56

Special Publication No. 24

MORTALITY CASE STUDY MATLAB, BANGLADESH

Stan D'Souza

INTERNATIONAL
CENTRE FOR
DIARRHOEAL DISEASE
RESEARCH,
BANGLADESH

MORTALITY CASE STUDY MATLAB, BANGLADESH

Stan D'Souza

Former Scientific Programme Head

INTERNATIONAL CENTRE FOR
DIARRHOEAL DISEASE RESEARCH, BANGLADESH
G P O Box 128, Dhaka 2
Bangladesh

September 1985

This paper is based on a manuscript "prepared for the UNITED NATIONS/WORLD HEALTH ORGANIZATION THIRD PROJECT COLLABORATORS MEETING ON CASE STUDIES OF DETERMINANTS OF MORTALITY CHANGE AND DIFFERENTIALS - GENEVA 14-17 DECEMBER, 1982"

PREFACE

The International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B) is an autonomous, international, philanthropic, non-profit centre for research, education, training and clinical service. The Centre is derived from the Cholera Research Laboratory (CRL). Its activities are to undertake and promote study, research and dissemination of knowledge in diarrhoeal diseases and the directly related subjects of nutrition and fertility--with a view to developing improved health care methods and to prevent and control diarrhoeal diseases and improve public health programmes, especially in developing countries. The ICDDR,B issues an annual report, working papers, scientific reports, special publications, monographs, theses, dissertations, and a bi-monthly newsletter, which demonstrates the type of research activities currently in progress. The views expressed in these papers are those of the authors, and do not necessarily represent the views of the ICDDR,B. They should not be quoted without the authors' permission.

ACKNOWLEDGEMENTS

The Matlab Demographic Surveillance System was funded by the United Nations' Fund for Population Activities (UNFPA) under a grant no. INT/P13/80 and is currently funded by the Canadian International Development Agency (CIDA). The International Centre for Diarrhoeal Disease Research, Bangladesh is supported by countries and agencies which share its concern about the impact of diarrhoeal diseases on the developing world. Current major donors giving assistance to ICDDR,B are: Aga Khan Foundation, Arab Gulf Programme, Australia, Bangladesh, Belgium, Canada (Canadian International Development Agency and the International Development Research Centre), the Ford Foundation, Japan, Norwegian Agency for International Development, Saudi Arabia, Swedish Agency for Research Co-operation with Developing Countries, Switzerland, United Kingdom, United Nations Children's Fund, United Nations Development Programme, United States Agency for International Development, and World Health Organization.

The author gratefully acknowledges the assistance of the members of the Community Services Research Working Group, in particular, Ms S Zimicki, Mr M Rahman, Mr M K Chowdhury and Dr A P Satterthwaite; the computational efforts of Mr R Karim and Mr A Razzaque, respectively Research Associate and Senior Statistical Officer of the Data Management Branch; the excellent supervision of the DSS by Mr A M Sarder, Senior Field Research Officer; and the secretarial skills of Ms L Saldanha.

CONTENTS

ABSTRACT

The Matlab mortality case study was prepared within the context of a joint UN Population Division/WHO project. Mortality levels and trends were studied in five countries: Bangladesh, Guatemala, Kenya, Senegal and Sri Lanka. In the case of Bangladesh it was recognised that vital registration data would be inadequate, and that data prepared under the Demographic Surveillance System (DSS) maintained by the ICDDR,B in Matlab thana would be of great relevance for the project.

The Case Study report has been constructed with a set of illustrative investigations done in the Matlab area prior to 1982. Studies on sex and socio-economic differentials in mortality are provided. Problems related to cost and "cause of death" are discussed.

Despite the complexity of the development problems faced in attempting to reduce mortality, some simple strategies are available that can have a rapid impact on infant and child mortality. The impact of a tetanus immunisation programme has been documented in the Matlab area.

Comparisons between the Matlab area and the rest of Bangladesh have not been attempted, though some information from surveys and other indirect estimation procedures are provided. The few studies cited in the report should not be considered comprehensive, either for Bangladesh or for Matlab itself. They are intended to help policy makers choose those options whereby mortality can be monitored and reduced in developing countries.

INTRODUCTION

Vital registration in Bangladesh is woefully inadequate, both with regard to its coverage and accuracy. Estimates of mortality levels have been made through a study of the age structure of various censuses. The data from the decennial censuses have serious deficiencies with regard to age reporting and completeness of enumeration. Mortality information in Bangladesh generally has relied on indirect estimation procedures, utilizing data that have been obtained from sample surveys. Apart from sampling errors and biases present in retrospective data--memory lapses etc.--this information is unable to follow the rapid changes in mortality patterns that have taken place in Bangladesh over the last decade.

Against this background, the Demographic Surveillance System (DSS) maintained by the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B) in Matlab thana, assumes great importance. While the original purpose of setting up a surveillance area for vital events was to facilitate cholera vaccine trials, the significance of the registration data for demographic studies soon became apparent. Since 1966, the Matlab area has maintained continuous mortality registration; and it thus is possible to trace periods of high mortality linked to the liberation struggle of 1971 (Curlin *et al.*, 1976) and the famine of 1974 (Choudhury *et al.*, 1977). Studies related to fertility and contraceptive intervention also utilized the data base to measure acceptance and impact (Rahman M *et al.*, 1980). This Case Study Report on mortality has been constructed with a set of illustrative investigations recently done in the Matlab study area. A list of DSS annual reports is attached to the references.

Besides the problems related to measuring rapid mortality changes, the assessment of mortality differentials is difficult when retrospective data based on small samples is used. For instance, it has been inferred that several South Asian countries have higher female than male mortality rates, since the census data sex ratio of the population analysis favored males at all age groups (Jain, 1975). This pattern, different from that found in most developed countries and other parts of the world, has been difficult to explain from retrospective surveys, since sex-selective omissions have vitiated indirect estimation procedures as a tool to investigate sex-related mortality differentials. The Matlab data set has permitted such a study (D'Souza and Chen, 1980), and the results are presented in Appendix 1.

There has been increasing concern among developing world health planners that mortality rates of the lower socioeconomic groups were not falling at the same rate as those of higher classes. It thus would appear that health planning and the availability of health services were not achieving their goal--of reaching out to the widest groups possible, especially the poorest (Antonovsky, 1979).

Against this background, studies of socioeconomic differentials in mortality have been made in various parts of the world (WHO, 1979). The

Matlab data set provides strong evidence that such mortality differentials do exist, and that mothers' education levels could prove an important indicator for the level of mortality--the latter being inversely related to education level (D'Souza and Bhuiya, 1982).

The monitoring of "causes of death" in rural areas is difficult. Physicians are not available to assess death causes. As a result, even when vital registration systems are in place, the assignment of death cause remains questionable, since one must depend on reporters who have not been adequately trained. The World Health Organization has recognised this problem, and a serious attempt to obtain accurate cause of death data through lay reporters has been promoted (WHO, 1978). Cause of death data have been collected at Matlab since the inception of the study area. However, there are serious problems with regard to the symptoms noted and the assignment of the underlying cause of death. While a few results appear in the text of this study, methodological questions are raised in Appendix 2. Some results from a study (Chowdhury and Khan, 1980) done in the Companiganj Thana of Bangladesh also are provided.

The availability of health services, in developing countries especially, is linked intimately to cost considerations. Within the Matlab area this question is not easy to assess, because health services are related to research considerations. Attempts have been made to quantify the costs of deaths averted with regard to the major health intervention undertaken by the ICDDR,B: diarrhoea. Various estimates have been given, and some of these results are provided, though none should be considered conclusive. The monitoring of mortality and morbidity requires an appropriate registration system. The comparative costs of maintaining the surveillance system at Matlab with those of a "small study area" in Companiganj Thana are presented.

Despite the complexity of the development problems faced in attempting to reduce mortality, some simple strategies are readily available, that can have a rapid impact on infant and child mortality. Such health interventions as tetanus and measles immunization can have a fairly immediate effect. The impact of a tetanus immunization (Rahman M *et al.*, 1982) program administered in the Matlab area provides an illustrative example in Appendix 3.

Mortality data for Bangladesh as a whole, especially in the detail available at Matlab, do not exist. Comparisons between the Matlab area and the rest of Bangladesh will not be attempted. However, in order to relate the Matlab results to the levels and trends of mortality in the country, some information from surveys and other indirect estimation procedures are provided. The few studies cited in the report should not be considered comprehensive, either for Bangladesh or for Matlab itself, but rather as illustrative of some problems related to mortality and its estimation. They are intended to help policy makers choose those options whereby mortality can be monitored and reduced in developing countries.

History of the Matlab Demographic Surveillance System

The Matlab Demographic Surveillance System (DSS) is a unique demographic resource in Asia. Beginning in 1963, the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B)* initiated a Demographic Surveillance System in selected villages within an area adjacent to Matlab Thana, Comilla District, Bangladesh. The DSS combined periodic censuses of the study population with continuous registration of vital events: births, deaths and migrations. In 1966, a census was conducted in the Matlab Demographic Surveillance Area (DSA), covering a population of 110,000 people residing in 132 villages referred to as the OTA.** The DSA was doubled in 1968 with the addition of 101 adjacent villages, referred to as the NTA.*** At the 1974 census, the population of the total DSA was 264,000 residing in 233 villages. In October 1978, the study area was reduced to 149 villages containing an estimated 1974 population of 160,000. All these retained villages are within Matlab Thana (Becker *et al.*, 1982). In 1982, a new census update was undertaken. The 1982 population total was approximately 180,000.

The study area population is 88 percent Muslim and 12 percent Hindu. The average household consists of six persons. Households of patrilineally-related families are grouped in clusters called "baris," having a common courtyard. Landholding is skewed, with 18 percent of the households owning 47 percent of the land. About 40 percent of the males and 16 percent of the females over age 15 have completed four years of schooling. About 70 percent of the males and 6 percent of the females are classified as "economically active." Over the past decade, the Matlab Demographic Surveillance System has generated an enormous volume of unusually reliable data. Population censuses are available for 1966 (OTA), 1968 (NTA), 1970 (OTA), and 1974 (DSA). Vital events have been registered since 1966 in the OTA and since 1968 in the NTA. Beginning in January 1975, continuous registration of marital unions and dissolutions was introduced. Depending upon the census, selected socioeconomic information is available for all households. During the past two years, census books updated till 1982 have been prepared. A 1982 socioeconomic survey of individual households also has been undertaken. The data have been computerized. (cf. D'Souza, 1981)

Long-range Objectives

There are three major objectives in the long-term development of the Matlab Demographic Surveillance and Operational Research and Training Project (DORT).

First, the primary and ultimate goal of population concerns is the improvement of the health and welfare of individuals and communities (cf. WHO Alma Ata 1978 goal "Health for all by the Year 2000)." The selection of the

---

* Formerly known as the Cholera Research Laboratory

** Old Trial Area

*** New Trial Area

most appropriate and effective technologies in health and family planning services, implemented by the most effective delivery system, is crucial to the achievement of that goal. The operations of an integrated village-based MCH-FP program in half of the Matlab DSS, along with the independent collection of health and other welfare impact indicators (mortality, morbidity, nutrition, fertility) by the Matlab DORT project, provide an opportunity to contribute to sounder intervention efforts.

Secondly, knowledge of demographic trends, determinants, and consequences of contemporary Asian and other less developed countries cannot be extrapolated from historical studies of developed countries. In the past quarter century, most Asian countries have undergone, and continue to experience, profound, rapid socioeconomic and demographic changes the beginnings of fertility decline; massive urbanization due to rural-urban migration; increases in the age at marriage, and changes in the role of women. That these changes have profound welfare implications is beyond debate. The challenge is to modify them to the betterment of people living in many less developed countries. Studies in the Matlab DSS, which by no means, is typical or representative of all rural less developed regions in Asia, can provide unusual insights into the determinants, rate, and consequences of these processes, thereby providing the knowledge base for policy and program formulation.

Thirdly, research products include, among others, studies on; cholera and other infectious diseases; epidemiology; vaccine effectiveness and development; beliefs about food, feeding and health; social relationships and community structure; and biosocial determinants and correlates of fertility, mortality, migration and marriage. These studies are made possible by the quality and breadth of the data base.

Fourthly, the need to develop human resources throughout Asia is pressing. Particularly deficient have been training sites within the region (as opposed to developed countries), in rural areas (as opposed to a class-room in a city), and in an applied program setting, including the use of the computer. The Matlab DORT project provides an environment for practical, applied field training.

Immediate Objectives

Some immediate objectives of the Matlab project—a four-year framework—are:

1. To provide a "small area" vital registration system suitable for assessing the effectiveness, safety and acceptability of Maternal and Child Health-Family Planning (MCH-FP) technologies (contraception, oral therapy, nutrition and immunization), to be used within the context of national programs in the region and in other developing countries.

2. To undertake research related to diarrhoeal diseases, and on the measurement and determinants of fertility and mortality within one specific field site of the region. This research should help facilitate the formulation of more effective program strategies and policy planning, both in Bangladesh and beyond. Assistance in particular to "health information units" will be available through research on "lay reporting" of "cause of death," etc.

3. During the next four years of the project, efforts will be made to develop a population register. Linkage of various events files, past and present, are being improved. A registration number and a current number now have been assigned to each individual in the DSS. These data form the basic information required for various mortality and morbidity studies.

4. Alternative designs to assist in distinguishing research and service needs will be developed. Such designs will be tried in other areas of Bangladesh and in developing countries collaborating with the ICDDR,B. Operations research on systems which are less expensive and more replicable than those used in Matlab, but are based on experience there, and that would entail greater community involvement, are being studied.

5. Analysis of existing data will form a major component of the research effort for the next two years. The creation of data files appropriate for such analysis will be stressed. Prioritization of data analysis would be directed towards understanding the linkages among nutrition, morbidity, mortality and fertility. Child survival studies would represent a particular focus. A distinction must be made between data sets required for monitoring service delivery and evaluation research.

6. To develop a demographic field site which can be used to train program planners, researchers and implementors of national and "developing country" programs.

7. To share the results of the Matlab DSS with other interested agencies, within Bangladesh and throughout the region.

Data Collection and Processing Procedures

The scientific "support" work of the ICDDR,B is undertaken by "branches," each branch having a specific technical role. The DSS involves three branches: the Field Station at Matlab, the Data Management Branch and the Computer Information Services Branch in Dhaka.

The Demographic Surveillance Program of the Matlab Field Station, headed by a Senior Field Research Officer, is responsible for the field operation and collection of the surveillance data. The Dhaka Data

Management Branch is responsible for editing, processing, and initial tabulations of the demographic field data. The Computer Branch is responsible for the computerization of data on the ICDDR,B's IBM System 34.

Following is an operational diagram of the DSS activities:

FIELD STATION MATLAB		DATA MANAGEMENT BRANCH, DHAKA		COMPUTER BRANCH DHAKA
Field operations and data collection	→	Editing, coding	→	Data entery, preliminary tabulations
Verification	⇄	Verification	⇄	Verification
		Preparation of annual reports	←	Final tabulations

In Progress: Full computerization of the data processing system and creation of a computerized population register and data base use.

The current data collection system under the Demographic Surveillance Program of the Matlab Field Station is a three-tier system. Detection of vital events is primarily the responsibility of the 110 female community health workers (CHWs). Eighty CHWs undertake primary detection of the vital events in half of the surveillance area, as part of their work in providing village-based MCH-FP services. Each CHW covers approximately 300 households and visits each family fortnightly. In the remaining half of the Matlab study area, 30 CHWs -- covering approximately 500 households each -- only do demographic surveillance work, visiting each household weekly. All CHWs have at least a seventh grade education. They inquire about births, deaths, migrations, marriages and divorces, and record these events in register books. The work of CHWs is checked by 12 to 16 male health assistants (HAs) who, accompanied by the CHWs, visit each household monthly to review the completeness of the registration and to record the vital events on standard registration forms. The area covered by an HA is called a "field unit," and contains about 16,000 people (2,800 households). The work of HAs is checked by 3 or 4 senior health assistants (SHAs), who visit each household at least three times annually. All these workers are supervized by the DSS Senior Field Research Officer, who, along with two assistant supervisors, randomly checks on the quality and completeness of the field work.

The IBM Systems 34 Computer has been managed and run by locally-hired staff, trained either in Bangladesh or abroad. On-the-job training at the Centre has been undertaken with the assistance of the United Nations

Statistical Office and a collaborative arrangement with the University of Namur, Belgium. Appropriate software to permit data analysis has been and is being developed. A current and updated population register is being established for the Matlab population. Large data sets have been transferred back to the Centre, from the Johns Hopkins University in Baltimore. However, for data analysis utilizing scientific packages such as SPSS, etc., a more powerful scientific computer is required. Some ad-hoc arrangements with computer centers in Bangladesh and elsewhere have been pursued, but the purchase of a large, scientifically oriented computer is urgent.

LEVELS AND TRENDS IN MORTALITY

Table I provides mid-year population totals for the Matlab surveillance area, as well as crude birth and death rates. There have been varying degrees of coverage. The figures from 1966-74 refer to data from the OTA. The data from 1974-77 stem from both OTA and NTA villages and begin with the 1974 census. From 1978, the data are from the reduced area of 149 villages.

Even though the base populations are different, the size of the study area always has been large enough to ensure against random fluctuations. Variations in birth and death rates reflect the conditions in the country. The crude birth rate per 1,000 has shown a steady decline, from about a 47 to just under 40. The low rate for 1975 of 29.4 is due entirely to conditions produced by the famine. Falling rates after 1979 result from a health intervention program in the Matlab MCH-FP (Bhatia *et al.*, 1980), and are discussed later.

For the period 1966-71, the crude death (CDR) rate per 1.000 was about 15. From 1971-75, the CDR fluctuated substantially, reaching about 21 during the liberation struggle (1971) and the famine period (1975). In 1976, the CDR was back to normal (14.8). It since has fallen to under 14 per 1,000. The crude rate of natural increase (RNI) has varied from about 25 to 33 per thousand, reflecting variations in birth and death rates. Except for the low value of 8.6 per 1,000 during the famine year (1975) the effect of fertility changes on the RNI has not been substantial. Since the CDR cannot be expected, even under the most optimistic condition, to fall more than a few points, major changes in the RNI must come from lowering fertility levels.

Recent review papers have attempted to assess mortality levels and trends in Bangladesh since the turn of the century (ESCAP, 1981). CDR estimates have been based mainly on data from the decennial census. Table II shows CDRs in Bangladesh since 1881. Notable is that until 1951, namely the period before the partition of the Indian subcontinent, the CDRs generally were higher than 40 per 1,000. From 1950-65, a decline to about 20 per 1,000 was registered. This decline has not been maintained over the last decade, i.e. during the 1970's, due to problems related to

TABLE I--CRUDE BIRTH AND DEATH RATES AND RATES OF NATURAL INCREASE AT MATLAB, 1966-1981

Year	Mid-Year Population	CBR (per 1000)	CDR (per 1000)	Crude Rate of Natural Increase
1966-67	112,771	47.1	15.0	32.1
1967-68	114,561	45.4	16.6	28.8
1968-69	116,909	46.6	15.0	31.6
1969-70	120,217	45.3	14.9	30.4
1970-71	124,082	43.5	14.8	28.7
1971-72	127,840	44.5	21.0	23.5
1972-73	130,218	41.8	16.2	25.6
1973-74	132,797	45.6	14.2	31.4
1974	263,807	42.9	16.5	26.4
1975	259,194	29.4	20.8	08.6
1976	260,381	43.3	14.8	28.5
1977	268,894	46.4	13.6	32.9
1978	173,443	34.8	13.2	21.6
1979	175,887	40.9	13.8	27.1
1980	179,290	41.2	13.0	28.2
1981	183,011	39.5	13.1	26.4

Note: The mid-year population totals relate to varying degrees of coverage. From 1974-1977, the figures include the NTA. From 1978 onward, the study area was reduced to 149 villages.

TABLE II--CRUDE DEATH RATES, 1881-1974, BANGLADESH

Year	Crude Death Rates (Per 1,000 Population)
1881-1891[a]	41.3
1891-1901[a]	44.4
1901-1911[b]	45.6
1911-1921[b]	47.3
1921-1931[b]	41.7
1931-1941[b]	37.8
1941-1951[b]	40.7
1951-1961[b]	29.7
1961-1965[b]	18.5
1961-1974[c]	19.4

Sources: a Kingsley Davis, The Population of India and Pakistan (Princeton, University Press, 1951), p. 36;

b Statistical Pocketbook of Bangladesh, 1978 (Dhaka, Bangladesh Bureau of Statistics, 1978), p. 95;

c D'Souza and Rahman, 1977.

the cyclone (1970), to the liberation movement (1971), the famine 1974-75, and the consequent prevailing economic uncertainty.

Utilizing stable population theory and data from the 1974 census, a CDR of 19.4 per 1,000 has been estimated for the 1961-71 period. The West model life tables were utilized for this estimate--the selected levels being 12.14 for males and 10.8 for females (D'Souza and Rahman, 1978). Figure 1 shows the percentage distribution at various age groups of the enumerated census population for Bangladesh for 1974, un-adjusted with the corresponding model life table values (adjusted). Superimposed on this graph, are the percentage age distributions for Matlab for the years 1974 and 1979. One notices the fair similarity between the model curve and the actual data for Matlab. The broad base of 1974 Matlab data follows the natural pattern. In 1979, the signs of fertility reduction in Matlab, manifested by the narrowing base of the figure, is noticeable. It is interesting to note in the Matlab data that the excess in the 10-15 age group in the 1974 data moves over as expected to the 15-20 age group in 1979. The presence of large discrepancies within certain age groups probably is due to migration (males in the 20-35 age group, for instance). There also may be some slippage towards the 10-15 age group resulting from the initial start in 1966. The enumeration census results portray the saw-tooth picture consequent on age heaping at the zeroes and fives.

Census data do not provide sufficiently-reliable information on which to build age-specific death rates. These rates have been estimated by the use of indirect procedures using data from surveys--the population growth estimation (PGE) project (Krotki and Ahmed, 1964), and the Bangladesh Retrospective Survey of Fertility and Mortality (1977). Some data from these surveys are compared in Table III, with corresponding age-specific death rates obtained from the Matlab area. From the Table one notices that the Matlab data in 1975 matches the high levels of the 1974 retrospective survey data. The sex differentials in mortality noted at Matlab, where female is higher than male mortality, is not replicated in the BRSFM data. The classical U-shape of high death rates in under-5 year-olds and then at older ages beginning with age group 50-54 years is maintained throughout.

Infant mortality rates for the Matlab area for 1966-81 are provided in Table IV. Conventional rates are presented except when specifically indicated for some results in 1975 and 1976. On the whole, male infant mortality appears to be greater than female mortality. However, a review of the neonatal and post-neonatal ratio indicates that, while this is true for neonatal rates (except for 1980), for post-neonatal rates, female rates are higher. The question of sex differentials in mortality rates are discussed in more detail as an illustration in Appendix 1, for the period 1974-77.

From the data, it would appear that, as expected, infant mortality rates have reflected the crisis periods of the decade. The highest rates, 164.3 and 146.8, are found in 1971/72 and 1975, respectively. It would appear from the data that rates varying between 110 and 140 per 1,000 have been the general pattern. The lowest values, about 110, are seen after 1977. The value of 110.7 in 1966 may be valid, but also could result from under-enumeration in the first surveillance year.

FIGURE 1

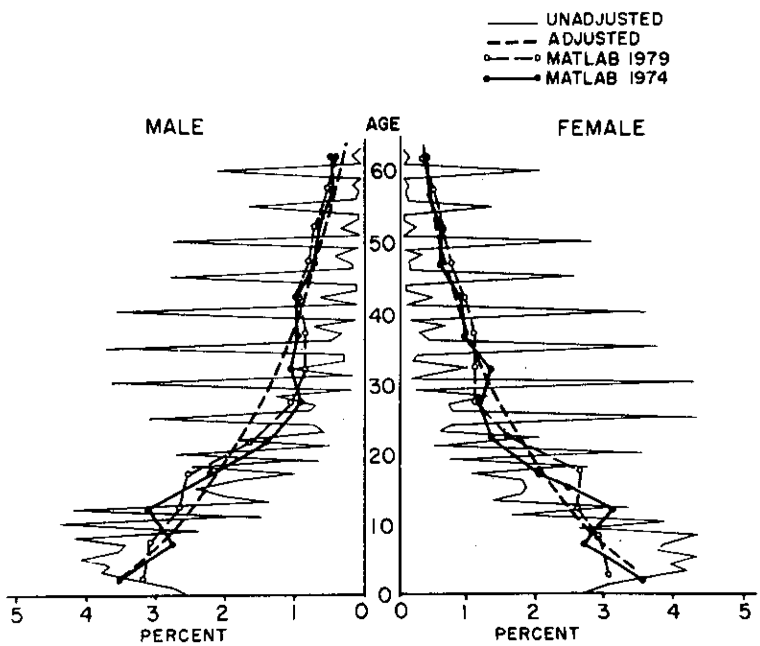


Fig 1- PERCENTAGE DISTRIBUTION OF UNADJUSTED AND ADJUSTED POPULATION OF BANGLADESH-1974 WITH MID-YEAR POPULATION OF MATLAB-1974 AND MATLAB-1979

TABLE III--AGE-SPECIFIC DEATH RATES, 1962-1964, 1974, 1975, 1977, 1979
(DEATHS PER 1,000 POPULATION)

A R E A	BANGLADESH						MATLAB			
	PGE 1962-1964		Retrospective Survey 1974		CRL 1975		CRL 1977		ICDDR,B 1979	
Age group	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females
0	161.1	127.5	179.1	160.6	165.1[a]	184.1[a]	113.3[b]	114.2[b]	118.7[b]	114.0[b]
1-4	22.6	27.4	47.5	45.4	28.8	41.3	19.5	25.2	16.1	27.6
5-9	6.8	6.3	5.6	5.4	4.9	6.8	3.4	4.6	4.5	5.2
10-14	2.1	2.6	2.9	2.9	1.5	2.0	1.0	1.3	0.8	1.1
15-19	1.9	6.8	4.0	3.9	1.9	2.8	0.9	2.8	0.7	2.5
20-24	3.2	6.6	7.4	7.3	3.1	3.9	2.2	3.1	1.9	3.0
25-29	3.1	8.8	7.7	7.6	4.7	3.7	1.8	2.5	1.5	3.1
30-34	5.4	8.3	7.6	7.6	4.6	4.5	2.9	2.6	2.4	3.9
35-39	6.2	9.8	8.3	8.3	8.6	6.9	3.5	4.7	3.2	4.8
40-44	8.1	9.5	9.6	9.7	14.8	6.0	5.0	2.5	5.1	3.6
45-49	12.0	9.7	11.9	12.0	22.3	11.7	10.8	6.7	13.1	7.5
50-54	17.0	15.5	15.2	15.5	34.9	13.7	15.2	11.4	13.1	9.3
55-59	21.3	25.8	20.5	21.0	44.5	35.9	21.8	19.0	24.6	18.1
60-64	33.4	40.3	28.7	29.6	60.9	49.2	31.9	33.7	32.6	27.0
65-69	49.9	54.8	41.2	42.9	113.4	111.5	76.2	76.2	68.3	84.1
70-74	76.3	85.7	61.1	63.9						
75+	111.3	136.0	92.4	97.1						

Sources: F. Yusuf "Abridged Life Tables for Pakistan and Its Provinces 1962-64", Sydney Conference Proceedings (Liege, IUSSP, 1967), pp. 533-541; Report on the 1974 Bangladesh Retrospective Survey of Fertility and Mortality (Dhaka, 1977), pp. 89-90; Demographic Surveillance System, Matlab, Vol. 6, 1979, and Vol. 9, 1982.

a per 1,000 related births

b per 1,000 live births of the same calendar year

TABLE IV--INFANT MORTALITY RATES AND NEONATAL AND POST-NEONATAL RATES (PER 1,000 LIVE BIRTHS), MATLAB (1966-1981)

Rate	Year														
	1966 -67	1967 -68	1968 -69	1969 -70	1970 -71	1971 -72	1972 -73	1974	1975	1976	1977	1978	1979	1980	1981**
Neonatal															
Male	65.5	73.2	93.3	96.0	90.7	90.2	74.4	87.9	81.6*	72.0*	73.1	73.0	77.2	61.8	67.8
Female	53.6	62.3	72.5	78.7	82.1	76.0	66.7	67.8	78.1*	58.1*	69.4	75.3	68.5	71.6	67.3
Total	59.5	67.8	83.1	87.5	89.9	83.2	70.9	78.1	79.9*	65.2*	71.3	74.1	73.0	66.6	67.6
Post-neonatal															
Male	52.0	53.9	36.9	41.2	37.0	63.0	53.2	54.6	98.4*	33.3*	40.2	43.6	41.5	28.4	37.3
Female	50.5	61.5	43.6	38.8	45.7	64.3	59.4	65.1	126.3*	42.2*	44.8	49.1	45.5	46.8	47.8
Total	51.2	57.6	41.0	40.0	41.3	63.6	56.2	59.8	111.9*	37.6*	42.4	46.3	43.4	37.3	42.4
All Infants															
Male	117.5	127.1	130.2	137.2	134.6	153.2	127.6	142.5	165.1*	113.6*	113.3	116.6	118.7	90.2	105.1
Female	104.1	123.8	117.8	117.4	127.9	140.2	126.1	132.9	184.1*	110.3*	114.2	124.3	114.0	118.5	115.1
Total	110.7	125.4	124.1	127.6	131.3	146.8	126.8	137.9	174.3*	111.9*	113.7	120.4	116.0	103.9	110.0

* Cohort Measure

** Preliminary figures

Table V provides a monthly breakdown of infant deaths at Matlab by sex and age for 1979 and 1980. More than 60% of infant deaths occurred in the neonatal period, and nearly 90% before age 6 months. Male neonatal deaths usually were more frequent than female neonatal deaths, as shown for 1979. Mortality rates--both neonatal and post-neonatal--were low for males in 1980, being, respectively, 61.8 and 28.4 per 1,000 live births (Table V). This phenomenon is being investigated. However, the overall pattern of more than 60% of deaths in the first month of life and about 90% before age six months is maintained. It should be noted, however, that for females, the percentage of infant deaths--for the post-neonatal period and particularly between 6 and 11 months--is higher than for males. This would indicate that cultural factors, such as male preference, etc., may be more important at this stage than mere biological differences between the sexes (cf. Appendix 1).

A brief reference to the index ($e^o o$) expectation of life at birth may be appropriate as a conclusion to this section. From the beginning of the century until about 1941, the $e^o o$ for both sexes increased slowly, from about 23.7 to 31.8. A more rapid increase was discerned from 1951 to 1971--the $e^o o$ rose to around 50 in the late sixties (cf. ESCAP, 1981). Since then, as explained earlier, there have been fluctuations due to the unsettled conditions during the liberation struggle (1971) and the famine (1974-75) period. Indirect estimates of the $e^o o$ for males and females based on the 1974 national census are 44.97 and 44.50, respectively (D'Souza and Rahman, 1978). The most recent estimates of the $e^o o$, based on Matlab 1980 data, are 56.1 for males, 52.8 for females, and 54.5 for both sexes (DSS Report, Vol. 10, 1982).

MORTALITY DIFFERENTIALS BY SOCIOECONOMIC STATUS*

Socioeconomic differentials of mortality will be considered by the variables of education, occupation, dwelling size, ownership of cows, and health practices.

The choice of particular variables is related to culture; and measurement errors are present wherever interviewers attempt to obtain data in rural areas. The socioeconomic classification provided by Doring-Bradley and Johnston contains income as one of the variables (1979). Use of an ownership variable as a proxy for income has been made here, since payment by specific salaries practically is nonexistent in rural Bangladesh. Mortality data for 1974 and 1977 are linked to the 1974 SES file. Data after 1977 have not been matched to the file for the following reasons: a reduction in the surveillance area in 1978, and uncertainty regarding changes in SES characteristics in the area, especially due to the famine in 1975. Bangladesh endured a period of acute shortage of food and other commodities in late 1974 and all of 1975. The impact of this crisis resulted in increased mortality levels for 1975, as well as migration and sale of land.

---

* From "Socioeconomic Mortality Differentials in a Rural Area of Bangladesh," by D'Souza S and Bhuiya A, Population Dev. Review, Vol. 8, No. 4, Dec. 1982

TABLE V--NUMBER OF INFANT DEATHS BY SEX AND AGE IN MONTHS, MATLAB 1979 AND 1980

			Age at Death in Months											
Year	Sex	N	0	1	2	3	4	5	6	7	8	9	10	11
1979	Male	441	287	55	27	19	12	10	9	7	2	4	3	6
	Female	396	238	31	23	19	15	11	7	11	9	11	9	12
	Total	837	525	86	50	38	27	21	16	18	11	15	12	18
	Percent	100	62.7	10.3	6.0	4.5	3.2	2.5	1.9	2.2	1.3	1.8	1.4	2.2
1980	Male	342	235	38	14	13	7	6	4	8	6	3	5	3
	Female	425	257	44	29	17	13	7	12	15	8	8	9	6
	Total*	768	493	82	43	30	20	13	16	23	14	11	14	9
	Percent	100	64.2	10.7	5.6	3.9	2.6	1.7	2.1	3.0	1.8	1.4	1.8	1.2

* Sex of one child was not indicated.

Education

In this section, mortality rates of children aged 1-4 years are considered in relationship to two educational indicators: education of the household head and the highest education of any family member.

Table VI presents mortality rates in early childhood by education of household head. Three levels of education have been considered: persons with no schooling or with religious education only; those who have completed one to six years of schooling, and persons completing seven or more years schooling. At all three educational levels, there is a peak in mortality rates for 1975, while 1977 rates are fairly similar to those of 1974. Considering mortality for particular years, one notices markedly lower death rates with increasing education. The ratio of mortality rates at the lowest education level to the highest (I:III) exceeds 1.70 in each of the four years, although a slight decline in this ratio is noticed with time. Of note, too, is the fact that during the crisis year of 1975 the mortality rate at the lowest educational level is 44.6.

The higher level groups cope better under stress conditions. Figure 2 shows male and female mortality rates for ages 1-4 years by education of household head. Apart from the differentials by education level, the higher female mortality levels are clearly evident.

Table VII considers mortality rates by educational attainment of the person with the highest level of schooling in the family. As before, education is measured by years of schooling. These results trace the same patterns for mortality rates as noted in Table VIII; the ratio I:III being even higher--1.90 or greater.

Caldwell has noted that education of mothers is an important predictor of mortality levels. Due to limitations of the data, matching of deaths with educational levels of mothers can be done only for children who died between ages one and three and only for the years 1975-77. These results are presented in Table VIII. As in Tables VI and VII, a relationship between increasing education and mortality levels is evident, although the ratio I:III is now as high as 5.3.

Table IX considers mortality rates of children aged 5-14, adults 15-44, and adults 45 years and over, in relation to the education of the household head. The general pattern noted for very young children is maintained: the ratio 0:7+ of mortality rates remains high for all age groups in each of the four years 1974 to 1977, although the differences appear to narrow in 1977. Statistically significant differences between the mortality rates at levels I and II likewise are noted. The differences between levels II and III are less marked. In fact, for the age group 45+ in 1976, the mortality rate for level II is 24.2, compared with 24.7 for level III. This could be due to the selection effect in 1975--the high mortality year--when the differences in rates between groups II and III rose to 6.6, compared with 5.6 in 1974. A difference of 7.0 is again noted in 1977.

TABLE VI--MORTALITY RATES[a] (PER 1,000) AT AGES 1-4 FOR BOTH SEXES BY EDUCATION (YEARS OF COMPLETED SCHOOLING) OF HOUSEHOLD HEAD, MATLAB, BANGLADESH 1974-77

Education of household head (years of schooling)	N[c] 1974	1974	1975	1976	1977	1974-77
I 0 (no schooling)[b]	15,406	27.3	44.6	37.3	26.0	34.5
II 1-6	9,854	21.2	33.9	27.9	19.0	25.8
III 7+	3,569	12.0	23.3	21.4	15.4	18.1
All	28,829	23.3	38.3	32.1	22.2	29.4
Ratio I:II		2.23	1.91	1.74	1.72	

a Under usual statistical assumptions, the differences in mortality rates at educational levels I and III are highly significant ($t=7437$, $p<.01$, $d.f.=3$).

b Or religious schooling only ("Maktab")

c N represents number of persons in 1974. This is the case for all tables except when explicitly stated otherwise.

FIGURE 2

MORTALITY RATES (1974-1977) OF CHILDREN AGED 1-4 YEARS BY EDUCATION OF HOUSEHOLD HEAD

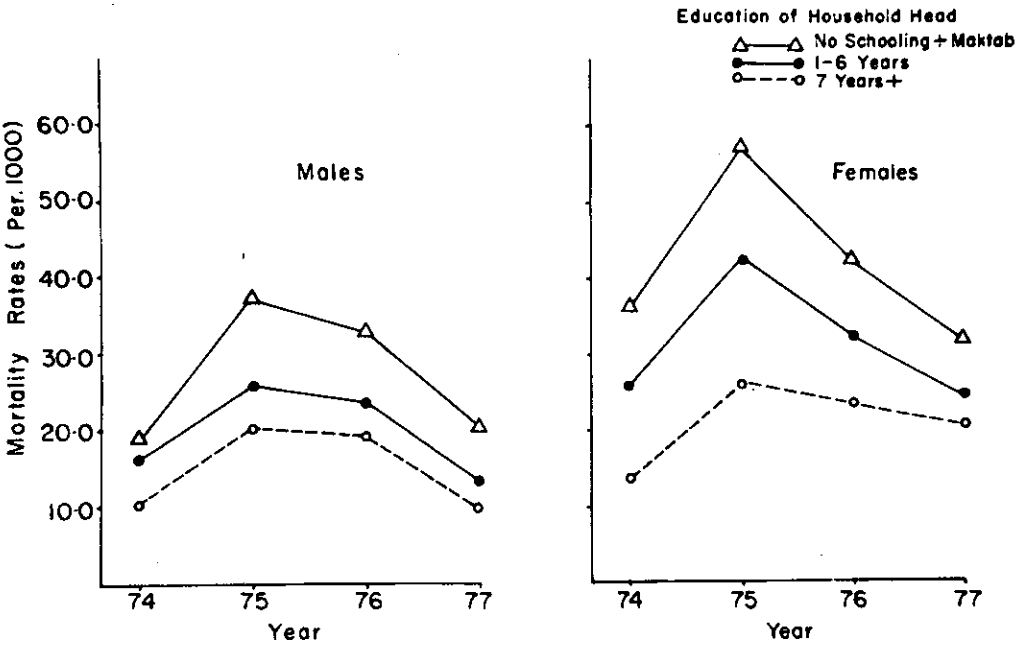


TABLE VII--MORTALITY RATES[a] (PER 1,000) AT AGES 1-4 FOR BOTH SEXES BY THE HIGHEST EDUCATION (YEARS OF SCHOOLING) IN THE FAMILY, MATLAB, BANGLADESH, 1974-77

Highest education in the family (years of schooling)	1974[N]	1974	1975	1976	1977	1974-77
I 0 (no schooling)[b]	7,577	34.7	54.3	42.3	33.9	41.9
II 1-6	13,380	24.0	36.3	32.3	21.4	28.9
III 7+	7,872	11.5	26.2	22.3	13.4	18.5
All	28,829	23.2	38.3	32.0	22.2	29.4
Ratio I:III		3.07	2.08	1.90	2.53	

a Significance tests show that the difference between mortality rates at educational levels I and III are highly significant ($t=11.976$, $p<.001$, d.f. = 3).

b Or religious schooling only ("Maktab").

TABLE VIII--MORTALITY RATES (PER 1,000) AT AGES 1-3 FOR BOTH SEXES BY EDUCATION (YEARS OF SCHOOLING) OF MOTHER, FOR THE 1974 BIRTH COHORT FOLLOWED THROUGH 1977, MATLAB, BANGLADESH

Education of mother (years of schooling)	N (mothers)	1975-77
I 0 (no schooling)[a]	21,278	33.3
II 1-6	7,439	20.2
III 7+	853	6.3
All	29,480	29.2
Ratio I:III		5.29

a Or religious schooling only ("Maktab")

The conclusion one may draw at this stage is that education levels are important to understanding differential mortality. While, for practical purposes, the education of the household head is sufficient to identify the groups more susceptible to death, mother's education may in fact be a more sensitive indicator, and should be used, especially where young children are concerned. Stratification by highest education of any family member also might be useful, but requires more intensive data collection and tabulation.

Number of years of education of the household head or mother is relatively easy to measure. But a problem exists regarding the type of school attended. Religious schools (Maktab) may not have the same type of modernizing influence on health practices as secular schools. Hence, it is important that allowances be made for the type of school attended.

SES data from five villages were collected early in 1981 for a pilot study. They were chosen according to criteria on size, distance from the Centre, and religious composition. A full-scale 1982 SES census for the entire Demographic Surveillance System area been has now undertaken on the basis of information--logistic and scientific--provided by the pilot study.

Mortality rates for 1980 for children 1-4 years were tabulated by mother's education (Table X). Results similar to those recorded in Table VIII are obtained, although it should be noted that the number of mothers in Group III is very small.

TABLE IX--MORTALITY RATES (PER 1,000) IN THREE AGE GROUPS FOR BOTH SEXES, BY EDUCATION (YEAR OF SCHOOLING) OF HOUSEHOLD HEAD, MATLAB, BANGLADESH, 1974-77

Education of household (years of schooling)	N 1974	1974	1975	1976	1977	1974-77
			Age group 5-14			
I 0 (no schooling)[a]	43,203	3.0	3.6	3.8	2.4	3.2
II 1-6	27,815	2.2	3.3	2.2	1.9	2.4
III 7+	10,080	1.7	2.0	0.9	2.0	1.6
All	81,908	2.6	3.3	2.8	2.2	2.7
Ratio I:III		1.76	1.80	4.22	1.20	
			Age group 15-44			
I 0 (no schooling)[a]	60,257	2.5	4.8	2.5	2.2	3.0
II 1-6	37,944	1.9	3.3	2.2	2.1	2.4
III 7+	13,654	1.4	3.0	1.0	1.6	1.7
All	111,855	2.2	4.0	2.2	2.1	2.6
Ratio I:III		1.79	1.60	2.50	1.38	
			Age group 45+			
I 0 (no schooling)	23,484	22.9	50.9	28.2	23.9	31.2
II 1-6	14,711	19.8	38.8	24.2	25.2	26.9
III 7+	5,293	14.2	32.2	24.7	18.2	22.3
All	43,488	20.8	44.5	26.4	23.7	28.7
Ratio I:III		1.61	1.58	1.14	1.31	

a Or religious schooling only ("Maktab")

TABLE X--MORTALITY RATES (PER 1,000) OF CHILDREN 1-4 YEARS BY MOTHER'S EDUCATION, FIVE SELECTED VILLAGES IN MATLAB, BANGLADESH, 1980

Education of mother (years of schooling)		N (mothers)	1980
I	0	1,096	24.6
II	1-6	379	13.2
III	7+	47	0.0
All		1,522	21.0

Source: Unpublished DSS data, Matlab

Occupation

In the 1974 census of socioeconomic status, all persons over eight years of age were considered eligible for the labor force, and questions thus were asked regarding their economic activity. Occupational classification of heads of household in this section refers to primary occupation. Further, since the number of occupations in the census varied greatly, occupational criteria of household heads have been considered at three levels. At the lowest socioeconomic level (I) are agricultural laborers, and at the highest level (III) are landowners--persons who work or live off their own land. In between, at level II, are owner/workers--persons who, while owning some land, do work for others. This group includes self-employed, such as fishermen, fish vendors, boatmen, and businessmen. Also included are salaried employers of industrial concerns, for example, mill workers. Clearly, some workers at level II could be considered fairly well off, thus blurring the line between levels II and III.

Table XI shows mortality rates for the three levels of occupation. As was true for education, mortality rates show declines with increasing socio-economic status. As before, rates for 1975 show the effects of crisis, with the lowest level economic groups paying the highest price in terms of mortality. If one considers children between ages one and four years, the peak for group III appears in 1976. In the same age group, the ratios I:III remain higher than 1.9 for the four years under consideration.

Mortality patterns for children aged 5-14 and for adults 15-44 years are similar to those described in Table IX. The ratios I:III are higher than unity for all four years. The difference between rates at level I and III remains significant for age groups 5-14 and 15-44.

TABLE XI--MORTALITY RATES (PER 1,000) OF VARIOUS AGE GROUPS FOR BOTH SEXES, BY OCCUPATION OF HOUSEHOLD HEAD, MATLAB, BANGLADESH, 1974-77

Occupation of household head	N 1974	1974	1975	1976	1977	1974-77
			Age group 1-4			
I Agricultural laborer	4,989	35.3	57.9	43.9	31.3	42.9
II Owner/worker	20,580	21.0	35.7	29.5	21.2	27.5
III Landowner	1,113	18.0	14.5	21.7	8.8	15.9
All	26,682	23.6	38.9	31.4	22.5	29.6
Ratio I:III		1.96	3.99	2.02	3.56	
			Age group 5-14			
I Agricultural laborer	14,201	3.5	4.6	4.3	3.6	4.0
II Owner/worker	56,523	2.5	3.2	2.0	1.9	2.6
III Landowner	3,314	2.4	2.1	2.1	1.5	2.0
All	74,038	2.7	3.4	2.9	2.2	2.8
Ratio I:III		1.46	2.19	2.05	2.40	
			Age group 15-44			
I Agricultural laborer	19,962	2.8	5.7	3.6	2.4	3.6
II Owner/worker	77,807	1.8	3.5	2.0	2.1	2.4
III Landowner	4,390	2.7	3.2	1.2	1.7	2.2
All	102,159	2.0	3.8	2.3	2.3	2.7
Ratio I:III		1.04	1.78	3.00	1.41	
			Age group 45+			
I Agricultural laborer	7,372	18.6	65.6	29.9	23.4	34.0
II Owner/worker	29,452	16.2	35.3	20.4	21.7	23.3
III Landowner	2,156	19.9	44.1	24.0	26.8	28.7
All	38,980	16.9	41.4	22.4	22.3	25.6
Ratio I:III		0.93	1.49	1.25	0.87	

Consideration of the mortality rates of persons over age 45 shows that differences between levels I and III are less marked and are even reversed in 1974 and 1977. Agricultural laborers will bear the brunt of crisis situations: mortality rates for this occupational level in 1975 reach 69.6, whereas for levels II and III they are 35.3 and 44.1. An interesting feature of this age group is that level II rates are below level III rates for all four years 1974-77. Reasons for these differences are under study. One can speculate that a selection effect has taken place in earlier years, and that survivors in level I and especially level II are selectively more robust as compared with those in level III. Further, Group II comprises a variety of occupations, some of which may provide similar economic security after age 45+ to ownership of land. The ratios I:III are not significant.

Size of Dwelling

A single aspect of housing conditions is considered--the floor area of dwellings. The 1974 census included questions on several other items, for instance type of roof. For our purposes, the item mentioned provides sufficient evidence that mortality rates are inversely correlated with levels of housing conditions.

Households are divided into three groups according to the floor area of dwellings. In Group II, the residential area ranges from 170 to 242 square feet. Group III consists of households occupying 243 or more square feet of residential area. Table XII shows that levels of child mortality (ages 1-4) are nearly twice as high for Group I as for Group III. Patterns of mortality for age groups 5-14, 15-44, and 45+ are similar to those indicated in Tables IX and XI.

Ownership

The 1974 census had several questions inquiring about ownership of consumer durables and producers' goods, including numbers of boats and cows possessed by the household. If one considers the number of cows owned and mortality rates in Table XIII, one notices the same pattern of socioeconomic differences discussed earlier. Group I consists of households owning no cows, Group II households having one or two cows, and Group III households having three or more. The mortality rates of children in Group I are well over 25 per 1,000 for the four-year period 1974-77, whereas those for Group III are under 25 for 1975 and 1976 and about 15 per 1,000 in 1974 and 1977. Mortality rates for 1975 and 1976 in Group I are as high as 46.4 and 35.8, respectively. For older age groups results, similar to earlier tables are noted. Figure 3 shows mortality rates for children aged 1-4 by number of cows owned by household heads. Sex differentials clearly are noted, even after controlling for ownership levels.

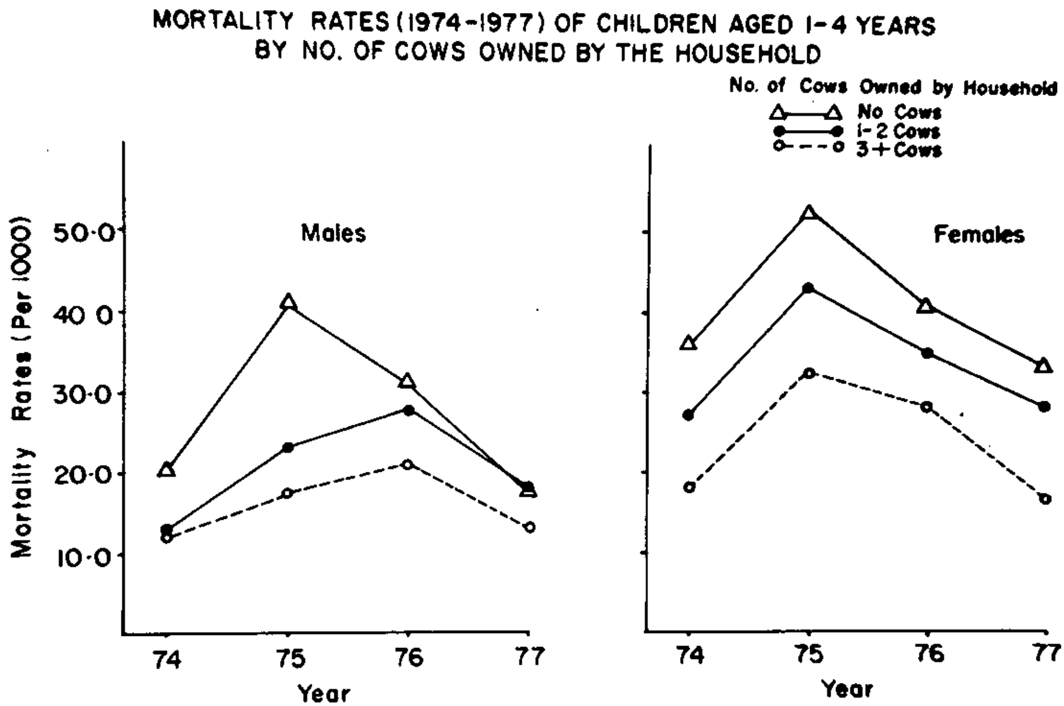
TABLE XII--MORTALITY RATES (PER 1,000) OF VARIOUS AGE GROUPS FOR BOTH SEXES, BY AREA OF DWELLING OF HOUSEHOLDS, MATLAB, BANGLADESH, 1974-77

Area of dwelling (in sq. ft.)	N 1974	1974	1975	1976	1977	1974-77
			Age group 1-4			
I ≤169	8,575	33.1	52.7	36.9	30.5	39.0
II 170-242	6,788	24.7	39.7	33.7	26.7	31.5
III 243+	13,466	16.4	28.9	28.5	15.7	22.7
All	28,829	23.2	38.4	32.1	22.2	29.4
Ratio I:III		2.02	1.82	1.29	1.94	
			Age group 5-14			
I ≤169	22,072	3.9	4.8	4.5	2.8	4.0
II 170-242	20,141	2.7	3.4	3.1	2.3	2.9
III 243+	38,885	1.8	2.4	1.8	1.7	1.9
All	81,098	2.6	3.8	2.9	2.2	2.7
Ratio I:III		2.17	2.00	2.50	1.65	
			Age group 15-44			
I ≤169	30,265	3.3	5.6	2.7	2.7	3.6
II 170-242	25,830	1.8	3.9	2.3	2.1	2.5
III 243+	55,760	1.6	3.1	2.0	1.7	2.1
All	111,855	2.2	4.0	2.3	2.1	2.6
Ratio I:III		2.66	1.81	1.35	1.59	
			Age group 45+			
I ≤169	9,619	28.3	58.9	29.8	23.6	34.7
II 170-242	10,022	21.3	51.5	27.0	24.0	30.7
III 243+	23,847	17.5	35.8	24.8	23.6	25.4
All	43,488	20.8	44.5	26.4	23.7	28.7
Ratio I:III		1.62	1.65	1.20	1.00	

TABLE XIII--MORTALITY RATES (PER 1,000) OF VARIOUS AGE GROUPS BY NUMBER OF COWS OWNED PER HOUSEHOLDS, MATLAB, BANGLADESH

Number of cows owned	N 1974	1974	1975	1976	1977	1974-77
			Age group 1-4			
I 0	15,425	27.0	46.4	35.8	25.2	34.4
II 1-2	7,290	20.6	33.1	31.2	22.8	27.2
III 3+	6,114	15.0	24.6	24.5	14.8	19.9
All	28,829	23.2	37.8	32.1	22.2	29.4
Ratio I:III		1.86	1.89	1.46	1.70	
			Age group 5-14			
I 0	41,821	3.2	3.9	3.2	2.6	3.2
II 1-2	21,750	2.0	2.5	2.6	1.9	2.3
III 3+	17,527	1.7	2.8	2.3	1.5	2.0
All	81,098	2.6	3.3	2.8	2.2	2.7
Ratio I:III		1.88	1.39	1.39	1.73	
			Age group 15-44			
I 0	57,820	2.7	4.8	2.5	2.2	3.0
II 1-2	28,995	1.7	3.2	2.1	2.2	2.3
III 3+	25,040	1.6	2.9	1.8	1.5	1.9
All	111,855	2.2	4.0	2.3	2.1	2.6
Ratio I:III		1.69	1.66	1.39	1.47	
			Age group 45+			
I 0	20,908	25.2	54.5	29.8	26.1	33.7
II 1-2	11,911	19.6	39.2	25.1	22.6	26.5
III 3+	10,669	13.4	31.4	21.3	19.9	21.4
All	43,488	20.8	44.5	26.4	23.7	28.7
Ratio I:III		1.88	1.74	1.40	1.31	

FIGURE 3


MORTALITY RATES (1974-1977) OF CHILDREN AGED 1-4 YEARS
BY NO. OF COWS OWNED BY THE HOUSEHOLD
No. of Cows Owned by Household
No Cows
1-2 Cows
3+ Cows
Males
Females
Mortality Rates (Per 1000)
50.0
40.0
30.0
20.0
10.0
74
75
76
77
Year

HEALTH PRACTICES

The ICDDR,B has begun studies of health practices, especially those linked to mortality due to diarrhoea and water use. Hygienic practices are related to both mortality and social status. Mortality rates for 1974-77 were tabulated for users and nonusers of fixed latrine facilities. For all age groups considered, mortality rates for nonusers of latrines in the home were higher than those of users (see Table XIV). The 1974 census had questions on water use, for example, the use of tubewells, tanks, and other sources of supply. Interpretation of this data is not straightforward, since households utilize a variety of water sources.

The results presented show a clear inverse relationship between various levels of mortality and socioeconomic status in the Matlab area. This inverse relationship persists for all age groups considered: 1-4, 5-15, 15-44 and 45+ years. The criteria used for assessing socioeconomic status--years of education of head of household or mother, occupation, size of dwelling, ownership of cows, and health practices--all were effective for demonstrating higher mortality rates for the lower socioeconomic groups.

Results from the 1975 Bangladesh Fertility Survey (BFS) confirm the findings summarized in the present article. The survey covered the entire country, and the sample consisted of 1,519 urban and 4,626 rural households. Using Brass-type indirect estimation procedures to analyze the information on proportions dead among children ever-born at the time of the survey, Mitra (1979) also has found an inverse relationship between mortality and parents' education, father's occupation, and economic status. Table XV presents estimates of child mortality by educational level of mothers.

Similar results are obtained for the other socioeconomic characteristics. Estimation of q(1), q(3) and q(5)generally is considered to be less affected by reporting errors than is q(0). Using the estimates of q(2), q(3), q(5), implied estimates of q(0) can be obtained from model life tables.

Table XVI shows that the general pattern of higher mortality for children of mothers with less education remains true even in the case of infant mortality. Some caution must be exercised in the conclusions drawn from these results, since an inquiry based solely on infant mortality data in the Matlab area did not show significant differences between the socioeconomic classes. While one can understand that for infants--since they are breast-fed--socioeconomic differences may play a smaller role, the fact remains that the matching of infant deaths to mothers is not easy. In the case of living children, omission of children is very unlikely, since they are recorded at the regular rounds of the enumerator. For dead children, especially those who survived for only a few hours or days, errors in vital registration arise through omission or mis-classification as stillbirths. Results from the Bangladesh Retrospective Survey of Fertility and Mortality 1974 also are consonant with the findings of our

TABLE XIV--MORTALITY RATES (PER 1,000) OF VARIOUS AGE GROUPS FOR BOTH SEXES, BY USE OF LATRINE IN HOUSEHOLDS, MATLAB, BANGLADESH, 1974-77

Use of fixed latrine	N 1974	1974	1975	1976	1977	1974-77
			Age group 1-4			
I No	4,976	28.9	51.0	36.5	23.1	35.6
II Yes	23,853	22.2	35.8	31.2	22.0	28.1
All	28,829	23.2	38.4	32.1	22.2	29.4
Ratio I:III		1.30	1.42	1.17	1.05	
			Age group 5-14			
I No	14,090	3.4	4.5	4.4	2.9	3.8
II Yes	67,008	2.4	3.0	2.5	2.1	2.5
All	81,098	2.6	3.3	2.9	2.2	2.7
Ratio I:III		1.42	1.50	1.76	1.38	
			Age group 15-44			
I No	19,585	2.6	5.0	2.9	2.6	3.3
II Yes	92,270	2.1	3.7	2.1	2.0	2.5
All	111,855	2.2	4.0	2.3	2.1	2.6
Ratio I:III		1.24	1.35	1.38	1.30	
			Age group 45+			
I No	7,479	25.4	52.4	29.1	24.3	32.5
II Yes	36,009	19.8	42.8	25.9	23.5	27.9
All	43,488	20.8	44.5	26.4	23.7	28.7
Ratio I:III		1.28	1.22	1.12	1.03	

study. Among the more important socioeconomic mortality differentials studied in the survey were those by education (of both women and their husbands) and house types.

Clearly, the variables we have discussed in this article are correlated. Persons of higher education are likely to belong to families having more possessions, larger houses, and the like. In order to assess whether education still would be important after controlling for the various other parameters--occupation, area of dwelling, number of cows owned, use of fixed

TABLE XV--ESTIMATES OF CHILD MORTALITY BETWEEN BIRTH AND AGE X, Q(X), BY EDUCATIONAL LEVEL OF MOTHERS

Educational level of mother	Estimates of child mortality		
	q(2)	q(3)	q(5)
Illiterate	20.4 (987)	23.5 (865)	24.0 (645)
Less than 5 years	17.8 (145)	17.4 (124)	18.6 (77)
5-8 years	13.2 (162)	12.7 (126)	15.6 (62)
9 years or more	13.4 (63)	14.4 (37)	6.2 (18)

Note: Figures in parentheses are the numbers of respondents in each category.
Source: Bangladesh Fertility Survey, 1975.

TABLE XVI--IMPLIED INFANT MORTALITY RATE,[a] Q(O) BY EDUCATIONAL LEVEL OF MOTHERS

Educational level of mother	Derived from the estimate		
	q(2)	q(3)	q(5)
Illiterate	16.2 (2278)	17.3 (3564)	16.0 (645)
Less than 5 years	14.2 (328)	12.8 (564)	12.6 (456)
5-8 years	10.7 (383)	9.7 (490)	10.8 (350)

a Derived from the Coale-Demeny West model life tables, assuming a sex ratio at birth of 100(M/F)=105.

Note: Figures within parentheses are the numbers of children ever-born to respondents in each category.

Source: Bangladesh Fertility Survey, 1975.

latrine--three-way tabulations were prepared. These are found in Table XVII. The inverse relationship of mortality rates with education, even controlling for other socioeconomic characteristics, are quite clear from the table.

Mitra, (1979) using BFS data, constructed a simple index of economic status--poor, middle, rich-depending on the possessions of such items as radio or watch. Controlling for economic status thus defined, he found a similar inverse relationship between parents' literacy and mortality.

In order to understand more clearly the relationships among the various socioeconomic variables, multivariate analysis of the data is being undertaken. Within the limited framework of existing computer facilities at the ICDDR,B (an IBM System 34), preliminary work has been done on the 1981 SES data. Table XVIII shows a zero-order correlation matrix of some of the variables studied.

From the table, one notices, somewhat unexpectedly, that the number of years of schooling of the household head is lightly correlated with the other variables. The strongest correlation (0.91) exists between highest education and area of house. Interestingly enough, use of a fixed latrine is fairly strongly correlated with highest education (0.44) and with area of house (0.46). On the basis of the limited data, one might propose the use of highest education of a family member as a reasonable proxy for the information contained in the other two variables. A factor analysis study clearly would be useful.

Apart from the development of methodological tools for mortality studies, the major importance of the results from the Matlab investigations is that serious differentials in mortality levels have been documented for various socioeconomic strata in a rural area of Bangladesh--the lowest strata having the highest mortality levels. The inverse relationship between education of mother and mortality rates have been shown strikingly. In the age group 1-3 years, the mortality rates are more than five times higher for children of mothers having no education, compared with mothers having seven or more years of schooling. The vulnerability of the lowest socioeconomic status groups to very high mortality rates during times of crisis also has been shown. Higher SES groups appear to have a higher capacity to withstand the hardships arising from floods and subsequent shortage of food.

Differentials in infant mortality rates by SES are linked to such biological factors as month of gestation, height of mothers and weight of infant (Chowdhury, 1982). Pre-term deliveries were common among mothers with no education. Higher neonatal death rates are found among children of mothers with no education. More studies on infant mortality need to be undertaken, to separate the various confounding social and biological variables. Further studies relating birth weights and infant mortality can be undertaken in the rural setting of Matlab.

TABLE XVII-MORTALITY RATES (PER 1,000) FOR CHILDREN OF BOTH SEXES AGED 1-4 YEARS, BY EDUCATION OF HOUSEHOLD HEAD AND OTHER SOCIOECONOMIC VARIABLES, MATLAB, BANGLADESH 1974-77

Education of household head (years of schooling)	N 1974	Occupation			
		Agr.laborer	Owner/ worker	Land-Owner	All
0 (no schooling)[a]	128,772	32.8	23.0	20.4	25.2
1-6	83,066	26.9	18.5	8.9	19.1
7+	30,021	9.5	13.5	10.4	13.1
All	241,859	31.2	19.9	13.5	21.7
		Area of dwelling			
		169	170-242	243+	All
0 (no schooling)[a]	142,350	31.4	26.7	18.3	25.3
1-6	90,324	24.8	19.6	16.2	18.8
7+	32,596	17.0	19.6	11.5	12.9
All	265,270	28.9	23.5	16.2	21.5
		Number of cows owned			
		0	1-2	3+	All
0 (no schooling)[a]	142,250	29.2	22.6	16.9	25.3
1-6	90,324	22.0	17.6	14.0	18.9
7+	32,596	14.3	13.1	10.3	13.0
All	265,270	25.3	19.6	14.8	21.5
		Use of fixed latrine			
			Yes	No	All
0 (no schooling)[a]	142,350		22.3	28.7	25.3
1-6	90,324		18.7	19.6	18.8
7+	32,596		12.6	16.0	12.9
All	265,270		20.6	26.0	21.5

a Or religious schooling only ("Maktab")

Note: The slight differences in rates for "All" in the "Occupation" section of the table are due to the differences in N. The results for "All" in the other sections are in principle identical, except for "rounding off" differences. Deaths of a few children born before 1974 have been missed from the data tape from which the three-way table has been prepared, using computer facilities in Bangkok. The results substantially are comparable with those presented earlier in two-way tabulations.

TABLE XVIII--ZERO-ORDER CORRELATION MATRIX OF SOCIOECONOMIC VARIABLES FROM FIVE SELECTED VILLAGES IN MATLAB, BANGLADESH, 1981

	X_1	X_2	X_3	X_4	X_5	X_6
X_1	1	-0.08	0.12	0.06	-0.07	-0.17
X_2		1	0.44	-0.12	0.46	0.11
X_3			1	0.07	0.91	-0.14
X_4				1	0.13	-0.09
X_5					1	-0.10
X_6						1

X_1 = Years of schooling of household head

X_2 = Use of fixed latrine

X_3 = Highest education of member of household

X_4 = Number of cows owned

X_5 = Area of house

X_6 = Occupation of household head

CAUSE OF DEATH

The Matlab death reporting system has undergone some changes over the last 15 years. As of 1966 (the first year for which the Data Management Branch has documentation), deaths were classified in 22 categories. Those categories were reduced to nine in 1968, and the list was expanded to 27 categories in 1974. In 1980, smallpox was dropped. Details of the methods used and limitations of the cause of death data are discussed in Appendix 2.

Much valuable information has been generated by the system to date. Tabulations of deaths by causes are available in DSS reports for 1974 through 1979 (see reference list); 1980 and 1981 reports will be available in the near future. Based on an analysis of 1975-1977 data, Chen *et al.* (1980) reported that the tetanus neonatorum death rate (per 1,000) was 37.4 at Matlab. After adjusting for the effect of a diarrhoea treatment center they concluded that the infant death rates (per 1,000) due to diarrhoea was 19.6, for respiratory diseases 10.4 and for fever 7.3. However, the rate of infant deaths due to "other" causes as well as unknown causes was as high as 62.2 (per 1,000). The overall infant mortality rate was 142.6/1,000. In the case of children (aged 1-4 years) death rates (per 1,000) due to diarrhoea - 15.1 (adjusted rate) and measles - 4.5 were recorded as the most important reported rates of causes of death in the absence of health interventions. Another study from the Matlab area has provided valuable insight into the coincidence between the clinical syndrome of neonatal tetanus and the local classifications of *alga, dhanustonkar* and *takuria,* demonstrating that not all *alga, dhanustonkar* or *takuria* deaths could be attributed to neonatal tetanus (Rahman *et al.,* 1981).

Table XIX presents data on infant and child deaths for 1975-77 (D'Souza and Chen 1980). A few important causes of death--tetanus, diarrhoeal diseases, respiratory diseases, and measles--have been singled out, because of their relevance and the reasonable likelihood of accurate identification. For infants, tetanus appears to account for about a quarter of all deaths. Respiratory and diarrhoeal diseases are next in importance. Sex differentials with regard to cause of death do not appear significant during infancy. Since tetanus presumably is due to unhygienic treatment of the umbilical cord during the neonatal period, the lack of a strong sex differential for this cause of death is not surprising. For the age group 1-4 years, diarrhoeal diseases, respiratory diseases and measles are the most important causes of death. Sex differentials are noted for all infectious causes of death, with female deaths being consistently higher than male deaths.

Table XX provides reported "cause of death" of infants by sex and age at death in months for the year 1979. Tetanus accounts for more than 50% of the reported infant deaths, and more than 70% of the deaths occurred under age 1 month. As mentioned earlier, the large majority of watery diarrhoea deaths are averted by the treatment center. Respiratory diseases and measles are two other important reported causes. Measles deaths first are reported between 5 and 6 months of age. The occurrence of measles among children 6 months of age has been recorded by the DSS. The implications for measles vaccine campaigns are important, since the vaccine usually is administered to children over 9 months of age. Further studies, with serological confirmation of measles, are underway. The large number of deaths in the "other" classification, at ages under 3 months, also requires more investigation.

Causes of death have been studied in greater detail in the Companiganj Health Project than in the Matlab area. Causes of death were determined retrospectively by family interviews, which were reviewed by a committee of physicians. Immediate and underlying causes of death were recorded. Where some doubts remained, a physician was sent to interview the family. As field investigators became more proficient, fewer visits by physicians were necessary--the percentage of such visits required for the years 1975, 1977

TABLE XIX--INFANT (0-11 MONTHS) AND EARLY CHILDHOOD (1-4 YEARS) MORTALITY BY SEX AND MAJOR CAUSES OF DEATH IN MATLAB, BANGLADESH, 1975-77

Cause of Death	Sex	Infant Deaths Number	Infant Deaths Per 1,000 Live Births	Child Deaths Number	Child Deaths Rate Per 1,000 Population
Tetanus	Both sexes	1174	37.42	59	0.60
	Male	599	37.26	30	0.59
	Female	575	37.59	29	0.61
Diarrhoeal diseases	Both sexes	91	2.90	153	1.55
	Male	50	3.11	67	1.32
	Female	41	2.68	86	1.80
Respiratory diseases	Both sexes	328	10.45	160	1.62
	Male	163	10.14	66	1.30
	Female	165	10.79	94	1.96
Measles	Both sexes	96	3.06	440	4.46
	Male	45	2.80	194	3.82
	Female	51	3.33	246	5.14
Others	Both sexes	2352	74.96	1992	20.19
	Male	1180	73.39	824	16.24
	Female	1172	76.62	1168	24.39
All causes	Both sexes	4041	128.80	2804	28.43
	Male	2037	126.69	1181	23.27
	Female	2004	131.01	1623	33.89

TABLE XX--NUMBER OF INFANT DEATHS BY SEX, REPORTED CAUSE OF DEATH AND AGE AT DEATHS IN MONTHS, MATLAB, 1980

SEX	Cause of Death	%	N	Age at Death in Months											
				0	1	2	3	4	5	6	7	8	9	10	11
MALES	1. Tetanus	59.6	204	175	17	5	4	1	1	0	0	1	0	0	0
	2. Measles	1.2	4	0	0	0	0	0	0	1	0	0	1	0	2
	3. Diarrhoea	1.8	6	0	0	0	1	0	1	1	1	1	0	1	0
	4. Respir.	6.4	22	5	4	2	2	2	2	0	0	2	1	2	0
	5. Others	31.0	106	55	17	6	6	4	2	2	7	2	1	2	1
	Total	100.0	342	235	38	13	13	7	6	4	8	6	3	5	3
FEMALES	1. Tetanus	50.4	214	174	21	9	3	2	0	2	2	0	1	0	0
	2. Measles	2.6	11	0	0	0	0	0	1	1	1	2	2	2	2
	3. Diarrhoea	3.3	14	0	0	1	1	2	1	2	3	2	0	2	0
	4. Respir.	7.1	30	8	7	0	6	1	0	3	2	1	1	1	0
	5. Others	36.7	156	75	16	19	7	8	5	4	7	3	4	4	4
	Total	100.0	425	257	44	29	17	13	7	12	15	8	8	9	6

Note: The data are from the DSS. Analyses and comparability of reported cause of death for various time periods is underway (Zimicki, *et al.*, c.f., Appendix 2).

and 1978 were 78,62,37 and 25, respectively (Chowdhury, S.A. and Khan A.H., 1980). Table XXI shows death by sex and cause for the years 1975-78. The most frequent causes of death were diarrhoea, malnutrition, pneumonia and birth-associated causes (prematurity, birth injury, neonatal tetanus).

If one related causes of death to land holdings one could better understand the variations in death rates that took place over the years 1975-78. Diarrhoea and malnutrition account for most of the observed variation in mortality over the years 1975-78, and of differences between the various land holding groups (Figure 4). Families with more than 3 acres of land have very few deaths from birth-associated conditions. Diarrhoea deaths are highest among the poorer groups. Better sanitation among wealthier families may have played a role, though such differences as exist are not great. The drop in diarrhoea deaths among the landless from the crisis years (1975-76) to the normal years (1977-78) is remarkable. On this evidence, it is more likely that the difference in diarrhoea death rates between richer and poorer groups is due to better nutrition.

This section on "cause of death" provides useful information, but large areas have been undocumented. Adult mortality must be investigated. Some studies have considered specific problems, for example maternal mortality (Chen *et al.*, 1974). Morbidity and mortality for the age group (45 years and over) remains to be investigated. A list of health problems of Bangladesh are found in the "Bangla Health Profile" (1977). This incidence and mortality rates quoted remain tentative in a country with a meagre vital and morbidity registration system.

The specific role of the ICDDR,B is to conduct research in diarrhoeal diseases and directly related subjects of nutrition and fertility. Thus, the mandate of the ICDDR,B is fairly restricted; and the health interventions undertaken by the Centre have, apart from diarrhoea control, concentrated on components of an MCH/FP package (Rahman and D'Souza, 1980).

At its inception, the focus of research in the Matlab area was mainly on cholera. A diarrhoea treatment center was established, and a fleet of speedboats was maintained as ambulances to transport patients to the treatment center. Direct assessment of mortality reduction due to the treatment center is not possible, since nearly all cases of watery diarrhoea deaths are saved through the system of speedboats and the clinic. Indirect estimates of "deaths averted" have been made. Assuming that 50% of the cholera field cases would have died without the facilities of the treatment unit, Mosley *et al.* (1972), concluded that the reduction in the crude death rate in the Matlab area was 9.1%. Using severity of dehydration information at the treatment center and similar assumptions, Chen (1978) assessed the reduction in the CDR due to the treatment center to be about 14.2%.

Between 1963 and 1974, the ICDDR,B conducted five large-scale cholera vaccine trials in the Matlab area. The results showed that the protection achieved was partial and short-lived (Mosley *et al.*, 1973, Curlin *et al.*, 1975). As a result of these studies, it was concluded that hospital-based therapy was more effective.

TABLE XXI--CAUSES OF DEATH AT COMPANIGANJ ACCORDING TO SEX, PERCENTAGE AND RATE PER 100,000 (CUMULATIVE 1975-78)

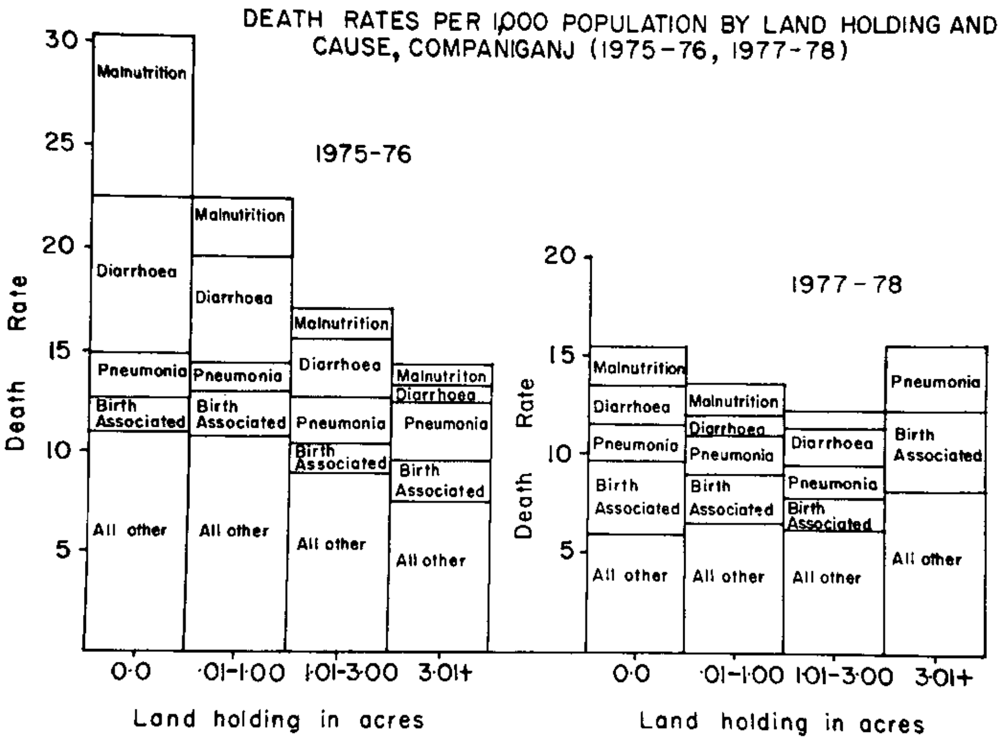
Causes of death	Male (No.)	Female (No.)	Total (No.)	Percent	Rate/100,000
ALL CAUSES	385	392	777	100	1791.9
Diarrhoeal diseases	50	77	127	16.3	292.9
Malnutrition	50	52	102	13.1	235.2
Pneumonia	39	45	84	10.8	193.7
Prematurity/birth Injury/asphyxia etc.	39	28	67	8.6	154.5
Senility	24	23	47	6.0	108.4
Tetanus	19	15	34	4.4	78.4
C.V.A.	17	18	35	4.5	80.7
Pulmonary T.B.	18	8	26	3.3	60.0
Fever	10	11	21	2.7	48.2
Measles	10	11	21	2.7	48.2
Drowning	10	10	20	2.6	46.1
Heart diseases	12	5	17	2.2	39.2
Chr. lung disease (not TB)	10	6	16	2.1	36.9
Maternal death	0	12	12	1.5	27.7
Acute abdomen/ intest. obst.	6	3	9)		
Cancer	5	4	9)		
Injury/accident	3	5	8)		
Liver disease	4	3	7)		
Anemia	2	5	7)		
Skin infection/abcess	4	2	6)		
Whooping cough	3	2	5)		
Acute nephritis	2	3	5)		
Burn	1	3	4)		
Meningitis	2	2	4)	10.4	186.3
Peptic ulcer	4	0	4)		
Suicide/homicide	0	3	3)		
Diphtheria	2	0	2)		
Chicken pox	1	1	2)		
Rheumatic fever	1	1	2)		
Sore mouth	1	1	2)		
Brain tumor	0	1	1)		
Congenital deformity	1	0	1		
Others	12	6	13	2.3	41.5
Unknown	23	26	49	6.3	113.0

Denominator: 43362

Individual percentage and rates have not been calculated for frequencies under 10.

Source: Chowdhury and Khan, 1980.

FIGURE 4



Source: Chowdhury and Khan, 1980

Following recent trends regarding health care, the ICDDR,B has focused its attention on community-based interventions. An evaluation of a second ICDDR,B field station at Teknaf--where transport is not provided to patients--showed that 90% of the diarrhoeal patients lived within one mile of the Teknaf treatment centre. The attendance rate fell to 60 and 40 percent, respectively, for patients living two or three miles away from the station. Few patients living more than 5 miles away utilized the Centre (Rahaman M.M. *et al.*, 1982).

To assess the impact of a village-based approach to diarrhoea treatment, an oral therapy field trial was set up in 1978. An 80% use rate was registered within a few months of the inception of the program. These results indicate that it is possible to decentralize hospital services, without adversely affecting the mortality rate.

Moreover, people from the areas where ORS was distributed came less frequently to the Matlab diarrhoea treatment center than did people from other areas. Most of this difference--amounting to about 6 per 1,000 population--was due to a smaller number of patients with at most mild dehydration at the time of admission. By the second year of the study, a small difference of about one year per thousand population was noted with moderate or severe dehydration (Zimicki *et al.*, 1982). An earlier result, based on a pilot study, reported a greater difference (Chen *et al.*, 1980-b).

The components of the MCH-FP package were introduced gradually into the Matlab area from October 1977. Initially, only family planning services and the treatment of minor ailments in women and children were offered; but as the programme got underway other selected inputs--immunization, oral therapy, and nutrition education--were introduced. These inputs were introduced in half the study zone (treatment area), while in the other half (comparison area) there were no specific inputs besides overall diarrhoeal services through the ambulance system and ORS. Table XXII shows a striking difference between the treatment and comparison area with regard to the CBR. A five-point difference in 1978 increased to over 8 points in 1980-81, and was as large as 12 points in 1978. The CDR for the treatment area has been brought under 12 per thousand, but remains more than 14 per 1,000 for the comparison area.

Table XXIII considers neonatal and post-neonatal rates for the 4 years 1978-81, by treatment and comparison area. For the MCH-FP area, one notices that the years 1980-81 show substantially lower rates than do the corresponding ones for the years 1978-79. Thus, the neonatal mortality rates per 1,000 are 59.3 and 65.8 in 1980 and 1981, respectively, as against 69.0 and 70.9 in 1978 and 1979, respectively. The post-neonatal rates also are lower in the years 1980 and 1981, compared to the years 1978 and 1979. The very low 1980 male neonatal and post-neonatal mortality rates in the MCH-FP area are under investigation. If one turns to the comparison area, one also notices a decline over the four years: 1978 through 1981 neonatal rates being 78.7, 74.6 and 69.0, respectively. These rates remain a few points higher than the corresponding MCH-FP area rates. With regard to the post-neonatal rates in the comparison area, while male children have similarly

TABLE XXII--CRUDE BIRTH AND DEATH RATES AND RATES OF NATURAL INCREASE FOR THE MCH-FP AND COMPARISON AREAS IN MATLAB (1978-1981)

Area	Year	Mid-year Population	CBR (per 1000)	CDR (per 1000)	Crude Rate of Natural Increase
MCH-FP	1978	88,925	32.1	12.5	19.6
	1979	89,574	34.9	12.1	22.8
	1980	91,010	37.1	11.3	25.8
	1981	92,634	35.3	11.9	23.4
Comparison	1978	84,518	37.8	13.8	24.0
	1979	86,313	47.0	15.6	31.4
	1980	88,280	45.5	14.8	30.7
	1981	90,377	43.8	14.4	29.4

declining rates as in the treatment area, the mortality rates for female children show little decline over the four years. The difference between the MCH-FP and comparison area female post-neonatal rates was 1.5 in 1978, whereas in 1981 it rose to 16.5.

The introduction of the immunization program would account for the lowering of neonatal mortality, particularly in the MCH-FP area. The specific mortality impact due to tetanus immunization in the Matlab area is presented in Appendix 3, as an extract from a paper by Rahman *et al.* (1982). The integrated health program, including oral therapy, may account for the lowering of post-neonatal rates in the treatment area, some cross-over effect to the comparison area also may be occurring. Sex biases in mortality have been reported in the Matlab area beginning with post-neonatal rates. The comparison area rates would tend to confirm this culturally-related phenomenon (D'Souza and Chen, 1980, cf. Appendix 1).

A review of Table XXIV shows that for children aged 1-4 years, mortality rates in the MCH-FP area are lower (about 19 per 1,000) than in the comparison area (about 25 per 1,000). The higher female rates in both areas should be noted. One thus would legitimately conclude that, while the presence of health services does bring about a lowering of mortality rates, the use of such services remains subject to the various cultural and other biases that may exist within the population.

TABLE XXIII--NEONATAL AND POST-NEONATAL MORTALITY RATES (PER 1,000 LIVE BIRTHS) OF THE SAME CALENDAR YEAR, MATLAB (1978-81) FOR THE MCH AND COMPARISON AREAS

Area		MCH-FP		Comparison	
Year	Sex	Neonatal	Post-Neonatal	Neonatal	Post-Neonatal
1978	Male	70.9	42.7	75.0	44.4
	Female	67.0	48.5	82.5	49.6
	Both	69.0	45.5	78.7	47.0
1979	Male	71.3	40.5	81.9	42.1
	Female	70.6	46.6	66.9	44.6
	Both	70.9	43.5	74.6	43.3
1980	Male	51.0	23.2	70.0	32.6
	Female	67.2	42.4	75.6	50.8
	Both	59.3	32.6	72.7	41.3
1981	Male	67.4	36.6	68.2	37.8
	Female	64.2	38.8	69.8	55.3
	Both	65.8	37.7	69.0	46.3

TABLE XXIV--AGE/SEX SPECIFIC DEATH RATES (PER 1,000) FOR CHILDREN UNDER 5 YEARS OF AGE, FOR THE MCH-FP AND COMPARISON AREAS IN MATLAB (1978-81)

Area	Age Group (years)	Sex	1978	1979	1980	1981
All	<1*	M	116.6	118.7	91.0	105.1
		F	124.3	114.0	120.1	115.1
		T	120.4	116.4	105.1	110.0
	1-4	M	16.9	16.1	16.1	16.0
		F	28.2	27.6	27.8	28.2
		T	22.3	21.6	21.7	21.9
MCH -FP	<1*	M	113.6	111.8	74.8	104.0
		F	115.5	117.3	109.6	103.0
		T	114.5	114.4	91.9	103.5
	1-4	M	17.3	13.7	14.5	11.7
		F	28.0	20.8	22.9	26.7
		T	22.5	17.1	18.6	18.9
Comparison	<1*	M	119.4	124.0	102.6	106.0
		F	132.0	111.4	126.4	125.1
		T	125.8	118.0	114.0	115.3
	1-4	M	16.3	18.5	18.5	20.0
		F	28.3	34.5	32.9	29.7
		T	22.1	26.2	25.4	24.7

* Per 1,000 live births of the same calendar year.

In the section on levels and trends in mortality, it has been shown that in Bangladesh, as a whole, mortality rates (per 1,000) fell from about 40 to about 20 during the period 1950-65. This achievement on a national level largely has been the result of such vertical programs as malaria and smallpox eradication. The availability of drugs and some preventive measures, including the introduction of tube wells etc., also are considered as reasons for the reduction in death rates. It is suggested that the establishment of rural health complexes would have a direct impact on future reduction of mortality levels (ESCAP, 1981). The Teknaf study referred to earlier, showing rapidly falling clinic attendance after 3 miles, throws some doubt on this approach.

Studies on tube well use also have shown that the mere introduction of tube wells does not diminish the incidence of diarrhoea, since water is utilized from a variety of sources (Curlin *et al.*, 1977). There is a need for health education, including appropriate sanitation, e.g. a small study on hand washing has shown that the use of soap can diminish secondary attack rates of *Shigella* (Khan M.U., 1980). Some approaches which appear simple, such as the use of boiled water for drinking, in fact are outside the reach of large sections of the population. A study in fuel use has shown that the costs of boiling water would account for more than 30% of a poor family's income (Skillicorn and Gilman, 1981).

The Companiganj data on causes of death show that for the period 1975-78 malnutrition accounted for 13.1% of deaths (Table XXI). The availability of food always is a crucial question in Bangladesh, and depends heavily on climatic conditions and favorable monsoons. The unsettled political situation during the last decade also contributed to the problem of the availability of food. Forty-six percent of families in rural areas and 95% in urban areas have calorie intakes below an acceptable level. Iron and vitamin A deficiencies are common (Bangladesh Health Profile, 1977). Per capita protein and calorie consumption have been estimated to have declined during the 1960-76 period. The average total calorie intake was estimated at 2,094 in 1975-76, compared to 2,301 in 1962-64 (Nutrition Survey 75-76). Any strategy to cover mortality must take into account a stabilization of food stocks and availability over crisis periods. The fragile economy of the country largely has been responsible for the overall crude death rate for the last decade in Bangladesh, remaining at the fairly high level of just under 20 per 1,000.

SOME COST CONSIDERATIONS

In this section, some data related to the cost of the DSS and the diarrhoea treatment center in Matlab are presented. The collection of mortality data on the DSS is a costly, intensive affair, which cannot easily be replicated elsewhere. A comparison of the costs involved in the DSS with other projects which monitor vital events in "small areas" can provide important elements for policy decisions regarding vital registration. Design and costs of data collection from the Companiganj health project briefly are compared with the DSS, to point out some strengths and weaknesses of the two systems. With regard to the treatment of diarrhoea, the cost per patient utilizing the Matlab treatment center and a small decentralized unit at Shotaki village in the Matlab area are compared. Costs for using the speedboats as ambulances are assessed, and results attempting to quantify the "cost per death averted" are shown.

Comparative Vital Registration Costs

A detailed description of the DSS was presented at the beginning of this report. The Companiganj health project started as a joint venture of the Government of Bangladesh and a voluntary agency. It was designed to establish a model of the National Integrated and Family Planning Program of 1973 in a single thana. In this model, it was proposed that various features of the government's program would be tested and evaluated, and that there would be experimentation with certain modifications, particularly local recruitment of women to work in their own unions (a sub-unit of a thana) and the development of a maternal child care program.

In September 1974, a separate Evaluation Unit was established, that carried out a 10% enumeration survey and began monthly vital registration to record all births, deaths, and migrations in a 10% sample of houses. The objective was to observe changes in vital rates which might occur as a result of project interventions, and to provide basic information on demographic and health variables in a defined population (Ashraf *et al.*, 1980).

Table XXV presents a comparison of some of the main items distinguishing the Matlab and Companiganj health projects. One striking element is clearly the difference in cost. The DSS has been budgeted to cost around $300,000 per year, in comparison with $20,000 per year for the Companiganj project. On a per capita survey basis, however, the costs are not very different.

Efforts are being made to reduce the costs of the DSS system. An integral part at the moment is supervision of staff, which is effected by speedboats. The rising costs of gasoline make intense supervision costly.

Twenty percent of the budget has been allocated to transport costs. Personnel costs are high, accounting for nearly half of the overall budget. Cheaper surveillance systems clearly are necessary. The question remains whether the type of intensive field check-ups, both in terms of vital registration and of in-depth studies, that can be done in Matlab are feasible using cheaper surveillance systems.

The Companiganj project has been conducted on a sample basis. The evaluation unit costs about $20,000 per annum. Some of the advantages of the Matlab project are shared by the Companiganj health project. However, intensive field case-control studies have not been carried out in the CHP, since the orientation of the two projects is quite different. Of interest in the Companiganj project is the fact that an evaluation unit can be attached to a health intervention program without much additional cost

TABLE XXV--ITEMS OF COMPARISON BETWEEN MATLAB AND COMPANIGANJ HEALTH PROJECT

Item	Matlab Project	Companiganj Health Project
1. Population (1974)	160,000	114,000
2. Cost	$ 300,000 p.a.	$ 20,000 p.a.
3. Type	Longitudinal	Longitudinal
4. Sample	100%	10% systematic
5. Lowest level data-collection personnel	Educated female workers	Uneducated female workers
6. Purpose	Research-oriented with special ref. to diarrhoeal diseases	Program evaluation oriented with ref. to integrated and Family Planning Programs
7. Studies undertaken	Vital Rates/ Several In-depth studies	Vital Rates/Causes of death
8. Time period	1966 - Present	1975-1980
9. Scope	Related to national and international programs	Related to national programs
10. International staff	Presence continuing	Present for first few years

(Chowdhury S.A. *et al.*, 1978). If one needed vital rates and changes only, evaluation units of the Companiganj type would be sufficient. Similar inverse relations between mortality and socioeconomic status were recorded within Matlab and Companiganj. However, even in Companiganj, due to the size of the effects of the famine, it has not been possible to separate out the effects of the program from those due to the famine.

Limitations of the Matlab project also would apply to the Companiganj health project. For instance, if a long-term use of the same sampled areas were envisaged, a "contamination" effect would set in. To avoid this, some sort of sample rotation would be necessary. In fact, the Companiganj evaluation unit has been closed for lack of funding. The Companiganj project too suffered from inadequate data reporting: the first full scale reports covering the five-year period were issued in 1980. This aspect of data processing is one which is overlooked in many projects in developing countries. The time lag between data collection and publication of reports often is as long as three to five years. The value of the results thus are diminished (D'Souza, 1981).

Cost Effectiveness Studies

The Matlab treatment center was opened in 1963 to treat diarrhoeal diseases in the area, in particular cholera. While services were provided, the focus of work was mainly for research, and a fleet of speedboats was used as ambulances for ethical reasons, to prevent any deaths in the study area. As reported in the health intervention and mortality section, one study (Mosley *et al.*, 1972) showed that the treatment center was more effective than a cholera vaccine campaign. During the cholera epidemic, it was estimated that the treatment center averted 159 deaths of the 318 cases treated. The assumption utilized was that 50% of the cases would have died. Inoculation against cholera would have averted fewer than 143 of the hospital cases, and thus fewer deaths. In 1980 prices--using a World Bank price index--the cost of treatment per patient would have been $14.91 and the cost per death averted--$603.48. Mosley's cost estimates for the treatment center and an immunization program suggest that the former would have been more cost-effective. A later study (Oberle, *et al.*, 1980) showed that the cost per patient in the hospital was between $38 to $81. Translated into 1980 prices, costs would have been $13.83 per patient treated and $48 to $102 per death averted. The costs of an immunization campaign were not calculated, but were indicated to be higher. The 1980 price conversions mentioned earlier are taken from a working paper (Horton, 1982) recently prepared, to compare the cost-effectiveness of the Matlab treatment center with its speedboat ambulance service and an alternative decentralized unit in Shotaki village in the Matlab area. When an ambulance boat was withdrawn from Shotaki, the unit was set up with community participation for diarrhoea treatment. The ICDDR,B supplies the necessary medical and office supplies, and has trained six volunteers to give oral and I.V. fluids, as well as certain drugs.

Table XXVI--presents a summary of cost-effectiveness figures for the Matlab treatment center, with ambulance costs shown separately, and for the Shotaki clinic. The term "long-run average cost" includes both user-dependent cost (drugs, food, gasoline) and user-independent costs (wages, etc.), as well as equipment and depreciation costs. In the determination of costs, the concept of economic resource costs was utilized. Even for a resource which is available free to the center, such as the building of the Matlab treatment center, a cost was imputed equivalent to the cost that would have been necessary to rent the facility. Further, since the treatment center has a research function, some joint costs had to be allocated partially as a service cost. Various estimates have been provided in the working paper. The maximum variant has been shown in Table XXVI.

The cost "per death averted" by the treatment center shown in the table is more than twice that estimated by Mosley, and more than 12 times that

TABLE XXVI--SUMMARY OF COST-EFFECTIVENESS FIGURES, IN US $

	Matlab TC*	Ambulance	Shotaki
Long-run average cost per patient	16.77	12.89	3.36
Long-run average cost per severe patient[1]	676.21	178.53	93.59
Long-run average cost per "death averted"[2]	1352.40	357.06	187.19
User Numbers	10,618	4,359	891
Number of severely dehydrated	263	157	32

Note: 1 Patients for whom severe dehydration was recorded on admission

2 It is assumed 50% of severely dehydrated patients would have died in the absence of treatment

TC Treatment Center

Source: Horton, 1982

of Oberle. Clearly, there are differences of methodology and assumptions. The Oberle study, for instance, takes no account of expatriate supervision. The estimates of "cost per patient treated" are closer in the various studies, if the rising costs of gasoline are reviewed separately. If one compares the table data for the Matlab treatment center and Shotaki, a first assessment would be that decentralization is cost-effective, even when the high ambulance costs are separated out. However, there are serious problems of comparability. For example, the classification of dehydration status by the volunteers of Shotaki and the staff at the Matlab treatment center could be different. The economic resource cost of Shotaki could have been underestimated. The efficacy of Shotaki depends to a large extent on the continuing logistic and technical support of the Matlab treatment center. Estimation of the cost of such support only in terms of supplies delivered, would be inadequate. A fairer comparison would estimate the costs of maintaining the whole study area by a set of decentralized units completely independent of the Matlab treatment center. The ability to handle epidemic situations that occur seasonally also should be compared. The working paper provides interesting results and highlights the complexity of cost-effectiveness studies, particularly when the confounding needs of both research and services are present and must be separated.

This brief section on cost considerations points to the need for further research and standardization of methodology. Questions related to effectiveness, cost, and availability must be studied. Clearly, immunization, such as that against tetanus, is both effective and cost-effective. Measles vaccine still is costly, though quite effective. Both these immunization approaches require a cold chain, which is difficult to maintain in rural areas without electricity. A vaccine for cholera that is effective still must developed. Savings in costs for diarrhoea treatment by the use of oral rehydration rather than I.V. fluid are considerable (Mosley, 1972). Decentralization of treatment to the village or home also could be a future avenue for cost savings, as well as assuring availability. Studies of costs for introducing preventive measures--water, sanitation and health education especially of the mother--should be undertaken.

CONCLUSION

The brief discussion of the DSS and the various studies done in the Matlab area referred to in this report are an attempt to illustrate the utility of maintaining a "small study area," within which mortality and morbidity processes can be investigated. For a developing country situation, such an area can provide immensely valuable data about a wide range of health and population issues.

The DSS constitutes one of the most valuable institutional resources of the ICDDR,B--and is vital for the conduct of certain types of field research in diarrhoeal diseases, nutrition, population and health care.

Seven broad areas in which the system possesses distinct comparative advantages have been identified:

1. The Matlab Surveillance System is necessary for health, nutrition and demographic research, which require an accurate account of the population. Such demographic information is essential for the computation of rates. Vital and other rates are essential for field research, particularly for the assessment of the impact of various programatic or technologic interventions (e.g., vaccine, oral therapy, contraceptives).

2. The Matlab Surveillance System provides accurate sampling frames for sample surveys or in-depth studies.

3. Because the DSS has been operational since 1966, the age of most children under 14 is known with accuracy in most of the area. Precise age data strengthen selected research in nutrition, population and infectious diseases.

4. Because of the continuous relationship of the ICDDR,B with the Matlab population, including the provision of health and diarrhoeal disease prevention services, some studies requiring client cooperation may be more easily conducted in this, as compared to other areas.

5. The longitudinal nature of the surveillance system facilitates prospective research designs, including the documentation of time trends.

6. The demographic data may reflect national trends, if not national levels, and, thus, may be helpful for national planning purposes.

7. The DSS may be employed as a field training area, in epidemiological, population, nutrition and health care research.

Five limitations of the system are:

1. The DSS is an expensive research instrument, operated by an institution which enjoys a high level of autonomy. It does not necessarily represent a replicable model for others who may require a surveillance system for other purposes.

2. The DSS provides reliable measurements of outcome variables (such as births and deaths), but contains little information on antecedent biosocial causes or processes responsible for the observed outcomes. Except where study designs take this into account, only inferences may be made about the determinants of the observed outcomes.

3. The data collection of the surveillance systems is hierarchical and depends upon close supervision. There is insufficient community participation in the data collection or in the use of the information generated.

4. Past intervention research, current health services, and multiple, concurrent research designs only are several of the factors that may "contaminate" the study design of any individual study in the DSA, sometimes introducing an unquantifiable bias into research results.

5. The transfer of health technology developed at Matlab to other areas of Bangladesh may not be easy. Differentials in pay structure, motivation and supervision, as well as local political and other problems, could be important obstacles to such a transfer.

At the inception of the Matlab project, health intervention was limited to the needs of research projects focusing primarily on vaccine trials. Now, the limited health interventions in the MCH-FP area constitute a serious attempt to combine service and research goals. Recent studies at Matlab have shown that the MCH-FP project had a sustained affect on lowering fertility rates (Phillips, *et al.*, 1982; Stinson, *et al.*, 1982). The affect on the mortality level yet must be assessed, though the reduction cannot be attributed to a single component, such as lower fertility or immunization. Nutrition studies have been made, but major nutritional interventions, apart from education, have not been carried out. A study on food allocation (Chen, *et al.*, 1981), has shown that females may receive less food than males at corresponding ages and requirement levels. This may account for sex differentials in mortality, at least partially indicative of cultural bias.

Education, especially of the mother, is an important indicator of mortality differentials. During the difficult years of 1974-77, children under three years of age of mothers with no education suffered mortality rates five times higher than children of mothers with seven years or more of education. Health care delivery systems must take into account the social stratification of the community. The national health policy will have to focus on selected health care items which reach the economically and culturally disadvantaged segments of the population suffering from the highest mortality rates.

The ICDDR,B is studying the possibility of setting up surveillance systems which are based on repeated cross-sectional surveys. Studies of this kind have been undertaken in various countries. However, indirect estimates of mortality based on such surveys have been unable to provide conclusive results (National Academy of Sciences, 1982). Elements of the Matlab health intervention programs that can be replicated within a framework of normal government inputs, and can be evaluated through a low-cost mechanism are being investigated. A growing need is being felt for field studies to include information on development as well as on health services, in order to evaluate the relative cost-efficiency of different strategies for reducing mortality. At the ICDDR,B, studies are being undertaken relevant to this issue. Problems relating to procedures used by traditional birth attendants and consequent high neonatal mortality have been studied (Bhatia, *et al.*, 1979; Islam, *et al.*, 1982 a, b). Training of such personnel and traditional medical practitioners could be a cost-effective approach to reducing mortality. The decentralization of oral rehydration therapy to small clinics and the family has been referred to in the report.

The fall in neonatal mortality rates due to tetanus immunization of pregnant mothers would indicate that particular preventive measures are, in fact, more efficacious, in the short term, in lowering infant mortality rates than are alternative policies oriented towards more general development. The relationship between nutrition, morbidity and mortality now is under study. The morbidity indicators which would enable health planners to determine particular sectors of the population at high risk of mortality may be isolated. Intervention programs then could be better-focused, if a set of simple input points could be identified. However, long-term and sustained falls in mortality levels would require overall development and availability of food during crisis periods.

REFERENCES

Antonovsky A. Implications of socioeconomic differentials in mortality for health systems. Paper presented at the Mexico City Conference on Socio-economic Determinants and Consequences of Mortality, 19-25 June, 1979.

Ashraf A, Alam N, Khan AH. Companiganj demographic survey 1975 - baseline survey results. Evaluation Unit Report No. 01, Christian Commission for Development in Bangladesh (CCDB), Dhaka, 1980.

Bangladesh Health Profile 1977. Dhaka: Health Information Unit, Health and Population Control Division, Ministry of Health and Population Control.

Bangladesh Census Commission, Statistics Division. Report on the 1974 Bangladesh retrospective survey of fertility and mortality. Dhaka, Ministry of Planning, 1977.

Bangladesh Fertility Survey 1975. First report. Dhaka: Ministry of Health and Population Control, 1978.

Becker S. Seasonality of deaths in Matlab, Bangladesh. Int J Epidemiol 1981;10:271-80.

Bhatia S, Mosley WH, Faruque ASG, Chakraborty J. The Matlab Family Planning-Health Services Project. Stud Fam Plan 1980;11:202-12.

Bhatia S, Chakraborty J, Faruque ASG. Indigenous birth practices in rural Bangladesh and their implications for a maternal and child health programme. Dhaka: International Centre for Diarrhoeal Disease Research, Bangladesh, 1979. 18 p. (Scientific report no. 26).

Black RE, Huber DH, Curlin GT. Reduction of neonatal tetanus by mass immunization of non-pregnant women duration of protection provided by one or two doses of aluminium-absorbed tetanus toxoid. Bull WHO 1980;58:927-30.

Bytchenko B. Geographical distribution of tetanus in the world, 1951 - 60: a review of the problem. Bull WHO 1966;34:71-104.

Chen LC, Gesche MC, Ahmed S, Chowdhury AI, Mosley WH. Maternal mortality in rural Bangladesh. Stud Fam Plan 1974;5:334-41.

Chen LC, Chowdhury AKMA, Huffman SL. Anthropometric assessment of energy-protein malnutrition and subsequent risk of mortality among preschool aged children. Am J Clin Nutr 1980;33:1836-45.

Chen LC, Black RE, Sarder AM, *et al.* Village-based distribution of oral rehydration therapy packets in Bangladesh. Am J Trop Med Hyg 1980; 29:285-90.

Chen LC, Huq E, D'Souza S. Sex bias in the family allocation of food and health care in rural Bangladesh. Pop Dev Rev 1981;7:55-70.

Chowdhury AKMA, Chen LC. The interaction of nutrition, infection, and mortality during recent food crises in Bangladesh. Food Res Inst Stud 1977;16:47-61.

Chowdhury AKMA. Education and infant survival in rural Bangladesh. Health Pol Educ 1982;2:369-74.

Chowdhury SA, Ashraf A, Aldis W. Health care motivation in Companiganj, Bangladesh. Evaluation Unit Companiganj, Bangladesh, 1978.

_____________, Khan AH. Causes of death, Companiganj, Bangladesh 1975-78. Dhaka Christian Commission for Development in Bangladesh, 1980.

Curlin GT, Levine R, Aziz KMA, Rahman ASMM, Verwey WF. Field trial of cholera toxoid. In: Proceedings of the 11th Joint Conference on Cholera. US-Japan Cooperative Medical Science Program. New Orleans, Lousiana, Nov 4-6, 1975:314-29.

Curlin GT, Chen LC, Hussain SB. Demographic crisis: the impact of the Bangladesh civil war (1971) on births and deaths in a rural area of Bangladesh. Pop Stud 1976;30:87-105.

Curlin GT, Aziz KMA, Khan MR. The influence of drinking tubewell water on diarrhoea rates in Matlab Thana, Bangladesh. Dhaka: Cholera Research Laboratory, 1977. 18 p. (Working paper no. 1).

Doring-Bradley B, Johnston R. Socioeconomic classification for the study of mortality differentials. Paper presented at the Mexico City Conference on Socioeconomic determinants and Consequences of Mortality, 19-25 June, 1979.

D'Souza S, Rahman S. Intercensal population growth rates of Bangladesh. Soc Action 1977;27:

_____________, Rahman S. Estimates of Fertility in Bangladesh. Soc Action 1978;28:

D'Souza S, Chen LC. Sex differentials in mortality in rural Bangladesh. Pop Dev Rev 1980;6:257-70.

D'Souza S. Population Laboratories for studying disease processes and mortality; the demographic surveillance system, Matlab, Comilla, Bangladesh. Seminar on Methodology and Data Collection in Mortality Studies. International Union for the Scientific Study of Population, Dakar, 7-10 Jul 1981.

__________________. Small Area Intensive studies for understanding mortality and morbidity processes - two models from Bangladesh: the Matlab Project and the Companiganj Project. Presented at the United Nations/WHO Working Group on Data Bases and Measurement of Levels, Trends and Differentials in Mortality, Bangkok, October 20-23, 1981.

D'Souza S, Bhuiya A. Socio-economic mortality differentials in a rural area of Bangladesh. Pop Dev Rev 1982;8:753-69.

ESCAP. Country Monograph Series No. 8 - Population of Bangladesh - especially Chapter IV "Trends and Differentials in Mortality" Elahi M and Ruzicka LT, ST/ESCAP/147, United Nations, New York, 1981.

Gilman RH, Skillicorn P, Gilman JB, Islam A. Drinking and boiling water: can a fuel scarce community afford it. Manuscript in preparation.

Horton S, Claquin P. Cost effectiveness study of hospital and of ambulance services at Matlab treatment centre. Dhaka: International Centre for Diarrhoeal Disease Research, Bangladesh, 1982. 52 p. (Working paper no. 26).

Islam MS, Rahaman MM, Aziz KMS, Rahman M, Munshi MH, Patwari Y. Infant mortality in rural Bangladesh: an analysis of causes during neonatal and post-neonatal periods. J Trop Pediatr 1982;28:294-8.

Islam MS, Rahaman MM, Aziz KMS, Munshi MH, Rahman M, Patwari Y. Birth care practice and neonatal tetanus in a rural area of Bangladesh. J Trop Pediatr 1982;28:299-302.

Jain MK. Growing imbalance in the sex composition of India. Demography India 1975;4:305-15.

Khan MU, Shahidullah M, Ahmed WU, *et al.* Intervention of shigellosis by hand washing. Dhaka: International Centre for Diarrhoeal Disease Research, 1981. 16 p. (Scientific report no. 54).

Krotki J, Ahmed N. Vital rates in East and West Pakistan - tentative results from the PGE experiment. Pak Dev Rev 1964;4:734-59.

Meira AR. Duration of immunity after tetanus vaccination. Lancet 1973; 2:659-61.

Miller JK. The prevention of neonatal tetanus by maternal immunization. J Trop Paediatr Environ Child Health 1972;18:160-7.

Mitra SN. Infant and childhood mortality in Bangladesh: levels and differentials. Australia: Australian National University, 1979. Thesis.

Mosley WH, Bart KJ, Sommer A. An epidemiological assessment of cholera control programs in rural East Pakistan. Int J Epidemiol 1972;1:5-11.

Mosley WH. Aziz KMA, Rahman ASMM, Chowdhury AKMA, Ahmed A. Field trials of monovalent Ogawa and Inaba cholera vaccines in rural Bangladesh: three years of observation. Bull WHO 1973;49:381-7.

National Academy of Science. Committee on Population and Demography. Report No. 5. Estimation of recent trends in fertility and mortality in Bangladesh, 1982.

Newell KW, Lehmann AD, LeBlanc DR, Osorio NG. The use of toxoid for the prevention of tetanus neonatorum: final report of a double-blind controlled field trial. Bull WHO 1966;35:863-71.

Oberle NW, Merson MH, Islam MS, Rahman ASMM, Huber DH, Curlin GT. Diarrhoeal disease in Bangladesh: epidemiology, mortality averted and costs at a rural treatment centre. Int J Epidemiol 1980;9:341-8.

Phillips JF, Stinson WS, Bhatia S, Rahman M, Chakraborty J. The demographic impact of the Family Planning Health Services Project in Matlab, Bangladesh. Stud Fam Plann 1982;13:131-40.

Rahaman MM, Aziz KMS, Munshi MH, Patwari Y, Rahman M. A diarrhea clinic in rural Bangladesh: influence of distance, age, and sex on attendance and diarrheal mortality. Am J Public Health 1982;72:1124-8.

Rahman M, Mosley WH, Khan AR, Chowdhury AI, Chakraborty J. Contraceptive distribution in Bangladesh: some lessons learned. Stud Fam Plann 1980; 11:191-201.

Rahman M, D'Souza S. A review of findings on the impact of health intervention programmes in two rural areas of Bangladesh. Joint WHO/ESCAP Meeting on Mortality in Asia - A Review of Changing Trends and Patterns 1950-1975, Manila, 1-5 Dec 1980.

Rahman M, Chen LC, Chakraborty J, *et al.* Use of tetanus toxoid for the prevention of neonatal tetanus. 1. Reduction of neonatal mortality by immunization of non-pregnant and pregnant women in rural Bangladesh. Bull WHO 1982;60:261-7.

Rahman M, Chen LC, Chakraborty J, Yunus M, Faruque ASG, Chowdhury AI. Use of tetanus toxoid for the prevention of neonatal tetanus. 2. Immunization acceptance among pregnant women in rural Bangladesh. Bull WHO 1982; 60:269-77.

Stinson WS, Phillips JF, Rahman M, Chakraborty J. The demographic impact of the Contraceptive Distribution Project in Matlab, Bangladesh. Stud Fam Plann 1982;13:141-8.

World Health Organization. Manual of the International Statistical Classification of Diseases, Injuries and Causes of Death, Vol. 1 and 2, Geneva, 1967.

World Health Organization. Lay reporting of Health Information, Geneva, 1978.

WHO/UN Proceedings of the meeting on socioeconomic determinants and consequences of mortality in Mexico City, 19-25 June, 1979, Geneva/New York 1979.

Yusuf F. Abridged life tables for Pakistan and its provinces 1962 - 64. Sydney Conference Proceedings (Liege, IUSSP): 533-41, 1967.

Zimicki S, D'Souza S. Validity of Matlab DSS cause of death reporting 1974 - 1982. Manuscript in preparation.

____________, Yunus M, Chakraborty J, D'Souza S. A field trial of home-based oral rehydration solution in rural Bangladesh. Manuscript in preparation.

REPORTS OF DSS ACTIVITIES

1. Demographic Surveillance System - Matlab. Volume One. Methods and Procedures by Ruzicka L.T., Chowdhury A.K.M.A. March 1978. 27 p. ICDDR,B Scientific Report No. 9.

2. Demographic Surveillance System - Matlab. Volume Two. Census 1974 by Ruzicka L.T., Chowdhury A.K.M.A. March 1978. 44 p. ICDDR,B Scientific Report No. 10.

3. Demographic Surveillance System - Matlab. Volume Three. Vital Events and Migration, 1974 by Ruzicka L.T., Chowdhury A.K.M.A. March 1978. 42 p. ICDDR,B Scientific Report No. 11.

4. Demographic Surveillance System - Matlab. Volume Four. Vital Events and Migration, 1975 by Ruzicka L.T., Chowdhury A.K.M.A. March 1978. 45 p. ICDDR,B Scientific Report No. 12.

5. Demographic Surveillance System - Matlab. Volume Five. Vital Events and Migration and Marriages, 1976 by Ruzicka L.T., Chowdhury A.K.M.A. March 1978. 52 p. ICDDR,B Scientific Report No. 13.

6. Demographic Surveillance System - Matlab. Volume Six. Vital Events and Migration, 1977 by Samad A., Sardar A.M., Becker S., Chen L.C. February 1979. 56 p. ICDDR,B Scientific Report No. 18.

7. Demographic Surveillance System - Matlab. Volume Seven. Vital Events and Migration, 1978 by Chowdhury M.K., Becker S., Razzak A., Sardar A.M., Shaikh K., Chen L.C. May 1981. 71 p. ICDDR,B Scientific Report No. 47.

8. Demographic Surveillance System - Matlab. Volume Eight. Census Update 1978 by Becker S., Razzak A., Sardar A.M. April 1982. 31 p. ICDDR,B Scientific Report No. 55.

9. Demographic Surveillance System - Matlab. Volume Nine. Vital Events and Migration, 1979 by Chowdhury M.K., Razzak A., Becker S., Sardar A.M., D'Souza S. May 1982. 56 p. ICDDR,B Scientific Report No. 56.

10. Demographic Surveillance System - Matlab. Volume Ten. Vital Events and Migration - Tables - 1980 by Chowdhury M.K., Razzak A., Mostafa G., Sardar A.M., D'Souza S. November 1982. 61 p. ICDDR,B Scientific Report No. 58.

11. Demographic Studies in Rural Bangladesh: May 1969 - April 1970 by Chowdhury A.I., Aziz K.M.A., Shaikh K. April 1981. 21 p. ICDDR,B Working Paper No. 16.

12. Demographic Studies in Rural Bangladesh: May 1970 - April 1971 by Chowdhury A.I., Aziz K.M.A., Shaikh K. April 1981. 23 p. ICDDR,B Working Paper No. 17.

13. Demographic Studies in Rural Bangladesh: May 1971 - April 1972 by Chowdhury A.I., Aziz K.M.A. November 1982. 24 p. ICDDR,B Working Paper No. 28.

14. Demographic Studies in Rural Bangladesh: May 1972 - April 1973 by Chowdhury A.I., Aziz K.M.A. November 1982. 24 p. ICDDR,B Working Paper No. 29.

15. Demographic Studies in Rural Bangladesh: May 1973 - April 1974 by Chowdhury A.I., Aziz K.M.A. November 1982. 22 p. ICDDR,B Working Paper No. 30.

Earlier CRL Reports on DSS

1. Demographic Studies in Rural East-Pakistan: May 1966 - April 1967 by Mosley W.H., Chowdhury A.K.M.A., Aziz K.M.A., Islam M.S., Fahimuddin. June 1968. 30 p. Pakistan-SEATO Cholera Research Laboratory.

2. Demographic Studies in Rural East-Pakistan: May 1967 - April 1968 by Chowdhury A.K.M.A., Aziz K.M.A., Mosley W.H. June 1969. 26 p. Pakistan-SEATO Cholera Research Laboratory.

3. Demographic Studies in Rural East-Pakistan: May 1968 - April 1969 by Chowdhury A.K.M.A., Aziz K.M.A., Mosley W.H. October 1970. 19 p. Pakistan-SEATO Cholera Research Laboratory.

APPENDIX I

SEX DIFFERENTIALS IN MORTALITY*

The results in this section are based on demographic surveillance data for 1974-77. In addition to demonstrating pronounced excess female over male mortality, the data also reveal the abnormally high mortality among both sexes during the flooding and food shortage years of 1974 and 1975. Because the overall level of death rates was exceptional during these two years, the sex differentials found are not necessary reflective of normal periods.

Table 1.1 presents infant mortality rates by sex. The rates for both sexes are markedly higher for the years 1974 and 1975. It should be noted that, since the infant mortality rate relates infant births and deaths within a calendar year, acute disruptions artificially could influence the rate, by temporary fluctuations of births and infant deaths. Better estimates could be computed if cohort rates were measured. Differentials by sex do not appear important, if one considers the overall infant mortality rates in the four study years. However, a breakdown into neonatal and post-neonatal mortality rates (i.e., rates for infants up to one month and for infants aged 1-12 months) present a very different picture. Neonatal rates for males are significantly higher than those for females.** Conversely, post-neonatal female rates are significantly higher than male rates.*** Sex differentials of infant mortality therefore display a reversal from the neonatal to the post-neonatal period. It also appears that the 1974-75 disturbances affected the post-neonatal rates to a larger extent than the neonatal rates.

Table 1.2 presents mortality data among children aged 1-4 years. Higher mortality rates are registered for females than males at each age. The excess female mortality rate for the age group 1-4 years is highly significant.****

Figure 1.1 depicts the direction and magnitude of sex differentials in mortality for children under age 5 years for 1974-77. The ratios for female to male mortality at specific ages are plotted. Male mortality exceeds female mortality only during the neonatal period. Thereafter, female mortality exceeds male mortality by increasing amounts up to age 3 years, when female death rates are 46 to 53 percent higher than the corresponding male rate. The ratio declines in the fourth year of life and falls further, to 1.35 for ages 5-14.

---

* From "Sex Differentials in Mortality" by D'Souza S and Chen L.C., *Population and Development Review*, Vol. 6 No. 2, June 1980.

** $p<.05$, $t=2.\ 53$, $df=3$.

*** $p<.05$, $t=2.53$, $df=3$

**** $p<.005$, $t=8.\ 75$, $df=3$

Table 1.1: Infant mortality rates (per 1,000 live births) by year and sex in Matlab, Bangladesh, 1974-77

Mortality Measure	1974	1975	1976	1977	1974-77
Infant mortality rate (all infants)					
Both sexes	137.9	191.8	102.9	113.7	131.2
Male	142.5	165.1	113.6	113.3	130.9
Female	132.9	184.1	110.3	114.2	131.5
Neonatal mortality rate (infants less than one month)					
Both sexes	78.1	79.9	65.3	71.3	73.0
Male	87.9	81.6	72.0	73.1	78.2
Female	67.8	78.1	58.1	69.4	67.6
Post-neonatal mortality rate (infants 1-11 months)					
Both sexes	59.8	111.9	37.6	42.4	58.2
Male	54.6	98.4	33.3	40.2	52.6
Female	65.1	126.3	42.1	44.8	63.9

Table 1.2: Early childhood mortality rates (per 1,000 population) by year and sex in Matlab, Bangladesh, 1974-77

Age (years)	Sex	1974	1975	1976	1977	1975-77[a]
1	Both sexes	31.6	47.4	48.2	29.9	43.10
	Male	22.9	38.4	40.9	23.8	35.23
	Female	40.6	56.8	55.9	36.6	51.28
2	Both sexes	34.8	38.6	33.0	23.8	32.53
	Male	25.7	31.4	29.5	16.1	26.59
	Female	44.4	46.1	36.6	32.2	38.80
3	Both sexes	22.5	31.7	24.1	18.2	24.36
	Male	16.0	26.0	20.4	12.6	19.37
	Female	29.2	37.7	28.1	24.0	29.65
4	Both sexes	11.6	18.8	15.2	10.5	14.83
	Male	7.7	17.2	13.0	8.4	12.86
	Female	15.8	20.6	17.5	12.7	16.94
1-4	Both sexes	25.4	24.9	29.6	19.6	28.43
	Male	18.3	28.8	25.5	14.5	23.27
	Female	32.9	41.3	33.9	25.2	33.89

a 1974 not included

Figure 1.1

RATIO OF FEMALE TO MALE MORTALITY RATES FOR CHILDREN UNDER FIVE YEARS IN MATLAB, BANGLADESH, 1974-77

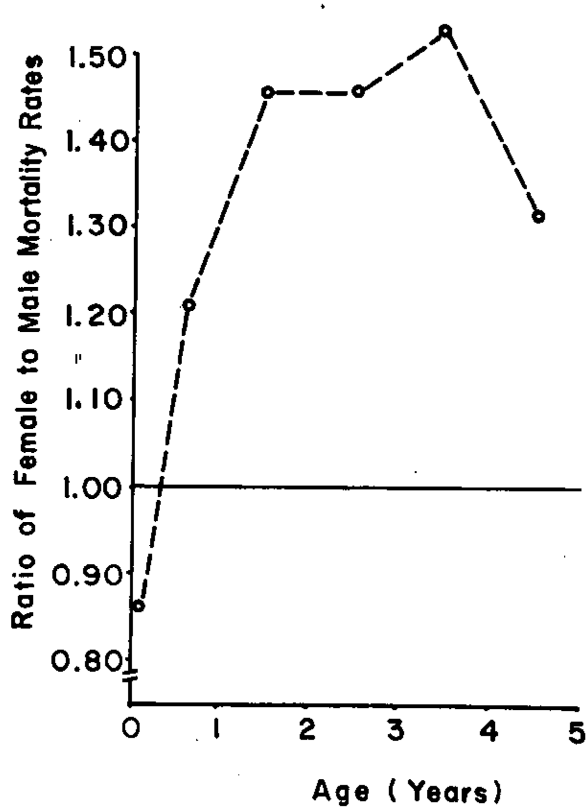


Table 1.3 presents mortality rates by sex for ages 5-14, 15-44, 45-64, and 65 and older. Higher levels of female mortality are maintained in the 5-14 year and 15-44 year age groups. The differentials are reversed for the two age groups above 45 years. In the child-bearing period (15-44 years), female mortality rates were higher than male in 1974, 1976, 1977, and for the four years combined. Some inconsistencies in these differentials are to be expected, given the disasters in 1974-75, when migration, which is predominantly male, increased markedly and mid-year population estimates were likely to be affected differentially by sex.

Table 1.3: Mortality rates for children and adults (per 1,000 population) by age and sex in Matlab, Bangladesh, 1974-77

Age	Sex	1974	1975	1976	1977	1974-77
5-14	Both sexes	3.34	3.78	3.18	2.51	3.19
	Male	2.78	3.13	2.78	2.16	2.70
	Female	3.92	4.23	3.60	2.87	3.70
15-44	Both sexes	3.40	4.75	2.90	2.69	3.70
	Male	2.84	5.24	2.86	2.36	3.61
	Female	3.95	4.26	2.95	3.00	3.79
45-64	Both sexes	17.46	31.02	17.84	16.53	20.24
	Male	18.42	37.12	18.99	17.80	22.13
	Female	16.36	24.10	16.57	15.11	18.00
65 and older	Both sexes	88.75	112.58	74.64	76.15	88.46
	Male	77.84	113.41	74.04	76.15	85.72
	Female	103.12	111.48	75.43	76.15	92.07

Table 1.4 presents data on infant mortality among twin live births for the four study years combined. Presumably, twins are at higher biologic risk at birth, but during early infancy, any sex biases in parental decisions--both explicit and implicit--with regard to the quality of care and level of resource investment might be reflected in different mortality of twins by sex. The data in Table 1.4 confirm the very high mortality risks among twins, with overall infant mortality rates ranging from 451.2 to 535.7 per thousand live births, three times the level for single births. Surprisingly, sex differentials are not marked during the post-neonatal period, when parental care would be expected to be most critical. In fact, the ratios of female to male post-neonatal mortality rates of 1.21 (calculated for twins of the same sex) and 1.06 (among twins of mixed sex) are lower than the sex ratio for single births (1.23, see Figure 1.1). Overall, these data fail to confirm the hypothesis that, under resource stress, the male half of twin live births may receive preferential care in comparison to the female half. It should be noted, however, that the differential may be disguised by the very high levels of infant mortality--essentially 50 percent

Table 1.4: Infant mortality of twin births in Matlab, Bangladesh, 1974-77

Twin Status	Live Births	Neonatal Deaths		Post-Neonatal Deaths		All Infant Deaths	
		Number	Rate	Number	Rate	Number	Rate
Twins of identical sex							
Male	212	71	334.9	25	117.9	96	452.8
Female	196	77	392.8	28	142.8	105	535.7
Twins of different sex							
Male	82	21	256.1	16	195.1	37	451.2
Female	82	21	256.1	17	207.3	38	463.4

of all twins die in the first year. Also noteworthy is the fact that female-female twin births experienced the highest infant mortality rate and male-male twin births experienced the lowest post-neonatal mortality rate.

The consequences of extreme privation for sex differentials in mortality can be examined during times of crisis. This is attempted in Figure 1.2, where the percent of "excess" female death rates in comparison to male rates is shown during the food shortage of 1974-75 and during the "normal" years 1975-77. For three critical age groups (1-12 months, 1-4 years, and 5-14 years) "excess" female mortality consistently was higher during the food shortage years, suggesting that the increased mortality during disaster was disproportionately experienced by young girls.

The excess female mortality pattern during crises did not appear to operate with regard to adult mortality. Higher male than female mortality for the adult age group 15-44 years was noted in 1975 (Table 1.3). This represents a reversal of the pattern for normal years. During the crisis year of 1975, net out-migration of adult males was considerably higher than in other years. If the resident male population consisted of a less healthy group than the out-migrants, this partially might explain the observed pattern.

Although data for developing countries analogous to those from Matlab are scarce, model life tables can provide a useful framework for comparison. To show how the sex differentials in mortality observed in Matlab differ from average experience reflected in reliably-recorded mortality information in historical data, we have selected the "West" model life tables. (Comparison to sex differentials of mortality in other model life tables would lead to broadly similar conclusions). Panel A of Figure 1.3 shows that the excess male relative to female infant mortality shown by the "West" model is reproduced much less intensely, if at all, in Matlab data for the years 1974, 1976, and 1977, while in the crisis year of 1975, female infant mortality is higher by a gross margin than would be expected from the model relationship. For the age groups 1-4 and 5-14 years, panels B and C indicate that, in contrast to the "West" tables, which show a slight male excess mortality, the Matlab data exhibit consistently higher female mortality rates.

The relative disadvantage of Bangladesh females with respect to the chances of dying also is pronounced in the age group 15-44 and to a lesser degree in the age group 45-64 years. The comparisons are shown in panels D and E. In both instances, 1975 is an exception. An explanation for the relatively higher mortality of males in that year could be that, in a crisis, a higher proportion of males in the adult age groups migrated to cities in search of food and work. As a result, the population left behind may have been sex-selectively biased in favor of less healthy males staying home and, thus, at greater death risk.

FIGURE 1.2

Percent by Which Female Mortality Rates Exceeded
Male Mortality Rates in Infancy and Childhood
during Period of Food Shortage (1974–75)
and during Normalcy (1976–77), Matlab, Bangladesh

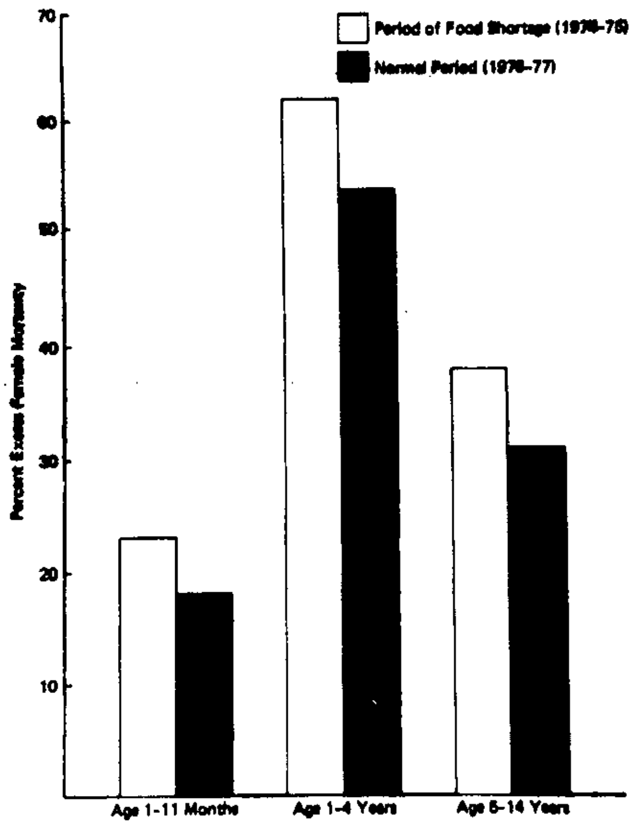
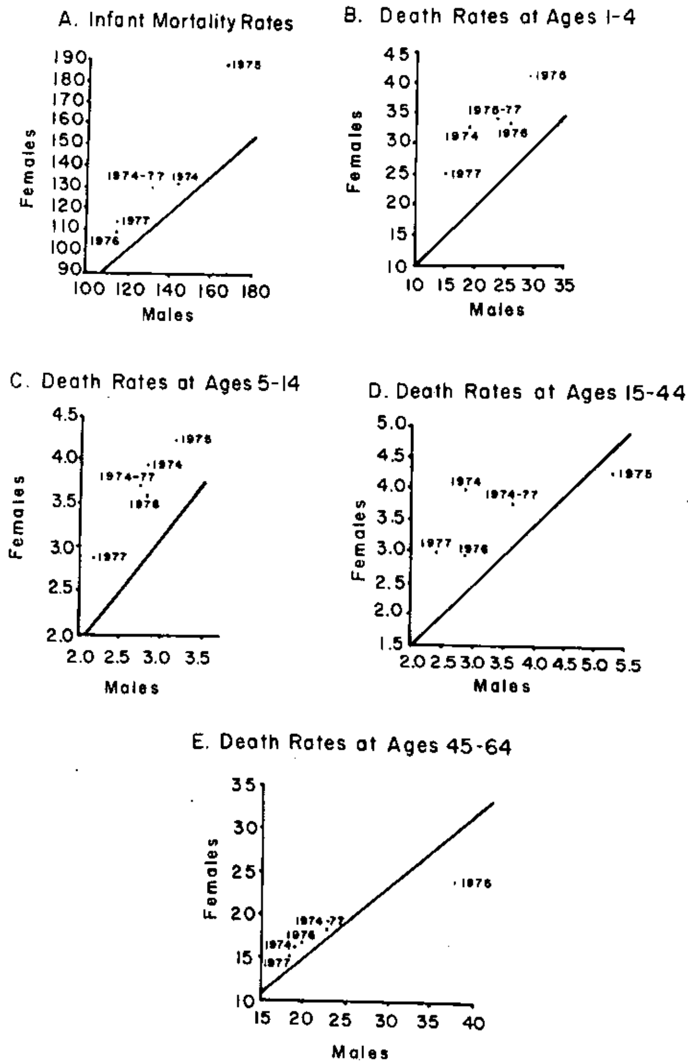


FIGURE 1.3

MORTALITY RATES IN WEST MODEL LIFE TABLES AND OBSERVED IN MATLAB, BANGLADESH, 1974-77



APPENDIX 2

MATLAB DSS CAUSE OF DEATH REPORTING

The ICDDR,B (International Centre for Diarrhoeal Disease Research, Bangladesh) has been using a lay reporting system for cause of death since 1966. Some of the problems encountered and the potential for improvement will be discussed here.

The death reporting system in the Matlab field trial area has been operating since 1966, in a population which in 1979 numbered about 176,000. Twelve field and two office staff of the demographic surveillance system are responsible for death reporting. The field workers, who are responsible for reporting all vital events, interview families about the cause of death and complete a death report form. Until 1974, they indicated if diarrhoea was present before death and briefly recorded "events and symptoms leading up to death" (in English). All classification was done in the office on the basis of this information. At the system's inception, deaths were classified into 22 categories; in 1968 the number of categories was reduced to 9 (Table 2.1). Beginning in 1974, the number of categories was expanded to 27; and a new report form was gradually introduced, with boxes for the field workers to tick for some specific classifications (asterisked in Table 2.1) and "other", and space to write a description of symptoms leading to death (see attached death report form). In the office, this information is used to check the field coding and to categorize death marked "other" by the field worker. The finally-coded forms are key-punched and maintained in files for each year. Basic tabulations are available in annual yearbooks (see list of DSS reports).

Despite this wealth of data, only a few epidemiologic or demographic analyses have been undertaken or even have made any use of this information (Becker 1981; Chen, *et al.*, 1975; Chen, *et al.*, 1980a; Chen, *et al.*, 1980b; D'Souza and Chen 1980). One reason for this under-utilization is lack of assurance about the validity of the coded causes of death. Circumstances of death are determined from the retrospective open-ended interview with relatives, carried out by experienced but non-medically trained interviewers, and classified by office workers. The cause list contains a number of types of classification; specific diseases (measles, tetanus); associated circumstances (accident, child-birth); major symptom (jaundice, dysentery); organ system affected (respiratory); unknown; and "other", meaning that a specific cause can be assigned, but the death does not fit into one of the coding categories, for example, cancer. Thus, there may be times when two codes would be equally valid: for example, "liver disease" and "jaundice" for a death from infectious hepatitis. There is no documentation of decision rules which have been used in such cases. In fact, for both

---

Based on Zimicki S., Nahar L., Sardar A.M., and D'Souza S., "Cause of Death Reporting in Matlab- Source Book of Cause-Specific Mortality Rates 1975-1981" DSS -Matlab Vol. 13, ICDDR,B internal publication.

Table 2.1: Matlab cause of death categories 1966-1982

1966 - 67	1968 - 73	1974 - 82
Smallpox Measles	Pox and Measles	*Smallpox *Measles
Fever	Fever	Fever
Respiratory	Respiratory	Respiratory
Childbirth	Childbirth	*Childbirth
Drowning Other accident	Accident	*Drowning Accident
Cholera proved Non-cholera diarrhoea Diarrhoea, rectal swab not done	Acute diarrhoea	*Diarrhoea acute *Diarrhoea chronic Cholera (proved)
Gastrointestinal (Non-cholera)	Gastrointestinal, dysentery	*Dysentery acute *Dysentery chronic Gastrointestinal
Murder Suicide Heart Liver Venereal disease Skin Ear, nose and throat Rheumatism Old age Epidemic dropsy Unknown	Other	*Murder *Suicide Heart disease Liver disease Venereal disease Skin disease Ear, nose and throat Rheumatism Old age Dropsy Jaundice *Other
	Takuria and unknown	Unknown *Tetanus

* Cause is listed on death report form

DEATH REPORT
C R L

~~Card~~ (1) [2]

Sl. No. [ ]   Study No. (2—4) [ ]

Name of deceased : ______________________   Identification (5—8) [ ]

Date of death : Day (9—10) [ ] Month (11—12) [ ] Year (13—14) [ ]

Age : Years (15—16) [ ] Months (17—18) [ ] Days (19—20) [ ] Sex (21) [M | F]

Type of age : [Census] [M-In] Date of M-In __________ Date of Birth __________

(22—30)

VTS No : '68/'70 ______________________ Census No. '74 __________

Mother's VTS No. '68/'70 ______________________ Census No. '74 (If any) __________

Marital status at the time of death (31)

Never married [1] Married [2] Widowed [3] Separated [4] Divorced [5]

Education at death (32—33) [ ] Occupation at death (34—35) [ ]

Events and symptoms leading up to death (36—37) :

Smallpox	01	Diarrhea : Acute	07	Chronic	08
Measles	02	Dysentery : Acute	09	Chronic	10
Tetanus	03	Childbirth	11		
Drowning	04	Jaundice	12		
Murder	05	Space for future use			
Suicide	06				
Other not covered above	13				

Symptoms Leading up to death ______________________

Usual Residence : ______________________ Code (38) [ ]
Village P. O. Thana

Place of death . ______________________ Code (39) [ ]
Village P. O. Thana

Type of Doctor consulted (40) : Licensed Allopath [1] Allopath Quack [2]

Homoeopath [3] Kaviraj [4] Other [5] Doctor not consulted [6]

Remarks : ______________________

Reported by : ______________________ Date : __________

Date entered in field census vol. [ ] Date entered in Matlab census vol. [ ] Date entered in Dacca census vol. [ ]

elicitation of information about circumstances of death and classification of cause, the system has relied greatly on the common sense of the workers. The potential for respondent interviewer, and classifier bias is obvious.

Respondent bias. Some misclassification arises when relatives interviewed are reluctant or unable to speak about the circumstances of death, or when they emphasize only particular aspects of these circumstances. In Bangladesh, there is no general cultural stricture against speaking of the dead or about circumstances of death. As might be expected, however, in cases such as illegitimate infants, burdensome elders and women pregnant out of wedlock, the circumstances may be mispresented. In the Matlab field trial area, most interviews take place within 4 to 6 weeks of death, so memory about the event usually is good. The main reason for delay in reporting--deaths away from home--arises proportionately more frequently for neonatal than for other deaths, because most women go to their parents' home for the birth of at least their first child and often for the births of subsequent children (a woman customarily lives with her husband's family). In addition to the delay factor, information about very early infant death may be less than optimal, because only the mother is available for interview and not the birth attendant, who might know more about the circumstances of death.

Even when the person who is most knowledgeable about the circumstances of death is interviewed soon after it occurs, misclassification can arise, because of the emphasis given to particular aspects of these circumstances. An example of this is the classification "dropsy": edema is a late-appearing symptom in many deaths associated with dysentery. Because it is readily-apparent and probably also because its appearance predicts death, it may be given more emphasis than the dysentery; and so some deaths resulting from dysentery during which dropsy developed are classified as due to dropsy.

Interviewer and classifier bias. The kind of misclassification or lack of consistent classification cited above results not only from emphasis given by relatives, but probably even more directly from how the interviewer asks questions and how he records the information. Since 1974, 12 of the cause categories and "other" are listed on the death report form. Examination of death reports completed by three field workers during 1980 revealed that most of the time they marked the box for "other" rather than one of the definite categories. In these circumstances, what the field worker writes about symptoms leading up to death is all that the office worker has to make a classification decision. Most of the time, the office workers confirmed the judgement of the field workers: in cases when the field worker indicated a definite category on the form, it was retained by the office worker; and when the field worker marked "other" it was either recoded to one of the categories listed on the form, or maintained as "other". A certain amount of time, however-up to 36.0 percent depending on the field worker--the office worker assigned the death to one of the categories listed on the form (See Table 2.2, for example, of classification decisions).

Table 2.2: Examples of information available on death report forms and final classification assigned

Age	Sex	Symptoms leading up to death	Category: Field worker ticked	Category: Office coded
2 days	M	Since his birth could not suck breast milk, and his color became discolored. People said evil spirit.	Other	Tetanus
7 days	M	Did not suck mother, cramps hands and legs; changed body's color	Tetanus	Tetanus
20 days	F	Want of milk (mother died)	Other	Other
1 year	F	Had been suffering dysentery for about a month	Acute dysentery	Acute dysentery
5 years	F	Died of dysentery with fever, and had been suffering from dropsy for about 3 or 4 days	None	Dropsy
32 years	F	Had been suffering from dropsy for about 6 months, and died 6 hours after delivery	Other	Dropsy
76 years	M	Old age is the major cause of death. Could not take food properly, due to poverty	Other	Old age
95 years	M	He had been suffering from rheumatism for long since. Before death attacked with dropsy	Other	Rheumatism

The same review of the death reports revealed that assignment to cause category by the office workers was not consistent. For example, deaths for which the recorded information was that pneumonia was present were coded both as "fever" and as "other". This is difficult to examine in great detail, however, because coders are not identified on the form.

Local vs. medical perception of disease. It is clear that inconsistencies in the elicitation and recording of information and in classification have resulted in misclassification of cause of death. However, one of the most important reasons for misclassification is the lack of fit between local and medical notions of why people die. A good example of this discrepancy can be seen by evaluating deaths attributed to neonatal tetanus.

Although tetanus is the coded cause for about half the neonatal deaths, examination of the day of death and the sex ratios of deaths suggests that many "tetanus" deaths may be due to other causes. The incubation period and duration of disease caused by *Clostridium tetani* makes it likely that tetanus deaths will not occur before the fourth day of life (Newell, *et al.*, 1966). Without different handling of the cord for the two sexes, which has never been reported in Bangladesh, the incidence should be about the same for males and females. For each year between 1977 and 1981, at least 30% of deaths attributed to tetanus occurred before the fourth day of life, and more of these deaths occurred to males than females (Table 2.3). Some causes other than tetanus, which might occasion death during this time, and a predominance of male deaths are prematurity, congenital defects and hyaline membrane disease, all of which may be evidenced by one of the symptoms which help define the local diseases "alga", "takuria" or "dhanustonkar"--the infant convulsing or turning blue in combination with inability or refusal to feed (Rahman *et al.*, 1982). These diseases are perceived as forming a definite category of death caused by evil spirits. Deaths due to tetanus clearly belong in this category; what creates the difficulty is the illogical inference that all deaths of this category should be classified as tetanus.

The problems encountered in the Matlab reporting system for cause of death can thus be summarized: (1) because local perceptions of disease differ from medical models, it is insufficient simply to ask "what did this person die of?" and expect to receive directly-codable information; (2) because the interviewers are not medically trained and, therefore, their own ideas of disease causation may differ, information about circumstances of death is not elicited or recorded consistently, and the level of training and supervision given has not been sufficient to overcome this; (3) because office workers also have varying ideas about disease, and because there are no documented rules for decision when two classifications are possible, the same kind of death may be coded in two or more categories. Even if field workers and office classifiers all were fully medically qualified, misclassification would occur. It would be less frequent, simply because of the longer period of standardized training and more standardized views about causal pathways.

One partial solution with which the ICDDR,B is experimenting is to substitute a comprehensive questionnaire for the open-ended interview which relies on training and common sense. Most symptoms that are important to distinguish between various causes of death are described fairly easily and unambiguously by people in Matlab (rash and convulsions are two exceptions).

Table 2.3: Time distribution and sex ratios of neonatal deaths attributed to tetanus and other causes

Year	Attributed Cause	N (% of total)	% Occurring day 0-3	% Occurring day 4-28	M:F ratio day 0-3	M:F ratio day 4-28
1977	Tetanus	361(38.9)	31.3	68.7	1.1	1.1
	Other	567(61.1)	51.7	48.3	1.2	1.2
1978	Tetanus	282(63.5)	35.8	64.2	1.1	1.2
	Other	162(36.5)	50.6	49.4	.7	.7
1979	Tetanus	259(49.6)	35.5	64.5	1.6	1.1
	Other	263(50.4)	56.3	43.7	1.6	.8
1980*	Tetanus	346(71.0)	35.5	64.5	1.4	.9
	Other	141(29.0)	53.9	46.1	.9	.6
1981*	Tetanus	273(56.6)	36.6	63.4	1.2	1.1
	Other	209(43.4)	48.8	51.2	1.2	.9

* Preliminary data

In the system being tried, field workers ask a set of questions, to ascertain the presence or absence of symptoms or conditions during the period before death, their time of onset and duration. Using this information and decision rules, such as those suggested by WHO (1979), deaths can be categorized. During the development phase, physicians independently will determine cause of death for a sample of deaths, in order to calibrate the system.

This new system should standardize reporting by field workers. It also should provide more exact knowledge of the absence as well as the presence of conditions which might contribute to death. Documentation of decision rules will clarify the meaning of various categories, and use of rules will improve consistency of classifications. Because information will be coded and permanently retrievable, different sets of decision rules can be applied, as we learn more about epidemiology, clinical manifestations, and cultural perceptions of diseases through small, intensive studies. This potential for multiple classification also will be useful, because interest in various categories may change with time or point of view. The International Classification of Diseases (WHO 1967) and systems derived from it are based on a medical (pathophysiological) model of disease (rather than, say, a nutritional deficiency model), and are most useful for evaluating the effect of medical interventions, such as immunization programs or the use of penicillin by community health workers. As Rahman, *et al.* have demonstrated for a tetanus immunization program (1982), when the local system of disease classification differs from the medical one, the effect of health education (or the health education component of medical intervention) may be better-understood if local categories are used.

Even as a basis for decisions about medical interventions, the classification systems currently used may be problematic, because they only allow deaths to be classified as due to a single cause. Death often is multi-causal, and, in situations where mortality might be reduced by intervening against an antecedent cause or contributory condition (say, malnutrition, or measles in the measles-viral pneumonia progression), knowledge about these causes may be more important than about direct causes for which no intervention is feasible.

APPENDIX 3

TETANUS IMMUNIZATION*

Tetanus neonatorum is one of the leading causes of infant death throughout the world, accounting for up to one-third of all neonatal deaths in some developing countries (Bytchenko, 1966, Miller, 1972). One approach to the prevention of this problem is through improving the quality if orenatal, obstetric, and post-natal maternal and child health services. Another complementary approach is the active immunization of women before or during pregnancy with tetanus toxoid.

Any program which aims to protect all neonates by means of active immunization of mothers, confronts two strategic choices. The first is the immunization of women during pregnancy with two injections of an aluminium-absorbed tetanus toxoid. This immunization procedure is highly efficacious, but its implementation depends upon the capacity to identify, in a timely manner, all eligible women; to maintain a "cold-chain" for vaccine preservation, transport, and delivery; and to ensure continuous provision of health services. In many developing countries, such an advanced health infrastructure has not yet been developed, and in these countries mass immunization of women, both pregnant as well as non-pregnant, is an alternative strategy. However, mass immunization campaigns may disrupt rather than strengthen the village-based basic health service infrastructure, organization, and development. The constraints to this approach also include logistic difficulties in delivering two immunizations to the eligible population and in providing booster immunizations at appropriate intervals (Meira, 1973; Black, 1980).

Work in progress at the Matlab field station of the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B) provided a unique opportunity to study the effectiveness of certain aspects of these two strategies. In 1974, during a field trial of cholera toxoid vaccine, two injections of an aluminium phosphate tetanus-diphtheria toxoid were provided as a control to a randomly-assigned group of non-pregnant women.

Beginning in June 1978, a program of immunizing women during pregnancy with aluminium-absorbed tetanus toxoid was initiated, in conjunction with the implementation of a village-based maternal--child health and family planning program in half of the same Matlab surveillance area. Throughout the period of these two programs, the ICDDR,B maintained an independent, longitudinal, vital registration system, identifying all births and deaths in the study area.

---

*From "Use of Tetanus Toxoid for the Prevention of Neonatal Tetanus. 1. Reduction of Neonatal Mortality by Immunization of Non-pregnant and Pregnant Women in Rural Bangladesh", by Makhlisur Rahman, *et al.*, Bulletin of the World Health Organization, 60(2):261-267 (1982).

As a consequence, precise data are available on the neonatal mortality experience of children born to mothers who were immunized with tetanus toxoid during pregnancy, before pregnancy, or never immunized.

Table 3.1 presents the number of live births in this study, analyzed according to maternal tetanus immunization status. The mothers of 956 infants (9.7%) had accepted full immunization (2 injections), while non-pregnant during the July-August 1974 program, and 934 (9.5%) had accepted full immunization during pregnancy in the 1978-79 program. The mothers of the remaining infants (729 or 7.4%) accepted partial immunization (1 injection in one or the other program or partial immunization on one program and full immunization in the other, or full immunization in both programs). None of the study mothers was exposed to any other national or local tetanus immunization program.

Table 3.1: Number of live births between 1 September 1978 and 31 December 1979, according to immunization status of their mothers

Immunization status	MCH-FP area	Comparison area	Total[a]
Fully immunized[b]			
While non-pregnant in 1974	436	520	956(9.7)
During pregnancy in 1978-79	934	-	934(9.5)
Mixed or partially immunized[c]	495	234	729(7.4)
Non-immunized	2379	4858	7237(73.4)
Total no. of live births	4244	5612	9856(100.0)

a Figures in parentheses represent percentage.

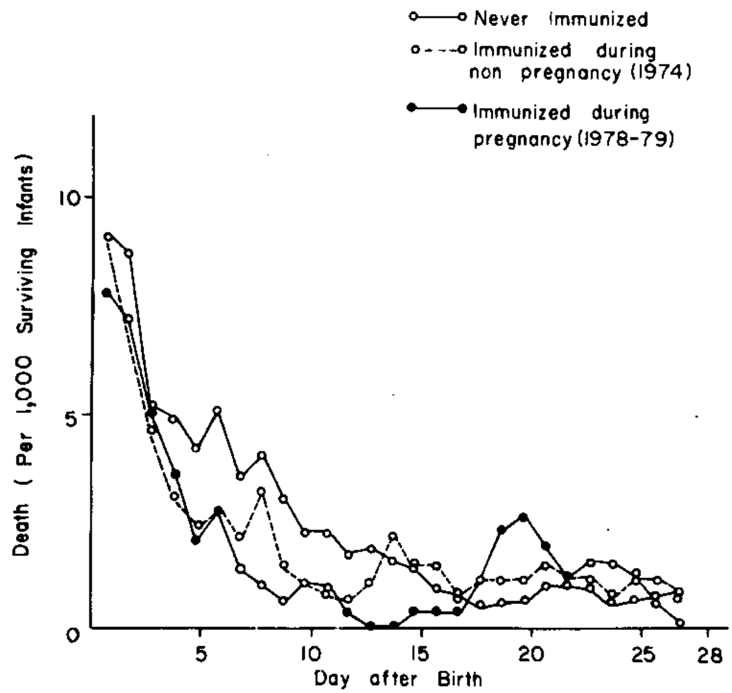
b Acceptance of 2 injections either in the 1974 program or in the 1978-79 program.

c Partial immunization means acceptance of 1 injection either in 1974 or in 1978-79. Mixed immunization means acceptance of 1 or 2 injections in 1974 and again 1 or 2 injections in 1978-79.

Examination of the neonatal mortality rates (data not shown here) for the study infants according to the day of death and the immunization status of the mother, suggests that the infants whose mothers had received full immunizationwhile not pregnant in 1974 and the infants whose mothers had received full immunization during pregnancy in 1978-79 had lower death rates between 5 and 12 and 6 and 15, respectively, compared with the infants whose mothers had not accepted immunization on either occasion. The three-day moving average are shown in Figure 3.1 and a similar pattern emerges: differences in mortality rate are observed between day 4 and day 16 between the non-immunized group and the group immunized in 1978-79, and between day 4 and day 13 between the non-immunized and the group immunized in 1974. The prominent increase in deaths on days 19-21 in the 1978-79 immunized group was due to the death of two pairs of twins.

Table 3.2 shows the overall rates of neonatal mortality (days 0-28) and the neonatal mortality on days 4-14, when tetanus is considered to be the main cause of death (4). The differences in neonatal mortality rates (both 0-28 and 4-14 days) between the 1978-79 fully-immunized group and the non-immunized group were statistically significant ($P<0.01$). The difference between the 4-14 day neonatal mortality rates for the 1974 fully-immunized group and the non-immunized group was statistically significant ($P<0.05$) in the MCH-FP area only. All other comparisons were not significant.

FIGURE 3.1


Never Immunized
Immunized during non pregnancy (1974)
Immunized during pregnancy (1978-79)
Death (Per 1,000 Surviving Infants)
10
5
0
5
10
15
20
25
28
Day after Birth