ESTIMATION OF ADULT MORTALITY FROM WIDOWHOOD

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Abstract

An attempt has been made in this study to provide some indirect estimates on mortality based on widowhood information to alleviate the problem of lack of recent and reliable indices of mortality in Bangladesh. In the virtual absence of an adequate vital registration system, mortality levels have so far been obtained from data collected in population census and in specially designed sample surveys. Because of the shortcomings of such data, there has been considerable uncertainty about recent levels and trends in mortality. The estimates from the data which are being collected by the Cholera Research Laboratory in Matlab, a rural area of Bangladesh since 1966, are considered reliable but not representative for the country as a whole. Recently the Bangladesh Bureau of Statistics has implemented a sample vital registration system to generate reliable and nationally representative estimates of annual demographic indices. But the results obtained from this data appear to be suspiciously low in comparison to many other available estimates.

In this situation, the indirect estimation methods are extremely useful. The underlying assumption of the methodology has been that mortality changes in the past

can be neglected. But empirical evidence from the countries where these indirect methods have been used has demonstated that mortality has been declining in the recent past in many developing countries. Under the changing conditions, these techniques yield survivorship probabilities which do not, strictly speaking, relate to specific time periods, but they refer to different periods in the past. However, the time reference of the estimates can only be obtained when mortality in population has been changing regularly. In reality these sort of assumptions may not hold true. If, however, information on widowhood are available from censuses and surveys conducted at two points in time, survivorship probabilities applicable to the intervening period can be estimated from the constructed proportions on widowhood for a hypothetical cohort of respondents.

The application of the generalised stable population relations which have been used to derive hypothetical set of proportions on widowhood, requires two sets of information from a census or a survey conducted at two points in time. But in Bangladesh, only one such information is available. However, another set of data has been generated through a special technique, and the procedure has been described in detail.

The generalised stable population relations are based on the assumption that the population is closed to migration between the censuses. The application of the method is simple whatever may be the length of the intercensal period. The method avoids difficulties introduced into analysis and interpretation by the influence of trends in mortality on measures obtained from the lifetime experience of the respondents. However, information by older respondents has been found to be affected by age misreporting and other errors.

In spite of considerable errors in the data provided by the 1974 BRSFM and the population census, the widowhood technique applied to the hypothetical data produces reliable results for the male period adult mortality levels for Bangladesh for the period 1974-1981.

The conclusion drawn is that the results obtained from retrospective information and widowhood are plausible and consistent.

Data Sources

This study depends mainly on the marital status data from the 1974 Bangladesh Retrospective Survey of Fertility and Mortality (BRSFM, 1974), which was conducted simultaneously with the post enumeration check of the 1974 population census of Bangladesh. The study also utilises information on marital status from the 1974 and 1981 population censuses of Bangladesh.

This study also utilises information on children everborn and children surviving from the BRSFM, 1974 and from the Sample Vital Registration System which has been in operation since 1980 by the initiative of the Bangladesh Bureau of Statistics. In addition, information on age specific death rates from the Sample Vital Registration system for the period 1980-1983 have been utilised. This system collects data adopting the dual record system, consisting of continuous recording of vital events by the local registrars and an independent quarterly retrospective survey in which vital events are collected by the enumerators from the headquarter. Results from this system suggests that the dual record system appears to be superior in terms of coverage to any single system and/or Retrospective Sample Survey.

This study is divided into two parts. The first part consists of a theoretical frame work and the second consists of the application of various demographic techniques.

P A R T   O N E

CHAPTER 1

Theoretical Framework

1.1 Introduction

The straightforward calculation of adult mortality requires acknowledge of two kinds of information about the population. First, it is necessary to know the distribution of deaths by age and sex, over some period of time. Second, it is necessary to know the distribution of population exposed to the risk of dying by age and sex for the same period; this is generally approximated by the mid period population. From these two kinds of information, age specific mortality rates can be estimated, and a conventional life table constructed.

The direct construction of coventional indices of mortality is possible for a country only when it has virtually a complete and reliable death registration system and population censuses which are also free from major distortions. Although Bangladesh Census Data are reasonably extensive, the coverage of registration of births and deaths, which had its origin in the births, deaths and marriages act of 1886, is badly incomplete (Rabbani et al, 1983). As a result, no attempt has been made to tabulate the information collected through the registration system. This kind of situation does exist in many developing countries.

Efforts in the past devoted to the improvement of the vital registration system in Bangladesh have proved unsuccessful because of in built deficiencies of the system and the socio-economic conditions of the population. However the recent changes that were made in the births and deaths registration (amendment) ordinance in 1979, are in their infancy and have yet to bring any tangible effect on the quality and timeliness of production of vital events.

Estimation of mortality is, therefore, difficult in Bangladesh. This is not only because of the absence of conventional data in the form of registration of deaths and accurate census counts, but also because the censuses and occasional specially designed national sample surveys are characterised by very extensive misreporting of age, understatement of parity (at least among older women) and overall misenumeration which means underenumeration or overenumeration etc. The analysis becomes further complicated because of extensive unrecorded international migration and because of fluctuations in fertility and mortality caused by recent natural disasters or political disturbances.

Since the vital registration system is deficient and an immediate transformation of it into a practical and dependable one capable of producing current reliable statistics on vital events seems implausible, the Bangladesh Bureau of Statistics initiated a nationwide population programme entitled "Bangladesh Demographic Survey and Vital Registration (BDSVR)" in April 1980 to provide reliable estimates of birth and death rates at national and regional levels. The BDSVR is a dual-record system, consisting of continuous enumeration of vital events by the local registrars and an independent quarterly retrospective survey for collection of vital events by the headquarter's based enumerators. The activities of the project and the results obtained have been reviewed and evaluated, and claimed to be encouraging (Rabbani et al, 1984).

Efforts to reduce undercounts in Bangladesh Censuses have proved successful, but efforts to improve errors in age reporting have proved unsuccessful. It is observed that undercount in the 1981 census is the lowest found so far in the censuses held in Bangladesh, but that the magnitude of age errors in the 1981 census is relatively the same as observed in previous censuses (BBS, 1981). Reasons for this failure with regard to age, may be attributable to high illiteracy and lack of age consciousness.

However, the spread of education, careful recruitment, training and supervision of enumerators and greater efforts to interview persons directly are likely to increase the reliability of age estimates. (Byerlee et al, 1981).

A number of studies have focused on the mortality situation in Bangladesh. Robinson (1984) suggests that mortality declined gradually in Bangladesh during the 1930's and 1940's with a sharp fall occurring in the 1950's and 1960's which was mainly because of elimination of the great epidemic and endemic diseases. He mentions that this crude death rate seems to have leveled off at or just below 20 per thousand in the 1970's. Another study based on the Matlab demographic surveillance system (DSS) shows statistically a non-significant trend in mortality in Matlab, a rural area of Bangladesh between 1966 and 1978. In contrast, a sample vital registration data based study reveals a continuous declining trend since 1920. It is evident that there remains still confusion about the true levels and trends in mortality in Bangladesh because of well known shortcomings of the data. However, there are indications of mortality decline in India. Preston et al (1984) observes that mortality in India has fallen faster in recent years than was expected. On the other hand, death rates are rising in Hungary (Compton, 1985).

What is known on a firm basis, not only for Bangladesh but for many developing countries, is the level of child mortality, which is estimated from reports by mothers on the survival status of their children. This is mainly because this technique is relatively robust with regard to choice of the mortality schedule, and has proved to be a powerful estimation procedure despite data inadequacies in developing countries. Adult mortality, however, can be based upon registered deaths, but often the degree of completeness of registration is unknown. PGE (Population Growth Estimation) data shows over reporting of deaths, considerably more over reporting being in the case of male (125%) deaths than in the case of female (114%) deaths. Reasons for this over reporting of deaths have been discussed in Chapter 3. On the other hand, the 1974 Bangladesh Retrospective Survey data shows underreporting of deaths, indicating 57 percent completeness of deaths recording for males and approximately 48 percent for females (The Committee on Population, 1981). Analysis, however, based on data from two sources produces similar estimates of adult mortality for 1964-65 and 1974, indicating a declining trend over this period. It may be mentioned here that underreporting of deaths has been found in Indian SRS data. The applications of Brass (1975) and Preston et al (1980) methods for completeness for death recording show 87 percent completeness for females and 93 percent for males for the first half of the 1970's SRS data (Preston et al, 1984). These two methods have been discussed in Chapter 8.

The research reported in this thesis is directed towards estimation of adult mortality on the basis of widowhood technique by using two sets of data. An attempt is made to estimate adult mortality levels at national and regional levels of Bangladesh. Further attempts will be made to ascertain factors responsible for improvement in adult mortality between 1974 and 1981.

The research will utilize information on standard marital status data from 1974 Bangladesh Retrospective Survey for Fertility and Mortality, 1974 Census, 1981 Census and several other demographic sources available in Bangladesh.

Further, the research is also intended to show whether widowhood technique can yield plausible period estimates by using intercensal changed proportions never widowed estimated by Generalised Stable Population Procedures.

1.2 Bangladesh and Its People

Bangladesh is a deltaic land covering an area of 143,998 square kilometers. It lies in the north eastern part of the South Asia between 20^{o} 34' and 26^{o} 38' north latitude and 88^{o} 01' and 92^{o} 41' east latitude. The country is bounded by India in the west and north and India and Burma in the east and the Bay of Bengali in the south. The Himalayas are not far from the north-west boundary of the region.

Except the hilly regions in the north-east and south-east, and some areas of high land in the north and north western part, the country consists of plain alluvial land which constitutes more than 85 percent of the land crisscrossed by the great rivers - the Padma, Meghna and Jamuna and by their innumerable tributaries.

Bangladesh enjoys generally a sub-tropical monsoon climate, and six seasons in a year, winter, summer, and monsoon being the predominant ones. Mean annual temperatures vary between 57° F and 80° F. The annual rainfall varies from 50 inches in the west to 100 inches in the south-east and to 200 inches in the Assam hills in the north.

As far back as 2,000 years B.C., the Central Asian Aryans migrated to the sub-continent of Bangladesh, India and Pakistan. As a result, the original inhabitants of the land, Dravidians had to move to the south because the Aryans were more organized and progressive. Around 1,000 years B.C., the Bang tribe of the Dravidian people left their original homes and settled in the delta of the Ganges and Brahmaputra rivers. The Aryans then Delineated the area where the Bang tribe lived in the Vedic era as Bengal . The word 'Bengal' has been originated from it, and the land is Bangladesh and the people of the land are called Bangladeshies.

Since ancient times, the region has been known to the outside world for its glorious history and tradition and its strategic geographical location on the Bay of Bengal. During the period from the eighth to the twelfth centuries, a high level of cultural development, particularly based on the religious philosophy took place in the region under the Buddhist Kings. In the following centuries two important developments took place. The region remained under the Muslim rule from the early Thirteenth Century until the Eighteenth Century, when the British took over and ruled the region until 1947.

Once again, two important developments took place in the 20th Century. In 1947, the partition of India occurred.

As a result, the two independent states of India and Pakistan were created. Pakistan consisted of the Muslim areas of the north west and north east parts of the Indian sub-continent, known respectively as west Pakistan and east Pakistan (now Bangladesh). The two wings of Pakistan were separated by the 1,500 miles of foreign territory, and moreover, they differ in climate, topography, language and sociocultural characteristics. Bangladesh remained with Pakistan for over two decades, but Pakistan did little to bring about change in the socio-economic condition of Bangladesh, the then east

Pakistan. This resulted in a liberation war in 1971. After a bloody armed struggle for a short period of nine months against Pakistan, Bangladesh became independent on 16th December 1971. Due to the liberation movement, Bangladesh suffered a heavy loss of physical capital and of lives including managerial experts.

During the first years of independence, the country witnessed a serious economic crisis and more importantly, political instability. In addition, in the past, natural disasters like famine in 1943, and cyclones and floods on numerous occasions devastated the economy of the country. Bangladesh is governed by a unitary form of Government of Presidential type. For administrative convenience, the country is divided into four administrative divisions:- Dhaka, Chittagong, Khulna and Rajshahi. The various general features of the divisions are described below.

Each division is further sub-divided into districts. The number of districts stand at 64 at present after the administrative re-organisation carried out by the present Government of Bangladesh. The newly established districts are basically the former sub-divisions. Each district has a Deputy Commissioner who acts as the head of the district, being assisted by other officers.

Each district consists of several Upazilas which were formerly known as Thanas (police stations). There are 495 Upazilas which are regarded as upgraded Thanas where the administrative set-up has been thoroughly re-organised and expanded in an effort to take the administration to the door-step of the people and make it more responsive to the needs of the people. Under the present system of administration, the Upazilas have become the focal point of the public administration. Each Upazilas administration is headed by an elected Upazila Chairman.

Dhaka is the capital city of Bangladesh. Chittagong, Khulna, Narayanganj and Rajshahi are the four other main cities of the country. Bengali is the official language, and this is spoken by everybody and understood throughout the country.

The major religious group is the muslim who **constitutes** 86.6 percent of the population, and other religious groups such as Hindu who constitute 12.1 percent and Buddhists and Christians who constitute less than 2 percent. The percentage of the Muslim population appears to be the highest in the Dhaka Division (89.7 percent) followed by the Rajshahi Division (87.4 percent) and the Chittagong Division (85.6 percent). The percentage of the Muslim population seems to be the lowest in the Khulna Division (82.4 percent). These divisional values relate to 1981 Census.

Bangladesh is one of the most rural nations in the world. In the last few decades, the percentage of rural population has decreased from 95.6 percent in 1951 to 84.9 percent in 1981. On the other hand, the urban section has increased from 4.43 percent in 1951 to 15.12 percent in 1981. Although Bangladesh is the least urbanised country in the south Asian countries, the rate of urbanization has also increased significantly in the country.

The urban population has increased by 621 percent from its initial size of 1.9 million in 1951 to 13.7 million in 1981, while the total population has increased by 104 percent from 44.2 million in 1951 to 89.9 million in 1981. However, experiences from other countries suggest that the trend of urbanization is likely to accelerate in the near future in Bangladesh.

Regional variation exists in respect of urbanization (1981 Census). The highest urbanized division is the Dhaka Division (19.99 percent) followed by the Chittagong Division (15.00 percent) and the Khulna Division (14.36 percent). The least urbanized division is the Rajshahi Division (10.08 percent). The main reasons for high urbanization in the Dhaka Division are primarily attributed to the establishment of the Capital City (Dhaka) and location of public offices, industrial and commercial organizations, educational institutions etc.

Furthermore, in recent years urban growth in the country has been significantly affected by the rural-urban migration. This has resulted in a high degree of concentration of population in Dhaka and Chittagong and hence widening the access to modern community and social services to a greater section of the population. The real challenge is now to promote non-agricultural activities in the urban centers to absorb this ever growing section of the population.

Literacy level is very low in the country, this being particularly low among females, in comparison to many developing countries. Literacy rate for population aged 5 years and above has increased from 21.5 percent in 1961 to 23.8 percent in 1981. During this period from 1961 to 1981, the male literacy level appears to have remained constant, while the female literacy level has increased from 10.7 percent to 16.0 percent (50 percent increase).

Literacy level varies according to the divisions (1981 Census). The highest literacy level has been observed in the Khulna Division (27.2 percent) followed by the Chittagong Division (22.37 percent) and the Dhaka Division (21.02 percent). The literacy rate is the lowest in the Rajshahi Division (20.5 percent).

Adult literacy level (15 years plus) is also low in Bangladesh in comparison to many developing countries. The adult literacy level has increased from 25.8 percent in

1974 to 29.2 percent in 1981. During this period from 1974 to 1981, the male literacy rate has increased to about 7 percent, while the female literacy has increased to about 36 percent.

The adult literacy level also varies according to the region (1981 Census), but follows the same pattern as in the case of the literacy rate for population 5 years and above. The Khulna Division (33.7 percent) is at the top followed by the Chittagong Division (27.15 percent) and the Dhaka Division (25.78 percent). The adult literacy level of the Rajshahi Division (25.72 percent), though not far from the literacy level of the Dhaka Division, represents the lowest among the divisions.

The existing socio-economic condition of Bangladesh demonstrates a peculiar paradox of rich natural resources counter balanced by extreme economic poverty. Bangladesh enjoys fertile agricultural land, but the agricultural output is substantially below potential level. During 1965-66, for example, in the production of rice which utilizes roughly 80 percent of the total cultivable land, yield per acre was less than 25 percent of that in Australia, about 30 percent of that of Japan and considerably lower than that of most of the neighboring rice producing countries which experience similar geographical and human circumstances (Khan, 1972). Lack of irrigational facilities and fertilizers, use of primitive methods of cultivation, small size of land-holding and the like are primarily responsible for this sort of situation. Despite predominance in agriculture, the country has to import a significant portion of its requirements in food grains every year.

It has been suggested that food deficit is increasing and hence import is also increasing because of the low level of education among cultivators, the concentration of land in the hands of large farmers and the high incidence of share tenancy (Hossain, 1980).

Because of poor yields of rice (1.2 metric ton per hectare) and other food crops, over four-fifths of the population are below minimum caloric requirements. Per capita income is about US $121 which represents one of the lowest in the world.

Although Bangladesh is predominantly an agricultural country, a number of large scale industries based on both local and imported raw materials have been set up. Most of these industries are located in and around Dhaka and Chittagong. These produce goods which are basically needed for domestic consumptions. In addition, several natural gas fields with large reserves have recently been discovered in the Sylhet District of the Chittagong Division. This opens up the prospect for the petro-chemical industry in the Country.

Rajshahi and Khulna Divisions lag behind in terms of industrial development. There was no practically large scale industry in the Rajshahi Division until 1961. After 1964, a remarkable progress took place in this sector. Both large scale and small scale industries have been established in this division.

The present revised policy of the Bangladesh Government is to promote private participation on a wider scale and direct public ventures to supplement resources mobilized by the private sector in order to accelerate industrialisation in the country. The targets of the industrial policy of the Government is to create a public industrial sector which can supplement and guide private enterprises and to mobilize creative energies of private ownership, which is intended to ensure all possible incentive for stimulating private initiatives.

Efforts will also be directed to relax the bureaucratic and administrative controls which are likely to interfere with the progress of private entrepreneurship, and also to reduce investment in the nationalized industrial concerns and hence a greater activity of the private sector in the process of industrialisation will be encouraged.

Recently, the planners of Bangladesh have shown interest in promoting 'Agro-based' industries. It has also been suggested that the comparative advantage is greater in the Agro-based industries like sugar, edible oil, tobacco, jute textile etc - in which the domestic production is likely to be economical, although these industries are capital intensive (Azad, 1985).

Although Bangladesh exports a huge quantity of tea, jute and jute manufactured goods constitute more than 75 percent of exports. The basic simulation of the 1974-90 period suggests that the world jute market during the period will not change much, and hence the prospects of any considerable increase in the foreign exchange earnings from the exports of jute by the major producing countries are extremely unlikely (Mujeri, 1979).

Export policy of the government of Bangladesh is, however, directed towards increasing in export earning, strengthening the product base and improving the share of non-Jute, non-traditional and secondary commodity export in total foreign currency earnings.

1.3 Age And Sex Structure Of The Population

The age and sex structure of any population is very important in the study of a variety of demographic aspects, such as mortality, fertility and nuptiality, and of many other fields of demographic analysis. Its study reveals various aspects of the census results. The analysis of the age and sex structure, especially the observed change from census to census, are also useful in the evaluation of the quality of the census enumerations.

Fig 1.1 and Tables 1.1a and 1.1b show, by sex, the proportions in successive five year age groups reported by the four population censuses. In addition, Tables 1.1a and 1.1b show the proportions as reported by each of the data sources that provide a national age-sex distribution.

A widespread ignorance of age exists in the populations of most developing countries. In Bangladesh, the vast majority of the population are illiterate and lack age consciousness, and their ages have to be estimated by indirect means. The age statistics are thus liable to substantial errors. The most common types of errors which have been found in the Bangladesh age distribution indicate a very strong preference for the digits '0' and '5' and to a lesser extent for '2' and '8'.

These can cause a substantial heaping of population at certain ages, thus reducing the corresponding numbers at ages ending in 1, 3, 4, 6, 7 and 9.

Digital preference of this sort has always been a source of concern in both the censuses and the survey of many developing countries and it persists despite various techniques which have been employed to eliminate it. The incidence of age heaping could be detected through the application of the Whipple's index. The Whipple's index is calculated by summing the population recorded with ages ending in '0' and '5' between the ages of 23 and 62, and dividing the sum by one-fifth of the total population obtained between these two ages. The ratio thus obtained is expressed as a percentage. The index varies between 100, representing no preference for '0' or '5' and 500, reflecting that only digits '0' and '5' were reported. Between these extremes, the scale for evaluating the reliability of the data has been suggested by the United Nations (U N, 1962; New York, 1955). Thus the enumerated data can be regarded as highly accurate, fairly accurate, approximate, rough and very rough depending on whether the Whipple's index is less than 105, 105 to 109.9, 110 to 124.9, 125 to 174.9 and 175 and over.

The magnitude of the Whipple's index of Bangladesh as a whole and of different districts, shown in Table 1.2 and Table 1.3 respectively, reveals that the age reporting in Bangladesh is very rough, but that the age reporting in 1981 census is slightly better than that of the earlier census.

The magnitude of the Whipple's index for BLDS data is substantially less than that of the censuses and survey, suggesting that the quality of the data recorded in the BLDS survey is better than the age data recorded in earlier census and survey.

However, the distortions in age reporting have been considerably reduced when the data are classified by 5 year age groups.

The Bangladesh age distribution are not only affected by digital preference; the BRSFM (1977) suggests that the age data suffer from other more serious distortions. The most common types of these distortions are as follows-

1) A general tendency to report too many children aged 5-9 in comparison to those 0-4, due partly to a systematic over-representation of ages of young children and partly to selective under enumeration of such younger children (except 1981 census).

2) A tendency to underestimate the age of adolescents, particularly of females in the 10-14 and 15-19 age groups.

3) A general tendency to exaggerate the ages of adults particularly of males, becoming proportionate higher as age advances.

Fig 1.1 and Tables 1.1a and 1.1b demonstrate the clear-cut evidence of irregularities in the Bangladesh national age distributions, features well known in the sub-continent. Some of these irregularities could be real and may have been the result of events such as the Bengal famine of 1943 and the post-independence migration between India and Bangladesh. Krotki, (1961) analysed the 1951 census age distribution of the then Pakistan employing theoretical approach which stems basically from Lotka's formulation of the Stable Population theory and its quasi-stable variant which has been suggested by Coale (1957). The author demonstrates that the reasons for these irregularities may be attributable to age mis-reporting, but not to real demographic facts.

It is obvious that the age distributions are affected by errors of age reporting or of completeness of enumeration, but the patterns of error do not seem to be consistent from one census to the next.

Thus, inspite of the fact that the age distributions demonstrate a general tendency to report too many children in the 5-9 age group in comparison to those aged 0-4, the 1961 census shows deficit of population in the 10-14 age group and a noticeable plateau between 15 and 34. Bean et al (1966) suggest an explanation for the sharp change in the recorded age distribution between 1951 and 1961 which occurs because of the change in the lowering of the age limit of coverage for occupational questions from 12 years old in 1951 to 10 years old in 1961. The authors note that enumerators in 1961 systematically transfered respondents to ages below the limit without asking the extra questions, and thus the population under 10 in 1961 has been inflated.

Furthermore, the figures from the various enumerations tend to show erratic fluctuations across age groups because of age mis-reporting, but the fluctuations are particularly marked in the first three age groups (Tables 1.1a and 1.1b). When the three age groups are aggregated to produce the percentage aged under 15, the fluctuations tend to be minimised. These are presented in Table 1.4 which shows a high proportion of children and a low proportion of old people, representing a typical population with high fertility.

Table 1.5 shows the percentage age distributions of each sex for various enumerations according to various sources.

Table 1.5 suggests relatively little difference among these age distributions. The percentage under 15 for males demonstrates an increasing trend for Chittagong and Dhaka Divisions, whereas the percentages in Khulna and Rajshahi Divisions show decreasing trend over the period 1974 to 1981. The corresponding percentages for females show a decreasing trend in all the divisions. It should be mentioned that the rate of decreasing or increasing is negligibly small.

It should be mentioned that the application of the stable population theory is doubtful in the Bangladesh population because of the extensive migration that took place around the time of partition of India in 1947, and the substantial migration that occurred subsequently

(Khan, 1974), though the migratory factor does have a little effect on the age distribution. Moreover, the age distributions are seriously affected by the age reporting error and incompleteness of coverage. However, The Committee On Population (1981) applies stable population analysis to the 1951, 1961 and 1974 age distributions of the Muslim population of Bangladesh which appears to be less affected by international migration over the period.

This attempt has been made in order to highlight weaknesses in the data rather than to produce reliable estimates. In this analysis, both the male and female distributions have been used.

Stable populations based on the "North" age pattern of mortality has been used. This is because the mortality patterns indicated by the PGE and BRSFM surveys tend to conform more closely to the "North" pattern than to any of the other three regional patterns.

For 1961 and 1974, the growth rates used in the analysis have been taken from the observed intercensal growth rates for the Muslim population during the period, and this has been rounded to the nearest figure for which stable populations are tabulated by Coale and Demeny. Two growth rates have been used for 1951, and the range suggested by extrapolating backward the observed rates after 1951 and extrapolating forward those for 1951, has been covered.

Mortality level 11 has been used for both 1961 and 1974. This is because the analysis of the child survival data from the BRSFM suggests that level 11 is appropriate for the years prior to 1974 and the PGE survey suggests similar estimates of child mortality for the early 1960's.

Two major conclusions have emerged from this analysis.

1) The proportion of the population under age 5 is too low in 1951 and 1974, whereas the proportion under age 10 appears to be too high in 1961 and 1974 (particularly in 1961) and the proportion under age 15 is too high in 1974. On the other hand, the proportions under 10 and under 15 do not seem to be suspiciously high in 1951.

2) The male and female birth rates obtained based on a fixed growth rate are found to be very different, the female birth rate being almost 10 points (difference between two rates) higher than the male rate in each case. But the sex-specific birth rates estimated on the basis of a constant mortality level have been found to be much more compatible, the observed difference being only two or three points. The estimating procedure which is based on a fixed rate of growth is more vulnerable to errors

of age reporting than that based on a constant mortality level. It has been suggested that the reasons for at least some of the differences indicated in the cases which are based on a fixed rate of growth may be attributable to a greater tendency for males to exaggerate their age than females.

1.4 Completeness Of Enumeration

Population growth rates evaluated from various censuses are vulnerable to changes in the completeness of enumeration of the censuses. This is not appropriate to estimate demographic parameters by using growth rates in combination with population age distributions. The observed growth rates for the whole population of Bangladesh for the period 1972-1981 are presented in Table 1.6.

Between 1872 and 1941 the average annual growth rate was less than one percent, and by 1941 or 1951 the growth rate began accelerating. Robinson (1984) reviewed the long-term trends in fertility, mortality and natural increase in Bangladesh. The author suggests that the best estimate of the growth rate in the recent past may be the average annual rate obtainable from the adjusted 1961 and 1981 census totals, and this may be about 2.70 percent per annum.

Considering the population as a whole, the report on the post-enumeration check of the 1974 census suggests that the observed population should be adjusted upward by 19.3 percent in the four principal cities and by 6.5 percent elsewhere.

However, not much confidence can be laid in these estimates because Bangladesh (1977) reports that households in the census and those in the post-enumeration check could be matched in only 59 of the 482 sampled census blocks. The post-enumeration check of the 1961 census indicated an overcount of 1.5 percent. But Krotki (1965) indicates a net undercount of 8.62 percent for 1961 by demographic analysis. On the other hand, the 1981 census represents a net undercount rate of 3.1 percent which seems to be the lowest observed so far in the censuses carried out in Bangladesh.

Rabbani et al (1984) state that the PEC for 1981 census has been conducted carefully.

Cohort survivorship probabilities obtainable from the successive censuses age distributions often represent better indicators of variations in completeness of enumeration or of net migration than of the level of mortality, but these do not work well for the old ages. It may be mentioned that considerably low estimates of survivorship suggest emigration, particular kinds of errors in age reporting, or a relative underenumeration at the second census, while considerably high survivorship estimates suggest immigration, different types of age reporting errors, or an indication of relatively better coverage at the second census.

The committee on population (1981) observes that the Muslim population enjoys the highest survivorship probabilities, followed by the Caste Hindus, with the scheduled Caste showing the lowest survivorship probabilities. In addition, the committee observes that some Muslim Cohorts between 1961 and 1974 represent survivorship ratios in excess of 1.0. Since it is difficult to interpret such survivorship probabilities, they have been transformed into equivalent mortality levels in the "North" family of Coale - Demeny model life tables. In obtaining equivalent mortality levels, allowance has been made for the age distribution of a stable population having a growth rate of 2.0 percent between 1951 and 1961, and 2.5 percent between 1961 and 1974. It should be mentioned that the closed Cohorts (Cohorts aged 0-9, 10-29 and 30-49) do not depend on the choice of the growth rate, but the open-ended Cohorts depend on the assumed age structure and growth rate, the effect being highest for open-ended groups starting from age 10, 20, or 30 and for low mortality conditions.

In order to resolve uncertainties associated with adult mortality, indirect techniques can be useful. Indirect estimation of adult mortality is based on information about the survival of close relatives, specifically parents and first spouses. Experience shows that these two methods are able to yield plausible estimates of adult mortality, despite their various limitations.

It should be pointed out that indirect methods measure the mean effect of mortality over a spread of ranges or periods, and thus they are not suitable for estimating age specific mortality rates. Indirect methods are, therefore, intended to provide a satisfactory estimate of the overall level of mortality, which can broadly be divided into child and adult components. The two independent estimates are then to be linked up to construct life table, and this linkage is usually performed with reference to a model life table.

However, if the indirect estimates are satisfactory, and the model life table assumed is based on a real situation, the resultant description of mortality is likely to be more satisfactory than those obtainable by the direct methods, because the indirect techniques have in-built mechanisms of taking into account the factors of underreporting of vital events and mother's age to arrive at an approximately correct estimate.

In this study, survivorship probabilities for closed and open-ended Cohorts, by sex, have been examined.

The analysis suggests the following:-

1) The results for the period 1951-1961 tend to be fairly consistent, indicating certain patterns of age reporting, particularly an increasing tendency to exaggerate age as age advance (indicated by the systematic pattern which shows that mortality level of the open-ended survivorship ratios increases with age) and a relative underenumeration of 10-19 year olds in 1961 in comparison to 0-9 year olds in 1951 (indicate by the low mortality levels estimated for the 1951 Cohort aged 0-9).

2) The 1951-1961 results indicate low mortality levels for Caste Hindus and even lower levels for the scheduled Caste. The estimated mortality levels for both groups of Hindus seem to be implausibly low and suggest selective underenumeration or substantial emigration of Hindus between 1951-1961. If the Cohorts affected by age mis-reporting are ignored, the survivorship ratios for the Muslim population indicate a mortality level of around 6 or 7, which the committee thinks to be plausible for the period.

This also suggests that the completeness of enumeration in 1951 may have been similar to that in 1961. However, the deficit of Hindus has been attributed to net emigration, presumably to India.

3) The results for the period 1961-1974 tend to be more surprising. The very low survivorship ratios suggest a clear deficit of Hindus in 1974 relative to 1961. The results also suggest that the Cohort aged 0-9 in 1961 was either too large in 1961, may be because of age reporting errors connected with the occupation questions used in the 1961 census, or too small in 1974. The other Cohorts suggest too many Muslims in 1974 compared to 1961, implying survivorship ratios in excess of 1.0 for many Cohorts, the number of males being particularly excessive. However, the results suggest that enumeration was more complete in 1974, for males, or that there was some net immigration of Muslims between 1961 and 1974. Such change in completeness of enumeration suggests that the observed intercensal growth rate of the Muslim population was greater than the rate of natural increase.

4) It is concluded that the Hindu, particularly the scheduled Caste, tends to decrease during the intercensal periods 1951-1961 and 1961-1974 to such an extent that the mortality fails to explain, which suggests net emigration to India.

Recently Kabir et al (1985) applied the Preston and Benett technique to the Bangladesh census data to obtain the adult mortality level during the intercensal period 1974-1981. Preston and Benett (1983) proposed the estimation of the expectation of life at each age x, using extensive cumulation both of the reported population and of the observed age specific growth rates. The advantages of the method are that its application is relatively simple and it does not require assumptions of stability. The method is based on the element of cumulation, which reduces the age errors. However, the method is based on the assumption that the population is closed to migration between the censuses.

The authors plotted the ratios of the estimates of the life expectancy to those of the West level 14 for the females, and found no systematic pattern, showing irregular, fluctuating from one age group to another. The authors mentioned that taking ratios of life expectancies to those in the West level 14 table is precisely a simple way of using a model life table system for the estimation of e_5 (life expectancy at age 5). However, the authors tend to suggest that there is a differential completeness of census coverage, although the irregularities in the ratios might also stem from age mis-reporting.

Furthermore, the estimated life expectancies based on this method show sudden rise at the age of 15, which means that the method is affected by age exaggeration. Alternatively, the model life table systems have been used to derive more reasonable set of estimates of life expectancy. The life expectancies obtained at various ages from the procedure have been compared with those of a model life table system. It has been assumed that West family represents the best the age pattern of mortality in Bangladesh and the level of mortality as indicated by each estimated e_x has been obtained by taking mean ratios of life expectancy at various levels in the west model life table system. Thus, the life expectancy at age 5 (e_5) has been estimated as 53.74 against the level 11.59, whereas the method based estimate of the life expectancy at age 5 is 56.6. However, the authors conclude that despite various difficulties, the method provides a reasonable level of female adult mortality.

Conclusion

Review suggests that the Bangladesh age distributions are of poor quality, and they are affected by various sources of errors. Age distribution analysis indicates that the mis-reporting of age under 10 is of a serious nature, the 0-4 age group being too small in all Bangladesh age distributions (except 1981), which may result either from omission or from age mis-reporting, and the 5-9 age group being too large, which could stem from age mis-reporting. Stable population analysis indicates a tendency for males to exaggerate their ages relative to females. Age exaggeration has also been observed in Cohort analysis.

Furthermore, cohort analysis by religion and broad age groups suggests an emigration of Hindus, but this analysis demonstrates inconsistent results for Muslims. In addition, this analysis indicates a deficit in 1961 relative to 1951 and a surplus in 1974 when compared with 1961 figures.

Review, however, suggests that uncertainty prevails as to the size and the age distribution of the population. Because of inconsistencies in error patterns, age mis-reporting and net migration, it seems practically impossible to adjust the age distributions satisfactorily so that they can be used for the estimation of demographic parameters.

Review also suggests that the censuses 1951, 1961 and 1974 do not show firm evidence that they are affected by differential enumeration completeness, although the evidence of surprising changes in age reporting has been found.

Table 1.1a

Distribution of the population by age and sex from major sources, 1951-1981:- Bangladesh Males.

Proportion of the population reported in each age group									
Age Group	1951 Census	1961 Census	1964-65 PGE	1974 Census	1974 BRSFM	1975 BFS	1980 BLDS	1981 Census
0-4	.139	.174	.164	.162	.145	.144	.143	.166
5-9	.145	.185	.178	.178	.167	.172	.155	.160
10-14	.135	.099	.127	.135	.145	.151	.150	.139
15-19	.094	.073	.075	.085	.090	.093	.102	.092
20-24	.078	.069	.059	.065	.072	.080	.081	.072
25-29	.077	.076	.069	.063	.070	.065	.076	.072
30-34	.069	.064	.066	.055	.057	.051	.059	.056
35-39	.060	.059	.063	.055	.056	.050	.057	.053
40-44	.052	.048	.047	.047	.047	.038	.043	.043
45-49	.043	.039	.040	.037	.037	.034	.037	.035
50-54	.039	.036	.036	.035	.033	.029	.029	.032
55-59	.023	.023	.022	.021	.021	.023	.021	.021
60-64}	.028}		.025	.025	.024	.022	.018	.023
65-69}	}	.056	.011	.012	.012	.017	.010	.012
70-74}	.019}		.009	.013	.013	.012	.010	.012
75 + }	}		.099	.012	.012	.015	.009	.014

Sources: Census Census of Pakistan 1961 Vol 2
PGE Final Report of the Population Growth Estimation Experiment, Dhaka1971.
BFS Bangladesh Fertility Survey Report 1975
Others as in Table 1.2

Table 1.1b

Distribution of the population by age and sex from major sources, 1951-1981:- Bangladesh Females.

	Proportion of the population reported in each age group							
Age Group	1951 Census	1961 Census	1964-65 PGE	1974 Census	1974 BRSFM	1975 BFS	1980 BLDS	1981 Census
0-4	.154	.191	.177	.176	.160	.156	.154	.174
5-9	.153	.190	.189	.189	.180	.176	.166	.165
10-14	.117	.083	.105	.122	.136	.147	.151	.129
15-19	.106	.081	.078	.080	.088	.105	.104	.095
20-24	.088	.081	.079	.073	.077	.085	.085	.084
25-29	.084	.082	.079	.074	.076	.072	.079	.075
30-34	.068	.063	.064	.059	.059	.048	.056	.059
35-39	.055	.051	.051	.052	.052	.043	.049	.049
40-44	.047	.045	.047	.044	.043	.039	.038	.042
45-49	.032	.033	.034	.032	.033	.034	.033	.030
50-54	.035	.033	.038	.032	.031	.025	.026	.030
55-59	.020	.018	.018	.017	.018	.027	.018	.017
60-64}			.021	.022	.020	.016	.016	.021
65-69}	.027}	.049	.008	.009	.009	.011	.009	.009
70-74}	}		.006	.011	.010	.007	.008	.010
75 + }	.015}	.077	.010	.009	.007		.007	.011

Table 1.2

The Whipple's Index

Year	Source	Both Sex	Male	Female
1974	Census		337.6	354.2
1974	BRSFM		313.4	318.9
1980	BLDS	228		
1981	Census		316	335

Source:- 1974 Census

BRSFM, 1974: Report on the 1974 Bangladesh Retrospective Survey of Fertility and Mortality, Census Commission, Ministry of Planning, Dhaka.

1980, BLDS: Current Demographic situation in Bangladesh - G. Rabbani and S. Hussain, B.B.S. June, 1983.

1981 Census.

Table 1.3

Whipple's Accuracy Index, 1981.

Districts	Whipple's Index Male	Female
Bangladesh	316	335
Bandarban	306	326
Chittagong H.T.	296	308
Chittagong	313	345
Comilla	330	343
Noakhali	342	358
Syvhet	331	347
Dhaka	318	344
Faridpur	332	346
Jamalpur	328	340
Mymensingh	334	348
Tangail	317	330
Barisal	342	358
Jessore	300	321
Khulna	276	291
Kushiat	303	325
Patuakhali	364	377
Bogra	297	319
Dinajpur	286	310
Pabna	314	331
Rajshah	273	301
Rangpur	307	327
Statistical Metropolitan Areas		
Chittagong	292	329
Dhaka	312	350
Khulna	318	340
Rajshahi	285	327

Source:- 1981 Census Report.

Table 1.4

Reported Percentage of each sex under 15 years: BRSFM and other sources.

Source	Year	Males	Females
Census	1951	41.8	42.4
Census	1961	45.8	46.6
PGE	1964	46.6	46.9
BRSFM	1974	45.7	47.6
Census	1974	47.5	48.7
BFS	1975	46.7	47.9
BLDS	1980	44.8	47.1
Census	1981	46.5	46.8

Table 1.5

Percentage age distribution by division.

Division	Year	Male Total	Male 0-14	Male 15-49	Male 50 +	Female Total	Female 0-14	Female 15-49	Female 50 +
Chittagong	BRSFM 1974	100.0	44.2	44.2	11.6	100.0	46.7	43.7	9.6
	Census 1974	100.0	46.3	41.4	12.3	100.0	47.6	42.1	10.3
	Census 1981	100.0	46.6	41.5	11.9	100.0	46.4	43.6	10.0
Dhaka	BRSFM 1974	100.0	44.6	43.8	11.6	100.0	47.3	42.6	10.1
	Census 1974	100.0	46.4	41.7	11.9	100.0	48.3	41.3	10.4
	Census 1981	100.0	45.3	43.4	11.3	100.0	46.2	43.9	9.9
Khulna	BRSFM 1974	100.0	47.1	41.1	11.8	100.0	48.4	41.8	9.8
	Census 1974	100.0	48.3	40.2	11.5	100.0	49.6	40.6	9.8
	Census 1981	100.0	47.0	41.9	11.1	100.0	47.5	42.8	9.7
Rajshahi	BRSFM 1974	100.0	47.7	41.2	11.1	100.0	48.4	42.5	9.1
	Census 1974	100.0	49.4	39.4	11.2	100.0	49.8	40.9	9.3
	Census 1981	100.0	47.2	41.9	10.9	100.0	47.3	43.3	9.4

Source: BRSFM 1974: Bangladesh Retropsective Survey of Fertility and Mortality, Census Commission, Statistics Division, Ministry of Planning, Dhaka

1974 Census: B.B.S.
1981 Census: B.B.S.

Table 1.6

Census Population Size

Year	Population (000)	Intercensal Percent Growth	Annual Growth Rate (%)
1872	22,779	-	-
1881	24,926	9.4	1.0
1891	27,010	8.4	0.8
1901	28,928	7.1	0.7
1911	31,555	9.1	0.9
1921	33,254	5.4	0.5
1931	35,604	7.1	0.7
1941	41,997	18.1	1.7
1951	42,063 (44,166)	0.2	-
1961	50,840 (55,223)	20.9	1.9 (2.26)
1974	71,479 (76,398)	40.6	2.6 (2.48)
1981	87,120 (89,912)	21.8	2.9 (2.32)

Source: A. Miranda, 'The Demography of Bangladesh', DERAP Publication, The CHR Michelsen Institute, Bergen, Norway, 1982, as modified by W.C. Robinson.

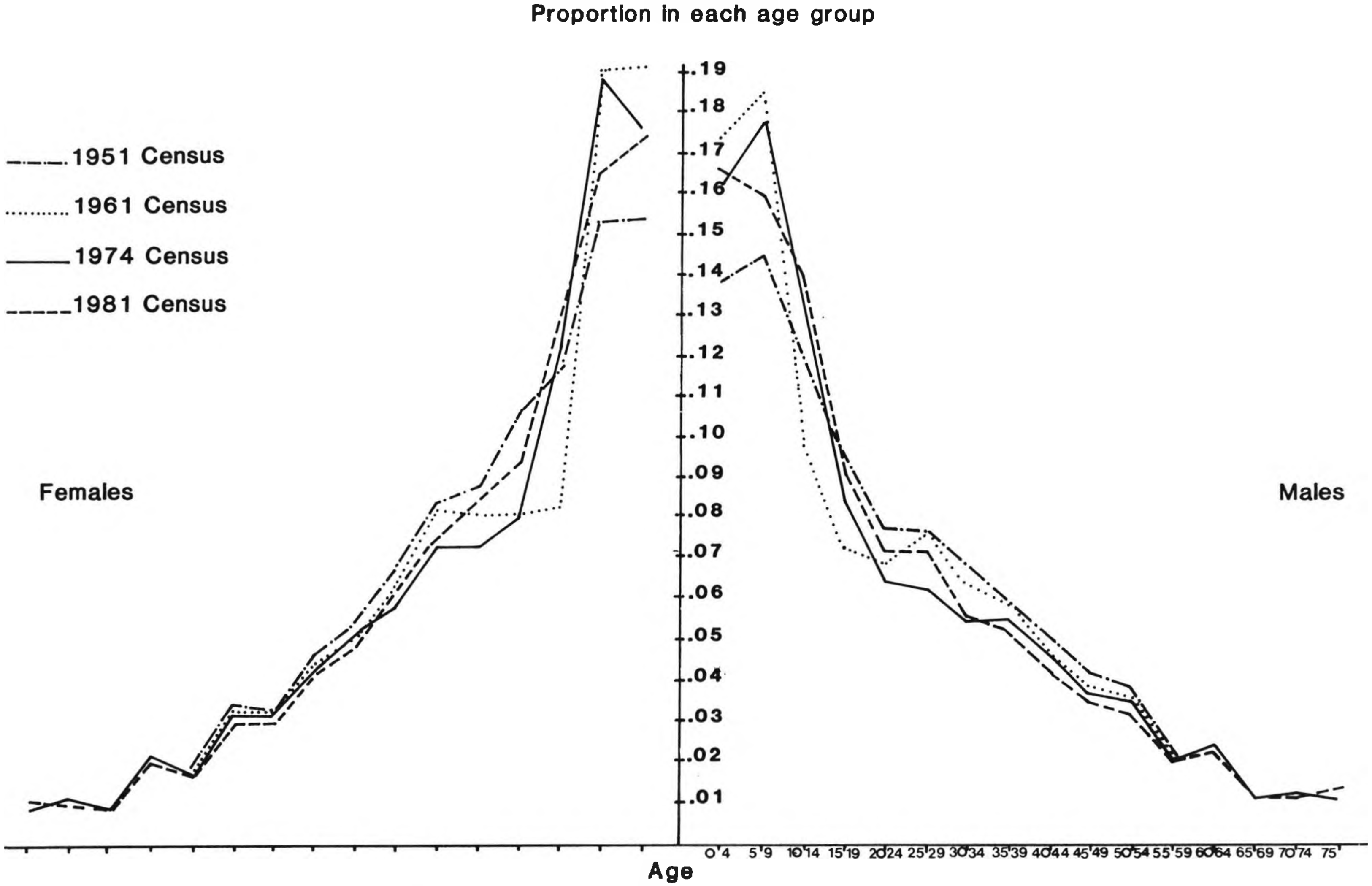

Fig:1.1 Age distributions of the population by sex census in 1951, 1961, and 1981 Bangladesh.

Sources: As in Table 1.1a

CHAPTER 2

Marriage

2.1 Introduction

Marriage in Bangladesh is traditionally regarded as the legal union between a man and a woman, and this is solemnised in accordance with certain religious norms. Marriage is aimed at establishing a family in which both the partners can lead a conjugal life. However, marriage is regarded as an event that marks the beginning of the child-bearing period. This is because exta-marital fertility is non-existent in Bangladesh.

Marriage in Bangladesh, as in many developing countries, is virtually uiniversal for both males and females. It is, therefore, considered as an important social institution. Marriages are mostly arranged either by the parents or other close relatives.

The simple and most important division of the population by marital status is between the never-married and ever-married. The percentages of never-married in each age group for both males and females from various censuses and surveys are shown in Tables 2.1a and 2.1b.

The most likely source of error in the data on marital status by age may be differential under enumeration. Khan (1975) suggests that there was substantial omission of children and single females at younger ages. But it should be mentioned that this comment has not yet been officially verified. If, however, this kind of error exists in marital status data the proportion single at such ages are likely to be deflated.

Marriage in Bangladesh takes place early and is universal, especially for women. Marriage for men is also almost universal, but it occurs on the average, relatively later in life.

The Table 2.1b demonstrates very early marriage for women in 1951 and 1961, indicating that about 90 percent of women in the age group 15-19 were married. The percentage of never-married for women in this age group has increased to 31.3 in 1981, indicating a remarkable decline in the percentage of women married between 1961 and 1981. It might be thought that the observed results might be due to the better enumeration, but since the figures are based on proportions, the results are unlikely to be afffected by this. Another interesting feature of Table 2.1b is that a negligibly small percentage of women tend to remain never married, a phenomenon which is evident from the percentages of women remaining single at ages over 35.

On the other hand, only 79 percent of men aged 25-29 was found to be married at least once in 1981, expressing a decline from 85 percent of the same age group in 1951 (Table 2.1a). Generally speaking, there appears to have been a steady rise in the percentages of men never married from 1951 to 1981. Another important feature is that early marriage was not common for men in both 1951 and 1961. The percentage of men who were married in the age group 10-14 was only 2 and it had declined to 0.1 in 1981.

Another important aspect to note is that the vast majority of males tend to marry eventually like their female counter parts, but they appear to do so relatively later.

2.2 Age at First Marriage

Age at first marriage is of considerable interest to demographers who are particularly interested in fertility analysis. This is because entry into a first marriage represents an approximate indicator of the beginning of a woman's exposure to the risk of child-bearing. But the problem is that age at first marriage may not always reflect the true situation because of two reasons. First, in several Asian populations it has been found that girls are married at very young ages, but do not generally start living with their husbands until after reaching puberty. Second, in Latin America, girls may start living with their husbands before a formal marriage ceremony or may continue cohabiting without having made it formal. However, in Bangladesh where the vast majority of the population are Muslims, girls start their conjugal life immediately after marriage takes place, even though marriage is early. In this connection, a study of Caldwell et al (1983) can be mentioned. The authors suggest that in South India, 95 percent of Muslim marriages are consummated within 24 hours, but among Hindus the median delay is three months, with only 25 percent of couples who start their conjugal lives within the first month. Thus age at marriage in Bangladesh is likely to be an important measure in fertility analysis.

Demographic studies have shown that differences in age at first marriage can account for considerable variation in the fertility of different populations and that changes in age at first marriage have a remarkable influence on fertility levels in populations of many countries. In a country like Bangladesh where extramarital fertility is virtually non-existent, changes in age at first marriage are likely to have some impact on fertility. Age at marriage is, therefore, the most important factor which tends to regulate the potential reproductive period of women. Coale and Tye (1961), employing the stable population technique, demonstrate that fertility, in general, decreases with an increased age at marriage, which in fact implies the reduction of the average length of marital life. In the Mysore population study it was suggested that if no women married before reaching 18 years of age, then the overall fertility would decrease by about 15 percent (United Nations, 1961). Agarwala (1965) suggests that in India an increase in average age at marriage from the existing 15.6 years to 19-20 years, would result in an annual crude birth rate 30 years (length of the reproductive period) later of 33.9 births per 1000 population instead of 47.8, implying a decline of 29 percent. Sadiq (1967) observes that in Pakistan, an increase of minimum age at marriage by about 5 years will result in an immediate decline in the birth rate, which will imply moving towards a permanent decline.

It has been observed in Population Growth Estimation Experiments (PGE) that more than 50 percent of women have three or more children before reaching 20-24 age group. An increase in age at marriage by 5 years will however, reduce the length of the reproductive period of women which is likely to have a considerable effect on the birth rates to women under 35 years old.

Despite the usefulness of age at marriage in connection with developing fertility models, no attempt has yet been made to collect information on age at marriage through various censuses of Bangladesh. It should be mentioned here that before the introduction of the Muslim Family Laws Ordinance in March 1961, which requires all Muslim marriages to be registered with the nominated persons, there was no all-embracing civil organisation for such registration, although Muslim marriages were generally recorded by the religious registrars such as Quazis, Mosque Imams etc. Since data under the new provision are not yet available, indirect methods to estimate age at marriage as developed by Hajnal (1953) can be employed. Data required for this estimation are marital status by age which are available through the censuses and surveys. However, this measure is based on proportions ever married which is considered up to age 50, because after that a very few first marriages are likely to take place.

It may also be noted that this measure uses proportions from a single point in time and does not reflect the behaviour of various age Cohorts.

Thus if any change in marriage patterns is taking place, it is highly unlikely to be reflected in this. The singulate mean age at marriage for Bangladesh are shown in Table 2.2.

Table 2.2 shows that child marriage was traditionally popular in Bangladesh. The female age at marriage in 1931 was considerably low because of the effect of the Child Marriage Restraint Act which was enforced in April, 1930. It may be mentioned that the implementation of the Act was delayed because all sections throughout India opposed it and because it had also been debated for a long time in the Legislative Assembly before it became law on October 1, 1929. Many persons availed themselves of this opportunity and solemnised early marriages of their daughters. This has produced huge proportions of very youny married women, as recorded in the 1931 Census. As a result, female age at marriage became extremely low. However, child marriage is going out of fashion now-a-days because of increasing literacy, and social and economic changes and the enlightment, stemming from the contact with the outside world and more importantly, because of the effect of the Child Marriage Act. Table

2.2 suggests that female age at marriage has risen to 17.8 years in 1981 from 12.6 years in 1931, with a slight drop in 1961. The drop in 1961 may be due to some definitional or data collection problem which affected the information for 1961. It may be noted that deficiencies in age reporting in the 1961 Census have already been discussed in Chapter 1 in the population characteristics section.

On the other hand, the male age at marriage has also risen to 25.8 years in 1981 from 19.0 years in 1931. Thus over the last 50 years, the age at marriage for females has increased by about 5 years, which means that it has increased at the rate of 1.2 months per year. During the same period, the age at marriage for males has increased by about 7 years, which means that the male age at marriage has increased at a relatively faster rate than that of the females. It may also be noted that gap between male and female age at marriage has increased from 6.4 years in 1931 to 7.9 years in 1982. In patriarchal societies and in societies characterised by patrilineal kinship organisation, the age difference between spouses has been found to be relatively large, and unions in which the husband is ten or more years older are relatively frequent, whereas in societies where the status of women is comparatively high because of the process of modernisation and westernisation, the age difference is relatively small (Casterline et al, 1986). Bangladesh society is also a patriarchal society where the status of women is low (Cain et al, 1979), such difference in age at marriage is expected.

A comparison of the 1980 BLDS and 1981 Census percentages for never married females, as shown in columns 6 and 7 of Table 2.1b, suggests that the percentage figures below 30 for BLDS are considerably higher than that of the 1981 Census. This appears to have resulted in a higher age at marriage for females in 1980 than 1981.

The discrepancies between these two figures seem unrealistic and they could stem from the following considerations. It has to be remembered that BLDS is based on a sample survey, of 102 districts, each having 250 households (Rabbani et al, 1983). It may be that the sample was biased or may have omitted significant numbers of married women and hence over-estimated single women in all age groups below 30, overestimation being particularly high in the 15-19 age category. The increased coverage in survey areas is likely to improve the quality of the data. Since marital status data for the never married males are not available from BLDS, it seems particularly difficult to state the reasons for the differences observed between the 1981 Census and VRS (Vital Registration System). However, the factors stated above may contribute to it. However, when 1974 and 1981 Census figures are considered, the age at marriage for men does not seem to have increased but shows sign of a declining trend. On the other hand, the age at marriage for women has been found to be still rising during the period between 1974 and 1981, although after 1981, it shows a slight tendency to decline.

Other studies also support the suggestion that the age at marriage has increased in Bangladesh since 1951 or 1961.

Based on a sample of women from the 1961 Census, Afzal (1967) suggested that the mean age (estimated from reported duration of marriage) had been rising in both urban and rural areas of East Pakistan for some time prior to 1961. Sadiq (1965) calculated the singulate mean age at marriage from census data for the period 1921-1961 and observed a similar trend in age at marriage. Alam (1968) also observed an increasing trend in the mean age, studying the 1964 PGE data, even after making due allowance for the limitations of his estimates. On the other hand, Sirageldin et al (1975) demonstrated little change in marriage behaviour, examining the 1968-69 National Impact Survey data. It should be mentioned that the last study was based on stated age at first marriage. The authors however, mentioned that the observed relation in median age at marriage appeared to be erratic for the sample as a whole, and the suggestion that the authors offered was not conclusive.

In recent years, age at marriage has risen in many developing countries. For instance, in India, the mean age of women at marriage rose from about 13 to 17 years from the 1st quarter of the century to 1971. On the other hand, the mean age at marriage of men in India had increased slowly from 20 to 22 years during the same period.

However, there is no doubt that the age at marriage for the females in Bangladesh appear to be rising, apparently since 1951. But Bangladesh females still marry earlier than those in developing countries. In the Cross National Summary on age at first marriage, Smith (1980b) suggests that women in Bangladesh tend to marry at the youngest ages, with marriages often arranged before puberty. The author further suggests the following:-

1. The range of ages at first marriage is substantial among the other Asian countries. Korea tends to indicate a pattern of relatively late marriage and the other countries tend to experience positions which lie in between Korea and Bangladesh. All

Asian countries appear to demonstrate one common pattern with regard to the proportion of women who ultimately marry, the proportion being over 95 percent in all countries.

2. Recent changes in age at first marriage appear to have been relatively more substantial in Asia than in Latin America and the Caribbean. Over the five year period prior to each survey, the Asian countries witnessed rises in the SMAMS by between one and two years.

   In contrast, the Latin American countries witnessed increases in the SMAMS on an average about half the level of the changes taking place in Asia.

3. Latin American countries appear to be more homogeneous in the ages at which women marry, but tend to demonstrate more variation in the proportions of women who ever marry, these proportions having been found to vary from 98 percent in Jamaica to 90 percent in Colombia and Costa Rica.

Change in age at first marriage in Bangladesh is likely to have some impact on fertility measurement, because it affects the distribution of the currently married women, which is also affected by marital dissolution. Table 2.3, shows the percentage of women currently married by age group from the censuses for the period 1951-1981. Table 2.4 shows the percentages of persons in each age group who were widowed or divorced. It should be mentioned that the large majority of such persons were widowed and thus divorced persons generally represented less than 1 per cent in each age group.

Table 2.3 shows that the percentage of currently married women under 20 declined considerably during the period 1951-1981, although 1961 values are out of line because of data errors already mentioned in Chapter 1.

On the other hand, the percentage of women currently married above age 25 have increased considerably over the same period. Table 2.4 is relevant here. This shows that the percentages of women widowed declined significantly over the period. For instance, in 1951, the percentage of women widowed in the age group 35-39 is 20, which declined to 10 in 1961. This appears to indicate a rapid decline in the incidence of widowhood, which does not seem realistic, but it indicates a possible increase in the incidence of remarriage. This possibly has resulted in increases in the percentage of women currently married above age 25. However, the Committee On Population (1981) examiens the effects on fertility of the changes in age at first marriage. In this report, a marital fertility schedule has been prepared using BRSFM data, by dividing the number of births in the year before the survey by the number of currently married women in each age group. Then to obtain total fertility, this has been applied to each distribution of women by current marital status. However, the report suggests that rise in age at marriage has a little influence on fertility because of the effect of the continuing decrease in the probability of widowhood, which tends to have an upward influence on fertility measures.

However, it is difficult to assess the amount of distortions in marital status distributions satisfactorily.

The differential under-enumeration discussed above may have occurred in all censuses, which is likely to give a continuing bias in the same direction. It may be mentioned that in the 1961 Census it was assumed that no person could have married before age 10, with the result that some married persons may have been excluded.

It has already been mentioned in Chapter 1 that the under-reporting of ages for female adolescents (15-19 years)is one of the features of the age distribution errors. The reson for this occurrence may be due to the association of age with marital status. It may be noted that an enumerator can record the stated age below which no person can be married or can assume a 'normal' age at marriage which is different from the real mean age. This is likely to give rise to errors in the stated age of young married women. It has been suggested that in Tropical Africa the common assumption of a higher 'normal' age than is the one in reality will lead to the down-grading of teenage unmarried females and the up-grading of similarly aged married females.

In addition to its influence on the age distribution, this bias is likely to artificially inflate the proportions married at ages over 10 for Bangladesh and thus in turn is likely to affect the singulate mean age at marriage and other measures.

2.3 A First Marriage Model For Bangladesh Females

From the information on proportions single and ever-married in each age group, a model of first marriage rates by single years of age has been constructed (BRSFM, 1977). This is shown in Table 2.5, which demonstrates both the first marriage frequencies (annual number of marriages per 1000 women) and the proportions ever-married. However, Coale (1971) found that a double expotential represented a close fit to recorded first marriage frequencies, and that the model could be ascertained by three parameters:-

a_o, the origin of the curve and representing approximately the earliest age at which a significant number of marriages occurs.

k, the time-scale during which first marriages take place; when k=1.0 the first marriages will be spread out over an age range of 40 years, so that a woman who reaches the age of $a_o + 40$ without ever having been married is unlikely ever to do so. When k is less than, or greater than 1.0 this 40 year period is shortened or extended proportionately.

c, The proportion ever married when first marriage have effectively ceased and thus represents the ultimate proportions ever-married.

The values of these three parameters obtained from the BRSFM data and used for the construction of the model are presented in Table 2.6, which also contains the values of those parameters evaluated from the 1951 and 1961 Census data.

A comparison of the 1951 and 1974 parameters suggests that the initial age at which marriages occurred had climbed and simultaneously they were spread out over a wide age range.

Furthermore, the Coale marriage curve is applied to the available Cohort experience in WFS (World Fertility Survey) data, and the results obtained are shown in Table 2.7 (Smith et al, 1983). The implied completed marriage pattern for each Cohort is summarised with reference to a mean (μ) and a standard deviation (σ) for the distribution of ages at first marriage and by an estimate of the proportion of each Cohort ultimately marrying (C). This alternative expression of the Coale's a_o and k parameters which have been defined as the mean (μ) and the standard deviation σ of the age at marriage distribution, has been discussed elsewhere (Rodriguez and Trussell, 1980).

For some countries and Cohorts an alternative model has been estimated in which C is fixed at a plausible level. These 'fixed-C' results are presented whenever the "estimated" C exceeds 1.0 or is appreciably lower than what seems realistic. It should be mentioned that the underlying problem of the application of this technique is that the experience of most of the Cohorts in the study is incomplete and hence the ultimate proportion marrying remain undetermined. However, the Coale age at marriage curve is good for predicting the subsequent age pattern of marriage for those in a Cohort who are likely to marry but have not yet done so, if it is possible to make a reasonable approximation about the proportion of currently unmarried women who will ultimately marry. Experience has demonstrated that results of the Coale model are rather sensitive to the proportion ultimately marrying that is utilised (Rodriguez and Trussell 1980, Trussell 1980).

However, the results shown in Table 2.7 suggest that marriage is virtually universal with no Cohort trend in C although μ is rising, and this pattern is corroborated by the census and survey data shown earlier as well. These results are also applicable to Indonesia, Korea and Nepal. The report (Smith et al, 1983) has drawn the following conclusions:-

1) Substantial judgement is necessary in interpreting the parameter estimates of the youngest Cohorts, considerably hinging on the choice of C

values. This does not appear to be a huge problem for most Asian societies where C approaches unity, but C does not seem to have declined among recent Cohorts. However, the serious difficulty will lie in regions like Europe and Latin America where C has been found to be more variable.

2) It has been observed that the upward trend in μ is likely to overstate the true upward trend, at least slightly, in a situation where age heaping exists. However, this effect appears to be negligible in the Asian data investigated in this study.

3) A source of systematic bias has been found in the age at marriage response in the WFS Surveys examined here. This bias has resulted in too low estimates of μ among older Cohorts.

The authors, however, tend to suggest that the last two points indicate some overestimation of any true upward trend in μ, but the effect appears to be insignificant. Further, it has been suggested that the uncertainty relating to C values represents a more complex situation in determining future trends.

2.4 Age At Marriage By Divisions

Table 2.8 gives the singulate mean age at marriage for males and females for the geographical divisions and urban/rural residence for 1961-1981, and the singulate mean ages at marriage by religion corresponding to the 1961 Census, and the BRSFM, 1974.

Table 2.8 shows that the singulate mean age at marriage for males has increased between 1961 and 1974 in all the divisions, the highest increase being observed in Chittagong followed by Dhaka and Khulna, and the lowest increase being found in Rajshahi. It is interesting to note that the SMAMS for males appear to have declined after 1974 in all divisions. On the other hand, the SMAMS for females appear to have increased in Rajshahi and Khulna divisions between 1961 and 1981, but SMAMS for females tend to have climbed between 1961 and 1974 in Dhaka and Chittagong and thereafter, SMAMS cease to have increased. Furthermore, Muslim women appear to marry almost 1 year earlier than the Hindu women, while the difference was 1.5 years for men in 1961 and declined to 1.1 years in 1974.

However, all the divisions witnessed rises in SMAMS for men between 1961 and 1974, though less rapidly than for women, with the result that for each division, the difference between SMAMS of men and women had narrowed to approximately 8 years in 1974 from approximately 9 years in 1961. The gap further had narrowed down to 7 years in 1981.

Furthermore, Chittagong experiences the highest mean age at marriage for both males and females, followed by Dhaka and Khulna, and the lowest being observed in Rajshahi. Reasons for the youngest age at marriage in Rajshahi division may be attributed to the least urbanisation of the division, and lowest level of literacy among females. This sort of result has also been found in another study. Jones (1981) observes that among Malays in Peninsular Malaysia, age at marriage has been noted to be the lowest in those areas in which education is the least advanced, economic welfare least, and traditional Islamic practices strongest.

However, slight variation exists in the mean age at marriage of the divisions. The gaps among the divisions in singulate mean age at marriage for men and women have narrowed, the difference among males having been declined from 2.7 years in 1974 to 2.0 in 1981 and among females from 1.8 years in 1961 and 1.2 in 1981.

Table 2.8 reveals that mean age at first marriage in urban areas appears to be constantly higher than that in rural areas by about 2 years. This is applicable to both males and females. The urban/rural difference in the female age at marriage may result from various factors. Firstly, people in the rural areas are relatively more fatalistic and tradition-minded than their counterparts in urban areas. Second, the level of education affects the marriage. This is because of the fact that the urban people are extremely likely to receive higher education which would in turn lead them to refrain from early marriage. Third, experience suggests that there is an increasing tendency among males in the urban areas to marry when they have some economic security in life. Moreover, parents desire their daughters to marry educated men with urban jobs because such men are likely to have certain incomes which are not subject to climatic cycles and which are paid monthly to support their families.

Another interesting feature to note is that both urban and rural areas experienced a rapid rise in the SMAMS between 1961 and 1974 and that the increase appears to have persisted even after 1974, although increases in the SMAMS have slowed down after 1974. This feature is applicable to both males and females (except urban males).

Table 2.9 gives the values of the parameters of Coale's first marriage model for Bangladesh females for domains in 1974 and for earlier years. It should be mentioned that the first marriage model has not been constructed from

BRSFM data, due to likely sampling errors in some of the BRSFM data, and that C approached 1 for all domains.

It is evident from Table 2.9 that all the domains experience a slow rise in the initial age a_o, implying little variation among them. All divisions appear to show a rising trend in the "tempo" parameter k, the values of which vary appreciably among the divisions.

2.5 Conclusion

Marriage in Bangladesh is virtually universal and early for females, and for males, marriage is also almost universal, but tends to take place on average somewhat later in life. Despite the importance of the age at first marriage particularly in fertility analysis, no attempt has yet been made to include questions on marriage in the previous censuses so that the age at fisrt marriage can be calculated directly. However, the age at first marriage can be calculated by the Hajnal's method which requires information on never married status. But this is available easily through the Censuses and Surveys. But the problem is that the data on marital status by age are subject to differential under-enumeration which affects the measure. Another point is that the measure also does not reflect any change in marriage patterns.

However, the SMAMS computed by the Hajnal's technique suggest that child marriage for females was near universal in Bangladesh, although this appears to have virtually disappeared because of the impact of education, western influence and other aspects of economic and social change, and moreover, the Child Marriage Act also seems to contribute to it.

In contrast, child marriage was not common among males in Bangladesh. The age at first marriage for males shows increasing trend up to 1974, and thereafter shows stagnation or slight decline. In contrast, the female age at marriage has been found to be still rising in Bangladesh. However, when divisional SMAMS have been compared, it has been found that the male age at marriage tends to decline slightly in all divisions after 1974, but the female age at marriage appears to be still rising in Rajshahi and Khulna divisions, and tends to have levelled off in the other two divisions. The most interesting finding is that the age at marriage for both males and females has been found to be still increasing in both urban and rural areas. The Coale model also suggests that age at marriage increased between 1951 and 1974.

Furthermore, age at marriage has tended to be lowest in the Rajshahi division where education is least advanced, and urbanisation lowest. A similar situation prevails among Malays in Peninsular Malaysia. However, there appears no reason to disbelieve the relevance to Bangladesh of results from recent Cross National Studies that education, urbanisation, and non-agricultural activities (especially for women) have contributed significantly in raising age at marriage and will continue to do so in future (Smith et al, 1978; Sundaram, 1977).

The marriage pattern is changing in Bangladesh especially among young females, but this change does not have a significant effect on fertility in Bangladesh because of the upward impact on fertility to the continuing decline in the incidence of widowhood.

Table 2.1a

Percentages never married in each age group, (1951-1981):-
Bangladesh Males.

Age Group	1951 Census	1961 Census	1965 PGE	1974 BRSFM	1974 Census	1980 BLDS	1981 Census
10-14	97.9	97.8	99.4	99.7	99.3	-	99.9
15-19	83.9	87.8	93.4	95.3	92.3	-	93.3
20-24	46.3	49.7	51.5	66.0	60.1	-	59.7
25-29	15.1	17.3	11.7	24.1	22.4	-	21.2
30-34	5.5	5.3	2.5	6.0	5.7	-	6.3
35-39	2.6	2.6	1.7	2.0	2.2	-	2.3
40-44	2.0	1.1	0.5	1.0	1.5	-	1.9
45-49	1.3	0.8	0.7	0.8	1.1	-	1.2

Sources:- 1951 - Census of Pakistan, 1951, Census Bulletin No.5 Part II, East Bengal Table 4.
1961 - Census of Pakistan 1961, Volume 3, East Pakistan, Table 13.
1965 - Final Report of the Population Growth Estimation Experiment, 1962-1965, Table V.8.
1974 - Bangladesh Retrospective Survey of Fertility and Mortality.
1974 - Census
1980 - Current Demographic Situation in Bangladesh, B.B.S., 1983.
1981 - Bangladesh Population Census, 1981, Analytical Findings and National Tables, August, 1984, B.B.S.

Table 2.1b

Percentages never married in each age group, (1951-1981):-
Bangladesh Females.

Age Group	1951 Census	1961 Census	1965 PGE	1974 BRSFM	1974 Census	1980 BLDS	1981 Census
10-14	73.7	67.4	82.0	94.0	90.5	97.3	98.0
15-19	11.3	8.3	13.0	32.3	24.5	42.6	31.3
20-24	3.0	1.3	1.6	4.6	3.2	6.7	5.1
25-29	1.1	0.5	0.2	1.1	0.9	2.1	-
30-34	0.5	0.4	0.3	0.4	0.6	0.5	1.0
35-39	0.2	0.2	0.3	0.2	0.4	0.3	0.4
40-44	0.2	0.2	0.2	0.2	0.5	0.2	0.7
45-49	0.2	0.1	0.2	0.3	0.3	0.3	0.3

Source:- The same as in Table 2.1a.

Table 2.2

Singulate mean age at marriage by sex, (1931-1982).

Year	Source	Male	Female
1931	Population Census	19.0	12.6
1941	Population Census	21.5	13.7
1951	Population Census	22.4	14.4
1961	Population Census	22.9	13.9
1965	PGE	22.9	14.8
1974	Population Census	24.0	15.9
1974	BRSFM	23.9	16.6
1975	BFS	24.5	16.4
[a] 1980	BLDS,BBS	24.9	17.5
1981	Population Census	23.9	16.8
1981	VRS (Direct) BBS.	25.8	17.8
1982	VRS (Direct) BBS.	25.6	17.7

Source:- Table 8, Page 67; Bangladesh Population Census, 1981, Analytical Findings and National Tables, August, 1984; BBS.

[a] Current Demographic Situation in Bangladesh, BBS, June, 1983.

Table 2.3

Percentages of the Female Population Currently Married by Age Group for the Period 1951-1981, Bangladesh.

Age Group	1951 Census	1961 Census	1974 Census	1981 Census
10-14	25.42	31.75	8.84	7.02
15-19	86.12	89.48	71.76	65.42
20-24	93.38	95.60	92.98	90.86
25-29	92.12	94.75	95.20	94.37
30-34	86.02	90.77	93.35	92.88
35-39	79.32	84.66	89.85	89.76
40-44	66.01	71.55	81.38	81.85
45-49	60.46	61.31	75.12	74.47

Table 2.4.

Percentages Widowed and Divorced in each Age Group; Bangladesh (1951-1981).

Age Group	Males				Females			
	1951	1961	1974	1981	1951	1961	1974	1981
15-19	0.6	0.3	0.3	0.1	2.6	2.2	3.3	3.3
20-24	1.8	1.5	1.3	0.4	3.6	3.1	4.2	4.0
25-29	2.8	2.3	1.7	0.5	6.7	4.7	4.3	4.3
30-34	3.5	2.6	2.0	0.6	13.5	8.8	6.5	6.1
35-39	3.8	2.7	2.1	0.7	20.4	15.1	10.2	9.6
40-44	5.0	3.9	2.2	1.0	33.8	28.3	18.2	17.4
45-49	5.9	4.8	3.1	1.3	39.3	38.6	26.7	25.2
50-54	8.3	6.3	4.0	2.0	55.9	54.7	40.7	36.3
55-59	12.8	7.5	5.1	2.6	64.6	62.4	51.9	44.9
60 +	21.5	15.2	11.5	8.6	79.6	82.5	74.8	66.6

Sources:- 1951 - Census of Pakistan 1951, Census Bulletin No.5, Part II, East Bengal, Table 4.

1961 - Census of Pakistan 1961, Volume 3, East Pakistan Table 13.

1974 - Report on the 1974 Bangladesh Retrospective Survey of Fertility and Mortality, Census Commission, Ministry of Planning, Dhaka.

1981 - Bangladesh Population Census, 1981, Analytical Findings and National Tables, August, 1984, B.B.S.

Table 2.5

First Marriage Model for Bangladesh Females.

Age	Frequency of First Marriage	Proportions Ever married
11	.000	.000
12	.027	.009
13	.104	.072
14	.177	.216
15	.188	.404
16	.155	.578
17	.112	.711
18	.078	.806
19	.053	.867
20	.035	.916
21	.023	.942
22	.015	.960
23	.011	.972
24	.008	.982
25	.005	.988
26	.003	.992
27	.002	.994
28	.000	.996

Source:- Table 2.5, Report of the 1974 Bangladesh Retrospective Survey of Fertility and Mortality, Ministry of Planning, Dhaka.

Table 2.6

The Values of the Parameters, Bangladesh (1951-1974)

Parameters	1951 Census	1961 Census	1974 BRSFM
a_0	10.6	10.0	11.9
k	0.31	0.33	0.40
C	0.998	0.999	0.996

Source:- Report of the 1974 Bangladesh Retrospective Survey of Fertility Mortality, Ministry of Planning, Dhaka, 1977.

Table 2.7

Estimates of the Mean and Standard Deviation of the Age Distribution of First Marriage, and the Proportion eventually marrying, both household and individual data, Bangladesh, 1975.

Age Groups	Type of Estimate %	μ	σ	C
15-19	Estimated	17.7	5.8	1.282
	Estimated Fixed (C=0.996)	16.0	4.5	0.996
20-24	Estimated	14.3	3.6	0.994
25-29	Estimated	13.6	3.2	0.994
30-34	Estimated	12.9	2.9	0.999
35-39	Estimated	13.1	3.3	0.996
40-44	Estimated	12.9	2.9	0.998
45-49	Fixed (C=1.00)	13.1	3.5	1.000
Broad Age Groups				
15-49	Estimated	14.1	3.7	0.998
20-49	Estimated	13.5	3.2	0.997

Source:- Table 5, Comparative studies No.22, April, 1983, Peter C. Smith, M. Shahidullah and A.N. Alcantara; Cohort Nuptiality in Asia and the Pacific: An Analysis of WFS Surveys, London, U.K.

Table 2.8

Singulate Mean Ages at Marriage for Domains of Study.

Area	*1961 Census		*1974 BRSFM		1981 Census	
	Male	Female	Male	Female	Male	Female
Rashahi	21.9	13.0	23.1	15.7	22.7	16.1
Khulna	22.3	13.6	23.9	16.0	23.0	16.6
Dhaka	23.3	13.9	24.9	16.9	23.7	16.9
Chittagong	23.7	14.8	25.8	17.4	24.7	17.3
Urban	25.2	15.9	26.1	18.1	27.8	19.1
Rural	22.7	13.8	24.3	16.5	25.4	17.6
Muslim	22.1	14.2	24.4	16.3	-	-
Hindu	23.6	15.1	25.5	17.4	-	-

Source:- *Table 2.7, Report on the 1974 Bangladesh Retrospective Survey of Fertility and Mortality, Ministry of Planning, Dhaka.

Table 2.9

The parameters for domains in 1974 and for earlier years.

Domains	a_o		K	
	1961	1974	1961	1974
Chittagong	10.9	12.3	.33	.46
Dhaka	10.6	12.4	.28	.38
Khulna	10.2	11.8	.25	.37
Rajshahi	9.6	11.9	.29	.34
Urban	10.4	12.2	.44	.48
Rural	10.3	12.0	.29	.40
Muslim	10.6*	12.0	.30*	.38
Hindu	10.5*	12.0	.34*	.48

* For 1951

Source: Report of the 1974 Bangladesh Retrospective Survey of Fertility and Mortality, Ministry of Planning, Dhaka, 1977.

CHAPTER 3

Mortality

3.1 Introduction

Mortality levels in developing countries remain high despite the increasing development of sophisticated medical technology to combat disease because nutrition is relatively more important than medical intervention (McKeown et al, 1962). But it is extremely difficult to make an assessment of the condition because of lack of adequate data sources to measure levels and trends in mortality.

The situation in Bangladesh is no exception. Effective registration of deaths does not take place in the country. The data sources are, therefore, restricted to the censuses and to sample surveys and special area studies. However, mortality information in Bangladesh can be of two types. First, mortality information, may be indirect tending to reflect the mortality situation without being the parameters of mortality itself. Second, mortality may be evaluated from sample surveys but this source is subject to the risk of substantial sampling errors, particularly for individual age and sex-specific mortality rates.

3.2 CDR

Table 3.1 shows the different estimates of crude death rates from various sources for the period 1911-1983. The crude death rate is defined as the number of deaths per 1000 of the mid year population.

Table 3.1 suggests that the mortality situation in the country has undergone two distinct phases over the past decades. These data suggest that the first phase is characterised by a period of slow decline in the level of mortality which appears to have started in the mid and late 1920's and persisted until about 1970, showing a slight increase during the 1940's, which may be attributed to the effects of famine in 1943 and the partition of India in 1947. The second phase shows a rapid decline in the mortality levels which is believed to have started after 1950 and the level approaches around 20 deaths per thousand during 1962-1965. Robinson (1967) mentioned several stages through which mortality in Bangladesh had passed.

"Stage one. The first several decades of this century, saw the elimination of famine and epidemics which traditionally devastated the population every decade or so.

Even without significant improvement of normal mortality, the removal of these occasional 'catastrophes' had the effect of lowering the average death rate and increasing average life expectancy. During the second stage the three traditional killing diseases, Smallpox, Plague and Cholera, were bought under control. The third stage can be dated from the beginning of the 1950's. The causes of this decline are almost certainly environmental and medical. The killing incidence of all diseases has weakened under the combined impact of the rural public health programme, a diffusion of antibiotic medicines, rising levels of real income and nutrition, and progress in sanitation and water supply".

Robinson (1984) briefly reviews the longer term trends in fertility, mortality and natural increase in Bangladesh. The author observes that the last 20 years or so, suggest very little further fall in the level of mortality in Bangladesh after what has been called stage three 20 years ago. The author tends to suggest that the crude death rate seems to have levelled off at or just below 20 per thousand in the 1970's. But the author suggests that further decline in the mortality level is likely to depend on:-

1) Continued attacks on the remaining endemic disease such as Malaria, Cholera, Typhoid and Tuberculosis by improving sanitation and water supply and increasing real income and nutrition.

2) Reducing fertility and hence fertility-related deaths such as maternal mortality and excess infant and child deaths.

It is not very clear whether any of the above steps have taken place in reality in Bangladesh. Still the Bangladesh Bureau of Statistics figures are surprisingly lower than other estimates (Table 3.1). However, this data can be checked with other available estimates to see their reasonableness. The Matlab date are relevant here. Table 3.2 shows the CDR for the DSS area in Matlab. It should be mentioned that a Demographic Surveillance System in Matlab under the sponsorship of the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR'B) provides a wealth of data on mortality for a rural area of Matlab Upazilla, although the levels and patterns of mortality are unlikely to be representative of the country as a whole because all diarrhoeal diseases are effectively treated in this area. In general Matlab data suggest a slightly lower mortality level than the comparable rates for the country as a whole derived from other sources.

These features of Matlab data should be expected because medical treatment are provided to the population. But it is an interesting point to note that the BBS figures appear to be even lower than the Matlab figures, which does not seem to be realistic. However, the mortality rates in Matlab for the period 1966 to 1980 show very little decline. But the rates show sharp fluctuations, indicating clearly the impact of natural disasters and political disturbances during the period 1966 to 1980. It may be noted that short-term fluctuations in births and deaths due to disasters - famine, epidemic, war - were common features in the present industrialized world prior to the demographic transition (Wrigley, E,A, 1969).

The Demographic Surveillance System in Teknaf Thana of Chittagong district, which is an extension project of the Cholera Research Laboratory, gives estimates of mortality for the period 1976-77. The data collected from Teknaf are assumed to be of high quality like Matlab data, even though Teknaf data have not yet been examined thoroughly. However, the CDR is 16.1 for males and 16.9 for females in (Teknaf Thana Rahman et al, 1980). These rates appear to be very consistent when compared with the general level of mortality observed for Bangladesh as a whole. It may be noted that Teknaf results should not be considered as representative of the whole country.

Crude death rates, however, in Bangladesh appear to have levelled off below 20, which is still high in comparison with that of many developing countries. This finding is not very unexpected. Various studies suggest that mortality decline, instead of accelerating, has been unexpectedly slowing down in major areas of the world (Gwatkin, 1980; Ruzicka and Hansluwka, 1982).

Crude death rates by areas in Table 3.3 show wide differences between the urban and the rural area, the rural mortality levels being consistently higher than the urban levels. Furthermore, it appears that the differences between the urban and the rural areas appear to have widened since 1981.

3.3 Infant Mortality And Child Mortality

Table 3.4 shows the trend in infant mortality level for the country from 1911. Evidently in the first half of the twentieth century there was a substantial decline in infant mortality. During the subsequent period a further decline took place, but the decline was relatively less marked. This may be because of the unsettled social and economic conditions caused by the war of liberation, localized famines and floods. However, the infant mortality rate was 144 per 1000 live births according to the PGE estimates in the early 60's. During the first half of the 1970's, the infant mortality rate appear to lie between 152 and 158 per 1000 live births. Afterwards, the figures suggest a further decline in infant mortality, but this does not seem to be plausible. Reasons will be discussed later on in this section.

It is important to investigate whether the estimates are consistent or not. This can be carried out only when the estimates at the national level are available from other sources. However, PGE estimates can be compared with that of the 1961-1962 Demographic Survey of East Pakistan (DSEP). The survey collected a complete maternity history from a sample of some 4,000 ever married women in Central Bangladesh (Muniruzzaman, 1965, 1966a, 1966b; Obaidullah, 1966).

Infant mortality rates obtained directly from the DSEP maternity histories for the period 1952-60 are shown in Table 3.5. The DSEP data can also be used for the application of an indirect mortality estimation that employs information on the proportion dead of the children ever born by women classified by the standard age group.

Table 3.5 shows infant mortality rates which appear to be remarkably consistent over 8 years. This table suggests that the overall rate lies between 150 and 160 per thousand for the births occurring between 1955 and 1960. Table 3.6 shows the indirectly obtained estimates which tend to confirm the general level of child mortality for a similar period. However, it should be noted that the equivalent infant mortality rates shown in table 3.6 are based on the age pattern of mortality embodied in the "North" model life tables. Furthermore, the results of the DSEP cannot be regarded as nationally representative because it collected data only in Central Bangladesh, covering only 27 percent of the total population of the country. Despite various limitations, the results of the DSEP suggest a child mortality level for the late 1950's that seems to be very similar to the child mortality estimates obtained from the PGE for the early 1960's.

The time periods do not coincide exactly, of course. Nevertheless, the two surveys tend to confirm each other's estimates and suggest that infant mortality remained rather constant from the mid-1950's to the mid-1960's.

Furthermore, the PGE estimates could be compared with the National Impact Survey (NIS) results. But the problem is that the survey provides the only data tabulated for females married at the time of the survey, and it might generally be suspected that the children of such females would have experienced mortality risks which were below average. It is also suspected that child deaths were under recorded by the NIS (Sirageldin et al, 1975). According to the NIS, the estimated infant mortality rates are 139 for the period 1960-62, 116 for 1963-65 and 113 for 1966-68.

It may be mentioned that the National Impact Survey was conducted during 1968-69 to investigate the impact of the national family planning programme. It is a frustrating source of data because information was collected from ever-married women and also because the only published results are for currently married women

(Sirageldin et al, 1975). The committee on population (1981) compares the average number of children everborn per currently married women calculated from the NIS and from the BFS (Bangladesh Fertility Survey) in 1975-76, and found that the two distributions are similar up to age 30, indicating that the fertility of young women in the 10 to 15 years prior to 1975-76 was very much the same to that for a similar period prior to 1968-69, which appears to be inconsistent with the marital fertility decline indicated by the NIS data for the period 1960-68. The Committee also obsserves that the average number of children of the BFS are considerably higher than that of the NIS for currently married women over age 30, implying that the number of children everborn was underreported by older women in the NIS. Sirageldin et al (1975) also mention that such omission may have taken place, because the infant mortality rates obtained from the NIS appear to be lower than would be expected in comparison to other information. The Committee (1981) finally suggests that the reasons for the sharp downward trend in marital fertility demonstrated by the NIS data may be attributable to the dating errors in the reporting of births in the pregnancy history. This kind of error has been found to be present in data collected in fertility history surveys (Potter, 1977).

Although the PGE estimates agree considerably well with other estimates, it should be remembered that there are doubts about the reliability of the data.

In order to establish recent trends in the infant mortality rates, Matlab data are once again needed. Table 3.7 shows the trend in infant mortality and child mortality for the period 1966-1982.

The figures for infant mortality suggest very little downward trend during the period 1966-1982, indicating sharp fluctuations which could stem from the unsettled social and economic conditions, the effect of the war of liberation, localized famine and floods. However, it can be concluded that the trend, if it at all exists in infant mortality levels, appears to be weak.

It is interesting to note that infant mortality rates provided by the BBS appear to have increased from 102 in 1980 to 121 in 1982 and thereafter appear to have declined. This situation however can be partly attributed to year to year fluctuations and partly to the better coverage by the vital registration system in the later years. In contrast, Matlab figures are 114.0 (control area) in 1980 and 114.5 (control area) in 1982. The Matlab estimate for 1980 is well above the national sample vital registration system estimate as might be expected because the Matlab estimate is based on a well managed efficient registration system. However, the situation reversed in 1982 when the national sample registration estimate is above the Matlab estimate, suggesting that an improvement takes place in the vital registration system of the BBS.

However, the infant mortality rate in Bangladesh seems to be in the region of 150 per thousand live births with some year to year fluctuations but with little indication of sustained trend, suggesting that child mortality may have fallen in the early 1950's. But the rate is still very high in comparison to those of the contemporary developing world. Rates of similar order can be found in Yemen A.R. (163 per 1000 in 1982) and Senegal (155 per 1000 in 1982).

3.4 Differentials In Mortality By Sex, Urban/Rural And Religion

Table 3.8 shows infant mortality rates by sex and rural-urban residence, revealing clearly the existence of urban-rural and sex differentials. The figures suggest that male rates in both urban-rural areas are higher than the female rates, differentials being relatively higher in the urban areas, and the difference between urban and rural areas is 28 percent in 1980 and 22 percent in 1983, when both the sexes are considered together.

By religion, Muslims appear to experience higher rates in both urban and rural areas in 1980 (Table 3.9). In 1981, however, the Hindu male rate seems to be higher than the Muslim rate in the rural areas, although the Hindu male rate is considerably less than the Muslim rate in the urban areas. The table 3.9 further reveals that the urban Hindu population have about twice the rates of their rural counterparts, as might be expected due to socio economic difference between them. On the other hand, the urban-rural differences are relatively less pronounced among the Muslims, but the differences tend to decrease for the Muslim population, while among the Hindu population the differences tend to increase.

But it is interesting to note that the Hindu female rates appear to be consistently lower than the Muslim rates for both the urban and rural areas except the urban female rate in 1980 which suggests over reporting of female deaths in the urban areas. On the contrary, the Hindu female rate in 1980 for the urban areas is suspiciously low, which cast doubt about the reliability of the data.

These mortality differences between Hindus and Muslims may not necessarily lie in the religions. Nevertheless, they are doubtless important. Caldwell (1986) suggests that the main aspect of the association between Islam and mortality levels is obviously the separate and distinctive position of women operating partly not only through the low levels of female schooling, but also through the low levels of family planning and through the limited access to employment outside home. From the experiences gathered from Sri Lanka, Kerala and Costa Rica, the author tends to suggest that mortality will be reduced if the following conditions can be achieved:-

1. Sufficient female autonomy

2. Substantial inputs into both health services and education according to the modern or western model, with special emphasis on increasing the female schooling levels which should be closer to the male levels

3. Health services accessible to all irrespective of their usual residence and socio economic status

4. The health services should work efficiently

5. Distributing nutritional flour among poor people in an egalitarian way

6. Universal immunization should be attained

7. Providing antenatal and postnatal health services and having deliveries conducted by persons with full medical knowledge

8. Providing advisory services by health visitors who will call on households to give advice for the treatment of their children.

Table 3.10 shows estimates of child death rates (mortality of children aged 1-4 years) from direct observations.

Table 3.10 suggests that the figures have increased until 1982 and thereafter appear to have declined, indicating a wide differential between the urban and rural estimates and between sexes.

Reasons for the increasing trend may be once again attributable partly to year to year fluctuations and partly to the better coverage which takes place in the later years.

Matlab data is relevant in this context too. Like infant mortality, child mortality does not appear to show any definite decline during the period 1966-1977. It may also be mentioned that the child mortality rate in the comparison area does not appear to show any decline during the period 1978-82.

It is interesting to note that when the BBS figures for the period 1980-1983 are compared with the Matlab figures for the similar period, it appears that the BBS figures are lower than the Matlab figures, which does not seem plausible. Reasons have been outlined in the previous section.

Furthermore, another interesting aspect to note is that the mortality differences are relatively less marked in the BBS figures, although the ratios (female/male) tend to increase up to 1982, but the trend seems to be disappearing afterwards. A similar trend is also observed in rural areas, but in the case of urban areas, the ratios tend to increase up to 1981, then the differentials tend to disappear. This occurs earlier than the same feature observed in the national figures. In contrast, Matlab and Teknaf data show marked differentials in child mortality, which persist for the period 1966-1981, the ratios lie between 1.33-1.80. It is, therefore, reasonable to suggest that the BBS figures are not very reliable, suggesting that the female child mortality is affected by substantial under enumeration.

However, infant mortality and child mortality levels do not seem to have declined in Bangladesh recently. There is also other evidence in this direction based on an analysis of the data from the Impact Survey (1969), World Fertility Survey (1975), and Rural Poverty and Fertility Survey (1977), Amin et al (1986) suggest no declining trend in infant and child mortality in Bangladesh, although Amin (1988), based on an analysis of the data from the World Fertility Survey, Bangladesh (1975), and Contraceptive Prevalence Survey, Bangladesh (1979) suggests that the infant and child mortality levels have declined slightly, but their levels are still high in Bangladesh, by a developing country's standards.

It should be pointed out that these estimates are based on survey data which are subject to sampling error, there might be some doubt as to their reliability on this account.

However, it may be mentioned that the contraceptive prevalence studies (CPS) were conducted in 1979 and in 1981 to examine the impact of national family planning programme. Information was collected from ever-married women under age 50, and limited fertility data were collected (Waliullah et al, 1984). It should not therefore, be considered as a satisfactory source of data to provide national mortality estimates.

However, to investigate the consistency of the survey data provided by the BFS (1975) and the CPS (1979), Amin (1988) calculated the sex ratios of the number of children by dividing the number of male children by the number of female children. The overall sex ratios of the 1975 BFS and the 1979 CPS were 1.054 and 1.071 respectively, suggesting the underenumeration of female children in the latter survey. Furthermore, a comparison of mean number of children ever born to ever married women under 50 years of age between the 1979 CPS and the 1981 CPS indicates that the two distributions for any age group younger than 30 years are equal, but the 1981 CPS figures for the age groups 30-34 and above appear to be higher than the corresponding figures of the 1979 CPS, which may be due to the relatively better reporting by older women in the 1981 CPS than in the 1979 CPS (Waliullah et al, 1984). This suggests that the number of children ever born was under reported by older women in the 1979 CPS, which will lead to the under estimation of infant mortality. Another interesting point to note that the proportions of dead children do not appear to increase consistently over the age groups, suggesting omission of dead children. Finally, Amin (1988) estimated infant mortality rate from the 1979 CPS as 109 per thousand which appears to be less than the Teknaf infant mortality rate estiamte corresponding to 1979 (142.7 per thousand live births) (Rahman et al, 1983). Rahman et al (1983) suggest that infant mortality rates in Teknaf, a rural area of Bangladesh fluctuated over the past 8 year period from 1976 to 1983 reaching the highest level in 1983 (154 per thousand live births). It may be mentioned that births, deaths marriages, divorces and migration have been collected in Teknaf, a rural area of Bangladesh by the Demographic Surveillance System (DSS) of the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B) through monthly house-to-house visits of field workers since 1976. The data collected from Teknaf are thought to be of high quality, because the data Collection System is organised by a strong group of research workers.

However, the infant mortality estimate from Teknaf seems to be consistent with the general level of mortality for Bangladesh as a whole, although of course Teknaf can not be regarded as representative of the whole country. Hence it can be stated that the infant mortality level estimated from the 1979 CPS does not represent true level of mortality.

Another study also can be mentioned to show that the mortality decline Amin (1988) detected during the period 1975-79 is not plausible.

Chowdhury et al (1984) fitted least square regression lines to the Matlab infant and childmortality data for the period 1966-77 and suggested that neither infant nor child mortality revealed any definite decline during this period. It may be mentioned that Matlab data are considered as reliable, although these are not nationally representative.

Any decline in the infant and child mortality levels can hardly be expected with such a low level of development in Bangladesh (Arthur and Menicoll, 1978) where health facilities are extremely poor. Moreover, the environmental conditions in Bangladesh are seriously bad; housing situations are extremely poor and unhygenic; and sanitation and water supply are badly inadequate. In the absence of maternal and child care facilities, various diseases such as Diarrhoea and Tetanus, adversely affect the survival chances of substantial numbers of children (McCormack et al, 1973). In these circumstances, the poor people who constitute the majority of the population, can hardly improve the survival prospects of their children.

Mortality differentials between the sexes have been reported for most countries of the world. Generally females experience relatively lower mortality than males. But exceptions to the norm are observed in South Asian countries where females tend to have higher mortality level than that of males. Data from these countries demonstrate that the sex ratio (males/females) tends to increase with age, suggesting environmental factors have counteracted expected female superiority in life expectancy. To assess the situation, adequate and high quality data are needed. Unfortunately, such mortality data do not exist in most developing countries.

In those countries, Vital Registration Systems are either absent or imperfect, and retrospective methods depend heavily on the ability of mothers to recall accurately child births and deaths (United Nations, 1967). Problems of sex-selective omissions cause reporting biases, particularly in societies where strong preferences for male children exist (D'Souza, 1978).

D'Souza, et al, (1980) used data from Matlab Thana, Comilla District, Bangladesh for the period 1974-77 and documents higher female than male mortality shortly after birth and through the childbearing ages in a rural area in Bangladesh. Male mortality exceeded female mortality in the neonatal period, but this differential is reversed during the post-neonatal period. Higher female than male mortality continued through childhood into adolescence and extended through the childbearing ages. The most pronounced differentials were found in the 1-4 year age group, where female mortality exceeded male mortality by as much as 50 percent. It may be pointed out that the higher male mortality rate during the neonatal period is consistent with results from many societies that the biological risk of death is higher among male children than among female children (Poppel, 1978). But in exploring the reasons for the markedly high female mortality, Chen et al (1981) showed that food intake and health care practices, two proximate determinants of mortality, appeared to be biased towards male children. While their important study offers convincing reasons for higher female child mortality, the authors failed to document two questions:-

1. Is sex-biased distribution of food more marked during food crisis?

2. Is sex-biased distribution of food linked to socio economic status?

Bairagi (1986) studies the effect of the 1974-75 famine on sex-biased allocation of food among children aged 1-4 and investigates the association between allocation of food and socio economic status. The author shows unexpected relationships between socio economic status on the one hand and sex differentials in the nutritional status of children on the other. An improvement in household resources undoubtedly increased the nutritional status of all children, but it appeared to benefit males more than females. The effect of the hardship related to the famine was greater among female children. However, the wider difference observed among the high socio economic status group was surprising. This finding has also been observed in Morinda, a rural area in Punjab, India, where the differences by sex in nutritional status measured by weight for age, height for age, and weight for height were more pronounced among the higher caste Jats than the lower caste Ramdasian (Levinson, 1974).

In order to improve the situation, people who are in charge of allocating resources during crisis time should ensure that famine relief reaches both needy female and male children. It is suggested that feeding at a relief centre may be more effective than supplying food to the family for home consumption, may be because of the possibility that parents may divert the food from a girl to a boy or to a less needy person (most likely male) in the family. In general, the amount of intrahousehold reallocation that takes place under the two types of distribution is little understood, but researchers in this field feel that direct feeding is more likely to benefit the recipient than in food taken home for distribution and consumption (Beaton et al 1982).

However, the male-female difference in nutritional status in Bangladesh can be attributed to women's inferior socio economic status. In rural Bangladesh, a male child is regarded as an asset. This is because a male child will become an economically productive member of the family as well as an asset to parents in their old age. On the otherhand, a female child is regarded as an econominc liability because she will represent another family after marriage.

A mere improvement in the household resources, therefore, seems to be extremely unlikely to reduce the male-female differences in nutritional status. The solution, however, may lie in a fundamental structural change in the role, status and economic value of women in Bangladesh.

3.5 <u>Mortality Differentials By Socio Economic And Demographic Conditions</u>

The study of mortality differentials has been regarded as valuable. This is because the study of the mortality differentials by socio-economic status indicate that an extent of success has been achieved in one section of the community that has not been achieved in others. Experience suggests that occupation and employment status, income, education, industry, housing conditions, urban and rural residence, and ethnicity as characteristics are useful to mortality studies, although such data are difficult to be obtained.

Among the several indexes of socio economic status, educational level is the most satisfactory index in the understanding of differential mortality. It may be mentioned that education defined by years of schooling is reliably reported. Vaidyanathan (1972) studies mortality differentials for India by geographical location rural-urban habitat, religion and caste, occupation, education, type of housing and lighting, landholding and income. The author suggests an inverse relationship between occupational class and mortality: owners and tenant cultivators have lower mortality than agricultural labourers; white-collar workers have lower mortality rates than blue-collar workers.

The Un Mysore population study used type of housing and lighting as proxies for socio economic status in urban areas and landholding status in rural areas (United Nations, 1961). The infant mortality rates for labourers and tenants appear to be 59 percent higher than the overall rural rate. In the urban areas of Bangalore City, the infant mortality rate for the population living in huts or mud houses with thatched roofs and for those without electricity appear to be about 11 percent higher than the city population rate as a whole.

Based on Nigerian data, Caldwell (1979) demonstrates that education, especially of the mother, is negatively correlated with child mortality rates. Using data of Sudan Farah et al (1982) suggest the importance of parental education and regional residence in mortality differentials. Martin et al (1983) have shown that mother's education is strongly and negatively associated with mortality levels, even when father's education status is controlled. Based on an analysis of WFS data for 28 countries, Hobcraft et al (1984) suggest that mother's education appears to be an important factor in determining children's survival chances in several Latin American and South East Asian countries.

Adlakha et al (1985) used data from the 1976 Jordan Fertility Survey, the 1978 Tunisia Fertility Survey, and the 1980 Egypt Fertility Survey which were conducted by the National Statistical Organisations in collaboration with WFS. The authors suggest that infant mortality are affected significantly by all four demographic characteristics such as mother's age, birth order, birth interval and previous infant loss, but amongst the socio economic characteristics, the education of the mother and rural-urban residence appear to affect infant mortality. It has been found that the relation between the socio economic variables and infant mortality is relatively weak.

In childhood, among the demographic factors, only birth interval appears to affect child mortality significantly, revealing that the risk of child mortality tends to decrease substantially with the increase in the birth interval. However, among the socio economic variable, only rural-urban residence appears to affect child mortality. Furthermore, it has been pointed out that the reasons for the weak associations between socio economic variable and child mortality may be attributable to the deficiences in the retrospective data.

Based on an analysis of the World Fertility Survey data for 26 developing countries, Hobcraft et al (1983) suggest that comparatively narrow spacing of births is not a rare event, revealing that the incidence of live births preceded by an ealier birth within 24 months was 23 percent in Nepal, 28 percent in Pakistan, 30 and 32 percent in Sri Lanka and Bangladesh. It has been suggested that close spacing tends to increase infant mortality by at least 60 percent in Nepal and Sri Lanka, and almost double it in Pakistan and Bangladesh. Close spacing has also been found to affect child mortality, although its effect on child mortality are relatively less.

Victora et al (1986) investigate the influence of socio economic and environmental variables on child mortality rates in Southern Brazil. The socio economic variables, particularly family income, place of residence and education of the head of the family and of the mother have been found to be strongly associated with the survival prospects of children. Employment status of the head of the family, on the otherhand, appears to be less important during the decade. The child mortality levels are also found to be affected by the environmental variables such as piped water facility in-side the house, although the effects of all these variables tends to be weaker when they are adjusted for socio economic status.

Only recently populations specialists have begun to devote more research effort to the study of mortality differentials in Bangladesh, and the literature on the topic is therefore still relatively sparse.

Since independence in 1971, Bangladesh has witnessed two severe crisis periods, one being connected with the liberation struggle and the other being connected with 1974/75 famine. Chowdhury et al (1977) suggest that death rates were higher during these periods, particularly being so among poorer groups.

The 1974 Bangladesh Retrospective Survey on Fertlity and Mortality has provided mortality differentials in childhood by socio economic status (BRSFM, 1977). Children of women who lived in houses having brick walls have higher chances of survival than children whose mothers lived in houses having mud walls. Infant and child mortality appeared to decrease with the educational level of both husband and wife. It should be pointed out that these data are based on indirect estimation procedures, which tend to have their particular limitations. Another important feature to note is that vital registration is virtually non-existent in Bangladesh, hence the main data sources on mortality differentials have to be based on small area studies.

Chen et al (1980) have demonstrated that children under age five accounted for 53.1 percent of all deaths in the period 1975-77. Among infants the principal cause of death was Tetanus, indicating that neonatal Tetanus was responsible for 26.2 percent of all infant deaths. A significant shift in causes of death has been found to take place for children in the age group 1-4 years, which suggests that diarrhoeal diseases accounted for 43.9 percent of deaths. Measles have been found to be the next most significant cause of death which accounts for 13 percent. The interpretation of these results should be carefully made because the data are likely to have some limitations because of the diagnosis made on the basis of the reports of the fieldworkers with no formal medical training.

Using data from the 1975 Bangladesh Fertility Survey (BFS, 1975) and using Brass type indirect estimation procedures to analyse the information on proportions among children ever born at the time of the survey, Mitra (1979) has documented an inverse relationship between mortality and rising education status of parents, and higher occupation status of father.

Using Matlab data for the period 1974-77, D'Souza et al (1982) demonstrate a clear inverse relationship between mortality and socio economic status in the Matlab area. The inverse association exists for all the age groups 1-4, 5-14, 15-44, and 45+ under investigation. The variables used in this investigation for the assessment of socio economic status are education of the head of the household or mother, occupation, size of dwelling, ownership of cows and health practices. All of the variables appear to suggest consistently higher mortality rates associated with the lower socio economic groups. The inverse association between education of mother and mortality rates has been firmly demonstrated. In the age group 1-3 years the mortality rates are over 5 times greater for children of mothers with no education in comparison with mothers with seven or more years of schooling. It has been observed that the lowest socio economic groups seem to be vulnerable to very high mortality rates during crisis periods. Moreover, it appears that higher socio economic groups have a relatively greater capability of withstanding the shock which takes place at floods which in turn results in shortage of food.

The authors point out that it is pertinent to consider whether unequal distribution of health care exists in Bangladesh. If it exists the main beneficiaries of the present national health care system are likely to be those who belong to the higher socio economic groups. Studies in this direction will be definitely useful.

Finally, the authors suggested that decentralised, low cost primary health care is likely to be more cost effective than the present health complexes that are often difficult to reach.

Based on an analysis of the trends and differentials of infant and child mortality from three sample surveys of Bangladesh (National Impact Survey of 1968, The World Fertility Survey of 1975, and the Fertility and Poverty Survey of 1977, carried out by the Bangladesh Institute of Development of Studies (BIDS)), Amin et al (1986) suggest that infants whose fathers belong to higher socio economic status, whose parents live in urban areas, and are relatively well off tend to have lower child mortality. It has been observed that the magnitude of difference in infant and child mortality according to these variables appear to have relatively more marked, reflecting that the people in the higher socio economic group are more likely to utilize the recently available modern medicines. The authors further suggest that the lower socio economic differences in infant and child mortality in the past could stem from the fact that many families may have failed to provide sufficient health facilities to their infants and children.

Among demographic factors, child spacing seems to be the important factor in using WFS data, Majumder (1988) suggests that the length of the preceding birth interval is the most important variable affecting infant and child mortality in Bangladesh, but infant and child mortality can be reduced substantially if intervals between births is at least one and a half years.

It has been further suggested that the influence of mother's education and residence on infant and child mortality appear to be independent of the effects of mother's age at birth, birth order and the preceding birth interval. Using data from the 1975 World Fertility and 1971 Contraceptive Prevalence Survey of Bangladesh, Amin (1988) demonstrates that socio demographic characteristics such as mother's education and higher birth orders appear to have considerable independent influences for the reduction of infant and child mortality, while foetal loss, father's education, or land ownership do not appear to affect infant and child mortality significantly. The effect of urban residence on infant and child mortality has been found to be positive when the socio demographic variables are controlled. These findings are not very surprising. It has been argued that the majority of urban people of Bangladesh has to survive through various unfavourable circumstances such as high population density, poor rural migrants, which are likely to increase the urban child and infant mortality.

However, among the demographic variables, child spacing appears to be the important factor affecting child mortality. In the case of birth interval, maternal depletion syndrome is often stated as a mechanism having deleterious influences on the infant's and child's probability of surviving (Jelliffe, 1966). Thus a mother with repeated pregnancies, especially with narrow birth spacing tends to be deficient from the nutritional stand point, which leads to the higher chances of pregnancy loss and of low birth weight. The other mechanism through which narrow spacing of birth affects the child's survival is "competition". In the families where food supply is extremely inadequate, all children (and the mother) are likely to be under-nourished. The worsening factor is often the early subsequent pregnancy which leads to an early wearing of the older child having a consequent unfavourable effect on its nutritional status and survival.

Among the socio economic characteristics, parental education, especially of the maternal education, has been found to be the most important variable in developing countries like bangladesh influencing infant and child mortality. Educated mothers are more likely to belong to higher income households, have better knowledge for caring children, especially in the case of the sick child.

So more concentration of effort on the supply of modern medical services and on the improvement of medical technology are extremely unlikely to bring any change in infant and child mortality in Bangladesh unless they are reinforced by social changes which particularly affect the socio economic status of women.

3.6 Adult Mortality In Bangladesh

Estimates of adult mortality in Bangladesh are based either on registered or recorded deaths or on reports on the survival status of parents or spouses. Various methods have been developed from stable population theory, and these methods require information on the age structure of reported deaths and the age structure of the population to assess the completeness of death recording and to provide an estimate of the rate of natural increase. Then methods are based on the assumption that the population is stable and that the proportion of deaths recorded is constant by age, at least after childhood. The first method, proposed by Brass (1975), using information on the age distribution of the population and of recorded deaths, provides the estimates of the completeness of death recording and the rate of natural increase of the population. The estimate of the completeness of death recording can then be applied to adjust the reported deaths before proceeding to smoothing and calculation of life tables. Recently alternative approaches based on similar information, have been proposed (Preston, S, et al, 1980).

Since all the approaches have been found to give rise to essentially similar results, the Brass method has been applied by the committee on population (The Committee on Population, 1981).

However, in this report two types of data have been used. One comes from the PGE final report for 1964 and 1965, which provides data on deaths and population by sex and five year age groups. The number of deaths are available from Longitudinal Registration (LR) and Cross-Sectional Survey (CS). These data have been adjusted by the Chandrasekaran-Deming formula for Correction for Omissions (CD). The Chandrasekaran-Deming Technique is a method to estimate the coverage of two independent systems collecting information about demographic or other events, based on the assumption that the probability of an event being recorded by one system is the same whether or not tha event is recorded by the other system. The events recorded by both the systems are matched to establish M = the number of events registered by both the systems, n1 = the number of events recorded only by system 1; and n2 = the number recorded only by system 2. The Chandrasekaran-Deming formula to estimate total events can be expressed as follows:-

$$N = M + n1 + n2 + \frac{n1\ n2}{M}$$

The Brass method (1975) has been applied by sex to the numbers of adjusted deaths (CD) for the two years together. This method uses information on the age distribution of the population and of recorded deaths to estimate completeness of deaths recording and the rate of natural increase of the population. The method is based on the assumption that the population is stable and that the proportion of deaths recorded is consistent by age.

In this report partial birth rates (=N(x)/N(xt), where N(x) is the number of persons at exact age x and N(xt) is the total number of persons aged x and over) and partial death rates (= $\frac{D(x+)}{N(x+)}$, where D(xt) is the total number of deaths occurring to persons aged x and over) have been calculated for each age group.

It should be noted that a plot of partial birth rates against partial death rates should produce a straight line which has an intercept equal to the growth rate and a slope equal to unity. However, if the recording of deaths is incorrect by a constant factor, all the death rates tend to be too small or too large by that factor. A plot of the partial death rates will still show a straight line which will have an intercept equal to the growth rate but will have a slope equal to the reciprocal of the completeness of death recording.

The group average method attempts to fit a straight line through the points which lie approximately around a straight line. The points are divided into two components, one comprising points for an example for ages ranging from 5 to 30 and the other from 35 to 60.

The mean abscissa and ordinate values for each group are calculated by summing the observations for each age group and dividing the sum by the number of observations in each group. Hence the slope of the fitted line is calculated by dividing the difference of the ordinate means by the difference of the abscissa means.

1. The partial birth rates are plotted against partial death rates. It has been found that the points for young ages fall on a reasonable straight line for both males and females, but the later points indicate a distinct saw tooth pattern and also drop down to the right of the trend line of the points at young ages. The reasons for the former pattern have been attributed to age heaping of the population and the latter to the exaggeration of reported age at death. Since the points for younger ages are less likely to be affected by these errors, a straight line has been drawn covering the categories 35+ to 65+ for both males and females, using a simple group-average fitting approach.

2. Table 3.11 shows the slope, an estimate of the reciprocal of completeness of death reporting, and the intercept, an estimate of the rate of natural increase, for males and females. The table

suggests two growth rates for males (2.92 percent) and females (3.06 percent) which seem to be fairly similar to one another and that the results seem plausible for Bangladesh in the early 1960's. Another interesting feature of Table 3.11 is that the slopes of the two fitted lines appear to be less than 1.0, which means that the number of deaths after applying a correction factor according to the Chandrasekaran-Deming formula is too high. Furthermore, the completeness of death is 1.25, which suggests greater over reporting in the case of male deaths than that of female deaths, for which the estimated completeness is 1.14.

3. It has been concluded that the Logitudinal Registration of deaths over age 5 in Bangladesh by the PGE seems to be about complete, in comparison to enumeration completeness and that the matching operation with Cross-Sectional data and the application of the correction factor seem to make matters worse rather than better. The basis of the conclusion is that when deaths of all ages above 5 are considered, the application of the Chandrasekaran-Deming correction appears to increase the number of male deaths by a factor of 1.20, and the number of female deaths by a factor of 1.17, over the number of recorded deaths.

4. Following the principle of the Brass (1971) Logit Life Table System, the probabilities of surviving from age 5 to age a {1(a)/1(5)} have been transformed into their logits and compared with similarly transformed survivorship probabilities from a "North" level 10 life table of the appropriate sex taken from the Coale-Demeny (1966) regional families. A straight line has been fitted to each set of points by employing a simple group average procedure. Its slope and intercept of the line have been found to be 1.0 and -0.465 for males. These values indicate that the pattern of mortality matches that of the standard but at a lower level of mortality. On the other hand, the slope for females has been found to be 1.03, which implies a similar age pattern of mortality, and the intercept has been found to be -0.202, which indicates lower mortality, but this does not appear to be too much lower as observed for males.

The second type of data has come from the BRSFM which provides data on deaths classified by age and sex occurring in the household during the 12 months prior to the survey. A similar method of analysis has been applied to these data. A summary of the estimates obtained for completeness of recording and rate of natural increase by sex is presented in table 3.12. The results are presented as follows:

1. The rates of natural increase do not appear to be consistent as has been observed in the case of the application of the method to the PGE data, implying that the male rate is considerably lower than the female rate. The reason for this difference has been attributed to a slight exaggeration of the mortality advantage of males over females.

2. The straight lines fitted to the logit transformation of the adjusted and standard survivorship functions from age 5 by sex suggest that the slopes of the lines are 0.98 for males and 0.97 for females, which appear to be similar to the results as implied by the PGE. The intercepts appear to be different, however, representing an overall reduction in mortality level between the ages of 5 and 65 during the period from 1964-65 to 1973-74.

3.7 Conclusion

1. Mortality level is still high in Bangladesh,

although mortality declined during the 1930's and 1940's with a rapid decline taking place in the 1950's. Mortality declined little afterwards, rather it appears to have become stagnant in the recent years. The further decline in the mortality level depends on the elimination of remaining endemic diseases such as Malaria, Cholera, Typhoid and Tuberculosis, which may be achieved through improvements in sanitation and water supply, and increase in real income and nutrition.

Crude death rates by urban-rural residence show wide differentials, reflecting that the mortality levels in the rural areas are consistently higher than in the urban areas. In addition, the mortality differentials between urban and rural areas appear to have widened recently.

2. The mortality estimates of the Bangladesh Bureau of Statistics figures appear to be suspiciously low. So the downward trend it shows does not seem to be plausible.

3. Estimates of child mortality are largely based on reports by mothers on the survival status of their children. The mortality estimates obtained from

this sort of data suggests little change in child mortality from the late 1950's to the mid 1970's, although the rates do fluctuate from year to year around the approximately constant value. Infant and child mortality in Matlab shows no definite decline during the period 1966-77, but they show year to year fluctuations. Infant mortality rates in Matlab show a very slow decline during the period 1978-82, although child mortality rate in the comparison area (where no medical interventions were provided) appears to remain stable during 1978-82. In contrast, the BBS figures suggest further downward trend in infant mortality, which does not seem to be plausible.

Infant mortality rates by sex and urban-rural residence reflects the existence of urban-rural and sex differentials, with male rates higher in both urban-rural areas than the female rates. The female child mortality is higher than male mortality and stays in the same order through the childbearing ages, suggesting preferential care and treatment of male offspring.

Economic development is still low in Bangladesh. Moreover, adequate maternal and child care facilities are rare in Bangladesh, and there are various diseases still affecting the children's chances of survival. In addition, child spacing is low in Bangladesh, which also affects infants and child mortality. However, child mortality is unlikely to be reduced through medical intervention because the reduction of child mortality depends more on socio economic conditions and environmental factors. In these circumstances, any decline in infant and child mortality to be expected, does not seem to be reasonable.

4. Two available sets of the first type of information on deaths by age give similar estimates of adult mortality for 1964-65 and 1974, although the estimates of completeness appear to be quite different in the two periods. However, analysis based on such data suggests that adult mortality is low in comparison to child mortality, and that adult mortality for both sexes declined somewhat between 1964-65 and 1974.

Table 3.1

Census - Based and other estimations of Crude Death Rate in Bangladesh 1911-1983

Year	Source	CDR
1911	Census	45.6
1921	Census	47.3
1931	Census	41.7
1941	Census	37.8
1951	Census	40.8
1961	Census	29.7
1962-65	PGE	20.0
1974	Census	19.4
1974	BRSFM	19.8
1975	BFS	19.0
1980-BLDS	BBS	10.2
1981-VRS	BBS	11.5
1982-VRS	BBS	12.2
1983-VRS	BBS	12.3

Source:- As described in text.

Table 3.2

ICDDR'B estimates of the Crude Death Rate in Matlab Thana

Year	Crude Death Rate
1966-67	15.0
1967-68	16.6
1968-69	15.0
1969-70	14.9
1970-71	14.8
1971-72	21.4
1972-73	16.2
1973-74	14.2
1974	16.5
1975	20.8
1976	14.8
1977	13.6
1978 [c]	13.2
1979 [c]	13.8
1980 [c]	14.0

[c] Comparison area

Source:- ICDDR,B Reports for years covered.

Table 3.3

Crude Death rate (CDR) per 1000 population by rural-urban residence in Bangladesh, 1980-1983.

Area	1980	1981	1982	1983
National	10.18	11.50	12.17	12.32
Rural	10.77	12.23	12.78	13.20
Urban	6.81	7.21	6.92	7.46

Source:- A.K. M.G Rabbani and Hussain, Shahadat "Levels of Fertility and Mortality From the National Sample Vital Registration System," Proceedings of a National Seminar, Dhaka, 1984.

Table 3.4

Infant Mortality Rate in Bangladesh, 1911-1983.

Year	Source	Infant Mortality Rate per 1000 live births
1911	Davis	205
1922	Davis	198
1931	Davis	179
1951	Census	168
1961	PGE	144
1969-1970	Mitra	152
1970-1972	Mitra	158
1972-1973	Mitra	154
1974	BRSFM	153
1977	BLDS, BBS (Feeny Method)	108
1980	VRS, BBS	102
1981	VRS, BBS	112
1982	VRS, BBS	121
1983	VRS, BBS	118

Source:- As described in Text

Table 3.5

Estimates of Infant and Child Mortality by Calendar, 1952-60, calenlated directly from the DSEP Fertility Histories; Central Bangladesh.

Year of Birth	Infant Mortality Rate (per thousand)	Death Rate for Ages 1-4 (per thousand)
1952	173	33
1953	172	27
1954	167	20
1955	156	34
1956	156	23
1957	158	n.a
1958	150	n.a
1959	155	n.a
1960	156	n.a

Weighted average of separate estimates for urban and rural areas.

Source:- Schultz and Davano (1970)

Table 3.6

Deviation of Child Mortality Estimates from data on children ever born and surviving, DSEP 1961-62: Central Bangladesh.

Age Group	Average number of Children		Age x	Probability of dying	Time Ref. of estimate (years before survey)	Mortality level implied	Equivalent IMR (per 1000)
	Ever Born	Surviving					
20-24	2.294	1.794	2	.1990	2.7	10.0	155
25-29	3.852	2.960	3	.2062	4.8	11.0	141
30-34	5.050	3.663	5	.2579	7.3	10.2	152

From Coale Demeny "North" model life tables.

Source:- Estimation of Recent Trends in Fertility and Mortality in Bangladesh, National Academy Press, Washington, D.C., 1981.

Table 3.7

Demographic trends in Matlab between 1966-82

Year	IMR	CDR 1-4
1966	110.7	25.0
1967	127.4	24.0
1968	124.1	24.0
1969	127.6	24.1
1970	131.3	24.4
1971	146.8	40.2
1972	126.8	31.7
1973	126.0	18.8
1974	137.9	25.4
1975	174.3	33.8
1976	119.9	36.6
1977	113.7	19.6
1978 [c]	125.8	22.1
1979 [c]	118.0	26.2
1980 [c]	114.0	25.4
1981 [c]	114.5	24.8
1982 [c]	114.5	27.4

[c] Comparison

Source:- Chowdhury, D.A.K.M Alauddin and Rahman Mizarur, "Matlab data on Fertility and Mortality", Recent Trends in Fertility and Mortality in Bangladesh, proceedings of a National Seminar, Planning Commission, Dhaka, 1984.

Table 3.8

Infant Mortality Rates by Sex and Residence, 1980-83.

Sex	1980	1981	1982	1983
National				
Both Sex	101.4	111.5	121.9	117.5
Male	102.3	113.4	124.1	118.8
Female	97.4	109.4	119.4	116.0
F/M	0.95	0.96	0.96	0.98
Rural				
Both Sex	103.5	112.5	123.2	120.8
Male	105.8	114.0	124.9	121.0
Female	101.0	110.8	121.5	120.6
F/M	0.95	0.97	0.97	1.0
Urban				
Both Sex	80.7	99.4	103.0	98.8
Male	84.2	105.2	114.0	106.5
Female	76.4	93.4	91.6	90.6

Source:- BBS

Table 3.9

Infant Mortality Rate per 1000 Live Births by Sex, Religion and Residence, 1980-1981.

	1980 Muslims			1981 Muslims		
Areas	Both Sexes	Male	Female	Both Sexes	Male	Female
Rural	103.12	104.13	102.01	110.79	110.64	110.94
Urban	85.73	95.05	75.95	105.01	110.42	99.35
	1980 Hindu			1981 Hindu		
Rural	94.18	101.69	86.96	119.24	132.60	106.38
Urban	46.39	17.54	87.50	62.15	68.97	55.56

Source:- BBS

Table 3.10

Child Death Rate per 1000 children of ages 1-4 years by Sex, 1966-83.

Year	Source	Deaths per 1000 Persons		
		Male	Female	F/M
1966-69	ICDDR'B, Matlab	22.3	29.6	1.33
1974	ICDDR'B	18.3	32.9	1.80
1975	ICDDR'B	25.5	33.9	1.33
1976	ICDDR'B, Teknaf	18.9	32.8	1.74
1977	ICDDR'B, Matlab	14.6	25.2	1.73
	ICDDR'B, Teknaf	9.4	12.8	1.36
1981	ICDDR'B, Matlab	16.2	28.3	1.75
Range				0.47
1980	VRS, BBS, National	12.7	12.7	1.0
	Rural	13.2	13.1	0.99
	Urban	7.7	8.3	1.08
1981	VRS, BBS, National	15.7	18.0	1.15
	Rural	16.3	18.8	1.15
	Urban	8.5	10.3	1.21
1982	VRS, BBS, National	20.5	23.9	1.17
	Rural	21.5	25.6	1.19
	Urban	10.7	7.4	0.69
1983	VRS, BBS, National	25.5	22.0	0.86
	Rural	27.8	24.5	0.88
	Urban	12.7	8.3	0.65
Range				0.31

Source:- Dr A.K.M.G. Rabbani and Mr Shahadat Hussain, Levels of fertility and Mortality from the National Sample Vital Registration System of the Bangladesh Bureau of Statistics, Proceedings of a National Seminar, Dhaka, 29-31 January, 1984.

Table 3.11

Estimates of the Completeness of Death Recording and rate of natural increase, from PGE 1964-65: Bangladesh.

Sex	Completeness of Death Recording	Rate of Natural Increase
Male	1.245	2.92
Female	1.136	3.06

Source:- Table 24, Estimation of Recent Trends in Fertility and Mortality in Bangladesh, National Academy Press Washington, D.C., 1981.

Table 3.12

Estimates of the Completeness of Death Recording and Rate of Natural Increase, from BRSFM, 1974: Bangladesh.

Sex	Completeness of Death Recording	Rate of Natural Increase
Male	0.570	2.92
Female	0.475	3.29

P A R T T W O

Chapter 4

Methodology

4.1 Introduction

It has been mentioned in the previous chapters that the quality of the demographic data in Bangladesh is far from being adequate to be of any value for the estimation of mortality. The direct estimation of mortality levels is, therefore, not possible and hence indirect estimation techniques namely the widowhood and the orphanhood will be useful in this situation. The widowhood technique is based on information on widowhood from the first spouse, which can be collected very easily through sample surveys in developing countries where concepts of marriage are well defined, while the orphanhood technique is based on the proportion of the population in various age groups whose parents are alive. There is also another approach which is intended to adjust underenumeration of deaths in vital registration systems and demographic surveys.

However, the point is that the indirect techniques have several drawbacks. First the drawbacks from which both the methods, particularly the orphanhood method suffer, is that the estimated survival probabilities do not link to particular time periods. Second, the methods are based on constant mortality. These techniques are, therefore, not suitable to be applied in developing countries where the mortality conditions are subject to change. As a result of the application of the indirect techniques, it is well known that mortality has declined in the recent past in most developing countries where conventional data sources are either non-existent or inadequate.

In this report, attempt has been made, however, to combine two independently collected sets of widowhood data from Bangladesh to yield a single set of adult mortality estimates referring to the intervening period.

The specific methodologies adopted in this study will be described more fully at each stage when they are used. In this chapter, only the choices of the methods and some reasons for their preference, along with brief descriptions have been given.

4.2 Plan of Analysis

The following steps have been undertaken to carry the analysis of this study.

1. A technique has been developed by Brass specially for this study to estimate $K = \frac{D-W}{M-W}$ (where D is the number of the first husband dead, W is the number of widows and M is the number of ever married women) for each age group of women from the 1974 Retrospective Survey of Bangladesh, and the procedure has been described in Chapter 5. This technique is based on the assumption that the re-marriages for women in Bangladesh are negligible after a certain age.

2. Applying the estimated K values to 1981 Census marital status data, proportions never widowed females corresponding to 1981 for Bangladesh and various geographical divisions have been estimated. The analysis has been carried out to estimate proportions never widowed males for Bangladesh and various divisions. These are shown in Chapter 5.

3. To apply the generalised stable population relations to the proportions of never widowed females of 1974 and 1981 to obtain the

intercensal estimates of proportions never widowed females for Bangladesh, divisions and various districts.

This analysis has been done for proportions never widowed males for Bangladesh and divisions.

4. The ever-widowed method has been applied to three sets of data to estimate male survivorship probability.

5. From the estimated survivorship probabilities, the period life tables for males for Bangladesh and various geographical regions have been constructed.

   Child mortality has been estimated for two periods for Bangladesh by the Brass method. Child mortality has also been estimated for various divisions of Bangladesh by using the same method.

6. The growth balance method has also been applied to investigate the plausibility of the estimates of adult mortality.

Finally, an investigation has been carried out to determine factors affecting adult mortality in Bangladesh.

Methods

1. A technique to estimate K values has been described .

2. The Generalised Stable Population Relations

   Preston et al (1982) developed the generalisation of stable population relations, and recently Preston (1983) suggested that this can be applied to the estimation of adult mortality from two sets of data on orphanhood. The generalisation of the equations characteristic of a stable population has been found when the constancy in the mortality and fertility rates has been ignored. The method is based on the assumption that the population is closed to migration.

   Recently, Timaeus (1986) applied various methods including the Preston one to combine two sets of orphanhood data from Peru, Kenya and Malawi to produce adult mortality estimates for the intersurvey period. The Preston method, however, has been found to yield slightly better estimates for countries where age reporting is bad, because it compares the same age groups rather than the same age cohorts. Furthermore, the Preston method is simple to apply and can be applied to any intersurvey interval, not just to five or ten year periods. The methods have been found to provide plausible estimates to the recent level of adult female mortality by combining two sets of data on orphanhood. The disadvantage of the technique is that the period estimates are vulnerable to differential reporting errors.

Another advantage of this sort of method is that since the period estimates are not affected by mortality trends, it is possible to investigate the consistency of the estimates based on the reports of respondents of different ages.

Very recently, the generalised stable population relations has been described in simple terms by Brass (1984).

The application of the method proposed by Brass specially for this study has been presented in Chapter 5.

3. Widowhood Technique

Two widowhood techniques have been applied to the intercensal proportions never widowed females to produce the period adult mortality for males for Bangladesh and various geographical regions.

The widowhood technique has first been proposed by Hill (1977) to estimate adult mortality from information on widowhood. Since the technique is affected by re-marriage, the technique requires information on widowhood from first spouse, which can be collected very easily through sample surveys in developing countries. The author calculated proportions widowed of first spouse by age group by using the assumption that all respondents marry at the same age, namely at the mean age at first marriage for all those who ever marry. This is intended to avoid the use of a family distribution of age at first marriage and to fix the mean exposure to risk, and to use a single first marriage distribution, that for all first marriages. The calculated proportions are then compared with certain survivorship ratios, and conversion factors calculated. In applications, a set of conversion factors is chosen with reference to observed patterns of marriage, and proportions widowed are transformed into life table survivorship probabilities.

Later on Hill and Trussell (1977) revised the widowhood technique. They proposed several regression models for the estimation of adult survivorship functions from information on spouse survival and age patterns of nuptiality. The regression models developed have been used to estimate mortality of adult men from information on widowhood status of female respondents. An equivalent model exists to estimate mortality of adult women from the information on spouse survival of male respondents. The age specific parameters of the equations have been estimated by regression of simulated data. The regression constants by age of respondents for application are given by the authors.

The main advantage of the technique is that the multiple responses and adoption effect that constitute sources of bias for orphanhood data, are well controlled for the information on widowhood.

4. Child Mortality and Logit Model

Before constructing life tables, child mortality has been estimated from children ever born and children surviving, which is shown in Chapter 7. The method has also been described in detail in this Chapter.

Brass (1975) developed a procedure to convert the proportionsdead among children ever born to women in successive five-year age groups into estimates of the probability of dying between birth and exact age x. The form of equation proposed by Brass is

$$q(x) = K(i)\ D(i)$$

where $q(x) = 1 - l(x)$

$D(i)$ = the proportions dead among children ever born to women in successive five-year age groups (where i=1 signifies age group 15-19; i=2 denotes 20-24 etc).

The Brass Multiplier K(i) has been developed on the assumption that the relationship between proportions of children dead D(i) and the probability of dying q(x) is affected mainly by the fertility conditions and, in particular, by the age at the onset of child-bearing. Therefore, the appropriate value of a conversion multiplier depends on fertility conditions.

Sullivan (1972) estimated another set of multipliers by using least-squares regression to the equation ($q(x) = K(i) D(i)$) to data derived from observed fertility schedules and the Coale-Demeny life tables. Trussell (1975) obtained a third set of multipliers by the same means but using data generated from the model fertility schedules developed by Coale and Trussell (1974). The general theory on which these methods are based is essentially the same, but their multipliers are somewhat different from each other, which is because of the data bases used in each study are different.

The authors have concluded that the Brass methodology yields reasonable results, but that estimating equations based on parameters of observed distributions can give results which are in theory slightly better.

Then the logit model based on the general standard and various Coale-Demeny model life table systems have been used to link the estimates of child mortality and adult mortality to generate the period life tables for Bangladesh and various divisions. The logit model has been used to obtain the period life tables for various districts of Bangladesh.

Various model life table systems exist to describe closely the range of observable mortality conditions in all human populations. Since mortality patterns are varied and complex in real situations, there is no model life table system that can reflect fully the range of actual mortality experiences of real populations. The first model life system widely used in Demography was the one parameter United Nations set (U.N., 1955). Since then, efforts have been made to create more flexible tables. The logit system provides a more flexible alternative to the existing model life tables systems. Others are due to Lederman et al (1959) and Coale and Demeny (1966). The Coale and Demeny systems provide four families of tables which are primarily based on European experiences. These tables are based on one parameter and hence they have little flexibility. Experience suggests that single parameter based model life table systems are not enough to describe the variation in mortality that is observed in different populations. By factor analysis, Lederman et al (1959) have identified five parameters which would be required for a system to represent closely the range of empirical schedules which they investigated. But fewer parameters based model life tables like the logit model which is based on two parameters can often capture the significant features.

The logit of a survivorship function $l(x)$ is defined as half the natural logarithm of the ratio of the proportion dying to surviving. This is expressed as follows:-

$$\text{logit } l(x) = \frac{1}{2} \text{ loge } \frac{1 - l(x)}{l(x)}$$

If $l(x)$ and $ls(x)$ are the life table survivorship functions of two different populations, then the linear relation

$$\frac{1}{2} \text{ loge } \frac{1 - l(x)}{l(x)} = \alpha + \beta \frac{1}{2} \text{ loge } \frac{1 - ls(x)}{ls(x)}$$

is hold.

It has been estimated empirically that this relation reflects much of the real situation. The α and β are the parameters of the equation, the first one reflects the level of mortality and the second one reflects the adult-child comparison respectively.

If $$Y(x) = \frac{1}{2} \log_e \frac{1 - l(x)}{l(x)}$$

Then $$l(x) = \frac{1}{1 + e^{2Y(x)}}$$

$$l(x) = \frac{1}{1 + e^{2(\alpha + \beta\ Ys(x))}}$$

where Ys(x) is the logit of s standard mortality schedule.

The above equation can be used to generate model life tables simply with reference to an adequate standard. Potentially, any life table can be used, but for simulation and fitting purposes the standard proposed by Brass (1971) is frequently used. The "general" standard is different from the so called "African" standard also proposed by Brass (1968). Carrier and Hobcraft (1971) produced a set of model tables based on the African standard and the Brass logit system. The African standard differs from the general standard only in the childhood mortality experience. The former is characterised with relatively lower infant mortality and higher child mortality in comparison to the latter one.

Since the study is concerned with the estimation of adult mortality, it does not matter which standard is used for estimation.

The logit model life table system is particularly convenient for use in computer applications. For this reason, life tables derived by the logit system are very often used for simulation purposes. Furthermore, the logit system is also useful for projecting mortality.

5. The Brass Growth Balance Method

This method has been applied to the age-specific death rates of Bangladesh collected by the BBS (the Bangladesh Bureau of Statistics) to estimate the completeness of death recording.

Various techniques have been developed based on the stable population theory to investigate the completeness of death recording. These methods use information on the age distribution of reported deaths, along with either the age distribution of the population or an estimate of the rate of natural increase. The methods are based on the assumption that the population is stable and that the proportions of deaths recorded is constant by age, at least after childhood.

The first method, developed by Brass (1975) requires information on the age structure of the population and of recorded deaths to obtain the estimates of the completeness of death recording and the rate of natural increase.

The method uses the relation that in a stable population, the rate of entry into the population aged x and over by reaching age x is equal to the rate of departure from the same population segment through death plus the stable population growth rate (which is the same for all values of x) to estimate the stable growth rate and the relative completeness of death recording.

Other methods were due to Preston et al (1980). Preston and Coale derives an equation from stable population theory that links the population of age x to the deaths over age x expanded by a series of factors taking the growth rate into consideration. The ratios of the estimated population of age x obtained from deaths over age x to the reported population of age x provide the relative completeness of death recording. Although an estimate of r is apparently necessary for the use of the method in practice, the pattern of the estimates of the completeness of death recording will provide information about the best value of r. This method is more robust to departures from stability than the Brass method, but it is more vulnerable to certain types of age misreporting. Preston and Hill (1980) method compares recorded death between two censuses with the deaths indicated by the census age distributions.

However, in this study, the Brass Method has been employed, since it does not give heavy weight to the deaths, at old ages.

Finally, an investigation has been carried out from very limited information available from Matlab, a rural area in Bangladesh, which is not nationally representative to ascertain factors affecting adult mortality.

4.3 Data Sources

BRSFM, 1974

A single retrospective survey of fertility and mortality was conducted by the population census commission of the Government of the People's Republic of Bangladesh in conjunction with the post enumeration check of the 1974 Population Census. The preliminary plans for the survey including a draft schedule, the sample design, codes, tabulation programme, time-table of field operation and estimates of costs were drawn up in November, 1973 by Dr J.G.C. Blacker, a consultant of the Population Bureau of the Ministry of Overseas Development, London in consultation with the population census commission of Bangladesh. The objective of the survey was to provide reliable estimates of fertility and mortality based on indirect methods at national and divisional levels. The sample size consisted of 0.5 percent of the 1974 census enumeration blocks, the total number of census blocks in the sample being 482. The field operations were carried out by the highly trained enumerators and field supervisors. Most of the field work was conducted in April, 1974.

The survey collected information on age, sex, marital status, children everborn and children surviving by sex of child, date of the most recent births and whether the child was still alive, survival of parents and first spouse, religion, education, and deaths in the households which took place in the two years before the survey by age, sex, and approximate date.

The age distribution of the survey population is extremely rough, and is subject to various sorts of defects, which have been discussed in detail in Chapter 1 (section 1.3). The children in the age group 0-4 have been found to be deficient because of over-stating of ages of young children and because of selective under-enumeration of such children. Another feature is that the ages of adolescents, particularly of females, have been observed to be under-reported, while the ages of adults, particularly of males, appear to have been over-reported.

BBS, Sample Survey

The Bangladesh Bureau of Statistics implemented a nationwide programme entitled "Bangladesh Demographic Survey and Vital Registration (BDSVR)" in April, 1980. The aim of this programme is to produce reliable and nationally representative estimates of annual demographic indices and to assess indirectly the impact of the national family planning programme.

The survey was conducted in 102 sample areas comprising of 62 rural and 40 urban areas, each of them having 250 households. Thus the total sample size was 25,500 households which were selected by a stratified cluster random sample design based on the 1981 census frame. The field operation of the Bangladesh Demographic Survey and Vital Registration encompassed Conduct of Base Line Demographic Survey (BLDS) in January, 1981 simultaneously with the collection of Vital Statistics from the same 250 households in the sample areas using the same questionnaires and forms. The BLDS operation involves recording of vital events of births, deaths, marriages and migration by the two independent methods (the dual record system), one being the continuous registration of vital events by the local registrars and the other being the quarterly recording of vital events by the headquarter staff.

Special measures have been adopted to ensure the operational independence of the two methods, including the rotation of the second method's interviewers among others and close supervision and quality control.

On completion of each quarterly round of survey by the headquarter's based enumerators, events of births and deaths reported by them are matched with those reported by the local registrars in accordance with selected pre-fixed criteria such as household number, mother's name etc. After matching two records, the total number of events that occurred in the sample area are obtained following the in built techniques of the system.

The dual record system is expensive, but this system has been found to provide relatively better estimates of vital rates than a single system of data collection.

However, from early 1984, the sample size has been updated to 150 rural clusters from existing number 62 and urban sample clusters to 60 from the present 40, covering a total of 52,500 households.

The quality of the age distribution of the sample survey appears to be relatively better than that of the previous censuses and BRSFM, 1974, although the age distribution is affected by massive age heaping, and various other sources of error (Rabbani et al, 1983), as detailed below.

1. The age group 0-4 has been found to be relatively deficient which is caused by the overstatement of the ages of children.

2. An understatement of ages for the girls aged 10-14 has taken place, particularly in the rural areas, while in the urban areas the ages of the girls aged 15-19 have been reported to be understated.

1974 Census

The first census of Bangladesh was conducted in 1974. The census collected information on age, sex, marital status, occupation, religion, educational status etc. In addition, the first census collected data on children everborn.

The post-enumeration check which was carried out in the same year, suggests an underenumeration of 19.3 percent in the four major towns and 6.5 percent elsewhere. These estimates are not dependable because households in the census and those in the post-enumeration check could be matched in only 59 of the 482 census blocks (Bangladesh, 1977).

The age distribution is of poor quality and various sources of errors are indicated in Chapter 1.

1981 Census

The 1981 population census, the second population census of Bangladesh, was carried out in March, 1981. The census collected data on age, sex, relationship with the head of the household, marital status, literacy, main activity/occupation etc.

A post-enumeration check on PEC was conducted in order to examine the quality of enumeration and overall coverage of the census. The PEC suggests a net undercount of 3.1 percent in the 1981 population census count, but the estimated net undercount rate appear to be much lower than those of any previous censuses.

The interesting aspect to note is that the magnitude of age reporting appear to have remained as erroneous as before.

Another interesting feature of the 1981 population census is that the sex-ration is obtained ass 106.41 which appear to be relatively lower than those of any of the past four population censuses, reflecting a better coverage of females in the 1981 census.

CHAPTER 5

Methods of Analysis for the Estimation of Intercensal Changed Proportions from two sets of data.

5.1 Introduction

Estimation of adult mortality in developing countries can follow two different routes. One approach to this problem has been to develop methods that adjust for undercount of deaths in civil registration systems and other demographic enquiries (Brass, 1975; Preston and Hill, 1980; and Bennett and Horiuchi 1981). Another approach has been to apply indirect techniques which translate a survivorship statistic, reflecting risks during a segment of adult life, into probabilities of surviving to various ages. These indirect methods are generally used when registered deaths are either not available, or too unreliable to be of any value. The latter approach includes two different techniques. The first requires information on the proportion of the population in various age groups whose mother (father) is alive. The second requires information on the proportion of widows (Widowers) in various age groups. The former one is called orphanhood technique and the latter one widowhood technique.

These methods have proved very useful in developing countries, and as a result, our knowledge of demographic situations in many countries has been considerably increased. However, these methods have two fold weaknesses. These should be mentioned first to show why the hypothetical Cohort approach is necessary to be developed to estimate adult mortality applicable to intersurvey periods. This approach combines two independently collected sets of data on indirect indicators of mortality such as orphanhhood or widowhood for the same country to yield a single set of adult mortality estimates referring to the intervening period.

First, the weakness from which both the methods, particularly the orphanhood method, suffer, is that the estimated probabilities of survival do not refer to specific time periods. This is because they imply average measures over a long period of exposure to the risk of dying of the population under study. It should be mentioned that the analysis of orphanhood is generally based on information supplied by respondents aged 20 to 40, who have been exposed to the risk of becoming orphans for a period which ranges from 20 to 40 years. In contrast, the analysis of widowhood which is based on information on first spouse is slightly different from that of maternal orphanhood. The time reference of mortality estimates obtained from period proportions with surviving first spouse is obviously uncertain, but it does not represent so far in the past as observed in the case of maternal orphanhood, because first marriages only take place in a narrow age band.

Second, there are no problems of interpretation of estimates obtained in countries where mortality has remained constant. This is because they are likely to represent the same unchanging mortality levels, when the data errors are absent. However, widespread application of indirect techniques suggests that mortality has declined during the recent past in most developing countries lacking accurate conventional data sources. An almost similar situation prevails in Banglsdeh where adult mortality has been found to have declined, although there are confusions about whether the overall mortality has ceased to decline.

It may be noted that the methods available are based on constant mortality, so these are not likely to be suitable for estimatimg trends in mortality, and even they are unlikely to be suitable for estimating levels when these are subject to change.

Interpretation and assessment become easier when the estimates obtained through the implementation of these approaches, can be linked to specific time periods. However, if it can be assumed that mortality has been changing regularly and that the adult mortality pattern of the target population is similar to that implied by the general standard, it is possible to estimate a reference time to which each probability of survivorship refers. The estimation method for this situation has recently been developed by Brass and Bamgboye (1981).

This method can be used in both the analysis of orphanhood and widowhood. More recently, Palloni et al (1984) have proposed an alternative approach to estimate the time references related to maternal orphanhood in a population whose mortality can be described in terms of the newly devised United Nations mortality model. This method is based on the assumption that the progression of the force of mortality is linear, and that the linear progression is controlled by an age-invariant rate, which is reasonably small. However, in cases where a population's true experience does not conform to these particular models of change, the estimates produced by these methods are extremely unlikely to be accurate. In this context, there is a need for developing suitable indirect techniques which may be useful under any circumstances of changing mortality.

In this research report, efforts will be devoted to describe a general approach that makes possible the estimation of mortality levels for a specified time period despite the confounding influences of trends.

How the methods have been developed will be discussed in the chapter. However, this approach can be used whenever the information needed for the implementation of a particular indirect method is available from two surveys (or censuses) conducted at two points in time(not just five or ten).

The data from the two surveys are used to construct a set of synthetic Cohorts which represent the effects on a hypothetical Cohort of prolonged exposure to the vital rates prevailing during the intersurvey period. This third data set constructed thus can be analysed using the existing indirect demographic techniques (that assumed constant mortality rates) to obtain estimates that are particularly applicable to the intersurvey period. The concepts underlying this procedure are not new, and this has been widely used in the study of fertility and mortality. This approach was first described by Hajnal (1953) and applied by Agarwala (1962). However, the extension of this concept to estimation of mortality has recently been developed by Zlotnik and Hill (1981) and subsequently applied in many situations by Timaeus (1986) who used various methods of analysis to construct synthetic Cohorts.

However, the main demographic data sources for this approach will be censuses and sample surveys. This can be applied to data supplied by two sample surveys, by two censuses, or by a census and a sample survey, as long as the sample survey provides unbiased estimates at the same level, regional or national, covered by the censuses. Thus, it is not necessary that the individuals who appear in the first survey, should also appear in the second survey.

Rather, it is important that both the surveys obtain information about variables of interest for Cohorts from the same population. It is evident that the use of data from one sample survey is likely to introduce some sampling error into the results. The errors involved are likely to be substantial when data from two sample surveys are used, but the magnitude of the probable error can be assessed.

In a paper published in 1981, Zlotnik and Hill employed a hypothetical Cohort method to maternal orphanhood data collected in the 1972 census and 1976 demographic survey of Peru. This investigation is also devoted to an assessment of the technique with a different approach which they have called the hypothetical Cohort method. This method will not be discussed in this chapter but can be found in Zlotnik and Hill (1981). This method has produced the estimates of conditional lifetable survivorship which refers to the intervening period and which represents what they consider as an implausibly low level of adult mortality for the intersurvey period. They have put forward two reasons for this low estimate. First, this may be attributable to a tendency on the part of respondents to exaggerate their ages. Second, this may be associated with mothers being reported mistakenly as alive when in reality, they are dead. However, they seem to accept the second explanation, although age exaggeration also has been found to affect the results.

On the basis of this result, they are rather doubtful about the performance of the orphanhood method. Timaeus (1986) employed a number of different approaches along with the one suggested by Preston for combining two independently collected sets of orphanhood data for the same country to provide a single set of adult mortality estimates referring to the intervening period. This study is also an attempt towards an assessment of the orphanhood method, but with a different approach. The author has used several pairs of sets of data on maternal orphanhood from Peru (1972 Census, 1976 Retrospective Demographic Survey and 1981 Census), Kenya (1969 and 1979 Census) and Malawi (1971 Survey and 1977 Census). The data have been analysed in depth by using techniques for estimating the time location of mortality measures (Brass and Bamgboye, 1981; Moser, 1983;

Brass, 1985). Furthermore, the level of mortality has been measured by the α parameter of the logit relational life table family based on Brass's (1971) General Standard with β=1.0. This study suggested two main conclusions. The First, as has often been assumed, the 'Adoption Effect' is likely to introduce considerable biases into orphanhood-based estimates of mortality but the method used in the study limits its impact to data provided by young respondents. Secondly, reports by respondents aged over 45 or 50 are likely to lead to underestimates of mortality. Furthermore, the study tends to suggest that both age exaggeration and the combined effect of selection biases which stem from an association between the mortality of parents and children and which are likely to increase with age and under-reporting of orphanhood can contribute to this. However, information on orphanhood for older age groups are generally not considered for an estimation of mortality.

Moreover, the study demonstrates incompatibly steep declines of conventional orphanhood-based estimates of adult female mortality for countries such as Kenya and Malawi, reflecting underestimation of mortality for the recent past. This trend is likely to be associated with the so called 'Adoption Effect' which is biasing the proportions of non-orphans downwards. It may be mentioned that adoption effect arises because orphans are adopted by relatives, who are reported as true parents. Palloni et al (1984) showed that 'Adoption Effect' is likely to yield more or less constant relative errors in the proportions of non-orphans for different age groups. However, this pattern of error is likely to produce much more substantial underestimation of the level of mortality based on the information supplied by younger respondents than from those provided by older respondents. Thus, it can create the impression of exaggerated decline in mortality when in fact this is not occurring. In contrast, in Peru where changes in orphanhood reported for children demonstrate only slightly lighter mortality than those for young adults, the different series of estimates tend to be close.

Although the intersurvey based estimates are very sensitive to differential reporting errors, the information on young adults seems to generate plausible estimates of adult mortality in the absence of significant effect of adoption practice. On the basis of this evidence, the author tends to conclude that it seems possible to obtain reliable estimates of the recent level of adult female mortality by combining two sets of information on orphanhood.

Analysis carried out by Ian Timaeus demonstrates that the Zlotnik and Hill method and the Preston method yield very similar series of estimates of adult mortality. It may be noted that the amount of computation involved in the implementation of their approaches is almost comparable, but the Preston method is much easier to apply to two sets of data collected in surveys which have not been conducted exactly five or ten years apart. In addition, the Preston method is expected to yield better estimates for countries where age data are poor because they involve comparisons between age groups rather than age Cohorts. Furthermore, it has to be stressed that the other methods can not conveniently be applied to any intersurvey interval; they need the surveys to be conducted five or ten years apart. This is because the methods involve comparisons between age cohorts of two sets of data, rather than age groups.

However, the hypothetical Cohort approach has proved very useful in developing countries. It has been observed that the method can eliminate some sources of reporting error and hence identify the nature and size of others. It has to be remembered that the period measures generated through this approach are not influenced by the trends in mortality, and thus can be used to examine the consistency of the estimates of adult mortality obtained on the basis of the reports of the respondents of various ages. This method also has several drawbacks. It has been found that the Cohort approach which combines two sets of data is vulnerable to differential reporting errors. Besides, the impact of sampling errors has been observed to be seriously exaggerated.

It may be concluded that there is no doubt that the available techniques to estimate adult mortality have proved very successful in developing countries having inadequate or deficient data. But, since these methods are based on some regularity conditions (assumptions of constant mortality in the past) which may not hold true in reality, they are not appropriate for estimating mortality trends, or for estimating levels in the presence of trends. Under these circumstances, the Cohort approach by utilizing information on indirect indicators from a series of surveys is likely to resolve several of the problems stemming from changing mortality conditions. This is because this sort of method gives rise to the period specific mortality, which is likely to be less influenced by the trends.

It may be mentioned that some special problems are involved in the analysis of widowhood information. The most important being that the information may be seriously affected by re-marriages. But this problem can be avoided by collecting the data relating to the survival of the first spouse. However, it should be mentioned that the sort of data on proportions never widowed needed for the implementation of the widowhood technique to estimate adult mortality levels are available only from the 1974 Bangladesh Retrospective Survey of Fertility and Mortality (BRSFM, 1977).

In this research study, it is intended to develop period adult mortality levels for the period 1974-81 from the intercensal information on widowhood. The advantage of the period adult mortality levels has already been discussed above. However, in order to generate the sort of intercensal information, it is necessary to have two sets of information on widowhood collected by two successive censuses or a census and a survey conducted at two points in time. But the problem is that the data needed for the estimation of the intercensal information are not available in Bangladesh. Fortunately, it is possible to generate the second set of data corresponding to 1981 using the results from BRSFM, 1974. The procedure adopted for the estimation of 1981 information on widowhood has been described below.

Furthermore, efforts have been made in this chapter to evaluate intercensal information on widowhood based on 1974 and 1981 estimated information by using generalised stable population procedure. The discussion of the generalised stable population relations has been included in this chapter. It is intended to demonstrate that this technique is very powerful in generating intercensal information, despite its various drawbacks.

It should be mentioned that the data estimated thus corresponding to 1974-1981 will, henceforth, be referred to as the intercensal estimates for the sake of convenience.

Brass specially proposed for this study the following method for the estimation of the proportions never widowed for 1981.

5.2 Estimation of the proportion of women never widowed (1981)

Methods exist for the estimation of adult mortality from the numbers ever-widowed by age. Special questions on survivorship of first spouse are needed to collect the basic data. If there is no re-marriage, widowhood and death of first spouse is the same. Where remarriage, at least after a moderate age is rare, widowhood data may be adjusted to give ever-widowed measures.

Women in Bangladesh are in this category and the adjustments may be obtained from the 1974 Retrospective Survey.

Suppose that D is the number of first husbands reported dead by an age group in which there are M ever-married women. Then the relation between D/M and W/M where W is the number of currently widowed can be estimated as follows.

Let R be the number of remarried women divided in the proportion P and (I-P) between cases where the first husband was dead at remarriage and when he was alive (divorce). To a good approximation the live first husbands can be taken to have the mortality of the population subsequently, that is D/M will be dead. This approximation depends on the fact that remarriage is at comparatively early ages before which mortality is small.

Then $$D=W + (1-p) \frac{D}{M} R + PR - C$$

Where C is the number of remarried women who have been subsequently widowed. Again as a first approximation the proportion will be taken as D/M. It can be verified from the 1974 Survey where deaths of first spouse and remarriages were reported that these approximations are quite reasonable (Table 5.35).

Then $$D=W + (1-P) \frac{D}{M} R + PR - \frac{D}{M} R$$

and re-arranging gives

$$\frac{D}{M} - \frac{W}{M} = \frac{PR/M}{1+ PR/M} \left(1 - \frac{W}{M}\right)$$

or

$$\frac{D - W}{M - W} = \frac{PR/M}{1+ PR/M}$$

Here (I - W/M) is the proportion of ever-married women not widowed, which can be calculated from standard marital status data. If P is constant by age and R/M also beyond some initial point the correction to obtain the ever-widowed from the widowed is a constant factor times {I - W/M}. This holds for the 1974 Survey at ages beyond 40. At earlier ages R/M the proportion re-married is lower as would be expected and P also seems to be lower perhaps because of increased divorce.

The assumption that the adjustments in 1981 will be close to those of 1974 seems acceptable, at least at higher ages where great consistency is displayed and the size of the correction is relatively small. At early ages where so many of the husbands deaths are for re-married women the error may be considerable but the mortality is low. After correction then the 1981 measures can be used to estimate male mortality in the usual way. In addition, the 1974-81 changes can be analysed by a generalised stable population procedure.

The analysis has been carried out in the following steps.

1. Calculated (D-W)/(M-W) for each age group of women from the 1974 survey; call this K (say). It will be seen that K increases with age up to 35-39. Thereafter, it fluctuates with no consistent trend.

2. For ages over 40 estimate a Common K by adding (M-W) and (D-W) over all ages before dividing. At under age 40 take the calculated K's for age groups.

3. Assuming these K hold for the 1981 estimate (D-W)/M and hence D/M by multiplying the $(1-\frac{W}{M})$ values for that census.

4. Use the ever-widowed method to estimate adult male mortality from the 1981 measures of D/M.

5. Apply the generalised stable population theory to the D/M of 1974 and 1981 to obtain the intercensal estimates of proportions widowed and hence adult male mortality.

Steps for calculating item 3.

$$\frac{D - W}{M} = \frac{D - W}{M - W} \quad \frac{M - W}{M}$$

Where D is the number of first husband dead

W is the number of widows

M is the number of ever-married women

$$\frac{D - W}{M} = K \quad \frac{M - W}{M}$$

Where K is

$$\frac{D - W}{M - W}$$

If little re-marriage after earlier ages then K is roughly constant.

In addition, the following steps are taken to carry out further analysis:-

1. Assuming the K values for females of the divisions estimated from the 1974 BRSFM data hold their respective districts, proportions never widowed of females for each district have been estimated by using in these cases 1974 census district marital status data. Similarly, 1981 census marital status data have been used to obtain proportions never widowed of females corresponding to 1981.

   Thereafter, intercensal proportions never widowed of females have been estimated by using generalised stable population relations.

2. K values of males for Bangladesh and its divisions have been estimated by using 1974 results with the help of the procedure adopted in the case of the females. Then, assuming the K values hold for 1981, proportions never widowed of males have been estimated for Bangladesh and for its various divisions using the 1981 Census male marital status data. In this case, the original K value are used for estimation, because they tend to show an increasing trend over various age groups. This, in turn, indicates that the re-marriages in the case of males tend to increase with age.

Furthermore, assuming the K values of divisions hold for their respective districts, proportions never-widowed of males for various districts can be estimated for 1974 and 1981 using marital status data provided by the 1974 and 1981 Censuses. Thereafter, the generalised stable population relations can be used to estimate intercensal proportions.

The values of K for females have been estimated for Bangladesh, divisions and religious sub-groups. These are presented in Table 5.1. It is evident that the K values show an increasing trend up to age 35-39, and thereafter they tend to fluctuate around some constant values, indicating little re-marriage after age group 35-39.

For this reason, a common value has been computed for each sub-group of Bangladesh population including Bangladesh population as a whole. These have been shown in Table 5.2. However, the final K values used for estimation of 1981 proportions never widowed females are shown in Table 5.3, and the estimated proportions never-widowed of females are shown in Table 5.4. The calculations of femele K values, never widowed females, male K values, and never widowed males for Bangladesh and various divisional levels only are shown in Tables A5.1-5.5.

It is interesting to note that the age pattern of K values are broadly similar in Bangladesh up to age 35 (Fig 5.1). The figure shows that the K values of the Rajshahi Division represent the highest pattern, and in contrast, Chittagong Division gives the lowest K values. Another interesting feature of the K values is that the value of K for Bangladesh, Khulna Division and Rajshahi Division seem to increase rapidly from age group 25-29, whereas for Dhaka and Chittagong Divions, rapid increase in K values are evident in between age groups 25-29 and 30-34, and thereafter, the increase slows down.

The estimated K values of males are shown in Table 5.5. This table reveals that the values of K tend to increase up to age group 65-69 (the only exception in this case is the Chittagong Division), and after that the values appear to show fluctuations around certain values. In this case the original K values up to age group 60-64, have been used to estimate proportions never-widowed in males.

The important feature of the K values is that there exist remarkable similarity in the age pattern of the K values, reflecting the existence of the uniformity in the widow re-marriage system for Bangladesh males (Fig 5.2). A comparison with the female age pattern of K values shows that the rate of increase tends to be less in the case of males in Bangladesh. The figure further shows that the increasing trend in the K values is smooth, reflecting that the male series are less affected by age errors.

Furthermore, it may be pointed out that K values are not affected by over or underenumeration, but they have been found to be affected by differential underenumeration in components of K values by age. Since there is no confirm evidence that such differential underenumeration in marital status data of Bangladesh exists, thhe estimated K values are robust.

5.3 Generalised Stable Population Relations

Preston and Coale (1982) demonstrated that each of the equations indicating relationships among demographic parameters in a stable population represents a particular case of a similar and equally simple equation that refers to any closed population. For the development of the procedure, they have assumed that there exists a relationship in a closed population between a population's age structure at time t, its age-specific mortality rates at time t, and its set of age-specific growth rates at time t. However, their main interest was to suggest mathematical expressions applicable to stable populations in a more general form. The authors have stated that the generalisation of the relations established in stationary and stable populations is possible to be devised by considering the expression in terms of the relative rate of change of the number of persons at each age as age increases. However, the derivation of the generalised stable population relations is described below for the sake of convenience. The discussion on stationary and stable population are presented in Appendix A5.1. If the number of persons in a population is assumed to be a continuous function of age, then the relative change in number as age increases can be represented as:-

$$\frac{1}{N(a)} \frac{d\,N(a)}{da} \quad \text{or} \quad \frac{d\,\log N(a)}{da}$$

Where N(a) is the number of persons aged a at time t.

The number of persons in a stationary population at each age does not change with time because the number of births and a set of mortality rates remain the same for every year. In such a population

$$\frac{1}{N(a)} \quad \frac{d\,N(a)}{da} = -\ \mu(a)$$

Where $\mu(a)$ is the force of mortality at exact age a.

The number of births in a stable population where the mortality pattern is the same from year to year, changes with time at a constant rate r. This is likely to produce some constant rate of change in the number of persons at each age, which, in turn, is likely to lead each successive younger cohort to be larger (or smaller if r is negative) at every age than its older cohort by a constant multiple. Thus, the relative number at age a in such a growing stable population in which there is no mortality, would decrease at a rate r, or

$$\frac{1}{N(a)} \quad \frac{d\,N(a)}{da} = -r$$

Furthermore, since the stable population is generally subject to a fixed level of mortality $\mu(a)$, the relative change in number with the increase in age which is likely to occur because of independent effects of mortality at age a and the relative difference in size of adjacent cohorts r, can be represented as:-

$$\frac{1}{N(a)} \frac{d\,N(a)}{da} = -\mu(a) - r \qquad (5.1)$$

The extension to less restricted situations where both mortality and fertility are subject to change with time is straightforward. It has to be remembered that in any closed population, the relative number is likely to change as age advances because of mortality, and because of the advancement of a large or small cohort in age which tends to replace one different in size. The authors have mentioned that the equation (5.1) appears to be applicable to any closed population at any moment in time when the rate of increase in the number at age a can be assumed to be a continuous function of age. Thus, at any moment, the equation (5.1) can be written as:-

$$\frac{1}{N(a)} \frac{d\,N(a)}{da} = -\mu(a) - r(a)$$

Then they have converted the revised equation into logarithmic form and derived the following expression on integration:-

$$N(a) = N(o)\,e^{-\int_o^a r(x)\,dx - \int_o^a \mu(x)\,dx} \qquad (5.2)$$

Where

N(a) = Number of persons aged a at time t

or

$$P(a) = e^{-\int_0^a \mu(x)\,dx}$$

= probability of surviving from age o to age a according to the life table existing at time t

$\mu(x)$ = the mortality function aged x at time t

$r(x)$ = the annual growth rate of persons aged x at time t

The authors have also demonstrated how the equation (5.2) leads to a simple generalisation of the equations characteristic of a stable population.

The development of the generalised stable population procedures is based on the assumption that the population is closed to migration. However, the extension of the formulation to an open population having an age-specific force of net out-migration function of $e(x)$ is simple. In that case, it has to be assumed that the force of migration function acts on the growth process in exactly the same way as the force of mortality is acting.

In this study efforts have been devoted to develop a more general procedure applicable to any population for the translation of population structure into equivalent functions for a stationary population than the stable populations with constant growth rates generally used for this purpose. The information required for implementation of this approach is only a set of age-specific growth rates, which are also likely to be affected by errors like other demographic series. They have mentioned that errors of the estimates based on intercensal population change are likely to result from differences in coverage completeness between the censuses and from intercensal changes in the patterns of age mis-reporting.

It has been suggested that the later source of error is unlikely to produce large error in the estimates if it remains consistent from one census to the next. Furthermore, they tend to suggest that if the change in the pattern of age mis-reporting is related to only transfers between two age groups, the effect of this on the equations is extremely unlikely to be large because of the fact that they are all based on the cumulative sum of growth rates up to a particular age.

However, they tend to suggest that differences in census coverage completeness are likely to be more problematic than the changes in age mis-reporting for many countries. In an effort to demonstrate the seriousness of the problem, they have noted that a 2 percent improvement or deterioration in coverage between censuses conducted 10 years apart appears to produce a change in all age-specific growth rates by .002, the effect of which is appreciable on the $\exp\{-\int_o^a r(x)\,dx\}$ function, which in turn tends to change by the factor .951 by age 25. They have, finally, noted that no satisfactory methodology has yet been devised for dealing with a series of growth rates affected by various kinds of errors.

Preston et al (1982) have demonstrated how the new technique can be applied to various situations with a particular emphasis on demographic estimation from deficient data. It has been suggested that these equations can equally be applied to many other relevant fields. Finally they have concluded that the development of the new strategy tends to occupy a central place in demographic estimation and measurement because of the ability of the technique to demonstrate the long-term implications of changes in mortality and fertility.

Recently Preston (1983) developed new procedures based on generalisation of stable population to provide a mathematical representation of the different types of processes involved in family demography and a formulation that can be used for estimation. Preston showed that the number of survivors of a single decrement process can be represented as follows by assuming that each cohort aged x is subjected to a single force of decrement function of intensity of $\mu(x)$

$$N(a) = N(o)\, e^{-\int_o^a \mu(x)\,dx} \tag{5.3}$$

where

N(a) = the number of persons aged a who have survived the risk of death from all causes combined at all prior ages.

$\mu(x)$ = the proportionate change in N(x), the number of survivors in the cohort at age x, per unit change in x as changes in x become smaller and smaller.

Preston has stated that a particular decrementation can be decomposed into components and the formulation can be extended by giving due recognition to various types of decrementation. It has to be noted that the extension should be based on the assumption that the different decrements can be added together.

Furthermore, Preston showed that a population at a moment in time can be expressed as follows, by noting that a population at any moment in time is composed of several cohorts, and assuming that each cohort aged x at time t is subject to a force of decrement function from all causes combined,

$$N(a, t) = N(o, t)\, \bar{e}\ \int_o^a \left[\mu\ (x, t) + r\ (x, t) \right] dx \tag{5.4}$$

where

$$-\mu(x, t) = \frac{\partial \ln N(x,t)}{\partial t} + \frac{\partial \ln N(x,t)}{\partial x}$$

or

$$\frac{\partial \ln N(x,t)}{\partial x} = -\mu(x,t) - r(x,t)$$

where

$r(x,t)$ = the contemporaneous growth rate function

the formula (5.4) can be written as follows:-

$$e^{-\int_o^a \mu(x,t)\, da} = \frac{N(a,t)}{N(o,t)} e^{\int_o^a r(x,t)\, dt} \qquad (5.5)$$

Where

$e^{-\int_o^a \mu(x,t)\, da}$

= $P(a, t)$

= probability of survival from age o to age a under the period risk function $\mu(x,t)$

The author has suggested that the equation (5.5) can be used to infer the amount of mortality during the intercensal period using two successive censuses, and to provide insights into various other kinds of process. It is to be noted that the information required for the implementation of this new approach can be derived from censuses, vital statistics and from surveys in the absence of vital statistics.

Furthermore, Preston have stated that it is often convenient to conduct analysis in family demography using proportions, and he referred to Hajnal, who demonstrated in 1953 how a gross nuptiality table could be constructed by using a single cross-sectional observation on proportions married by age. It should be remembered that the construction of the table is based on the assumption that death rates and net migration rates are the same for the single population as for the ever-married, and that the marriage rates for the population remain constant over the past period. Preston, however, mentioned that a problem of interpretation arises when marriage rates are subject to change, and hence the rates of the table constructed will represent the nuptiality situation that referring to an ill-defined past, and as a result, the proportions married at older ages imply a product of earlier nuptiality experiences than the proprotions at younger ages. But the author tends to suggest that the time indeterminacy can be avoided by using two cross-sectional observations and the new techniques, and hence a gross nuptiality table can be constructed to represent the period between observations.

In an effort to show how the proportions single can be constructed, the author tends to consider the equation

(5.4) for the total population in which a migration term has been introduced, and also considers an equivalent expression for the single population at time t, which is subject to an additional force of decrement, indicated by the rate of first marriage for the single population. Dividing the second equation by the first, Preston derived the following expression for the proportions single at age a by assuming no current differential mortality or migration by marital status at time t

$$s(a,t) = \frac{S(a,t)}{N(a,t)}$$

$$= e^{\int_o^a \left[r(x,t) - r_s(x,t) \right] dx} \; e^{-\int_o^a n(x,t)\, dx} \qquad (5.6)$$

where

N(a, t) = total population at age a, time t

$$= N(o,t)\; e^{-\int_o^a r(x,t)dx}\; e^{-\int_o^a h(x,t)dx}\; P(a,t)$$

h(x, t) = the rate of net outmigration at age x, time t

S(a, t) = the single population at age a, time t

$$= N(o,t)\; e^{-\int_o^a r_s(x,t)dx - \int_o^a h_s(x,t)dx}$$

$$\times\; P_s(a,t)\; e^{-\int_o^a n(x,t)dx}$$

$r_s(x,t)$ = age specific growth rates for the single population at age x, time t

$h_s(x,t)$ = the rate of net outmigration at age x, time t

$P_s(a,t)$ = probability of surviving for the single population from age o to age a

$n(x,t)$ = First marriage rate for the single population aged a at time t

It should be mentioned here that the exprssion (5.6) states the proportion single at age a, at time t with reference to current age-specific nuptiality conditions, $n(x,t)$, and the difference between age-specific growth rates of the total population and the single population.

Furthermore, Preston has noted that the objective of the period gross nuptiality table is to express the proportions living in the single state exclusively in terms of the force of nuptiality function existing at the moment, denoted by $n(x,t)$. He then has stated that for a cohort all of whose members are in single status at age 15, the proprotions remaining single at age a according to the period force of nuptiality function can be given by

$$\pi(a,t) = e^{-\int_{15}^{a} n(x,t)}, \quad a \geq 15$$

But from (5.6) it is evident that

$$\pi(a,t) = e^{-\int_{15}^{a} n(x,t)\,dx}$$

$$= S(a,t)\ e^{-\int_{15}^{a}\left[r_s(x,t) - r(x,t)\right]dx}$$

$$= S(a,t)\ e^{-\int_{15}^{a} r_D(x,t)\,dx} \qquad (5.7)$$

where $r_d(x,t)$ $\left[= r_s(x,t) - r(x,t) \right]$ is the growth rate of the proportion single at age x at time t. However, Preston tends to suggest that since the equation (5.7) can be determined only by proportions remaining single, it allows estimation which can be based on comparisons of successive censuses or a census and a survey. The author further has pointed out that the equation (5.7) represents an associated single decrement process in which nuptiality alone affects the single population, and it thus provides an opportunity to correct the observed proportions single, S (a,t), so that they represent what those proportions would be provided they were evaluated exclusively by period nuptiality situations. Preston has, therefore, mentioned that correction factor is mainly based on the difference in age-specific growth rates between the single and the total population, and if the difference is zero at all ages, then $\pi(a,t) = S(a,t)$ in which situation Hajnal's procedure is likely to produce unbiased estimates.

The author has also indicated that the correction factor is intended to adjust for whatever changes have occurred in nuptiality conditions. It should be mentioned that if there has been no changes in nuptiality, growth rates for the single and the total population will be the same, representing the situation in which the single and the total population will be growing by the same factor at a particular age. It has to be remembered that constant nuptiality is likely to produce constant proportions single by age, and if, however, nuptiality is found to be declining, then the growth rate for the single population, S (a,t) tends to understate $\pi(a,t)$. The author tends to suggest that the reasons for this is that the current proportions single, S (a,t) seems to be the product of the higher nuptiality conditions that reffered to the past, whereas $\pi(a,t)$ is likely to describe only current nuptiality conditions.

However, two main conclusions tend to emerge from this study. First, the bias in Hajnal's procedure may be substantial when marriage behaviour is changing, and hence the adjustment factor will not be negligible. The most vulnerable age group is 25-29 where error in the proportion single has been found to be maximum. On the otherhand, SMAM (Singulate mean age at marriage) has been found to be more robust to changing nuptiality than are either person-years lived in the single state of proportions remaining single at age 50.

The explanation for this which has been suggetsed, is that SMAM represents a ratio of the two, and the errors are likely to be partially offsetting.

However, Preston has touched on the derivation of the results, with the comment that the results obtained by converting the terms of the equation from continuous forms to the discrete ones, are reasonable and satisfactory.

More recently, Brass (1984) described the method suggested by Preston and Coale and later on modified by Preston, in simple terms, and demonstrated the application of the technique in terms of the estimation of the measures for Great Britain of the numbers of children living with their parents at the critical ages for leaving home. The basic approach is rather different from the one discussed in the preceding section. This method will be described in brief below.

In a stable population where mortality and growth rates are constant, the number of persons at the age point x is proportional to $Exp\{-rx\} . l(x)$, where $l(x)$ is the life table survivorship to age x and r is the rate of natural increase.

Brass has noted that the expression can be generalised in two ways. First, when the conditions of constancy are removed, the expression can be represented as

$$\text{Exp}\{ - \sum_{o}^{x} r \ (y)\} \ l(x)$$

Where l(x) is still the life table survivorship to age x at the period measures are evaluated using the current death rates of the growth x, and $\sum_{o}^{x} r(y)$ represents the sum of the growth rates at each age from zero to age x. Brass notes that the sum should strictly be based on the integral over rates as a function of age but the approximation by values at single years is likely to be satisfactory.

Secondly, the other extension can be done by recognising various components of change, embodied either in the life table losses or in the growth rates. Then the number of persons aged x can be given by

$$\text{Exp}\{ - \sum_{o}^{x} r_1 \ (y) - \sum_{o}^{x} r_2 \ (y)\} \ l(x) \ S(x)$$

Where S(x) is the life table survivorship for an independent cause of loss from the population, for instance, immigration, and the r_1 (y) and r_2 (y) are growth rates at age y because of different factors, such as natural increase and immigration.

The extension of the formulation for any number of components is straight-forward.

Brass notes that the technique can be applied to an appropriate sub-group such as never-married persons, and the S(x) which seems to represent the life table for the losses by marriage, can be estimated from the age distribution having values for the other components.

It is evident from the previous discussion that it is often convenient to undertake analysis in family demography by reformulating the numbers as ratios or proportions. Thus Brass tends to consider the age distribution of a class A of persons which is proportional to

$$\mathrm{Exp}\{ - \sum_{o}^{x} r_1 (y) - \sum_{o}^{x} r_{2(y)}\} l(x) S(x)$$

and also to consider for another age distribution of class B which is proportional to

$$\mathrm{Exp}\{ - \sum_{o}^{x} r_1 (y)\} \ l(x)$$

Then dividing A by B, Brass derives the following expression by assuming that mortality is the same for the two classes

$$\mathrm{Exp}\{ - \sum_{o}^{x} r_{2(y)}\} S(x) \qquad (5.8)$$

Where r_1 (y) is the rate of growth of numbers at age y common to, for example, the single and all women, r_2 (y) is the residual growth which affects, for example, the single only and S(x) is the survivorship in the time period gross nuptiality table.

From two sets of expressions (5.8) separated by a short time interval the r_2 (y) and hence S(x) can be evaluated.

It should be mentioned that if the numbers of single and all women are increasing at the same rate, then the $r_2(y)$ becomes zero, and hence S(x) can be computed from one of proportions only. This situation leads to the well known, Hajnal procedure to estimate the singulate mean age at marriage (SMAM), and it has been discussed in the preceding section that changing marriage behaviour is likely to introduce appreciable bias in the procedure. Brass, however, points out that the results are not vulnerable to the assumption of equal mortality for single and other women. He supports it by stating that the significant transitions indicated by the S(x) are likely to occur at ages where death rates are low.

Efforts have been made by Brass to smooth the measures, but the values of the S(x) have been found to be moderately erratic. He recommends that further graduation or curve fitting is likely to be needed for accurate derivation of the values of S(x).

Brass type analysis ahs been adopted to estimate intercensal proportions in this study. This has been described below.

5.4 Estimation of Intercensal Proportions

1. The S(x) for 1974 are the proportions of married women never widowed obtained directly from the 1974 Retrospective Survey. The corresponding 1981 values are as derived by adjustment from the proportions widowed at the census. Column 4 (Table 5.6-5.10) is the average of A and B, representing the S(x) at the middle of the intercensal period.

2. The formula for the S(x) at a point in time can be written as:-

$$S(x) = L(x) \, \text{Exp} \{ - \int_o^x r(y) \, dy$$

Where the S(x) are the measures for cohorts (as obtained here) and the L(x) are the proportions with surviving husbands at the current rates. The r(y) are the growth rates for the cohort proportions S(y) at ages y and $\int_o^x r(y) \, dy$ cumulates the growth upto age x. It is sufficient to estimate the r(y) for 5 year age groups.

3. The ratios of the 1981 to the 1974 S(x) measures give $\exp\{7r_i\}$ since the increase is over 7 years where r_i is for five year age groups. This is translated into $\exp\{5r_i\}$ by raising to the power of 5/7 which gives the values in column 6 of the Tables 5.6-5.10. Column 7 gives the cumulated measures $\exp\{ \int_o^x r(y) \, dy$ by successive multiplication of the values in

column 6. However, in each case the last multiplier has to be the square root of the corresponding age group value to give the cumulation the mid point of the age group to which the S(x) refers. Finally the products of column of 4 and column 7 give the estimates of L(x) for he current rates of ever-widowhood.

4. The L(x) are synthetic time period measures which can be translated into estimates of male adult mortality by the standard procedures, namely the widowhood technique.

5. The technique should be applied to sub-groups where widowhood in 1981 and 1974 can be obtained and assumptions about the adjustment to give the ever-widowed are reasonable in the light of the 1974 results. (It may be mentioned that widowhood information from population sub-groups are not available in the Bangladesh Population Censuses).

The proportions never-widowed of females for various districts for 1974, 1981, and 1974-1981 are presented in Tables 5.11-5.29. The proportions never widowed males for Bangladesh and divisions are presented in Tables 5.30-5.34.

The proportions never-widowed of females shown in Tables 5.6-5.10 do not seem to fall with perfect regularity with age (Figs 5.3-5.7). It is possible that variations from age group to age group can be attributed to sampling error. It should be mentioned that the possible sampling errors of proportions are likely to be greater for a given sample size in a population because the widowhood technique is only concerned with the ever-married section of the respondents, the numbers of which are likely to be small in a rapidly growing population or a late marrying population. Bangladesh is a rapidly growing population in which this condition may contribute to the increase in sampling errors. However, district level proportions are unlikely to be affected by sampling errors because the resultant values are based on two censuses. Furthermore, the gap between the proportions of 1974 and 1981 and the intercensal proportions tends to increase with the increase of age. This may reflect the widowhood experiences of the older age groups which are likely to subject to the past higher widowhood regimes than that of the earlier age groups. It is also possible that the impact of the sampling errors are also present because the results are based on one sample survey and another one census. Age exaggeration may also contribute to it. Another interesting feature of the tables is that the proportions for 1974-81 tend to be higher in all age groups from that of 1974 and 1981 for Bangladesh and for other divisions except Rajshahi Division where no change is observed in proportions never-widowed females between 1974 and 1981. Examination of the district level results suggests that the pattern with respect to the change in the proportions never widowed females observed in the district level results is consistent with the divisional pattern.

Finally, it is evident that the proportions never-widowed males shown in Tables 5.30-5.34 appear to be substantially higher than that of the females. It is also evident from Figure 5.8. The results are, therefore, thought to be unreliable, and further calculation on the basis of these results will not be undertaken. Possibly three reasons can be ascribed to the underenumeration of widowhood. First, widows experience substantially higher mortality risks than the currently married, reports of widowhood will be reduced. Second, re-marriage for males in Bangladesh is substantial, which also increases with age up to age groups 65-69, and third, males are not very careful about their first wives.

5.5 Conclusion

Existing indirect estimation techniques to estimate adult mortality level in developing countries like Bangladesh have proved very useful, but they are not sufficiently flexible to obtain trends, or in obtaining levels when the trends are present. However, information on indirect indicators from a series of surveys can resolve several of the problems which may result from changing mortality rates. Information on indirect indicators from two surveys or censuses conducted at two points in time (not just 5 or 10), can be combined together to simulate the effect of inter-survey mortality rates on a hypothetical cohort of respondents exposed for an indefinite period to such rates. Then the standard methods namely the widowhood method can be applied to the derived data set to estimate the mortality rates for the inter-survey period.

The advantage of the inter-survey based methods is that they avoid the complexities introduced into analysis and interpretation by the impact of trends in mortality on measures based on respondent's lifetime experience. In addition, the methods have the advantage that if events taking place during the inter-survey period are fully reported, under-reporting of more distant events will have insignificant impact on the results. Because they eliminate trends and at least some under-reporting, such methods can indicate inconsistencies in the data that would not be apparent if information was available from only one survey. However, the methods have been found to be vulnerable to differential reporting and sampling errors.

Estimated intercensal proportions never-widowed of females do not seem to be affected seriously by age reporting errors. This, in turn, suggests that the estimation of k values are less vulnerable to age reporting errors. But the sampling errors are likely to be present in the results of Bangladesh and other divisions mainly because they are based on a sample survey and a census, whereas district level intercensal data are to less extent likely to be affected by sampling errors. This is because the district level data are based on 1974 and 1981 censuses. It should be mentioned here that no estimate of the sampling errors has been provided in Bangladesh Retrospective Survey of Fertility and Mortality, 1974 and thus magnitude of sampling errors can not be indicated. But it may be reasonable to assume that they could explain much of the variations present in proportions with age. In addition, there has been a change found to have occurred in proportions never-widowed between 1974 and 1981. This suggests improvement in widowhood status in Bangladesh. However, it seems likely that it will be worth invetigating the possibility of developing the period adult mortality levels on proportions, and this will be done in Chapter 6.

Table 5.1

Value of $K = \frac{D-W}{M-W}$ for females, Bangladesh, various divisions and religious groups.

Age	Bangladesh	Dhaka	Chittagong	Khulna	Rajshahi	Muslim	Hindu
10-14	.0072	.0040	.0097	.0069	.0083	.0080	-
15-19	.0123	.0100	.0084	.0157	.0152	.0127	.0103
20-24	.0230	.0217	.0157	.0299	.0266	.0251	.0106
25-29	.0294	.0273	.0249	.0289	.0368	.0326	.0128
30-34	.0504	.0475	.0455	.0518	.0582	.0567	.0134
35-39	.0679	.0533	.0530	.0790	.0929	.0757	.0259
40-44	.0865	.0653	.0589	.0932	.1383	.0974	.0224
45-49	.0825	.0780	.0519	.1069	.0999	.0950	.0158
50-54	.0835	.0802	.0636	.0901	.1065	.0961	.0209
55-59	.0874	.0766	.0635	.0947	.1220	.1002	.0250
60-64	.0757	.0761	.0414	.0925	.1096	.0891	-
65-69	.0928	.0784	.0806	.1067	.1161	.1005	.0468
70-74	.0810	.1026	.0322	.1053	.0756	.0929	-
75-79	.0419	.0666	.0801	.0555	-	.0491	-
80-84	.0751	.1335	-	.0768	.0830	.0912	-
85+	.0402	.0837	.0008	-	.0016	.0435	.0048
Total	-	.0409	.0346	.0508	.0571	.0509	.0151

Table 5.2

Values of K for Females for Ages 40+, 45+...., Bangladesh, Various Divisions and Religious Groups, 1974.

Age	Bangladesh	Dhaka	Chittagong	Khulna	Rajshahi	Muslim	Hindu
40+	.0841	.0743	.0572	.0962	.1168	.0959	.0193
45+	.0827	.0790	.0563	.0981	.1044	.0950	.0176
50+	.0828	.0796	.0589	.0923	.1076	.0950	.0189
55+	.0821	.0791	.0546	.0942	.1086	.0941	.0170
60+	.0782	.0809	.0487	.0939	.0979	.0897	.0110
65+	.0815	.0868	.0601	.0958	.0851	.0905	.0252
70+	.0692	.0964	.0367	.0869	.0455	.0796	-
75+	.0521	.0878	.0427	.0570	-	.0610	.0003
80+	.0638	.1114	.0002	.0589	.0667	.0746	.0006
85+	.0402	.0837	.0008	-	.0016	.0435	.0048
Mean	.0717	.0859	.0416	.0859	.0816	.0819	.0127

Table 5.3

Values of K used for Estimation of 1981 Proportions Never Widowed Females.

Age	Bangladesh	Dhaka	Chittagong	Khulna	Rajshahi	Muslim	Hindu
10-14	.0072	.0040	.0097	.0069	.0083	.0080	-
15-19	.0123	.0100	.0084	.0157	.0152	.0127	.0103
20-24	.0230	.0217	.0157	.0299	.0266	.0251	.0106
25-29	.0294	.0273	.0249	.0289	.0368	.0326	.0128
30-34	.0504	.0475	.0455	.0518	.0582	.0567	.0134
35-39	.0679	.0533	.0530	.0790	.0929	.0757	.0259
40-44	.0841	.0743	.0572	.0962	.1168	.0959	.0193
45-49	.0841	.0743	.0572	.0962	.1168	.0959	.0193
50-54	.0841	.0743	.0572	.0962	.1168	.0959	.0193
55-59	.0841	.0743	.0572	.0962	.1168	.0959	.0193

D = Number of First Husband Dead
W = Number of Widow
M = Number of Ever-married Women

Table 5.4

Proportions of Never Widowed Females, Bangladesh and Divisions, 1981.

Age	Bangladesh	Dhaka	Chittagong	Rajshahi	Khulna
15-19	.9762	.9779	.9801	.9729	.9738
20-24	.9604	.9619	.9694	.9547	.9546
25-29	.9430	.9462	.9516	.9314	.9460
30-34	.9007	.9046	.9108	.8831	.9023
35-39	.8471	.8622	.8709	.8077	.8416
40-44	.7598	.7692	.7980	.7073	.7580
45-49	.6878	.6992	.7256	.6339	.6857
50-54	.5817	.5802	.6191	.5445	.5792
55-59	.5056	.5188	.5511	.4427	.4993
60-64	.3758	.3837	.4137	.3298	.3683

Table 5.5

K Values for Males, Bangladesh and Divisions, 1974.

Age	Bangladesh	Dhaka Div	Chittagong Div	Rajshahi Div	Khulna Div
15-19	.0116	.0193	.0229	.0105	-
20-24	.0189	.0154	.0169	.0179	.0272
25-29	.0348	.0339	.0226	.0344	.0507
30-34	.0545	.0549	.0440	.0568	.0653
35-39	.0699	.0629	.0572	.0831	.0839
40-44	.1072	.0974	.0864	.1260	.1267
45-49	.1353	.1227	.1241	.1549	.1457
50-54	.1782	.1681	.1529	.2033	.1995
55-59	.2031	.1821	.1760	.2396	.2228
60-64	.2272	.2250	.1916	.2649	.2330
65-69	.2517	.2252	.1906	.3370	.2688
70-74	.2917	.2724	.2694	.3071	.3392
75-79	.2802	.2472	.2353	.3728	.2933
80-84	.2770	.2857	.2514	.2888	.2824
85+	.3805	.4138	.3386	.4045	.3506

Table 5.6

Calculation of Inter-censal Proportions of Women Never-Widowed, Bangladesh

Age of Women (1)	1974(A) (2)	1981(B) (3)	$\frac{A+B}{2}$ (4)	B/A= exp $\{7r_i\}$ (5)	exp $\{5r_i\}$ (6)	exp $\{\Sigma 5r_i\}$ (7)	L(x) 4x7 (8)
					1.0000		
15-19	.9724	.9762	.9743	1.0039	1.0028	1.0014	.9757
20-24	.9583	.9604	.9594	1.0022	1.0016	1.0036	.9628
25-29	.9408	.9430	.9419	1.0023	1.0017	1.0052	.9468
30-34	.8948	.9007	.8978	1.0066	1.0047	1.0085	.9054
35-39	.8386	.8471	.8429	1.0101	1.0072	1.0145	.8551
40-44	.7507	.7598	.7553	1.0121	1.0086	1.0225	.7723
45-49	.6765	.6878	.6822	1.0167	1.0119	1.0329	.7047
50-54	.5452	.5817	.5635	1.0669	1.0474	1.0634	.5992
55-59	.4394	.5056	.4725	1.1507	1.1054	1.1442	.5407
60-64	.3062	.3758	.3410	1.2273	1.1575	1.2943	.4414

Table 5.7

Calculation of Inter-Censal Proportions of Women Never Widowed, Dhaka Division

Age of Women (1)	1974(A) (2)	1981(B) (3)	$\frac{A+B}{2}$ (4)	B/A= exp $\{7r_i\}$ (5)	exp $\{5r_i\}$ (6)	exp $\{\Sigma 5r_i\}$ (7)	L(x) 4x7 (8)
					1.0000		
15-19	.9754	.9779	.9767	1.0026	1.0018	1.0009	.9776
20-24	.9611	.9619	.9615	1.0008	1.0006	1.0021	.9635
25-29	.9473	.9462	.9468	.9988	.9992	1.0020	.9487
30-34	.9010	.9046	.9028	1.0040	1.0029	1.0030	.9055
35-39	.8517	.8622	.8570	1.0123	1.0088	1.0089	.8646
40-44	.7629	.7692	.7661	1.0083	1.0059	1.0163	.7786
45-49	.7001	.6992	.6997	.9987	.9991	1.0188	.7129
50-54	.5556	.5802	.5679	1.0443	1.0314	1.0342	.5873
55-59	.4543	.5188	.4866	1.1420	1.0995	1.1013	.5359
60-64	.3333	.3837	.3585	1.1512	1.1058	1.2144	.4353

Table 5.8

Calculation of Inter-Censal Proportions of Women Never Widowed, Chittagong Division

Age of Women (1)	1974(A) (2)	1981(B) (3)	$\frac{A+B}{2}$ (4)	B/A= exp $\{7r_i\}$ (5)	exp $\{5r_i\}$ (6)	exp $\{\Sigma 5r_i\}$ (7)	L(x) 4x7 (8)
					1.0000		
15-19	.9684	.9801	.9743	1.0121	1.0086	1.0043	.9785
20-24	.9608	.9694	.9651	1.0090	1.0064	1.0118	.9765
25-29	.9422	.9516	.9469	1.0100	1.0071	1.0186	.9645
30-34	.8988	.9108	.9048	1.0134	1.0095	1.0271	.9293
35-39	.8516	.8709	.8613	1.0227	1.0161	1.0403	.8960
40-44	.7748	.7980	.7864	1.0299	1.0213	1.0682	.8401
45-49	.7039	.7256	.7148	1.0308	1.0219	1.0913	.7801
50-54	.5589	.6191	.5890	1.1077	1.0758	1.1442	.6740
55-59	.4737	.5511	.5124	1.1634	1.1142	1.2527	.6419
60-64	.3376	.4137	.3757	1.2254	1.1563	1.4219	.5342

Table 5.9

Calculation of Inter-Censal Proportions of Women Never Widowed, Khulna Division

Age of Women (1)	1974(A) (2)	1981(B) (3)	$\frac{A + B}{2}$ (4)	B/A= exp $\{7r_i\}$ (5)	exp $\{5r_i\}$ (6)	exp $\{\Sigma 5r_i\}$ (7)	L(x) 4x7 (8)
					1.0000		
15-19	.9721	.9738	.9730	1.0017	1.0012	1.0006	.9736
20-24	.9567	.9546	.9557	.9978	.9984	1.0004	.9561
25-29	.9398	.9460	.9429	1.0066	1.0047	1.0019	.9447
30-34	.8877	.9023	.8950	1.0164	1.0117	1.0101	.9041
35-39	.8246	.8416	.8331	1.0206	1.0147	1.0234	.8526
40-44	.7516	.7580	.7548	1.0085	1.0061	1.0340	.7805
45-49	.6281	.6857	.6569	1.0917	1.0647	1.0702	.7030
50-54	.5364	.5792	.5578	1.0798	1.0564	1.1350	.6331
55-59	.4148	.4993	.4571	1.2037	1.1416	1.2464	.5697
60-64	.2795	.3683	.3239	1.3177	1.2178	1.4696	.4760

Table 5.10

Calculation of Inter-Censal Proportions of Women Never Widowed, Rajshahi Division

Age of Women (1)	1974(A) (2)	1981(B) (3)	$\frac{A+B}{2}$ (4)	B/A= exp $\{7r_i\}$ (5)	exp $\{5r_i\}$ (6)	exp $\{\Sigma 5r_i\}$ (7)	L(x) 4x7 (8)
					1.0000		
15-19	.9725	.9729	.9727	1.0004	1.0003	1.0001	.9728
20-24	.9537	.9547	.9542	1.0010	1.0007	1.0007	.9548
25-29	.9323	.9314	.9319	.9990	.9993	1.0007	.9326
30-34	.8886	.8831	.8859	.9938	.9956	.9981	.8842
35-39	.8200	.8077	.8139	.9850	.9893	.9905	.8062
40-44	.7075	.7073	.7074	.9997	.9998	.9851	.6969
45-49	.6606	.6339	.6473	.9596	.9710	.9706	.6283
50-54	.5229	.5445	.5337	1.0413	1.0293	.9703	.5179
55-59	.4063	.4427	.4245	1.0896	1.0632	1.0150	.4309
60-64	.2569	.3298	.2934	1.2838	1.1953	1.1442	.3357

Table 5.11

Calculation of Inter-censal Proportion of Women Never-Widowed, Faridpur District

Age of Women (1)	1974(A) (2)	1981(B) (3)	$\frac{A+B}{2}$ (4)	B/A= exp $\{7r_i\}$ (5)	exp $\{5r_i\}$ (6)	exp $\{\Sigma 5r_i\}$ (7)	L(x) 4x7 (8)
					1.0000		
15-19	.9776	.9801	.9789	1.0026	1.0019	1.0009	.9798
20-24	.9587	.9635	.9611	1.0050	1.0036	1.0037	.9647
25-29	.9439	.9472	.9456	1.0035	1.0025	1.0068	.9520
30-34	.8991	.9056	.9024	1.0072	1.0051	1.0106	.9120
35-39	.8470	.8590	.8530	1.0142	1.0101	1.0183	.8686
40-44	.7463	.7639	.7551	1.0236	1.0168	1.0320	.7793
45-49	.6771	.6892	.6832	1.0179	1.0128	1.0473	.7155
50-54	.5324	.5721	.5523	1.0746	1.0527	1.0814	.5973
55-59	.4524	.5099	.4812	1.1271	1.0892	1.1580	.5572
60-64	.2996	.3661	.3329	1.2220	1.1540	1.2983	.4322

Table 5.12

Calculation of Inter-censal Proportion of Women Never-Widowed, Dhaka District

Age of Women (1)	1974(A) (2)	1981(B) (3)	$\frac{A+B}{2}$ (4)	B/A= exp $\{7r_i\}$ (5)	exp $\{5r_i\}$ (6)	exp $\{\Sigma 5r_i\}$ (7)	L(x) 4x7 (8)
					1.0000		
15-19	.9750	.9775	.9763	1.0026	1.0018	1.0009	.9772
20-24	.9592	.9613	.9603	1.0022	1.0011	1.0026	.9628
25-29	.9459	.9461	.9460	1.0002	1.0002	1.0035	.9493
30-34	.9074	.9054	.9064	.9978	.9984	1.0028	.9089
35-39	.8737	.8664	.8701	.9916	.9940	.9990	.8692
40-44	.7789	.7764	.7777	.9968	.9977	.9949	.7737
45-49	.7163	.7073	.7118	.9874	.9910	.9893	.7042
50-54	.5688	.5920	.5804	1.0408	1.0290	.9990	.5798
55-59	.5237	.5294	.5266	1.0109	1.0078	1.0173	.5357
60-64	.3658	.3989	.3824	1.0905	1.0638	1.0533	.4028

Table 5.13

Calculation of Inter-censal Proportion of Women Never-Widowed, Tangail District

Age of Women (1)	1974(A) (2)	1981(B) (3)	$\frac{A + B}{2}$ (4)	B/A= exp $\{7r_i\}$ (5)	exp $\{5r_i\}$ (6)	exp $\{\Sigma 5r_i\}$ (7)	L(x) 4x7 (8)
					1.0000		
15-19	.9799	.9796	.9997	.9798	.9998	.9999	.9797
20-24	.9643	.9627	.9983	.9635	.9988	.9992	.9627
25-29	.9490	.9464	.9973	.9477	.9981	.9976	.9455
30-34	.9129	.9066	.9931	.9098	.9951	.9942	.9045
35-39	.8765	.8721	.9950	.8743	.9964	.9900	.8655
40-44	.7938	.7858	.9899	.7898	.9928	.9846	.7777
45-49	.7219	.7153	.9909	.7186	.9935	.9779	.7027
50-54	.5972	.6033	1.0102	.6003	1.0073	.9783	.5872
55-59	.5549	.5372	.9681	.5461	.9771	.9706	.5300
60-64	.3627	.4064	1.1205	.3846	1.0847	.9992	.3843

Table 5.14

Calculation of Inter-censal Proportion of Women Never-Widowed, Mymensingh District

Age of Women (1)	1974(A) (2)	1981(B) (3)	$\frac{A+B}{2}$ (4)	B/A= exp $\{7r_i\}$ (5)	exp $\{5r_i\}$ (6)	exp $\{\Sigma 5r_i\}$ (7)	L(x) 4x7 (8)
					1.0000		
15-19	.9763	.9768	.9766	1.0005	1.0004	1.0002	.9768
20-24	.9602	.9614	.9608	1.0012	1.0009	1.0008	.9616
25-29	.9501	.9458	.9480	.9955	.9968	.9996	.9476
30-34	.9028	.9028	.9028	1.0000	1.0000	.9980	.9010
35-39	.8671	.8571	.8621	.9885	.9917	.9939	.8568
40-44	.7822	.7608	.7715	.9726	.9804	.9800	.7561
45-49	.7217	.6923	.7070	.9593	.9707	.9560	.6759
50-54	.5760	.5676	.5718	.9854	.9896	.9370	.5358
55-59	.5223	.5082	.5153	.9730	.9806	.9230	.4756
60-64	.3421	.3739	.3580	1.0930	1.0655	.9435	.3378

Table 5.15

Calculation of Inter-censal proportion of Women Never-Widowed, Sylhet District

Age of Women (1)	1974(A) (2)	1981(B) (3)	$\frac{A+B}{2}$ (4)	B/A= exp $\{7r_i\}$ (5)	exp $\{5r_i\}$ (6)	exp $\{\Sigma 5r_i\}$ (7)	L(x) 4x7 (8)
					1.0000		
15-19	.9810	.9816	.9813	1.0006	1.0004	1.0002	.9815
20-24	.9676	.9705	.9691	1.0030	1.0021	1.0015	.9705
25-29	.9467	.9509	.9488	1.0044	1.0032	1.0041	.9527
30-34	.8993	.9051	.9022	1.0064	1.0046	1.0080	.9094
35-39	.8470	.8543	.8507	1.0086	1.0061	1.0134	.8621
40-44	.7477	.7679	.7578	1.0270	1.0192	1.0262	.7777
45-49	.6820	.6548	.6684	.9601	.9713	1.0211	.6825
50-54	.5175	.5410	.5293	1.0454	1.0322	1.0224	.5412
55-59	.4606	.4768	.4687	1.0352	1.0250	1.0516	.4929
60-64	.3319	.3507	.3413	1.0566	1.0401	1.0858	.3706

Table 5.16

Calculation of Inter-censal proportion of Women Never-Widowed, Noakhali District

Age of Women (1)	1974(A) (2)	1981(B) (3)	$\frac{A + B}{2}$ (4)	B/A= exp $\{7r_i\}$ (5)	exp $\{5r_i\}$ (6)	exp $\{\Sigma 5r_i\}$ (7)	L(x) 4x7 (8)
					1.0000		
15-19	.9772	.9800	.9786	1.0029	1.0020	1.0010	.9796
20-24	.9682	.9690	.9686	1.0008	1.0006	1.0023	.9708
25-29	.9490	.9521	.9506	1.0033	1.0023	1.0038	.9542
30-34	.9112	.9127	.9120	1.0016	1.0012	1.0055	.9171
35-39	.8813	.8775	.8794	.9957	.9969	1.0046	.8834
40-44	.8080	.8134	.8107	1.0067	1.0048	1.0054	.8151
45-49	.7638	.7612	.7625	.9966	.9976	1.0066	.7675
50-54	.6483	.6555	.6519	1.0111	1.0079	1.0094	.6580
55-59	.6077	.5965	.6021	.9816	.9868	1.0067	.6061
60-64	.4294	.4467	.4381	1.0403	1.0286	1.0142	.4443

Table 5.17

Calculation of Inter-censal proportion of Women Never-Widowed, Comilla District

Age of Women (1)	1974(A) (2)	1981(B) (3)	$\frac{A + B}{2}$ (4)	B/A= exp $\{7r_i\}$ (5)	exp $\{5r_i\}$ (6)	exp $\{\Sigma 5r_i\}$ (7)	L(x) 4x7 (8)
					1.0000		
15-19	.9806	.9804	.9805	.9998	.9999	.9999	.9804
20-24	.9675	.9703	.9689	1.0029	1.0021	1.0009	.9698
25-29	.9535	.9524	.9530	.9988	.9992	1.0015	.9545
30-34	.9079	.9133	.9106	1.0059	1.0042	1.0032	.9135
35-39	.8753	.8738	.8746	.9983	.9988	1.0047	.8787
40-44	.8014	.8016	.8015	1.0002	1.0002	1.0042	.8049
45-49	.7456	.7365	.7411	.9878	.9913	.9999	.7410
50-54	.6067	.6218	.6143	1.0249	1.0177	1.0043	.6170
55-59	.5597	.5596	.5597	.9998	.9999	1.0131	.5670
60-64	.3840	.4237	.4039	1.1034	1.0728	1.0493	.4238

Table 5.18

Calculation of Inter-censal proportion of Women Never-Widowed, Chittagong District

Age of Women (1)	1974(A) (2)	1981(B) (3)	$\frac{A+B}{2}$ (4)	B/A= exp $\{7r_i\}$ (5)	exp $\{5r_i\}$ (6)	exp $\{\Sigma 5r_i\}$ (7)	L(x) 4x7 (8)
					1.0000		
15-19	.9823	.9792	.9808	.9968	.9977	.9989	.9797
20-24	.9705	.9684	.9695	.9978	.9985	.9969	.9665
25-29	.9510	.9515	.9513	1.0005	1.0004	.9963	.9478
30-34	.9102	.9117	.9110	1.0016	1.0012	.9971	.9083
35-39	.8807	.8778	.8793	.9967	.9976	.9965	.8762
40-44	.7886	.8087	.7987	1.0255	1.0181	1.0043	.8021
45-49	.7420	.7459	.7440	1.0053	1.0038	1.0152	.7553
50-54	.5906	.6538	.6222	1.1070	1.0753	1.0547	.6563
55-59	.5150	.5563	.5357	1.0802	1.0566	1.1242	.6023
60-64	.3764	.4273	.4019	1.1352	1.0948	1.2091	.4859

Table 5.19

Calculation of Inter-censal proportion of Women Never-Widowed, Chittagong Hill Tract District

Age of Women (1)	1974(A) (2)	1981(B) (3)	$\frac{A+B}{2}$ (4)	B/A= exp $\{7r_i\}$ (5)	exp $\{5r_i\}$ (6)	exp $\{\Sigma 5r_i\}$ (7)	L(x) 4x7 (8)
					1.0000		
15-19	.9725	.9701	.9713	.9975	.9982	.9991	.9704
20-24	.9613	.9631	.9622	1.0019	1.0014	.9989	.9611
25-29	.9545	.9495	.9520	.9948	.9963	.9977	.9498
30-34	.9231	.9194	.9213	.9960	.9971	.9944	.9162
35-39	.8987	.8956	.8972	.9966	.9976	.9918	.8898
40-44	.8595	.8497	.8546	.9886	.9918	.9866	.8431
45-49	.8270	.8185	.8228	.9897	.9926	.9789	.8055
50-54	.7013	.7135	.7074	1.0174	1.0124	.9813	.6942
55-59	.5744	.6980	.6362	1.2152	1.1494	1.0585	.6734
60-64	.4797	.5267	.5032	1.0980	1.0691	1.1733	.5904

Table 5.20

Calculation of Intercensal Proportions of Women Never-widowed, Rangpur District

Age of Women (1)	1974(A) (2)	1981(B) (3)	$\frac{A + B}{2}$ (4)	B/A= exp $\{7r_i\}$ (5)	exp $\{5r_i\}$ (6)	exp $\{\Sigma 5r_i\}$ (7)	L(x) 4x7 (8)
					1.0000		
15-19	.9725	.9695	.9710	.9969	.9978	.9989	.9699
20-24	.9581	.9490	.9536	.9905	.9932	.9944	.9483
25-29	.9368	.9234	.9301	.9857	.9898	.9859	.9170
30-34	.8890	.8693	.8792	.9778	.9841	.9730	.8555
35-39	.8021	.7878	.7950	.9822	.9872	.9591	.7624
40-44	.6824	.6775	.6800	.9928	.9949	.9505	.6463
45-49	.6525	.6060	.6293	.9287	.9486	.9234	.5811
50-54	.5029	.4836	.4933	.9616	.9724	.8869	.4375
55-59	.4394	.4179	.4287	.9511	.9648	.8590	.3683
60-64	.2626	.2906	.2766	1.1066	1.0751	.8748	.2420

Table 5.21

Calculation of Intercensal Proportions of Women Never-widowed, Rajshahi District

Age of Women (1)	1974(A) (2)	1981(B) (3)	$\frac{A + B}{2}$ (4)	B/A= exp $\{7r_i\}$ (5)	exp $\{5r_i\}$ (6)	exp $\{\Sigma 5r_i\}$ (7)	L(x) 4x7 (8)
					1.0000		
15-19	.9728	.9747	.9738	1.0020	1.0014	1.0007	.9745
20-24	.9541	.9576	.9559	1.0037	1.0026	1.0027	.9585
25-29	.9372	.9362	.9367	.9989	.9992	1.0036	.9401
30-34	.8895	.8911	.8903	1.0018	1.0013	1.0038	.8937
35-39	.8170	.8187	.8179	1.0021	1.0015	1.0052	.8222
40-44	.7087	.7251	.7169	1.0231	1.0165	1.0142	.7271
45-49	.6633	.6442	.6538	.9712	.9793	1.0119	.6166
50-54	.5098	.6189	.5644	1.2140	1.1486	1.0732	.6057
55-59	.4270	.4512	.4391	1.0567	1.0402	1.1730	.5151
60-64	.2764	.3729	.3247	1.3491	1.2385	1.3314	.4323

Table 5.22

Calculation of Intercensal Proportions of Women Never-widowed, Pabna District

Age of Women (1)	1974(A) (2)	1981(B) (3)	$\frac{A + B}{2}$ (4)	B/A= exp $\{7r_i\}$ (5)	exp $\{5r_i\}$ (6)	exp $\{\Sigma 5r_i\}$ (7)	L(x) 4x7 (8)
					1.0000		
15-19	.9712	.9747	.9730	1.0036	1.0026	1.0013	.9743
20-24	.9544	.9569	.9557	1.0026	1.0019	1.0035	.9591
25-29	.9345	.9352	.9349	1.0007	1.0005	1.0050	.9395
30-34	.8995	.8949	.8972	.9949	.9963	1.0034	.9002
35-39	.8360	.8314	.8337	.9945	.9961	.9996	.8333
40-44	.7322	.7419	.7371	1.0132	1.0094	1.0023	.7388
45-49	.6883	.6809	.6846	.9892	.9923	1.0031	.6867
50-54	.5607	.5690	.5649	1.0148	1.0106	1.0045	.5674
55-59	.5006	.4964	.4985	.9916	.9940	1.0068	.5019
60-64	.3202	.3597	.3400	1.1234	1.0866	1.0464	.3558

Table 5.23

Calculation of Intercensal Proportions of Women Never-widowed, Dinajpur District

Age of Women (1)	1974(A) (2)	1981(B) (3)	$\frac{A + B}{2}$ (4)	B/A= exp $\{7r_i\}$ (5)	exp $\{5r_i\}$ (6)	exp $\{\Sigma 5r_i\}$ (7)	L(x) 4x7 (8)
					1.0000		
15-19	.9753	.9741	.9747	.9988	.9991	.9996	.9743
20-24	.9568	.9561	.9565	.9993	.9995	.9988	.9554
25-29	.9353	.9315	.9334	.9959	.9971	.9971	.9307
30-34	.8837	.8798	.8818	.9956	.9968	.9941	.8766
35-39	.8065	.7966	.8016	.9877	.9912	.9881	.7921
40-44	.6903	.6915	.6909	1.0017	1.0012	.9844	.6801
45-49	.6319	.6152	.6236	.9736	.9811	.9756	.6084
50-54	.4891	.5034	.4963	1.0292	1.0208	.9763	.4846
55-59	.3868	.4227	.4048	1.0928	1.0654	1.0182	.4122
60-64	.2643	.3031	.2837	1.1468	1.1028	1.1037	.3131

Table 5.24

Calculation of Intercensal Proportions of Women Never-widowed, Bogra District

Age of Women (1)	1974(A) (2)	1981(B) (3)	$\frac{A+B}{2}$ (4)	B/A= exp $\{7r_i\}$ (5)	exp $\{5r_i\}$ (6)	exp $\{\Sigma 5r_i\}$ (7)	L(x) 4x7 (8)
					1.0000		
15-19	.9747	.9744	.9746	.9997	.9998	.9999	.9745
20-24	.9580	.9587	.9584	1.0007	1.0005	1.0001	.9585
25-29	.9400	.9381	.9391	.9980	.9986	.9996	.9388
30-34	.8920	.8919	.8920	.9999	.9999	.9989	.8910
35-39	.8210	.8208	.8209	.9998	.9998	.9988	.8199
40-44	.7190	.7193	.7192	1.0004	1.0003	.9988	.7184
45-49	.6900	.6464	.6682	.9368	.9544	.9759	.6521
50-54	.5580	.5217	.5399	.9349	.9531	.9093	.4909
55-59	.4520	.4406	.4463	.9748	.9819	.8797	.3926
60-64	.3180	.3186	.3183	1.0019	1.0013	.8723	.2776

Table 5.25

Calculation of Inter-censal Proportions of Women Never-widowed, Patuakhali District

Age of Women (1)	1974(A) (2)	1981(B) (3)	$\frac{A+B}{2}$ (4)	B/A= exp $\{7r_i\}$ (5)	exp $\{5r_i\}$ (6)	exp $\{\Sigma 5r_i\}$ (7)	L(x) 4x7 (8)
					1.0000		
15-19	.9707	.9746	.9727	1.0040	1.0029	1.0014	.9741
20-24	.9532	.9578	.9555	1.0048	1.0034	1.0046	.9599
25-29	.9407	.9515	.9461	1.0115	1.0082	1.0104	.9560
30-34	.8872	.9071	.8972	1.0224	1.0160	1.0226	.9175
35-39	.8310	.8512	.8411	1.0243	1.0173	1.0396	.8744
40-44	.7233	.7682	.7458	1.0621	1.0440	1.0714	.7990
45-49	.6551	.6950	.6751	1.0609	1.0431	1.1181	.7548
50-54	.5331	.5752	.5542	1.0790	1.0558	1.1734	.6503
55-59	.4317	.5061	.4689	1.1723	1.1203	1.2761	.5984
60-64	.2559	.3682	.3121	1.4388	1.2968	1.5381	.4800

Table 5.26

Calculation of Inter-censal Proportions of Women Never-widowed, Kushtia District

Age of Women (1)	1974(A) (2)	1981(B) (3)	$\frac{A+B}{2}$ (4)	B/A= exp $\{7r_i\}$ (5)	exp $\{5r_i\}$ (6)	exp $\{\Sigma 5r_i\}$ (7)	L(x) 4x7 (8)
					1.0000		
15-19	.9722	.9725	.9724	1.0003	1.0002	1.0001	.9725
20-24	.9489	.9506	.9498	1.0018	1.0013	1.0008	.9506
25-29	.9467	.9421	.9444	.9951	.9965	.9998	.9442
30-34	.8915	.9016	.8966	1.0113	1.0081	1.0021	.8985
35-39	.8304	.8463	.8384	1.0191	1.0136	1.0130	.8493
40-44	.7427	.7631	.7529	1.0275	1.0195	1.0298	.7753
45-49	.6733	.6985	.6859	1.0374	1.0266	1.0535	.7226
50-54	.5773	.5841	.5807	1.0118	1.0084	1.0719	.6224
55-59	.4610	.5069	.4840	1.0996	1.0701	1.1135	.5389
60-64	.3205	.3604	.3405	1.1245	1.0874	1.2012	.4090

Table 5.27

Calculation of Inter-censal Proportions of Women Never-widowed, Khulna District

Age of Women (1)	1974(A) (2)	1981(B) (3)	$\frac{A+B}{2}$ (4)	B/A= exp $\{7r_i\}$ (5)	exp $\{5r_i\}$ (6)	exp $\{\Sigma 5r_i\}$ (7)	L(x) 4x7 (8)
					1.0000		
15-19	.9676	.9719	.9698	1.0044	1.0032	1.0016	.9713
20-24	.9490	.9521	.9506	1.0033	1.0023	1.0044	.9548
25-29	.9368	.9420	.9394	1.0056	1.0040	1.0075	.9465
30-34	.8877	.8978	.8928	1.0114	1.0081	1.0136	.9049
35-39	.8190	.8325	.8258	1.0165	1.0117	1.0237	.8453
40-44	.7196	.7490	.7343	1.0409	1.0290	1.0445	.7670
45-49	.6372	.6695	.6534	1.0507	1.0360	1.0784	.7046
50-54	.5344	.5753	.5549	1.0765	1.0541	1.1269	.6253
55-59	.4557	.4793	.4675	1.0518	1.0367	1.1780	.5507
60-64	.2942	.3708	.3325	1.2604	1.1797	1.3028	.4332

Table 5.28

Calculation of Inter-censal Proportions of Women Never-widowed, Jessore District

Age of Women (1)	1974(A) (2)	1981(B) (3)	$\frac{A + B}{2}$ (4)	B/A= exp $\{7r_i\}$ (5)	exp $\{5r_i\}$ (6)	exp $\{\Sigma 5r_i\}$ (7)	L(x) 4x7 (8)
					1.0000		
15-19	.9718	.9737	.9728	1.0020	1.0014	1.0007	.9735
20-24	.9493	.9543	.9518	1.0053	1.0038	1.0033	.9549
25-29	.9419	.9448	.9434	1.0031	1.0022	1.0063	.9494
30-34	.8941	.9009	.8975	1.0076	1.0054	1.0101	.9066
35-39	.8270	.8394	.8332	1.0150	1.0107	1.0182	.8484
40-44	.7381	.7513	.7447	1.0179	1.0127	1.0301	.7671
45-49	.6704	.6750	.6727	1.0069	1.0049	1.0392	.6990
50-54	.5394	.5638	.5516	1.0452	1.0321	1.0583	.5838
55-59	.4434	.4810	.4622	1.0848	1.0599	1.1069	.5116
60-64	.3140	.3439	.3290	1.0952	1.0671	1.1772	.3873

Table 5.29

Calculation of Inter-censal Proportions of Women Never-widowed, Barisal District

Age of Women (1)	1974(A) (2)	1981(B) (3)	$\frac{A+B}{2}$ (4)	B/A= exp $\{7r_i\}$ (5)	exp $\{5r_i\}$ (6)	exp $\{\Sigma 5r_i\}$ (7)	L(x) 4x7 (8)
					1.0000		
15-19	.9717	.9765	.9741	1.0049	1.0035	1.0018	.9758
20-24	.9509	.9581	.9545	1.0076	1.0054	1.0062	.9604
25-29	.9429	.9503	.9466	1.0078	1.0056	1.0117	.9577
30-34	.8902	.9054	.8978	1.0171	1.0122	1.0207	.9164
35-39	.8320	.8461	.8391	1.0169	1.0121	1.0331	.8669
40-44	.7264	.7642	.7453	1.0520	1.0369	1.0583	.7888
45-49	.6791	.7014	.6903	1.0328	1.0233	1.0902	.7525
50-54	.5402	.5932	.5667	1.0981	1.0691	1.1403	.6462
55-59	.4863	.5318	.5091	1.0936	1.0660	1.2173	.6197
60-64	.3279	.3894	.3587	1.1876	1.1306	1.3364	.4794

Table 5.30

Proportions Never-widowed, Males, Bangladesh

Age	1974	1981	1974-81
15-19	.9681	.9781	.9767
20-24	.9590	.9745	.9795
25-29	.9526	.9604	.9775
30-34	.9316	.9406	.9627
35-39	.9150	.9244	.9526
40-44	.8763	.8845	.9183
45-49	.8409	.8540	.8918
50-54	.7916	.8057	.8504
55-59	.7586	.7767	.8295
60-64	.7154	.7342	.7972

Table 5.31

Proportions Never-widowed, Males,

Dhaka Division

Age	1974	1981	1974-81
15-19	.9325	.9686	.9635
20-24	.9674	.9776	1.0030
25-29	.9538	.9613	.9941
30-34	.9327	.9405	.9779
35-39	.9235	.9319	.9747
40-44	.8883	.8949	.9423
45-49	.8519	.8677	.9171
50-54	.8024	.8171	.8750
55-59	.7855	.7997	.8676
60-64	.7200	.7405	.8126

Table 5.32

Proportions Never-widowed, Males,

Chittagong Division

Age	1974	1981	1974-81
15-19	.9697	.9685	.9687
20-24	.9658	.9756	.9733
25-29	.9678	.9716	.9772
30-34	.9407	.9502	.9575
35-39	.9249	.9364	.9501
40-44	.8965	.9045	.9264
45-49	.8575	.8650	.8916
50-54	.8162	.8309	.8607
55-59	.7827	.8044	.8428
60-64	.7450	.7579	.8109

Table 5.33

Proportions Never-widowed, Males,

Rajshahi Division

Age	1974	1981	1974-81
15-19	.9792	.9809	.9807
20-24	.9578	.9761	.9747
25-29	.9523	.9609	.9739
30-34	.9289	.9380	.9568
35-39	.8999	.9106	.9350
40-44	.8560	.8650	.8959
45-49	.8169	.8328	.8680
50-54	.7654	.7795	.8238
55-59	.7170	.7387	.7897
60-64	.6818	.7027	.7673

Table 5.34

Proportions Never-widowed, Males,

Khulna Division

Age	1974	1981	1974-81
15-19	.9803	.9911	.9896
20-24	.9430	.9669	.9711
25-29	.9333	.9453	.9682
30-34	.9207	.9307	.9622
35-39	.9050	.9115	.9502
40-44	.8564	.8659	.9068
45-49	.8314	.8440	.8903
50-54	.7716	.7839	.8358
55-59	.7406	.7554	.8141
60-64	.7089	.7301	.7970

Table 5.35

Proportions of Ist husband dead among evermarried females and widowed subsequently among remarried females, BRSFM, 1974.

M (000)	D (000)	D/M	R (000)	W (000)	W/R
17068	3632	0.2127	1456	299	0.2054

Note: M= Total number of ever married females

D= Total number of Ist husband dead

R= Total number of remarried females

W= Total number of widowed subsequently among remarried females

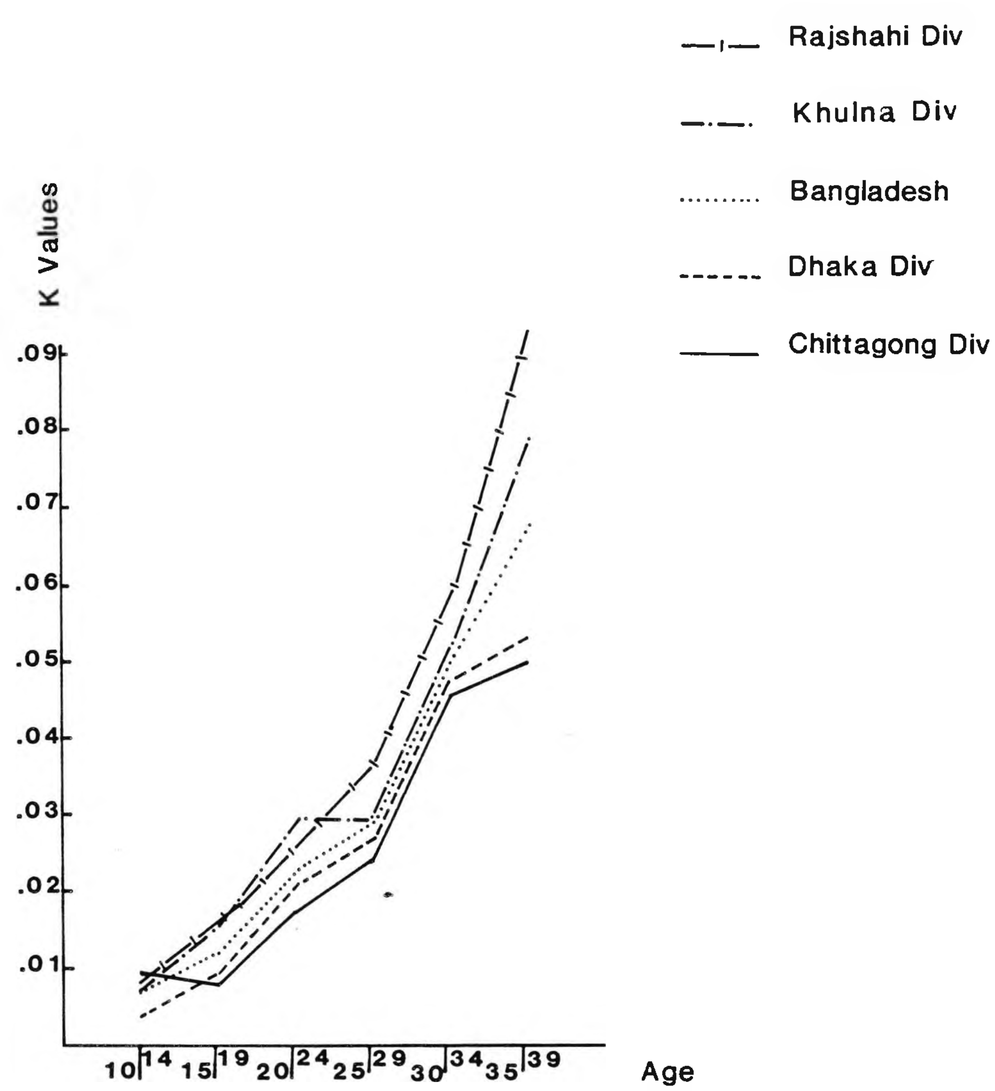

Fig :5.1 Female K Values for Bangladesh and divisions, 1974

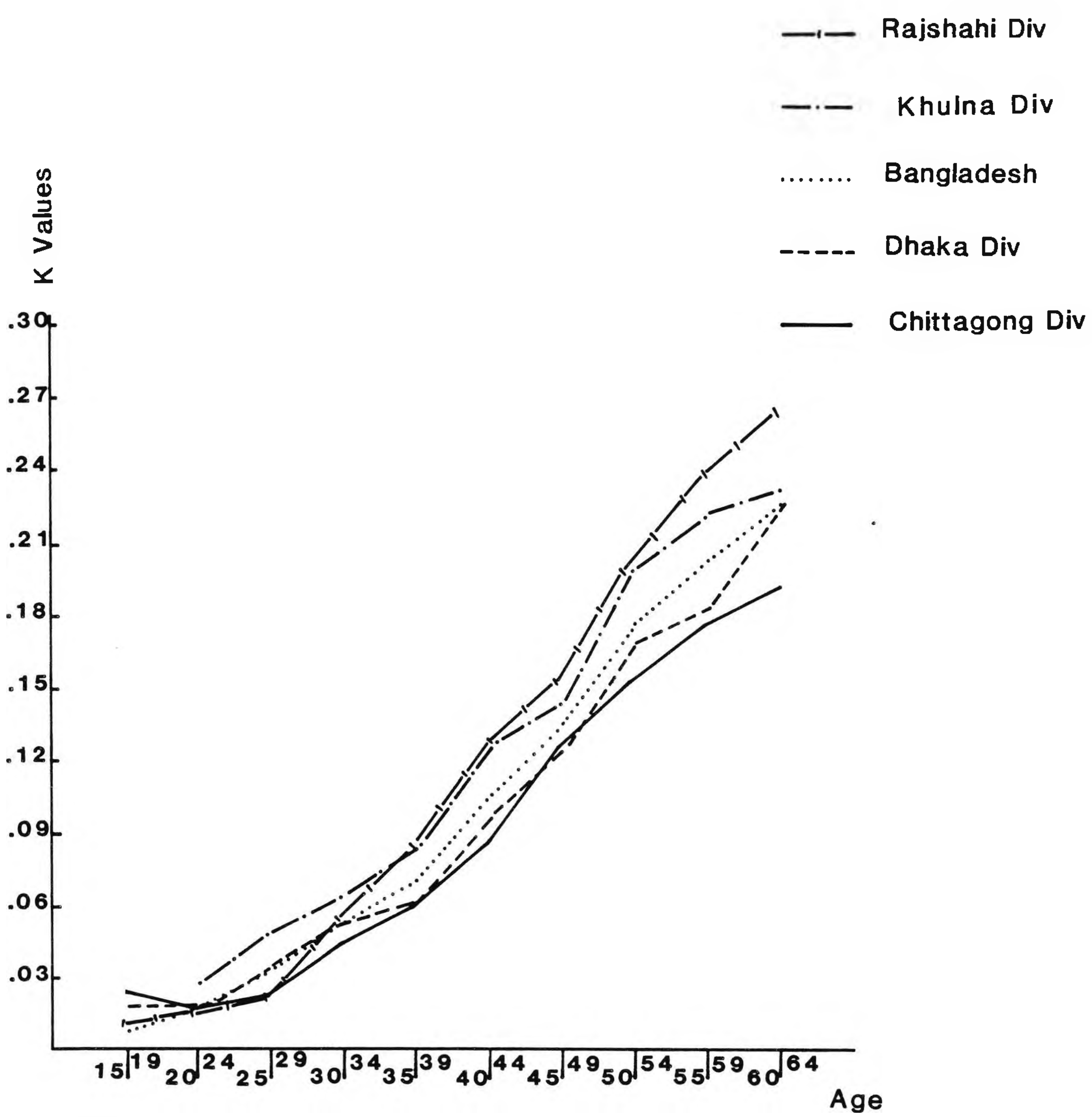

Fig :5.2 Male K Values for Bangladesh and Divisions, 1974

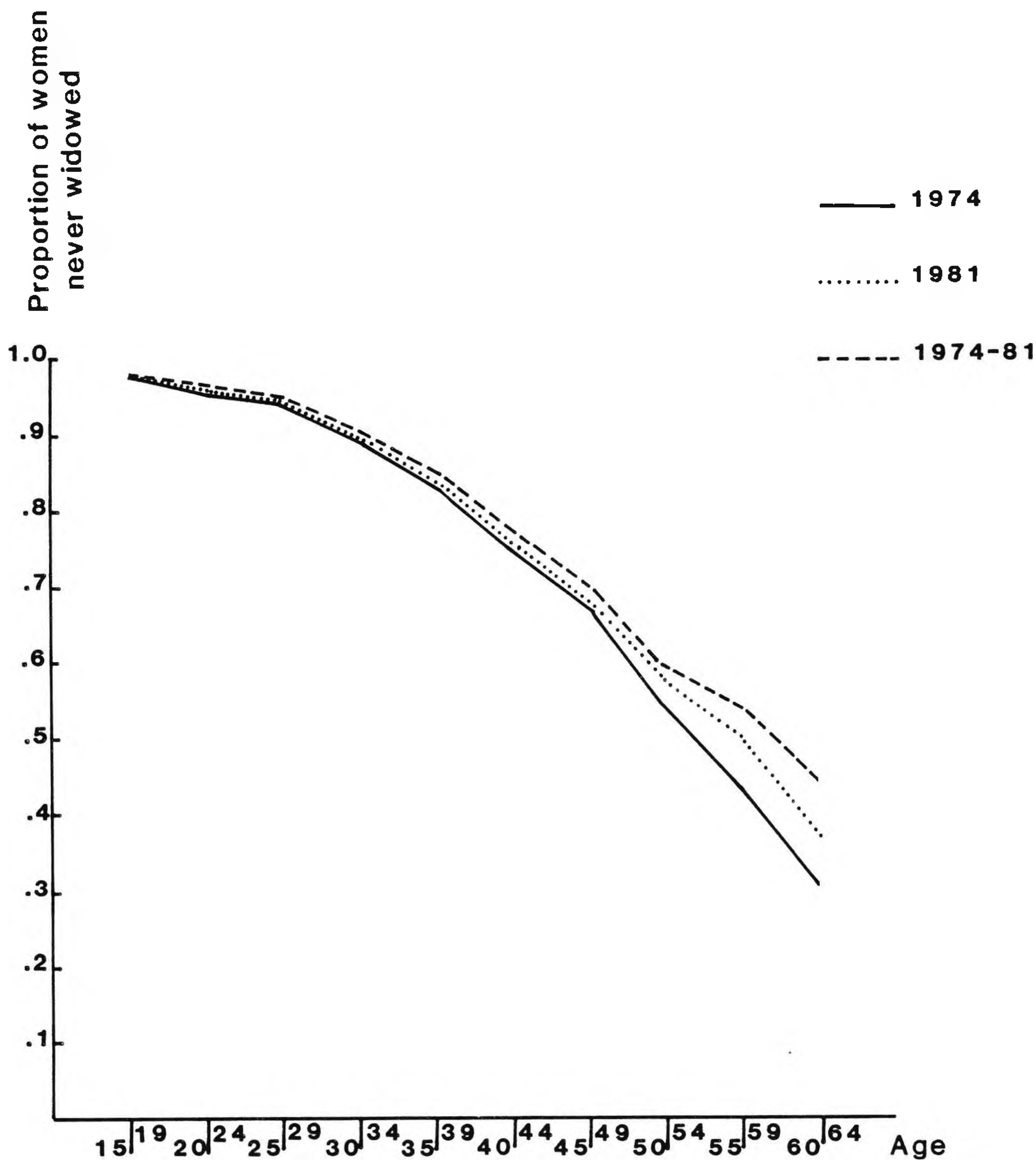

Fig :5.3 Proportion of women never widowed, Bangladesh

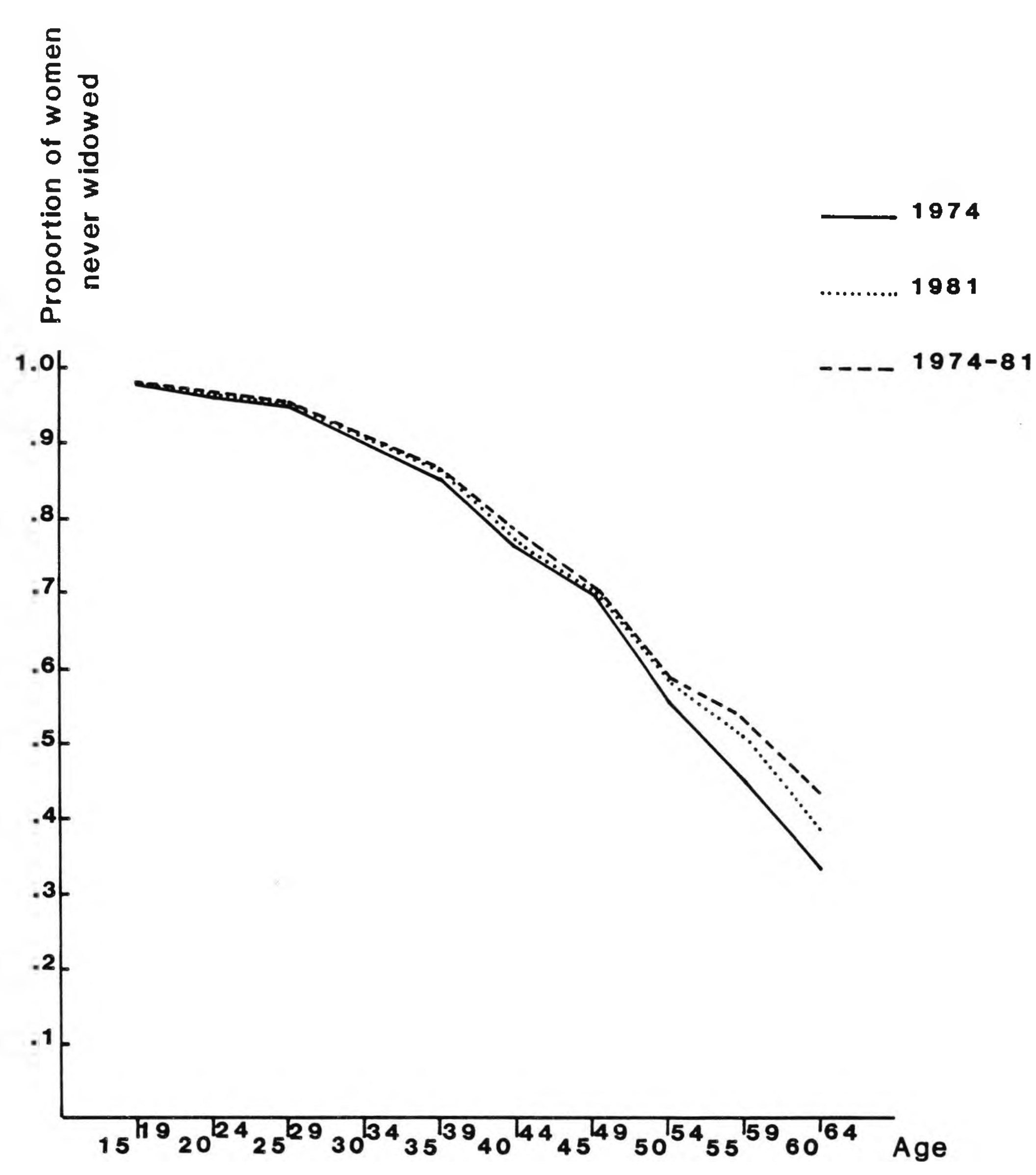

Fig :5.4 Proportion of women never widowed, Dhaka Division

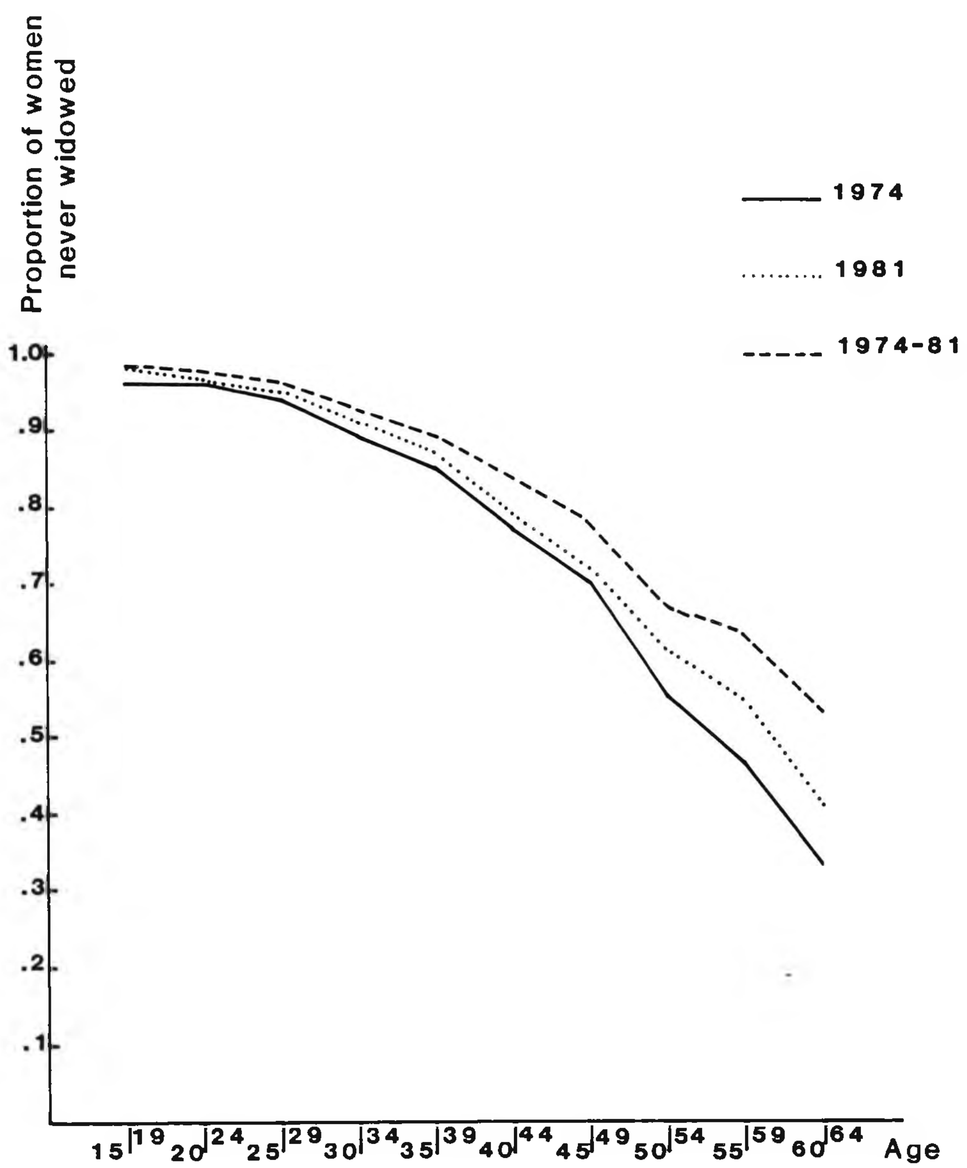

Fig :5.5 Proportion of women never widowed, Chittagong Division

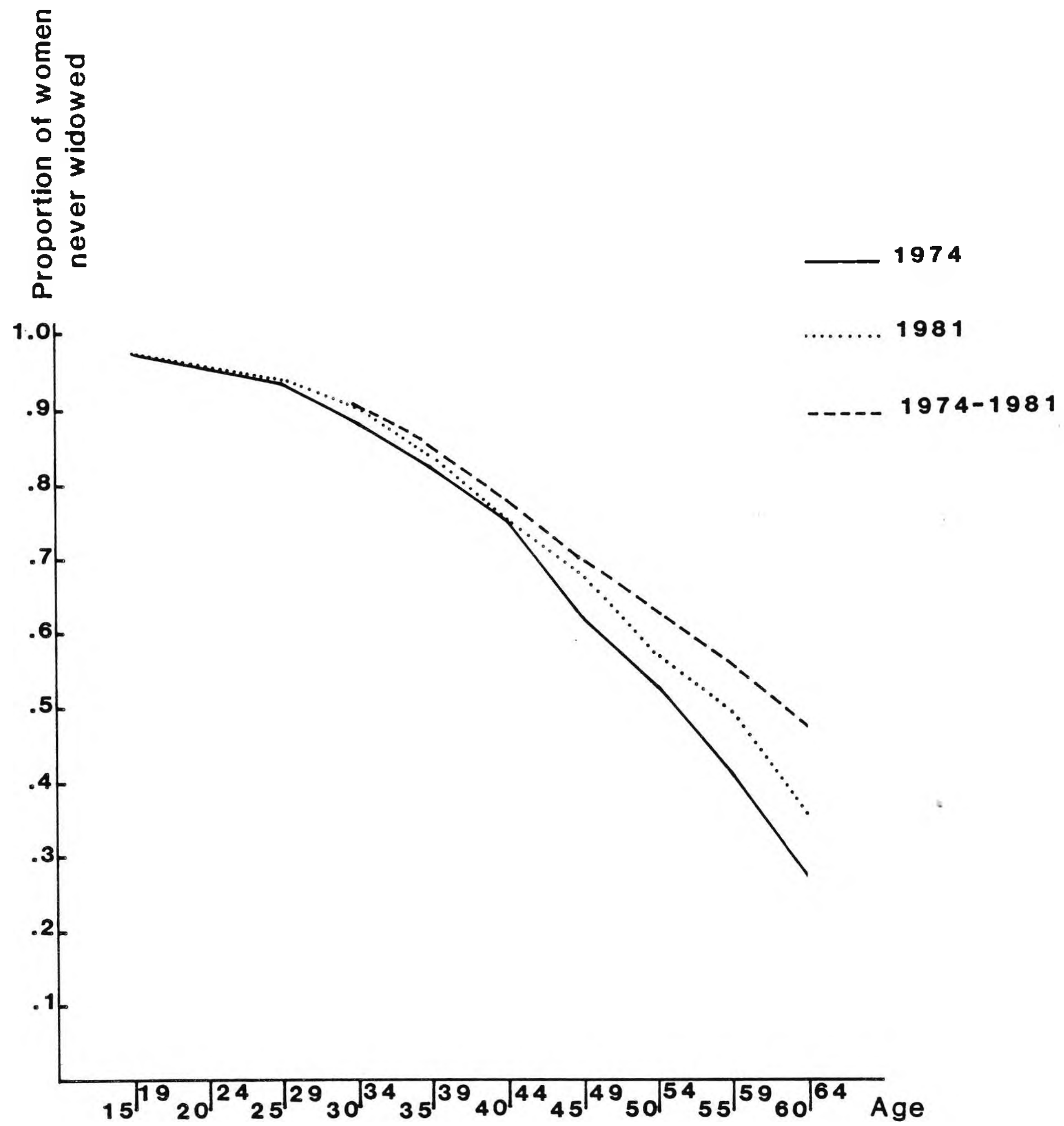

Fig :5.6 Proportion of women never widowed, Khulna Division

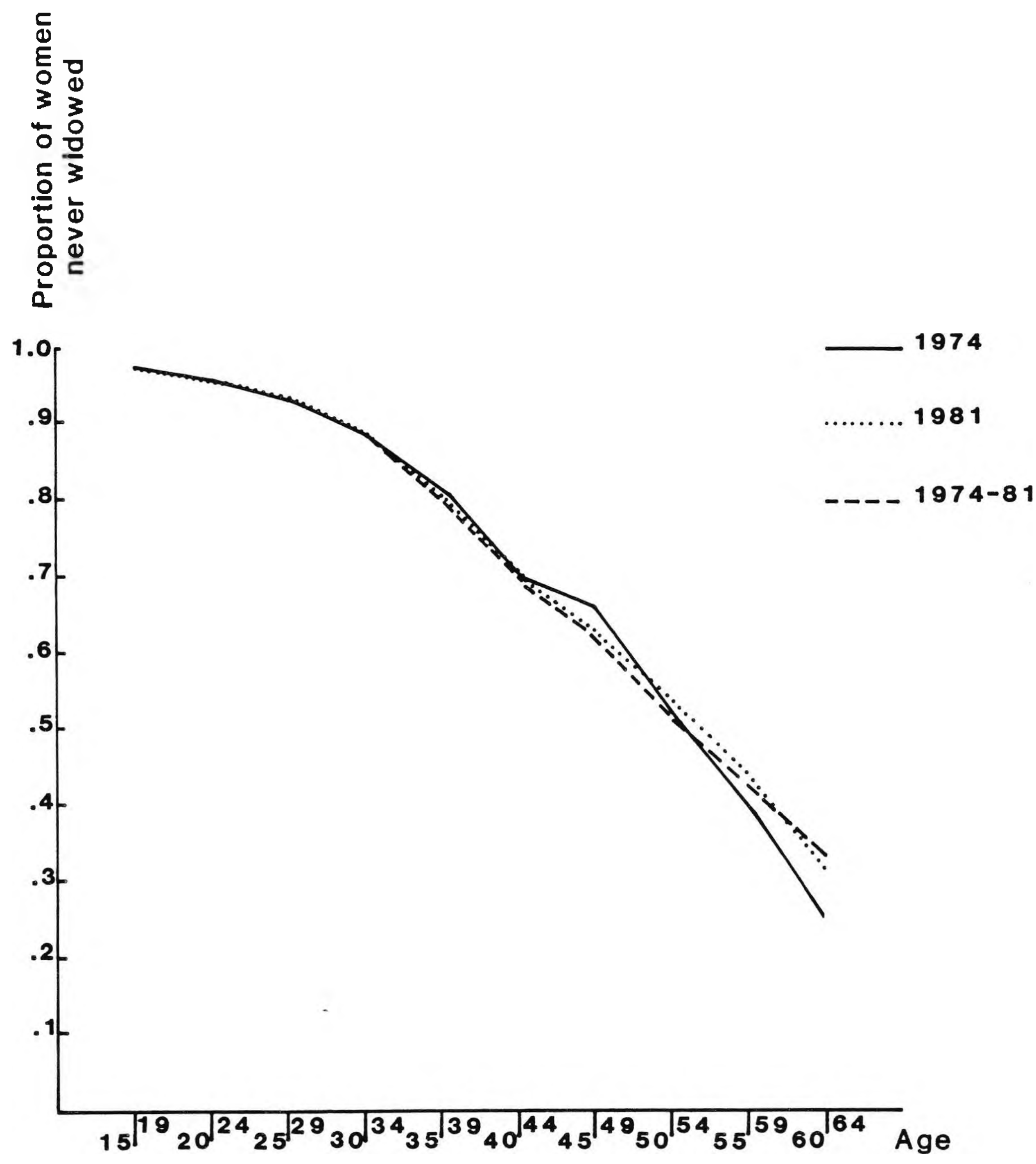

Fig :5.7 Proportion of women never widowed, Rajshahi Division

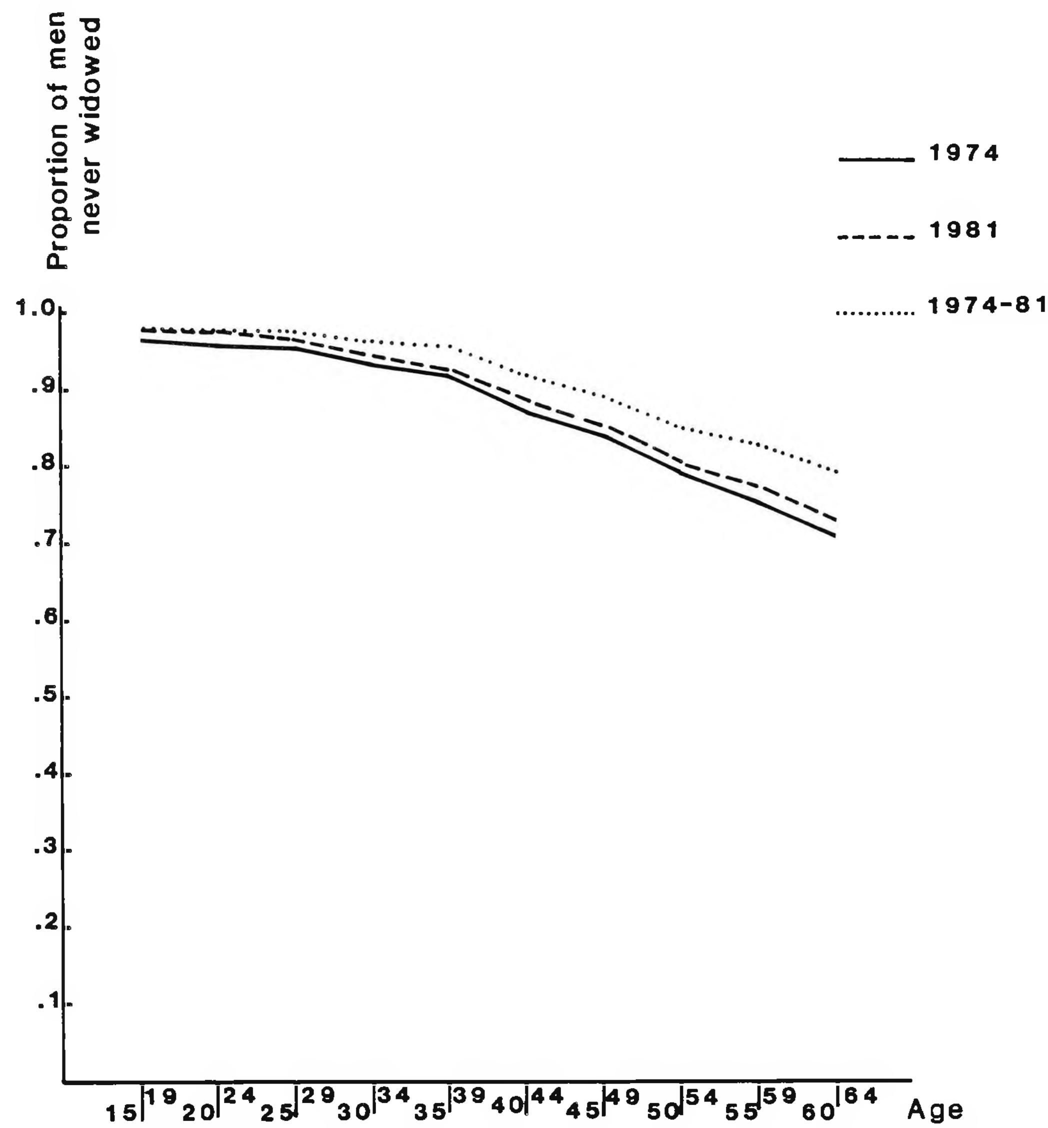

Fig :5.8 Proportion of men never widowed, Bangladesh

CHAPTER 6

Estimation of Period Adult Mortality from Intercensal Proportions Never Widowed

6.1 Introduction

This chapter will be concerned with two widowhood methods. One of them has been suggested by Hill (1977) and another has been later revised by Hill and Trussell (1977). The application of the two approaches in this chapter is made in order to compare their performances, and to throw light on their probable strengths and weaknesses, in addition to the estimation of the adult mortality level. However, it should be mentioned that these methods are called Conditional, because the estimated parameters represent conditional probabilities of survival that do not, by themselves, define a complete life table. For constructing a complete life table, information about child mortality is needed. The methods for combining information about child and adult mortality in an effort to derive life table values are described in Chapter 7.

It should be remembered that the sort of information required for the implementation of the widowhood technique has been generated in Chapter 5.

The widowhood method has several advantages over the orphanhood technique. First, the questions on which the widowhood analysis is based relates only to first spouse, and thus there should be only one report per event and more than one such report is extremely unlikely. On the otherhand, the number of reports of a parent's fate in the orphanhood analysis is dependant on the number of his or her children who are surviving. Second, the marriage has been found to be much more compact than the all children fertility function. This, in turn, diminishes the importance of probable deviations from model assumptions. Finally, the most important advantage of the widowhood technique is that it has no equivalent of the adoption effect which is associated with analysis of orphanhood.

The widowhood method suffers from several drawbacks however. First, since the method is based on the survival of the first spouse, this limitation may give rise to data accuracy problems. Second, marriage data of some regions where the majority of marital unions are probably based on temporary consensual unions, are generally regarded as suspicious by many demographers.

This is because the western concept of marriage, implicit in the questions asked, tends to be incomprehensible by the people under investigation and because the definition of marriage is imprecise. But this should not pose a serious problem as long as marriage is properly defined and reasonable consistency is maintained throughout. Thirdly, there is a considerable risk involved in the implementation of this approach for a population in which the marriage situation appears to be unstable. This risk is expected to increase with time elapsed since first marriage. Finally, there is also a problem posed by estimation of exposure to risk. In the case of orphanhood analysis, the exposure to risk of maternal orphanhood is equal to the age of respondent, and of paternal orphanhood analysis, is equal with approximation, to that age plus three quarters of a year for the female gestation period. It may be mentioned that no such straightforward relationship exists with widowhood analysis. The exposure problem of the widowhood technique becomes simple only when the data can be classified by time since first marriage. In the absence of this sort of data tabulated according to marriage duration, analysis of widowhood data can be based on the male marriage distribution, which will determine the widowhood probabilities, and the female marriage distribution, which will determine the exposure to risk structure within each group.

Furthermore, the widowhood technique is based on one of the assumptions of unchanging mortality and nuptiality in the past. It is to be noted that the method is vulnerable to changes in nuptiality experiences, but the problem arises when the method is applied to a population where mortality is declining. In such a population where mortality is declining, each survivorship estimate would refer to different periods in the past, depending upon the ages of the respondents. Since the assumption of constant mortality may not apply in many developing countries including Bangladesh, a new technique is necessary to be developed. In this chapter the estimates of adult survivorship probabilities specific for the intercensal period have been generated. This sort of period measure avoids the complexities introduced into analysis by the impact of trends in mortality on measures based on respondents life time. It should be mentioned that the application of the method to develop period measures from intercensal proportions never widowed are based on the following assumptions:-

1) The mortality and nuptiality situation remains constant during the intercensal period.

2) Mortality is the same among the various marital status groups.

An attempt has been made in this chapter to develop period adult mortality levels for males using intercensal proportions as shown in Chapter 5. An attempt has also been made to estimate male adult mortality corresponding to 1974 and 1981 using proportions never widowed.

Furthermore, an attempt has been made to describe the methods including computational procedures, and finally to draw conclusions.

6.2 Estimation of male Adult Mortality from Widowhood of female respondents

The first method of estimation based on widowhood status of female respondents was proposed by Hill (1977). The theoretical expression for proportions of surviving spouses for respondents married for x years may be given as follows:-

$$P(x) = \frac{\int_{\alpha}^{\beta} N(a)\ m(a)\ \frac{l(a+x)}{}da}{\int_{\alpha}^{\beta} N(a)\ m(a)\ l\ (a)\ da}$$

When $N(a)$ = The number of spouses aged x years ago

$m(a)$ = The number of spouses marrying x years ago

$\alpha \ \beta$ = The earliest and the latest ages at which spouses marry

$\frac{l(a+x)}{l(a)}$ = The probability of surviving from exact age a to exact age a+x

The author suggested two equations relating proportions not widowed in two contiguous age groups to a probability of surviving from a fixed age in early adult life to the central point of the two age groups, by the use of weights. This system of weighing has been introduced into the estimation process for smoothing purposes. It should be mentioned that since the exposure to risk at a particular age tends to vary with the mean age at marriage, two different equations have been developed for very different means when the mean age at first marriage for the female respondents is below 20, the equation has the form

$$\frac{l\ (N+5)}{l\ (22.5)} = W(N) \quad {}_5P_{N-5} + (1-W(N)) \ {}_5P_N \qquad (6.1)$$

where

N = the central point of the adjacent age groups

P = the proportion not widowed in an age group

W (N) = weights which can be estimated by using model values of P and survivorship probabilities into equations (6.1) and (6.2).

It has to be remembered that for respondents that aged 20-24 and 25-29, N will be 25, s0 the survivorship ratio estimated will be l (30)/l (22.5) which tends to represent a survivorship of 7 1/2 years from an age of 22 1/2. The author also mentions that if all the women married at 17 1/2, their exposure by age 25 would be 7 1/2 years, whereas if all the men married at 22 1/2, five years later than the woman, their exposure would have been 7 1/2 years from 22 1/2 which tend to represent the survivorship probability of the estimation equation. The author tends to suggest that this sufficiently demonstrates correspondence for conditions in which females appear to marry at a mean age below 20. when the mean age at female marriage is above 20, the equation has the form

$$\frac{l\ (N+5)}{l\ (27.5)} = W(N)\ {}_5P_{N-5} + (1-W(N))\ {}_5P_N \qquad (6.2)$$

The equation (6.2) tends to have a different starting point and duration of exposure, and tends to be more suitable for a later marriage situation.

Equivalent expressions for estimating female survivorship probability from the widowhood status of males do also exist.

More recently, Hill and Trussell (1977) suggested another estimation procedure based on the following equation.

$$\frac{lm\ (n)}{lm\ (20)} = a(n) + b(n)\ SMAM_f + c(n)\ SMAM_m + d(n)\ NW_f\ (n-5) \qquad (6.3)$$

Where a(n), b(n), c(n) and d(n) are co-efficients which are specific to age, have been estimated by regression of simulated data. The data required for the estimation of the regression co-efficients have been generated by specifying the underlying relationship between spouse survival, life table survivorship function and age at marriage in the stable population, and then varying the parameters of equation $SMAM_f$ and $SMAM_m$ refer to the singulate mean age at marriage of women and men. NW_f refers to the proportions never widowed females.

The value of the regression co-efficients, for each value of n, are shown in table 6.1.

The equivalent expressions for estimating female adult survivorship probability do exist.

The stages of the computational procedure of the first method are described below.

Stage 1: Calculation of a set of weights - two steps are required to obtain a set of weights. The female mean age at first marriage is needed first - this mean represents exposure to risk for a particular age group of respondents and the correct measure is a distribution mean which has been estimated from proportions single by Hajnal's singulate mean age at first marriage (1953). These are presented in Table 6.2. The female mean also indicates which equation has to be used. Since the mean in Bangladesh appears to be below 20, equation (6.1) has been used, and the weights are taken from part (a) of Table 6.3 and shown in Table 6.3a. It may be mentioned here that if the mean is above 20, the equation (6.2) has to be used and the weights need to be selected from Part (b) of Table 6.3.

A measure of male mean age at first marriage is required next, but this should be an age distribution weighted mean. The calculations of the age distribution weighted mean are shown in Table 6.4, for Bangladesh.

The calculations can be summarised as follows. Proportions ever-married by age group are expressed as rates for first marriage between mid-points of groups, and comparable population estimates have been evaluated from the age distribution by splitting co-efficients (Carrier and Hobcraft, 1971). Then synthetic numbers of first marriages have been calculated by multiplication, and the mean ages of these first marriages have been estimated in a straightforward way.

For Bangladesh and divisions, 1974 BRSFM data and 1981 Census divisional data have been used for calculation of weighted mean age at marriage for males. The results are summarised in Table 6.5.

The estimated mean then has been used as the point of entry into the relevant part of Table 6.3, interpolating linearly between the round values as shown. The weights thus estimated need to be adjusted for the true value of the female mean. The correction factors for a particular value of the female mean and the equation used have been obtained from Table 6.6. The correction factor thus obtained has been added to each weight already calculated.

It should be mentioned here that for all sorts of calculations for 1974-1981 average female singulate mean age at marriage and average weighted mean age at marriage for males during the intersurvey period (1974-1981) have been used. These average ages are shown in Tables 6.2 and 6.5.

Stage 2: Calculation of survivorship probabilities - the adjusted weights are then applied to the observed proportions never widowed females and life table survivorship ratios are estimated by using equation (6.1). The results are presented in Tables 6.7-6.11.

The stages of computational procedure of the second method are described below:-

Stage 1: Calculation of singulate mean age at marriage for males and females - these means have been estimated from proportions single by Hajnal's method (1953). The results are shown in Table 6.2 and Table 6.12.

Stage 2: Calculation of survivorship probabilities for males - using the values of the co-efficients shown in Table 6.1 and applying the version of equation (6.3) appearing in this table with female and male singulate mean ages at marriage, and the observed proportions not widowed, NW (n), the survivorship probabilities have been estimated. The results for Bangladesh and divisions are shown in Tables 6.13-6.17. The district results are presented in Tables 6.18-6.36.

Also shown in Tables 6.13-6.17 are the mortality levels to which each estimated survivorship probability corresponds in the Coale-Demeny West family of model life tables. These levels are obtained by interpolating linearly between the values given in model life tables. It is clear from the results that the mortality associated with value of n of 25 is relatively very high. On the otherhand, the low level of mortality associated with value of n of 60 are also suspect, and the reason may be attributed to a tendency that increases with age to over report surviving first husbands. Furthermore, the low mortality at this age may also be due to the consistent exaggeration of own age on the part of the older female respondents.

However, the estimates obtained for the intercensal period (1974-1981) seem to be reasonably consistent, if the first value and the last value are excluded. The average level for Bangladesh corresponding to 1974-81 is 14.1 and the range is 4. The average levels for Dhaka, Chittagong, Khulna and Rajshahi Divisions are 14.0, 17.4, 13.7, and 11.0 respectively and the corresponding ranges are 4.7, 4, 4.4, and 5 respectively. The average levels of 1974 and 1981 results appear to be consistently lower than that of 1974-81 results in Bangladesh including three divisions. This implies an improvement in mortality, and this improvement seems to be reasonable and plausible. The only exception in this case is the Rajshahi Division where the mortality situation appears to be stagnant. On the otherhand, the greater improvement in mortality has been found to have occurred in Chittagong Division. There is also evidence that a study based on PGE and BRSFM data produces rather similar estimates of mortality after correction for the completeness of death reporting, and indicate that adult mortality had declined somewhat from 1964-65 and 1973-74, the decline for males being somewhat larger than that for females (The Committee on Population, 1981).

Furthermore, the levels appear to decrease with the increase in age (age group 25-29 to 45-49), and this demonstrates a decreasing trend in mortality implied in the past.

In general, it should be mentioned that in countries where adult mortality has a declining trend, the levels obtained from the intercensal period tend to be higher (implying lower mortality) than those evaluated independently from information for each time point, since the later estimates refer to a rather long period in the past, while the period estimates refer strictly to the intercensal period.

The mortality levels to which each level estimated survivorship probabilities correspond in the Coale-Demeny west family model life tables have also been obtained and are shown in Table 7.3a (Chapter 7). The district mortality levels are not far from that of the divisions, suggesting that the adult mortality levels estimated from the widowhood are consistent and also plausible.

Since this chapter is devoted to produce period estimates which are of interest, by two methods, it is worth examining their performances. In an effort to throw light on this, the graphical representation of survivorship estimates corresponding to 1974-1981 obtained by the two methods have been shown in Figs 6.1-6.5. These figures reveal that the estimates up to age 35 appear to be the same, but the interesting feature is that the gap between the two estimates tends to increase after age 40. This kind of situation has also been observed in Bolivia, 1975,when the orphanhood methods are applied (UN 1983). It may be mentioned here that a study based on simulated cases in terms of the orphanhood method reveals that

Brass's method appears to perform as well as or better than the regression method for n not exceeding 30 years, whereas the regression yields substantially better estimates for higher values of n. Thus it is expected that since these methods tend to complement each other in the theoretical perspective, it may also complement each other in practical situations.

However, on examining the standard error and co-efficient of variation attached to the regression based estimates given in Hill's and Trussell paper, a different sort of explanation may be possible to be proposed about the error of prediction associated with the use of the regression equations. The highest standard errors are found to be associated with the regression equations for females in older age groups and demonstrate the fact that the goodness of fit of the linear model employed is relatively poorer in these cases. This explanation may be supported by the fact that although the fit of the model is extremely good, the values of R^2 appear to decrease from .994 to .986, indicating a consistent decline in R^2 from n of 40 to n of 60 (the range is .009). This situation can also be explained with the help of the analysis of the average relative error - roughly measured by co-efficient of variation. This measure shows that the technique produces the poorest results for females in the older age groups, where the relative error is 4.31 percent. It is interesting to note that the lowest relative error occurs in the age groups 20-24, 25-29 and 30-34, which represent the group of females for whom information can be obtained from a sample survey or census, such data tends to be generally most reliable. In these age groups, the relative errors appear to be below 2 percent. It may, therefore, be stated that the accuracy of the estimation procedure decreases as the respondents get older, i.e the longer the period of exposure to risks of mortality for males who have survived. It is obvious that the reduction in R^2 and the relative error associated with the old ages are negligibly small.

However, it is important to mention that the difference observed between the estimates produced by the two methods are extremely negligible, and so much confidence can be felt about both the estimates. Since the Hill and Trussell method gives relatively higher estimates at older ages, the estimated values based on this method have been used for further investigation.

It may be mentioned that both the methods of estimation were applied to nearly 1000 simulated cases that are not subject to the kind of errors usually observed in real situations by using different fertility and mortality schedules. This has been tested in relation to the orphanhood technique. The Brass method (1973) appears to produce results as well as or better than the regression method proposed by Hill Trussell (1977) for n not more than 30 years, whereas the regression method appears to give rise to considerably better results for higher values of n (U.N., 1983). But the reasons for this kind of results have not been mentioned. It can, however, be stated that the results produced by the regression methods are not obviously affected by age exaggeration, but these results should be considered as better results because Hill and Trussell used the model which represents well various observed female first marriage distributions from a variety of developing countries, whereas Hill used simple polynomials which represent the middle position between two extremes of the variations in the female first marriage distributions.

6.3 Conclusion

The present chapter describes the application of two methods of estimation of adult mortality for the period 1974-81 using widowhood information for Bangladesh, and its divisions and various districts. It is evident that the results are highly plausible and reasonably consistent. Both the methods are found to perform equally well; extremely negligible differences are observed between the estimates produced by them after certain age groups. Both the methods may, therefore, be regarded as powerful estimation procedures for the estimation of male adult mortality levels, and they seem to complement each other in a population like Bangladesh where data are subject to various sources of error. Further tests are necessary to show how far the results are consistent and reasonably accurate in comparison to other available estimates in Bangladesh, and this will be investigated in the next chapter (Chapter 7). In this case, the estimated values obtained by the Hill and Trussell method have been utilised.

However, while assessing the results, the various limitations of the method should be borne in mind. It has to be remembered that the method is based on the assumption that there is no relation between mortality experiences and marital status. This obviously has implications for the widowhood analysis.

Experience suggests that mortality is higher, probably as much as 50 percent higher, for the single population than the married population. It is also an established fact that mortality is higher amongst the widowed and divorced than amongst the married. This will tend to lower estimates of mortality by reducing the proportions widowed. The reason for this is that widows represent a small proportion of the population because widows are likely to die off faster than the married population. Another disturbing factor which also tends to produce underestimation of mortality, may be the existence of any relationship between the mortality risks of respondents and that of spouse. For an example, if a recent widow were more likely to die than a married person of the same age, commonly observed in developed countries, reports of widowhood would be reduced and hence mortality underestimated.

Furthermore, the concept of marriage and all possible interpretations, are likely to be sources of error. This is because the aim is to measure the mortality of the whole population, but the whole population is not infact covered. But in Bangladesh, marriage is universal and early, the widowhood estimates are, therefore, expected to represent the whole population. Broadly speaking, the results demonstrate improvement in mortality during the period covered, despite various errors present in the data.

Table 6.1

Co-efficients for estimation of conditional male survivorship probabilities from data on the widowhood status of female respondents.

Age	a(n)	b(n)	c(n)	d(n)
25	0.1082	-0.00209	0.00072	0.9136
30	-0.0284	-0.00465	0.00157	1.0822
35	-0.0159	-0.00638	0.00253	1.0831
40	0.0041	-0.00784	0.00395	1.0596
45	0.0152	-0.00953	0.00611	1.0324
50	0.0087	-0.01189	0.00925	1.0144
55	-0.0169	-0.01515	0.01353	1.0111
60	-0.0590	-0.01940	0.01880	1.0291

Source:- Manual x, Indirect Techniques for Demographic Estimator United Nations, 1983.

Table 6.2

Singulate mean age at marriage, females, Bangladesh, Divisions and Districts, 1974, 1981, and 1974-1981.

Area	1974	1981	1974-81
Bangladesh	16.5	16.7	16.6
Chittagong Div.	17.4	17.3	17.4
Chittagong H/T	18.53	18.5	18.52
Chittagong	17.5	17.6	17.55
Comilla	16.6	17.4	17.0
Noakhali	16.7	17.0	16.85
Sylhet	16.5	17.3	16.90
Dhaka Div.	16.9	16.9	16.9
Dhaka	15.8	17.2	16.5
Faridpur	16.6	17.0	16.8
Mymensingh	16.13	16.3	16.22
Tangail	16.5	16.7	16.6
Khulna Div.	16.0	16.6	16.30
Barisal	16.6	17.1	16.85
Jessore	15.8	16.4	16.1
Khulna	16.2	16.4	16.3
Kushtia	15.6	16.1	15.85
Patuakhali	16.1	16.4	16.25
Rajshahi Div.	15.7	16.1	15.9
Bogra	15.9	16.1	16.0
Dinajpur	15.7	16.1	15.9
Pabna	16.2	16.7	16.45
Rasjhahi	16.1	15.6	15.85
Rangpur	15.7	16.0	15.85

Source: Divisional Values of 1981 have been estimated Bangladesh and Division values of 1974 are taken from Table 2.2 and Table 2.7 (BRSFM Report 1974).

Table 6.3

Weights for converting proportions not widowed into life table survivorship ratios (female respondents).

(a) Mean age at female marriage:- 18 years

Male Mean	Central age of Women 20	25	30	35	40	45	50	55	60	65
19	0.4564	0.2573	0.2488	0.2209	0.1741	0.1102	0.0279	-0.0404	-0.1478	-0.2305
20	0.4928	0.3052	0.3100	0.3003	0.2771	0.2386	0.1802	-0.1299	0.0363	-0.0430
21	0.5232	0.3459	0.3648	0.3744	0.3749	0.3614	0.3259	0.2934	0.2137	0.1393
22	0.5481	0.3805	0.4142	0.4440	0.4683	0.4790	0.4657	0.4508	0.3853	0.3178
23	0.5678	0.4097	0.4590	0.5099	0.5580	0.5921	0.6002	0.6028	0.5521	0.4940
24	0.5830	0.4344	0.5006	0.5731	0.6447	0.7015	0.7303	0.7504	0.7154	0.6696
25	0.5945	0.4563	0.5404	0.6349	0.7294	0.8079	0.8568	0.8944	0.8767	0.8462
26	0.6038	0.4770	0.5799	0.6965	0.8131	0.9123	0.9807	1.0359	1.0375	1.0257
27	0.6120	0.4979	0.6205	0.7589	0.8966	1.0154	1.1027	1.1761	1.1994	1.2103

Source:- K. Hill (1977), Estimating Adult mortality levels from information on widowhood, Ps (1977).

Table 6.3

Weights for converting proportions not widowed into life table survivorship ratios (female respondents).

(b) Mean age at female marriage:- 22 years

Male Mean	Central age of Women 20	25	30	35	40	45	50	55	60	65
22	2.8983	0.7002	0.5121	0.4367	0.3235	0.1844	0.0291	-0.0997	-0.2547	-0.3663
23	2.8329	0.7180	0.5424	0.4851	0.3982	0.2902	0.1658	0.0617	0.0746	-0.1797
24	2.7839	0.7318	0.5682	0.5303	0.4703	0.3928	0.2980	0.2174	0.0992	0.0011
25	2.7490	0.7424	0.5910	0.5738	0.5409	0.4930	0.4263	0.3681	0.2677	0.1776
26	2.7243	0.7509	0.6127	0.6171	0.6113	0.5918	0.5516	0.5149	0.4319	0.3514
27	2.7054	0.7584	0.6347	0.6615	0.6823	0.6897	0.6745	0.6585	0.5930	0.5240
28	2.6871	0.7660	0.6582	0.7078	0.7544	0.7873	0.7957	0.7996	0.7521	0.6970
29	2.6659	0.7747	0.6837	0.7563	0.8277	0.8847	0.9155	0.9389	0.9104	0.8719
27	2.6407	0.7846	0.7112	0.8068	0.9019	0.9817	1.0340	1.0768	1.0690	1.0504

Table 6.3a

Weights for converting proportions not widowed into life table survivorship ratios (female respondents).

Age	21	22	23	24	25	26
25	.3459	.3805	.4097	.4344	.4563	.4770
30	.3648	.4142	.4590	.5006	.5404	.5799
35	.3744	.4440	.5099	.5731	.6349	.6965
40	.3749	.4683	.5580	.6447	.7294	.8131
45	.3614	.4790	.5921	.7015	.8079	.9123
50	.3259	.4657	.6002	.7303	.8568	.9807
55	.2934	.4508	.6028	.7504	.8944	1.0359
60	.2137	.3853	.5521	.7154	.8767	1.0375

Table 6.4

Calculation of populatoin weighted mean age at first marriage, (Bangladesh males, 1974 BRSFM).

Age Group	Population (000)	Proportion Single	Rate	New Age Group	Adjusted Population	Marriage (000)	Central Age
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
10-14	5,348	.987	.013	10.0-12.5	2,853	37	11.25
15-19	3,323	.945	.042	12.5-17.5	4,325	182	15
20-24	2,648	.656	.289	17.5-22.5	2,863	827	20
25-29	2,576	.240	.416	22.5-27.5	2,600	1082	25
30-34	2,101	.060	.180	27.5-32.5	2,336	420	30
35-39	2,073	.020	.040	32.5-37.5	2,079	83	35
40-44	1,724	.010	.010	37.5-42.5	1,919	19	40
45-49	1,368	.008	.002	42.5-47.5	1,534	3	45

$$\text{Mean} = \frac{\text{Sum of (7) X (8)}}{\text{Sum of (7)}}$$

Table 6.5

Weighted mean age at first marriage, Bangladesh and Divisions, 1974, 1981, and 1974-1981(Males).

Area	1974	1981	1974-81
Bangladesh	23.80	23.23	23.5
Chittagong Div	25.13	24.38	24.8
Dhaka Div	24.19	23.66	23.93
Khulna Div	23.03	22.65	22.84
Rajshahi Div	22.30	22.13	22.22

Table 6.6

Corrections for female mean age at first marriage

l(N+5)/l(22.5)		l(N+5)/l(27.5)	
Mean Age at First Marriage	Correction	Mean Age at First Marriage	Correction
15	0.6	20	0.4
16	0.4	21	0.2
17	0.2	22	-
18	-	23	-0.2
19	-0.2	24	-0.4
20	-0.4	25	-0.6

Source: Taken from 'Adult Mortality Levels from information on Widowhood' - K. Hill (PS, 1977).

Table 6.7

The estimation of male adult survivorship from widowhood: Female respondents, 1974, 1981 and 1974-1981.

Bangladesh

	1974				1981		
Age	Proportions Not widowed	N	W(N)	l(N+5)/ l(22.5)	Proportions Not widowed	W(N)	l(N+5)/ l(22.5)
20-24	.9583	25	.7295	.9536	.9604	.6746	.9547
25-29	.9408	30	.7923	.9312	.9430	.7273	.9315
30-34	.8948	35	.8605	.8870	.9007	.7825	.8890
35-39	.8386	40	.9274	.8322	.8471	.8353	.8327
40-44	.7507	45	.9796	.7492	.7598	.8740	.7507
45-49	.6765	50	1.0043	.6771	.6878	.8862	.6757
50-54	.5452	55	1.0209	.5474	.5817	.8923	.5735
55-59	.4394	60	.9827	.4371	.5056	.8448	.4855
60-64	.3062				.3758		

Bangladesh

1974-1981

Age	Proportions Not widowed	N	W(N)	l(N+5)/ l(22.5)
20-24	.9628	25	.7021	.9580
25-29	.9468	30	.7598	.9369
30-34	.9054	35	.8215	.8964
35-39	.8551	40	.8814	.8453
40-44	.7723	45	.9268	.7674
45-49	.7047	50	.9453	.6989
50-54	.5992	55	.9566	.5967
55-59	.5407	60	.9138	.5321
60-64	.4414			

Table 6.8

Dhaka Division

	1974				1981		
Age	Proportions Not widowed	N	W(N)	l(N+5)/ l(22.5)	Proportions Not widowed	W(N)	l(N+5)/ l(22.5)
20-24	.9611	25	.6588	.9564	.9619	.6470	.9564
25-29	.9473	30	.7286	.9347	.9462	.7081	.9341
30-34	.9010	35	.8055	.8914	.9046	.7741	.8950
35-39	.8517	40	.8816	.8412	.8622	.8387	.8472
40-44	.7629	45	.9428	.7593	.7692	.8887	.7614
45-49	.7001	50	.9756	.6966	.6992	.9113	.6886
50-54	.5556	55	.9992	.5555	.5802	.9261	.5757
55-59	.4543	60	.9677	.4504	.5188	.8864	.5035
60-64	.3333				.3837		

Dhaka Division

1974-1981

Age	Proportions Not widowed	N	W(N)	l(N+5)/ l(22.5)
20-24	.9635	25	.6519	.8583
25-29	.9487	30	.7164	.9364
30-34	.9055	35	.7868	.8968
35-39	.8646	40	.8560	.8522
40-44	.7786	45	.9106	.7727
45-49	.7129	50	.9373	.7050
50-54	.5873	55	.9556	.5850
55-59	.5359	60	.9191	.5278
60-64	.4353			

Table 6.9

Chittagong Division

	1974				1981		
Age	Proportions Not widowed	N	W(N)	l(N+5)/ l(22.5)	Proportions Not widowed	W(N)	l(N+5)/ l(22.5)
20-24	.9608	25	.5784	.9830	.9694	.5832	.9620
25-29	.9422	30	.6644	.9276	.9516	.6565	.9376
30-34	.8988	35	.7611	.8875	.9108	.7378	.9003
35-39	.8516	40	.8578	.8407	.8709	.8186	.8577
40-44	.7748	45	.9383	.7704	.7980	.8841	.7896
45-49	.7039	50	.9892	.7023	.7256	.9209	.7172
50-54	.5589	55	1.0286	.5613	.6191	.9480	.6156
55-59	.4737	60	1.0128	.4754	.5511	.9199	.5401
60-64	.3376				.4137		

Chittagong Division

	1974-1981			
Age	Proportions Not widowed	N	W(N)	l(N+5)/ l(22.5)
20-24	.9765	25	.5719	.9714
25-29	.9645	30	.6524	.9523
30-34	.9293	35	.7425	.9207
35-39	.8960	40	.8325	.8866
40-44	.8401	45	.9066	.8345
45-49	.7801	50	.9515	.7750
50-54	.6740	55	.9856	.6735
55-59	.6419	60	.9644	.6381
60-64	.5342			

Table 6.10

Khulna Division

	1974				1981		
Age	Proportions Not widowed	N	W(N)	l(N+5)/ l(22.5)	Proportions Not widowed	W(N)	l(N+5)/ l(22.5)
20-24	.9567	25	.8104	.9353	.9546	.6809	.9519
25-29	.9398	30	.8603	.9325	.9460	.7256	.9340
30-34	.8877	35	.9118	.8821	.9023	.7701	.8883
35-39	.8246	40	.9606	.8217	.8416	.8111	.8258
40-44	.7516	45	.9954	.7510	.7580	.8382	.7463
45-49	.6281	50	1.0041	.6285	.6857	.8399	.6686
50-54	.5362	55	1.0072	.5373	.5792	.8372	.5662
55-59	.4148	60	.9570	.4090	.4993	.7821	.4708
60-64	.2795				.3683		

Khulna Division

	1974-1981			
Age	Proportions Not widowed	N	W(N)	l(N+5)/ l(22.5)
20-24	.9561	25	.7439	.9532
25-29	.9447	30	.7900	.9362
30-34	.9041	35	.8367	.8957
35-39	.8526	40	.8801	.8440
40-44	.7805	45	.9095	.7735
45-49	.7030	50	.9133	.6969
50-54	.6331	55	.9124	.6275
55-59	.5697	60	.8587	.5565
60-64	.4760			

Table 6.11

Rajshahi Division

	1974				1981		
Age	Proportions Not widowed	N	W(N)	l(N+5)/ l(22.5)	Proportions Not widowed	W(N)	l(N+5)/ l(22.5)
20-24	.9537	25	.8493	.9505	.9547	.7634	.9492
25-29	.9323	30	.8876	.9274	.9314	.7987	.9217
30-34	.8886	35	.9238	.8834	.8831	.8306	.8703
35-39	.8200	40	.9552	.8150	.8077	.8573	.7934
40-44	.7075	45	.9729	.7062	.7073	.8703	.6978
45-49	.6606	50	.9661	.6559	.6339	.8592	.6213
50-54	.5229	55	.9564	.5178	.5445	.8460	.5288
55-59	.4063	60	.8953	.3907	.4427	.7820	.4181
60-64	.2569				.3298		

Rajshahi Division

1974-1981

Age	Proportions Not widowed	N	W(N)	l(N+5)/ l(22.5)
20-24	.9548	25	.8444	.9513
25-29	.9326	30	.8846	.9270
30-34	.8842	35	.9216	.8781
35-39	.8062	40	.9531	.8011
40-44	.6969	45	.9695	.6948
45-49	.6283	50	.9592	.6238
50-54	.5179	55	.9463	.5132
55-59	.4309	60	.8772	.4192
60-64	.3357			

Table 6.12

Singulate mean age at marriage for Bangladesh, division and district, Males.

District	1974	1981	1974-1981
Bangladesh	24.9	23.9	24.4
Chittagong Div	25.8	24.7	25.3
Chittagong H/T	23.82	24.1	23.97
Chittagong	25.8	25.7	25.75
Comilla	24.6	24.3	24.45
Noakhali	24.7	24.4	24.55
Sylhet	25.1	25.4	25.25
Dhaka Div	24.9	23.74	24.3
Dhaka	24.7	25.0	24.85
Faridpur	24.3	24.3	24.3
Mymensingh	23.6	23.1	23.34
Tangail	23.5	23.3	23.4
Khulna Div	23.9	22.98	23.4
Barisal	24.1	24.1	24.1
Jessore	22.7	21.9	22.3
Khulna	24.3	24.1	24.2
Kushtia	22.3	22.0	22.15
Patuakhali	22.8	22.8	22.8
Rajshahi Div	23.1	22.7	22.9
Bogra	22.6	22.4	22.5
Dinajpur	23.0	22.9	22.95
Pabna	23.5	23.3	23.4
Rajshahi	22.5	22.0	22.25
Rangpur	22.7	22.7	22.7

Source: Table 10: Singulate mean age at marriage by sex and districts 1974-81, population census national volume, 1981 For 1974, Table 2.2 and Table 2.7, BRSFM Report, 1974. For 1981, Division Values are Calculated.

Table 6.13

Survivorship probabilities for males, and west model levels, Bangladesh.

Age	Survivorship Probabilities			West Levels		
	1974	1981	1974-81	1974	1981	1974-81
25	.9671	.9679	.9707	12.5	12.7	13.6
30	.9521	.9520	.9573	15.6	15.6	16.5
35	.9110	.9136	.9206	14.1	14.4	15.2
40	.8617	.8652	.8764	13.3	13.5	14.4
45	.7851	.7865	.8034	11.8	11.9	12.8
50	.7291	.7289	.7519	12.1	12.0	13.1
55	.6213	.6416	.6676	10.8	12.6	12.5
60	.5412	.5867	.6341	11.1	12.7	14.5
Mean				12.9	13.2	14.1

Table 6.14

Survivorship probabilities for males, and west model levels, Dhaka Division.

Age	Survivorship Probabilities			West Levels		
	1974	1981	1974-81	1974	1981	1974-81
25	.9689	.9687	.9706	13.0	13.0	13.5
30	.9573	.9542	.9578	16.5	16.0	16.6
35	.9151	.9160	.9185	14.6	14.7	14.9
40	.8724	.8788	.8837	14.0	14.5	14.9
45	.7939	.7931	.8064	12.2	12.2	12.9
50	.7483	.7363	.7557	12.9	12.4	13.2
55	.6257	.6344	.6497	11.0	11.3	11.9
60	.5488	.5926	.6215	11.4	12.9	14.0
Mean				13.5	13.4	14.0

Table 6.15

Survivorship probabilities for males, and west model levels, Chittagong Division.

Age	Survivorship Probabilities 1974	1981	1974-81	West Levels 1974	1981	1974-81
25	.9682	.9755	.9822	12.8	15.2	17.6
30	.9508	.9598	.9742	15.4	17.0	19.7
35	.9119	.9227	.9436	14.2	15.4	17.7
40	.8719	.8888	.9170	14.0	15.3	17.6
45	.8069	.8251	.8713	12.9	13.9	16.7
50	.7545	.7675	.8272	13.2	13.8	16.8
55	.6337	.6812	.7433	11.3	13.1	15.7
60	.5760	.6369	.7397	12.3	14.6	18.6
Mean				13.4	14.8	17.4

Table 6.16

Survivorship probabilities for males, and west model levels, Khulna Division.

Age	Survivorship Probabilities 1974	1981	1974-81	West Levels 1974	1981	1974-81
25	.9660	.9622	.9645	12.1	11.1	11.7
30	.9518	.9543	.9549	15.6	16.0	16.1
35	.9040	.9136	.9185	13.5	14.4	14.9
40	.8468	.8565	.8722	12.3	12.9	14.0
45	.7847	.7800	.8086	11.8	11.5	13.0
50	.6767	.7195	.7445	9.9	11.6	12.7
55	.6064	.6282	.6929	10.3	11.0	13.5
60	.5068	.5648	.6510	9.9	11.9	15.2
Mean				12.2	12.6	13.7

Table 6.17

Survivorship probabilities for males, and west model levels, Rajshahi Division.

Age	Survivorship Probabilities			West Levels		
	1974	1981	1974-81	1974	1981	1974-81
25	.9633	.9631	.9638	11.4	11.3	11.5
30	.9438	.9403	.9429	14.2	13.4	14.1
35	.9048	.8953	.8983	13.5	12.6	12.9
40	.8411	.8234	.8242	11.9	10.8	10.8
45	.7371	.7307	.7231	9.4	9.1	8.8
50	.7058	.6703	.6688	11.1	9.6	9.5
55	.5865	.5969	.5757	9.5	9.9	9.1
60	.4888	.5110	.5065	9.3	10.0	9.9
Mean				11.6	11.0	11.0

Table 6.18

Survivorship probabilities for males, Dhaka Division.

Faridpur District

Age	Age	1974 Census	1981 Census	1974-81
20-24	25	.9669	.9704	.9719
25-29	30	.9541	.9558	.9619
30-34	35	.9135	.9180	.9262
35-39	40	.8674	.8770	.8887
40-44	45	.7760	.7903	.8081
45-49	50	.7230	.7305	.7595
50-54	55	.5987	.6328	.6613
55-59	60	.5414	.5928	.6453

Table 6.19

Dhaka District

Age	Age	1974 Census	1981 Census	1974-81
20-24	25	.9693	.9685	.9712
25-29	30	.9606	.9547	.9612
30-34	35	.9286	.9183	.9261
35-39	40	.9036	.8860	.8939
40-44	45	.8197	.8056	.8086
45-49	50	.7759	.7529	.7567
50-54	55	.6530	.6593	.6556
55-59	60	.6378	.6221	.6394

Table 6.20

Tangail District

Age	Age	1974 Census	1981 Census	1974-81
20-24	25	.9716	.9696	.9699
25-29	30	.9588	.9547	.9544
30-34	35	.9270	.9184	.9171
35-39	40	.8963	.8893	.8835
40-44	45	.8211	.8097	.8029
45-49	50	.7622	.7513	.7406
50-54	55	.6549	.6553	.6419
55-59	60	.6337	.6079	.6043

Table 6.21

Mymensingh District

Age	Age	1974 Census	1981 Census	1974-81
20-24	25	.9687	.9691	.9696
25-29	30	.9619	.9555	.9583
30-34	35	.9188	.9162	.9155
35-39	40	.8898	.8755	.8770
40-44	45	.8134	.7861	.7838
45-49	50	.7676	.7304	.7174
50-54	55	.6408	.6219	.5949
55-59	60	.6098	.5811	.5546

Table 6.22

Survivorship probabilities for males, Chittagong Division

Sylhet District

Age	Age	1974 Census	1981 Census	1974-81
20-24	25	.9758	.9770	.9777
25-29	30	.9588	.9601	.9637
30-34	35	.9164	.9183	.9251
35-39	40	.8714	.8740	.8848
40-44	45	.7832	.7983	.8113
45-49	50	.7365	.7022	.7336
50-54	55	.5960	.6117	.6159
55-59	60	.5668	.5736	.5951

Table 6.23

Noakhali District

Age	Age	1974 Census	1981 Census	1974-81
20-24	25	.9756	.9755	.9776
25-29	30	.9597	.9612	.9644
30-34	35	.9270	.9259	.9320
35-39	40	.9046	.8970	.9050
40-44	45	.8411	.8420	.8461
45-49	50	.8134	.8044	.8140
50-54	55	.7198	.7185	.7253
55-59	60	.7068	.6838	.6994

Table 6.24

Comilla District

Age	Age	1974 Census	1981 Census	1974-81
20-24	25	.9751	.9758	.9763
25-29	30	.9649	.9595	.9639
30-34	35	.9238	.9238	.9269
35-39	40	.8986	.8895	.8985
40-44	45	.8347	.8254	.8336
45-49	50	.7952	.7737	.7844
50-54	55	.6779	.6770	.6802
55-59	60	.6574	.6362	.6544

Table 6.25

Chittagong District

Age	Age	1974 Census	1981 Census	1974-81
20-24	25	.9769	.9747	.9731
25-29	30	.9599	.9598	.9561
30-34	35	.9236	.9343	.9211
35-39	40	.9020	.8977	.8966
40-44	45	.8202	.8394	.8334
45-49	50	.7920	.7938	.8044
50-54	55	.6642	.7252	.7292
55-59	60	.6165	.6552	.7045

Table 6.26

Chittagong H/T District

Age	Age	1974 Census	1981 Census	1974-81
20-24	25	.9649	.9668	.9648
25-29	30	.9558	.9510	.9510
30-34	35	.9260	.9228	.9189
35-39	40	.9052	.9032	.8964
40-44	45	.8716	.8634	.8556
45-49	50	.8477	.8419	.8273
50-54	55	.7339	.7503	.7287
55-59	60	.6206	.7535	.7253

Table 6.27

Survivorship probabilities for males, Rajshahi Division

Rangpur District

Age	Age	1974 Census	1981 Census	1974-81
20-24	25	.9671	.9581	.9578
25-29	30	.9480	.9321	.9259
30-34	35	.9042	.8810	.8670
35-39	40	.8206	.8031	.7773
40-44	45	.7088	.7009	.6701
45-49	50	.6939	.6432	.6197
50-54	55	.5609	.5368	.4925
55-59	60	.5154	.4874	.4393

Table 6.28

Rajshahi District

Age	Age	1974 Census	1981 Census	1974-81
20-24	25	.9624	.9663	.9668
25-29	30	.9463	.9468	.9502
30-34	35	.9017	.9054	.9072
35-39	40	.8324	.8362	.8389
40-44	45	.7309	.7495	.7508
45-49	50	.6982	.6802	.6972
50-54	55	.5591	.6702	.6564
55-59	60	.4911	.5163	.5819

Table 6. 29

Pabna District

Age	Age	1974 Census	1981 Census	1974-81
20-24	25	.9632	.9643	.9669
25-29	30	.9445	.9426	.9486
30-34	35	.9145	.9058	.9134
35-39	40	.8557	.8462	.8505
40-44	45	.7603	.7644	.7641
45-49	50	.7317	.7164	.7261
50-54	55	.6226	.6207	.6242
55-59	60	.5837	.5659	.5783

Table 6.30

Dinajpur District

Age	Age	1974 Census	1981 Census	1974-81
20-24	25	.9661	.9645	.9643
25-29	30	.9469	.9408	.9409
30-34	35	.8993	.8922	.8902
35-39	40	.8264	.8124	.8094
40-44	45	.7188	.7156	.7060
45-49	50	.6758	.6532	.6491
50-54	55	.5510	.5580	.5427
55-59	60	.4669	.4942	.4882

Table 6.31

Bogra District

Age	Age	1974 Census	1981 Census	1974-81
20-24	25	.9665	.9665	.9666
25-29	30	.9504	.9471	.9485
30-34	35	.9060	.9041	.9040
35-39	40	.8386	.8361	.8363
40-44	45	.7441	.7412	.7419
45-49	50	.7286	.6802	.6881
50-54	55	.6122	.5697	.5415
55-59	60	.5226	.5032	.4576

Table 6.32

Survivorship probabilities for males, Khulna Division

Patuakhali District

Age	Age	1974 Census	1981 Census	1974-81
20-24	25	.9618	.9654	.9676
25-29	30	.9506	.9608	.9664
30-34	35	.9000	.9196	.9319
35-39	40	.8485	.8675	.8933
40-44	45	.7478	.7913	.8245
45-49	50	.6927	.7296	.7921
50-54	55	.5867	.6247	.7029
55-59	60	.5016	.5723	.6702

Table 6.33

Kushtia District

Age	Age	1974 Census	1981 Census	1974-81
20-24	25	.9586	.9589	.9595
25-29	30	.9586	.9508	.9545
30-34	35	.9066	.9136	.9122
35-39	40	.8498	.8615	.8672
40-44	45	.7695	.7840	.7999
45-49	50	.7125	.7293	.7581
50-54	55	.6322	.6274	.6720
55-59	60	.5320	.5639	.6045

Table 6.34

Khulna District

Age	Age	1974 Census	1981 Census	1974-81
20-24	25	.9588	.9611	.9639
25-29	30	.9482	.9526	.9581
30-34	35	.9037	.9129	.9214
35-39	40	.8409	.8528	.8676
40-44	45	.7522	.7794	.7996
45-49	50	.6872	.7158	.7535
50-54	55	.6068	.6424	.6958
55-59	60	.5525	.5692	.6465

Table 6.35

Jessore District

Age	Age	1974 Census	1981 Census	1974-81
20-24	25	.9588	.9615	.9630
25-29	30	.9531	.9522	.9592
30-34	35	.9091	.9106	.9197
35-39	40	.8462	.8515	.8649
40-44	45	.7653	.7684	.7900
45-49	50	.7109	.7010	.7326
50-54	55	.5962	.6010	.6312
55-59	60	.5175	.5296	.5744

Table 6.36

Barisal District

Age	Age	1974 Census	1981 Census	1974-81
20-24	25	.9596	.9651	.9678
25-29	30	.9527	.9583	.9675
30-34	35	.9033	.9166	.9301
35-39	40	.8507	.8618	.8858
40-44	45	.7542	.7884	.8162
45-49	50	.7231	.7398	.7946
50-54	55	.6039	.6499	.7073
55-59	60	.5725	.6096	.7049

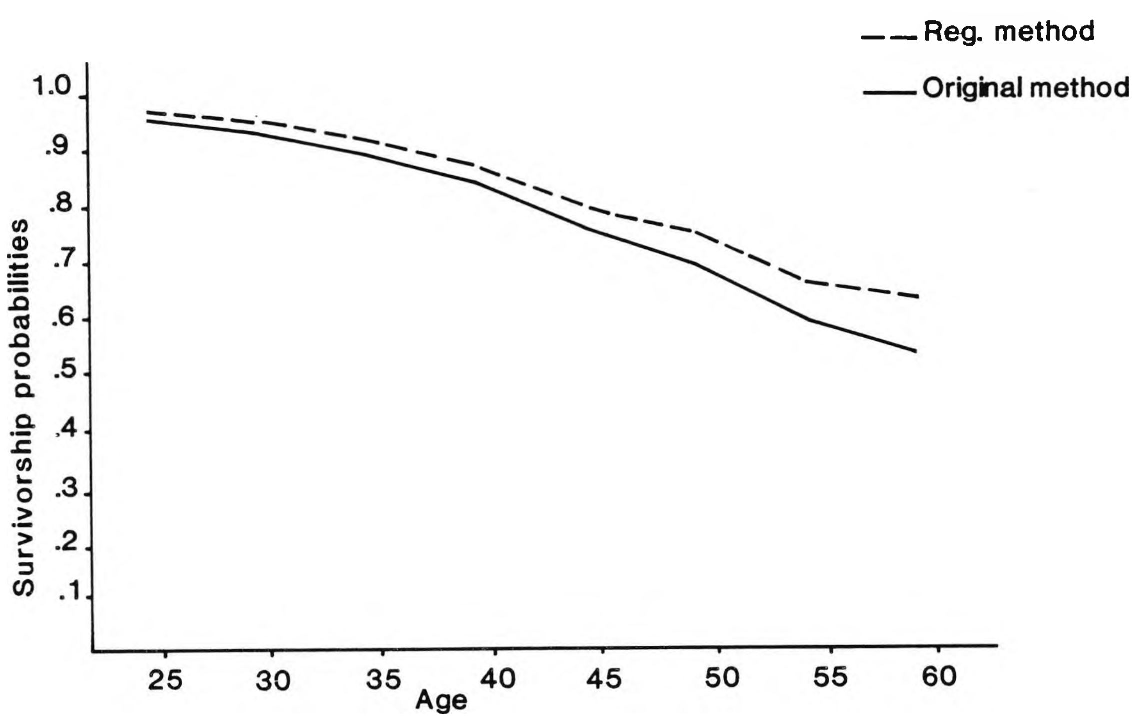

Fig :6.1 Survivorship probabilities of males, by two methods, Bangladesh, (1974-1981)

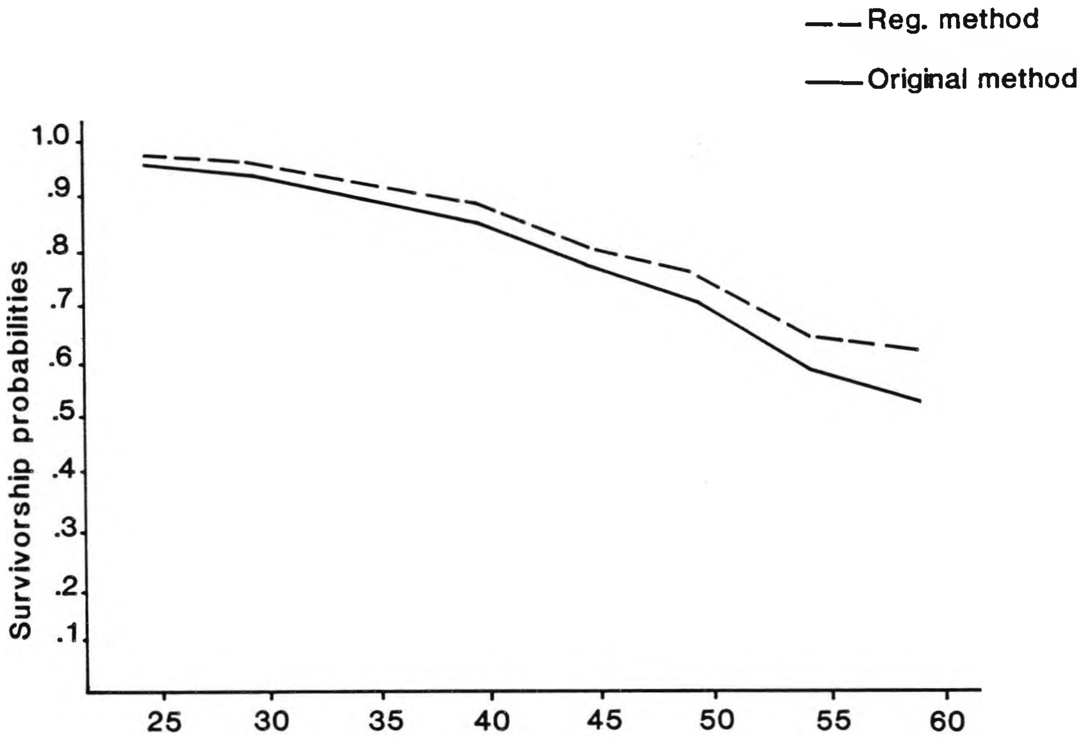

Fig :6.2 Survivorship probabilities of males, by two methods, Dhaka Division, (1974-1981)

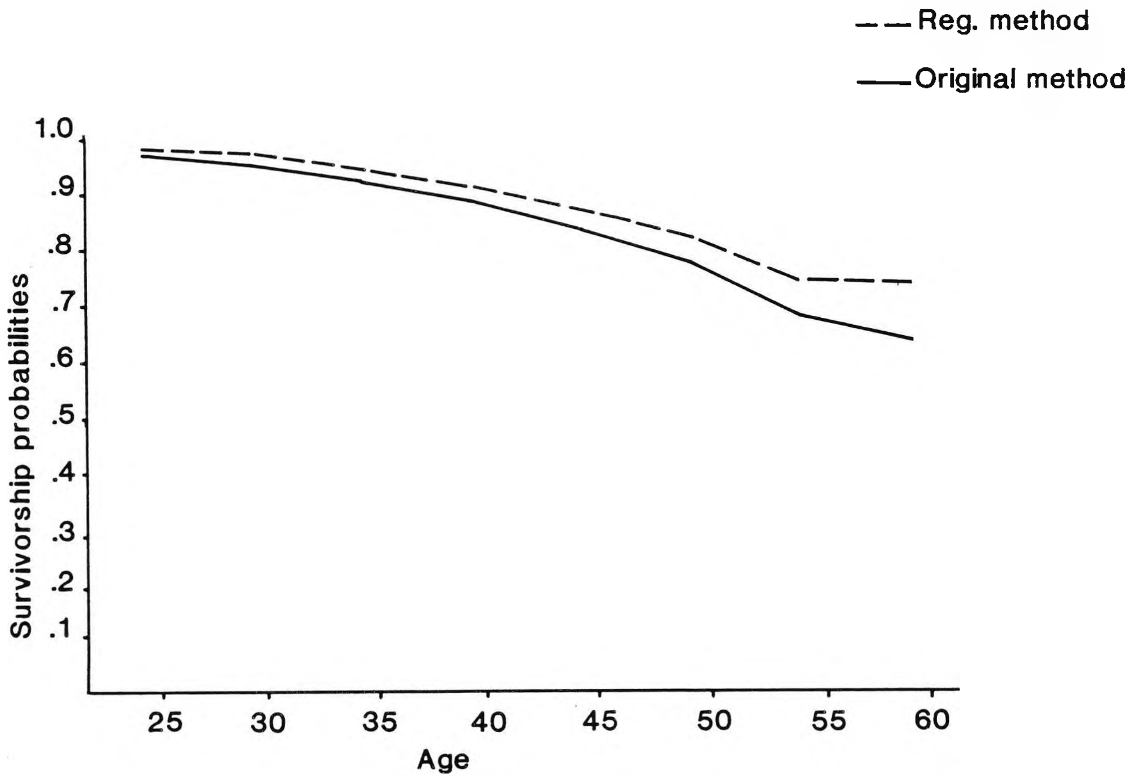

Fig :6.3 Survivorship probabilities of males, by two methods, Chittagong Division (1974-1981)

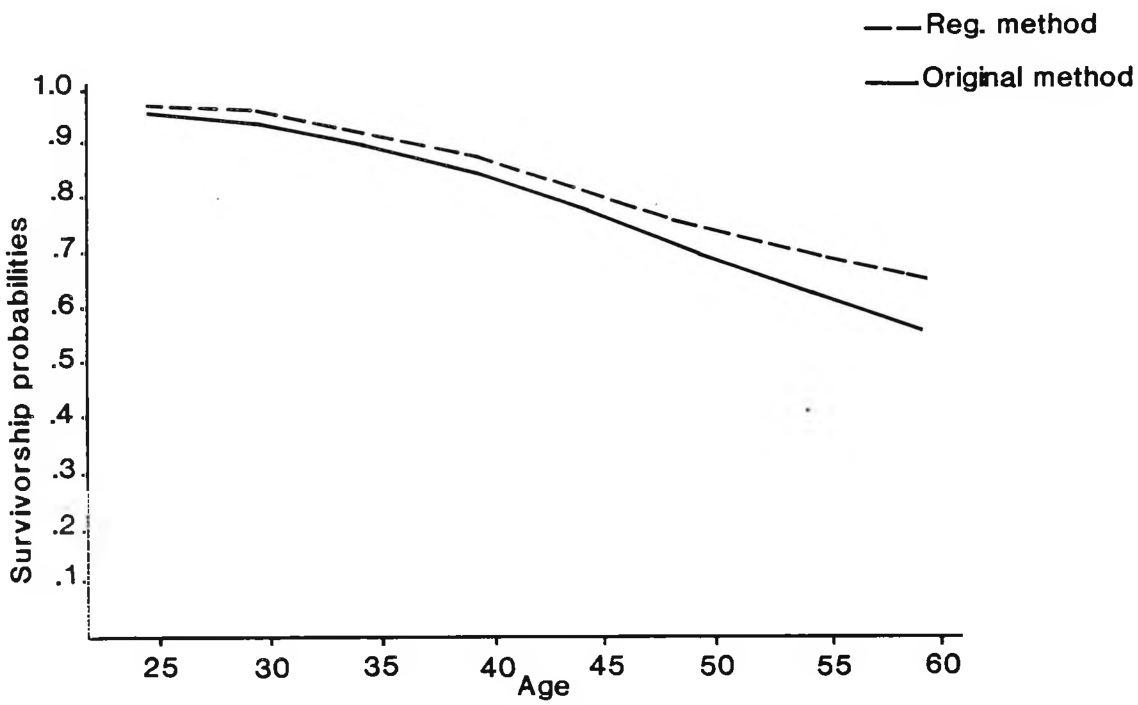

Fig :6.4 Survivorship probabilities of males, by two methods, Khulna Division (1974-1981)

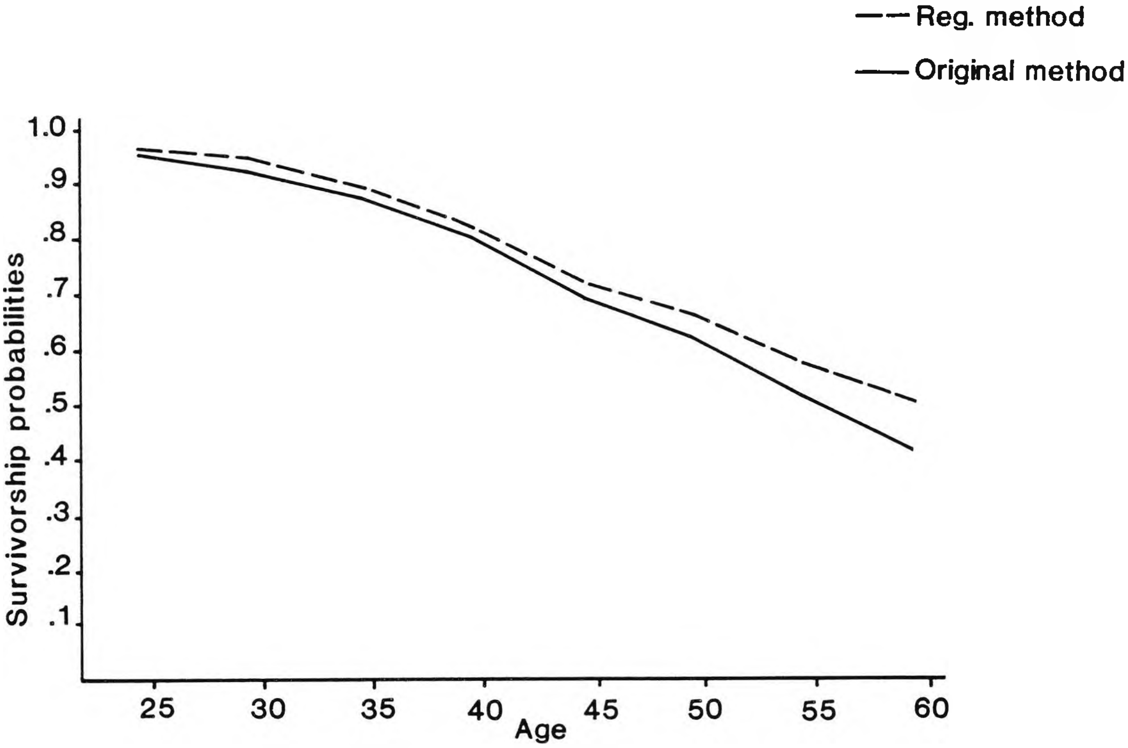

Fig :6.5 Survivorship probabilities of males, by two methods, Rajshahi Division (1974–1981)

CHAPTER 7

Derivation of a Smooth Life Table from a set of Survivorship Probabilities

7.1 Introduction

In fact there are a number of situations in which it is possible to obtain estimates of life table survivorship probabilities l(x), but it is still necessary to smooth these estimates with reference to a model life table. For instance, it is possible to construct a life table directly by transforming observed ${}_nm_x$ values into ${}_nq_x$ and hence into l(x) values. In other instances, even if the l(x) values are available, they may not define a complete life table because some l(x) values are applicable to childhood and some to adult ages (as those estimated from the widowhood method). This means that the estimates of the child survivorship probabilities are required for the construction of a life table, and these are possible to be estimated from information on children everborn and children surviving.

In another situation, it may be necessary to derive complete sets of life table survivorship probabilities l(x) from childhood mortality estimates and conditional survivorship probabilities related to adults (the probability of surviving from age x to age x+n, l(x+n)/l(x)). The later probabilities can usually be obtained from information on the widowhood or orphanhood status or by the use of some death distribution method, which have already been mentioned. In this study, it is to be noted that conditional survivorship probabilities for adult ages have been estimated using the widowhood technique (Chapter 6).

The Brass method has been used to estimate childhood survivorship probabilities, and then the two components have been combined to derive complete sets of life tables with reference to a model life table.

7.2 Method to Estimate Childhood Mortality

An indirect method can be used to obtain infant and child mortality by using information on children ever born and children surviving per woman. The method originally developed by Professor Brass (1975), uses proportions of children dead and employs a set of multipliers to transform these proportions into the probabilities of dying before ages 1, 2, 3, and 5 etc.

The Brass multipliers are based on the fact that the association between proportions of children dead and q(i), the probability of dying is affected primarily by the fertility pattern and particularly by the age at which childbearing begins. Sullivan (1972) and Trussell (1975) have also developed, using regression analysis, estimation equations of their own. These later studies are basically based on the same principle but their data bases vary from each other. However, any of the methods can be readily applied, and the assumption in the methods which states that fertility and childhood mortality have remained constant over the past few years preceding the estimation, applies to each method.

Table 7.1 shows the Brass type estimates of child mortality; one from the nationwide survey and one from the sample registration system of Bangladesh. Also provided in Table 7.1 are levels of mortality implied by q(x) estimates compared with those in the Coale and Demeny "West" model tables. Since age-specific estimates of child mortality were based on the reports of different cohorts of women, their date of reference also varies with age. But the time reference has not been computed here.

The most important aspect of the estimates shown in Table 7.1 is that comparisons of q(x) estimates within and between surveys fail to reveal any sign of decline in the past as well as within the period under investigation. The estimates of q(1) are not presented here because they are typically biased upward due to the age of mother and birth-order differences in childhood mortality. On the other hand, the estimates of q(x) for higher ages are also not shown because they are affected by a selective omission of girls by the older women. However, the estimates for ages 2, 3, and 5 from the same survey display more or less constant levels of mortality and the estimates for the same age, over time, also show a constant mortality level. The finding about child mortality is similar to that of Chapter 3, which suggests that the child mortality remained more or less constant during 1974-1981. Moreover, the estimates show a very consistent sex differential, female children experience better survival prospects, a common phenomenon in most populations.

It may be mentioned that Preston et al (1984) compared three nationwide surveys of India and demonstrated that the probability of dying before age 2 which was expressed by the graduated q(2), declined from a value of .215 in 1961 to a value of 0.164 in 1968, with a further decrease to about 0.143 in the mid-1970's.

Tables 7.2a-7.2e show the male child mortality levels for Bangladesh and various divisions for 1974 and also levels of mortality compared with those in the Coale and Demeny model tables. These tables reveal that the estimates of q(x) do not demonstrate any sign of decline in the past, but they indicate a more or less constant level of mortality for males in Bangladesh.

However, the estimates of q(x) are very high in Bangladesh. This pattern is comparable to that of many parts of Tropical Africa.

Another interesting aspect to note that child mortality varies little across the geographical regions of Bangladesh.

7.3 Logit Model

Having derived estimates both of child mortality and of adult mortality, the next step is to combine them together by reference to model life tables. For this purpose, the Brass's two-parameter model life table system has been used (Brass et al, 1968). In this system, the first parameter, α, measures the general level of mortality, and the second parameter, β, measures the association between adult and child mortality - i.e. the "steepness" with which the mortality rates increase with age. On the basis of these given parameters, the whole model life table can be expressed as follows:

$$Y(x) = \alpha + \beta_s (x)$$

where

$Y(x)$ = the logit of life table survivors at age x in the model to be constructed = $1/2 \log_e \frac{1-l(x)}{l(x)}$

$Ys(x)$ = the corresponding logit in a "standard" life table.

$$= 1/2 \log_e \frac{1-ls(x)}{ls(x)}$$

It may be mentioned that any life table may be considered as the standard and in this study Brass's "general standard" has been used (Brass, 1971). Both α and β may be obtained from the knowledge of the two values of life table survivors, one related to children and another one to adults.

Since one of the probabilities is conditional, the values of these parameters have to be determined iteratively. The steps of the computational procedure are given below (UN, 1983).

Step 1: Initial estimate of parameter α. In the first iteration, an estimate of α_1 is determined by assuming that β_1 =1.0. Furthermore, if it can be assumed that the estimates of l(2), l(3) and l(5) are reasonably accurate, α_1, can then be obtained as follows:-

$$\alpha_1 = Y\ (2,\ 3,\ 5) - Ys\ (2,\ 3,\ 5)$$

where Y (2, 3, 5) = the mean of the logit transformation of l(2), l(3) and l(5)

Ys (2, 3, 5) = the mean of the logit transformation of the general standard life table values ls(2), ls(3) and ls(5).

Step 2: Initial estimate of survivorship probability appearing as denominator. Using the value of α_1 , estimated in step 1 and assuming that β_1 = 1.0, a first estimate of the survivorship probability, l(y), denoted by l_1 (y=20) can be derived as follows:

$$l_1\ (20) = [1.0 + \exp\ \{2\ \alpha_1 + 2\ Ys\ (20)\}]^{-1}$$

Step 3: Initial estimates of survivorship probabilities from birth. Using l_1 (20), initial estimates of the survivorship probabilities from birth, l(x), for each value of x can be calculated as follows:

$$l_1(x) = \frac{l(x)}{l(20)} l_1(20)$$

Step 4: modified estimate of parameter β. This can be obtained as follows:

$$\beta_2(x) = \frac{Y(x) - Y(2, 3, 5)}{Ys(x) - Ys(2, 3, 5,)}$$

A single estimate of β_2 has been derived by taking the average of all β_2 (x) values.

Step 5: A second estimate of parameters α. Step 1 has been repeated, but the estimate of β_2 has been utilized. Thus, α_2 has been obtained as:

$$\alpha_2 = Y(2, 3, 5) - \beta_2 \; Ys(2, 3, 5)$$

Step 6: Second estimate of survivorship probability to age 20. Step 2 is now repeated, but the values of α_2 and β_2 have been used.

Thus

$$l_2(20) = [1.0 + \exp\{2\alpha_2 + 2\beta_2 Ys(20)\}]^{-1}$$

Step 7 and onward: Further iteration. The iterative procedure has been continued by repeating Step 3 to derive a second set of estimates of l(x), then repeating step 4 to obtain a revised estimate of β, then re-estimating α in Step 5 and l(y) in Step 6 using the new values of α and β, and so on, until the estimates of β tend to converge.

The final estimate of β has been arrived at by the first six iterations. The value of α corresponding to the final estimate of β is then obtained.

Final Step: Using the final estimates of α and β, the estimated function of the fitted life table, $l^*(x)$ can be calculated as:

$$l^*(x) = [1.0 + \exp\{2\alpha^* + 2\beta^* Ys(x)\}]^{-1}$$

where α^* and β^* are the final estimates.

It is, however, important to note that no single procedure always works best; others may appear plausible. It has, therefore, been suggested that as many techniques as possible may be tried for a particular data set in order to assess the validity of the results, and hence the underlying data.

However, the Coale-Demeny model life tables have also been used in this study (UN, 1983).

7.4 Coale and Demeny Model Life Tables System

Coale and Demeny proposed a one-parameter model life tables system (Coale and Demeny, 1966). In such a table, any survivorship probability, whether from birth or conditional on having reached a certain age, uniquely defines a life table, when a family of model life table has been chosen. Thus, each child survivorship probability from birth as well as each conditional survivorship probability of the type l(x)/l(y) represents a life table. The information on the two mortality components can be combined together by selecting the life table according to the average level of the child mortality estimates up to age y and then constructing the life table over age y by employing the conditional probabilities of survivorship from age y which tends to be consistent with the average level as indicated by the adult survivorship estimates.

The analysis has been carried out in the following steps.

Step 1: The levels of mortality implied by the q(x) estimates compared with those in Coale-Demeny family of model life tables have been calculated for Bangladesh and various divisions, for males and their average levels are shown in Table 7.2a-7.2e. In this case, BRSFM, 1974 child mortality data have been used.

Step 2: Table 7.3 shows the average adult mortality levels of Bangladesh and divisions, to which each estimated survivorship probability corresponds in the Coale-Demeny various families of model life tables. These levels have been estimated by linear interpolation. It should be noted that the average levels have been obtained by considering the age group from 25 to 55. The average adult mortality levels of various districts are shown in table 7.3a. The results are not far away from the divisional pattern, suggesting that the estimates are consistent.

Step 3: The average levels of male child mortality, calculated in Step 1, have been used to construct life tables for Bangladesh and divisions up to age 20, by linear interpolation (when necessary), and from age 20, the life tables have been completed by using the average adult mortality levels by applying the survivorship probabilities from age 20. The latter values have been calculated up to age 60 using linear interpolation. The life tables beyond age 60 have been calculated by assuming the adult mortality levels valid for the old ages.

Table 7.4 shows the estimates of $\alpha*$ and $\beta*$ produced by the iterative procedure. Several points can be made in favour of the application of the model. First, the final estimates of $\alpha*$ and $\beta*$ are not very far from the neutral values of 0.0 and 1.0, suggesting that the selected standard tends to represent a better model of the survivorship estimates which are being chained together. Secondly, the range of the estimates of β shown in Table 7.4a do not seem to vary much from the first iteration to the last iteration, which suggests that the estimates of β with age are fairly consistent and reasonable.

However, it may be concluded that the pattern of the standard represents fairly adequately the various mortality levels that have persisted in the past. Alternative estimation methods have also been used to check the validity of the method.

The estimates of $\beta*$ for various cultural divisions of Bangladesh range from 0.59 to 1.00, and the estimates of $\beta*$ for various districts vary from 0.66 to 1.19. However, the overall pattern of adult mortality in Bangladesh is relatively lower in relation to infant and child mortality (β < 1.0).

The Bangladesh adult mortality pattern, seems to conform to that of the South-eastern part of Africa (Blacker, 1977).

The resulting $l^*(x)$ values for Bangladesh generated by the logit model as well as by the Coale-Demeny model life tables are shown in Table 7.5. The resulting $l^*(x)$ values for the various geographical divisions are shown in Tables 7.6a-7.6d respectively. The $l^*(x)$ curves for Bangladesh and various divisions are provided in figures 7.1-7.5.

The life tables shown in columns 2 of Tables 7.5 and 7.6a-7.6d implied by the α^* and β^* values are more or less similar at all ages to the life tables shown in columns 3-6 of the same table generated by the Coale-Demeny model life table systems. The slight discrepancy is observed in case of the "North" model which shows relatively higher mortality from age 4 to 60 and relatively lower mortality from age 65 onwards.

Further, it may be noted that the results produced by the logit model which is based on the general standard and the west model appear to be fairly close, which is a further indication of the consistency of the estimates derived from the logit model based on the general standard.

It may be mentioned that the mortality pattern of the general standard is fairly similar to that of the west family of the Coale-Demeny models, which are likely to produce similar results based on two methods.

These life tables for Bangladesh and various divisions and districts are rough indicators of male mortality conditions for the period 1974-1981. They have been based on the indicators of the child mortality level and of the general relationship between child and adult mortality.

The results produced by the various models appear to be very close, suggesting that the estimates are consistent. However, the logit life table gives more consistent values than those of the Coale-Demeny model life tables (Figures 7.1-7.5). From the figures it is evident that the logit model values lie between west model and south-east model values. This suggests that, if the prevailing mortality pattern is unknown, the use of the logit model is the safest course. In addition, the logit model provides relatively higher expectations of life at birth for Bangladesh and various divisions than that of the

Coale-Demeny model life tables (Table 7.6e). They show the highest expectations of lie at birth for Chittagong division (51.2) and the lowest for the Rajshahi division (43.2), suggesting wide differentials in expectations of life at birth among various divisions. This result is expected because the Rajshahi division is the least advanced in education and least urbanised area. On the otherhand, the Chittagong division ranks the second position in education and urbanisation and is vastly industrialised area.

The life expectancy at the age of 5 also varies among divisions, indicating the highest expectations at the age of 5 for the Chittagong division and the lowest for the the Rajshahi division. The results appear to be consistent.

Table 7.7 shows the estimates of the life expectancy at birth of selected ages derived from the logit model based on the general standard and the other estimates obtained from various sources. It is interesting to note that the intercensal estimates for the period 1974-1981 appear to be lower than both the estimates of Cholera Research Laboratory, Matlab in Comilla District of Bangladesh and the estimates of National Vital Sample Registration System conducted by the BBS. It may be mentioned that the studies like DSEP, 1960-1961 and CRL, Matlab are not regarded as nationally representative of the whole of Bangladesh, the CRL areas particularly being a small rural population of Bangladesh where a special Kind of medical services is provided to the population. Furthermore, it has already been discussed in Chapter 3 that the VRS data are subject to under enumeration, specially of female children, which suggests lower mortality and in turn higher expectation of life at birth. The intercensal estimates are also lower than that of the National Academy of Science, 1974, which may be because of the entirely different methodology adopted.

However, the Table 7.7 suggest adult mortality decline in Bangladesh from 1960-1974. The trend is found to continue during the period 1974-1981.

Another point to note is that the expectation of life at age 5 is estimated as 55.6 for Bangladesh, which agree well with the estimated figure at the same age for female (53.74) obtained by Kabir et al (1985). This has been discussed in detail in Chapter 1. This differential by sex as expected suggests that the intercensal estimates based on the generalised stable population relations are plausible.

Furthermore, $l^*(x)$ values for various districts have been estimated based on logit model and are shown in Tables 7.8a-7.8d respectively.

The expectations of life for various age groups for Bangladesh as a whole and divisions are shown in Table 7.9. This table displays the existence of remarkable variation in the adult mortality levels of Bangladesh divisions. The expectations of life for various districts for various ages shown in Table 7.10a-7.10d, which reveal that the Patuakhali district of Bangladesh appears to witness the highest expectation of life at birth (49.7), While Dinajpur district witnesses the lowest expectation of life at birth (41.8).

The results are not very unexpected. The highest expectation of life at birth is found to be experienced by Patuakhali (49.7) which is not very far from Noakhali (49.5) district which belongs to the Chittagong division. The Chittagong division experiences the highest expectation of life at birth. It should be mentioned that Dinajpur district belongs to the Rajshahi division, where the expectation of life at birth is the lowest. The slight discrepancies observed in the results may be expected because they are based on various assumptions and the data on which the methods are based are also not free from errors.

7.5 Conclusion

Child mortality has been estimated from children-ever born and children surviving for males and females for 1974 and 1981 by using the Brass method, and the estimates of q(x) show no obvious trend. The estimates of q(x) for various geographical divisions suggest little variation among them. The estimates of q(x) are however, consistent.

Various methods have been applied to link child mortality with adult mortality in order to produce life tables for Bangladesh and divisions. The results produced by these methods are consistent, although the logit model appears to give more consistent estimates of l*(x) which are also plausible. The logit model suggests that the expectation of life at birth for Bangladesh is around 47, and the expectations of life at birth for Chittagong, Dhaka, Khulna and Rajshahi Divisions are 51, 46, 48 and 43 respectively. However, the Chittagong Division experiences the highest expectation of life at birth, while the Rajshahi Division experiences the lowest. The district level estimates are also consistent.

The intercensal estimate of the expectation of life at birth appear to be relatively lower than the other estimates of the same period. However, one comment can be mentioned here. Caldwell (1986) observes that "by 1982, of 29 predominantly Muslim countries among the 99 third world countries, one (Bangladesh) had received a mortality ranking much better than its income ranking (a life expectancy of 48 years but better than most countries with twice its per capita income)." The intercensal estimate for 1974-1981, whether it is plausible or not, will be carried out in the next chapter.

Furthermore, the various estimates of the expectations of life at age 5 and over suggests some improvement in adult mortality during the past decades, and the trend seems to have persisted during 1974-1981, which may be evident from the comparison of the intercensal estimates of 1974-1981 at selected ages with that of BRSFM, 1974.

Table 7.1

Brass-Type Estimates of Child Mortality of Bangladesh.

	BRSFM, 1974				BBS, 1982			
Age	Male		Female		Male		Female	
(x)	q (x)	West Level	q (x)	West Level	q (x)	West Level	q (x)	West Level
2	.206	11.3	.190	10.8	.331	6.0	.185	11.1
3	.218	11.5	.196	11.5	.192	12.7	.182	12.1
5	.232	11.7	.216	11.4	.218	12.3	.206	11.9
Mean		11.5		11.2		10.3		11.7

Table 7.2a

Levels of Child Mortality Estimates (Brass Method), Male Children, Bangladesh, BRSFM, 1974.

Age Group	Age	q(x)	l (x)	West	North	South	East
20-24	2	.206	.794	11.3	10.3	12.1	13.0
25-29	3	.218	.782	11.5	11.0	12.7	13.0
30-34	5	.232	.768	11.7	11.8	12.9	13.0
Mean				11.5	11.0	12.6	13.0

Table 7.2b

Levels of Child Mortality Estimates (Brass Method), Male Children, BRSFM, 1974, Dhaka Division.

Age Group	Age	q(x)	l (x)	West	North	South	East
20-24	2	.2141	.7859	10.9	9.9	11.7	12.6
25-29	3	.2208	.7792	11.4	10.8	12.6	12.9
30-34	5	.2426	.7574	11.3	11.3	12.5	12.6
Mean				11.2	10.7	12.3	12.7

Table 7.2c

Levels of Child Mortality Estimates (Brass Method), Male Children, BRSFM, 1974, Chittagong Division.

Age Group	Age	q(x)	l (x)	West	North	South	East
20-24	2	.2102	.7899	11.1	10.1	11.9	12.8
25-29	3	.2222	.7778	11.3	10.8	12.5	12.8
30-34	5	.2332	.7668	11.7	11.7	12.9	12.9
Mean				11.4	10.9	12.4	12.8

Table 7.2d

Levels of Child Mortality Estimates (Brass Method), Male Children, BRSFM, 1974, Khulna Division.

Age Group	Age	q(x)	l (x)	West	North	South	East
20-24	2	.1831	.8169	12.4	11.5	13.5	14.0
25-29	3	.1912	.8088	12.7	12.3	14.2	14.2
30-34	5	.2090	.7910	12.7	12.7	14.1	13.9
Mean				12.6	12.2	13.9	14.0

Table 7.2e

Levels of Child Mortality Estimates (Brass Method), Male Children, BRSFM, 1974, Rajshahi Division.

Age Group	Age	q(x)	l (x)	West	North	South	East
20-24	2	.2015	.7985	11.5	10.5	12.4	13.2
25-29	3	.2170	.7830	11.6	11.0	12.8	13.0
30-34	5	.2199	.7801	12.2	12.3	13.5	13.5
Mean				11.8	11.3	12.9	13.2

Table 7.3

Summary Table of Average Adult Mortality Levels for Males, Bangladesh and Divisions, 1974-1981.

Area	West	North	South	East
Bangladesh	14.1	14.5	11.9	11.9
Dhaka Division	14.0	14.5	11.9	12.0
Chittagong Division	17.4	18.4	15.6	16.3
Rajshahi Division	11.0	11.0	8.5	8.2
Khulna Division	13.7	12.0	10.5	11.6

Table 7.3a

West family levels obtained from Coale- Demeny model life tables corresponding to intercensal survivorship probabilities, Bangladesh, 1974-1981.

Districts	West levels
Faridpur	14.5
Dhaka	14.4
Tangail	13.7
Mymensingh	13.1
Sylhet	14.3
Noakhali	16.1
Comilla	15.3
Chittagong	15.3
Chittagong H/T	15.1
Rangpur	8.6
Rajshahi	12.3
Pabna	12.5
Dinajpur	10.4
Bogra	11.5
Patuakhali	15.1
Kushtia	13.3
Khulna	13.8
Jessore	13.2
Barisal	15.0

Table 7.4

Values of α^* and β^* of Different Divisions and Districts, Males, 1974-1981 (General Standard).

Area	α	β
Dhaka Division	-0.0974	0.79
Faridpur District	-0.1172	0.76
Dhaka District	-0.1106	0.77
Tangail District	-0.0861	0.80
Mymensingh District	-0.0580	0.85
Chittagong Division	-0.2401	0.59
Sylhet District	-0.1021	0.80
Noakhali District	-0.1941	0.66
Comilla District	-0.1547	0.72
Chittagong District	-0.1678	0.70
Chittagong H/T	-0.1678	0.70
Rajshahi Division	+0.0029	1.00
Rangpur District	+0.0029	1.19
Rajshahi District	-0.0431	0.93
Pabna District	-0.0563	0.91
Dinajpur District	+0.0555	1.08
Bogra District	+0.0029	1.00
Khulna Division	-0.1396	0.87
Patuakhali District	-0.1988	0.78
Kushtia District	-0.1265	0.89
Khulna District	-0.1462	0.86
Jessore District	-0.1134	0.91
Barisal District	-0.1922	0.79
Bangladesh	-0.1094	0.80

Table 7.4a

Values of β and Ranges of β (General Standard) Bangladesh, Males, (1974-1981).

No. of Iteration			Mean Values of β	Range of β
1st	"	(β_2)	.8746	.14557
2nd	"	(β_3)	.8289	.19354
3rd	"	(β_4)	.8120	.21135
4th	"	(β_5)	.8058	.21796
5th	"	(β_6)	.8040	.21985
6th	"	(β_7)	.8031	.22079

Table 7.4a

Values of β and Ranges of β (General Standard) Dhaka Division, Males, (1974-1981).

No. of Iteration			Mean Values of β	Range of β
1st	"	(β_2)	.86589	.17482
2nd	"	(β_3)	.81623	.22702
3rd	"	(β_4)	.79821	.24611
4th	"	(β_5)	.79160	.25314
5th	"	(β_6)	.78895	.25596
6th	"	(β_7)	.78807	.25690

Table 7.4a

Values of β and Ranges of β (General Standard) Chittagong Division, Males, (1974-1981).

No. of Iteration			Mean Values of β	Range of β
1st	"	(β_2)	.74845	.14102
2nd	"	(β_3)	.65066	.17570
3rd	"	(β_4)	.61339	.21350
4th	"	(β_5)	.59894	.22825
5th	"	(β_6)	.59362	.23369
6th	"	(β_7)	.59168	.23567

Table 7.4a

Values of β and Ranges of β (General Standard) Khulna Division, Males, (1974-1981).

No. of Iteration			Mean Values of β	Range of β
1st	"	(β_2)	.91374	.14358
2nd	"	(β_3)	.88338	.16942
3rd	"	(β_4)	.87243	.17997
4th	"	(β_5)	.86832	.18397
5th	"	(β_6)	.86694	.18527
6th	"	(β_7)	.86649	.18571

Table 7.4a

Values of β and Ranges of β (General Standard) Rajshahi Division, Males, (1974-1981).

No. of Iteration			Mean Values of β	Range of β
1st	"	(β_2)	1.0157	.26702
2nd	"	(β_3)	1.0211	.26234
3rd	"	(β_4)	1.0232	.26054
4th	"	(β_5)	1.0240	.25982
5th	"	(β_6)	1.0244	.25946
6th	"	(β_7)		

Table 7.5

Estimated Smoothed Survivorship Probabilities l*(x), Bangladesh, Males (1974-1981).

Age	Logit	West	North	South	East
1	.8329	.8365	.8483	.8508	.8242
2	.7963	.7981	.8075	.8018	.7944
3	.7802	.7813	.7827	.7793	.7820
4	.7710	.7703	.7642	.7672	.7742
5	.7652	.7621	.7502	.7605	.7684
10	.7500	.7432	.7137	.7427	.7526
15	.7388	.7298	.6955	.7331	.7440
20	.7205	.7111	.6752	.7189	.7303
25	.6967	.6913	.6544	.6960	.7087
30	.6732	.6702	.6333	.6739	.6875
35	.6498	.6468	.6115	.6509	.6646
40	.6247	.6199	.5878	.6260	.6374
45	.5964	.5877	.5604	.5963	.6045
50	.5628	.5492	.5286	.5612	.5640
55	.5218	.5008	.4892	.5172	.5135
60	.4707	.4416	.4419	.4615	.4505
65	.4070	.4045	.4366	.3793	.3573
70	.3291	.3106	.3506	.2930	.2693
75	.2394	.2093	.2491	.1930	.1743
80	.1466	.1143	.1463	.0973	.0886

Table 7.6a

Estimated Smoothed Survivorship Probabilities l*(x), Chittagong Division, Males (1974-1981).

Age	Logit	West	North	South	East
1	.8181	.8349	.8468	.8486	.8205
2	.7899	.7961	.8056	.7985	.7899
3	.7779	.7791	.7805	.7754	.7772
4	.7710	.7680	.7619	.7630	.7691
5	.7667	.7597	.7477	.7562	.7632
10	.7556	.7406	.7109	.7380	.7471
15	.7476	.7271	.6926	.7283	.7384
20	.7344	.7084	.6722	.7138	.7246
25	.7175	.6953	.6586	.6995	.7107
30	.7010	.6816	.6448	.6853	.6969
35	.6845	.6663	.6303	.6696	.6819
40	.6670	.6482	.6143	.6520	.6638
45	.6472	.6251	.5953	.6297	.6407
50	.6237	.5950	.5723	.6018	.6096
55	.5947	.5545	.5411	.5645	.5670
60	.5578	.5009	.5023	.5150	.5100
65	.5103	.5229	.5795	.4971	.4929
70	.4486	.4168	.4874	.4021	.3884
75	.3696	.2944	.3711	.2834	.2672
80	.2729	.1712	.2398	.1571	.1478

Table 7.6b

Estimated Smoothed Survivorship Probabilities l*(x), Dhaka Division, Males (1974-1981).

Age	Logit	West	North	South	East
1	.8270	.8316	.8438	.8476	.8186
2	.7900	.7920	.8018	.7969	.7877
3	.7738	.7747	.7762	.7735	.7748
4	.7645	.7634	.7572	.7609	.7666
5	.7586	.7549	.7428	.7540	.7607
10	.7434	.7356	.7054	.7356	.7444
15	.7321	.7218	.6869	.7258	.7356
20	.7138	.7029	.6664	.7113	.7217
25	.6899	.6833	.6459	.6886	.7006
30	.6665	.6625	.6251	.6668	.6798
35	.6432	.6394	.6036	.6440	.6573
40	.6182	.6128	.5801	.6194	.6307
45	.5901	.5809	.5531	.5900	.5983
50	.5568	.5428	.5217	.5553	.5585
55	.5163	.4950	.4828	.5117	.5087
60	.4658	.4365	.4361	.4566	.4466
65	.4030	.4045	.4366	.4102	.3601
70	.3264	.3106	.3506	.3210	.2717
75	.2381	.2093	.2491	.2155	.1761
80	.1467	.1143	.1463	.1116	.0896

Table 7.6c

Estimated Smoothed Survivorship Probabilities 1*(x), Rajshahi Division, Males (1974-1981).

Age	Logit	West	North	South	East
1	.8492	.8414	.8526	.8539	.8277
2	.8061	.8042	.8129	.8068	.7987
3	.7866	.7879	.7888	.7851	.7866
4	.7752	.7772	.7708	.7734	.7790
5	.7680	.7693	.7572	.7670	.7734
10	.7491	.7508	.7215	.7498	.7578
15	.7351	.7377	.7037	.7405	.7494
20	.7119	.7194	.6837	.7266	.7358
25	.6814	.6920	.6555	.6944	.7064
30	.6512	.6630	.6270	.6637	.6776
35	.6209	.6311	.5980	.6334	.6467
40	.5884	.5952	.5666	.6015	.6107
45	.5520	.5536	.5309	.5647	.5684
50	.5091	.5068	.4908	.5232	.5193
55	.4576	.4510	.4441	.4732	.4621
60	.3951	.3871	.3896	.4125	.3948
65	.3208	.3020	.3202	.2818	.2511
70	.2370	.2224	.2448	.2074	.1803
75	.1513	.1421	.1614	.1271	.1093
80	.0772	.0722	.0853	.0578	.0505

Table 7.6d

Estimated Smoothed Survivorship Probabilities l*(x), Khulna Division, Males (1974-1981).

Age	Logit	West	North	South	East
1	.8567	.8542	.8652	.8642	.8420
2	.8211	.8208	.8291	.8228	.8160
3	.8052	.8061	.8071	.8037	.8052
4	.7960	.7965	.7908	.7935	.7983
5	.7901	.7894	.7784	.7878	.7933
10	.7748	.7722	.7453	.7726	.7790
15	.7635	.7601	.7286	.7640	.7710
20	.7448	.7427	.7094	.7513	.7580
25	.7202	.7212	.6825	.7235	.7351
30	.6958	.6985	.6553	.6969	.7125
35	.6712	.6733	.6275	.6698	.6881
40	.6446	.6443	.5974	.6409	.6593
45	.6144	.6097	.5630	.6070	.6244
50	.5784	.5687	.5239	.5678	.5818
55	.5340	.5176	.4777	.5194	.5289
60	.4785	.4554	.4235	.4594	.4633
65	.4090	.3943	.3543	.3378	.3489
70	.3245	.3018	.2757	.2562	.2622
75	.2286	.2026	.1869	.1643	.1691
80	.1331	.1100	.1028	.0798	.0855

Table 7.6e: Estimates of Life Expectancy at Birth for males from various models, Bangladesh and Division, 1974-81

Area	Life Expectancy at birth				
	Logit	West	North	South	East
Bangladesh	46.7	45.7	44.9	45.8	45.8
Chittagong Division	51.2	48.7	48.5	48.7	48.9
Dhaka Division	46.2	45.2	44.4	45.8	45.4
Rajshahi Division	43.2	43.3	42.2	43.4	43.2
Khulna Division	47.8	47.0	44.4	46.3	47.0

Table 7.7

Comparison of the Expectations of Life of Males at Selected Ages: Intercensal Estimates and Other Surveys in Bangladesh.

Name of Sources with Period	AGE			
	0	5	15	45
DSEP 1960-1961	44.22	53.31	46.63	22.02
PGE 1962-1965	45.85	56.32	48.58	23.10
CRL 1966-1969	51.03	57.70	49.34	23.30
BRSFM 1974	45.80	54.38	46.31	24.42
National Academy of Sciences 1974 (NAS)	51.6	62.1	53.7	27.8
VRS 1981	55.3	61.6	52.9	25.7
ICDDR'B, Matlab 1979	56.1			
ICDDR'B, Matlab 1981	57.7			
Intercensal Estimate 1974-1981	46.7	55.6	47.4	24.9

Source: DSEP: Demographic Survey of East Pakistan 1961-62 Part 2 Chapter 2 "On Marriage Fertility and Mortality" by M. Obaidullah Tables 4.4 and 4.5.

PGE: Fauhat Yusaf and Naseem Iqbal Farooquin, Complete Life Tables for Pakistan and Provinces: 1962-1965 Pakistan Institute of Development Economics Research Report Series No. 85, Karachi, 1969. Tables VIII and IX.

CRL: A.K.M. Aluaddin Choudhury, K.M.A. Aziz and Wiley H. Morley: Demographic Studies in Rural East Pakistan 3rd Year, May 1968-April 1969. Dhaka 1970 Table 6.

BRSFM: The 1974 Bangladesh Retrospective Survey of Fertility and Mortality, Census Commission, Ministry of Planning, Dhaka.

NAS: Estimation of Recent Trends in Fertility and Mortality in Bangladesh, Report No.5, Washington, 1981.

VRS: Current Demographic Situation in Bangladesh: BBS, June 1983.

ICDDR'B: Matlab 1979

ICDDR'B: Matlab 1981

Table 7.8a

Estimated Smoothed Survivorship Probabilities l*(x) Based on Logit Model, Various Districts of Chittagong Division, Males (1974-1981).

Age	Sylhet	Noakhali	Comilla	Chittagong	Chittagong H/T
1	.8308	.8224	.8260	.8248	.8248
5	.7625	.7653	.7641	.7645	.7645
10	.7472	.7529	.7505	.7513	.7513
15	.7360	.7437	.7404	.7415	.7415
20	.7176	.7289	.7241	.7257	.7257
25	.6936	.7096	.7028	.7051	.7051
30	.6700	.6908	.6820	.6849	.6849
35	.6465	.6721	.6612	.6649	.6649
40	.6212	.6520	.6390	.6433	.6433
45	.5929	.6294	.6139	.6191	.6191
50	.5593	.6026	.5842	.5903	.5903
55	.5182	.5695	.5476	.5549	.5549
60	.4671	.5277	.5018	.5104	.5104
65	.4034	.4743	.4436	.4538	.4538
70	.3259	.4062	.3709	.3825	.3825
75	.2367	.3217	.2833	.2958	.2958
80	.1448	.2235	.1865	.1983	.1983

Table 7.8b

Estimated Smoothed Survivorship Probabilities l*(x) Based on Logit Model, Various Districts of Dhaka Division, Males (1974-1981).

Age	Faridpur	Dhaka	Tangail	Mymensingh
1	.8252	.8258	.8263	.8306
5	.7593	.7591	.7567	.7574
10	.7446	.7442	.7411	.7409
15	.7339	.7333	.7297	.7287
20	.7163	.7155	.7110	.7088
25	.6935	.6923	.6867	.6829
30	.6711	.6696	.6629	.6573
35	.6488	.6469	.6391	.6319
40	.6249	.6227	.6137	.6046
45	.5981	.5954	.5851	.5741
50	.5663	.5631	.5513	.5379
55	.5274	.5237	.5102	.4941
60	.4788	.4745	.4591	.4400
65	.4180	.4129	.3958	.3737
70	.3430	.3374	.3189	.2946
75	.2551	.2493	.2310	.2067
80	.1616	.1565	.1409	.1205

Table 7.8c

Estimated Smoothed Survivorship Probabilities l*(x) Based on Logit Model, Various Districts of Rajshahi Division, Males (1974-1981).

Age	Rangpur	Rajshahi	Pabra	Dinajpur	Bogra
1	.8867	.8454	.8443	.8534	.8492
5	.8062	.7694	.7698	.7664	.7680
10	.7863	.7519	.7527	.7458	.7491
15	.7712	.7390	.7401	.7305	.7351
20	.7460	.7176	.7193	.7052	.7119
25	.7121	.6896	.6920	.6717	.6814
30	.6778	.6620	.6651	.6386	.6512
35	.6430	.6342	.6380	.6054	.6209
40	.6050	.6044	.6090	.5699	.5884
45	.5621	.5710	.5764	.5302	.5520
50	.5112	.5314	.5377	.4837	.5091
55	.4499	.4834	.4908	.4284	.4576
60	.3762	.4245	.4330	.3625	.3951
65	.2908	.3530	.3625	.2860	.3208
70	.1993	.2697	.2796	.2030	.2370
75	.1140	.1806	.1898	.1227	.1513
80	.0497	.0984	.1053	.0582	.0772

Table 7.8d

Estimated Smoothed Survivorship Probabilities l*(x) Based on Logit Model, Various Districts of Khulna Division, Males (1974-1981).

Age	Patuakhali	Kushtia	Khulna	Jessore	Barisal
1	.8520	.8577	.8561	.8587	.8525
5	.7918	.7898	.7903	.7894	.7916
10	.7782	.7741	.7752	.7734	.7778
15	.7682	.7625	.7640	.7614	.7677
20	.7517	.7433	.7456	.7417	.7509
25	.7301	.7180	.7213	.7158	.7290
30	.7087	.6929	.6972	.6900	.7073
35	.6872	.6676	.6730	.6640	.6854
40	.6639	.6402	.6467	.6358	.6618
45	.6376	.6092	.6170	.6040	.6350
50	.6060	.5722	.5815	.5660	.6030
55	.5670	.5267	.5377	.5193	.5633
60	.5175	.4698	.4828	.4612	.5131
65	.4544	.3991	.4140	.3893	.4493
70	.3752	.3138	.3300	.3032	.3694
75	.2803	.2181	.2340	.2080	.2742
80	.1776	.1246	.1375	.1166	.1721

Table 7.9

Expectations of Life Based on Logit Model at Various Ages, Males for Bangladesh and Divisions (1974-1981).

Age	Bangladesh	Chittagong	Dhaka	Rajshahi	Khulna
5	55.6	61.4	55.6	50.9	55.1
10	51.7	57.3	51.6	47.1	51.2
15	47.4	52.9	47.4	43.0	46.9
20	43.6	48.8	43.6	39.3	43.0
25	40.0	44.9	40.0	36.0	39.4
30	36.3	40.8	36.3	32.5	35.7
35	32.5	36.8	32.5	29.0	31.9
40	28.7	32.7	28.7	25.4	28.1
45	24.9	28.6	25.0	22.0	24.4
50	21.3	24.6	21.3	18.6	20.7
55	17.8	23.2	17.8	15.4	17.2
60	14.4	19.5	14.5	12.5	13.9
65	11.3	15.9	11.3	9.8	10.9
70	8.4	12.3	8.4	7.3	8.1
75	5.6	8.2	5.6	5.1	5.4
e_o^o	46.7	51.2	46.2	43.2	47.8

Table 7.10a

Expectations of Life Based on Logit Model at Various Ages, Males, Districts of Chittagong Division (1974-1981).

Age	Sylhet	Noakhali	Comilla	Chittagong	Chittagong H/T
5	55.5	59.4	57.7	58.2	58.2
10	51.6	55.3	53.7	54.2	54.2
15	47.3	51.0	49.4	49.9	49.9
20	43.5	46.9	45.4	45.9	45.9
25	39.9	43.2	41.7	42.2	42.2
30	36.2	39.3	37.9	38.4	38.4
35	32.4	35.3	34.0	34.5	34.5
40	28.6	31.3	30.1	30.5	30.5
45	24.9	27.3	26.3	26.6	26.6
50	21.2	23.4	22.5	22.8	22.8
55	17.7	19.6	18.8	19.1	19.1
60	14.4	16.0	15.3	15.5	15.5
65	11.3	12.5	12.0	12.2	12.2
70	8.4	9.2	8.8	9.0	9.0
75	5.6	6.0	5.8	5.9	5.9
e^{o}_{o}	46.4	49.5	48.2	48.6	48.6

Table 7.10b

Expectations of Life Based on Logit Model at Various Ages, Males, Districts of Dhaka Division (1974-1981).

Age	Faridpur	Dhaka	Tangail	Mymensingh
5	56.4	56.1	55.2	54.0
10	52.4	52.1	51.3	50.1
15	48.2	47.9	47.1	45.9
20	44.3	44.0	43.2	42.1
25	40.7	40.4	39.7	38.6
30	36.9	36.7	36.0	35.0
35	33.1	32.9	32.3	31.4
40	29.3	29.1	28.5	27.7
45	25.5	25.3	24.8	24.0
50	21.8	21.6	21.1	20.4
55	18.2	18.1	17.6	17.0
60	14.8	14.7	14.3	13.8
65	11.6	11.5	11.2	10.8
70	8.6	8.5	8.3	8.1
75	5.7	5.6	5.5	5.4
e_o^o	46.9	46.7	45.9	45.0

Table 7.10c

Expectations of Life Based on Logit Model at Various Ages, Males, Districts of Rajshahi Division (1974-1981).

Age	Rangpur	Rajshahi	Pabna	Dinajpur	Bogra
5	49.0	52.6	53.1	49.1	50.9
10	45.2	48.8	49.3	45.4	47.1
15	41.0	44.6	45.1	41.3	43.0
20	37.3	40.8	41.3	37.7	39.3
25	33.9	37.4	37.8	34.4	36.0
30	30.5	33.9	34.2	31.1	32.5
35	27.1	30.2	30.6	27.6	29.0
40	23.6	26.6	26.9	24.2	25.4
45	20.2	23.0	23.3	20.8	22.0
50	17.0	19.5	19.8	17.6	18.6
55	13.9	16.2	16.5	14.5	15.4
60	11.2	13.1	13.3	11.7	12.5
65	8.7	10.3	10.4	9.2	9.8
70	6.6	7.7	7.8	7.0	7.3
75	4.7	5.2	5.3	4.9	5.1
e_0^o	43.8	44.6	45.0	41.8	43.3

Table 7.10d

Expectations of Life Based on Logit Model at Various Ages, Males, Districts of Khulna Division (1974-1981).

Age	Patuakhali	Kushtia	Khulna	Jessore	Barisal
5	57.5	54.6	55.4	54.1	57.2
10	53.4	50.7	51.4	50.2	53.2
15	49.1	46.4	47.1	45.9	48.8
20	45.1	42.5	43.2	42.1	44.9
25	41.4	38.9	39.6	38.5	41.1
30	37.5	35.3	35.9	34.9	37.3
35	33.6	31.5	32.1	31.1	33.4
40	29.7	27.8	28.3	27.4	29.5
45	25.9	24.0	24.5	23.7	25.7
50	22.1	20.4	20.9	20.1	21.9
55	18.4	17.0	17.4	16.7	18.3
60	14.9	13.7	14.1	13.5	14.8
65	11.7	10.7	11.0	10.6	11.6
70	8.6	8.0	8.1	7.9	8.5
75	5.7	5.4	5.4	5.3	5.6
e_o^o	49.7	47.4	48.0	46.9	49.5

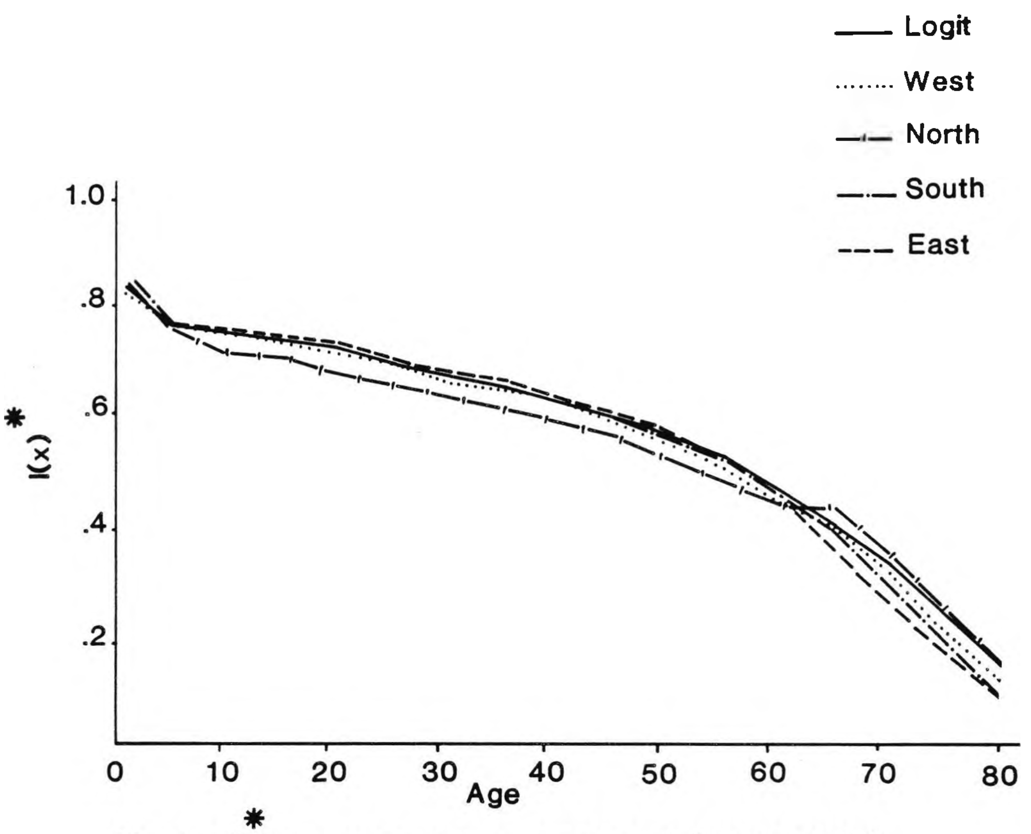

Fig :7.1 l(x)* curve for males, Bangladesh (1974-1981)

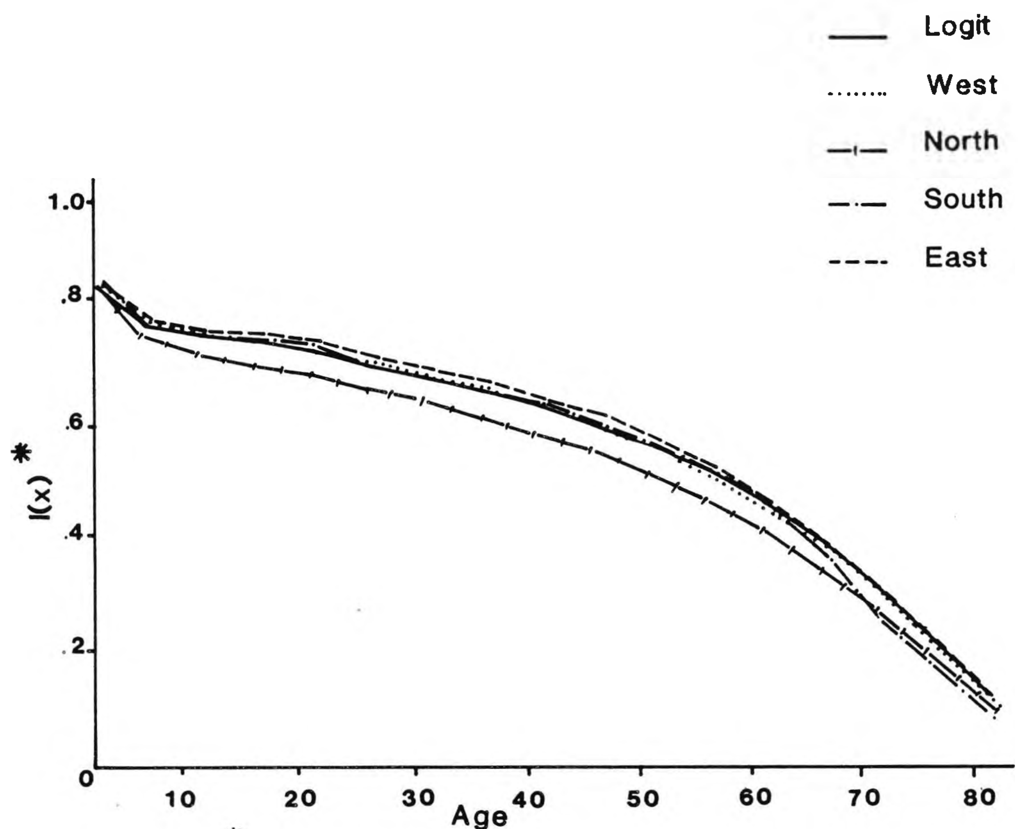

Fig :7.2 l(x)* curve for males, Khulna division (1974-1981)

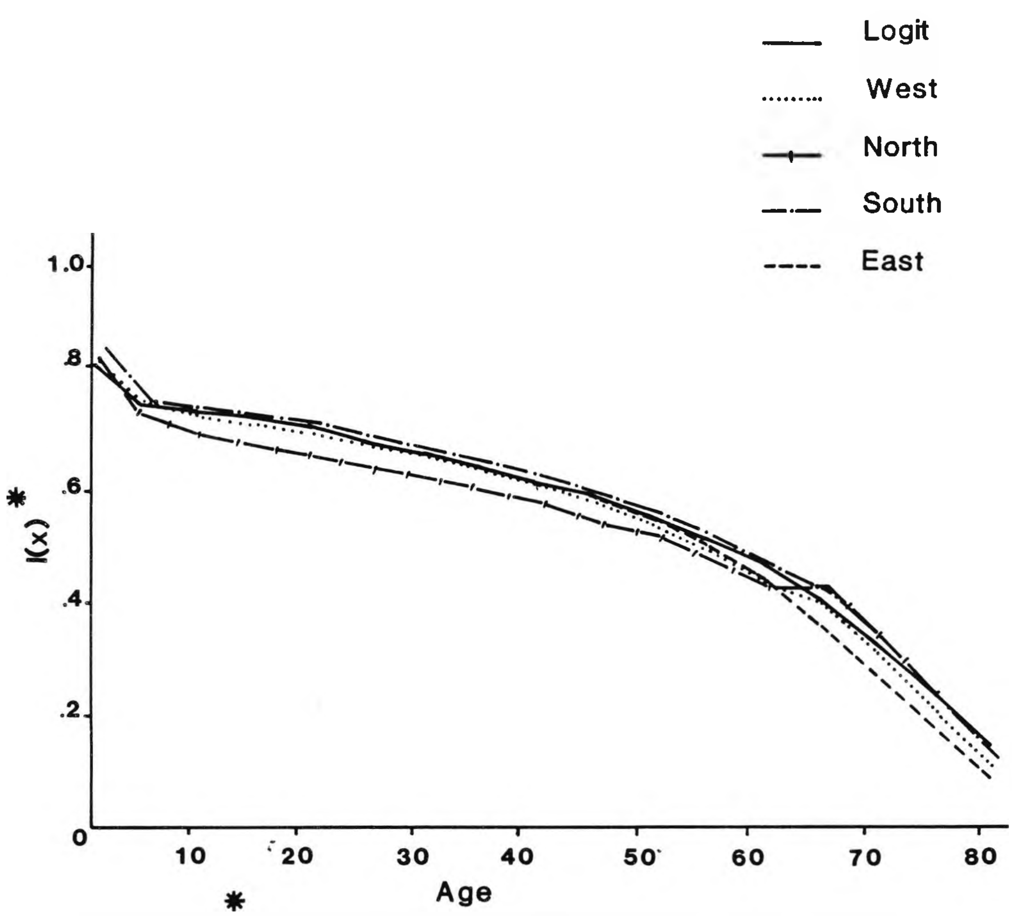

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Fig :7.3 K(x) curve for males, Dhaka division (1974–1981)

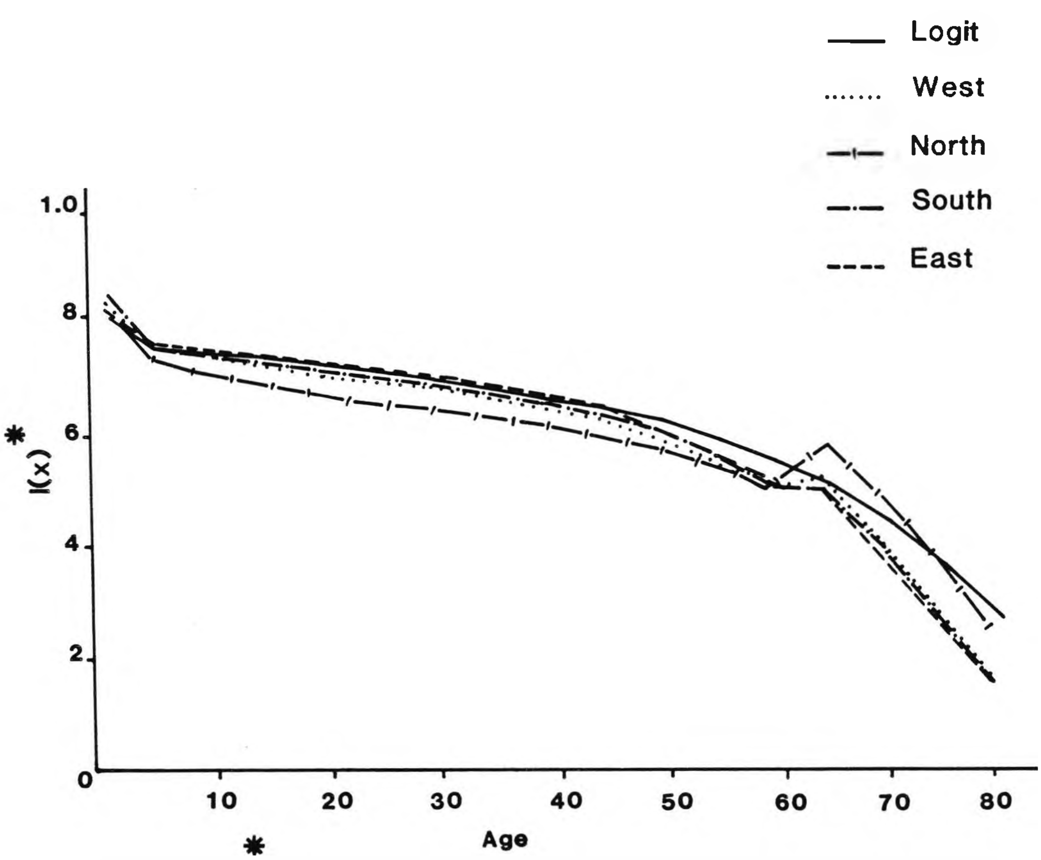

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Fig :7.4 l (x) curve for males, Chittagong division (1974-1981)

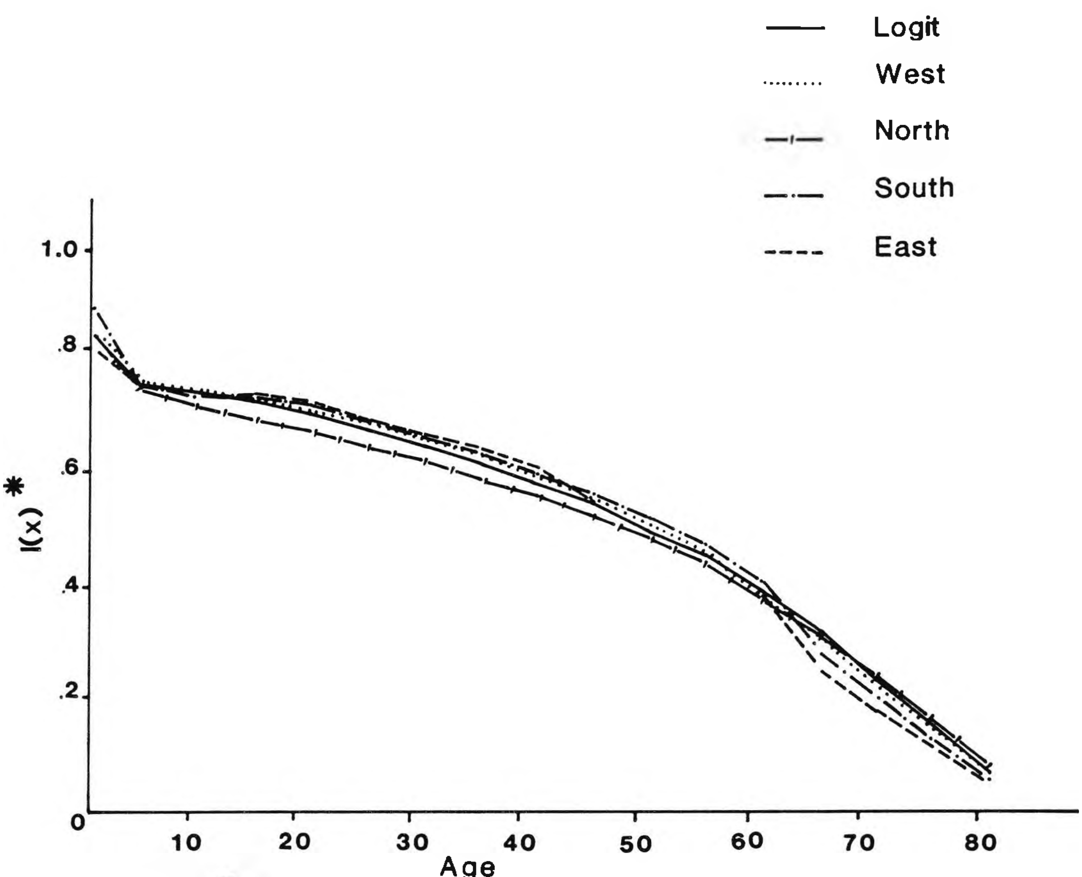

Fig :7.5 l(x)* curve for males, Rajshahi division

CHAPTER 8

Brass Growth Balance Method

8.1 Introduction

The direct way of obtaining mortality rates is by using the information on deaths by sex and age provided through a vital registration system together with information of the population at risk provided by a census or survey. Such information sources exist in many populations, but it is often the case that not all the deaths are recorded. As a result, the death rate indicated by the reported deaths represents usually an underestimate of the true death rate of the population which is under investigation. Some methods of adjustment are, therefore, needed to convert the reported deaths into a better estimate which could represent the true mortality conditions of a population.

Over the years, demographers have developed several methods of adjustment (Brass, 1975; Preston et al, 1980). These techniques are basically based on the stable population theory, and use the age structure of reported deaths, in conjunction with either the age distribution of the population or an estimate of the rate of natural increase in order to determine the completeness of death recording. These two methods are based on the assumptions that the population is stable and that the completeness of recording of deaths is the same at all ages. One of the two later methods is based on the intercensal comparisons of successive cohorts, with an accounting for registered intercensal cohort deaths.

The Brass method has been used in this study.

The population for 1980 and age specific death rates for 1980-1983 have come from the National Vital Registration System, being conducted by the Bangladesh Bureau of Statistics since 1980. The dual record operation for collection of vital events is followed in the system, and the Chandrasekaran-Deming adjustment has also been applied to adjust the recorded deaths.It may be mentioned that the Chandrasekaran-Deming technique has been described in Chapter 3.

Furthermore, a simple group average fitting procedure has been applied in this Chapter to fit a straight line to the points defined by partial birth and death rates discussed in section 8.2. This procedure has also been described in Chapter 3.

8.2 Brass Method

Brass (1975) proposed a method to estimate the completeness of registration of adult deaths. The basic equation of the method is:-

$$N(x) = rN(x+) + d\,D(x+) \qquad (8.1)$$

where

$N(x)$ = the population proportion per year of age around x;

$N(x+)$ = the population proportion per year over the age of x;

r = the rate of increase in the stable population;

$D(x+)$ = the proportion of deaths at ages over x;

d = The Crude death rate.

Brass also proved that the expression (8.1) is exact for a stable population.

An important aspect of the technique is that the expression remains valid whatever the magnitude of underregistration of deaths, on condition that the proportions of under-reporting is the same at all ages. The expression is also valid for any age, not just age zero, but because child and adult deaths are very often underreported to a different extent, the technique essentially refers only to the estimation of the completeness of registration of adult deaths.

Brass has developed a modification of the technique. The equation can also be written as:-

$$\frac{N(x)}{N(x+)} = r + k \frac{D(x+)}{N(x+)} \qquad (8.2)$$

The values of N(x), N(x+) and D (x+) can be calculated for absolute numbers rather than proportion. The coefficient k, is the slope of the line, and this is used as the adjustment factor which can be applied to the deaths to estimate the completeness of death registration. It may be pointed out that this adjustment factor can then be applied either to the total number of deaths to determine a corrected crude death rate, or the adult deaths only.

The Brass Growth Balance method is based on three basic assumptions:

1) that the completeness of reporting of deaths is the same at all ages, at least for adults;

2) that the population is approximately stable, or at least at quasi-stable stages;

3) that the age structure of deaths or of the population are free from age reporting inaccuracies.

Some comments need to be made about the validity of eatimates obtained by this method when the population is not stable. However, simulation demonstrates that when stable populations are affected by prolonged mortality changes that take place slowly, the bias introduced in the estimation of k due to the lack of stability is relatively small (Roshad, 1978), although bias may be substantial only when sudden changes in the mortality take place (Martin, 1980).

It should be remembered that if the age distribution of deaths or of the population suffer from age misreporting, the estimates of this technique are likely to be biased, although the use of a cumulation process and carefully eliminating points from the fitting procedure will tend to remove that effects of such errors.

Furthermore, it may be pointed out that the points hardly make a straight line, but k is estimated by choosing the line that best fits the observed points. However, when the points appear to be seriously non-linear, it is usually difficult to determine a unique factor responsible for this lack of linearity, or to adjust the data, because deviations from linearity could stem from various causes such as the inaccuracy of the data in the form of age misreporting, differential completeness of death registration by age, and the lack of stability of the population. If, however, non-linearity is concentrated on the points associated with old people, a straight line can be drawn by ignoring the outliers in order to remove serious distortions from the estimation.

In general, a plot of the observed points D(x+)/N(x+) against N(x+)/N(x+) provides a good basis for examining the validity of this technique to obtain k.

It is also important to note that the relationship expressed by the equation (8.2) allows the estimation of both k, the adjustment factor for the registered deaths, and of r, the population growth rate. It should be remembered that the estimate of r is not robust to deviations from the assumptions on which basis the equation (8.2) is obtained and hence the estimate of r should not be regarded as a very sound estimate. However, the estimate of r may be compared with other available estimates so that a reasonable agreement could be reached about r which will lead to a check on the validity of assumptions made.

The advantage of the method is that it does not give considerable importance to deaths occurs at old ages. This method is also less vulnerable to age exaggeration.

The Preston method, however, can be used when the age distribution of deaths at old ages are initially adjusted, but the adjustment depends on the use of models, which is likely to reduce the effectiveness of the method.

The Brass method just described has been applied by sex to the numbers of adjusted deaths (adjustment has been done according to Chandra-Deming technique) for 1980. The partial birth (N(x)/N(x+)) and death (D(x+)/N(x+)) rates for both males and females are shown in Table 8.1 and Table 8.2 and are plotted against each other in Figures 8.1 and 8.2.

For both the males and the females, the points for young ages fall on a straight line fairly reasonably, but the later points bend down to the right of the trend line of the earlier points. The reasons for this pattern can be attributed to the age heaping of the population and the overstatement of reported age at death for the older people. Since the points for the younger ages are less likely to be influenced by such errors, an attempt has therefore been made to draw the straight line through these points. However, various age ranges for both males and females have been used for fitting purposes. The results for both males and females have been summarised in Table 8.3 which shows the slope (k), an estimate of the reciprocal of completeness of death reporting (c) and the intercept, an estimate of the rate of natural increase (r), for males and females. Table 8.3 suggests that the values of k and r are more or less consistent but the slopes of the two fitted lines are less than 1, implying that the number of deaths after having made adjustment by the Chandrasekaran-Deming formula appear to be too high. The completeness of death recording for male deaths varies from 1.37 to 1.58, whereas the completeness of death recording for female deaths varies from 1.55 to 1.67, indicting a greater overreporting of female deaths than of male deaths. This finding is contrary to the results of Population Growth Experiment data (PGE) in which the committee on population (1981) observes relatively more over-reporting in the case of male deaths than in the case of female deaths. On the other hand, while the growth rate for females varies from .0377 to .0398, the growth rate for males is from .0320 to .0347. These two growth rates are fairly similar to one another, although the rates are fairly high which does not seem to be plausible in 1981.

However, to resolve this problem of over-reporting of deaths, which does not seem to be plausible in this kind of sample investigation, the average deaths for both the sexes combined for the years 1981-83 have been considered in the hope that year to year fluctuations in the death rates will be removed in this process. The calculation of deaths from average age specific death rates for 1981-83 and the partial birth rates and death rates for both sexes are shown in Table 8.4 and Table 8.5 and are plotted against each other in Figure 8.2.

The slope of the plot of N(x)/N(x+) against D(x+)/N(x+) is close to one and it can be concluded that the recording of deaths was satisfactory within the limits of the method.

The contrast between the 1980 and subsequent rates suggests however, that there may be upward biases in the ages of the dead. If this was so the slope of the plot would still be fixed downwards. It seems clear that the child deaths from the sample survey are too low. The conclusion that the retrospective estimates from child survivors and widowhood are more accurate is plausible.

8.3 Factors Responsible for Adult Mortality Improvement

Infectious diseases are the major health problems in Bangladesh. Virtually no information is available about mortality and morbidity statistics. This is because no reliable nationwide system for reporting the incidence of infectious diseases or for registering deaths and causes of death exist in Bangladesh. Limited information is, however, available from Matlab and Comilla District, where births, deaths and probable causes of death have been registered since 1966. It should be mentioned that such information are also subject to limitation because most deaths are reported by non-medical persons.

This discussion is included however, not to state unequivocally factors responsible for improvement in adult mortality but to throw some light on this complicated subject. This discussion will be concentrated on various studies in the past.

McCormack et al (1973) analyse Matlab data and observe that:-

1. Infection appears to be responsible for a considerable proportion of total deaths, and most of the deaths appear to have occurred at the extreme age.

2. Cholera is a diarrheal disease endemic in the deltaice regions of Bengal, and Cholera, like most other infectious diseases in Bengal, is concentrated among children, with the attack rates found to be the highest among 1 to 4 year old children and decrease with advancing age. The reasons for the low attack among older age groups have been attributed to increasing vibriocidal antibody titers and to immunity developed through exposure to Cholera vibrios and through Cholera Vaccination.

It should be mentioned that population at all age groups are equally vulnerable to the disease in a non-endemic area.

However, Cholera patients treated by the modern treatment procedure consisting mainly of the intravenous or oral replacement of the diarrheal water and electrolytic losses appear to have a case fatality rate of less than 1 percent. Still Cholera has a considerable impact on mortality in Bangladesh.

3. Smallpox can be controlled through vaccination with Vaccinia (Cowpox) virus. This vaccine gives durable immunity, and protects most people who have been vaccinated against infection for over five years.

4. Deaths due to measles are concentrated among 1 to 5 year old children. Very little is known about the incidence of Poliomyelitis. It is believed that most people are likely to be infected with wild strains of Polio Virus in their infancy. Thus immunity grows among them.

5. Tuberculosis is a major health problem among adults. It has been estimated that the incidence of active disease appears to be as high as 500 per 100,000. However, that disease can be prevented through vaccination with Bacille Calmette Guerin (B.C.G.). It should be pointed out that improvement in diet is very important in preventing this disease (McKeown et al, 1962).

The Malaria situation in South-East Asia shows no improvement over the past few years despite national endeavours to completely eradicate it. The reasons have been attributed to parasite resistance to antimalarial drugs and vector resistance to insecticides. However, it has been suggested that although the fatality rate (number of deaths per 100 or 1000 reported cases), has remained at low level, the incidence of Malaria was considerably increasing in Sri Lanka, India, Bangladesh, Indonesia and many other countries during the 1970s (WHO, 1980).

Energy and protein deficiency have been reported in nutritional surveys of many countries of South Asia during the 1970s. The groups who have suffered greatly appear to be pre-school and, school children and pregnant women. Similar situation prevails in Bangladesh (Rosenberg, 1973).

Infectious diseases are still a major health issue in overall morbidity and mortality statistics in Bangladesh. They do not seem to have any contribution to the decline in mortality in the country. In addition, there is no evidence of change in disease virus. However, it seems that immunity acquired through exposure to virus and the government eradication and vaccination programmes may be one of the factors contributing to the decline in adult mortality level in Bangladesh. Another factor may be attributed to the widespread use of locally manufactured antibiotic drugs.

Table 8.1

Partial Birth and Death Rates, from Sample Registration, Male, Bangladesh, 1980

Age	Population at age x N(x)	Population at x+ N(x+)	Death x+ D(x+)	N(x)/N(x+)	D(x+)/N(x+)
5	2224.8	64009	451	.0348	.0070
10	2278.3	52451	434	.0434	.0083
15	1883.9	41226	425	.0457	.0103
20	1364.3	33612	420	.0406	.0125
25	1168.6	27583	415	.0424	.0150
30	1008.0	21926	410	.0460	.0187
35	866.4	17503	404	.0495	.0231
40	747.3	13262	392	.0563	.0296
45	598.7	10030	375	.0597	.0374
50	493.4	7275	352	.0678	.0484
55	376.8	5096	319	.0739	.0626
60	296.9	3507	282	.0847	.0804
65	215.1	2127	237	.1011	.1114
70	148.4	1356	197	.1094	.1453

Table 8.2

Partial Birth and Death Rates, from Sample Registration, Female, Bangladesh, 1980

Age	Population at age x N(x)	Population at x+ N(x+)	Death x+ D(x+)	N(x)/N(x+)	D(x+)/N(x+)
5	2211.6	58534	371	.0378	.0063
10	2195.2	47061	351	.0466	.0075
15	1766.1	36582	343	.0483	.0094
20	1308.9	29400	334	.0445	.0114
25	1135.6	23493	326	.0483	.0139
30	933.8	18044	319	.0518	.0177
35	727.8	14155	311	.0514	.0220
40	601.1	10766	300	.0558	.0279
45	493.8	8144	285	.0606	.0350
50	412.5	5828	267	.0708	.0458
55	304.4	4019	241	.0757	.0600
60	234.5	2784	209	.0842	.0751
65	174.7	1674	177	.1044	.1057
70	116.5	1037	148	.1123	.1427

Table 8.3

Estimates of the Completeness of Death Recording and Rate of Natural Increase from 1980 Sample Survey.

MALE, 1980

Age Points	k	c	r
5-60	.6629	1.51	.0342
[a] Trimmed mean	.6311	1.58	.0347
20-65	.6316	1.58	.0345
20-55	.7286	1.37	.0320
5-65	.6391	1.56	.0345
15-55	.6854	1.50	.0339
5-55	.6828	1.46	.0340

FEMALE, 1980

Age Points	k	c	r
5-60	.6066	1.65	.0395
[a] Trimmed mean	.5985	1.67	.0398
35-65	.6429	1.56	.0377
20-55	.6451	1.55	.0385
5-65	.6198	1.61	.0392
15-55	.6178	1.62	.0397
5-55	.6138	1.63	.0394

Note:-

k = slope of the line
c = an estimate of the completeness of death reporting
r = The intercept, an estimate of the rate of natural increase

[a] Trimmed mean is based on weighted observations

Table 8.4

Calculation of Deaths from Average Age Specific Death Rates (ASDR) for both Sex, Bangladesh (1981-83)

Age	Total Population	ASDR 81-83 M and F	Deaths
0-4	21333		
5-9	23031	400	92
10-14	21704	133	29
15-19	14796	200	30
20-24	11936	267	32
25-29	11106	300	30
30-34	8312	300	25
35-39	7630	400	31
40-44	5854	567	33
45-49	5071	633	32
50-54	3988	1233	49
55-59	2824	1633	46
60-64	2490	2567	64
65-69	1408	3533	50
70-74	1241	5333	66
75+	1152	14100	162
Total	143876		

Table 8.5

Partial Birth and Death Rates for Both Sexes, Bangladesh.

Age	N(x+)	D(x+)	D(x+)/ N(x+)	N(x)	N(x)//N(x+)
5	122543	771	.0063	4436.4	.0362
10	99512	679	.0068	4473.5	.0450
15	77808	650	.0084	3650.0	.0469
20	63012	620	.0098	2673.2	.0424
25	51076	588	.0115	2304.2	.0451
30	39970	558	.0140	1941.8	.0486
35	31658	533	.0168	1594.2	.0504
40	24028	502	.0209	1348.4	.0561
45	18174	469	.0258	1092.5	.0601
50	13103	437	.0334	905.9	.0691
55	9115	388	.0426	681.2	.0747
60	6291	342	.0544	531.4	.0845
65	3801	278	.0731	389.8	.1026
70	2393	228	.0953	264.9	.1107

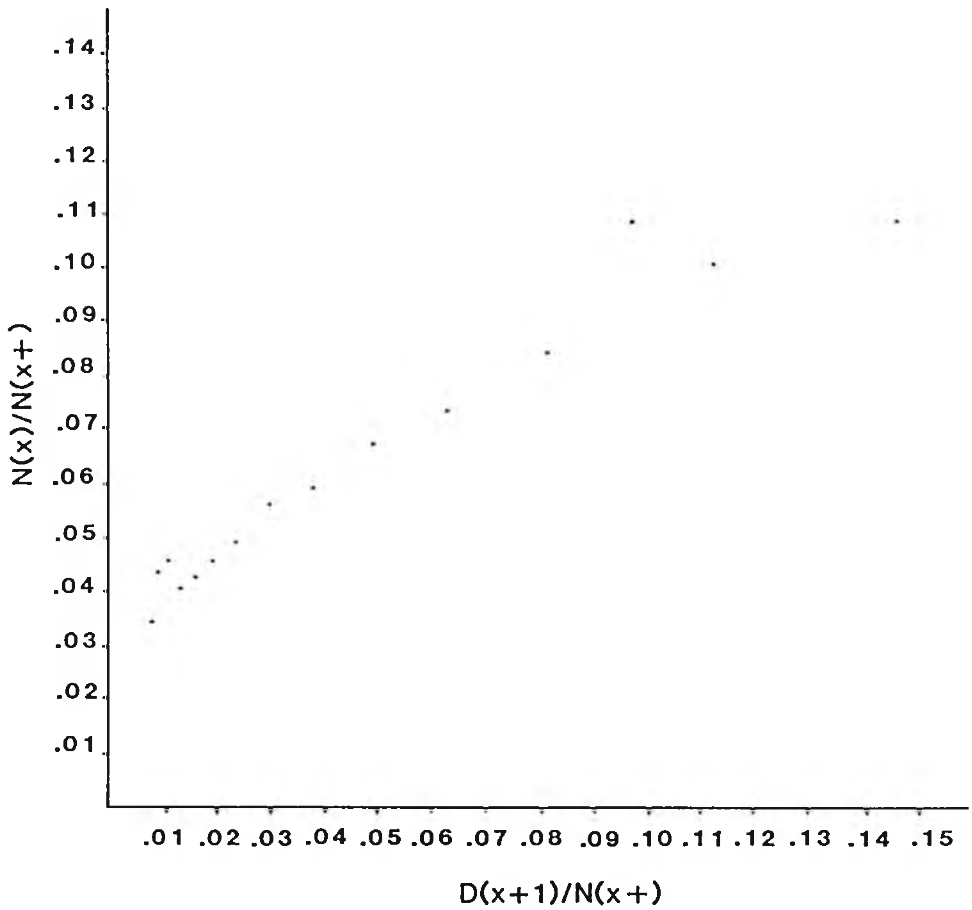

Fig :8.1 Partial birth and death rates over successive ages, Male, 1980 (sample survey)

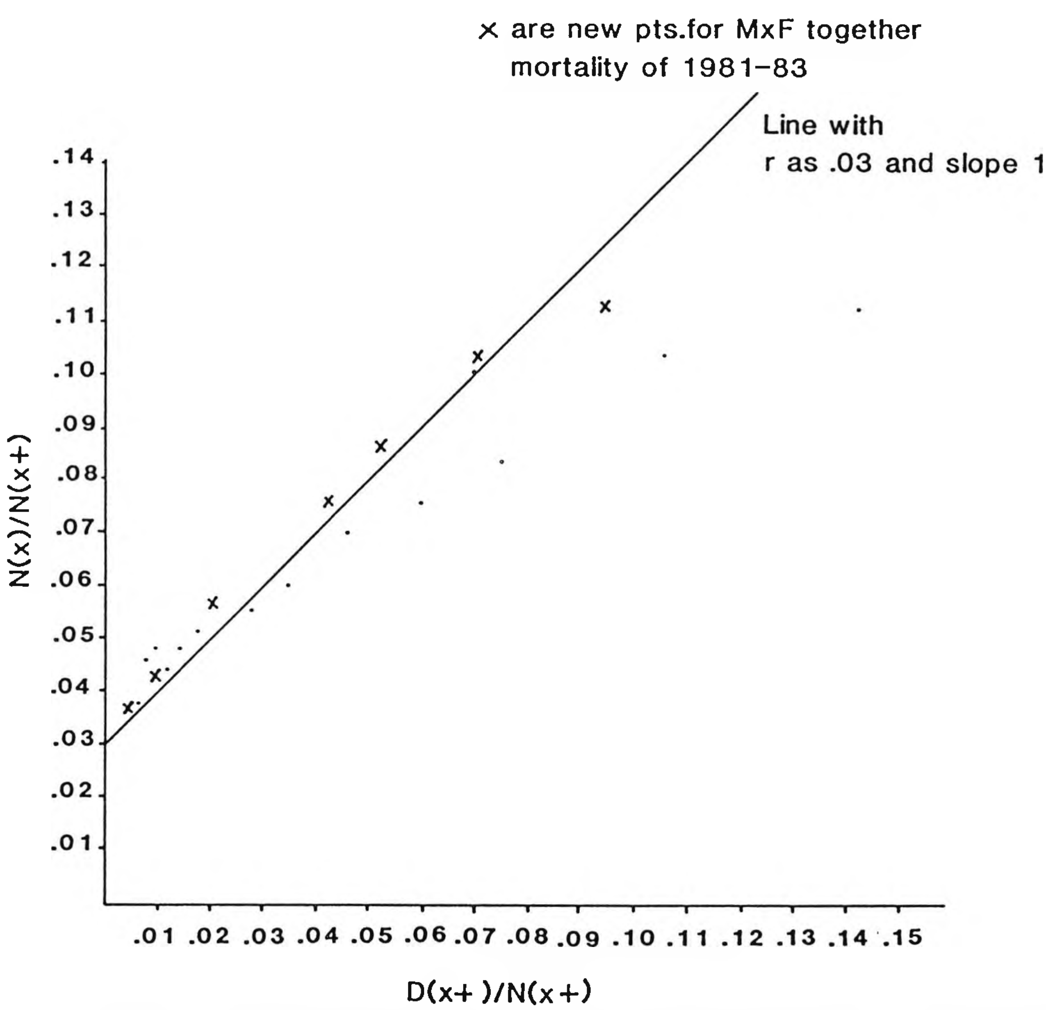

Fig :8.2 Partial birth and death rates over successive ages, Female, 1980 and both sexes combined, 1981-83 (sample survey)

CHAPTER 9

CONCLUSION

An attempt has been made in this study to develop period adult mortality for Bangladesh males for the period 1974-1981 from the intercensal information on widowhood, which has been obtained by the applications of the Generalised Stable Population Relations. The reasons for the use of indirect techniques are the unavailability or unreliability of the basic demographic data necessary to apply direct methods in developing countries like Bangladesh.

The original theoretical formulation of the survivorship proportions as a basis for the estimates of childhood and adult mortality are based on the assumptions of unchanging mortality level in the past. But as a result of the applications of various indirect estimation techniques in countries lacking adequate conventional data sources, it is accepted that mortality has declined in many developing countries. Most of the methods are, therefore, not useful in producing plausible results under changing mortality conditions. However, the Generalised Stable Population Relations are useful in this situation. The method uses based on information of indirect indicators from two surveys to produce a hypothetical data set which reflects the effect of intersurvey vital rates of respondents who are exposed to such rates for an indefinite period. The method is based on the assumption that the population is closed to migration. The application of the method is simple whatever may be the length of interval between surveys or censuses, but the thing is that the surveys or censuses should represent the same population.

The Generalised Stable Population Relations utilised information on widowhood from the 1974 BRSFM, and estimated information on widowhood from the 1974 and 1981 censuses. It should be mentioned that both the census results have been obtained from their marital status data by using adjustments of 1974 BRSFM marital status data through a special technique which has been described in detail.

The applications of the Generalised Stable Population Relations suggest that the intercensal proportions never widowed females appear to be higher in all age groups from that of 1974 and 1981 for Bangladesh and various divisions (except Rajshahi Division). The pattern with respect to the change in the district level results have been found to be consistent with the divisional pattern.

However, the results obtained from information by the older respondents have been found to be affected by the age exaggeration and other errors.

The technique has been found to be unsuccessful in producing reliable results for female mortality, may be because the observed proportions of males not widowed are likely to be more unreliable than the female figures due to relatively higher male remarriage rates especially at the older ages.

In summary, the Generalised Stable Population Relations have proved to be extremely useful in undestanding the adult mortality conditions in Bangladesh as a whole and district level in particular, which had never been possible before. The technique can also be applied if information on widowhood for population subgroups is available, at two points in time.

The widowhood techniques have been applied to hypothetical proportions of never widowed females, generated through the applications of the generalised stable population relations, to estimate period adult male mortality. Hill and Trussell method has been found to give higher values of survivorship probabilities at older ages. The reasons for this have been discussed. The advantages and disadvantages of the widowhood techniques have also been discussed.

However, the application of the technique may produce biases because of the assumption that mortality risks among the never married are similar to those obtained for the ever married. The biases due to the application of the technique in Bangladesh are likely to be small because marriage is virtually universal in Bangladesh, this is particularly so for females (described in chapter 2).

Furthermore, the mortality levels to which each estimated survivorship probability corresponds in the Coale-Demeny west family of model life tables have been obtained corresponding to 1974, 1981 and 1974-1981. The results suggest that the widowhood technique underestimates mortality at older ages which may be attributable to the consistent exaggeration of own age on the part of the female respondents at older ages. However, if the last values are excluded, the estimated survivorship probabilities with age have been found to be consistent.

The average mortality level for Bangladesh corresponding to 1974-1981 has been found to be 14.1. The average mortality levels for Dhaka Chittagong, Khulna and

Rajshahi divisions are 14.0, 17.4, 13.7 and 11.0 respectively. The district mortality levels (average) vary from 8.6 to 16.1. Further, the average west mortality levels of 1974 and 1981 results have been found to be consistently lower than that of 1974-1981 results in Bangladesh and divisions (except Rajshahi division), suggesting an improvement in mortality. It may be noted that in countries where adult mortality has a declining trend, the levels estimated from the intercensal period tend to be higher (implying lower mortality) than those obtained independently from data for each time period, since the later estimates refer to a rather long period in the past, while the period estimates refer strictly to the intercensal period. A study based on PGE and BRSFM data suggested that adult mortality declined somewhat from 1964-65 to 1973-1974.

However, the results produced by the technique suggest that the adult mortarlity level is still improving in Bangladesh, but the adult mortality levels vary substantially among divisions of Bangladesh.

Inspite of substantial data errors discussed in Chapter 1 and Chapter 2, the widowhood technique represents a powerful basis of estimation of the period adult mortality levels in developing countries like Bangladesh. Complete sets of life tables for Bangladesh, various divisions and districts corresponding to 1974-1981 have been derived by linking childhood mortality estimates with the conditional survivorship probabilities related to adults obtained by the widowhood technique with reference to the Brass's two parameter model life table system based on the Brass's general standard.

The Brass method has been used to obtain child mortality from information on children everborn and children surviving per woman. The method utilized information from BRSFM 1974 and BBS 1982. The estimated figures suggest that child mortality has not improved during this period. This finding supports the conclusion drawn in Chapter 3 in connection with child mortality that it has not declined in the recent years.

Child mortality has been estimated for various divisions from data collected by BRSFM 1974. The estimated figures suggest that child mortality varies little among regions of Bangladesh.

Since one of the probabilities is conditional, the values of the parameters of the logit model for Bangladesh, Divisions and various districts have been obtained iteratively. The results suggest that the final estimates of the parameters of Bangladesh and various regions (except Chittagong division and Noakhali district) are not very far from the neutral values of 0.0 and 1.0, suggesting that the selected standard tends to represent a better model of the survivorship estimates which are linked together. Further, the range of the estimates of β do not seem to vary much from the first iteration to the last iteration, suggesting that the estimates of β with age are fairly consistent and reasonable. The final estimates of β for Bangladesh appears to be 0.80.

Alternatively, the Coale-Demeny model life tables have been used in this study to check the validity of the Logit model.

The applications of the logit model and Coale-Demeny model life tables suggest that the results produced by them are more or less similar and that they are consistent. However, the logit model has been found to give more consistent values than the Coale-Demeny model life table systems. Moreover, the logit model has been found to give relatively higher values for the expectations of life at birth and represents the middle ground among the various models compared. This may be because the Coale-Demeny model life table systems are based mainly on European experiences and each of the life tables is based on one parameter. On the other hand, the logit model is a two parameter model which is likely to be more flexible and which can capture all the information contained in the data.

Furthermore, the expectations of life at various ages produced by the logit model appear to fall regularly according to the increase in age. This suggests that the age-specific expectations of life are not affected by age exaggeration. The results are not very far from other available estimates, and they are consistent.

The applications of the Brass Growth Balance method to the BBS data suggest that the results derived from retrospective information and widowhood are plausible and consistent.

Expectation of life at birth for Bangladesh appears to be 46.7. Expectations of life at birth have been found to be the highest in the Chittagong division (51.2) and the lowest in the Rajshahi division (43.2). This result is expected because the Chittagong division contains many important offices and industries. On the other hand, the Rajshahi divison is the least urbanised and least advanced in education.

The adult mortality indicated by the expectation of life at the age of 5 has been found to agree well with other indirect estimates. Most important thing is that the adult mortality appears to vary across regions in Bangladesh.

Appendix 5.1

Stable and Stationary Population

A stationary population is a population in which there has been a constant number of births occurring each year and the mortality pattern remains constant over time. Furthermore, in such a population the annual number of births and the annual number of deaths will be constant and equal. In consequence, the age structure of such a population will become static. In addition, the stationary population is also closed to migration, and in such a population, the crude birth rate equals the crude death rate, which in turn is equal to the reciprocal of the life expectancy at birth.

On the other hand, the concept of stable population was initially suggested and subsequently proven and developed by Alfred J. Lotka,

Lotka demonstrated that if a closed population can be assumed, and can be subjected to a schedule of constant age specific fertility and mortality, then over a long period of time, a constant age distribution will tend to emerge which tends to increase in size at a constant rate. A stable population, therefore, represents one with a constant age distribution, which is likely to increase at a constant rate. In a stable population, the crude birth rate and death rate, e_o, and the other measures of population pattern remain unchanged, although the absolute number in age group tends to increase at a constant rate. This constant rate obviously implies the intrinsic rate of natural increase, r. In a stable population, however, the probability of living or dying is governed by the life table derived from empirically obtained age specific mortality rates. The most important thing to note is that the intrinsic rate of natural increase represents that constant rate which a closed population having constant age specific fertility and mortality rates will tend to reach eventually.

Finally,, it may be noted that a stationary population tends to represent a special case of a stable population with a zero growth rate and an age distribution which is the life table distribution.

A 5.1

Calculation of K values, Females, Bangladesh (BRSFM) 1974.

Age	M	D	W	D-W	M-W	$K=\frac{D-W}{M-W}$
10-14	276696	6708	4741	1967	271955	.0072
15-19	2027891	56026	31472	24564	1996419	.0123
20-24	2525471	105251	48242	57009	2477229	.0230
25-29	2575958	152611	79334	73277	2496624	.0294
30-34	2003469	210694	115629	95065	1887840	.0504
35-39	1765848	284981	177037	107944	1588811	.0679
40-44	1474309	367563	262790	104773	1211519	.0865
45-49	1130604	365772	296957	68815	833647	.0825
50-54	1042799	474270	422448	51822	620351	.0835
55-59	603187	338132	312740	25392	290447	.0874
60-64	688898	477935	460656	17279	228242	.0757
65-69	319623	236432	227922	8510	91701	.0928
70-74	322408	277102	273108	3994	49300	.0810
75-79	121377	103806	103037	769	18340	.0419
80-84	112502	102507	101696	811	10806	.0751
85+	76665	71722	71515	207	5150	.0402
Total	17067705	3631522	2989324	642198	14078381	.0456

M = Number of ever married women

W = Number of widowed women

D = Number of first husband dead

Table A5.1

Calculation of K values, Females, Dhaka Division (BRSFM) 1974.

Age	M	D	W	M-W	D-W	$K=\frac{D-W}{M-W}$
10-14	53232	1243	1036	52196	207	.0040
15-19	588661	14499	8699	579962	5800	.0100
20-24	756643	29412	13256	743387	16156	.0217
25-29	747323	39355	19470	727853	19885	.0273
30-34	566913	56132	30655	536258	25477	.0475
35-39	518237	76845	51990	466247	24855	.0533
40-44	442843	105015	81401	361442	23614	.0653
45-49	339070	101700	81609	257461	20091	.0780
50-54	320636	142505	126970	193666	15535	.0802
55-59	192424	105015	97765	94659	7250	.0766
60-64	203815	135877	130284	73531	5593	.0761
65-69	101907	72702	70216	31691	2486	.0784
70-74	99215	84716	83058	16157	1658	.1026
75-79	41840	36040	35626	6214	414	.0666
80-84	35834	33141	32726	3108	415	.1335
85+	27341	25063	24855	2486	208	.0837
Total	5035934	1059260	889616	4146318	169644	.0409

Table A5.1

Calculation of K values, Females, Chittagong Division (BRSFM) 1974.

Age	M	D	W	M-W	D-W	$K = \frac{D-W}{M-W}$
10-14	38865	1467	1100	37765	367	.0097
15-19	447313	14116	10449	436864	3667	.0084
20-24	645121	25299	15399	629722	9900	.0157
25-29	684902	39598	23099	661803	16499	.0249
30-34	569041	57564	33182	535859	24382	.0455
35-39	469313	69664	47298	422015	22366	.0530
40-44	385899	86896	68196	317703	18700	.0589
45-49	280487	83046	72230	208257	10816	.0519
50-54	280121	123561	112928	167193	10633	.0636
55-59	142810	75163	70580	72230	4583	.0635
60-64	188458	124844	122095	66363	2749	.0414
65-69	77180	56281	54448	22732	1833	.0806
70-74	82313	71313	70947	11366	366	.0322
75-79	27132	22916	22549	4583	367	.0801
80-84	27132	24382	24382	2750	0	-
85+	23099	21816	21815	1284	1	.0008
Total	4369186	897926	773447	3595739	124479	.0346

Table A5.1

Calculation of K values, Females, Khulna Division (BRSFM) 1974.

Age	M	D	W	M-W	D-W	K= (D-W)/(M-W)
10-14	84828	1346	769	84059	577	.0069
15-19	434914	12118	5386	429528	6732	.0157
20-24	488581	21159	6732	481849	14427	.0299
25-29	501854	30200	16158	485696	14042	.0289
30-34	376823	42318	24044	352779	18274	.0518
35-39	350854	61553	36740	314114	24813	.0790
40-44	298919	74249	51167	247752	23082	.0932
45-49	232750	86560	69055	163695	17505	.1069
50-54	206204	95600	84636	121568	10964	.0901
55-59	119645	70017	64824	54821	5193	.0947
60-64	141765	102140	98101	43664	4039	.0925
65-69	67901	55013	53474	14427	1539	.1067
70-74	65593	55783	54629	10964	1154	.1053
75-79	24044	20774	20582	3462	192	.0555
80-84	24236	21928	21736	2500	192	.0768
85+	15003	14234	14234	769	0	-
Total	3433914	764992	622267	2811647	142725	.0508

Table A5.1

Calculation of K values, Females, Rajshahi Division (BRSFM) 1974.

Age	M	D	W	D-W	M-W	$K=\frac{D-W}{M-W}$
10-14	99770	2652	1836	816	97934	.0083
15-19	557002	15302	6937	8365	550065	.0152
20-24	634942	29380	12854	16526	622088	.0266
25-29	641879	43458	20607	22851	621272	.0368
30-34	490693	54680	27749	26931	462944	.0582
35-39	427443	76919	41010	35909	386433	.0929
40-44	346647	101403	62026	39377	284621	.1383
45-49	278297	94466	74036	20403	204234	.0999
50-54	235655	112421	97730	14691	137925	.1065
55-59	148126	87937	79572	8365	68544	.1220
60-64	154859	115073	110176	4897	44683	.1096
65-69	72635	52437	49783	2654	22852	.1161
70-74	75287	65290	64473	817	10814	.0756
75-79	28361	24076	24280	-204	4081	. -
80-84	25299	23055	22852	203	2447	.0830
85+	11222	10610	10609	1	613	.0016
Total	4228117	909158	708189	200969	3519928	.0571

Table A5.1

Calculation of K values, Females, Muslim (BRSFM) 1974.

Age	M	D	W	M-W	D-W	K= (D-W)/(M-W)
10-14	248933	6312	4345	244588	1967	.0080
15-19	1769701	48925	26777	1742924	22148	.0127
20-24	2164434	93550	40286	2124148	53264	.0251
25-29	2176677	131748	62845	2113832	68903	.0326
30-34	1702820	180026	88504	1614316	91522	.0567
35-39	1488456	240975	138836	1349620	102139	.0757
40-44	1237941	310370	210332	1027609	100038	.0974
45-49	931483	269698	230068	701415	66630	.0950
50-54	862798	393568	343707	519091	49861	.0961
55-59	493493	274360	249969	243524	24391	.1002
60-64	559443	384624	367529	191914	17095	.0891
65-69	257671	188351	180604	77067	7747	.1005
70-74	263157	225933	222122	41035	3811	.0929
75-79	95969	81090	80321	15648	769	.0491
80-84	89823	81742	80931	8892	811	.0912
85+	62129	57576	57369	4760	207	.0435
Total	14404928	2995848	2384545	12020383	611303	.0509

Table A5.1

Calculation of K values, Females, Hindus (BRSFM) 1974.

Age	M	D	W	M-W	D-W	K= (D-W)/(M-W)
10-14	26435	396	396	26039	0	. -
15-19	238690	6744	4328	234362	2416	.0103
20-24	326096	11150	7773	318323	3377	.0106
25-29	356042	19710	15335	340707	4375	.0128
30-34	261700	28790	25635	236065	3155	.0134
35-39	245647	41696	36278	209369	5418	.0259
40-44	209020	52494	48904	160116	3590	.0224
45-49	178593	64973	63154	115439	1819	.0158
50-54	157243	73945	72167	85076	1778	.0209
55-59	99336	60404	59404	39932	1000	.0250
60-64	11769	86953	86953	29816	0	-
65-69	55410	43610	43030	12380	580	.0468
70-74	53703	46904	46905	6798	-1	-
75-79	23734	21409	21409	2325	0	0
80-84	20783	19437	19437	1346	0	0
85+	13404	13197	13196	208	1	.0048
Total	2382605	591812	564304	1818301	27508	.0151

A 5.2

Calculation of K_{40+}, K_{45+}, ..., Females, Bangladesh (BRSFM), 1974.

Age	D-W	M-W	$K = \frac{D-W}{M-W}$
40+	282372	3359503	.0841
45+	177599	2147984	.0827
50+	108784	1314337	.0828
55+	56962	693986	.0821
60+	31570	403539	.0782
65+	14291	175297	.0815
70+	5781	83596	.0692
75+	1787	34296	.0521
80+	1018	15956	.0638
85+	207	5150	.0402

A 5.2

Calculation of K_{40+}, K_{45+},...., Females, Dhaka Division (BRSFM), 1974.

Age	M-W	D-W	$K = \frac{D-W}{M-W}$
40+	1040415	77264	.0743
45+	678973	53650	.0790
50+	421512	33559	.0796
55+	227846	18024	.0791
60+	133187	10774	.0809
65+	59656	5181	.0868
70+	27965	2695	.0964
75+	11808	1037	.0878
80+	5594	623	.1114
85+	2486	208	.0837

A 5.2

Calculation of K_{40+}, K_{45+},...., Females, Chittagong Division (BRSFM), 1974.

Age	M-W	D-W	$K = \frac{D-W}{M-W}$
40+	874461	50048	.0572
45+	556758	31348	.0563
50+	348501	20532	.0589
55+	181308	9899	.0546
60+	109078	5316	.0487
65+	42715	2567	.0601
70+	19983	734	.0367
75+	8617	368	.0427
80+	4034	1	.0002
85+	1284	1	.0008

A 5.2

Calculation of K_{40+}, K_{45+},...., Females, Khulna Division (BRSFM), 1974.

Age	M-W	D-W	$K = \frac{D-W}{M-W}$
40+	663622	63860	.0962
45+	415870	40778	.0981
50+	252175	23273	.0923
55+	130607	12309	.0942
60+	75786	7116	.0939
65+	32122	3077	.0958
70+	17695	1538	.0869
75+	6731	384	.0570
80+	3269	192	.0589
85+	769	0	-

A 5.2

Calculation of K_{40+}, K_{45+},...., Females, Rajshahi Division (BRSFM), 1974.

Age	D-W	M-W	$K = \frac{D-W}{M-W}$
40+	91204	780824	.1168
45+	51827	496203	.1044
50+	31424	291969	.1076
55+	16733	154044	.1086
60+	8368	85490	.0979
65+	3471	40807	.0851
70+	817	17955	.0455
75+	0	7141	-
80+	204	3060	.0667
85+	1	613	.0016

A 5.2

Calculation of K_{40+}, K_{45+},...., Females, Muslim (BRSFM), 1974.

Age	M-W	D-W	$K = \frac{D-W}{M-W}$
40+	2830955	271360	.0959
45+	1803346	171322	.0950
50+	1101931	104692	.0950
55+	582840	54831	.0941
60+	339316	30440	.0897
65+	147402	13345	.0905
70+	70335	5598	.0796
75+	29300	1787	.0610
80+	13652	1018	.0746
85+	4760	207	.0435

A 5.2

Calculation of K_{40+}, K_{45+},...., Females, Hindus (BRSFM), 1974.

Age	M-W	D-W	$K = \frac{D-W}{M-W}$
40+	453436	8767	.0193
45+	293320	5177	.0176
50+	177881	3358	.0189
55+	92805	1580	.0170
60+	52873	580	.0110
65+	230572	580	.0252
70+	10677	0	0
75+	3879	1	.0003
80+	1554	1	.0006
85+	208	1	.0048

A 5.3

Calculation of Never Widowed Females, Bangladesh, 1981.

Age	M (000)	M (000)	$\frac{W}{M}$	$1-\frac{W}{M}$	K	$K(1-\frac{W}{M})$	$\frac{D}{M}$	$1-\frac{D}{M}$
15-19	2761	32	.0116	.9884	.0123	.0122	.0238	.9762
20-24	3354	57	.0117	.9830	.0230	.0226	.0396	.9604
25-29	3138	89	.0284	.9716	.0294	.0286	.0570	.9430
30-34	2447	126	.0515	.9485	.0504	.0478	.0993	.9007
35-39	2072	189	.0912	.9088	.0679	.0617	.1529	.8471
40-44	1761	300	.1704	.8296	.0841	.0698	.2402	.7598
45-49	1273	317	.2490	.7510	.0841	.0632	.3122	.6878
50-54	1255	458	.3649	.6351	.0841	.0534	.4183	.5817
55-59	692	310	.4480	.5520	.0841	.0464	.4944	.5056
60 +	2142	1430	.6676	.3324				
Total	21276	3290						

A 5.3

Calculation of Never Widowed Females, Dhaka Division, 1981.

Age	M	W	$\frac{W}{M}$	$1-\frac{W}{M}$	K	$K(1-\frac{W}{M})$
10-14	94744				.0004	
15-19	811598	9940	0.0122	0.9878	.0100	.0099
20-24	1029110	17294	0.0168	0.9832	.0217	.0213
25-29	946621	25757	0.0272	0.9728	.0273	.0266
30-34	740087	37198	0.0503	0.9497	.0475	.0451
35-39	612961	54715	0.0893	0.9107	.0533	.0485
40-44	531777	89917	0.1691	0.8309	.0743	.0617
45-49	376333	92077	0.2447	0.7553	.0743	.0561
50-54	379375	141600	0.3732	0.6268	.0743	.0466
55-59	202614	89079	0.4396	0.5604	.0743	.0416
60-64	276853	162084	0.5855	0.4145	.0743	.0308

Dhaka Division, 1981.

Age	$\frac{D}{M} = K(1-\frac{W}{M}) + \frac{W}{M}$	$1-\frac{D}{M}$
10-14		
15-19	.0221	.9779
20-24	.0381	.9619
25-29	.0538	.9462
30-34	.0954	.9046
35-39	.1378	.8622
40-44	.2308	.7692
45-49	.3008	.6992
50-54	.4198	.5802
55-59	.4812	.5188
60-64	.6163	.3837

A 5.3

Calculation of Never Widowed Females, Chittagong Division, 1981.

Age	M	W	$\frac{W}{M}$	$1-\frac{W}{M}$	K	$K(1-\frac{W}{M})$
10-14	68596				.0097	
15-19	598796	6949	0.0116	0.9884	.0084	.0083
20-24	830663	12532	0.0151	0.9849	.0157	.0155
25-29	818403	19699	0.0241	0.9759	.0249	.0243
30-34	661781	30300	0.0458	0.9542	.0455	.0434
35-39	558254	44896	0.0804	0.9196	.0530	.0487
40-44	475338	73016	0.1536	0.8464	.0572	.0484
45-49	336391	77514	0.2304	0.7696	.0572	.0440
50-54	340315	116827	0.3433	0.6567	.0572	.0376
55-59	177016	73547	0.4155	0.5845	.0572	.0334
60-64	239159	134225	0.5612	0.4388	.0572	.0251

Chittagong Division, 1981.

Age	$\frac{D}{M} = K(1-\frac{W}{M}) + \frac{W}{M}$	$1-\frac{D}{M}$
10-14		
15-19	.0199	.9801
20-24	.0306	.9694
25-29	.0484	.9516
30-34	.0892	.9108
35-39	.1291	.8709
40-44	.2020	.7980
45-49	.2744	.7256
50-54	.3809	.6191
55-59	.4489	.5511
60-64	.5863	.4137

A 5.3

Calculation of Never Widowed Females, Khulna Division, 1981.

Age	M	W	$\frac{W}{M}$	$1-\frac{W}{M}$	K	$K(1-\frac{W}{M})$
10-14	89974				.0069	
15-19	577011	6177	0.0107	0.9893	.0157	.0155
20-24	640156	10221	0.0160	0.9840	.0299	.0294
25-29	599477	15477	0.0258	0.9742	.0289	.0282
30-34	466168	22569	0.0484	0.9516	.0518	.0493
35-39	401581	34610	0.0862	0.9138	.0790	.0722
40-44	342582	55258	0.1613	0.8387	.0962	.0807
45-49	259632	62655	0.2413	0.7587	.0962	.0730
50-54	237452	85288	0.3592	0.6408	.0962	.0616
55-59	143426	64183	0.4475	0.5525	.0962	.0532
60-64	173624	102863	0.5924	0.4076	.0962	.0392

Khulna Division, 1981.

Age	$\frac{D}{M} = K(1-\frac{W}{M}) + \frac{W}{M}$	$1-\frac{D}{M}$
10-14		
15-19	.0262	.9738
20-24	.0454	.9546
25-29	.0454	.9460
30-34	.0977	.9023
35-39	.1584	.8416
40-44	.2420	.7580
45-49	.3143	.6857
50-54	.4208	.5792
55-59	.5007	.4993
60-64	.6316	.3683

A 5.3

Calculation of Never Widowed Females, Rajshahi Division, 1981.

Age	M	W	$\frac{W}{M}$	$1-\frac{W}{M}$	K	$K(1-\frac{W}{M})$
10-14	127734				.0083	
15-19	774427	9391	0.0121	0.9879	.0152	.0150
20-24	853831	16395	0.0192	0.9808	.0266	.0261
25-29	774104	25563	0.0330	0.9670	.0368	.0356
30-34	579024	36063	0.0623	0.9377	.0582	.0546
35-39	498631	54674	0.1096	0.8904	.0929	.0827
40-44	411136	81892	0.1992	0.8008	.1168	.0935
45-49	300241	84757	0.2823	0.7177	.1168	.0838
50-54	298179	114344	0.3835	0.6165	.1168	.0720
55-59	169499	84540	0.4988	0.5012	.1168	.0585
60-64	203608	127586	0.6266	0.3734	.1168	.0436

Rajshahi Division, 1981.

Age	$\frac{D}{M} = K(1-\frac{W}{M}) + \frac{W}{M}$	$1-\frac{D}{M}$
10-14		
15-19	.0271	.9729
20-24	.0453	.9547
25-29	.0686	.9314
30-34	.1169	.8831
35-39	.1923	.8077
40-44	.2927	.7073
45-49	.3661	.6339
50-54	.4555	.5445
55-59	.5573	.4427
60-64	.6702	.3298

A 5.4

Calculation of K Values, Males, Bangladesh (BRSFM), 1974.

Age	M	W	D	M-W	D-W	$K = \frac{D-W}{M-W}$
10-14	14567	405	789	14162	384	.0271
15-19	155448	3199	4961	152249	1762	.0116
20-24	895772	20156	35700	875616	16544	.0189
25-29	1950513	25625	92546	1924888	66921	.0348
30-34	1972334	29049	134921	1943285	105872	.0545
35-39	2027962	32885	172439	1995077	139554	.0699
40-44	1705023	31464	210906	1673559	179442	.1072
45-49	1356504	37211	215765	1319293	178554	.1353
50-54	1207276	44353	251619	1162923	207266	.1782
55-59	789553	37946	190590	751607	152644	.2031
60-64	869356	64561	247390	804795	182829	.2272
65-69	435762	37781	137962	397981	100181	.2517
70-74	465710	59757	178162	405953	118405	.2917
75-79	186986	29016	73272	157970	44256	.2802
80-84	152019	27408	61929	124611	34521	.2770
85 +	113075	27465	60039	85610	32574	.3805

A 5.4

Calculation of K Values, Males, Dhaka Division (BRSFM), 1974.

Age	D	M	W	K
10-14	608	2837	405	.0835
15-19	2229	33036	1622	.0193
20-24	8310	254966	4459	.0154
25-29	27159	587962	7499	.0339
30-34	40535	602351	7904	.0549
35-39	48034	627483	9121	.0629
40-44	57154	511552	8107	.0974
45-49	59181	399676	11553	.1227
50-54	72355	366234	12971	.1681
55-59	50466	235306	9323	.1821
60-64	71950	256993	18241	.2250
65-69	34252	122821	8513	.2252
70-74	52088	145724	17025	.2724
75-79	22497	63235	9120	.2472
80-84	18241	45602	7296	.2857
85+	19457	36684	7296	.4138

A 5.4

Calculation of K Values, Males, Chittagong Division (BRSFM), 1974.

Age	D	M	W	K
10-14	181	-	-	-
15-19	723	23869	181	.0229
20-24	5967	174498	3074	.0169
25-29	14828	460206	4521	.0226
30-34	30922	521507	8318	.0440
35-39	41590	553875	10488	.0572
40-44	45930	443751	8318	.0864
45-49	51536	361655	7595	.1241
50-54	60035	326575	11935	.1529
55-59	42314	194752	9765	.1760
60-64	58226	228385	17902	.1916
65-69	28752	113199	8861	.1906
70-74	50270	133632	19529	.2694
75-79	16094	46654	6690	.2353
80-84	15009	38697	7052	.2514
85+	16094	31284	8318	.3386

A 5.4

Calculation of K Values, Males, Khulna Division (BRSFM), 1974.

Age	D	M	W	K
10-14	-	-	-	-
15-19	786	39891	786	. -
20-24	10611	186289	5699	.0272
25-29	26529	397929	6681	.0507
30-34	30066	379064	5699	.0653
35-39	35568	374544	4520	.0839
40-44	47948	333867	6485	.1267
45-49	45786	271574	7271	.1457
50-54	53450	234041	8450	.1995
55-59	43232	166639	7861	.2228
60-64	52861	181574	13756	.2330
65-69	33210	96289	10022	.2688
70-74	37926	89215	11594	.3392
75-79	15131	35961	6485	.2933
80-84	12183	30655	4913	.2824
85+	9825	19650	4520	.3506

A 5.4

Calculation of K Values, Males, Rajshahi Division (BRSFM), 1974.

Age	D	M	W	K
10-14	-	-	-	-
15-19	1222	58651	611	.0105
20-24	11812	280018	6924	.0179
25-29	24031	504236	6924	.0344
30-34	33398	469411	7127	.0568
35-39	47247	473060	8757	.0831
40-44	59873	415852	8553	.1260
45-49	59262	323599	10793	.1549
50-54	65779	280425	10997	.2033
55-59	54578	192856	10997	.2396
60-64	64353	202224	14662	.2649
65-69	41748	103454	10386	.3370
70-74	37879	97141	11608	.3071
75-79	19550	41137	6721	.3728
80-84	16496	37065	8145	.2888
85+	14663	25456	7332	.4045

A 5.5

Calculation of Never Widowed Males, Bangladesh, 1981.

Age	M	W	K	K(1- $\frac{D}{M}$)	$\frac{D}{M}$	1- $\frac{D}{M}$
15-19	278436	2912	0.0116	0.0115	0.0219	0.9781
20-24	1307066	8736	0.0189	0.0188	0.0255	0.9745
25-29	255399	12811	0.0348	0.0346	0.0396	0.9604
30-34	233670	12140	0.0545	0.0542	0.0594	0.9406
35-39	2304259	14101	0.0699	0.0695	0.0756	0.9244
40-44	1883527	17555	0.1072	0.1062	0.1155	0.8845
45-49	1565751	19426	0.1353	0.1336	0.1460	0.8540
50-54	1393386	27301	0.1782	0.1747	0.1943	0.8057
55-59	913000	23158	0.2031	0.1979	0.2233	0.7767
60-64	1027741	51401	0.2272	0.2158	0.2659	0.7342

A 5.5

Calculation of Never Widowed Males, Dhaka Division, 1981.

Age	M	W	K	$K(1-\frac{D}{M})$	$\frac{D}{M}$	$1-\frac{D}{M}$
15-19	74869	921	0.0193	0.0191	0.0313	0.9686
20-24	379889	2700	0.0154	0.0153	0.0223	0.9776
25-29	799938	3974	0.0339	0.0337	0.0386	0.9613
30-34	734772	3560	0.0549	0.0546	0.0594	0.9405
35-39	718284	4022	0.0629	0.0625	0.0681	0.9319
40-44	580562	4938	0.0974	0.0966	0.1050	0.8949
45-49	474553	5208	0.1227	0.1214	0.1323	0.8677
50-54	430271	7670	0.1681	0.1651	0.1829	0.8171
55-59	266757	5924	0.1821	0.1781	0.2002	0.7997
60-64	313016	13947	0.2250	0.2150	0.2595	0.7405

A 5.5

Calculation of Never Widowed Males, Chittagong Division, 1981.

Age	M	W	K	$K(1-\frac{D}{M})$	$\frac{D}{M}$	$1-\frac{D}{M}$
15-19	46088	408	0.0229	0.0227	0.0316	0.9685
20-24	238356	1827	0.0169	0.0168	0.0244	0.9756
25-29	562103	3324	0.0226	0.0225	0.0284	0.9716
30-34	577360	3524	0.0440	0.0437	0.0498	0.9501
35-39	587082	3986	0.0572	0.0568	0.0636	0.9364
40-44	488482	4887	0.0864	0.0855	0.0955	0.9044
45-49	404800	5060	0.1241	0.1225	0.1350	0.8650
50-54	374219	7138	0.1529	0.1499	0.1691	0.8309
55-59	236563	5632	0.1760	0.1718	0.1956	0.8044
60-64	279457	17447	0.1916	0.1796	0.2421	0.7579

A 5.5

Calculation of Never Widowed Males, Khulna Division, 1981.

Age	M	W	K	$K(1-\frac{D}{M})$	$\frac{D}{M}$	$1-\frac{D}{M}$
15-19	66480	593	0.0000	0.0000	0.0089	0.9911
20-24	276320	1677	0.0272	0.0270	0.0331	0.9669
25-29	507463	2162	0.0507	0.0505	0.0547	0.9453
30-34	450339	1914	0.0653	0.0650	0.0693	0.9307
35-39	446232	2267	0.0839	0.0835	0.0886	0.9115
40-44	368639	3119	0.1267	0.1256	0.1341	0.8659
45-49	319982	3842	0.1457	0.1440	0.1560	0.8440
50-54	266582	5541	0.1995	0.1954	0.2161	0.7839
55-59	188827	5299	0.2228	0.2166	0.2446	0.7554
60-64	200573	9654	0.2330	0.2218	0.2699	0.7301

A 5.5

Calculation of Never Widowed Males, Rajshahi Division, 1981.

Age	M	W	K	$K(1-\frac{D}{M})$	$\frac{D}{M}$	$1-\frac{D}{M}$
15-19	90999	787	0.0105	0.0104	0.0191	0.9809
20-24	412497	2532	0.0179	0.0178	0.0239	0.9761
25-29	684495	3351	0.0344	0.0342	0.0391	0.9609
30-34	571199	3142	0.0568	0.0565	0.0620	0.9380
35-39	552661	3826	0.0831	0.0825	0.0894	0.9106
40-44	445844	4611	0.1260	0.1247	0.1350	0.8650
45-49	366414	5316	0.1549	0.1527	0.1672	0.8328
50-54	322311	6952	0.2033	0.1989	0.2205	0.7795
55-59	220853	6303	0.2396	0.2327	0.2613	0.7387
60-64	234695	10352	0.2649	0.2532	0.2973	0.7027

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