DEMOGRAPHIC STUDIES IN RURAL EAST PAKISTAN

Preliminary analysis of the results of daily registration of Births, Deaths and Migrations in 132 villages in the Cholera Vaccine Field Trial Area in Comilla District, East Pakistan
May, 1966—April 1967

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JUNE, 1968

Mohakhali, Dacca, East Pakistan

The Pakistan-SEATO Cholera Research Laboratory is a part of the SEATO Cholera Research Program and is supported by the U. S. Agency for International Development, Department of State ; the National Institutes of Health and the National Communicable Disease Center of the Department of Health, Education and Welfare ; and by the Governments of Pakistan, United Kingdom and other SEATO nations. The NIH Cholera Advisory Committee co-ordinates the research program.

These studies were supported in part by Research Agreement No. 196802 between the National Institutes of Helath, Bethesda, Maryland, U. S. A., and the Pakistan-SEATO Cholera Research Laboratory, Dacca, East Pakkistan.

INTRODUCTION

The Pakistan-SEATO Cholera Research Laboratory has been conducting cholera vaccine field trials in villages in Matlab Thana in Comilla District in rural East Pakistan since 1963. The basic design of these field trials has involved taking a house-to-house census in the villages under study and assigning every individual an identifying census number. The vaccines to be tested are randomly assigned to the population and administered by vaccine teams. Then, in order to identify the cholera cases occurring in the population under study, field workers visit every household in the study area daily to make enquiries about the occurrence of acute diarrheal illness and any deaths associated with acute diarrhea. A field hospital has been set up in a central location with a speedboat ambulance service, to provide treatment for all severe acute diarrheal cases.

The field trials began in 1963 and covered 23 villages with a population of 27,629 individuals. In 1964 the trial was expanded to include an additional 35 villages and covered a total population of 60,177. In 1966 the field trial area was further expanded to cover an additional 74 villages, with a total population of 110,000 persons. A field staff of more than 200 maintains a daily household surveillance over this population.

Since the expansion of the area in March of 1966, the field staff have been maintaining a regular registration of all births, deaths and migrations which have been occuring in this population, in addition to carrying out their regular surveillance for acute diarrheal diseases. This report summarizes the method of data collection and gives an analysis of some of the demographic characteristics of this population based on the regular registrations of births, deaths and migrations for the twelve months from May, 1966 through April, 1967.

THE STUDY AREA

Matlab is located in the deltaic area of East Pakistan which is intersected by innumerable tidal rivers and canals, branches of the large rivers, Ganges, Brahmaputra and Meghna. The climate is sub-tropical, with the Tropic of Cancer passing through the area. There are three seasons : monsoon ; cool, dry ; and hot, dry. Most of the annual average rainfall of 85 inches falls during the monsoon which extends from June through September. It rains almost daily and most of the area is flooded. This is followed by the cool, dry season extending until February. During this time there is little rain ; the days are pleasant and warm and the evenings cool. The hot, dry season begins in March and ends with the beginning of the monsoon.

The people are almost entirely indigenous Bengalis. Over three quarters are Muslim. The great majority of the remainder are Hindu. Less than 25% are literate. The principal occupations are agriculture and fishing, the latter being mainly a Hindu occupation. Most of the farmland is given to rice, the dietary staple, and jute, the cash crop.

Villages have an average population of 1,000 persons. Each village is divided into many baris, a unit of two or more patrilineally-related families. Each family has its own one-or-two-room house with a mud floor, jute stick walls and a thatched grass or galvanized iron roof. The houses in baris are arranged around a central courtyard. The average population density approaches 1,700 per square mile. During the monsoon when most of the land is under water, the actual population density is much higher.

METHODS

The census was taken in March and April of 1966 by four teams, each consisting of two trained field workers. Each village was assigned a census number and the workers went from house to house collecting the basic information from each family on a simple form (Appendix I). For this study, a family was defined as a hearth unit, i.e. a group which eat together. There were commonly several patrilineally-related families living around a single courtyard in a unit called a bari.

Families were identified by the name of the family head and the location. The family members were listed by name, age and sex. Efforts were made to obtain a reasonably accurate age by beginning with the age of the youngest child in the family and then obtaining the ages of the older children and of the parents and other members. The census workers made an effort to correct any obvious discrepancies in the ages reported by the informants. No effort was made, however, to verify the reported ages by such means as dating of historical events.

At the completion of this census, census books were made up in triplicate from the family census sheets arranged in geographical order. Every individual was assigned a census number consisting of the village number and an individual serial number within the village. One copy of the census book was returned to the field worker who used them to issue individual family census cards to every family. At this time any discrepancies which were noted by the field workers were reported to the central office and corrected.

Surveillance for births and deaths was maintained by several levels of workers. A local female resident of each village was recruited to visit each household daily and enquire regarding births and deaths. A male field assistant supervised from 3 to 5 of these lady field workers. These men, with the equivalent of a high-school education (matriculates), visited each family an average of twice weekly and registered all the births and deaths and migrations on standard forms (Appendices II, III and IV). Supervision of this phase of work was maintained by Sanitary Inspectors who visited each household approximately twice a month to check on the completeness of birth and death registration. In turn, these worker were supervised by the Field Surveillance Supervisor and his Deputy who were responsible for the co-ordination of the field work.

Because of the phasing of the expansion of the study area, regular registration of births and deaths in the entire population did not actually get under way until approximately Septem-

ber of 1966. Thus, in some of the villages it was necessary to conduct a retrospective registration of births and deaths which had occurred from the time of census in March and April, 1966 to September, 1966.

DEFINITIONS

Only regular residents of the villages under study were included in the census. This excluded temporary visitors or guests who were present at the time the census was obtained. An individual who had a regular job outside the village but returned to his village home a minimum of one time a months was considered a resident. Likewise, migratory workers such as fishermen who were gone for six months of the year but return for the remaining six months were also considered as residents. An individual who regularly lived outside the village and returned to the village to visit less than one time a month was not considered a resident.

These same definitions applied to the registration of births and deaths in this area. All births which occurred to individuals included in the census, irrespective of the places of occurrence of the births, were registered and included in the calculation of the birth rates to the study population. Births which occurred within the study villages to temporary visitors were registered but were excluded from the calculation of birth rates. Similarly, all deaths among residents included in the census were registered, regardless of place of occurrece for the calculation of death rates. Deaths that occurred within the study area, but not to residents included in the census were registered but were excluded in the calculation of death rates.

In the registration of migrations, an emigrant was an individual who was originally listed on the census as a resident, but had permanently moved out of the study villages. Likewise an immigrant was an individual who permanently moved into the study villages from outside the area. Permanent migrations between the 132 villages which were within the study area were noted by the field workers but were not classified as migrations into or out of the area. There was no registration of transient visitors.

RESULTS

There were 111,748 persons in the 132 study villages at the time of the census. Table 1 gives the distribution of the population by age and sex. As the table indicates, this was a relatively young population. Forty-eight per cent of the population was under the age of 15 and only 11% of the population was over the age of 50. The sex ratio presents an interesting pattern. There is a slight preponderance of males in the age group 0-19 years. In the age group 20-34 years, there is a large excess of females. Again, in the age group 35 years and over, there is an excess of males. This relative lack of males in the age group 20-35 is predominantly a reflection of the fact that a large number of the young men have gone to the urban areas in search of work or education.

Table 2 gives the adjusted mid-year population, calculated by adding half of the births and half of the immigrants, and subtracting half of the deaths and half of the emigrants that were registered in the year. All rates will be calculated from this data. It will be noted that the adjusted population under 1 year of age is significantly less than the number of registered births. This is most likely due to over-ageing children less than 1 year at the time of census. This same error will be reflected in death registrations for the first year since census age is used to determine age at time of death.

Table 3 summarizes the total number of live births, deaths and migrations registered during the twelve months from May 1, 1966 through April 30, 1967. There were 5,308 live births for a crude birth rate of 47.1 per 1,000 persons. In this same period there were 1,694 deaths for a crude death rate of 15.0. Thus, the crude rate of natural increase was 3.21 per cent per year. There were 3,537 permanent migrations out of the population, or a rate of 31.4 and 1,877 permanent migrations into the population for a rate of 16.7 per 1,000.

MORTALITY

Table 4 shows the distribution of deaths by age and sex and the age specific death rates. Overall, 35.7% of the deaths were in children under the age of 1 year and an additional 21.9% of the deaths were in children ages 1-4. The infant mortality rate was 111 per 1,000.* The rate fell sharply to 25 per 1,000 in children 1-4 and reached the lowest levels of 2 per 1,000 in 10-14 year olds. Thereafter the death rate remained at 3-4 per 1,000 through the age group 35-39. In the older population the death rate rose gradually until the age of 69 and then there was a sharp rise in the age group over 70. The crude death rate was slightly higher in females than in males, with females having higher death rates in the 1-4 year age group, the 10-29 year age group and the 60 and above age group.

Table 5 presents a more detailed examination of the 588 infant deahts. This reveals that 30.4% of the infant deaths occurred in the first week of life, and 53.7% in the first month of life. The neonatal mortality rate was 59.5 per 1,000 live births.

Table 6 shows the distribution of deaths by four-week periods in the age groups under 1, 1-4, 5-39 and over 40. This suggests that there was a moderate seasonal trend in deaths with a larger proportion of deaths during the months of October through January. The seasonal trend is best defined in the age group under 1, where a larger proportion of deaths was seen during the months of December and January. This seasonal pattern of deaths in infants is a reflection of the fact that these are the months when the largest number of births are occurring and thus reflect the high neonatal mortality.

Since the deaths have been registered by non-medical personnel, it is not possible to adequately define the cause of death in most instances. Table 5 lists a broad classification of the causes of death in this population. Acute febrile illness was the most common factor

*Calculated using number of live births as the denominator.

associated with approximately one sixth of the deaths. This was seen most frequently in the children under 5 and adults over 40. Gastrointestinal diseases including acute and chronic diarrheas and dysenteries were the next most common symptoms associated with death. This was seen most frequently in the 1-4 year age group. Respiratory disease was common in children under 1 and adults over the age of 40. Among specific causes of death, measles and smallpox accounted for 57 deaths, being most frequently seen in the 1-4 year age group. Accidents accounted for 83 deaths, again most commonly in the 1-4 age group. In this area accidental drowning is a common cause of death during the monsoon. Not listed in Table 5 is death attributed by the villagers to an evil spirit called "Takuria". There were 51 deaths attributed to this cause, 43 of them in children ages less than 1 year, with the deaths most frequently in the age group 1 week to 1 month. The associated symptoms (rigidity and convulsions) suggest that this represents neonatal tetanus.

The abridged life tables calculated from the mortality data for both sexes and for males and females are given in Tables 8-11. The conventional method was used for constructing the abridged life tables ; the age specific death rates ${}_nm_x$ were converted to ${}_nq_x$ life table death rates by the Reed and Merrell standard table, except q_o (Appendix V). As the tables indicate, the expectation of life at birth in this population is 51.49 years. At age 5, the expectation of life is 57.69 years. The life expectancy is slightly higher for males than for females.

FERTILITY

During this twelve-month period the field workers reported the termination of 5,477 pregnancies. Table 12 gives the outcome of the pregnancy by the age group of the mother. The 5,477 pregnancies resulted in 5,308 live births ; 2,693 were males, 2,615 were females, giving a sex ratio at birth of 103.0 males per 100 females. Forty-nine of these pregnancies resulted in twins, giving a ratio of one set of twins per 112 pregnanciss. There was one set of triplets.

A still-birth has been defined as a pregnancy terminating in a dead baby in the seventh month of pregnancy or later according to the information given by the mother. Altogether there were 179 still-births, including those occurring with twinning. This gave a ratio of one still-birth for every 29.7 live births. There were 41 pregnancies reported terminating at less than seven months. The true frequency of this event is unknown since the field workers are not attempting to identify every pregnancy.

As shown in Table 13, there was a distinct seasonal pattern of births, with pregnancies terminating most frequently in the months of October through January. Overall 48% of the pregnancies terminated during this period. The lowest incidence of births was during the months of May through August. As the table indicates, the seasonal trend in births was consistent irrespective of whether this was a first or subsequent pregnancy for the mother.

Table 14 summarizes the number of previous pregnancies by age group in the 5,477 women reporting a birth. This indicates that more than half the women under age 20 were

having their first child although a significant number in this group had already had from two to six pregnancies. Women ages 20 to 24 had reported an average of 2.2 previous pregnancies. By 25-29 they had an average of 4.2 previous pregnancies. This continued to increase till age 45-49 where women had an average of 8.7 previous pregnancies prior to the delivery of the presently-reported birth.

Table 15, 16 and 17 give a more detailed analysis of the pregnancy experience of these 5,477 women according to the number of children now living (Table 15), the number of pregnancies terminating in a child born alive but dead at time of report (Table 16) and a child born dead (Table 17). From Table 15 it can be seen that women aged 20-24 had on the average 1.48 previous living children whereas by the time they approached the end of their child bearing years, in the age group 40-49 they had on the average 5 previous living children prior to the birth of the present child. As seen from Tables 16 and 17, the differences between the total pregnancies and the number of living children is primarily due to children born alive but dead at the time of the report of the new birth. Women approaching the end of their childbearing years had, on the average, 3 children born alive, but dead at the time of the report.

Table 15 reveals that 22% of the births occurred in women with no living children and more than half of the births (57.5%) occurred in women with less than 3 living children. Only 15% of the births in this area are occurring in women with 5 or more living children.

The age specific live birth rates are given in Table 18. Overall, there were 5,308 live births among the 29,870 women in the childbearing years from ages 10 through 49. The overall live birth rate per 1,000 women was 177.6. The birth rates were highest in women ages 15 through 35 with a peak birth rate of 331.4 per 1,000 women in the age group 20-24 years.

Table 19 shows a calculation of the gross and net reproduction rates and the intrinsic rate of natural increase. The gross reproduction rate was 3.31%. Taking into account the mortality conditions, the calculated net reproduction rate was 2.4%. This indicates that a Pakistani woman passing through her childbearing period after an allowance for mortality from birth to the end of the childbearing years could replace herself on the average by 2.45 similar women in the next generation. The average length of a generation, calculated by adding the years between the birth of the mother and the birth of the daughter and dividing by the number of daughters, comes to 27.08 years. With the net reproduction rate and the mean length of a generation, the intrinsic rate of growth (r) of the population can be calculated. The intrinsic rate of growth comes to 0.0338. With an intrinsic rate of growth of the population of 33.8 per 1,000 per year, the population can be expected to double in 20.8 years.

MIGRATION

The patterns of migration by age and sex are summarized in Table 20. For males, the rate of immigration ranged from 1% to 2.5% in the ages 0 to 49 years, being slightly higher in the 15 to 35 year age range. The rate of emigration for males was higher in all age groups,

with highest levels ranging from 4% to 6% in the 15-34 age group. This large emigration of young men is reflected in the sex distribution of the population which revealed a deficit of males in the 20 to 34 year age group (Table 1). Females also had a distinctive pattern of migration, with the rates of immigration and emigration both being highest in the 10 to 25 year age group. This is primarily a reflection of young girls marrying and joining their husbands' families. Overall, there was a significant net migration out of the study villages, reflecting the movement of families to urban areas.

DISCUSSION

The cholera vaccine field trials conducted by the Pakistan-SEATO Cholera Research Laboratory require the intensive surveillance of a large population. This daily personal contact, plus the provision of a field hospital and ambulance service for cholera and acute diarrheal disease, have resulted in the development of an excellent rapport with the villagers. Thus the field trial provides a unique situation for the regular collection of detailed information with a high degree of reliability from a large, rural population in East Pakistan.

The vaccine studies do have some effect on the morbidity and mortality in this population. For example, the cholera case rate in a part of the population has been significantly reduced by the vaccines under study, and the cholera mortality rate has fallen almost to zero (one death) by the provision of rapidly available and effective treatment. The field hospital has also reduced the mortality from other acute diarrheal diseases. To estimate the impact of the treatment center on mortality, we can consider that the case fatality rate for untreated cholera would be 50% and for untreated acute diarrheal diseases (severe enough to require hospitalization) it would be 15%. Thus, among the 170 bacteriologically-confirmed cholera cases hospitalized between May, 1966 and April, 1967, one could assume 85 deaths if no treatment had been available. Similarly, for the 268 acute diarrhea cases hospitalized over the same period, one could assume that there would have been 40 deaths without treatment. Thus, the field hospital probably prevented at least 125 deaths, or lowered the crude mortality rate by about 1.1 per 1,000.

Field surveillance in this population will be maintained for several years as a part of the long-term evaluation of cholera vaccine effectiveness. Thus, longitudinal observations of the trends of births, deaths and migrations will be available. The registration of vital events for the second year (May, 1967-April, 1968) is complete, and analysis of this data will be the subject of a subsequent report. The vaccine trial has been expanded during May-June, 1968 to cover an additional 100,000 persons in the same area, thus providing a larger population in which to follow vital events in the third and subsequent years. It is anticipated that the continuing observation of the trends of vital events in rural East Pakistan will be of value, not only for the medical research programs of the PSCRL, but also to workers in Health, Family Planning and Economic Development in East Pakistan.

ACKNOWLEDGEMENT

We wish to acknowledge the co-operation of Colonel S. A. Mallick, Director of Health Services, East Pakistan and Dr. N. R. Majumdar, District Health Officer, Comilla, East Pakistan and the support of Dr. R. A. Phillips, Director, Pakistan-SEATO Cholera Research Laboratory in making the study possible. The help of Dr. William McCormack and Dr. Albert Martin, Epidemic Intelligence Service Officers, National Coummunicable Disease Center, U. S. Public Health Service (assigned to PSCRL) is gratefully acknowledged.

Our grateful acknowledgements are also due to the members of the PSCRL field staff at Matlab, the staff members of the Statistical Unit and Maintenance of PSCRL without whose efforts this study would not have been possible.

TABLE 1

DISTRIBUTION OF THE POPULATION BY AGE AND SEX
APRIL, 1966 CENSUS

Age (in completed years)	Numbers			Sex Ratio M/F	Cumulative Per Cent		
	Male	Female	Total		Male	Female	Total
0-4	9,913	9,669	19,582	102.5	17.4	17.7	17.5
5-9	10,581	10,007	20,588	105.7	35.9	36.0	35.9
10-14	7,456	6,236	13,692	119.6	49.0	47.4	48.2
15-19	4,042	3,831	7,873	105.5	56.1	54.4	55.3
20-24	2,889	4,259	7,148	67.8	61.2	62.2	61.7
25-29	3,456	4,643	8,099	74.4	67.3	70.7	69.0
30-34	3,343	3,579	6,922	93.4	73.2	77.3	75.2
35-39	3,424	2,872	6,296	119.2	79.2	82.6	80.8
40-44	2,757	2,262	5,019	121.9	84.0	86.8	85.3
45-49	2,228	1,752	3,980	127.2	87.9	96.0	88.9
50-54	2,057	1,761	3,818	116.5	91.5	93.2	92.3
55-59	1,322	977	2,299	135.3	93.8	95.0	94.4
60-64	1,383	1,229	2,612	112.5	96.2	97.2	96.7
65 & over	2,268	1,477	3,745	153.5	100.2	99.9	100.1
Not Reported	30	45	75				
TOTAL	57,149	54,599	111,748				

TABLE 2

ADJUSTED MID-YEAR POPULATION

Age	Male	Female	Total
<1	2,045	2,091	4,136
1-4	7,841	7,693	15,534
5-9	10,876	10,240	21,116
10-14	7,540	6,414	13,954
15-19	4,336	4,036	8,372
20-24	2,819	4,231	7,050
25-29	3,454	4,751	8,205
30-34	3,202	3,557	6,759
35-39	3,496	2,896	6,392
40-44	2,629	2,242	4,871
45-49	2,313	1,743	4,056
50-54	2,030	1,758	3,788
55-59	1,312	965	2,277
60-64	1,364	1,213	2,577
65 & over	2,209	1,415	3,624
TOTAL	57,466	55,245	112,711

Mid-Year Population = Initial population + $\frac{1}{2}$ live births + $\frac{1}{2}$ migration in − $\frac{1}{2}$ deaths − $\frac{1}{2}$ migration out

TABLE 3

SUMMARY OF BIRTHS, DEATH AND MIGRATIONS
MAY, 1966-APRIL, 1967

Events	Number	Rate/1,000
Live Births	5,308	47.1
Deaths	1,694	15.0
Immigration	1,877	16.7
Emigration	3,537	31.4

TABLE 4

DISTRIBUTION OF PERSONS WHO DIED, ACCORDING TO THEIR SEX AND AGE AT THE TIME OF DEATH WITH AGE SPECIFIC DEATH RATE MAY, 1966-APRIL, 1967

Age	Male	Female	Both Sexes	Rate/1,000 Male	Rate/1,000 Female	Rate/1,000 Both Sexes
<1	316	272	588	118[a]	104[a]	111[a]
1-4	157	230	387	20	30	25
5-9	40	46	86	4	4	4
10-14	9	15	24	1	2	2
15-19	9	17	26	2	4	3
20-24	10	20	30	4	5	4
25-29	8	13	21	2	3	3
30-34	12	15	27	4	4	4
35-39	14	10	24	4	3	4
40-44	24	17	41	9	8	8
45-49	24	14	38	10	8	9
50-54	29	20	49	14	11	13
55-59	21	15	36	16	16	16
60-64	31	40	71	23	33	28
65-69	21	27	48	25	46	34
70 & over	111	87	198	76	94	82
TOTAL:	836	858	1,694	14.5	15.5	15.0

[a] Infant mortality rate calculated using number of live births from May, 1966 to April, 1967 as denominator.

TABLE 5

DISTRIBUTION OF INFANT DEATHS BY AGE AT TIME OF DEATH, AND SEX

Age	Male	Female	Both Sexes	Rate/1,000		
				Male	Female	Both Sexes
Neonatal						
0-7 days	102	76	178	37.9	29.1	33.5
8-29 days	74	64	138	27.6	24.5	26.0
Post Neonatal						
1-12 months	140	132	272	52.0	50.5	51.2
TOTAL	316	272	588	117.5	104.1	110.7

TABLE 6

DISTRIBUTION OF PERSONS WHO DIED FROM MAY, 1966 TO APRIL, 1967 BY 4-WEEK PERIODS AND AGE

Months	Week No.	AGE				
		Under 1	1-4	5-39	40 & above	All Ages
May 1 -May 28	1-4	29	18	14	27	88
May 29 -June 25	5-8	48	35	17	30	130
June 26-July 23	9-12	29	24	17	23	93
July 24-Aug. 20	13-16	34	24	22	30	110
Aug. 21-Sep. 17	17-20	39	35	18	34	126
Sep. 18-Oct. 15	21-24	40	45	14	34	133
Oct. 16-Nov. 12	25-28	48	26	26	49	149
Nov. 13-Dec. 10	29-32	53	34	21	41	149
Dec. 11-Jan. 7	33-36	72	35	16	58	181
Jan. 8 -Feb. 4	37-40	56	28	15	52	151
Feb. 5-Mar. 4	41-44	51	27	16	35	129
Mr. 5-April 1	45-48	43	22	13	34	112
April 2 -April 30	49-52	46	34	29	34	143
TOTAL		588	387	238	481	1,694

TABLE 7

DISTRIBUTION OF PERSONS WHO DIED DURING ONE YEAR PERIOD ACCORDING TO THEIR AGE AT DEATH AND REPORTED CAUSE OF DEATH

Cause	AGE					
	Under 1	1-4	5-14	15-39	40 & above	All Ages
Fever (all forms)	92	97	29	23	51	292
Acute Diarrhea	7	12	8	7	6	40
Other G. I. Disease	19	90	12	11	65	197
Respiratory Disease	55	17	3	18	73	166
Measles & Smallpox	11	35	8	3	—	57
Accidents	5	38	16	13	11	83
Unknown	301	25	4	6	17	353
Others	98	73	30	47	258	506
All Causes	588	387	110	128	481	1,694

SEASONAL - PATTERN OF DEATHS.

Fig.1

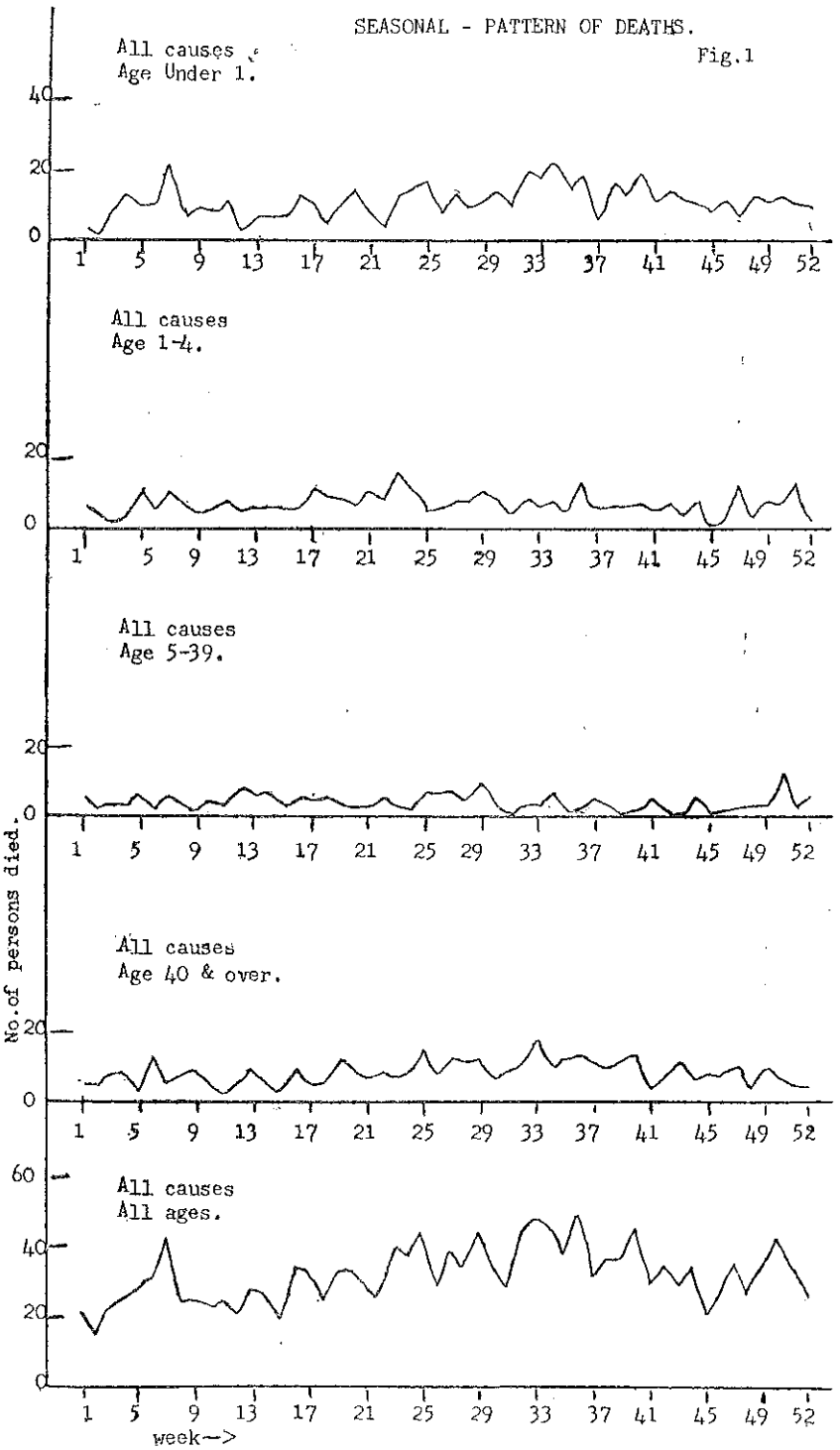


TABLE 8

AVERAGE LIFE EXPECTANCY ($^{o}e_x$) AT SPECIFIED AGES BY SEX
(BASED ON 1966-67 DEATH REPORT)

Age	Both Sexes	Male	Female
0	51·49	52·59	50·67
1	56·87	58·55	55·52
5	57·69	58·44	57·22
10	53·81	54·57	53·33
15	49·32	49·83	48·84
20	45·03	45·31	44·78
25	40·89	41·18	40·85
30	36·47	36·56	36·43
35	32·16	32·25	32·12
40	27·76	27·85	27·57
45	23·79	24·02	23·59
50	19·77	20·13	19·45
55	15·93	16·41	15·41
60	12·06	12·57	11·49
65	8·50	8·81	8·12
70	4·62	4·66	4·58

TABLE 9

ABRIDGED LIFE TABLE FOR RURAL EAST PAKISTAN-BOTH SEXES
(BASED ON 1966-67 DEATH REPORT)

Age in Years and sex	Life table death rate	Probability of surviving between age x and x+n	Number of deaths between age x and x+n	Survivors at exact age x	Years lived between age x and x+n	Total years lived after exact age x	Expectation of life (average number of years lived after exact age x
Both sexes	$1{,}000_nq_x$	$_np_x$	$_nd_x$	l_x	$_nL_x$	T_x	$^{o}e_x$
<1	110.881	0.889119	11,088	100,000	92,238	5,149,024	51·49
1-4	88·681	0·911319	7,885	88,912	382,363	5,056,786	56·87
5-9	19·817	0·980183	1,606	81,027	401,120	4,674,423	57·69
10-14	9·954	0·990046	791	79,421	395,127	4,273,303	53·81
15-19	14,897	0·985103	1,171	78,630	390,222	3,878,176	49·32
20-24	19·817	0·980183	1,535	77,459	383,457	3,487,954	45·03
25-29	14·897	0·985103	1,131	75,924	376,792	3,104,497	40·89
30-34	19·817	0·980183	1,482	74,793	370,260	2,727,705	36,47
35-39	19·817	0·980183	1,453	73,311	362,922	2,357,445	32·16
40-44	39·272	0·960728	2,822	71,858	352,235	1,994,523	27·76
45-49	44·080	0·955920	3,043	69,036	337,572	1,642,288	23·79
50-54	63·091	0·936909	4,164	65,993	319,555	1,304,716	19·77
55-59	77·120	0·922880	4,768	61,829	297,225	985,161	15·93
60-64	131·313	0·868687	7,493	57,061	266,572	687,936	12·06
65-69	157·310	0·842690	7,798	49,568	228,345	421,364	8·50
70+	1,000·000	0	41,770	41,770	193,019	193,019	4·62

TABLE 10

ABRIDGED LIFE TABLE FOR RURAL EAST PAKISTAN-MALES

Age in Years & Sex	Life Table Death Rate	Probability of surviving between ages x & x+n	Number of Deaths between ages x & x+n	Survivors at exact age x	Years lived between age x & x+n	Total years lived after exact age x	Expectation of life
Male	$1{,}000\ {}_nq_x$	${}_np_x$	${}_nd_x$	l_x	nLx	Tx	${}^oe_x$
<1	117·516	0·882484	11,752	100,000	91,774	5,258,710	52·59
1-4	72·370	0·927630	6,387	88,248	382,745	5,166,936	58·55
5-9	19·817	0·980183	1,622	81,861	405,250	4,784,191	58·44
10-14	4·989	0·995011	400	80,239	400,195	4,378,941	54·57
15-19	9·954	0·990046	795	79,839	397,207	3,978,746	49·83
20-24	19·817	0·980183	1,566	79,044	391,305	3,581,539	45·31
25-29	9·954	0·990046	771	77,478	385,463	3,190,234	41·18
30-34	19·817	0·980183	1,520	76,707	379,735	2,804,771	36·56
35-39	19·817	0·980183	1,490	75,187	372,210	2,425,036	32·25
40-44	44·080	0·995920	3,249	73,697	360,362	2,052,826	27·85
45-49	48·866	0·951134	3,443	70,448	343,632	1,692,464	24·02
50-54	67·789	0·932211	4,542	67,005	323,670	1,348,832	20·13
55-59	77·120	0·922880	4,817	62,463	300,272	1,025,162	16·41
60-64	109·105	0·890895	6,289	57,646	272,507	724,890	12·57
65-69	118·416	0·881584	6,081	51,357	241,582	452,383	8·81
70+	1,000·000	0	45,276	45,276	210,801	210,801	4·66

TABLE 11

ABRIDGED LIFE TABLE FOR RURAL EAST PAKISTAN—FEMALES

Age in Years & Sex	Life Table Death Rate	Probability of surviving between ages x & x+n	Number of Deaths between ages x & x+n	Survivors at exact age age x	Years lived between age x & x+n	Total years lived after exact age x	Expectation of life
Female	$1{,}000\ {}_nq_x$	${}_np_x$	${}_nd_x$	lx	nLx	Tx	${}^oe_x$
<1	104·055	0·895945	1,046	100,000	92,716	5,067,003	50·67
1-4	104·334	0·895664	9,348	89,594	382,140	4,974,287	55·52
5-9	19·817	0·980183	1,590	80,246	397,225	4,592,147	57·22
10-14	9·954	0·990046	783	78,656	391,322	4,194,922	53·33
15-19	19·817	0·980183	1,543	77,873	385,507	3,803,600	48·84
20-24	24·714	0·975286	1,886	76,330	376,935	3,418,093	44·78
25-29	14·897	0·985103	1,109	74,444	369,447	3,041,158	40·85
30-34	19·817	0·980183	1,453	73,335	363,042	2,671,711	36·43
35-39	14·897	0·985103	1,071	71,882	356,732	2,308,669	32·12
40-44	39·272	0·960728	2,781	70,811	347,102	1,951,937	27·57
45-49	39·272	0·960728	2,672	68,030	333,470	1,604,835	23·59
50-54	53·629	0·946371	3,505	65,358	318,027	1,271,365	19·45
55-59	77·120	0·922880	4,770	61,853	297,340	953,338	15·41
60-64	153·029	0·846971	8,735	57,083	263,577	655,998	11·49
65-69	207·146	0·792854	10,015	48,348	216,703	392,421	8·12
70+	1,000·000	0	38,333	38,333	175,718	175,718	4·58

TABLE 12

DISTRIBUTION OF WOMEN WHO EXPERIENCED PREGNANCY FROM MAY, 1966 TO APRIL, 1967 ACCORDING TO THEIR AGE AT THE TIME OF CENSUS, AND RESULT OF PREGNANCY

Age \ Result	Miscarriage or abortion (<7m)	Stillbirth (7-9 m)	Twin Stillbirth (7-9 m)	Live Birth (Male)	Live Birth (Female)	Twin Live Birth (Both Male)	Twin Live Birth (Both Female)	Twin Live Birth (Male and Female)	Twin Male Live Birth and Stillbirth	Twin Female Live Birth and stillbirth	Triplets (two male and one female)	TOTAL
10—14	1	4	—	42	33	—	—	—	—	—	—	80
15—19	6	32	2	535	458	2	2	1	—	1	—	1,039
20—24	8	51	—	685	707	1	6	—	1	—	—	1,459
25—29	10	37	—	713	673	3	5	5	—	—	1	1,447
30—34	8	23	—	419	441	4	3	1	1	1	—	901
35—39	7	19	—	192	186	3	—	3	—	—	—	410
40—44	1	2	—	53	49	1	3	—	—	—	—	109
45+	—	3	—	10	17	—	—	—	—	—	—	30
N R	—	—	—	2	—	—	—	—	—	—	—	2
All Ages	41	171	2	2,651	2,564	14	19	10	2	2	1	5,477

Male Live Births —2,693
Female Live Births—2,615
Total Live Births—5,308

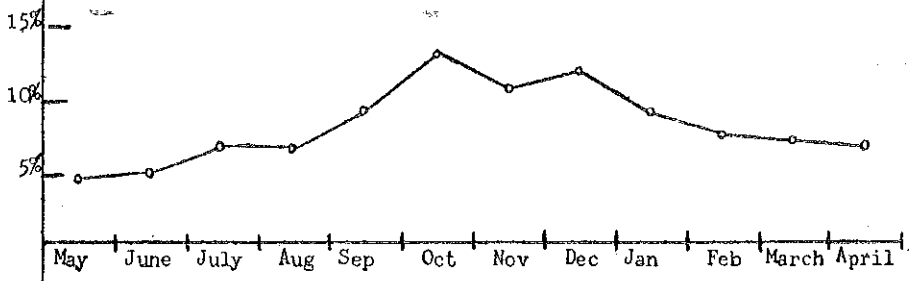
Sex Ratio at Birth—103.0

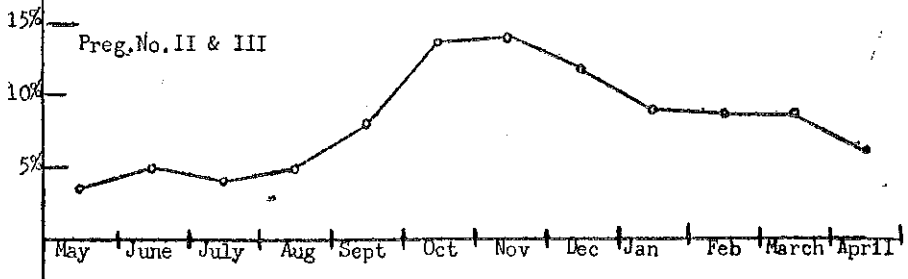
TABLE 13

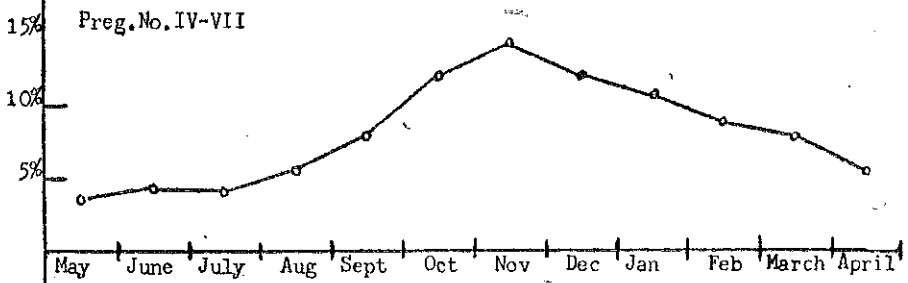
DISTRIBUTION OF WOMEN WHO EXPERIENCED PREGNANCY DURING LAST ONE YEAR ACCORDING TO THE MONTH OF TERMINATION

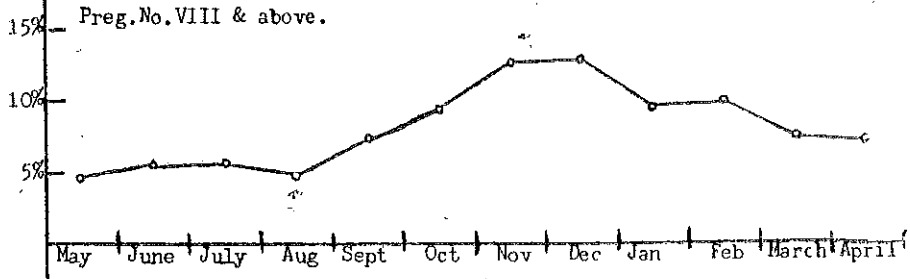
Month of Termination		Pregnancy				All Pregnancies	Pregnancy				All Pregnancies
		1	2,3	4-7	8+		1	2,3	4-7	8+	
		No.	No.	No.	No.	No.	%	%	%	%	%
1966	May	45	57	87	41	230	4.8	4.0	3.8	4.7	4.2
	June	47	74	102	50	273	5.0	5.1	4.6	5.8	5.0
	July	66	62	96	50	274	7.1	4.3	4.3	5.8	5.0
	August	64	72	130	43	309	6.8	5.0	5.8	5.0	5.6
	September	86	116	181	65	448	9.2	8.1	8.1	7.5	8.2
	October	122	199	278	82	681	13.0	13.8	12.4	9.5	12.4
	November	101	204	325	111	741	10.8	14.2	14.4	12.8	13.5
	December	113	174	269	113	669	12.1	12.1	12.0	13.0	12.2
1967	January	85	133	245	86	549	9.1	9.2	11.0	9.9	10.0
	February	74	129	206	90	499	7.9	9.0	9.2	10.4	9.1
	March	69	128	179	77	453	7.4	8.9	8.0	8.9	8.3
	April	63	92	136	60	351	6.7	6.4	6.1	6.9	6.4
	TOTAL	935	1,440	2,234	868	5,477	100.0	100.0	100.0	100.0	100.0

Preg. No.1 — SEASONAL - PATTERN OF BIRTHS. — Fig.2









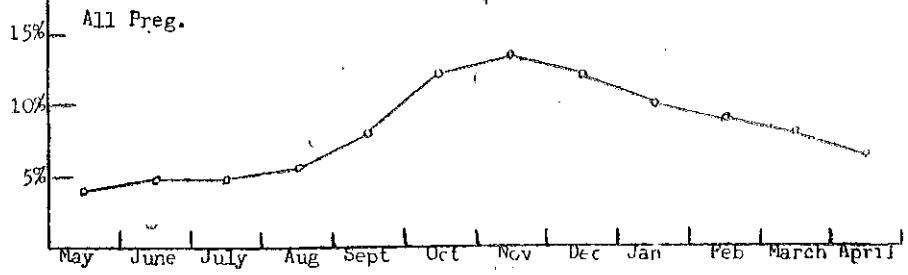


TABLE 14

DISTRIBUTION OF WOMEN WHO EXPERIENCED PREGNANCY FROM MAY, 1966 TO APRIL, 1967 ACCORDING TO THEIR AGE AT THE TIME OF CENSUS AND TOTAL NUMBER OF PREVIOUS PREGNANCIES

Age	Number of Previous Pregnancies													Total	Mean
	0	1	2	3	4	5	6	7	8	9	10	11	12+		
10—14	69	9	2	—	—	—	—	—	—	—	—	—	—	80	0.16
15—19	622	270	96	32	12	4	3	—	—	—	—	—	—	1,039	0.62
20—24	196	378	358	247	139	78	37	15	9	1	1	—	—	1,459	2.19
25—29	38	89	169	249	301	261	175	85	45	20	10	2	3	1,447	4.17
30—34	8	16	32	71	121	147	161	135	108	46	29	10	17	901	5.91
35—39	1	10	7	16	27	45	66	67	68	44	29	18	12	410	6.96
40—44	—	1	2	2	6	7	19	8	15	16	14	11	8	109	7.97
45+	—	—	1	1	1	1	4	4	2	3	2	5	6	30	8.73
N R	—	1	—	1	—	—	—	—	—	—	—	—	—	2	
All Ages	934	774	667	619	607	543	465	314	247	130	85	46	46	5,477	
%	17.1	14.1	12.2	11.3	11.1	9.9	8.5	5.7	4.5	2.4	1.6	0.8	0.8	100.0	
Cumulative %	17.1	31.2	43.4	54.7	65.7	75.7	84.2	89.9	94.4	96.8	98.3	99.2	100.0	100.0	

TABLE 15

DISTRIBUTION OF WOMEN WHO EXPERIENCED PREGNANCY FROM MAY, 1966 TO APRIL, 1967 ACCORDING TO THEIR AGE AT THE TIME OF CENSUS AND NUMBER OF LIVING CHILDREN

Age	Number of Living Children											Total	Mean
	0	1	2	3	4	5	6	7	8	9	10+		
10—14	75	4	1	—	—	—	—	—	—	—	—	80	0.07
15—19	752	224	52	7	3	1	—	—	—	—	—	1,039	0.35
20—24	315	504	380	177	62	18	2	1	—	—	—	1,459	1.48
25—29	72	191	335	399	267	134	35	8	5	1	—	1,447	2.84
30—34	13	47	125	190	213	176	82	38	13	4	—	901	3.88
35—39	4	15	30	59	87	100	66	25	16	6	2	410	4.57
40—44	1	2	5	14	21	23	18	13	11	1	—	109	5.04
45+	—	—	2	3	7	6	4	4	2	2	—	30	5.23
N R	—	1	1	—	—	—	—	—	—	—	—	2	
All Ages	1,232	988	931	849	660	458	207	89	47	14	2	5,477	
%	22.5	18.0	17.0	15.5	12.0	8.4	3.8	1.6	0.9	0.3	0.0	100.0	
Cumulative %	22.5	40.5	57.5	73.0	85.1	93.4	97.2	98.8	99.7	100.0	100.0	100.0	

TABLE 16

DISTRIBUTION OF WOMEN WHO EXPERIENCED PREGNANCY FROM MAY, 1966 TO APRIL, 1967 ACCORDING TO THEIR AGE AT THE TIME OF CENSUS AND TOTAL NUMBER OF CHILDREN BORN ALIVE BUT DEAD AT THE TIME OF THE REPORT

Age	Number of Children Died									Total	Mean
	0	1	2	3	4	5	6	7	8+		
10—14	77	3	—	—	—	—	—	—	—	80	0.04
15—19	865	134	33	7	—	—	—	—	—	1,039	0.21
20—24	857	391	140	55	12	3	1	—	—	1,459	0.62
25—29	563	425	263	115	55	19	5	2	—	1,447	1.14
30—34	209	258	208	112	60	30	9	8	7	901	1.75
35—39	77	98	94	65	40	16	10	7	3	410	2.08
40—44	14	25	24	18	12	6	3	2	5	109	2.59
45+	5	3	6	3	4	6	2	—	1	30	3.03
N R	1	1	—	—	—	—	—	—	—	2	
All Ages	2,668	1,338	768	375	183	80	30	19	16	5,477	
%	48.7	24.4	14.0	6.8	3.3	1.5	0.5	0.3	0.3	100.0	
Cumulative %	48.7	73.1	87.2	94.0	97.4	98.8	99.4	99.7	100.0	100.0	

TABLE 17

DISTRIBUTION OF WOMEN WHO EXPERIENCED PREGNANCY FROM MAY, 1966 TO APRIL, 1967 ACCORDING TO THEIR AGE AT THE TIME OF CENSUS AND THE NUMBER OF PREVIOUS PREGNANCIES TERMINATED IN A CHILD BORN DEAD

Age	Number of Children Born Dead							Total	Mean
	0	1	2	3	4	5	6		
10—14	76	4	—	—	—	—	—	80	0.05
15—19	991	41	5	2	—	—	—	1,039	0.05
20—24	1,344	100	9	3	1	1	1	1,459	0.10
25—29	1,250	148	37	7	1	3	1	1,447	0.19
30—34	718	139	29	12	2	1	—	901	0.27
35—39	329	53	15	9	4	—	—	410	0.31
40—44	86	13	8	1	1	—	—	109	0.33
45+	21	7	2	—	—	—	—	30	0.37
N R	2	—	—	—	—	—	—	2	
All Ages	4,817	505	105	34	9	5	2	5,477	
%	88.0	9.2	1.9	0.6	0.2	0.1	0.0	100.0	
Cumulative %	88.0	97.2	99.1	99.7	99.9	100.0	100.0	100.0	

TABLE 18

AGE SPECIFIC BIRTH RATE PER 1,000 WOMEN

Age of Mother (Corrected)	Number of Women	Male Live Births	Female Live Births	Total Live Births	Rate per 1,000 women
10—14	6,414	30	25	55	8.6
15—19	4,036	514	449	963	238.6
20—24	4,231	694	709	1,402	331.4
25—29	4,751	745	714	1,458	306.9
30—34	3,557	435	450	885	248.8
35—39	2,896	207	195	401	138.5
40—44	2,242	56	56	112	50.0
45—49	1,743	10	17	27	15.4
All Child-bearing Ages	29,870	2,691	2,615	5,306	177.6

TABLE 19

CALCULATION OF GROSS & NET REPRODUCTION RATE AND INTRINSIC RATE OF NATURAL INCREASE

Age	Female population	Live Births Female	Daughters Per 1,000	Pivotal Age	Proportion surviving the Pivotal age	Women Surviving to given age	Person years
10—14	6,414	25	3.90	12.5	0.7826	3.05	38.12
15—19	4,036	449	111.25	17.5	0.7710	85.77	1,500.96
20—24	4,231	709	167.57	22.5	0.7539	126.33	2,842.42
25—29	4,751	714	150.28	27.5	0.7389	110.42	3,036.55
30—34	3,557	450	126.51	32.5	0.7261	91.86	2,985.45
35—39	2,896	195	67.33	37.5	0.7135	48.04	1,801.50
40—44	2,242	56	24.98	42.5	0.6942	17.34	736.95
45—49	1,743	17	9.75	47.5	0.6669	6.50	308.75
TOTAL			661.57			489.31	13,250.70
5 x Total			3,307.85			2,446.55	66,253.50

Gross Reproduction Rate = 3.31
Net Reproduction Rate = 2.45
Mean Length of Generation = 27.08
Intrinsic Rate of Natural Increase = 33.8 per 1,000

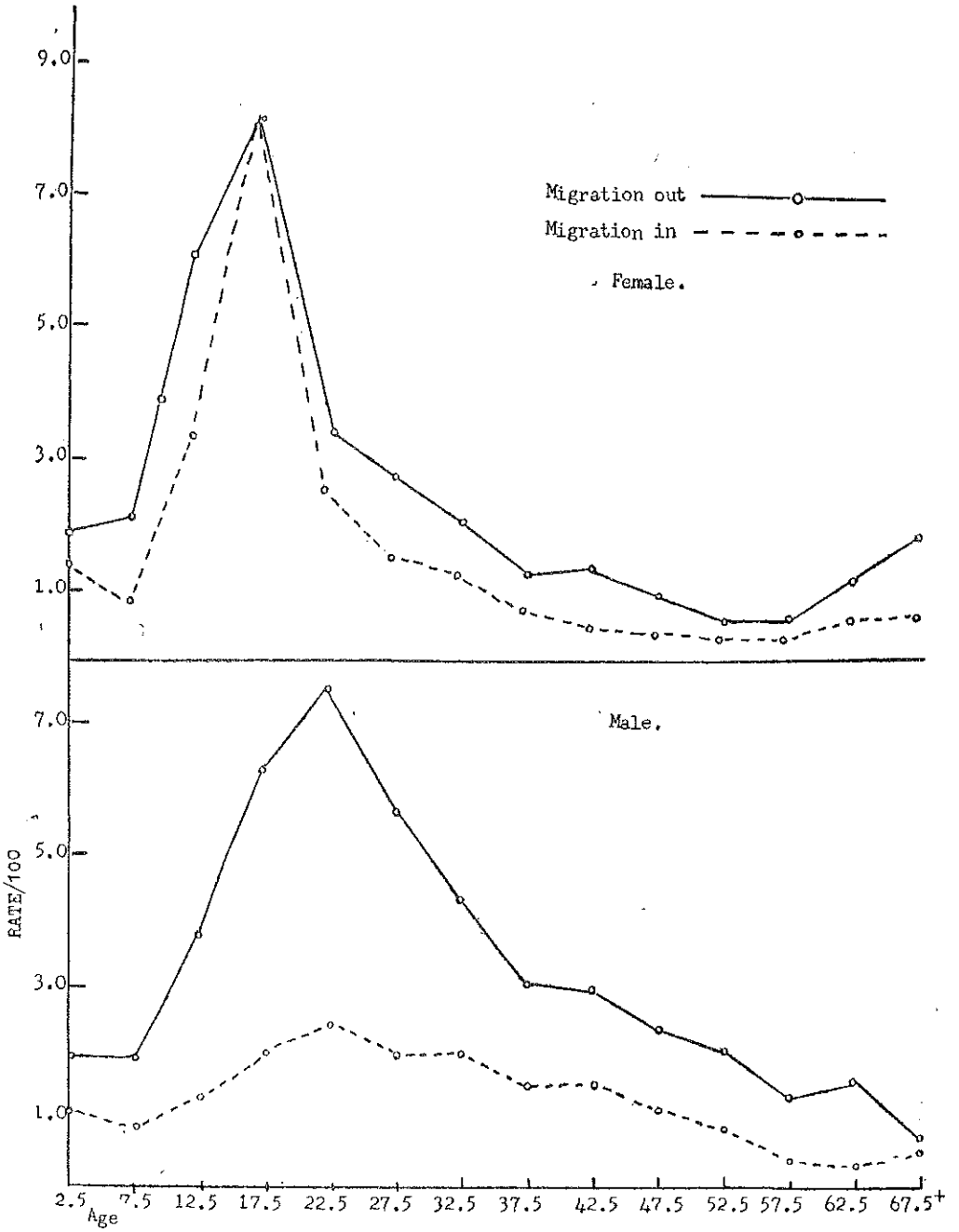
TABLE 20

DISTRIBUTION OF PERSONS WHO MIGRATED INTO AND OUT OF THE STUDY AREA FROM MAY, 1966 TO APRIL, 1967 BY AGE AND SEX

Age	Male		Female		Both Sexes		Male Rate (%)		Female Rate (%)		Both Sexes Rate (%)	
	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
0—4	118	201	143	194	261	395	1.19	2.03	1.46	1.98	1.33	2.01
5—9	108	223	95	227	203	450	0.99	2.05	0.93	2.22	0.96	2.13
10—14	104	291	219	395	323	686	1.38	3.86	3.41	6.16	2.31	4.92
15—19	93	276	333	331	426	607	2.14	6.37	8.25	8.20	5.09	7.25
20—24	70	214	113	147	183	361	2.48	7.59	2.67	3.47	2.60	5.12
25—29	72	197	75	135	147	332	2.08	5.70	1.58	2.84	1.79	4.05
30—34	64	142	47	77	111	219	2.00	4.43	1.32	2.16	1.64	3.24
35—39	53	109	21	38	74	147	1.52	3.12	0.73	1.31	1.16	2.30
40—44	41	79	11	33	52	112	1.56	3.00	0.49	1.47	1.07	2.30
45—49	28	55	7	18	35	73	1.21	2.38	0.40	1.03	0.86	1.80
50—54	18	42	6	11	24	53	0.89	2.07	034	0.62	0.63	1.40
55—59	5	17	3	6	8	23	0.38	1.30	0.31	0.62	0.35	1.01
60—64	4	22	7	15	11	37	0.29	1.61	0.58	1.23	0.43	1.44
65+	11	16	8	26	19	42	0.50	0.72	0.57	1.84	0.52	1.16
All Ages	789	1,884	1,088	1,653	1,877	3,537	1.37	3.28	1.97	2.99	1.67	3.14

ACE SPECIFIC MIGRATION RATE

Fig. 4.



PAKISTAN-SEATO CHOLERA RESEARCH LABORATORY VACCINE TRIAL

Family Census Sheet

Head of the family——————————————Identifying information of the Household——————————

(N A M E)

Village——————Union——————Thana——————P. O.——————Dist.——————

Serial No.	Immunization Schedule								Ind. No.	Name	Age	Sex	Prev.		Inc.	Remarks
	Type	Date	Type	Date	Type	Date	Type	Date					Yes	No	Unk.	
									1							
									2							
									3							
									4							
									5							
									6							
									7							
									8							
									9							
									10							
									11							
									12							
									13							
									14							

Appendix II

PAKISTAN-SEATO CHOLERA RESEARCH LABORATORY

Birth Report

Census No.———— Serial No.————
Name of newborn————(Leave blank if no name given)
Sex————This birth was, Single————Twin————Triplet————
Date of birth : Day————Month————Year————
Father's name————Census No.————Age————
Mother's name————Census No.————Age————
Previous deliveries to mother (Do not include this birth) :————
How many other children now living ?————
How many other children born alive, now dead ?————
How many children born dead ?————
Place were birth occurred :————
(Village, P. O., Thana)
Usual residence of mother :————
(Village, P. O., Thana)
Is infant now well ? Yes————No————if no describe illness :————
Is mother now well ? Yes————No————if no describe illness :————
Remarks : ————
Reported by : ————Date————

Instructions : This form is to be completed for :

1. All births that occur within the vaccine trial villages. If a mother from outside the trial area comes to a trial village to have her baby, complete this report and indicate in the Remarks that the mother is not a resident of the trial area.

2. All births to residents of the trial villages. If a mother in the census goes to another village (or Dacca) to have her baby, when she returns the birth is to be registered.

   If the baby is born alive, but then dies, a birth report, and a death report must be completed.

   If a baby is born dead only a birth report is to be completed, with the statement BORN DEAD in the Remarks line.

Appendix III.

PAKISTAN-SEATO CHOLERA RESEARCH LABORATORY

Death Report

Census No.———— Serial No.————

Name of deceased———— Age———— Sex————

Date of death : Day———— Month———— Year————

Place where death occurred :————

(Village, P. O., Thana)

Usual residence of deceased :————

(Village, P. O., Thana)

Was illness associated with diarrhea : Yes———— No————

If diarrheal illness, was culture obtained: Yes———— No————

Describe events leading up to death :————

Remarks : ————

Reported by———— Date————

Instructions :

This form is to be completed for :

1. All deaths that *occur* within the trial villages. If a person from outside the trial area dies in a trial village, indicate in the Remarks section that he is not a resident.

2. All deaths that occur to residents of the trial area who are in the census, regardless of where the death takes place.

Appendix IV

PAKISTAN-SEATO CHOLERA RESEARCH LABORATORY

Report of Migration Into/Out of census area

Census No.	Name	Age	Sex.

For persons *leaving* the trial area :
Date of moving : Day——————Month——————Year——————
Reason for leaving : ——————————————————
Where to : ——————————

For persons coming into trial area :
Date of arriving : Day——————Month——————Year——————
Reason for coming : ——————————————————
Where from : ——————————

Instructions :

This form is only to be completed on persons coming in, or moving out of the trial area. Persons moving from one village (or one house) to another *within* the trial area should only be indicated in the field census books that they have left their original home, and they should be entered in the census book at their new location.

For a person, or family leaving the trial area, list all individuals above, and give date and reason for moving.

For a person, or family arriving in the census trial area, list their names, ages and sex, and the date of arrival. Also complete a family census sheet and send in with this form. The sheet will be copied in the office, census numbers wil be assigned, and a copy will be returned to the field for insertion in the field book.

Reported by : ——————————
Date : ——————————

Appendix V

Method for Construction of Abridged Life-Tables

The conventional method has been used for constructing the abridged Life-Tables. The computed ${}_nm_{x's}$ were converted to ${}_nq_x$, life-table death rates, from the standard tables computed by Reed and Merrell.

The value of m_o (which is D_o/B, where D_o was the number of deaths under age 1 and B was the number of total births) was transcribed for q_o. It was assumed that l_o was 100,000 persons.

Other notations and derivations are as follows :

x : exact age in years.

n : age interval between two exact ages in years.

${}_nq_x$: it is the probability of dying between age x to x+n. ${}_nq_x = 1 - {}_np_x$

${}_np_x$: it is the probability of surviving from age x to x+n.

${}_nd_x$: it is the number of deaths which occur in age interval of n years i.e. between age x to x+n. ${}_nd_x = l_x \cdot {}_nq_x$.

lx : it is the number of survivors from an initial cohort of 100,000 births, l_o to exact age x. $l_{x+n} = l_x - {}_nd_x$.

nLx : it is the number of persons in the stationary population, or in other words, it is the number of years lived by the life-table cohort between age x and x+n.

$$ {}_nL_x = \frac{n(l_x + l_{x+n})}{2} $$

$$ \left.\begin{aligned} L_o &= 0.3\, l_o + 0.7 l_1 \\ L_{70+} &= (l_{70+}) \cdot \log (l_{70+}) \end{aligned}\right\} \text{(assumed).} $$

Tx : it is the total number of years lived by the life-table cohort after age x (all higher ages).

$$ T_x = \sum_{70+}^{x} {}_nL_x. $$

${}^oe_x$: it is the average number of years remaining to survivors at age x, or the expectation of life at age x.

$$ {}^oe_x = \frac{T_x}{l_x} $$

The Star Press, Dacca-1.