combined.

Results

Figure 1 shows the number of deaths per 1,000 population from diarrhoeal diseases and from other causes during the 22 years from 1966 to 1987 (hereafter, this duration will not be repeated in describing other portions of the results). The diarrhoeal death rates ranged between 2-4 per 1,000 with major peaks in 1971, the year of the Liberation War leading to the emergence of Bangladesh from Pakistan, and in 1974-1975, the years of famine. Diarrhoeal deaths declined progressively from 1976 up to 1981 with a third peak observed in 1984 followed by a sharp decline in 1986. This variable pattern, however, was not found in the death rates due to other causes, except a mild decline during recent years.

Table 1 shows diarrhoeal and other causes of deaths per 1,000 population by consecutive five-year periods and by gender differences. When acute and persistent diarrhoeal diseases were combined, girls and women were shown to die at a rate significantly higher than that of the boys and men in all the successive periods throughout the 22 years. This difference was most marked during 1981-1985. Similar finding was observed in case of persistent diarrhoea, the difference being least pronounced during 1976-1980. Also, deaths from persistent diarrhoea exceeded those from acute diarrhoea in both male and female persons. During the war and famine period of 1971-1975, the diarrhoeal death rate was 200% higher than the preceding period of 1966-1970, while the death rates due to other causes changed only slightly.

Figure 2a shows male diarrhoeal death rates in different age groups. The infant death rates particularly showed marked year-to-year variation. The rise in death rates due to the 1971 War of Liberation occurred during the same year in all age groups, whereas the rise in death rates due to the famine of 1974

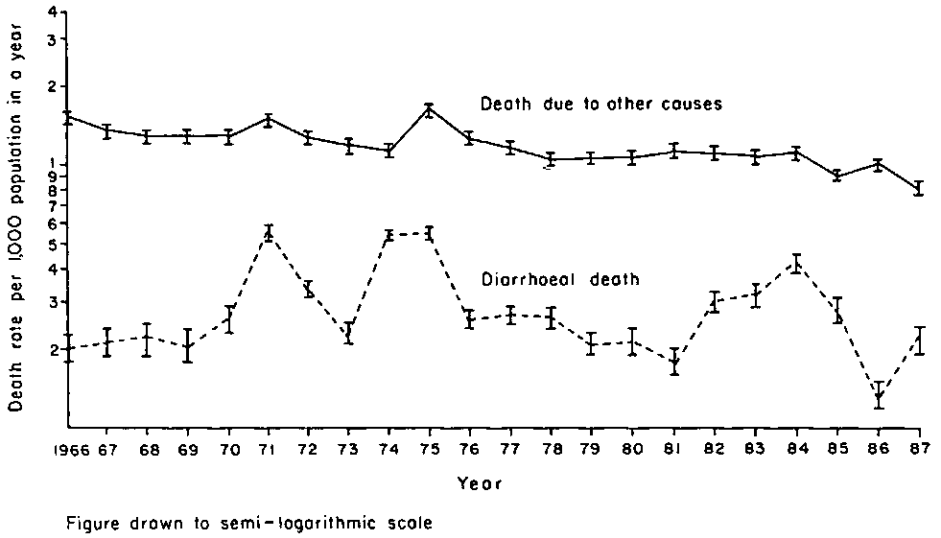

Fig. 1 – Deaths due to diarrhoea and other causes, 1966–1987 (rate per 1,000 population in a year).

TABLE I – DIARRHOEAL AND OTHER CAUSES OF DEATHS PER 1,000 POPULATION BY CONSECUTIVE FIVE-YEAR PERIODS AND BY GENDER DIFFERENCES DURING 1966–1987 IN THE DEMOGRAPHIC SURVEILLANCE SYSTEM AREA IN MATLAB, BANGLADESH (the last column gives two years' data)

Causes of death	1966–1970			1971–1975			1976–1980			1981–1985			1986–1987		
	M	F	All	M	F	All	M	F	All	M	F	All	M	F	All
Diarrhoea	2.1**	2.4**	2.2	4.3*	4.7*	4.5	2.4**	2.6**	2.5	2.7*	3.5*	3.1	1.5*	2.0*	1.8
Acute diarrhoea	0.2	0.2	0.2	0.7	0.7	0.7	0.2	0.3	0.3	0.7	0.9	0.8	0.6	0.8	0.7
Persistent diarrhoea	1.9	2.2	2.0	3.6	4.0	3.8	2.1	2.3	2.2	2.0	2.6	2.3	0.9	1.2	1.0
Other causes	13.0	13.5	13.3	13.3	13.7	13.5	11.4	11.9	11.7	10.6	10.7	10.7	9.2	8.6	8.9
Diarrhoeal death as a per cent of all deaths	13.9	15.1	14.5	24.3	25.4	24.9	17.2	17.9	17.6	20.4	24.6	22.5	14.1	19.0	16.5

The level of significance of the differences between the male and female deaths:
* $p<0.01$; ** $p<0.05$ (based on X^2 test with one degree of freedom)

was abrupt and very high during the same year for the infants, but the rise was manifested one year later for the other age groups.

Figure 2b shows the female diarrhoeal deaths in different age groups. The female death rates showed almost the same patterns as the male death rates. Maximum mortality

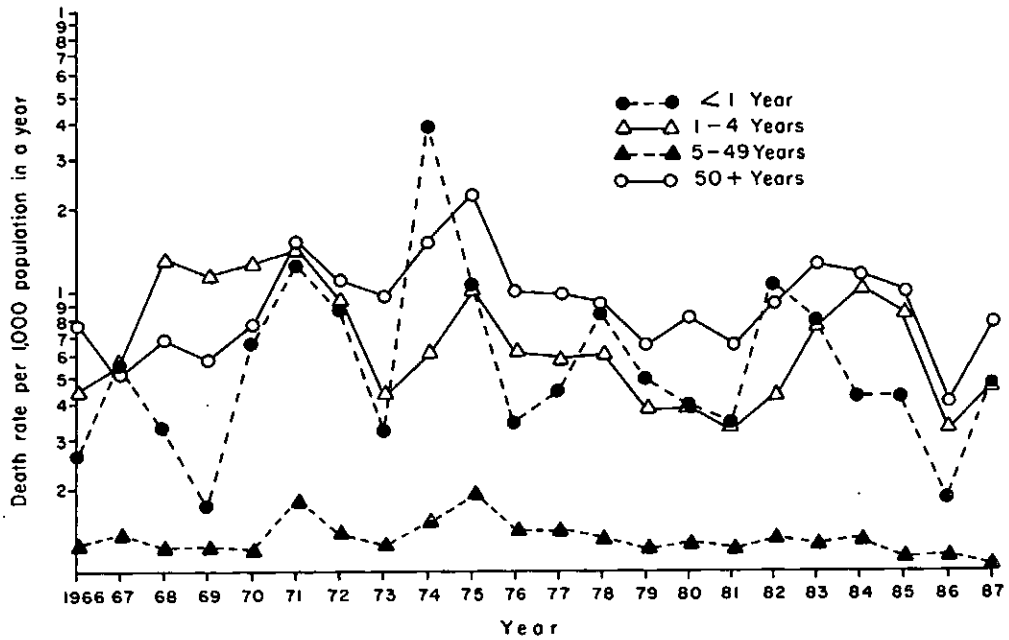

Fig. 2a – Yearly variations of diarrhoeal death rates in male, 1966 - 1987 (rate per 1,000 population in a year).

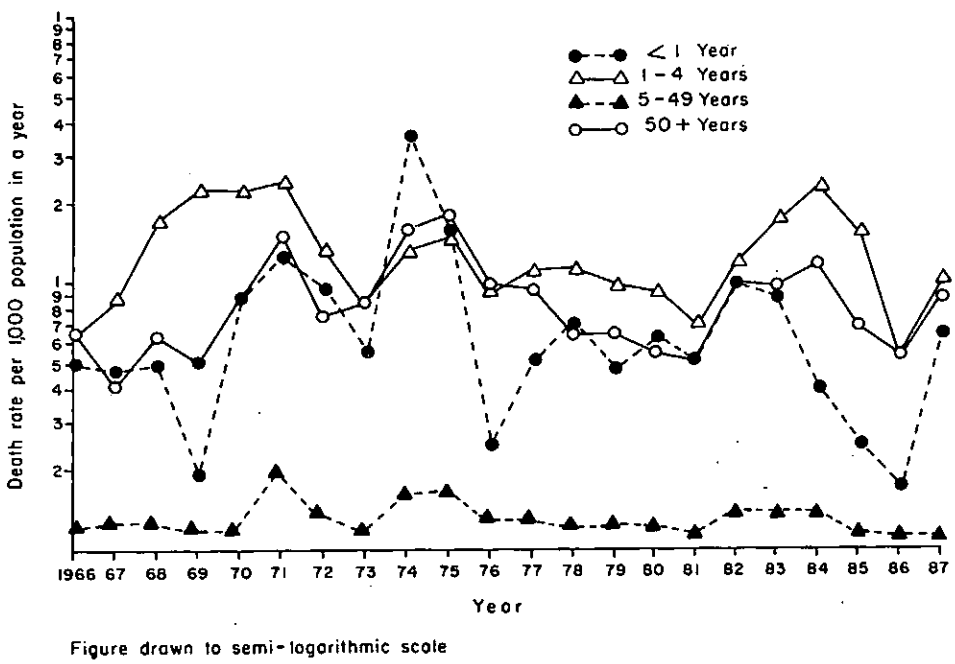

Fig. 2b – Yearly variations of diarrhoeal death rates in female, 1966 - 1987 (rate per 1,000 population in a year).

occurred in the 1 – 4 years age group except during the famine and post – famine years of 1974 – 1976 during which period infants of < 1 year had the highest death rates of 35.3 per 1,000 in 1974.

TABLE II – OVERALL DEATH RATES (PER 1,000 POPULATION) DUE TO DIARRHOEAL DISEASES AND OTHER CAUSES IN MATLAB DSS AREA DURING 1966 – 1987 SHOWN BY GENDER AND AGE GROUPS OF POPULATION

Causes of death		Age groups					
		< 1	1 – 4	5 – 19	20 – 49	50 +	ALL
Diarrhoea	M	8.3	7.2	0.6	1.0	10.6	3.0
	F	9.0	13.1	0.8	0.7	9.6	3.5
Other causes	M	121.9	16.7	1.8	3.8	32.7	12.1
	F	118.9	23.5	2.7	3.6	30.7	13.1
Diarrhoeal death as a per cent of all deaths	M	6.4	30.2	23.9	20.7	24.5	20.0
	F	7.1	35.7	28.7	16.1	23.8	20.9

Overall death rates due to diarrhoeal diseases and other causes are shown by age and gender of the population in Table II. The highest death rates due to diarrhoeal diseases were observed in girls aged 1 – 4 years. In the age groups between 5 and 49 years, the death rates due to diarrhoeal diseases were 20 times lower than those in other age groups. Also, in all age groups combined, except in infants up to one year, diarrhoeal diseases were responsible for at least one – fifth of the total number of deaths occurred.

Table III compared between the death rates due to diarrhoea and other causes during the MCH – FP intervention period of 1978 – 1987 and during the pre – intervention period of 1966 – 1977. It is evident from the table that the death rates both due to acute and persistent diarrhoeal diseases were higher in the pre – intervention period than those in the intervention period. It is also noticeable that diarrhoeal death rate was comparatively higher in the comparison area than that in the MCH – FP area. This difference of diarrhoeal mortalities between the two areas was shown to be substantially more pronounced in the age group 1 – 4 years.

TABLE III – COMPARISON BETWEEN THE DEATH RATES (PER 1,000 POPULATION) DUE TO DIARRHOEAL AND OTHER CAUSES DURING PRE – INTERVENTION AND INTERVENTION PERIODS INCLUDING THOSE IN COMPARISON AREA

Causes of death	Pre – intervention period 1966 – 1977					Intervention (MCH – FP vs comparison area) period 1978 – 1987									
	Age					Age									
	< 1	1 – 4	5 – 9	10 +	All	< 1		1 – 4		5 – 9		10 +		All	
						M	C	M	C	M	C	M	C	M	C
Diarrhoea	10.5	11.0	1.5	2.5	3.8	5.7	5.7	6.8	10.4	0.8	1.2	1.1	1.7	1.9	4.2
Acute diarrhoea	4.7	0.8	0.3	0.2	0.5	3.4	3.3	1.2	2.6	0.3	0.5	0.2	0.4	0.5	1.1
Persistent diarrhoea	5.8	10.3	1.3	2.3	3.3	2.2	2.4	5.2	7.8	0.5	0.8	0.8	1.3	1.4	3.1
Other causes	135.5	23.2	3.9	8.2	14.9	88.2	104.8	13.2	18.5	2.4	3.3	6.7	6.8	9.6	16.9
Diarrhoeal death as a per cent of all deaths	7.8	47.0	39.2	30.8	25.5	6.1	5.2	34.0	56.3	25.6	27.1	14.0	19.7	16.5	19.9

Note : M = MCH – FP C = Comparison

Seasonal variations of diarrhoeal deaths observed along the 22 years' study period are presented in Table IV. The peak of the adjusted diarrhoeal deaths occurred during the winter months of October through January with the highest deaths in the first two months. There is another smaller peak in the month of April.

The death rates from diarrhoeal diseases and other causes in the MCH-FP and comparison areas for the period of 1975-1987 are shown in Figure 3. Since starting the intervention in 1977, the diarrhoeal mortality has been shown to remain significantly lower in the MCH-FP area than in the comparison area. The difference in death rates due to other causes between these two areas was also statistically significant.

Discussion

During the 22-year study period, 20% of all deaths were related to diarrhoeal diseases amounting to 3.1 deaths per 1,000 population. Although the longitudinal pattern of diarrhoeal death rates showed a significant decline over time from 1976 to 1986, the decline did not appear to be commensurate with efforts given in the DSS area in the form of Family Planning Health Services Project, Family Welfare Centres, and MCH-FP. Also, there was a peak in diarrhoeal mortality during 1983-1984 associated with a major country-wide epidemic of shigellosis. These findings suggest that further improvement in the control of diarrhoeal diseases in Matlab DSS area is needed. The impacts of war and famine on both diarrhoeal and non-diarrhoeal mortalities during 1971 and 1974-1975 respectively are noteworthy. The higher female death rates, particularly in the age group of 1-4 years, during the entire period are disturbing and probably reflect strong cultural practices favouring a male offspring.

Analysing data from Matlab for the 1975-1981 period, Zimicki found a similar preponderance of female diarrhoeal mortality (5). Parents in this country take more care for the nutrition and treatment of a sick boy than they do for a sick girl. This speculation is supported by the earlier reports from Matlab that diarrhoea morbidity was similar in both boys and girls, but the diarrhoea-stricken boys aged 0-4 years were hospitalised much more frequently than the sick girls of similar age (6,7).

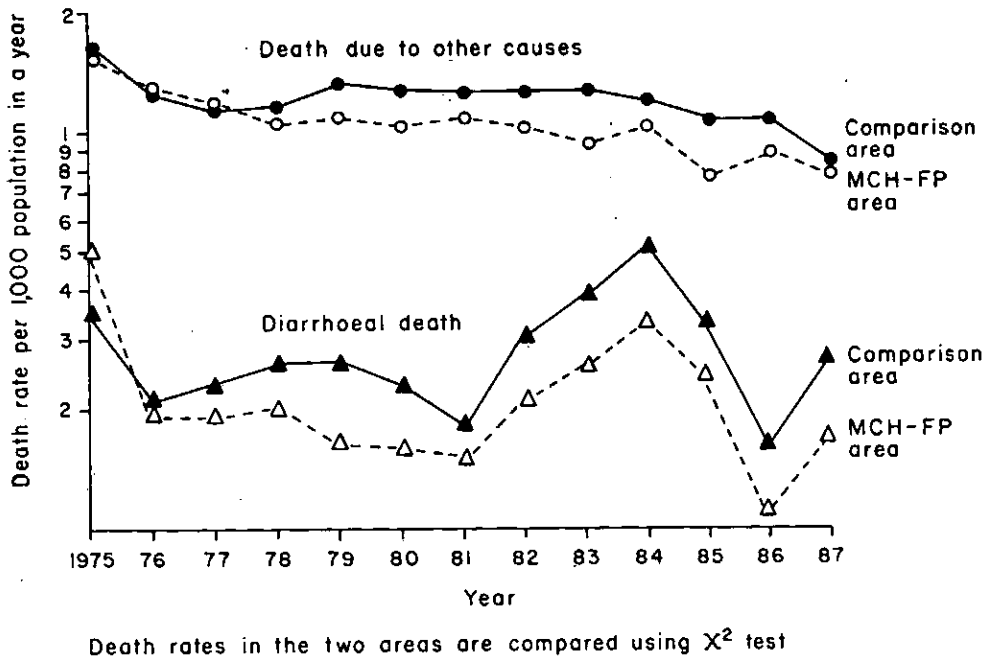

Fig. 3 - Variation of deaths due to diarrhoea and other causes in MCH-FP and comparison areas, 1975-1987 (rate per 1,000 population in a year).

TABLE IV – SEASONALITY OF ADJUSTED* DIARRHOEAL DEATH BY YEAR (1966 – 1987)

Months	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	Mean rank
Jan.	80	164 =	107	140	96	108	92	105	149 =	100	98	76	117	94	129 =	108	79	73	146 =	99	88	115	7.3
Feb.	96	85	(63)	104	90	(65)	93	84	148	124	95	(54)	(56)	70	119	(52)	79	(35)	(68)	73	14	58	4.3
Mar.	96	85	73	74	151	76	84	76	114	125	105	69	91	100	(72)	93	88	51	77	(59)	23	82	5.0
Apr.	133	130	93	59	131	78	107	86	112	132 =	119 =	79	75	114	79	60	146 =	69	115	99	(5)	110	6.8
May	96	70	66	79	53	67	109	103	(39)	83	95	62	125	(64)	104	78	(64)	83	146 =	121	19	82	5.0
Jun.	96	60	73	(46)	(47)	82	137 =	82	43	109	100	56	56	84	94	97	101	65	115	121	56	(55)	4.8
Jul.	91	75	110	81	67	92	124	82	56	101	103	57	59	107	85	112	75	85	114	86	70	110	5.6
Aug.	80	(50)	90	97	75	112	69	(74)	76	92	116	103	88	97	94	78	103	89	78	110	209	93	5.6
Sep.	(48)	80	112	99	108	121	(59)	130	109	96	114	145	131	114	75	130	105	142	98	81	223 =	121	6.0
Oct.	155 =	159	144	125	153	139	100	146 =	147	90	98	163	163 =	117	119	86	114	148	71	101	205	135	9.2
Nov.	123	115	159 =	150 =	163 =	151 =	107	127	113	(71)	91	192 =	133	140 =	110	145	133	163	98	110	167	102	9.2
Dec.	107	120	110	148	126	122	132	105	93	78	(67)	145	107	100	116	160 =	114	201 =	73	139 =	121	137 =	8.4

= Highest range, (◯) Lowest range

*To estimate any effect of seasonal variations on death, the number of adjusted deaths for each month within a year is calculated using the following formula:

$$\frac{dj}{\sum_{i=1}^{12} \frac{di}{12}} \times 100, \quad j = 1,2,.....12$$

where dj is the number of persons died of diarrhoea in the jth month and di is the number of persons died of diarrhoea in the ith month.

The number of adjusted deaths should be 100 in each month in the absence of any effect due to seasonal variations. Adjusted number of deaths for each month within a year is ranked which, over the years, would average out. The column of the average rank (Table IV) gives an estimate of the seasonality pattern of death over the entire period.

The two periods (October – January and April) showing the high and low peaks of death rates largely coincided with the two cholera seasons in the area (8). With a few exceptions, the post – monsoon period was the main peak season of diarrhoeal deaths in rural Bangladesh.

The difference between the diarrhoeal death rates in the DSS treatment and comparison areas was largest in 1979 when the programme of oral rehydration therapy of patients with diarrhoea started using ORS packets. The increase of mortality in the treatment area during the last epidemic was also substantial. This indicates the need to improve the existing diarrhoea treatment programme in the DSS area to prevent death of patients with diarrhoeal diseases.

Although the wealth of Matlab surveillance data on causes of death have been unique in a developing country, the validity of the coded causes of death should be taken with caution. The Field Workers and Health Assistants who took the interviews were not fully medically trained. The respondents were mostly illiterate who could possess various biases and faulty local perceptions of diseases in reference to those of medically trained persons. Interviewer bias could be another limitation. In fact, Zimicki *et al.* (5) argued that about 30% of infant deaths within 4 days of delivery, attributed to neonatal tetanus in the Matlab DSS area, could have been due to other causes like prematurity, congenital defects, and hyaline membrane disease. Also, the data showed an unexplainable male preponderance of death due to the same disease. However, in our opinion, the data on deaths attributed to diarrhoeal diseases should deserve good confidence because of the very visible sign of repeated passage of watery or bloody mucoid stools by the person who died. The classification of diarrhoeal diseases into acute and chronic types could, of course, suffer from some inaccuracy.

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