Distr.
GENERAL

E/ESCWA/SD/89/10
24 December 1989

ORIGINAL: ENGLISH

UNITED NATIONS

ECONOMIC AND SOCIAL COMMISSION

FOR WESTERN ASIA

SOCIAL DEVELOPMENT, POPULATION AND
HUMAN SETTLEMENTS DIVISION

# INFANT AND CHILDHOOD MORTALITY
# IN
# WESTERN ASIA

December 1989

E/ESCWA/SD/89/10

90-0021

Distr.
GENERAL
E/ESCWA/SD/89/10/Corr.1
10 June 1990
ORIGINAL: ENGLISH

# UNITED NATIONS

# ECONOMIC AND SOCIAL COUNCIL

## ECONOMIC AND SOCIAL COMMISSION FOR WESTERN ASIA



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**INFANT AND CHILDHOOD MORTALITY
IN
WESTERN ASIA**

Corrigendum

1. To be added to "References", pp. 40-46.

EL-Shalakani, M. H. 1984a. Level and Pattern of Mortality in the Kuwait Population, 1980. Population Bulletin of the United Nations Economic Commission for Western Asia (Baghdad, Iraq), No. 25, pp. 89-106.

El-Shalakani, M. H. 1984b. Levels of Mortality and Relative Contribution by Socio-Economic and Health Related Factors in Arab Countries. The Egyptian Population and Family Planning Review (Cairo, Egypt), vol. 18, No. 2, pp. 119-150.

United Nations Economic Commission for Western Asia. 1980a. Statistical Indicators of the Arab World for the Period 1970-1978. Beirut, Lebanon.

United Nations Economic Commission for Western Asia. 1980b. Syrian Arab Republic. The Population Situation in the ECWA Region. Beirut, Lebanon.

United Nations Economic Commission for Western Asia. 1980c. United Arab Emirates. The Population Situation in the ECWA Region. Beirut, Lebanon.

2. To be added to table 1, p. 47.

Sources:

Bahrain: Figures for 1975-1976 were calculated by the author. Figures for 1977-1987 were compiled from Bahrain Central Statistics Organization (1988). The figures for 1988 were compiled from Bahrain Ministry of Health (1989).

Egypt: Figures for 1960-1976 were compiled from H. Rashad (1981). Figures for 1977-1980 were compiled from Egypt, Central Agency for Public Mobilization and Statistics (several issues). The figures for 1981 was compiled from United Nations, Department of International Economic and Social Affairs (1987). The figure for 1982 is from United Nations, Department of International Economic and Social Affairs (1988c).

Jordan: Figures for 1961-1970 were compiled from M. Sivamurthy and A. A. Ma'ayta (1982). The figures for 1971-1979 were compiled from United Nations, Department of International Economic and Social Affairs (several issues).

Kuwait: Figures for both sexes in 1965 were compiled from K. L. Kohli and M. Al-Omaim and F. G. Torki (1982, 1986). The male and female figures for 1965-1968 were compiled from M. Sivamurthy and F. G. Torki (1982). The figures for 1973-1976 were compiled from A. Y. A. al-Sabah and M. H. el-Shalakani (1986). The figures for 1965-1986 were compiled from Kuwait Central Statistical Office (1980 through 1988).

U.A.E.: All figures for 1977-1982 and 1984 were compiled from U.A.E. Ministry of Planning (1979, 1984) and Abu Dhabi Department of Planning (several issues). Figures for 1983 and 1987 were obtained from the Khaleej Times (1989).

**NOTE**

The present publication on Infant and Child Mortality in Western Asia comprises two studies. The first one, dealing with patterns and trends of infant mortality in six Arab countries, namely Bahrain, Egypt, Jordan, Kuwait, Syria and the United Arab Emirates, was undertaken by Dr. Nabil Al-Khorazaty, Cairo University, Cairo, Egypt according to a framework prepared by ESCWA Population Programme staff. The second study, analysing socio-economic differentials of child mortality in Jordan, was finalized and written by Dr. Kenneth Hill, The Johns Hopkins University, Baltimore, Maryland, USA, from data processed by ESCWA Population Programme staff, according to analytical methods carried out by the United Nations Population Division.

Complimentary copies of this publication are available for researchers and training institutions interested in Arab population questions from:

Social Development and Population Division
ESCWA
P.O. Box 27
Baghdad, Iraq.

This publication has been made possible by a grant from the
**UNITED NATIONS POPULATION FUND**

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# LEVELS AND TRENDS OF INFANT AND CHILDHOOD MORTALITY IN SELECTED ESCWA COUNTRIES

## 1. INTRODUCTION

Mortality studies have received increased attention in recent years. While mortality is one of the three factors that contribute to population growth (the other two being fertility and migration), it is the recent trends in mortality that have spurred this emphasis. In addition to its direct or indirect effect on fertility, and thus on various aspects of social and economic planning of a nation, demographers are concerned recently about slackened mortality trends in the so-called developing countries. Thus, examination and identification of reliable estimates of levels and trends of mortality are gaining increased interest. With mortality under age five representing up to 50 per cent of the total number of deaths in some developing countries, the renewed emphasis in mortality studies focuses more on infant and childhood mortality.

Controversy over estimates of mortality levels, especially those of infant and childhood mortality, exists in countries lacking adequate vital registration systems. "There are very few developing countries where the most reliable information on mortality, deriving from a complete death registration combined with population censuses, is available," (United Nations, Department of International Economic and Social Affairs, 1982). At best a vital registration system may account for only a fraction of the actual number of deaths occurring in such countries, and, thus, levels of mortality are debatable. Most developing countries encounter this problem, and efforts to rectify it have long been attempted. Middle Eastern, and particularly Arab countries, are considered among those countries with very questionable and unreliable vital registration data. But since relatively little is known specially about the status of civil registration and vital statistics [systems] in the Arab countries" (International Institute for Vital Registration and Statistics, 1988), evaluation and assessment of the various aspects of those systems for the purpose of improvement are difficult. More details on the organization and status of civil registration and vital statistical systems in the Arab countries are found in El-Shalakani (1984b) and the International Institute for Vital Registration and Statistics(1988).

Data are available on only three aspects of civil registration : the date of its establishment, the issuance of vital statistics, and some measure of completeness - the last of which is the most useful index. Death registration in the early 1970s in countries such as Bahrain, Jordan, and Syria accounted for around one-third of the estimated total number of deaths (Vaidyanathan and Fouda, 1982). A recent survey by the International Institute for Vital Registration and

Statistics conducted in 1984 showed that death registration is 54 per cent complete in Syria (International Institute for Vital Registration and Statistics, 1988). While a death registration system was started in 1952 in Jordan and only in 1971 in Bahrain, one has been in operation since 1922 in Syria. The civil registration system did not start in the U.A.E. until the year 1976.

Only in Egypt, where the registration system dates back as far as 1912, and Kuwait, whose system is fairly new (started in 1964), is the completeness of death registration at least 90 per cent. The International Institute for Vital Registration and Statistics survey found that death registration in Egypt, Jordan, and Kuwait is considered complete (International Institute for Vital Registration and Statistics,1988). However, for Egypt this might be true for completeness of registration at ages five and above, but not for ages less than five. Bucht and El-Badry (1984) found that "the degree of underregistration of the infant mortality rate in 1974-75 [was] ... 44 per cent in rural areas and 6.5 per cent in urban areas [in Egypt]," while Rashad (1981) stated that "registered infant mortality rates for recent years [late 1970's] are only 75 per cent complete while adults rates are almost 100 per cent complete." This situation is well-known; as Brass (1975) put it, "when registration has reached a good level of efficiency, any residual deficiency is likely to be in the reporting of deaths ... of young children in the first year of life." Also, there is a larger tendency to underregister female dead children then male ones. Thus, coverage of death events differs largely among Arab countries, and among sexes and geographic regions within these countries.

In addition to the lack of the completeness of death registration, delayed registration of vital events and misreporting of the age at which the event took place also characterize registration systems in Arab countries. For example, about 15 per cent of Bahraini births registered in 1986 were born in earlier years, some as far back as 1970 (Bahrain, Central Statistics Organisation, 1987). Even when registration of deaths takes place, overstatement of age at death is a common practice. Accordingly, estimation of levels of infant and childhood mortality occupies an important position in demographic literature, in general, and in mortality literature, in particular.

On the other hand, infant and childhood mortality are sensitive indicators of the health situation and level of socio-economic development in a society, and thus are considered as two of the prime measures of welfare and development. While over 97 per cent of all children in developed countries survive through age five, only 75 to 80 per cent of all children in developing countries reach their fifth birthday (United Nations Children's Fund, 1984). Since these deaths are preventable with the current medical technology, the United Nations has set a target of 70 deaths under age five per 1000 live births to be achieved in all nations by the year 2000. The under-five mortality rate "reflects the nutritional health and the health knowledge of mothers; the level of immunization and ORT [oral rehydration therapy] use; the availability of maternal and child health services; income and food availability in the family; the availability of clean water and safe sanitation; and the overall safety of the child's environment," (United Nations Children's Fund, 1989). This index is therefore chosen by United Nations Children's Fund as its single most important indicator of the state of a country's children.

Accordingly, it is of paramount importance that measures of infant and childhood mortality be estimated with a high degree of accuracy. This would allow both levels and trends to be assessed, various social and health programs to be evaluated and, thus, actions to be taken. In the present study, data on several censuses and surveys for six Arab countries, namely, Bahrain, Egypt, Jordan, Kuwait, Syria, and the U.A.E., are analyzed according to relevant indirect methods for the period from 1955 till the present. As a result, vital registration statistics are evaluated in relation to completeness of infant and childhood mortality data. The purpose of this study is thus twofold: (1) to review the scattered and fragmented literature on estimates of infant and childhood mortality for the six Arab countries; and (2) to derive overlapping mortality measures, calculated using several data sources, in order to provide a basis for assessing the relative reliability of these sources and of vital registration systems.

Both information and studies on levels and trends of infant and childhood mortality for each of the six Arab countries, which are covered in this study, differ significantly among these countries. They are numerous for Egypt, Jordan, and Kuwait, but very scant for Bahrain, Syria, and the U.A.E. Review of the available literature will be divided into two sections: section 2 presents estimates of infant and childhood mortality which are based on data taken directly from vital registration systems, whether corrected for errors or not, or from surveys or censuses, but are not model-based estimates, and section 3 presents indirect estimates that use models and model-based assumptions, which, for convenience, may be referred to as Brass-type estimates.

Within this framework, infant and childhood estimates might be available from international organizations, such as the United Nations, the United Nations Children's Fund, the World Bank, the World Fertility Survey (WFS), etc., in which estimates are available for more than one of the six countries under study, from conferences held on this subject (e.g., Cairo Demographic Centre, 1982), or from individual studies that dealt with only one of the six countries. Data and rates presented for Bahrain, Kuwait, and the U.A.E. in the present study are for nationals only unless otherwise mentioned. Section 4 discusses the various sources of data and the methodology used in the present study. Results of the analyses conducted in this study on various sources of data available are demonstrated in section 5, followed by a summary and conclusions section.

## 2. DIRECT ESTIMATES OF INFANT AND CHILDHOOD MORTALITY

Direct estimates based on counts of child deaths, live births, and surviving children in vital registration systems, or birth/fertility history data, or household questionnaires assume that reporting and/or coverage are complete and accurate. However, disparities between registered/reported mortality rates and those estimated using various well-established indirect techniques shed some doubts on this assumption. Information available on direct mortality rates are presented in two sub-sections, dealing with mortality rates from vital registration data and those from surveys or censuses.

### 2.1 Infant and Childhood Mortality Rates based on Vital Registration Data

#### 2.1.1 Reported Vital Registration Data

Various sources were consulted to obtain registered infant and childhood mortality rates available from civil registration systems of the six countries for the period since 1955. However, because most of these systems were not in operation until recently (Bahrain, Jordan, Kuwait, the U.A.E.), or because mortality data were not published due to known high underregistration rates (Jordan, Syria), or because of a substantial time-lag between data collection and the publication of compiled statistics (Egypt), infant mortality rates are available only for a few years for these countries, as shown in Table 1. Data are mainly from the statistical yearbooks of each country or published secondary sources such as the UN demographic/statistical yearbooks. Detailed sources for the table are shown in the page following the table.

One should be careful in drawing definitive conclusions from this section about levels or trends of infant mortality, and any generalizations are necessarily hazardous and tenuous. Accordingly, no mention of percentage annual decline in mortality rates is given in this subsection.
In addition, each country is dealt with separately and no comparisons of levels of mortality will be attempted, since the completeness of vital registration systems varies widely among the six countries. The purpose of this section is only to present registered mortality rates for later evaluation of vital registration systems in these countries.

Registered infant mortality rates (IMRs) shown in Table 1 (and Figure 1) indicate that Egypt, with the longest available series, has a considerably high IMR. The registered rate was 136 infant deaths per 1000 live births in 1955, fluctuating sharply to reach 116 by the year 1972, then declining almost steadily afterwards to around 70-71 in the early 1980s - still a high rate. The observed sudden increase between the years 1961 and 1962 may be due to the change in the administration of the civil deaths registration system (Rashad, 1981; Bucht and El-Badry, 1984; and Egypt, Central Agency for Public Mobilization and Statistics, 1986). The decline, especially through 1972, has not been particularly rapid in comparison with other developing countries which experienced rapid declines since the end of World War II. The rate of decline could be faster than that observed if underregistration is considered, assuming that completeness of death registration has improved over the years.

Kuwait shows the second longest series among the six countries. It is the only other country besides Egypt with completeness of death registration of over 90 per cent. IMRs fluctuated during the period 1965-77 and then steadily declined over the period 1977-86. IMRs among the nationals fluctuated from 47 per 1000 live births in 1965, to only 32 in 1969, to 52 in 1973/74, then to 44 in 1977. Kohli and Al-Omaim (1986) pointed out that "registered [mortality] rates before 1970 are not very reliable. In the early 1970s there was a gradual upward trend in infant mortality rates until about 1974, which can be explained only by the improvement in registration of infant deaths." During the next decade IMRs declined rapidly to reach a value of only 16 in 1986. Provision of free health care and thus easy access to Western Asia medical services, establishment of high standards of hygiene, and accessibility to all goods and services available in highly developed societies (Hill, 1975), especially since the mid 1970s, are responsible for this accelerated rate of decline in IMRs.

The data on registered IMR's for the other four countries, shown in Table 1, should be considered with caution. As mentioned earlier, completeness of death registration in the early 1970s is about one-third of the actual number of deaths for Bahrain, Jordan, and Syria. In addition, the data available for the U.A.E. is only for the Abu Dhabi Emirate (A.D.E.), whose population represents about 38 and 43 per cent in the years 1975 and 1980, respectively, of the total population of the U.A.E.

For Jordan, data are available for the period 1961-80. The IMR values until the year 1966 represent both the East and the West Bank regions, while starting in 1967, the figures are for the East Bank region only. The data indicate that IMRs were stable in the early 1960s and started declining systematically since the mid 1960s to reach 11 in 1980 - about one-third its value 13 years earlier. Again, as in the case of Egypt, the decline could be faster if improvements in death registration over this period are taken into account.

Bahrain's data for the period 1975-88 connote no clear trend. However, with the civil registration system being introduced only in 1971, it is likely that death registration has improved over this period, thus implying a declining trend. Provision of free medical services would also assert the expected declining trend in mortality rates.

A major reason for death underregistration lies in the fact that a death certificate is not needed for burial purposes as in the other countries.

Syria and the U.A.E. (Abu Dhabi), on the other hand, show a declining trend in IMRs from 24 to only 13 over a period of six years (1971-77) for Syria, and from 33 to only 17 in just four years (1980-84) for the U.A.E. Halving of the rates in these short periods of time might be attributed "to improvements in public health facilities [in Syria]" (United Nations, Economic Commission for Western Asia, 1980a) and "as is the case in Bahrain, Kuwait, and other states in the Gulf, health services are provided free of charge in the United Arab Emirates" (United Nations, Economic Commission for Western Asia, 1980b). The registered IMRs declined even further to about 7 by 1984 for Syria, and to about 13 by 1987 for the U.A.E.

Sex of child is considered as one of the important demographic variables with a significant impact on infant and childhood mortality because of biological differences. Table 2 presents registered infant mortality rates for males and females calculated from vital registration data during the period 1955-88 in five of the six countries, excluding Syria. The data show that, in general, males have higher mortality than females except for the years 1979 and 1988 in Bahrain, all years in Egypt, years 1971 and 1972 in Jordan, and year 1977 in the U.A.E. However, no conclusions can be drawn from the data, since underreporting is expected to be higher in female deaths compared to male deaths, thus possibly reversing these results. Thus, the excess of female infant mortality rates in those countries might not be a genuine phenomenon. For example, Rashad (1981), using indirect methods and the 1976 census for Egypt, found that this is due to higher completeness of female death registration.

### 2.1.2 Adjusted Vital Registration Data

Appropriate adjustments for underregistration of death events and other errors, to obtain corrected measures from the basic data, were attempted only in Egypt and Kuwait (only for the 1960s, since Kuwait has had a complete account of death events since the early 1970s). The other four countries, namely, Bahrain, Jordan, Syria, and the U.A.E., all suffer from under-registration of deaths in the magnitude of 40 to 60 per cent of the total number of deaths. Thus, for these latter countries, it is logical to apply various indirect techniques of estimation rather than to attempt to adjust registered IMRs.

Underregistration of infant mortality in Egypt was estimated by several authors. However, incompleteness of infant death registration around the year 1960 ranged from 8 per cent (Valaoras, 1972) to 31 per cent (El-Badry, 1965) and 39 per cent (Hollingsworth, 1972). Accordingly, an intensive investigation survey of the civil registration system in Egypt was conducted in 1974/75 by Egypt, Central Agency for Public Mobilization and Statistics. The results suggest that registration is 13 per cent incomplete for all deaths and 33 per cent incomplete for infant deaths (Egypt, Central Agency for Public Mobilization and Statistics, 1979), and thus warrant an adjustment.

Application of a correction factor, estimated from indirect methods obtained from various censuses, to the registered IMRs in Egypt by the NRC (National Research Council, 1982) produced adjusted IMRs, and hence percentage underregistration for the period until 1976, as shown in Table 3. An earlier study by Fergany (1976), which adjusted the registered IMR figures for differentials in the place of occurrence and sex, and for age distribution at death within the first year, gave the adjusted IMRs presented in Table 3. The two studies reveal that under-registration in the reported number of deaths was around 50 to 60 per cent in the late 1950s, and then declined systematically to reach a value around 30 per cent in the 1970s. These results, shown in Figure 2, imply an IMR of around 200 per 1000 live births in the mid 1950s, which declined gradually afterwards to about 130 in the mid 1970s.

Using the corrected sex-age-specific death rates for Kuwait according to model life tables for the 1965 and 1970 censuses, Sivamurthy and Torki (1982) estimated the under-registration in infant deaths to be about 18 and 3 per cent for these two years, respectively. The results imply that infant death registration greatly improved in a short period of time and is to be considered as complete since the early 1970s.

## 2.2 Infant and Childhood Mortality Rates based on Survey/Census Data

Surveys or censuses may entail questions in fertility/birth or maternity histories pertaining to the calculation of infant and childhood mortality rates, either directly by calendar year(s) period of occurrence from tables giving both the numerators and the denominators, or indirectly from data on proportions dead of children ever born by age or marriage duration of women. Each methodology has its pros and cons, but this is out of the scope of the present study. (See, for example, Preston, 1985.) This subsection reviews the available literature on direct measures of infant and childhood mortality, calculated from retrospective data, for the six Arab countries.

Table 4, extracted from Rutstein (1983), shows direct estimates of infant and childhood mortality measures for quinquennial periods between 1955 and 1979, using the World Fertility Survey (WFS) data, for three of the six Arab countries covered in this study, namely, Egypt (EFS), Jordan (JFS), and Syria (SFS) (the WFS survey was not conducted in the three Gulf countries, namely, Bahrain, Kuwait, and the U.A.E.). Six measures are presented in the table. These measures are infant mortality rate (IMR): deaths between birth and age one year; non-infant child mortality rate

(NICMR): deaths between ages one and five years; under two, three, or five mortality rate (U2MR, U3MR, or U5MR): deaths between birth and age two, three, or five years, respectively; toddler mortality rate (TMR): deaths between ages one and two years; and child mortality rate (CMR): deaths between ages two and five years. While the denominator for the IMR, U2MR, U3MR, and U5MR is the total number of live births, it is the number of children surviving at age one for the NICMR and TMR, and the number of children surviving at age two for the CMR. These nomenclatures are used throughout this study.

The use of the same survey procedures in the three countries allows comparisons of levels of infant and childhood mortality to be made. This was not possible in subsection 2.1 since completeness of vital registration systems varies a great deal among the six countries, and accordingly, the measures for each country had to be considered separately. Variations in the levels of IMRs are very great among these three countries. While two in fifteen children died in Egypt in the 1970s before reaching their first birthday, only one child in fifteen died in Jordan and Syria before reaching his first birthday. These variations increase with the age of the child. Among those children surviving to one year of age, the chance of dying before reaching their second birthday in Egypt during the 1970s was three and a half times that in Jordan and Syria. Moreover, among those children surviving to two years of age, the chance of dying before reaching age five in Egypt during the 1970s was four times that in Jordan and Syria. The overall summary measure of death between birth and exact age five, U5MR, in the period 1970-74 in Egypt was almost three times that in Jordan and Syria for the same period (238 per 1000 live births, compared to 86 an 91, respectively).

Since "direct procedures allow the study of the trend in infant mortality in relation to trends in the mortality of older children" (Blacker, Hill, and Moser, 1983), the trends over the 25-year period shown in Table 4 may be compared. For all three countries, infant and childhood mortality have declined over time, with the greatest changes occurring in Jordan as seen in Figure 3. IMRs, TMRs, and CMRs in Egypt declined annually by 1.15, 4.44, and 6.42 per cent, respectively, over the period 1955-79. While various mortality measures for Jordan were higher than those for Syria in the period 1955-59, faster rates of decline for Jordan resulted in mortality measures in the 1970s very similar to those for Syria (Figure 4). The annual rates of decline for Jordan for the three measures IMR, TMR, and CMR for the period 1955-74 were 3.62, 9.68, and 11.36 per cent, respectively, compared to 2.19, 7.31, and 9.34 per cent, respectively, for Syria for the period 1955-77. Percentage declines in mortality rates get higher the older the age of the child in all three countries.

Using the EFS data, El-Deeb (1982) obtained single year direct estimates of IMRs, as shown in Table 3 and Figure 2, until the year 1978. The results show wide fluctuations from year to year and negative percentage underregistration, indicating an adjusted IMR smaller than the registered one.

This may be attributed to "fluctuations which reflect real events distorted to varying degrees by sampling and reporting errors" (Egypt, Central Agency for Public Mobilization and Statistics, 1986).

Direct estimation of mortality measures from the 1981 Jordan Demographic Survey (JDS) were attempted but gave very low estimates. The report by Jordan's Department of Statistics (1983) attributed the low figures to "reference period error and forgetfulness or concealment of deaths on the part of respondents." Similar results were obtained for the 1983 Jordan Fertility and Family Health Survey (JFFHS). The direct estimate of the IMR was only 26 per 1000 live births compared to 68 in the 1976 JFS (Jordan, Department of Statistics, 1984).

Table 5 exhibits direct estimates of male and female infant and childhood mortality measures for Egypt, Jordan, and Syria for quinquennial periods between 1955 and 1979, based on the EFS, JFS, and SFS data, respectively. Female IMRs were higher than those for males for Egypt during the periods 1955-59 and 1975-79 (Acsa'di and Issa (1982) found this to be true also for the period 1960-65, after adjusting for death registration), for Jordan for the periods 1955-59 and 1965-74, and for Syria for the periods 1955-[illegible] and 1970-77, as seen in Figure 5. Rutstein (1983), A[illegible]lakha and Suchindran (1985), and Makinson (1986) point out a persistent pattern of higher child mortality for females than for males in the three countries. This is true also for the TMR and the CMR for the three countries, except for Jordan during the most recent five years prior to the survey date. The question thus arises as to whether this phenomenon of excess female mortality is real, or whether the reporting of child deaths by sex in these surveys is accurate.

The overall summary measure, the U5MR, is higher for females than for males for almost the whole period from the mid 1950s to the late 1970s in the three countries. The excess of female childhood mortality might be attributed to problems with the data pertaining to earlier periods "due to the omission of births of children (especially those not surviving or not co-resident at the time of interview), misreporting of the age at death for children who died, or the exclusion of older women from interview because of selective age misreporting" (Rutstein, 1983). Otherwise, higher female than male infant and childhood mortality is to be accepted as a genuine phenomenon in the three countries.

It has been noted that "at ages 1-4 years, recorded death rates are higher for girls than for boys in such countries as Mauritius, Reunion, the United Arab Republic [Egypt], Costa Rica, Guatemala, Mexico, Puerto Rico and Taiwan, as well as in Ceylon [Sri Lanka], India and Pakistan" (United Nations, Department of International Economic and Social Affairs, 1973). This phenomenon "has also been observed in historical data for many developed countries for the nineteenth and early twentieth century " (United Nations, Department of International Economic and Social Affairs, 1986). Researchers have ascribed this phenomenon to prevailing environmental and cultural factors in these societies, in which males enjoy better living conditions than females. Thus females tend to be more vulnerable with respect to nurturing and nutritional status, including the likelihood of enlisting medical aid when they are sick (Arriaga and Way, 1988; El-Badry, 1969; Hallouda, Amin and Farid, 1983; and Hossain and Glass, 1988). Parents express greater concern about the health of their sons than of their daughters. Thus, parental preference of male children is observed in the procurement of medical care. In addition, wives believe that social status and marital security depend on the survival of male children (Makinson, 1986). This might not be true, though, in such societies for the first year of life, since "children [of both sexes] ... are breastfed for no less than a year and are subject to about the same environmental hazards" (Fergany, 1976). Accordingly, Rashad (1981), using data only for women aged 20-24 years in the 1976 census in Egypt and applying indirect techniques, found that "male infant mortality [rates] are higher than female infant mortality [rates] contrary to the implications from the registration data," due to higher completeness of death registration for females than for males - a result in contradiction with those of Hollingsworth (1972).

## 3. INDIRECT ESTIMATES OF INFANT AND CHILDHOOD MORTALITY

In this section indirect estimates of infant and childhood mortality for the six countries are reviewed. As mentioned earlier, indirect methods are all based on converting the proportions dead of children ever born (CEB) into life-table measures of the survival of the child. They are usually referred to as Brass-type estimates, since original works on this subject were initiated by Brass in the early 1960s. A discussion of the methodology is presented in section 4 below.

Table 6 presents infant and childhood mortality rates, namely, IMR, NICMR, and U5MR, for the six countries for quinquennial calendar periods from 1955 to 1989. The table, extracted from Ross, Rich, Molzan, and Pensak (1988), is based on the figures produced by the Population Division of the United Nations (United Nations, Department of International Economic and Social Affairs, 1988a, 1989) and United Nations Children's Fund(1987, 1988, 1989).

While in the second half of the 1950s, IMRs in Bahrain, Jordan, Syria, and the U.A.E were in the range 145-160, over the following 30 years Bahrain and the U.A.E. achieved higher rates of decline than the other two countries. The IMRs are estimated to be only around 26 in Bahrain and the U.A.E. during 1985-89, compared to around 44-48 in Jordan and Syria. Egypt and Kuwait represent the two extremes, as shown in Figure 6. Egypt had the highest IMR among the six countries during 1955-59 (about 185) and remained so for the whole period. The IMR is estimated to be around 85 in the period 1985-89. A recent survey conducted in 1988 showed that "overall, almost one out of six of the children to whom these [ever-married aged 15-49] women have given birth have died" (Egypt, National Population Council, 1989). On the other hand, Kuwait showed the lowest figures for the whole period compared to the other six countries. The IMR declined from 101 in the period 1955-59 to only an estimated 19 for the period 1985-89. Declines in IMRs were faster in Bahrain (one-sixth its value 30-35 years ago) and Kuwait and the U.A.E. (one-fifth its value 30-35 years ago), compared to Jordan and Syria (one-third its value 30-35 years ago) and Egypt (only one-half its value 30-35 years ago).

Similar patterns are observed for changes in NICMRs and U5MRs for the five countries (excluding Bahrain) over the 35-year period. Again, Kuwait and the U.A.E. showed the lowest rates, followed by Jordan and Syria and then by Egypt. While only 2 out of 100 children born were expected to die before reaching their fifth birthday in Kuwait in the late 1980s, the figures are 4 for the U.A.E., 6 for Jordan and Syria, and 12 for Egypt. The figure for Bahrain is expected to be somewhere between those of Kuwait and the U.A.E., i.e., about 3 out of 100 children were expected to die before the exact age of five in the late 1980s.

Data by single years for the three mortality measures for the five countries (again excluding Bahrain since its population is less than one million) are shown in Table 7 and Figure 7. The data are presented in World Bank publications (several years) and are from a variety of sources including United Nations Demographic Yearbooks, United Nations, Department of International Economic and Social Affairs (1983a) and World Bank estimates. NICMRs and CMRs were based on the relation with the IMR in the appropriate model life tables. Annual rates of decline in IMRs during the period from 1960 to 1987 were only 2.67 per cent in Egypt, 3.67 in Syria, 4.10 in Jordan, 5.72 in Kuwait, and 5.96 in the U.A.E. Similar results are observed for NICMRs and U5MRs. Annual rates of decline in NICMRs during the period 1960-85 were 2.95, 7.33, 8.64, 9.21, and 13.03 per cent, respectively, for the five countries, while those for U5MRs were 3.13, 4.37, 4.78, 6.36, and 7.33 per cent, respectively, during the period 1960-87.

Annual rates of decrease in probabilities of dying are higher as children become older, as countries are able to control childhood deaths more effectively than infant deaths. Remarkable achievements were accomplished in the U.A.E. and Kuwait. During the 25-year period from 1960 to 1985, NICMRs declined to a very low level. Only one in 1000 children surviving at exact age one is expected to die before reaching his fifth birthday, a figure comparable to those of developed countries. These figures are compared to 3 in 1000 in Jordan, 4 in Syria, and 11 in Egypt. Free access to quality medical and health facilities is partially responsible for these accomplishments.

Individual studies for the six countries using indirect mortality techniques are numerous, and only selective ones are to be reviewed herein.

Using the 1981 census of Bahrain, indirect estimates of IMRs were obtained (Bahrain, Directorate of Statistics, 1983). The Brass-type estimates of IMRs, using the West model life tables, were 77, 65, and 45 per 1000 live births for the periods 1965-71, 1971-76, and 1976-81, respectively. The figures for males were 85, 69, and 50, for the three periods, respectively, compared to 69, 61, and 39, respectively, for females. The annual rate of decrease was higher between the last two periods, i.e., in the 1970s, than that between the earlier two periods. Hill (1985) observed a "very fast decline [in the U5MRs] in the early 1960s in Bahrain." The figures for the years 1959 and 1966 were 233 and 123 per 1000 live births, respectively; an annual rate of decrease of 9.6 per cent. "The deepening coverage of the country by government-sponsored health activities, and a higher standard of living is assumed to be responsible for this trend" (Bahrain, Directorate of Statistics, 1983).

Rashad (1981) and Bucht and El-Badry (1984) estimated indirect mortality measures for Egypt using the 1947 census (only Rashad's study), the 1972 survey of rural areas in three governorates in Lower Egypt, the 1976 census, the 1979 Rural Fertility Survey (RFS), and the 1980 Egypt Contraceptive Prevalence Survey (ECPS) (only Bucht and El-Badry's study). Both studies applied Brass procedures and Trussell's version. However, Rashad used the West model life tables, while Bucht and El-Badry used the South tables. The analysis showed that "the data indicate a strong possibility of underreporting in the 1976 census of 'children who have died' ... [and] that estimates of infant and child mortality ... are bound to be deficient" (Bucht and El-Badry (1984). Also Rashad (1981) found that "the trend implied using the 1976 census data is unacceptable" and that the estimates are different from those using other sources. She accordingly restricted the analysis only to women aged 20-24. Bucht and El-Badry's estimates of IMRs for the seven five-year periods from 1952 to 1986 are 201, 177, 178, 173, 142, 114, and 100, respectively. The NICMR estimates for Egypt are 77, 61, 42, and 21 for the years 1937, 1947, 1960, and 1976, respectively, thus implying a much faster rate of decline than that of the IMRs. Rashad's IMR estimates for Egypt for the year 1975 are 118, 126, and 110 for both sexes, males, and females, respectively. Other estimates for urban and rural areas and governorates are also calculated. Underregistration is estimated by 33 and 25 per cent for census years 1947 and 1976.

Indirect mortality measures for Egypt from the 1980 EFS are also available (Hallouda, Amin, and Farid, 1983) using the Coale-Demeny West model life tables, and from the 1984 ECPS (Hamed, 1987) using the South model life tables. The EFS showed a declining IMR, from over 160 in the late 1960s to about 145 in the mid 1970s, while the ECPS estimate in the five years prior to the year 1984 was 132. U5MRs were at least 230 per 1000 live births in the late 1960s and early 1970s, and declined to 219 and 213 in the years 1974 and 1976, respectively, according to the EFS data. However, the estimate of the U5MR from the ECPS data stands at 217 during the five years preceding the year 1984. Again, in both surveys excess female mortality is observed. A detailed review and analysis of infant and childhood mortality in Egypt may be found in Central Agency for Public Mobilization and Statistics (1986).

Data from the first census for Jordan carried out in 1961 and from the 1972 Jordan National Fertility Survey (JNFS) revealed that indirectly estimated IMRs declined from 151 to 86 during this period (Sivamurthy and Ma'ayta, 1982), indicating an annual rate of decline of about 4 per cent. Applying the same estimation procedures to these two sources of data and the 1976 JFS, Blacker, Hill, and Moser (1983) found that the correspondence is extremely close. The IMR has fallen from about 160 per 1000 in 1950 to about 70 in 1975 and the U5MR has been reduced by two thirds between the late 1940s and the mid 1970s. Hill (1985) found that U5MRs declined from 240 per 1000 live births in 1958 to about 114 in 1973. However, the 1981 Jordan Demographic Survey (JDS) data have implied constant IMRs during the five years prior to the survey. Indirect estimates of the IMR were 65, 64, and 64 for the years 1977, 1979, and 1980, respectively (Jordan, Department of Statistics, 1983). The 1983 Jordan Fertility and Family Health Survey (JFFHS) data have shown significantly lower IMR figures, implying substantially lower reporting of mortality as a result of a different questionnaire design from that of the 1976 JFS and 1981 JDS (Jordan, Department of Statistics, 1984).

Earlier population censuses for the years 1957 and 1975 for the Kuwaitis, analyzed by Kohli and Al-Omaim (1982), have shown that the indirectly estimated IMRs, which in the late 1950s were around 110 per 1000 live births, had fallen to about 75 in 1965, and about 54 in 1970. Afterwards the IMR declined much more slowly to reach only 51 in 1975. These results imply an underregistration rate of about 15 per cent in 1975, contrary to the statement by Hill (1975) that the registered IMRs from about 1973 onwards are nearly complete. Similar results are indicated by El-Shalakani (1984a) and Al-Sabah and El-Shalakani (1986) in which underregistration of infant deaths for nationals and non-nationals combined is about 11 and 7 per cent for the years 1975 and 1980, respectively. Underregistration of female infant deaths is smaller than that for males (Al-Sabah and El-Shalakani, 1986), i.e., a similar result to that of Rashad (1981) for Egypt. Indirect estimates of IMRs for Syria are available for the 1970 Census, 1976 Sample Census, and Syrian Fertility, Follow-up Demographic, and Pregnancy Follow-up surveys (SFS, SFDS, and SPFS, respectively (Syria, Central Bureau of Statistics, 1984). IMRs for the years 1969, 1975, 1977, 1976-79, and 1976-79 are 123, 78, 78, 56, and 54, respectively. The five estimates are obtained using the 1970 Census, 1976 Sample Census, SFS, SFDS, and SPFS data, respectively. According to the SFS, SFDS, and SPFS data, the IMRs for males are 67, 61, and 60, respectively. These estimates correspond to the dates 1977, 1976-79, and 1976-79, respectively. The figures for females are 89, 50, and 47, respectively. Another study by Farag (1982), using the 1970 census, calculated the indirect estimates for IMRs and NICMRs for the two periods 1960-65 and 1965-70 for males and females. IMRs for males were 117 and 113 for the two periods, respectively, compared to 105 and 102 for females. The corresponding NICMRs for males were 66 and 61, compared to 63 and 59 for females in the two periods, respectively. Also, using the 1970 census, Brass-type estimates of the IMR and the NICMR were 98 and 77, respectively (Vaidyanathan, 1976), while IMRs for males and females were 111 and 99, respectively, for the period 1965-70 (Vaidyanathan and Fouda, 1982), i.e., somewhat lower than those of Farag and both lower than those published by Syria, Central Bureau of Statistics (1984). Indirect estimates for the U5MR were obtained by Hill (1985). He found that the U5MR was 171 and 113 per 1000 live births for the years 1966 and 1973, respectively.

## 4. METHODOLOGY AND DATA

Brass (1968, 1975) developed a methodology for estimating past infant and childhood mortality from data on children ever born (CEB) and children surviving (CS) by age of women available from censuses or surveys. Later, Sullivan (1972) showed similar estimates when data are available by duration of marriage. The methodology converts this data into estimates of probability of dying before reaching certain exact childhood ages. Assumptions of this methodology are: (1) the risk of a child dying is a function only of his age, (2) fertility has remained constant in the recent past, (3) infant and childhood mortality did not change during the period preceding the census/survey, (4) the infant and childhood age schedule of mortality conforms approximately to a model life table, and (5) reporting of data required for calculations is accurate.

The multipliers, which map the proportions of children dead for women at various ages to probabilities of dying between birth and exact ages, were modified and refined later by Sullivan (1972) and Trussell (1975), using a wider range of observations and applying least-squares regression. The set of multipliers depend on the age schedule of fertility, indexed by CEB ratios at various age groups and by mean age at childbearing, and thus are different for each of the four families of model life tables provided by Coale and Demeny (1966).

The problem of constant pattern and level of mortality was dealt with under the assumption of constant rate of change over time (Coale and Trussell, 1978). The derived time-location equations assign a date to each of the Brass-type mortality measures depending primarily on the age schedule of fertility and mothers' age group, and to a lesser extent on the age schedule of mortality. For details on this and other approaches to dealing with mortality decline, Feeney (1980), Kraly and Norris (1978), and Palloni (1979, 1980) can be consulted. Relaxations of other assumptions are discussed by Ewbank (1982), while possibilities for correcting the effects of inappropriate assumptions are presented in Arthur and Stoto (1983).

The sources of data used in the current study for the six Arab countries were:

A. Bahrain:
   (1) 1971 Population Census
   (2) 1981 Population Census

B. Egypt:
   (1) 1976 Population Census
   (2) 1980 Egypt Fertility Survey (EFS)
   (3) 1984 Egypt Contraceptive Prevalence Survey (ECPS)
   (4) 1988 Egypt Demographic and Health Survey (EDHS)

C. Jordan:
   (1) 1972 Jordan National Fertility Survey (JNFS)
   (2) 1976 Jordan Fertility Survey (JFS)
   (3) 1979 Population Census
   (4) 1981 Jordan Demographic Survey (JDS)
   (5) 1983 Jordan Fertility & Family Health Survey (JFFHS)

D. Kuwait:
   (1) 1975 Population Census
   (2) 1980 Population Census

E. Syria:
   (1) 1970 Population Census
   (2) 1976 Sample Population Census
   (3) 1978 Syria Fertility Survey (SFS)
   (4) 1981 Population Census

F. U.A.E.:
   (1) 1975 Population Census
   (2) 1980 Population Census

These sources were analyzed by applying the Brass methodology and Trussell's regression equations, to obtain overlapping indirect estimates of infant and childhood mortality. Trussell's equations, which allow age at first marriage to vary between 12 and 18 years, provide the better estimates, since the six Arab countries are characterized by early fertility. Horne and El-Khorazaty (1987) showed that Arab countries have young ages at first birth and long reproductive life spans. The results of their paper with respect to estimates of mean age at childbearing at various points in time were used in the current study.

It may be noticed that the data sources of this study are a mix of censuses and surveys. When the Brass methodology is "applied to complete census data, there is no sampling error in the observed [proportions of dead children] (although there may, of course, be errors due to bias corresponding to the exclusion of certain mothers or deceased children) ... [but] with survey data ... the [proportions of dead children] are observed with random variations and are, therefore, subject to sampling error" (Arthur and Stoto, 1983). On the other hand, a comparison between census and survey data is valid only to the extent that the estimates from both sources are accurate or are biased in the same direction and the same amount. Thus, comparability might not be strictly valid. However, this analysis will shed some light on whether the indirect estimates of infant and childhood mortality are more or less consistent among the various sources, and on the relative reliability of these sources.

Exactly the same estimation procedures, using the Trussell multipliers and the Coale-Demeny West model life tables, were applied to the various sources of data available for the six countries. Two computer software packages were used: the MORTPAK-LITE package produced by the Population Division of the United Nations (United Nations, Department of International Economic and Social Affairs, 1988b), and the AFEMO program produced originally by the National Academy of Sciences (Zlotnik, 1981) as one of eight separate programs intended as a supplement to United Nations, Department of International Economic and Social Affairs (1983b) Manual X, and has subsequently been revised (Newell, 1985). The latter program is considered "by far the best and most widely available software for obtaining Brass-type mortality estimates" (Trussell and Menken, 1984). Brass procedures were applied to data on proportions dead among CEB classified by age of the mother rather than by duration of marriage. In addition to the problems that might arise when marriage duration is not accurately measured, the six countries under study are Islamic countries and "the entrance into a legal marriage predates the initiation of cohabitation [and] in populations where these problems are likely to arise, the duration variant should not be used" (United Nations, Department of International Economic and Social Affairs, 1983b).

Because of irregularity in the estimates of probability of dying for women aged 15-19 years, as these women marry at young ages and generally have low socioeconomic status, thus resulting in atypical infant and childhood mortality estimates of the average woman, it was decided to discard various estimates for this age group. One should be cautious also "that this upward bias [among children born to mothers in this age range] can also extend into the age range of 20-24" (Preston, 1985), thus producing a decline in mortality that appears larger than actually occurred.

## 5. RESULTS OF ANALYSES OF VARIOUS SOURCES

Data on proportion of dead children by age groups of women for the aforementioned sources of data for the six countries are shown in Table 8. The sources span a period of eighteen years from 1970 to 1988. However, the period covered for each country ranges from only five years in Kuwait and the U.A.E., to around ten years for Bahrain, Jordan, and Syria, to twelve years in Egypt.

In general, the proportion of children dead by age of mother increases as one goes back in time. Very few exceptions may be observed. Hence, if there has been any error of omission, this error is not of sufficient magnitude to conceal a declining mortality trend. However, proportions of children dead by age of woman should not be compared directly, since they reflect the longer exposure to the risk of death of the children of the older women in addition to the level of mortality. Comparisons should be based on mortality measures referring to a uniform period of exposure.

The following is a detailed discussion of the results of the indirect analyses, applied to available data, for each of the six Arab countries covered in this study. Again, the results for the three Gulf countries, namely, Bahrain, Kuwait, and the U.A.E., are only for the national populations of these three countries.

## 5.1 **Bahrain**

During the period 1971-81, proportions dead among the children ever born to Bahraini women declined for all age groups, as seen in Figure 8. The magnitude of the decline increased systematically with the age of the woman until age group 30-34 years, after which the magnitude of the decline started to decrease. These results imply that children born to women in the middle age group, 25-39 years, have benefitted the most from the decline in mortality which occurred in Bahrain during the 1970s. Children of mothers at young or old ages are, in general, of low birth weight and poor health conditions, which are mainly due to biological rather than environmental conditions. Thus, improvements in health care and availability of free medical services are likely to affect children of mothers in the middle range of the reproductive span (25-39 years). Horne, El-Khorazaty, and Suchindran (1986) and Horne and El-Khorazaty (1987) found, in their studies on childbearing in 36 WFS developing countries and 16 Arab countries, respectively, that IMRs and NICMRs are negatively correlated with mother's age at first birth and positively correlated with her age at last birth. Overall, in 1971, about two out of seven children to whom Bahraini women gave birth had died by the time the women were aged 45-49, compared to about one out of seven children in 1981.

Two sets of indirect estimates of seven infant and childhood mortality measures for the period 1956-79 for the Bahraini population, based on the 1971 and 1981 population censuses, are presented in Table 9. In general, the two sets of estimates are consistent. The estimates based on the 1981 data are in fact a continuum of those based on the 1971 data. The consistency among the two sets of mortality measures is remarkable. Levels of infant mortality declined from about 172 per 1000 live births in 1956, to about 85-88 in 1967, and again to only 41 ten years later, as shown in Figure 9. However, the decline in non-infant child (NICMR), toddler (TMR), and child (CMR) mortality rates during the same period were more pronounced and extremely steep. The NICMR declined from 103 per 1000 children surviving to age one in 1956, to about 38 in 1967, and to only 12 in the period 1975-79 (Figure 9). The three figures for the TMRs are 53, 20, and 6, respectively, while those for the CMRs are 54, 19, and 6, respectively, per 1000 children surviving to age two.

The overall summary measure, the under-five mortality rate (U5MR), shows that while one out of every four live births were expected to die before their fifth birthday in 1956, only one out of eight did so in 1967, and one out of twenty in the period 1975-79, a decline of about 80 per cent over the twenty-year period from the late 1950s to the late 1970s.

Most of the decrease in the various measures of infant and childhood mortality occurred during the period 1956-75. This decline slackened afterwards, so that the measures were more or less stable during the second half of the 1970s. Additional data are required to assess the trends in infant and childhood mortality in the 1980s. More specifically, annual percentages of decline in the IMR during the two periods 1956-67 and 1967-77 are 6.1 and 7.6, respectively. The corresponding two percentages for the NICMR are 8.4 and 12.3, respectively, and those for the U5MR are 6.6 and 8.8, respectively (Table 18). Thus, the decline in non-infant child mortality was faster than the decline in infant mortality, an expected result since the advancements in health care and medical services are more effective after the first year of life, which is affected mainly by biological and hereditary factors.

In general, Bahrain in the late 1970s was expected to experience five and a half deaths of each 100 Bahraini live births before their fifth birthday. About five of these deaths occurred before the toddlers reached exact age two. Again, four and a half of these deaths were expected to occur during the first year of life. Only five out of 100 Bahraini children surviving to exact age two were expected to die within the following three years before reaching age five.

A consistent pattern of sex differentials is revealed by the 1981 population census data. Table 10 demonstrates that infant and childhood mortality estimates for females are lower than those for males. IMRs for males declined from 91 in 1967 to 48 in 1979, compared to 78 and 41, respectively, for females. The figures for NICMRs for males are 43 and 16, for the two years, respectively, compared to 34 and 12, respectively, for females. The U5MR decreased from 132 per 1000 Bahraini live births in 1967 to only 61 in 1977 for males, and from 108 to 44 for the two years, respectively, for females. Thus, the annual decline in the U5MR for females was higher (9.0 per cent) than that for males (7.7 per cent) during the ten-year period from 1967 to 1977. The decline in various measures of infant and childhood mortality in Bahrain, according to these estimates, occurred mainly during the eight-year period between 1967 and 1975, stabilizing afterwards in the second half of the 1970s.

### 5.2 **Egypt**

Data on proportions dead among the children ever born to Egyptian women, presented in Table 8, connote a general declining trend for all age groups of women during the period 1980-88. However, the figures for the 1976 population census show a different trend. Proportions of dead children in the 1976 census are systematically lower than those for the three surveys, namely, the 1980 EFS, 1984 ECPS, and 1988 EDHS. As mentioned earlier in section 3, several researchers (Rashad, 1981; Hallouda, Amin, and Farid, 1983; Bucht and El-Badry, 1984) found that dead children were underreported, and that the proportion dead was almost one-half of the corresponding proportion reported in surveys less than five years earlier. Accordingly, eventhough the results based on the 1976 census are presented here, the discussion is based mainly on the three nationwide surveys. The 1986 census data will be helpful in this matter when available.

In general, declines in the proportion of dead children were more pronounced during the period 1984-88 than during the period 1980-84, as seen in Figure 10. This was true for all age groups of women, except those in the 40-44 age group for which the decline was more pronounced during the period 1980-84. On average, proportions dead in 1988 were about 80 per cent of those observed in 1980, i.e., an annual decline of about 2.8 per cent. In 1980, Egyptian women at the end of their reproductive life span, i.e., in the age group 45-49 years, were expected to have experienced about one death out of every three children to whom they had given birth, compared to one death out of every four children in 1988.

Table 11 shows the four sets of Brass-type estimates of the seven infant and childhood mortality measures for the period 1963-85. Disregarding the results based on the 1976 census, one may observe that infant and childhood mortality estimates based on the 1988 EDHS are somewhat below those based on the other two surveys. The three surveys give very similar and consistent results for the period 1970-76, then diverge afterwards for the recent period. In general, the strong correspondence of directly estimated infant and childhood mortality based on the 1980 EFS data with indirectly estimated death probabilities from the three surveys assures the quality of the data of these surveys, and the choice of the assumptions of the Coale-Demeny West model life tables and Trussell's methodology.

Levels of infant mortality declined from about 168 per 1000 live births in 1966 to about 140 in 1979, then declined at a faster rate afterwards to about 111-114 during the period 1982-85 (Figure 11). A similar pace of decline is observed for the NICMRs in which the declines were faster in the late 1970s and early 1980s, as shown in Figure 12. The NICMR declined from 100 per 1000 children surviving to age one in 1966, to about 79 in 1974, and again to about 57-59 during the period 1982-85. The corresponding figures for the TMR and CMR were 52 and 51, respectively, for the year 1966 and about 29 for both rates during the period 1982-85. Recent information indicates that by 1989 Egypt had reached the target of universal immunization and wide use of ORT, thus raising the level of child survival (United Nations Children's Fund, 1989).

During the twenty-year period from 1966 to 1985, the overall summary measure, U5MR, declined from 251 per 1000 live births at the beginning of the period, to about 162-166 at the end of the period, a very modest decline. In other words, while one of every four live births was expected to die before reaching exact age five in 1966, one of six was expected to die in the mid 1980s, a decline of only 35 per cent over a twenty-year period. If Egypt is to achieve the United Nations' target of a U5MR of 70 by the year 2000, greater efforts and resources are required. With the current pace of decline it is more likely that the U5MR in the year 2000 will be over 100 per 1000 live births.

Specifically, annual percentages of decline in the IMR and NICMR during the period 1966-85 were only 2.0 and 2.8, respectively. The figures for TMR and CMR are 2.9 and 3.0 per cent, respectively. As mentioned earlier, the proportionate decline in non-infant child mortality was generally greater than the proportionate decline in infant mortality. However, these very modest rates of decline have kept the levels of infant and childhood mortality at moderately high rates. With mortality under five representing a high percentage of all deaths in Egypt, and with the incidence of infant and childhood mortality decreasing at this low pace, crude death rates have been almost stable in Egypt during the last ten years.

In summary, Egypt in the mid 1960s was expected to experience twenty-five deaths of each 100 live births before their fifth birthday. About twenty one of these deaths occurred before the toddlers reached exact age two. Again, seventeen of these deaths were expected to occur during the first year of life. In addition, about five of 100 children surviving to exact age two were expected to die within the following three years before reaching age five. Twenty years later, i.e., in the mid 1980s, it was expected that seventeen of each 100 live births would die before reaching exact age five. About fourteen of them were expected to die before reaching their second birthday, eleven of whom before their first birthday. Even among those who survive infancy, one of seventeen children were estimated to have died during their next four years of life. In the meantime, three out of 100 children alive at their second birthday were expected to die before their fifth birthday.

5.3 **Jordan**

Table 8 shows proportions of dead children for Jordan by age of woman, based on the data from the 1972 JNFS, 1976 JFS, 1979 population census, and 1981 JDS. The results of the 1983 JFFHS are not presented herein, as the survey suffers from underreporting of children who have died, possibly because of the way the questionnaire was designed. Both direct and indirect estimates of infant and childhood mortality rates from the 1983 survey were substantially lower than those from other surveys. Since the mean numbers of children ever born by age of woman are in agreement with those of the recent data sources, it is suggested "that infant and child deaths were seriously underreported in the [1983] survey" (Jordan, Department of Statistics, 1984).

Declines in proportions dead among children ever born to Jordanian women aged under 25 years were very modest during the nine-year period from 1972 to 1981, as seen in Figure 13. However, for women in the middle and upper age groups of the reproductive life span (25-39 and 40-49 years, respectively), proportions of dead children in the year 1981 were, on average, about 70 per cent of those observed in 1972, i.e., an annual rate of decline of about 4 per cent. In other words, in 1972, almost one out of five of the children to whom Jordanian women had given birth had died by the time the women were aged 45-49, compared to one out of seven nine years later in 1981.

The seven indirect estimates of infant and childhood mortality for Jordan for the period 1958-78, based on data from the four surveys on children ever born and children surviving by age of woman, are presented in Table 12 and Figures 14 and 15. The estimates regarding the 1972 and 1976 surveys are comparable with those of Blacker, Hill, and Moser (1983). The correspondence between the indirect estimates of the two surveys is extremely close, while those of the 1972 survey are somewhat irregular due to small numbers in some age groups. The four sets of estimates are, in general, consistent.

The results provide us with estimates of changes in infant and childhood mortality rates for detailed ages - infants, toddlers, non-infant children, etc. The pace of change in the survivorship of children during a long period of time may be evaluated. The indirect estimates of IMRs suggest that the level has declined from around 110 per 1000 live births in 1958, to about 71-78 in 1969, and to 62-64 for the period 1976-78. The decline in NICMRs during the twenty-year period was more pronounced. The NICMR for the year 1958 was around 56 per 1000 children surviving to age one, declining to 29-34 in 1969, and to about 25 in 1978. The corresponding figures for the TMR are 29, 14-17, and 11, respectively, while those for the CMR are 28, 15-17, and 13, respectively, per 1000 children surviving to age two. It is clear that the pace of change, implied by these trends, is faster for non-infant child mortality than infant mortality. Also, the rates of change slackened in the latter period

(1969 78) compared to the earlier period (1958-69).

The overall summary measure, the U5MR, declined by a faster pace in the earlier period (1958-69), from one out of every six live births to one out of every ten, compared to the second period (1969-78), in which the U5MR decreased to only one out of every twelve by the year 1978. However, it is more likely that Jordan is to achieve the target set by the United Nations of 70 deaths under age five per 1000 live births by the year 2000.

Comparison of the four sets of indirect mortality measures, based on the four data sources, with direct "observed" estimates based on the 1976 JFS may be conducted. In general, the correspondence between direct and indirect estimates is extremely good. This consistency and agreement give assurance of the quality of the data collected in these sources and of the assumptions adopted in the application of Brass-Trussell's methodology.

The trends in indirect estimates of infant and childhood mortality rates in Jordan during the twenty-year period in terms of annual percentages of decline for the IMR, NICMR, TMR, CMR, and U5MR are 2.7, 4.0, 4.8, 3.8, and 3.1, respectively. Again, higher rates of decline are observed for children beyond the first year of life compared to infants.

The mortality picture in Jordan in the late 1950s signifies that sixteen out of 100 live births were expected to die before their fifth birthday. Of these, fourteen were to die before reaching exact age two, and eleven before their first birthday. Three out of 100 children surviving to exact age two were expected to die in the following three years. The picture is different in the late 1970s. About eight out of 100 live births were expected to die in the following five years. Of these, seven were expected to die before their second birthday, and six before their first birthday. Only one out of 100 children surviving to exact age two were expected to die before their fifth birthday.

Sex differentials, shown in Table 13, indicate a changing direction. Excess male infant and childhood mortality is observed in the early 1960s and late 1970s. However, during the period 1963-76, excess female mortality is the general observation. Inconsistent sex differentials are also noticed for direct mortality estimates obtained from the 1976 JFS data as shown in Table 5. This could however be the result of poor data quality as cited in Preston (1985) in which he states that "Jordan is clearly a case where data errors are prevalent [and that] a stronger case for the differential omission of female deaths is made." An in-depth study similar to that conducted by Arriaga and Way (1988) for Sri Lanka, in which causes of death by sex of child were investigated, is recommended.

5.4 **Kuwait**

In spite of the short period covered by the two data sources, from 1975 to 1980, proportions of dead children among those ever born to Kuwaiti women connote a sharp decline in only five years. As seen in Table 8 and Figure 16, proportions of dead Kuwaiti children for all age groups of women declined, on average, by one third during this quinquennial period. In 1975, Kuwaiti women at the end of their reproductive life span (aged 45-49), were expected to have experienced about one death in seven children to whom they had given birth, compared to only one death in ten children in 1980, a sizeable achievement in that brief period.

Brass-type infant and childhood mortality rates estimated for the Kuwaiti population, using data available from the two population censuses, are shown in Table 14. The results cover the period from 1961 to 1978. In general, the estimates from the two censuses are comparable and quite close. Levels of infant mortality, shown in Figure 17, declined from about 87 per 1000 Kuwaiti live births in 1961, to about 38 in the early 1970s, and to 30 by 1974. However, in the ensuing four years, the rate of decline had slackened such that the IMR figure was only 28 by 1978. Similar patterns are observed for other childhood measures with faster rates of decline, especially during the 1960s. The NICMR declined from 40 per 1000 survivors at exact age one, to around 11 in the early 1970s, and to only 6 by 1978. The figures for both the TMR and CMR were 20, 5, and 3 child deaths for the years 1961, early 1970s, and 1978, respectively, per 1000 survivors to the earlier birthday.

The U5MR summary measure declined from 123 per 1000 live births in 1961, to 48 in the early 1970s, and to only 34 in 1978, a value about one-half the target set by the United Nations for the year 2000. In other words, while only one in every eight live births was expected to die before his fifth birthday in 1961, only one in thirty was expected to die in 1976-78, a decline of about 75 per cent over the fifteen-year period.

As mentioned above, most of the decrease in the seven measures of infant and childhood mortality occurred during the 1960s. The trend is similar to that observed in Bahrain, in which the decline slackened especially in the second half of the 1970s and mortality measures were more or less stable. Kohli and Al-Omaim (1983) observed that the decrease was rapid between 1955 and 1970 but slowed considerably afterwards. Annual percentages of decline in the IMR during the two periods 1961-72 and 1972-78 were 7.5 and 5.1, respectively. The corresponding two percentages for the NICMR were 11.7 and 10.1, respectively, while those for the U5MR were 8.6 and 5.7, respectively.

In summary, the Kuwaiti population in the early 1960s was expected to experience twelve deaths of each 100 live births before their fifth birthday. About ten of these deaths occurred before the toddlers reached exact age two, and nearly nine of these during their first year of life. In addition, two out of 100 survivors to exact age two were expected to die within the following three years. But in the late 1970s, it was expected that only about three and one-half of each 100 live births would die before reaching exact age five. Nearly three of these deaths were expected to occur during infancy. Among those who survived the first year of life, only six of each 100 were expected to die in the ensuing four years, half of them during their second year of life.

Sex differentials are in agreement with the general rule that mortality in infancy and childhood is higher among males than among females. All measures of probabilities of dying before or between selected ages of infancy and childhood follow this rule for the Kuwaiti population. Table 15 shows that of every 1000 male live births, 88 had died in their first year of life in 1961 compared to 84 females. However, faster rates of decline for females in the following decade brought IMRs for females further down and further apart from those for males. The two figures for the year 1972 were 42 for males and 34 for females, while those for the year 1978 were 31 and 25, respectively. Of each 1000 girls who survived their first year of life, 38 had died before their fifth birthday, compared to 41 of their male counterparts in 1961.

Seventeen years later, survival chances represented marked improvements for both sexes. The two figures for the NICMR in 1978 were only 5 and 8 for females and males, respectively. The U5MR declined from 127 per 1000 Kuwaiti male live births in 1961 to only 37 in 1978, an annual decrease of 7.3 per cent. During the same period, female U5MR declined from 118 per 1000 Kuwaiti female live births to only 31, an annual decrease of 7.9 per cent. Again, most of the decline occurred during the decade of the 1960s; afterwards infant and childhood mortality rates stabilized, especially from the mid 1970s.

## 5.5 **Syria**

Table 8 and Figure 18 exhibit proportions of dead children by quinquennial age groups of women in Syria, for the eleven-year period from 1970 to 1981. The results are based on data from the 1970 and 1981 population censuses, a 1976 sample census, and the 1978 SFS. A declining trend is very evident during this period. However, most of the decline occurred in the first half of the 1970s, followed by a slowdown in the rate of decline afterwards. Underreporting of dead children is observed in the young age group 15-19 in the 1976 data. The proportion of dead children is well below the figures observed in other sources. On average, the decline in proportions of dead children was about 30 per cent during the period 1970-76, and only about 15 per cent during the period 1976-81 for all age groups, except the 15-19 group. In other words, in 1970, by the time Syrian women had reached the end of their reproductive life span, i.e., age 45-49, two out of seven of their children had died, compared to two out of eleven in 1981.

The results of Brass-Trussell's methodology applied to the four data sets are presented in Table 16 for the period 1956-79. The declining trend in all seven infant and childhood mortality rates is evident during this period. The estimates for the 1976 and 1981 censuses and the 1978 SFS are fairly consistent with each other. However, all three sources show levels of infant and childhood mortality somewhat below those estimated from the 1970 census, as seen in Figures 19 and 20. Two plausible explanations are valid in this case: either the numbers of children ever born were underreported in the 1970 census, or, the numbers of children who had died were underreported in the other three sources - an unlikely event, considering the consistency of different types of sources.

Levels of infant mortality declined by about 50 per cent from 151 per 1000 live births in 1956 to only 75 in 1972, and to 66 in 1979. (The figure for the year 1979 is somewhat higher than that estimated from the Syria Follow-Up Demographic Survey (SFDS). The IMR for the period 1976-79 was estimated to be around 57 from the survey (Syria, Central Bureau of Statistics, 1981).) Similar trends are observed for the NICMR. The three corresponding figures are 87, 32, and 26, respectively, per 1000 survivors at exact age one. Figures for the TMR are 45, 16, and 12 for the years 1956, 1972, and 1979, respectively, per 1000 survivors to their first birthday, while those for the CMR are 46, 16, and 14, respectively, per 1000 survivors to their second birthday. As noticed earlier, childhood mortality measures declined at faster rates than those of infancy.

Declines in the overall measure of infant and non-infant child mortality, the U5MR, were steep during the period between 1956 and 1972. It declined from 226 per 1000 live births at the beginning of the period, to about 105 at the end of the period, i.e., by over 50 per cent during the sixteen-year period. However, in the following seven years the rate of decline slowed down so that the U5MR reached only 90 by 1979. The continuation of this slow rate of decline assures that by the year 2000 Syria will have achieved a value below that set by the United Nations (i.e., a U5MR of 70).

Specifically, annual percentages of decline in the Brass-type estimates of the IMR, NICMR, TMR, CMR, and U5MR during the twenty-three-year period were 3.6, 5.3, 5.7, 5.2, and 4.0, respectively. Indirect estimates of levels and trends of infant and childhood mortality which are based on all data sources, except those derived from the 1970 census, correspond fairly well to direct measures based on the 1978 SFS, as shown in Table 4.

To summarize, Syria was expected to experience in the mid 1960s about 15 infant deaths out of each 100 live births. In the following four years of their life, about nine children were expected to die out of 100 survivors to exact age one. About half of these nine deaths were to occur during their second year of life. The situation in the late 1970s was quite different. Only seven infant deaths out of each 100 live births were expected to occur. Nearly three more deaths out of 100 survivors to exact age one were expected in the following four years of their life, almost half of them were to happen when they were toddlers.

5.6 **U.A.E.**

The results of the 1975 and 1980 censuses of the U.A.E., with regard to proportions of dead children among children ever born by five-year age groups of Emirati women, are exhibited in Table 8 and Figure 21. In spite of the short interval between the two sets of data, declines in proportions of dead children were steep, especially for mothers aged 25-34. The magnitude of the decline increased gradually with women's age until age 30-34 years, after which the decline was less evident. The phenomenon is similar to that observed for Bahrain in section 5.1.

Infant and childhood mortality are significantly associated with too young and too old ages at the birth of a child (Horne and El-Khorazaty, 1987). While the improvements in proportions of dead children were about one-third for age groups 15-24 and 35-49 during the period 1975-80, they were reduced by nearly a half for the age group 25-34. Overall, in 1975, by the time Emirati women reached the age group 45-49, about one out of nearly four of their live born children had died, compared to one out of five in 1980. This is still a higher proportion compared to all other five countries, except Egypt.

Table 17 presents the two sets of Brass-type estimates of the seven infant and childhood mortality measures for the Emirati population during the period 1960-78. These results are based on the 1975 and 1980 population censuses. The two sets of estimates, as seen in Figure 22, are extremely consistent, and it appears that the measures based on the 1980 census are a continuum of those based on the 1975 census. The declining trends are evident throughout the whole period. In fact, the declining trend for various infant and childhood mortality measures gained a momentum in the 1970s, and mainly in the first half of the decade.

Levels of the IMR declined from 143 per 1000 live births in 1960 to about 96 in 1968, and to only 43 in 1978. Non-infant child mortality rates declined even faster during this period. The three corresponding figures for the NICMR were 81, 46, and 14, respectively, per 1000 survivors at exact age one. Declines in the TMR and CMR were similar: the three values for the TMR were 42, 24, and 6 per 1000 survivors to their first birthday, for the years 1960, 1968, and 1978, respectively, while those for the CMR were 43, 23, and 7 per 1000 survivors to exact age two, respectively. In addition, the three corresponding figures for the U5MR were 214, 138, and 56 per 1000 Emirati live births, respectively, a decline of about 75 per cent over the eighteen-year period. These figures agree with recent information available, in which the U5MR was estimated by 239, 43, and 33 for the years 1960, 1980, and 1987, respectively, according to health statistics (The Khaleej Times, 1989).

More precisely, the average percentage of decline in the IMR during the 1960-78 period was 6.7 annually. The figures for the NICMR, TMR, CMR, and U5MR were 9.8, 10.8, 10.1, and 7.4 per cent, respectively. These changes in infant and childhood mortality, similar only to those observed for Kuwait among the six Arab countries included in this study, are a result of "dramatic changes [in health care and services], as well as the general socio-economic improvements brought about by the oil wealth, [which] have done much to lower mortality levels in the United Arab Emirates" (United Nations, Economic Commission for Western Asia, 1980b). More recent data, such as the 1985 population census, will allow the assessment of trends in infant and childhood mortality during the 1980s, and the determination of whether these rates of decline have persisted or have slackened in recent years.

These improvements in mortality levels are better traced if the health picture in 1960 is compared to that in 1978. In general, in 1960 the Emirati population were expected to experience one out of every seven children dying during the first year of life, nearly one in twelve surviving to his first birthday during the following four years of life, and one in five of all children born dying before reaching age five. The picture in 1978 is quite different. Only one out of every twenty-three children died before the first birthday, about one in seventy survivors to exact age one died before reaching the fifth birthday, and one in eighteen of all children born died during the first five years of life.

## 6. SUMMARY AND CONCLUSIONS

Significant features, in terms of levels and time trends, of infant and childhood mortality in six Arab countries (Bahrain, Egypt, Jordan, Kuwait, Syria, and the U.A.E.) since 1955 are discussed. For the three Gulf countries, the results refer only to national populations. The study attempted first to review scattered and fragmented data available on this subject, either directly from civil registration systems or indirectly from censuses and surveys, whether reported by national or inter-national sources. Secondly, various censuses and surveys conducted in these six countries in the last two decades were analyzed, using the Brass-Trussell methodology, to provide time trends of several infant and childhood mortality measures since the mid 1950s. The results of these analyses provided the basis for evaluating the consistency and reliability of both censuses/surveys and death registration systems.

Due to the fact that civil registration systems have been in operation just recently in Bahrain, Jordan, and the U.A.E., and because of high incompleteness rates in reporting death events, especially under-five deaths, registered infant and childhood mortality rates in the six countries are either not available or inaccurate. However, registered data were presented here only for evaluation purposes. One of the salient features, though, from registered data is that infant and childhood mortality in all six countries has definitely declined in the last three decades.

A precise and accurate picture was acquired by analyzing various censuses and surveys using the Brass-Trussell methodology and the Coale-Demeny West model life tables. Seven measures of infant and childhood mortality were obtained describing various probabilities of dying between birth and exact ages, or between two exact ages of the first five years of life. In general, indirectly estimated Brass-type infant and childhood mortality measures closely correspond to directly estimated measures in the six countries, thus assuring the quality of the data from most censuses and surveys and the choice of the methodology and of the model life tables.

For the six Arab countries, it is striking that Egypt compares very poorly with the other five Western Asia Asian Arab countries with respect to infant and childhood mortality, especially in recent years. In the late 1950s and early 1960s, infant mortality rates (IMRs) for Egypt were above 170 infant deaths per 1000 live births, compared to 160-170 in Bahrain, 140-150 in Syria and the U.A.E., 110-120 in Jordan, and 90-100 in Kuwait. By the early 1980s, IMRs hovered around 120 in Egypt, 60-65 in Jordan and Syria, 40-45 in Bahrain and the U.A.E., and 30 in Kuwait.

Similar results were manifested for the under-five mortality rates (U5MRs). In the late 1950s and early 1960s, U5MRs for Egypt were above 230 deaths between birth and age five out of 1000 live births, compared to 210-230 in Syria and the U.A.E., to 160-190 in Jordan, and 120-140 in Kuwait. The picture in the early 1980s indicates that Egypt still had the highest U5MR among the six countries, with a value in the range of 170-190. The U5MRs were about 85-90 in Jordan and Syria, compared to 50-55 in Bahrain and the U.A.E., and 30-35 in Kuwait.

While Egypt and Kuwait kept their relative position during the twenty-five-year period, with the highest and lowest IMRs and U5MRs among the six countries, the order has changed for the other four countries. The relative positions of Bahrain and the U.A.E. have improved, while those of Jordan and Syria have deteriorated. While the decline in various measures of infant and childhood mortality was universal, annual rates of decline in the six Arab countries showed two different patterns. For Bahrain, Egypt, and the U.A.E., percentages of annual declines in recent years have accelerated compared to those in earlier years, as seen in Table 18, though the rates of decline were very modest for Egypt. IMRs in Bahrain declined at an annual rate of 6.1 per cent during 1956-67, compared to 7.6 per cent during 1967-77. Those in Egypt declined by 1.6 per cent during 1966-76 and by

2.5 per cent during 1976-85, while those in the U.A.E. declined by 5.0 per cent during 1960-68 and 8.0 per cent during 1968-78. The corresponding percentages for the U5MR were 6.6 and 8.8, respectively, for Bahrain, 1.7 and 2.7, respectively, for Egypt, and 5.5 and 9.0, respectively, for the U.A.E. Information from the 1985 U.A.E. census, 1986 Egypt census, and 1991 planned Bahrain census can be of great value in assessing recent trends.

The second pattern is observed in Jordan, Kuwait, and Syria. Percentages of annual declines have slackened in recent years compared to those in earlier years. As shown in Table 18, IMRs in Jordan declined at an annual rate of 4.1 per cent during 1958-68, compared to 1.3 per cent during 1968-78, while those in Kuwait declined by 8.2 per cent during 1961-69 and 5.3 per cent during 1969-78. In Syria, IMRs declined annually by 4.1 per cent during 1956-68 and 3.0 per cent during 1968-79. The corresponding percentages for U5MRs were 4.6 and 1.6, respectively, for Jordan, 9.4 and 5.9, respectively, for Kuwait, and 4.5 and 3.4, respectively, for Syria. Accordingly, attention should be directed "to the specific countries where mortality decline has stalled in order to identify and rectify the factors responsible" Hill, 1985) and there is no need for global concern. Of course, countries at lower levels of mortality are expected to experience slower rates of decline than those at higher levels of mortality.

Percentages of annual declines for other measures of childhood mortality, namely, the NICMR (non-infant child mortality rate: deaths between ages one and five) and the U2MR (under two mortality rate: deaths between birth and age two), are presented in Table 18. All childhood mortality rates (NICMR, U2MR, and U5MR) have declined at faster rates than the IMR. Generally, endogenous mortality is greater than exogenous mortality during infancy , while the opposite is true in the following four years of life. Thus, control of environmental health hazards manifests its effect mainly on children beyond the first year of life. The first few months of life are mostly affected by biological and hereditary determinants.

Regarding the maintenance of the pace of mortality decline (which is best measured by the average annual decline in U5MRs (Hill, 1985)), in those countries where the decline has slackened in recent years, Kitagawa (1977) states that "there is increasing evidence that social and economic development is an essential component of sustained rapid mortality decline." There comes a time when it is not enough to rely on free health services and improvements in public health facilities, and when social, cultural, and economic development play an effective role. Infant and childhood mortality are sensitive responses to both health programs and socioeconomic conditions in a society. High infant and childhood mortality, in at least three of the six Arab countries included in this study, especially Egypt, require effective and targeted policies to reduce their levels.

Among the six Arab countries included here, the three Gulf countries, namely, Bahrain, Kuwait, and the U.A.E., have already achieved the target set by the United Nations of a U5MR of 70 by the year 2000. Jordan and Syria are also likely to achieve this target by the year 2000, if the current pace of decline continues in the next decade. Egypt, however, is not likely to achieve the target, unless greater efforts and resources are allocated to control infant and childhood mortality through the provision of quality maternal and child care, and identification of those factors responsible for these high rates such that remedial measures can be taken.

The above analyses provide some insights into the quality and reliability of the various censuses and surveys employed as sources of data for the present study. For example, the 1976 population census in Egypt, the 1983 Jordan Fertility and Family Health Survey (JFFHS), and the 1970 population census in Syria all suffer from underreporting of the number of children ever born and/or the number of dead children. In addition, the results of the present analysis help in evaluating child death reporting in civil registration systems in these six Arab countries.

Table 19 shows estimates of completeness of infant death registration by sex during the period 1966-82. It is clear that, in the late 1960s and early 1970s, underregistration of infant deaths was around 25 per cent in Egypt and Kuwait and about 60 per cent in Jordan. The figure for Egypt is consistent with the 31-39 per cent estimated by El-Badry (1965) and Hollingsworth (1972) for 1960, and with the 25 per cent estimated by Rashad (1981) for 1976. By the early 1970s, death registration was considered 100 per cent complete in Kuwait (this is in agreement with a similar conclusion by Hill (1975)), while that in Egypt and Jordan did not change much. During the second half of the 1970s, underregistration of infant deaths was estimated to be about 75 per cent for Syria and 40 per cent for Bahrain and the U.A.E. There are some indications that completeness of infant death registration has improved in Bahrain, Egypt, and the U.A.E. in the late 1970s, compared to the mid 1970s. (see Figure 23.) These percentages of completeness of child death registration are conservative estimates, since indirect procedures are found generally to bias the levels of mortality upwards because of exceptionally high mortality among children born to mothers in age groups 15-19 and 20-24 (Preston, 1985).

Sex differentials in completeness of infant death registration are presented in Table 19 and Figure 24. For the three countries for which data are available by sex of child, completeness percentages were higher for females than males in Bahrain, with no specific pattern discernible in Jordan and Kuwait. The result for Bahrain is similar to that of Rashad (1981) for Egypt, and warrants an investigation. While deficiencies in the data due to registration patterns or errors may be the reason for excess female mortality, other factors such as nutritional or cultural practices were found to be the reason in Sri Lanka where this phenomenon also has been observed. To test this hypothesis, data on trends of mortality sex differentials are to be examined

(Arriaga and Way, 1988). However, data on causes of death are available only for Egypt and Kuwait (World Health Organization, 1986) and, though of a lesser quality, for Bahrain.

Two more salient features, in addition to that concerning the declining trend in infant and childhood mortality, mentioned at the beginning of this section, are noteworthy. First, the six Arab countries are not homogeneous in terms of infant and childhood mortality. The rates in the five Arab countries of Western Asia are much lower than those in Egypt, and those in Kuwait correspond to the levels prevailing in developed countries. And second, the levels and trends in infant and childhood mortality are, as expected, very sensitive indices of the surrounding environment as reflected by the standard and quality of life and economic development.

Finally, the analysis conducted in this study and the results and conclusions drawn herein have relied mainly on data from retrospective reports of women in censuses and surveys. The accuracy of the estimates, thus, depends upon the precision of the data. In addition, sample demographic surveys are subject to nonsampling errors, which cannot be evaluated, and "are not efficient methods for counting vital events occurring in an area [or] measuring changes in vital rates" (International Institute for Vital Registration and Statistics, 1988). The indirect estimates derived in this report depend a great deal on the assumptions implied in the indirect procedures and statistical models used, which may not be appropriate for the six Arab countries.

Refined sets of measures on levels and trends of infant and childhood mortality in a society, should be derived from sound vital registration systems capable of providing accurate and reliable sets of data and of meeting various demographic and statistical requirements. A strong vital registration system is important to document socioeconomic variations in infant and childhood mortality and long-term trends, the result of which is a better understanding and assessment of various factors affecting mortality decline. "Clearly, the various methods of estimating ... death rates are not substitutes for the registration method" (International Institute for Vital Registration and Statistics, 1988).

## REFERENCES


Acsa'di, G. and Issa, M.S. 1982. "Egyptian Mortality and Considerations on Arab Model Life Tables". In Mortality Trends and Differentials in Some African and Asian Countries. Research Monograph Series, no. 8. Cairo, Egypt: Cairo Demographic Centre, pp. 225-266.

Adlakha, A.L. and Suchindran, C.M. 1985. "Factors Affecting Infant and Child Mortality." Journal of Biosocial Science (Cambridge, England), vol. 17, no. 4, October, pp.481-496.

Arriaga, E.E. and Way, P.O. 1988. "Determinants of Excess Female Mortality." Population Bulletin of the United Nations (New York, USA), nos. 21/22, pp. 45-54.

Arthur, W.B. and Stoto, M.A. 1983. "An Analysis of Indirect Estimation." Population Studies (London, England), vol. 37, no.2, July, pp. 301-314.

El-Badry, M.A. 1965. "Trends in the Components of Population Growth in the Arab Countries of the Middle East: A Survey of Present Information." Demography (Washington, D.C.), vol. 2, no. 2, pp. 140-186.

El-Badry, M.A. 1969. "Higher Female than Male Mortality in Some Countries of South Asia: A Digest." Journal of the American Statistical Association (Washington, D.C.), vol. 64, pp. 1234-1244.

Bahrain, Central Statistics Organization. 1987 and 1988. Statistical Abstract. Bahrain: Central Statistics Organization.

Bahrain, Directorate of Statistics. 1983. Bahrain Census of Population & Housing - 1981: Trends and Prospects. Bahrain: Directorate of Statistics.

Bahrain, Ministry of Health. 1989. Annual Report of Public Health 1988. Bahrain: Ministry of Health.

Blackter, J.G.C.; Hill, A.G.; and Moser, K.A. 1983. Mortality Levels and Trends in Jordan Estimated from the Results of the 1976 Fertility Survey. World Fertility Survey Scientific Report. Voorburg, Netherlands: International Statistical Institute, vol. 47.

Brass, W. ED. 1968. The Demography of Tropical Africa. Princeton, New Jersey: Princeton University Press.

Brass, W. 1975. Methods of Estimating Fertility and Mortality from Limited and Defective Data. An Occasional Publication. International Program of Laboratories for Population Statistics. Chapel Hill, North Carolina: University of North Carolina.

Bucht, B.E. and El-Badry, M.A. 1984. Reflections on Recent Levels and Trends of Fertility and Mortality in Egypt. Working Paper Series no. 9. Cairo, Egypt: Cairo Demographic Centre.

Cairo Demographic Centre. 1982. Mortality Trends and Differentials in Some African and Asian Countries. Research Monograph series, no. 8. Cairo, Egypt: Cairo Demographic Centre.

Coale, A.J. and Demeny, P. 1966. Regional Model Life Tables and Stable Populations. Princeton, New Jersey: Princeton University Press.

Coale, A.J. and Trussell, T.J. 1978. "Estimating the Time to Which Brass Estimates Apply". Population Bulletin of the United Nations (New York, USA), no. 10, pp. 87-88.

El-Deeb, B. 1982. "Evaluation of Egyptian Fertility Survey 1980." Cited in Infant and Child Mortality in Egypt. Egypt, Central Agency for Public Mobilization and Statistics. 1986. Cairo, Egypt: Agency for Public Mobilization and Statistics.

Egypt, Central Agency for Public Mobilization and Statistics. 1979. Measurement of Underregistration of Vital Events Sample Survey. Cairo, Egypt: Central Agency for Public Mobilization and Statistics.

Egypt, Central Agency for Public Mobilization and Statistics. 1986. Infant and Child Mortality in Egypt. Prepared by L. Nawar, B. El-Deeb, M. Nizamuddin, and F. G. Tourkey. Cairo, Egypt: Central Agency for Public Mobilization and Statistics.

Egypt, Central Agency for Public Mobilization and Statistics. Several issues. Births and Deaths Statistics. Cairo, Egypt: Central Agency for Public Mobilization and Statistics.

Egypt, National Population Council. 1989. Egypt Demographic and Health Survey 1988: Preliminary Report. Cairo, Egypt: Egypt National Population Council, and Washington: Demographic and Health Surveys, Institute for Resource Development.

Ewbank, D.C. 1982. "The Sources of Error in Brass's Method for Estimating Child Survival: The Case of Bangladesh." Population Studies (London, England), vol. 36, no. 3, pp. 459-474.

Farag, M. 1982. "Mortality Level and Differentials Associated with Socio-Economic Development in Syria." In Trends and Differentials in Some African and Asian Countries. Research Monograph Series, no. 8. Cairo, Egypt: Cairo Demographic Centre, pp. 317-351.

Feeney, G. 1980. "Estimating Infant Mortality Trends from Child Survivorship Data." Population Studies (London, England), vol. 34, no.1, pp. 109-128.

Fergany, N. 1976. A Reconstruction of Some Aspects of the Demographic History of Egypt in the Twentieth Centry. Demographic Projection Analysis Project. Technical Paper, No. R/31. Cairo, Egypt: The American University in Cairo, January, pp. 56.

Hallouda, A.M.; Amin, S.Z.; and Farid, S.M. Eds. 1983. The Egyptian Fertility Survey 1980. Volume II: Fertility and Family Planning. Cairo, Egypt: Central Agency for Public Mobilization and Statistics.

Hamed, M.E. 1987. "Levels, Trends and Differentials of Infant and Child Mortality in Egypt." In Trend and Differentials in Some African and Asian Countries. Research Monograph Series, no. 8. Cairo, Egypt: Cairo Demographic Centre, pp. 171-197.

Hill, A.G. 1975. "The Demography of the Kuwaiti Population of Kuwait." Demography (Washington, D.C.), vol. 12, no. 3, pp. 537-548.

Hill, K. 1985. "The Pace of Mortality Decline Since 1950." In Quantitative Studies of Mortality Decline in the Development World, edited by DaVanzo, J.; Habicht, J.-P.; Hill, K.; and Preston, S.H. Population and Development Series no. 8, Working paper no. 683. Washington, D.C.: World Bank.

Hollingsworth, T.H. 1972. "The Egyptian Birth Rate and Its Sex Ratio." Egyptian Population and Family Planning Review. (Cairo, Egypt), vol. 5, no. 2, pp. 115-130.

Horne, A.D. and El-Khorazaty, M.N. 1987. "Childbearing Indices in the Arab World." Population Bulletin of the United Nations and Social Commission for Western Asia (Baghdad, Iraq ), no. 31, December, pp. 77-111.

Horne, A.D.; El-Khorazaty, M.N.; and Suchindran, C.M. 1986. "Differentials in Model Childbearing Measures in Developing Countries." The 1986 Proceedings of the Social Statistics Section. Washington, D.C.: American Statistical Association. pp. 379-384.

Hossain, M.M. and Glass, R.I. 1988. "Parental Son Preference in Seeking Medical Care for Children Less than Five Years of Age in a Rural Community in Bangladesh." American Journal of Public Health (Washington, D.C.), vol. 78, no. 10, pp. 1349-1350.

International Institute for Vital Registration and Statistics. 1988. Organization and Status of Civil Registration and Vital Statistics in the Arab Countries. Technical Paper no. 33, Bethesda, Merryland: International Institute for Vital Registration and Statistics. (IIVRS).

Jordan, Department of Statistics. 1983. Jordan Demographic Survey 1981. Principal Report. Prepared by A.A. Aziz; A Adlakha; and M. Nizamuddin. Amman, Jordan: Department of Statistics.

Jordan, Department of Statistics and Division of Reproductive Health, and Centre for Dicease Control, Atlanta, Ga, USA. 1984. Jordan Fertility and Family Health Survey 1983. Report of Principal Findings. Amman, Jordan: Department of Statistics.

Khaleej Times. 1989. "UAE Treats Infants Well." Press release on 19 July 1989.

Kitagawa, E.M. 1977. "On Mortality." Demography (Washington, D.C.), vol. 14, no. 4, pp. 381-289.

Kohli, K.L. and Al-Omaim, M. 1982. "Levels and Trends of Foetal, Infant and Childhood Mortality, and their Determinants. A Case Study of Kuwait." Population Bulletin of Economic and Social Commission for Western Asia (ESCWA) (Baghdad, Iraq), nos. 22/23, June and December, pp. 93-118.

Kohli, K.L. and Al-Omaim, M. 1983. "Infant and Child Mortality in Kuwait." Journal of Biosocial Science (Cambridge, England), vol. 15, no. 3, pp. 339-348.

Kohli, K.L. and Al-Omaim, M. 1986. "Mortality levels, trends and Differentials in Kuwait, 1957-1983." Population Bulletin of Economic and Social Commission for Western Asia (ESCWA) (Baghdad, Iraq), no. 28, June, pp. 91-123.

Kraly, E.P. and Norris, D.A. 1978. "An Evaluation of Brass Mortality Estimates Under Conditions of Declining Mortality." Demography (Washington, D.C.), vol.15, no. 4, pp. 549-557.

Kuwait, Central Statistics Office. 1980-1988. Annual Statistical Abstract. Kuwait.

Makinson, C. 1986. "Sex Differentials in Infant and Child Mortality in Egypt." Ph.D. Dissertation. Princeton, New Jersey: Princeton University.

National Research Council, Panel on Egypt. 1982. The Estimation of Recent Trends in Fertility and Mortality in Egypt. Committee on Population and Demography Report no. 9. Washington, D.C.: National Academy Press.

Newell, C. 1985. AFEMO: A program for Estimating Fertility and Child Mortality from Information on Children Ever Born and Children Surviving. London, England: Centre for Population Studies, and London School of Hygiene and Tropical Medicine.

Palloni, A. 1979. "A New Technique to Estimate Infant Mortality with an Application for El Salvador and Colombia." Demography (Washington, D.C.), vol. 16, no. 3, pp. 455-473.

Palloni, A. 1980. "Estimating Infant and Childhood Mortality under Conditions of Changing Mortality." Population Studies (London, England), vol. 34, no. 1, pp. 129-142.

Preston, S.H. 1985. "Mortality in Childhood: Lessons from WFS." Reproductive Change in Developing Countries: Insights from the World Fertility Survey. Edited by Cleland, J. and Hovcraft, J. New York, USA: Oxford University Press.

Rashad, H. 1981. Evaluation of the Completeness of Mortality Registration in Egypt. Regional Papers. Cairo, Egypt: The Population Council.

Ross, J.A.; Rich, M.; Molzan, J.P.; and Pensak, M. 1988. Family Planning and Child Survival: 100 Developing Countries. New York, USA: Centre for Population and Family Health, Columbia University.

Rutstein, S.O. 1983. Infant and Child Mortality: Levels, Trends and demographic Differentials. World Fertility Survey Comparative Studies no. 24. Voorburg, Netherlands: International Statistical Institute.

Al-Sabah, A.Y.A. and El-Shalakani, M.H. 1986. Population of Kuwait: Past-Present-Future (A Comparative Analytical Demographic Study). Kuwait: Department of Geography, University of Kuwait and Kuwaiti Geographic Society. (In Arabic).

Sivamurthy, M. 1982. "Components Analysis of Mortality in Some Arab Countries". In Mortality Trends and Differentials in Some African and Asian Countries. Research Monograph Series, no. 8. Cairo, Egypt: Cairo Demographic Centre, pp. 425-453.

Sivamurthy, M. and Ma'ayata, A.A. 1982. "A Study of Mortality in Jordan; With Special Reference to Infant Mortality." In Mortality Trends and Differentials in Some African and Asian Countries. Research Monograph Series, no. 8. Cairo, Egypt: Cairo Demographic Centre, pp. 267-315.

Sivamurthy, M. and Torki, F.G. 1982. "Trends and Differentials in mortality in Kuwait: 1965-70." In Mortality Trends and Differentials in Some African and Asian Countries. Research Monograph Series, no. 8. Cairo, Egypt: Cairo Demographic Centre, pp. 353-401.

Sullivan, J. 1972. "Model for the Estimation of Probability of Dying between Birth and Exact Ages of Early Childhood." Population Studies (London, England), vol. 26, no. 11, pp. 79-97.

Syria, Central Bureau of Statistics. 1981. Follow-Up Demographic Survey: Final Report 1976-1979. Damascus, Syria: Central Bureau of Statistics.

Syria, Central Bureau of Statistics. 1984. Statistical Abstract 1984. Damascus: Central Bureau of Statistics.

Trussell, T.J. 1975. "A Re-estimation of Multiplying Factors for the Brass Technique for Determining Childhood Survivorship Rates." Population Studies (London, England), vol. 29, no. 1, pp. 79-97.

Trussell, T.J. and Menken, J. 1984. "Estimating Levels, Trends, and Determinants of Child Mortality in Countries with Poor Statistics." In Child Survival: Strategies for Research. Edited by Mosley, W.H. and Chen, L.C. A supplement to Population and Development Review (New York, USA), vol. 10, pp. 325-346.

United Arab Emirates, Ministry of Planning, Central Directorate of Statistics. Several Issues. Statistical Yearbook. United Arab Emirates, Abu Dhabi: Department of Planning.

United Arab Emirates, Ministry of Planning, Central Directorate of Statistics. 1979 and 1984. Annual Statistical Abstract. United Arab Emirates, Abu Dhabi: Central Statistical Department.

United Nations Children's Fund. Several years. The State of the World's Children. New York, USA: United Nations Children's Fund.

United Nations, Department of Economic and Social Affairs. 1973. The Determinants and Consequences of Population Trends. New York, USA: United Nations Publications.

United Nations, Department of International Economic and Social Affairs. 1982. Levels and Trends of Mortality Since 1950. New York, USA: United Nations Publications.

United Nations, Department of International Economic and Social Affairs. 1983a. Infant and Child Mortality: World Estimates and Projections, 1950-2025. New York, USA: United Nations Publications.

United Nations, Department of International Economic and Social Affairs. 1983b. Manual X: Indirect Techniques for Demographic Estimation. New York, USA: United Nations Publications.

United Nations, Department of International Economic and Social Affairs. 1986. Selected Demographic and Social Characteristics of the World's Children and Youth. New York, USA: United Nations Publications.

United Nations, Department of International Economic and Social Affairs. 1988a. Mortality of Children Under Age 5: World Estimates and Projections, 1950-2025. New York, USA: United Nations Publications.

United Nations, Department of International Economic and Social Affairs. 1988b. MortPak-Lite: The United Nations Software Package for Mortality Measurement. New York, USA: United Nations Publications.

United Nations, Department of International Economic and Social Affairs. 1988c. Statistical Yearbook 1985/86. New York, USA: United Nations Publications.

United Nations, Department of International Economic and Social Affairs. 1989. World Population Prospects 1988. New York, USA: United Nations Publications.

United Nations, Department of International Economic and Social Affairs. Several issues. Demographic Yearbook. New York, USA: United Nations Publications.

Vaidyanathan, K.E. 1976. "Estimation of Infant and Child Mortality in Syria from the 1970 Census Data." Population Studies, Series No. 2. Damascus, Syria: Central Bureau of Statistics.

Vaidyanathan, K.E. and Fouda, S. 1982. "A Study on Infant and Child Mortality in Arab Countries." In Mortality Trends and Differentials in Some African and Asian Countries. Research Monograph Series, no. 8. Cairo, Egypt: Cairo Demographic Centre, pp. 511-557.

Valaoras, V.G. 1972. Population Analysis of Egypt, 1935-1970 (with Special Reference into Mortality). Occasional paper No. 1. Cairo, Egypt: Cairo Demographic Centre.

World Health Organization. 1986. World Health Statistics Annual, 1986. Geneva, Switzerland: World Health Organization.

World Bank. Several years. World Development Report. New York, USA: Oxford University Press.

Zlotnik, H. 1981. Computer Programs for Demographic Estimation: A User's Guide. Washington, D.C., USA: National Academy Press.

TABLE 1.

INFANT MORTALITY RATES FROM VITAL REGISTRATION DATA
DURING THE PERIOD 1955 - 1988 FOR SIX ARAB COUNTRIES

| Year | Bahrain | Egypt | Jordan | Kuwait | Syria | U.A.E.* |
|---|---|---|---|---|---|---|
| 1955 | | 136 | | | | |
| 1956 | | 124 | | | | |
| 1957 | | 130 | | | | |
| 1958 | | 112 | | | | |
| 1959 | | 109 | | | | |
| 1960 | | 109 | | | | |
| 1961 | | 108 | 60 | | | |
| 1962 | | 134 | 50 | | | |
| 1963 | | 119 | 50 | | | |
| 1964 | | 117 | 48 | | | |
| 1965 | | 113 | 63 | 47 | | |
| 1966 | | 127 | 36 | 44 | | |
| 1967 | | 116 | 31 | 37 | | |
| 1968 | | 131 | 28 | 39 | | |
| 1969 | | 119 | 25 | 32 | | |
| 1970 | | 116 | 22 | 41 | | |
| 1971 | | 103 | 21 | 40 | 24 | |
| 1972 | | 116 | 21 | 45 | 22 | |
| 1973 | | 98 | 23 | 52 | | |
| 1974 | | 101 | 22 | 52 | | |
| 1975 | 25 | 89 | 20 | 43 | 14 | |
| 1976 | 25 | 87 | 22 | 38 | 15 | |
| 1977 | 21 | 85 | 15 | 44 | 13 | 26 |
| 1978 | 18 | 74 | 12 | 39 | 13 | 21 |
| 1979 | 27 | 76 | 13 | 37 | 13 | 28 |
| 1980 | 25 | 76 | 11 | 31 | | 33 |
| 1981 | 22 | 70 | | 28 | 9 | 23 |
| 1982 | 22 | 71 | | 26 | 7 | 24 |
| 1983 | 17 | | | 22 | 9 | 20 |
| 1984 | 24 | | | 20 | 7 | 17 |
| 1985 | 21 | | | 20 | | |
| 1986 | 19 | | | 16 | | |
| 1987 | 21 | | | | | 13 |
| 1988 | 24 | | | | | |

* For Abu Dhabi Emirate only.

TABLE 2.

INFANT MORTALITY RATES FROM VITAL REGISTRATION DATA FOR MALES AND FEMALES DURING THE PERIOD 1955 - 1988

| Year | Bahrain | | Egypt | | Jordan | | Kuwait | | U.A.E.* | |
|---|---|---|---|---|---|---|---|---|---|---|
| | M | F | M | F | M | F | M | F | M | F |
| 1955 | | | 134 | 138 | | | | | | |
| 1956 | | | 122 | 127 | | | | | | |
| 1957 | | | 126 | 135 | | | | | | |
| 1958 | | | 107 | 118 | | | | | | |
| 1959 | | | 105 | 114 | | | | | | |
| 1960 | | | 104 | 115 | | | | | | |
| 1961 | | | 105 | 111 | | | | | | |
| 1962 | | | 127 | 141 | | | | | | |
| 1963 | | | 114 | 123 | | | | | | |
| 1964 | | | 113 | 121 | | | | | | |
| 1965 | | | 111 | 116 | | | 57 | 41 | | |
| 1966 | | | 123 | 130 | | | 44 | 33 | | |
| 1967 | | | 112 | 120 | | | 41 | 37 | | |
| 1968 | | | 125 | 138 | | | 41 | 39 | | |
| 1969 | | | 114 | 124 | | | 33 | 31 | | |
| 1970 | | | 111 | 122 | | | 42 | 41 | | |
| 1971 | | | 98 | 109 | 20 | 22 | 42 | 38 | | |
| 1972 | | | 110 | 123 | 20 | 22 | 49 | 41 | | |
| 1973 | | | 95 | 101 | 23 | 22 | 55 | 48 | | |
| 1974 | | | 98 | 105 | 23 | 21 | 56 | 48 | | |
| 1975 | | | 87 | 92 | | | 46 | 41 | | |
| 1976 | | | 85 | 90 | 23 | 20 | 41 | 35 | | |
| 1977 | 23 | 19 | 82 | 89 | 16 | 14 | 45 | 43 | 27 | 25 |
| 1978 | 20 | 17 | 73 | 74 | 12 | 11 | 40 | 37 | 20 | 22 |
| 1979 | 26 | 28 | 75 | 76 | | | 38 | 35 | 27 | 28 |
| 1980 | 28 | 23 | 75 | 76 | | | 33 | 29 | 34 | 32 |
| 1981 | 23 | 21 | | | | | 29 | 27 | 27 | 20 |
| 1982 | 22 | 22 | | | | | 29 | 23 | 26 | 22 |
| 1983 | 19 | 14 | | | | | 23 | 20 | | |
| 1984 | 26 | 22 | | | | | 22 | 19 | 16 | 17 |
| 1985 | 21 | 20 | | | | | 22 | 18 | | |
| 1986 | 17 | 20 | | | | | 17 | 15 | | |
| 1987 | 22 | 20 | | | | | | | | |
| 1988 | 22 | 25 | | | | | | | | |

* For Abu Dhabi Emirate only.

Sources : see Table 1.

TABLE 3.

ADJUSTED INFANT MORTALITY RATES* FOR EGYPT, 1955-1978

| Year | NRC Study | | Fergany's Study | | El-Deeb's Study | |
|---|---|---|---|---|---|---|
| | IMR | % under-registr. | IMR | % under-registr. | IMR | % under-registr. |
| 1955 | 195 | 43.4 | 185 | 36.0 | 192 | 41.2 |
| 1956 | 183 | 47.6 | 214 | 72.6 | 151 | 21.8 |
| 1957 | 196 | 50.8 | 195 | 50.0 | 180 | 38.5 |
| 1958 | 179 | 59.8 | 192 | 71.4 | 145 | 29.5 |
| 1959 | 171 | 56.9 | 162 | 48.6 | 146 | 33.9 |
| 1960 | 168 | 54.1 | 171 | 56.9 | 171 | 56.9 |
| 1961 | 166 | 53.7 | 160 | 48.1 | 146 | 35.2 |
| 1962 | 171 | 27.6 | 196 | 46.3 | 158 | 17.9 |
| 1963 | 157 | 31.9 | 171 | 43.7 | 141 | 18.5 |
| 1964 | 155 | 32.5 | 168 | 43.6 | 132 | 12.8 |
| 1965 | 149 | 31.9 | 161 | 42.5 | 141 | 24.8 |
| 1966 | 168 | 32.3 | 179 | 40.9 | 138 | 8.7 |
| 1967 | 153 | 31.9 | 162 | 39.7 | 147 | 26.7 |
| 1968 | 173 | 32.1 | 181 | 38.2 | 128 | -2.3 |
| 1969 | 157 | 31.9 | 163 | 37.0 | 119 | 0.0 |
| 1970 | 153 | 31.9 | 157 | 35.3 | 145 | 25.0 |
| 1971 | 136 | 32.0 | 138 | 34.0 | 139 | 35.0 |
| 1972 | 153 | 31.9 | 154 | 32.8 | 157 | 35.3 |
| 1973 | 130 | 32.7 | 129 | 31.6 | 145 | 48.0 |
| 1974 | 133 | 31.7 | | | 134 | 32.7 |
| 1975 | 118 | 32.6 | | | 126 | 41.6 |
| 1976 | 116 | 33.3 | | | 141 | 62.1 |
| 1977 | | | | | 135 | 58.8 |
| 1978 | | | | | 132 | 78.4 |

* Rates are per one thousand live births.

Sources:

- For NRC study: National Research Council, Panel on Egypt (1982).
- For Fergany's study: Fergany, N. (1976).
- For El-Deeb's study: El-Deeb, B. (1982).

TABLE 4.

WORLD FERTILITY SURVEY INFANT AND CHILDHOOD MORTALITY ESTIMATES FOR EGYPT, JORDAN, AND SYRIA : 1955 -1979
(Direct estimates)

| Period | Q(1): IMR | $_4q_1$: NICMR | Q(2): U2MR | Q(5): U5MR | $_1q_1$: TMR | $_3q_2$: CMR |
|---|---|---|---|---|---|---|
| | | | (1) Egypt | | | |
| Both sexes: | | | | | | |
| 1955-59 | 166 | 192 | 241 | 326 | 90 | 112 |
| 1960-64 | 151 | 155 | 218 | 283 | 79 | 82 |
| 1965-69 | 141 | 119 | 194 | 243 | 62 | 61 |
| 1970-74 | 146 | 108 | 198 | 238 | 62 | 50 |
| 1975-79 | 132 | 67 | 165 | 191 | 37 | 31 |
| | | | (2) Jordan | | | |
| Both sexes: | | | | | | |
| 1955-59 | 117 | 89 | 158 | 195 | 47 | 44 |
| 1960-64 | 89 | 53 | 119 | 138 | 33 | 21 |
| 1965-69 | 74 | 29 | 92 | 101 | 20 | 10 |
| 1970-74 | 68 | 19 | 79 | 86 | 11 | 8 |
| | | | (3) Syria | | | |
| Both sexes: | | | | | | |
| 1955-59 | 95 | 83 | 132 | 170 | 41 | 43 |
| 1960-64 | 78 | 49 | 99 | 124 | 22 | 28 |
| 1965-69 | 78 | 35 | 91 | 110 | 15 | 21 |
| 1970-74 | 70 | 23 | 81 | 91 | 13 | 11 |
| 1975-77 | 64 | 19 | 74 | 82 | 11 | 8 |

Rates shown are per thousand.

Source: Rutstein, S.O. (1983).

Notes:

IMR (Infant Mortality Rate): Deaths between birth and age one year.
NICMR (Non-Infant Child Mortality Rate): Deaths between ages one and five.
U2MR (Under Two Mortality Rate): Deaths between birth and age two years.
U3MR (Under Three Mortality Rate): Deaths between birth and age three years.
U5MR (Under Five Mortality Rate): Deaths between birth and age five years.
TMR (Toddler Mortality Rate): Deaths between ages one and two years.
CMR (Child Mortality Rate): Deaths between ages two and five years.

TABLE 5.

WORLD FERTILITY SURVEY INFANT AND CHILDHOOD MORTALITY ESTIMATES BY SEX FOR EGYPT, JORDAN, AND SYRIA : 1955 - 1979 (Direct estimates)

| Period | Q(1): IMR | $_4q_1$: NICMR | Q(2): U2MR | Q(5): U5MR | $_1q_1$: TMR | $_4q_1$: CMR |
|---|---|---|---|---|---|---|
| | | | (1) Egypt | | | |
| Male: | | | | | | |
| 1955-59 | 164 | 174 | 235 | 310 | 85 | 97 |
| 1960-64 | 157 | 141 | 220 | 276 | 75 | 71 |
| 1965-69 | 142 | 111 | 194 | 236 | 61 | 53 |
| 1970-74 | 150 | 95 | 193 | 230 | 51 | 46 |
| 1975-79 | 132 | 63 | 158 | 185 | 31 | 32 |
| Female: | | | | | | |
| 1955-59 | 168 | 209 | 246 | 342 | 95 | 126 |
| 1960-64 | 145 | 169 | 216 | 289 | 84 | 94 |
| 1965-69 | 140 | 129 | 194 | 251 | 63 | 70 |
| 1970-74 | 141 | 123 | 204 | 247 | 73 | 54 |
| 1975-79 | 134 | 72 | 172 | 197 | 43 | 30 |
| | | | (2) Jordan | | | |
| Male: | | | | | | |
| 1955-59 | 111 | 71 | 140 | 175 | 33 | 40 |
| 1960-64 | 98 | 48 | 123 | 141 | 28 | 20 |
| 1965-69 | 67 | 23 | 82 | 88 | 16 | 7 |
| 1970-74 | 63 | 21 | 75 | 83 | 13 | 8 |
| Female: | | | | | | |
| 1955-59 | 122 | 109 | 178 | 218 | 63 | 49 |
| 1960-64 | 81 | 59 | 115 | 135 | 38 | 22 |
| 1965-69 | 82 | 36 | 104 | 115 | 24 | 13 |
| 1970-74 | 73 | 17 | 83 | 89 | 10 | 7 |
| | | | (3) Syria | | | |
| Male: | | | | | | |
| 1955-59 | 86 | 81 | 123 | 160 | 40 | 43 |
| 1960-64 | 73 | 37 | 91 | 107 | 20 | 18 |
| 1965-69 | 81 | 35 | 93 | 113 | 14 | 21 |
| 1970-74 | 66 | 22 | 80 | 87 | 14 | 8 |
| 1975-77 | 55 | 19 | 65 | 73 | 11 | 8 |
| Female: | | | | | | |
| 1955-59 | 105 | 84 | 143 | 180 | 43 | 43 |
| 1960-64 | 84 | 62 | 107 | 141 | 25 | 38 |
| 1965-69 | 74 | 36 | 89 | 107 | 16 | 20 |
| 1970-74 | 73 | 25 | 83 | 96 | 12 | 13 |
| 1975-77 | 73 | 19 | 84 | 91 | 11 | 8 |

Rates shown are per thousand.

Sources and notes : see Table 4.

TABLE 6.

UN AND UNICEF ESTIMATES OF INFANT AND CHILDHOOD MORTALITY FOR BAHRAIN, EGYPT, JORDAN, KUWAIT, SYRIA, AND UAE (1955 - 1989)

| Period | Bahrain* | | | Egypt | | | Jordan | | |
|---|---|---|---|---|---|---|---|---|---|
| | Q(1): | $_4q_1$: | Q(5): | Q(1): | $_4q_1$: | Q(5): | Q(1): | $_4q_1$: | Q(5): |
| | IMR | NICMR | U5MR | IMR | NICMR | U5MR | IMR | NICMR | U5MR |
| 1955-59 | 150 | - | - | 183 | 155 | 310 | 145 | 110 | 239 |
| 1960-64 | 110 | - | - | 175 | 139 | 290 | 125 | 82 | 197 |
| 1965-69 | 78 | - | - | 170 | 133 | 280 | 102 | 53 | 150 |
| 1970-74 | 55 | - | - | 150 | 106 | 240 | 82 | 36 | 116 |
| 1975-79 | 38 | - | - | 120 | 75 | 186 | 65 | 25 | 88 |
| 1980-84 | 32 | - | - | 100 | 54 | 148 | 54 | 18 | 72 |
| 1985-89 | 26 | - | - | 85 | 42 | 124 | 44 | 13 | 57 |

| Period | Kuwait* | | | Syria | | | U.A.E.* | | |
|---|---|---|---|---|---|---|---|---|---|
| | Q(1): | $_4q_1$: | Q(5): | Q(1): | $_4q_1$: | Q(5): | Q(1): | $_4q_1$: | Q(5): |
| | IMR | NICMR | U5MR | IMR | NICMR | U5MR | IMR | NICMR | U5MR |
| 1955-59 | 101 | 52 | 148 | 145 | 110 | 239 | 160 | 131 | 270 |
| 1960-64 | 77 | 33 | 107 | 125 | 82 | 197 | 130 | 89 | 207 |
| 1965-69 | 55 | 19 | 73 | 107 | 59 | 160 | 85 | 38 | 120 |
| 1970-74 | 43 | 13 | 55 | 88 | 40 | 125 | 57 | 20 | 76 |
| 1975-79 | 34 | 8 | 42 | 70 | 28 | 97 | 38 | 14 | 59 |
| 1980-84 | 23 | 4 | 27 | 59 | 21 | 79 | 32 | 10 | 47 |
| 1985-89 | 19 | 3 | 23 | 48 | 15 | 63 | 26 | 7 | 38 |

Rates shown are per thousand.
* For both nationals and non-nationals combined.
- not available

Sources:

Ross, J.A.; Rich, M.; Molzan, J.P.; and Pensak, M. (1988), U.N. (1988a, 1989), and UNICEF (several years).

Notes:

IMR (Infant Mortality Rate): Deaths between birth and age one year.
NICMR (Non-Infant Child Mortality Rate): Deaths between ages one and five.
U5MR (Under Five Mortality Rate): Deaths between birth and age five years.

TABLE 7.

WORLD BANK ESTIMATES OF INFANT AND CHILDHOOD MORTALITY DURING THE PERIOD 1960-1987 FOR FIVE ARAB COUNTRIES

| Year | Egypt | Jordan | Kuwait* | Syria | U.A.E.* |
|---|---|---|---|---|---|
| | | | A. IMR | | |
| 1960 | 179 | 136 | 89 | 132 | 135 |
| 1965 | 173 | 114 | 66 | 116 | 108 |
| 1980 | 103 | 69 | 34 | 62 | 53 |
| 1982 | 104 | 65 | 32 | 58 | 50 |
| 1983 | 102 | 62 | 29 | 56 | 44 |
| 1984 | 94 | 50 | 22 | 55 | 36 |
| 1985 | 93 | 49 | 22 | 54 | 35 |
| 1986 | 88 | 46 | 19 | 50 | 33 |
| 1987 | 85 | 44 | 19 | 48 | 26 |
| | | | B. NICMR | | |
| 1960 | 23 | 26 | 10 | 25 | 26 |
| 1965 | 21 | 19 | 5 | 19 | 14 |
| 1980 | 14 | 6 | 1 | 5 | 3 |
| 1982 | 14 | 6 | 1 | 5 | 3 |
| 1983 | 14 | 5 | 1 | 4 | 2 |
| 1984 | 11 | 3 | 1 | 4 | 1 |
| 1985 | 11 | 3 | 1 | 4 | 1 |
| | | | C. U5MR | | |
| 1960 | 300 | 218 | 128 | 218 | 239 |
| 1980 | 164 | 80 | 34 | 87 | 43 |
| 1987 | 129 | 60 | 23 | 67 | 33 |

IMR and U5MR rates are per 1000 live births.
NICMR rates are per 1000 population aged 1-4 years.
* For nationals and non-nationals combined.

Source: World Bank (several years).

Notes:

IMR (Infant Mortality Rates): Deaths between birth and age one.
NICMR (Non-Infant Child Mortality Rate): Deaths between age one and five years.
U5MR (Under Five Mortality Rate): Deaths between birth and age five years.

TABLE 8.

PROPORTION OF DEAD CHILDREN BY AGE OF WOMAN DURING 1970-88 FOR BAHRAIN, EGYPT, JORDAN, KUWAIT, SYRIA, AND THE U.A.E.

| Age groups of woman | Census/Survey date | | | | | |
|---|---|---|---|---|---|---|
| | (1) Bahrain | | (2) Egypt | | | |
| | 1971 | 1981 | 1976 | 1980 | 1984 | 1988 |
| 15-19 | 0.078 | 0.044 | 0.115 | 0.190 | 0.169 | 0.117 |
| 20-24 | 0.089 | 0.046 | 0.132 | 0.177 | 0.176 | 0.147 |
| 25-29 | 0.114 | 0.048 | 0.144 | 0.192 | 0.179 | 0.150 |
| 30-34 | 0.152 | 0.051 | 0.153 | 0.217 | 0.201 | 0.159 |
| 35-39 | 0.188 | 0.072 | 0.167 | 0.243 | 0.220 | 0.192 |
| 40-44 | 0.267 | 0.105 | 0.187 | 0.271 | 0.232 | 0.221 |
| 45-49 | 0.312 | 0.148 | 0.204 | 0.306 | 0.290 | 0.256 |
| | (3) Jordan | | | | (4) Kuwait | |
| | 1972 | 1976 | 1979 | 1981 | 1975 | 1980 |
| 15-19 | 0.073 | 0.081 | 0.065 | 0.065 | 0.044 | 0.030 |
| 20-24 | 0.074 | 0.080 | 0.070 | 0.067 | 0.041 | 0.028 |
| 25-29 | 0.112 | 0.087 | 0.075 | 0.075 | 0.043 | 0.031 |
| 30-34 | 0.116 | 0.099 | 0.084 | 0.082 | 0.056 | 0.036 |
| 35-39 | 0.126 | 0.115 | 0.087 | 0.097 | 0.074 | 0.050 |
| 40-44 | 0.162 | 0.170 | 0.108 | 0.122 | 0.116 | 0.072 |
| 45-49 | 0.198 | 0.168 | 0.150 | 0.143 | 0.151 | 0.103 |
| | (5) Syria | | | | (6) U.A.E. | |
| | 1970 | 1976 | 1978 | 1981 | 1975 | 1980 |
| 15-19 | 0.108 | 0.030 | 0.076 | 0.061 | 0.075 | 0.053 |
| 20-24 | 0.127 | 0.093 | 0.083 | 0.073 | 0.079 | 0.048 |
| 25-29 | 0.148 | 0.099 | 0.086 | 0.084 | 0.103 | 0.056 |
| 30-34 | 0.172 | 0.116 | 0.102 | 0.101 | 0.140 | 0.083 |
| 35-39 | 0.202 | 0.139 | 0.113 | 0.111 | 0.169 | 0.114 |
| 40-44 | 0.239 | 0.168 | 0.139 | 0.149 | 0.240 | 0.160 |
| 45-49 | 0.275 | 0.199 | 0.168 | 0.180 | 0.266 | 0.192 |

Sources : see page 1x.

TABLE 9.

INFANT AND CHILDHOOD MORTALITY RATES IN BAHRAIN : 1956-1979, USING 1971 AND 1981 CENSUSES

| Year | Q(1): IMR | | $_4q_1$: NICMR | | Q(2): U2MR | | Q(3): U3MR | | Q(5): U5MR | | $_1q_1$: TMR | | $_3q_2$: CMR | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | '71 | '81 | '71 | '81 | '71 | '81 | '71 | '81 | '71 | '81 | '71 | '81 | '71 | '81 |
| 1956 | 172 | | 103 | | 216 | | 235 | | 258 | | 53 | | 54 | |
| 1959 | 159 | | 93 | | 199 | | 217 | | 238 | | 48 | | 49 | |
| 1962 | 121 | | 65 | | 151 | | 164 | | 179 | | 34 | | 33 | |
| 1964 | 106 | | 54 | | 131 | | 142 | | 155 | | 28 | | 28 | |
| 1967 | 88 | 85 | 41 | 38 | 107 | 103 | 115 | 111 | 125 | 120 | 21 | 20 | 20 | 19 |
| 1968 | 79 | | 35 | | 94 | | 101 | | 110 | | 16 | | 18 | |
| 1970 | | 68 | | 27 | | 81 | | 86 | | 94 | | 14 | | 14 |
| 1973 | | 52 | | 18 | | 61 | | 65 | | 70 | | 9 | | 10 |
| 1975 | | 41 | | 12 | | 47 | | 49 | | 53 | | 6 | | 6 |
| 1977 | | 41 | | 12 | | 47 | | 49 | | 52 | | 6 | | 5 |
| 1979 | | 44 | | 14 | | 50 | | 52 | | 56 | | 6 | | 6 |

Rates shown are per thousand.

Notes:

IMR (Infant Mortality Rate): Deaths between birth and age one year.
NICMR (Non-infant Child Mortality Rate): Deaths between ages one and five.
U2MR (Under Two Mortality Rate): Deaths between birth and age two years.
U3MR (Under Three Mortality Rate): Deaths between birth and age three years.
U5MR (Under Five Mortality Rate): Deaths between birth and age five years.
TMR (Toddler Mortality Rate): Deaths between ages one and two years.
CMR (Child Mortality Rate): Deaths between ages two and five years.

TABLE 10.

INFANT AND CHILDHOOD MORTALITY RATES IN BAHRAIN : 1967 - 1979 BY SEX USING 1981 POPULATION CENSUS

| Year | Q(1): IMR | $_4q_1$: NICMR | Q(2): U2MR | Q(3): U3MR | Q(5): U5MR | $_1q_1$: TMR | $_3q_2$: CMR |
|---|---|---|---|---|---|---|---|
| | | | A. Male | | | | |
| 1967 | 91 | 43 | 114 | 122 | 132 | 25 | 20 |
| 1970 | 76 | 33 | 93 | 99 | 107 | 18 | 15 |
| 1972 | 60 | 22 | 70 | 75 | 80 | 11 | 11 |
| 1975 | 46 | 15 | 53 | 56 | 59 | 7 | 6 |
| 1977 | 46 | 15 | 54 | 57 | 61 | 8 | 7 |
| 1979 | 48 | 16 | 53 | 56 | 60 | 5 | 7 |
| | | | B. Female | | | | |
| 1967 | 78 | 34 | 91 | 99 | 108 | 14 | 19 |
| 1970 | 59 | 22 | 68 | 73 | 79 | 10 | 12 |
| 1973 | 45 | 14 | 51 | 54 | 58 | 6 | 7 |
| 1975 | 36 | 10 | 40 | 42 | 45 | 4 | 5 |
| 1977 | 35 | 9 | 39 | 41 | 44 | 4 | 5 |
| 1979 | 41 | 12 | 46 | 49 | 53 | 5 | 7 |

Rates shown are per thousand.

Notes:

IMR (Infant Mortality Rate): Deaths between birth and age one year.
NICMR (Non-infant Child Mortality Rate): Deaths between ages one and five.
U2MR (Under Two Mortality Rate): Deaths between birth and age two years.
U3MR (Under Three Mortality Rate): Deaths between birth and age three years.
U5MR (Under Five Mortality Rate): Deaths between birth and age five years.
TMR (Toddler Mortality Rate): Deaths between ages one and two years.
CMR (Child Mortality Rate): Deaths between ages two and five years.

TABLE 11.

INFANT AND CHILDHOOD MORTALITY RATES IN EGYPT : 1963 - 1985 USING 1976 CENSUS, 1980 EFS, 1984 ECPS, AND 1988 EDHS

**A. Using 1976 census and 1980 EFS**

| Year | Q(1): IMR | | $_4q_1$: NICMR | | Q(2): U2MR | | Q(3): U3MR | | Q(5): U5MR | | $_1q_1$: TMR | | $_3q_2$: CMR | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | '76 | '80 | '76 | '80 | '76 | '80 | '76 | '80 | '76 | '80 | '76 | '80 | '76 | '80 |
| 1963 | 114 | | 60 | | 142 | | 154 | | 168 | | 32 | | 30 | |
| 1966 | 115 | 168 | 60 | 100 | 143 | 211 | 155 | 230 | 169 | 251 | 32 | 52 | 30 | 51 |
| 1968 | 110 | | 56 | | 136 | | 147 | | 160 | | 29 | | 28 | |
| 1969 | | 161 | | 94 | | 201 | | 219 | | 240 | | 48 | | 49 |
| 1970 | 108 | | 55 | | 133 | | 144 | | 157 | | 28 | | 28 | |
| 1971 | 107 | | 54 | | 131 | | 142 | | 154 | | 27 | | 26 | |
| 1972 | | 155 | | 90 | | 194 | | 211 | | 231 | | 46 | | 46 |
| 1973 | 103 | | 52 | | 125 | | 135 | | 147 | | 25 | | 25 | |
| 1974 | | 148 | | 85 | | 185 | | 201 | | 220 | | 43 | | 43 |
| 1976 | | 143 | | 81 | | 178 | | 194 | | 212 | | 41 | | 41 |
| 1978 | | 154 | | 89 | | 191 | | 208 | | 227 | | 44 | | 44 |

**B. Using 1984 ECPS and 1988 EDHS**

| Year | Q(1): IMR | | $_4q_1$: NICMR | | Q(2): U2MR | | Q(3): U3MR | | Q(5): U5MR | | $_1q_1$: TMR | | $_3q_2$: CMR | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | '84 | '88 | '84 | '88 | '84 | '88 | '84 | '88 | '84 | '88 | '84 | '88 | '84 | '88 |
| 1971 | 162 | | 96 | | 204 | | 222 | | 243 | | 50 | | 49 | |
| 1974 | 141 | 141 | 79 | 79 | 176 | 176 | 191 | 192 | 209 | 210 | 41 | 41 | 40 | 41 |
| 1976 | 143 | | 81 | | 178 | | 194 | | 212 | | 41 | | 41 | |
| 1977 | | 132 | | 73 | | 165 | | 179 | | 196 | | 38 | | 37 |
| 1979 | 140 | | 79 | | 174 | | 190 | | 208 | | 40 | | 41 | |
| 1980 | | 124 | | 67 | | 154 | | 168 | | 183 | | 34 | | 34 |
| 1981 | 136 | | 76 | | 169 | | 184 | | 201 | | 38 | | 39 | |
| 1982 | | 111 | | 57 | | 137 | | 149 | | 162 | | 29 | | 29 |
| 1985 | | 114 | | 59 | | 141 | | 152 | | 166 | | 30 | | 29 |

Rates shown are per thousand.

Notes:

IMR (Infant Mortality Rate): Deaths between birth and age one year.

NICMR (Non-infant Child Mortality Rate): Deaths between ages one and five.

U2MR (Under Two Mortality Rate): Deaths between birth and age two years.

U3MR (Under Three Mortality Rate): Deaths between birth and age three years.

U5MR (Under Five Mortality Rate): Deaths between birth and age five years.

TMR (Toddler Mortality Rate): Deaths between ages one and two years.

CMR (Child Mortality Rate): Deaths between ages two and five years.

TABLE 12.

INFANT AND CHILDHOOD MORTALITY RATES IN JORDAN : 1958 - 1978
USING 1972 JNFS, 1976 JFS, 1979 CENSUS, AND 1981 JDS

| | Q(1): IMR | | $_4q_1$: NICMR | | Q(2): U2MR | | Q(3): U3MR | | Q(5): U5MR | | $_1q_1$: TMR | | $_3q_2$: CMR | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **A. Using 1972 JNFS and 1976 JFS** | | | | | | | | | | | | | |
| Year | '72 | '76 | '72 | '76 | '72 | '76 | '72 | '76 | '72 | '76 | '72 | '76 | '72 | '76 |
| 1958 | 110 | | 56 | | 136 | | 147 | | 160 | | 29 | | 28 | |
| 1960 | | 94 | | 45 | | 115 | | 125 | | 135 | | 23 | | 23 |
| 1961 | 99 | | 49 | | 122 | | 132 | | 143 | | 26 | | 24 | |
| 1963 | | 103 | | 51 | | 127 | | 138 | | 150 | | 27 | | 26 |
| 1964 | 84 | | 38 | | 102 | | 110 | | 119 | | 20 | | 19 | |
| 1966 | 84 | 78 | 38 | 34 | 101 | 93 | 109 | 101 | 118 | 109 | 19 | 16 | 19 | 18 |
| 1968 | 87 | 73 | 40 | 30 | 105 | 87 | 113 | 93 | 123 | 101 | 20 | 15 | 20 | 15 |
| 1970 | 67 | | 27 | | 79 | | 85 | | 92 | | 13 | | 14 | |
| 1971 | | 70 | | 29 | | 83 | | 89 | | 96 | | 14 | | 14 |
| 1972 | | 74 | | 31 | | 87 | | 94 | | 102 | | 14 | | 16 |
| | **B. Using 1979 census and 1981 JDS** | | | | | | | | | | | | | |
| Year | '79 | '81 | '79 | '81 | '79 | '81 | '79 | '81 | '79 | '81 | '79 | '81 | '79 | '81 |
| 1966 | 87 | 83 | 40 | 37 | 105 | 101 | 114 | 108 | 123 | 118 | 20 | 20 | 20 | 19 |
| 1969 | 71 | 78 | 29 | 34 | 84 | 94 | 90 | 101 | 98 | 109 | 14 | 17 | 15 | 17 |
| 1971 | 62 | | 23 | | 72 | | 77 | | 84 | | 11 | | 13 | |
| 1972 | | 69 | | 28 | | 81 | | 87 | | 94 | | 13 | | 14 |
| 1973 | 63 | | 24 | | 74 | | 79 | | 86 | | 12 | | 13 | |
| 1974 | 59 | 63 | 22 | 24 | 69 | 74 | 74 | 79 | 80 | 85 | 11 | 12 | 12 | 12 |
| 1976 | 56 | 62 | 20 | 24 | 65 | 73 | 69 | 78 | 74 | 85 | 10 | 12 | 10 | 13 |
| 1978 | | 64 | | 25 | | 74 | | 80 | | 86 | | 11 | | 13 |

Rates shown are per thousand.

Notes:

IMR (Infant Mortality Rate): Deaths between birth and age one year.
NICMR (Non-infant Child Mortality Rate): Deaths between ages one and five.
U2MR (Under Two Mortality Rate): Deaths between birth and age two years.
U3MR (Under Three Mortality Rate): Deaths between birth and age three years.
U5MR (Under Five Mortality Rate): Deaths between birth and age five years.
TMR (Toddler Mortality Rate): Deaths between ages one and two years.
CMR (Child Mortality Rate): Deaths between ages two and five years.

TABLE 13.

INFANT AND CHILDHOOD MORTALITY RATES IN JORDAN : 1960-1978, BY SEX USING 1976 JFS AND 1981 JDS

| Year | Q(1): IMR | | $_4q_1$: NICMR | | Q(2): U2MR | | Q(3): U3MR | | Q(5): U5MR | | $_1q_1$: TMR | | $_3q_2$: CMR | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | '76 | '81 | '76 | '81 | '76 | '81 | '76 | '81 | '76 | '81 | '76 | '81 | '76 | '81 |
| **A. Male** | | | | | | | | | | | | | | |
| 1960 | 101 | | 50 | | 127 | | 137 | | 148 | | 29 | | 24 | |
| 1963 | 96 | | 46 | | 121 | | 130 | | 140 | | 28 | | 22 | |
| 1966 | 75 | 81 | 32 | 36 | 91 | 99 | 97 | 106 | 105 | 114 | 17 | 20 | 15 | 17 |
| 1969 | 68 | 77 | 27 | 33 | 81 | 94 | 87 | 101 | 93 | 109 | 14 | 18 | 13 | 17 |
| 1971 | 69 | | 28 | | 82 | | 88 | | 95 | | 14 | | 14 | |
| 1972 | | 65 | | 25 | | 77 | | 82 | | 89 | | 13 | | 13 |
| 1973 | 69 | | 28 | | 80 | | 86 | | 92 | | 12 | | 13 | |
| 1974 | | 66 | | 26 | | 79 | | 84 | | 91 | | 14 | | 13 |
| 1976 | | 60 | | 22 | | 70 | | 75 | | 80 | | 11 | | 11 |
| 1978 | | 67 | | 27 | | 79 | | 84 | | 91 | | 13 | | 13 |
| **B. Female** | | | | | | | | | | | | | | |
| 1960 | 87 | | 40 | | 103 | | 112 | | 122 | | 18 | | 21 | |
| 1963 | 111 | | 57 | | 123 | | 146 | | 160 | | 25 | | 31 | |
| 1966 | 81 | 86 | 36 | 39 | 96 | 101 | 104 | 110 | 114 | 121 | 16 | 16 | 20 | 22 |
| 1968 | 77 | | 33 | | 91 | | 99 | | 108 | | 15 | | 19 | |
| 1969 | | 79 | | 34 | | 93 | | 100 | | 110 | | 15 | | 19 |
| 1971 | 70 | | 29 | | 83 | | 89 | | 98 | | 14 | | 16 | |
| 1972 | 79 | 73 | 35 | 30 | 94 | 85 | 102 | 92 | 111 | 100 | 16 | 13 | 19 | 16 |
| 1974 | | 59 | | 22 | | 68 | | 73 | | 80 | | 10 | | 13 |
| 1976 | | 65 | | 26 | | 76 | | 82 | | 89 | | 12 | | 14 |
| 1978 | | 61 | | 23 | | 70 | | 75 | | 82 | | 10 | | 13 |

Rates shown are per thousand.

Notes:

IMR (Infant Mortality Rate): Deaths between birth and age one year.

NICMR (Non-infant Child Mortality Rate): Deaths between ages one and five.

U2MR (Under Two Mortality Rate): Deaths between birth and age two years.

U3MR (Under Three Mortality Rate): Deaths between birth and age three years.

U5MR (Under Five Mortality Rate): Deaths between birth and age five years.

TMR (Toddler Mortality Rate): Deaths between ages one and two years.

CMR (Child Mortality Rate): Deaths between ages two and five years.

TABLE 14.

INFANT AND CHILDHOOD MORTALITY RATES IN KUWAIT : 1961-1978, USING 1975 AND 1980 CENSUSES

| Year | Q(1): IMR | | $_4q_1$: NICMR | | Q(2): U2MR | | Q(3): U3MR | | Q(5): U5MR | | $_1q_1$: TMR | | $_3q_2$: CMR | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | '75 | '80 | '75 | '80 | '75 | '80 | '75 | '80 | '75 | '80 | '75 | '80 | '75 | '80 |
| 1961 | 87 | | 40 | | 105 | | 113 | | 123 | | 20 | | 20 | |
| 1964 | 75 | | 32 | | 89 | | 96 | | 104 | | 15 | | 16 | |
| 1966 | | 62 | | 23 | | 72 | | 77 | | 84 | | 11 | | 13 |
| 1967 | 54 | | 19 | | 62 | | 67 | | 72 | | 8 | | 11 | |
| 1969 | 45 | 49 | 14 | 16 | 51 | 56 | 54 | 60 | 58 | 64 | 6 | 7 | 7 | 8 |
| 1971 | 37 | | 10 | | 42 | | 44 | | 47 | | 5 | | 5 | |
| 1972 | | 38 | | 11 | | 43 | | 45 | | 48 | | 5 | | 5 |
| 1973 | 39 | | 12 | | 44 | | 46 | | 49 | | 5 | | 5 | |
| 1974 | | 30 | | 7 | | 34 | | 35 | | 37 | | 4 | | 3 |
| 1976 | | 28 | | 6 | | 31 | | 32 | | 34 | | 3 | | 3 |
| 1978 | | 28 | | 6 | | 31 | | 32 | | 34 | | 3 | | 3 |

Rates shown are per thousand.

Notes:

IMR (Infant Mortality Rate): Deaths between birth and age one year.
NICMR (Non-infant Child Mortality Rate): Deaths between ages one and five.
U2MR (Under Two Mortality Rate): Deaths between birth and age two years.
U3MR (Under Three Mortality Rate): Deaths between birth and age three years.
U5MR (Under Five Mortality Rate): Deaths between birth and age five years.
TMR (Toddler Mortality Rate): Deaths between ages one and two years.
CMR (Child Mortality Rate): Deaths between ages two and five years.

TABLE 15.

INFANT AND CHILDHOOD MORTALITY RATES IN KUWAIT : 1961-1978, BY SEX USING 1975 AND 1980 CENSUSES

| Year | Q(1): IMR | | $_4q_1$: NICMR | | Q(2): U2MR | | Q(3): U3MR | | Q(5): U5MR | | $_1q_1$: TMR | | $_3q_2$: CMR | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | '75 | '80 | '75 | '80 | '75 | '80 | '75 | '80 | '75 | '80 | '75 | '80 | '75 | '80 |
| | | | | | | | **A. Male** | | | | | | | |
| 1961 | 88 | | 41 | | 110 | | 118 | | 127 | | 24 | | 19 | |
| 1964 | 78 | | 34 | | 96 | | 103 | | 111 | | 20 | | 17 | |
| 1966 | | 64 | | 25 | | 76 | | 82 | | 88 | | 13 | | 13 |
| 1967 | 57 | | 21 | | 68 | | 72 | | 78 | | 12 | | 11 | |
| 1969 | 49 | 52 | 16 | 18 | 57 | 61 | 60 | 64 | 64 | 69 | | 9 | | 9 |
| 1971 | 31 | | 7 | | 46 | | 49 | | 52 | | 15 | | 6 | |
| 1972 | | 42 | | 12 | | 48 | | 50 | | 54 | | 6 | | 6 |
| 1973 | 44 | | 14 | | 50 | | 53 | | 57 | | 6 | | 7 | |
| 1974 | | 33 | | 9 | | 38 | | 39 | | 42 | | 5 | | 4 |
| 1976 | | 32 | | 8 | | 35 | | 37 | | 39 | | 3 | | 4 |
| 1978 | | 31 | | 8 | | 33 | | 35 | | 37 | | 2 | | 4 |
| | | | | | | | **B. Female** | | | | | | | |
| 1961 | 84 | | 38 | | 99 | | 108 | | 118 | | 16 | | 21 | |
| 1964 | 71 | | 29 | | 82 | | 89 | | 97 | | 12 | | 16 | |
| 1966 | | 59 | | 22 | | 67 | | 72 | | 79 | | 9 | | 13 |
| 1967 | 50 | | 17 | | 56 | | 60 | | 65 | | 6 | | 10 | |
| 1969 | 40 | 45 | 12 | 14 | 45 | 51 | 47 | 54 | 51 | 59 | 5 | 6 | 6 | 8 |
| 1971 | 33 | | 9 | | 37 | | 39 | | 41 | | 4 | | 4 | |
| 1972 | | 34 | | 9 | | 38 | | 40 | | 43 | | 4 | | 5 |
| 1973 | 34 | | 9 | | 37 | | 39 | | 42 | | 3 | | 5 | |
| 1974 | | 27 | | 6 | | 29 | | 31 | | 33 | | 2 | | 4 |
| 1976 | | 22 | | 4 | | 26 | | 27 | | 29 | | 4 | | 3 |
| 1978 | | 25 | | 5 | | 28 | | 29 | | 31 | | 3 | | 3 |

Rates shown are per thousand.

Notes:

IMR (Infant Mortality Rate): Deaths between birth and age one year.

NICMR (Non-infant Child Mortality Rate): Deaths between ages one and five.

U2MR (Under Two Mortality Rate): Deaths between birth and age two years.

U3MR (Under Three Mortality Rate): Deaths between birth and age three years.

U5MR (Under Five Mortality Rate): Deaths between birth and age five years.

TMR (Toddler Mortality Rate): Deaths between ages one and two years.

CMR (Child Mortality Rate): Deaths between ages two and five years.

TABLE 16.

INFANT AND CHILDHOOD MORTALITY RATES IN SYRIA : 1956 - 1979
USING 1970 CENSUS, 1976 SAMPLE CENSUS,
1978 SFS, AND 1981 CENSUS

| | Q(1): IMR | | $_4q_1$: NICMR | | Q(2): U2MR | | Q(3): U3MR | | Q(5): U5MR | | $_1q_1$: TMR | | $_3q_2$: CMR | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A. Using 1970 census and 1976 sample census | | | | | | | | | | | | | |
| Year | '70 | '76 | '70 | '76 | '70 | '76 | '70 | '76 | '70 | '76 | '70 | '76 | '70 | '76 |
| 1956 | 151 | | 87 | | 189 | | 206 | | 226 | | 45 | | 46 | |
| 1959 | 142 | | 81 | | 178 | | 194 | | 212 | | 42 | | 41 | |
| 1962 | 129 | 110 | 71 | 57 | 161 | 137 | 175 | 148 | 191 | 161 | 37 | 30 | 36 | 28 |
| 1964 | 119 | | 63 | | 148 | | 160 | | 175 | | 33 | | 32 | |
| 1965 | | 102 | | 51 | | 126 | | 137 | | 148 | | 27 | | 25 |
| 1966 | 112 | | 58 | | 138 | | 149 | | 162 | | 29 | | 28 | |
| 1968 | 111 | 92 | 57 | 43 | 135 | 112 | 146 | 121 | 159 | 131 | 27 | 22 | 28 | 21 |
| 1970 | | 84 | | 38 | | 101 | | 109 | | 118 | | 19 | | 19 |
| 1972 | | 78 | | 34 | | 94 | | 101 | | 109 | | 17 | | 17 |
| 1974 | | 84 | | 38 | | 100 | | 108 | | 117 | | 17 | | 19 |
| | B. Using 1978 SFS and 1981 census | | | | | | | | | | | | | |
| Year | '78 | '81 | '78 | '81 | '78 | '81 | '78 | '81 | '78 | '81 | '78 | '81 | '78 | '81 |
| 1965 | 95 | | 46 | | 117 | | 126 | | 137 | | 24 | | 23 | |
| 1967 | 87 | 101 | 40 | 50 | 106 | 124 | 114 | 134 | 124 | 146 | 21 | 26 | 20 | 25 |
| 1970 | 78 | 92 | 34 | 43 | 93 | 112 | 100 | 121 | 109 | 131 | 16 | 22 | 18 | 21 |
| 1972 | 75 | | 32 | | 90 | | 96 | | 105 | | 16 | | 16 | |
| 1973 | | 75 | | 32 | | 90 | | 97 | | 105 | | 16 | | 16 |
| 1974 | 69 | | 28 | | 81 | | 87 | | 95 | | 13 | | 15 | |
| 1975 | | 74 | | 31 | | 87 | | 93 | | 101 | | 14 | | 15 |
| 1976 | 75 | | 32 | | 88 | | 95 | | 103 | | 14 | | 16 | |
| 1977 | | 67 | | 27 | | 79 | | 85 | | 92 | | 13 | | 14 |
| 1979 | | 66 | | 26 | | 77 | | 83 | | 90 | | 12 | | 14 |

Rates shown are per thousand.

Notes:

IMR (Infant Mortality Rate): Deaths between birth and age one year.
NICMR (Non-infant Child Mortality Rate): Deaths between ages one and five.
U2MR (Under Two Mortality Rate): Deaths between birth and age two years.
U3MR (Under Three Mortality Rate): Deaths between birth and age three years.
U5MR (Under Five Mortality Rate): Deaths between birth and age five years.
TMR (Toddler Mortality Rate): Deaths between ages one and two years.
CMR (Child Mortality Rate): Deaths between ages two and five years.

TABLE 17.

INFANT AND CHILDHOOD MORTALITY RATES IN U.A.E. : 1960-1978, USING 1975 AND 1980 CENSUSES

| Year | Q(1): IMR | | $_4q_1$: NICMR | | Q(2): U2MR | | Q(3): U3MR | | Q(5): U5MR | | $_1q_1$: TMR | | $_3q_2$: CMR | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | '75 | '80 | '75 | '80 | '75 | '80 | '75 | '80 | '75 | '80 | '75 | '80 | '75 | '80 |
| 1960 | 143 | | 81 | | 179 | | 195 | | 214 | | 42 | | 43 | |
| 1963 | 141 | | 79 | | 176 | | 192 | | 209 | | 41 | | 40 | |
| 1965 | | 105 | | 53 | | 129 | | 140 | | 152 | | 27 | | 26 |
| 1966 | 108 | | 55 | | 133 | | 144 | | 157 | | 28 | | 28 | |
| 1968 | 97 | 96 | 47 | 46 | 119 | 118 | 128 | 127 | 139 | 138 | 24 | 24 | 23 | 23 |
| 1971 | 78 | 76 | 34 | 32 | 93 | 90 | 100 | 97 | 109 | 106 | 16 | 15 | 18 | 18 |
| 1973 | 67 | | 27 | | 78 | | 84 | | 91 | | 12 | | 14 | |
| 1974 | | 61 | | 23 | | 72 | | 77 | | 83 | | 12 | | 12 |
| 1976 | | 45 | | 14 | | 52 | | 55 | | 58 | | 7 | | 6 |
| 1978 | | 43 | | 14 | | 49 | | 52 | | 56 | | 6 | | 7 |

Rates shown are per thousand.

Notes:

IMR (Infant Mortality Rate): Deaths between birth and age one year.
NICMR (Non-infant Child Mortality Rate): Deaths between ages one and five.
U2MR (Under Two Mortality Rate): Deaths between birth and age two years.
U3MR (Under Three Mortality Rate): Deaths between birth and age three years.
U5MR (Under Five Mortality Rate): Deaths between birth and age five years.
TMR (Toddler Mortality Rate): Deaths between ages one and two years.
CMR (Child Mortality Rate): Deaths between ages two and five years.

TABLE 18.

PERCENTAGE ANNUAL DECLINE IN INFANT AND CHILDHOOD MORTALITY RATES IN SIX ARAB COUNTRIES : 1956 - 1985

| Country and period | Q(1): IMR | $_4q_1$: NICMR | Q(2): U2MR | Q(5): U5MR |
|---|---|---|---|---|
| Bahrain: | | | | |
| 1956-67 | 6.1 | 8.4 | 6.7 | 6.6 |
| 1967-77 | 7.6 | 12.3 | 7.8 | 8.8 |
| Egupt: | | | | |
| 1966-76 | 1.6 | 2.1 | 1.7 | 1.7 |
| 1976-85 | 2.5 | 3.5 | 2.6 | 2.7 |
| Jordan: | | | | |
| 1958-68 | 4.1 | 6.2 | 4.5 | 4.6 |
| 1968-78 | 1.3 | 1.8 | 1.6 | 1.6 |
| Kuwait: | | | | |
| 1961-69 | 8.2 | 13.1 | 9.0 | 9.4 |
| 1969-78 | 5.3 | 9.4 | 5.5 | 5.9 |
| Syria: | | | | |
| 1956-68 | 4.1 | 5.9 | 4.4 | 4.5 |
| 1968-79 | 3.0 | 4.6 | 3.4 | 3.4 |
| U.A.E.: | | | | |
| 1960-68 | 5.0 | 7.1 | 5.2 | 5.5 |
| 1968-78 | 8.0 | 11.9 | 8.8 | 9.0 |

Notes:

IMR (Infant Mortality Rate): Deaths between birth and age one year.
NICMR (Non-infant Child Mortality Rate): Deaths between ages one and five.
U2MR (Under Two Mortality Rate): Deaths between birth and age two years.
U5MR (Under Five Mortality Rate): Deaths between birth and age five years.

TABLE 19.

ESTIMATES OF COMPLETENESS OF INFANT DEATHS REGISTRATION IN SIX ARAB COUNTRIES DURING THE PERIOD 1966 -1982

| Year | Bahrain | Egypt | Jordan | Kuwait | Syria | U.A.E.* |
|---|---|---|---|---|---|---|
| | | | Both sexes | | | |
| 1966 | | 75.6 | 42.9 | 71.0 | | |
| 1967 | | | | 68.5 | | |
| 1968 | | | 38.4 | | | |
| 1969 | | 73.9 | 35.2 | 71.1 | | |
| 1972 | | 76.8 | 30.4 | | 28.2 | |
| 1973 | | | 36.5 | | | |
| 1974 | | 68.2 | 37.3 | | | |
| 1975 | 61.0 | | | | 18.9 | |
| 1976 | | 60.8 | 39.3 | | | |
| 1977 | 51.2 | 64.4 | | | 19.4 | 57.8 |
| 1979 | 65.9 | | | | 19.7 | 65.1 |
| 1980 | | 61.3 | | | | |
| 1982 | | 64.0 | | | | |
| | | | Male | | | |
| 1966 | | | | 68.8 | | |
| 1967 | | | | 71.9 | | |
| 1969 | | | | 67.3 | | |
| 1972 | | | 30.8 | | | |
| 1973 | | | 33.3 | | | |
| 1974 | | | 34.8 | | | |
| 1976 | | | 38.3 | | | |
| 1977 | 50.0 | | | | | |
| 1979 | 54.2 | | | | | |
| | | | Female | | | |
| 1966 | | | | 55.9 | | |
| 1967 | | | | 74.0 | | |
| 1969 | | | | 77.5 | | |
| 1971 | | | 31.4 | | | |
| 1972 | | | 30.1 | | | |
| 1974 | | | 35.6 | | | |
| 1976 | | | 26.3 | | | |
| 1977 | 54.3 | | | | | |
| 1979 | 68.3 | | | | | |

* For Abu Dhabi Emirate only.

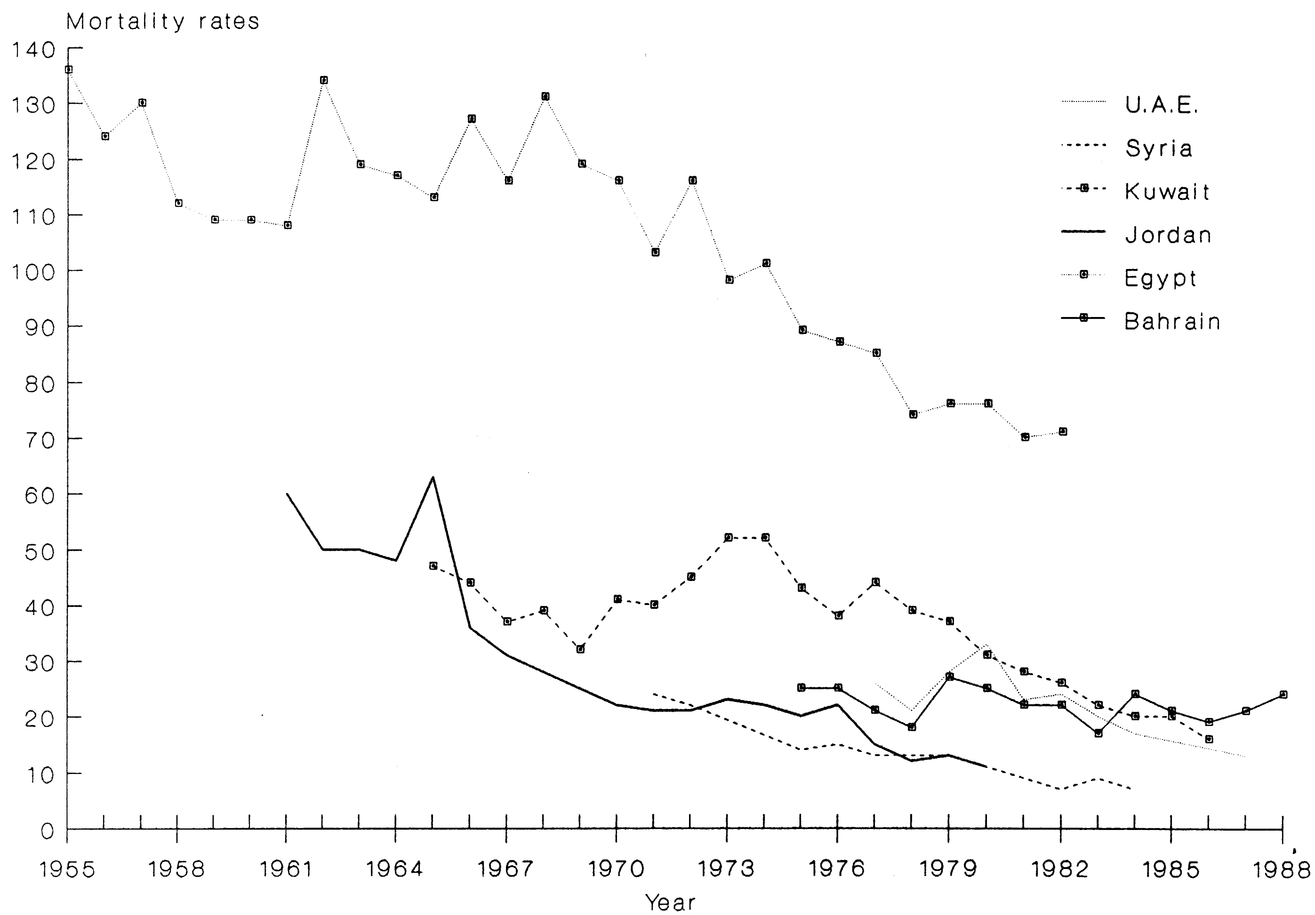


**Figure 1. Infant mortality in six Arab countries : 1955-1988, vital registration data.**

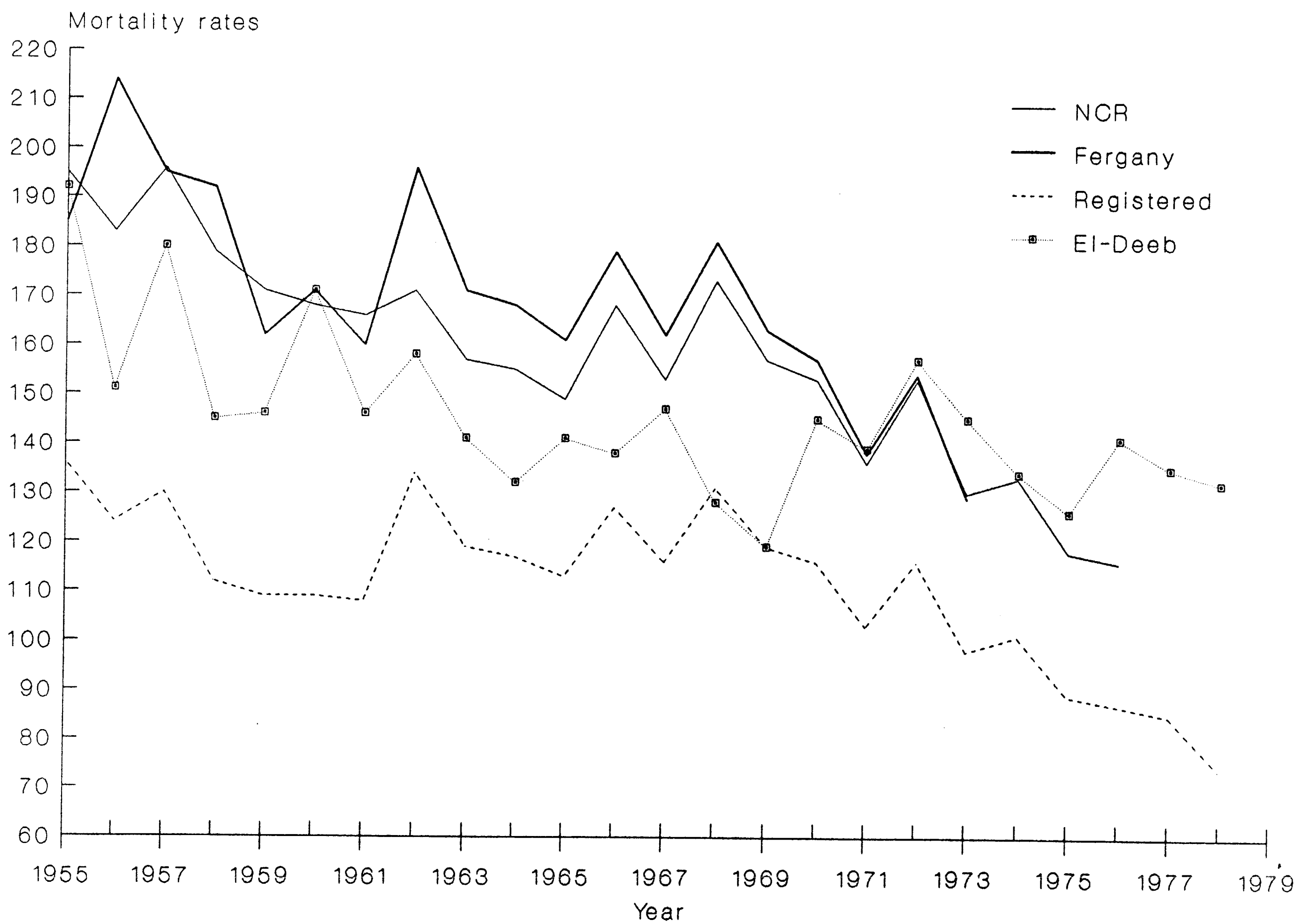


**Figure 2. Registered and adjusted infant mortality in Egypt: 1955-1978.**

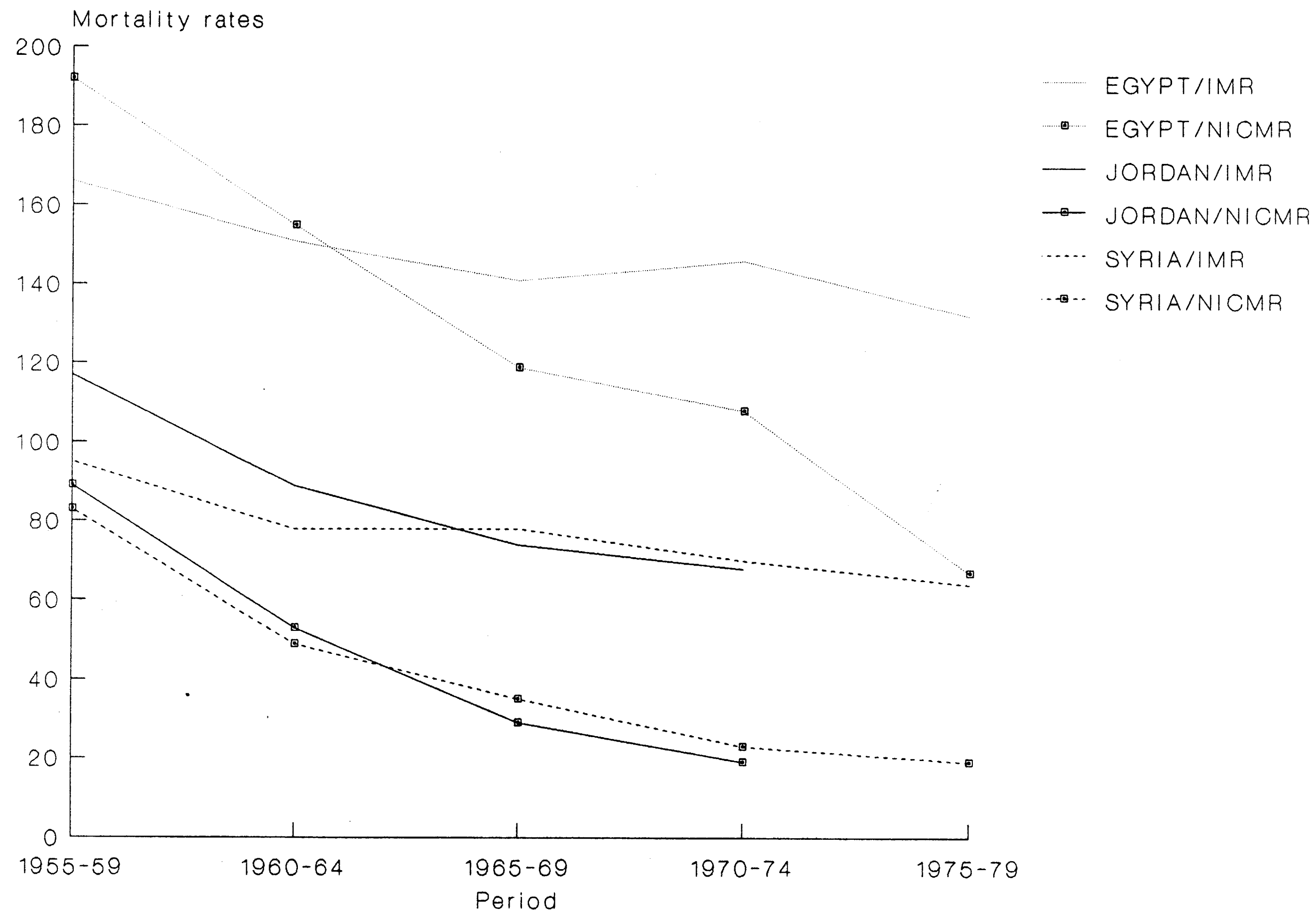


Figure 3. Infant and childhood mortality in Egypt, Jordan and Syria : 1955-1979, WFS.

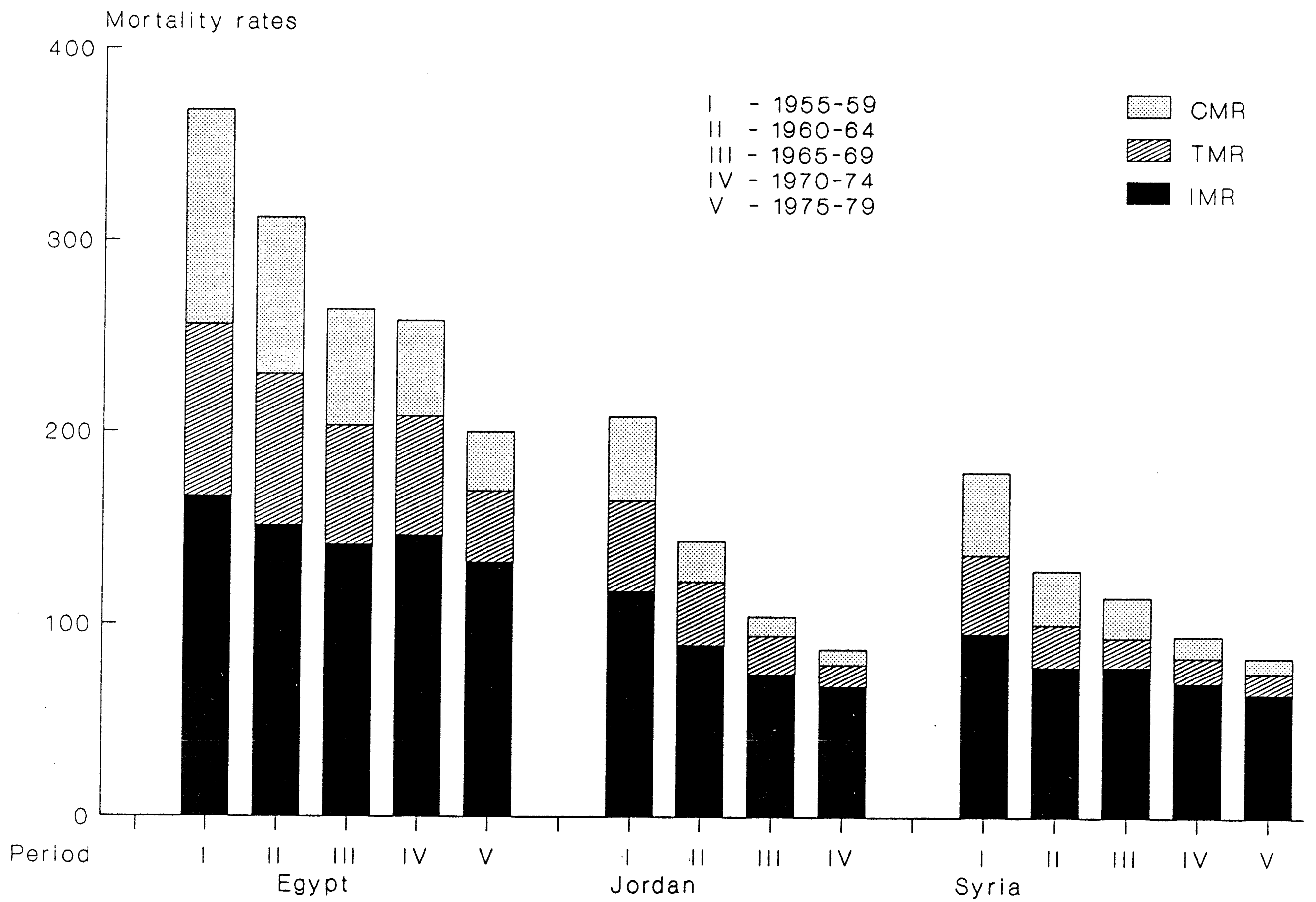


**Figure 4. Infant, toddler and child mortality in Egypt, Jordan and Syria : 1955-1979, WFS.**

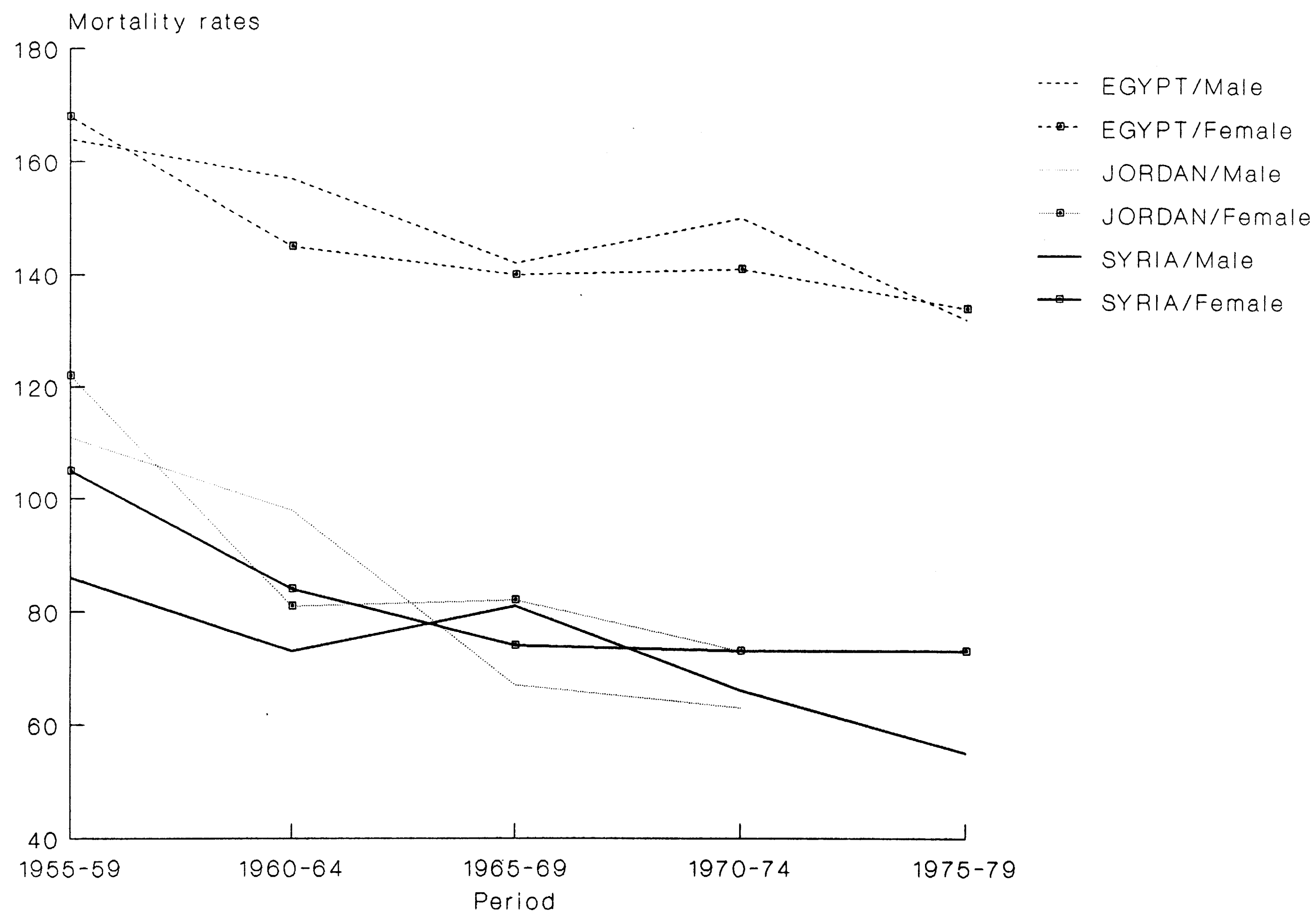


**Figure 5. Infant mortality in Egypt, Jordan and Syria, by sex : 1955-1979, WFS.**

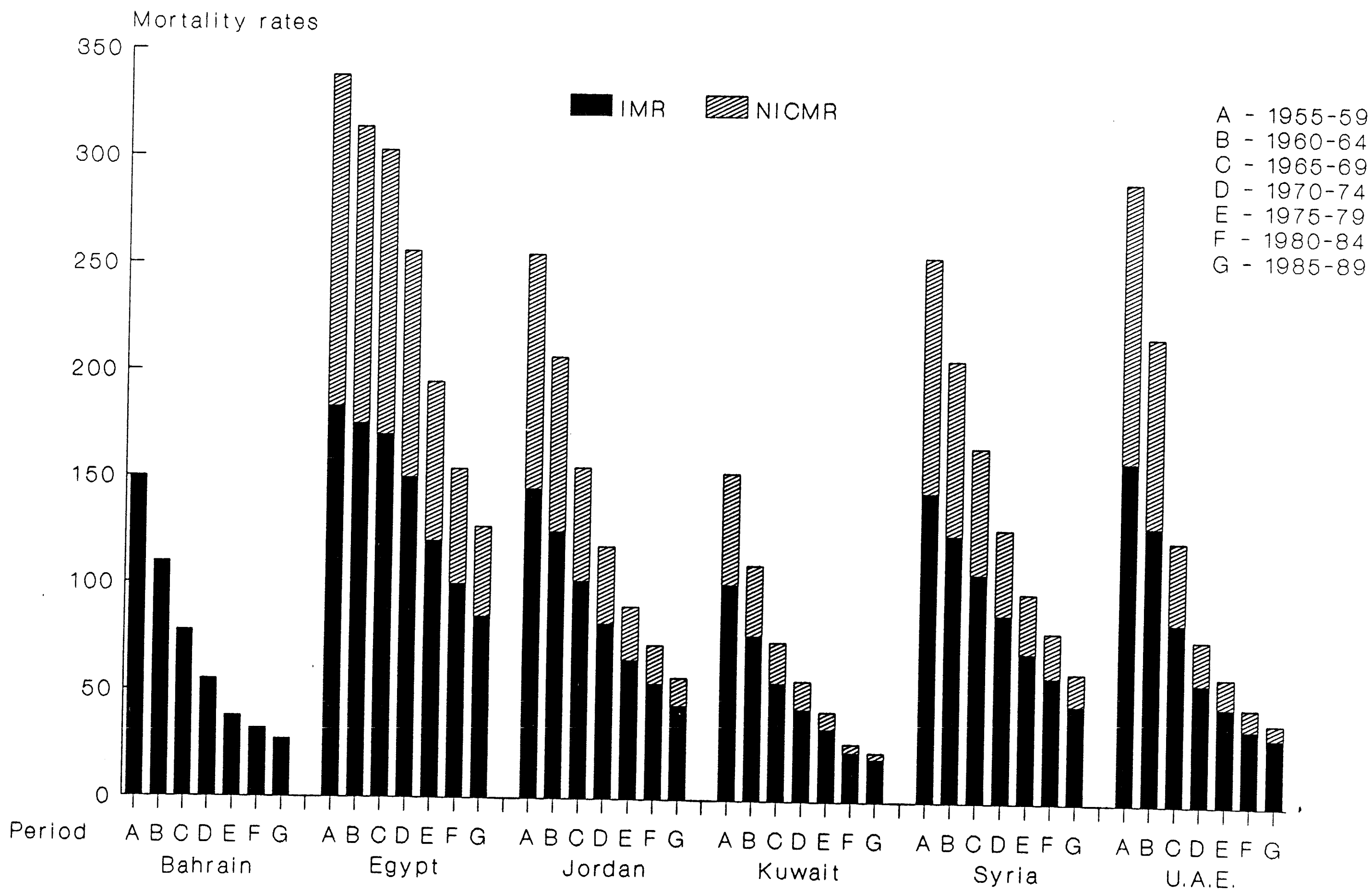


**Figure 6. Infant and non-infant child mortality : 1955-1989.**

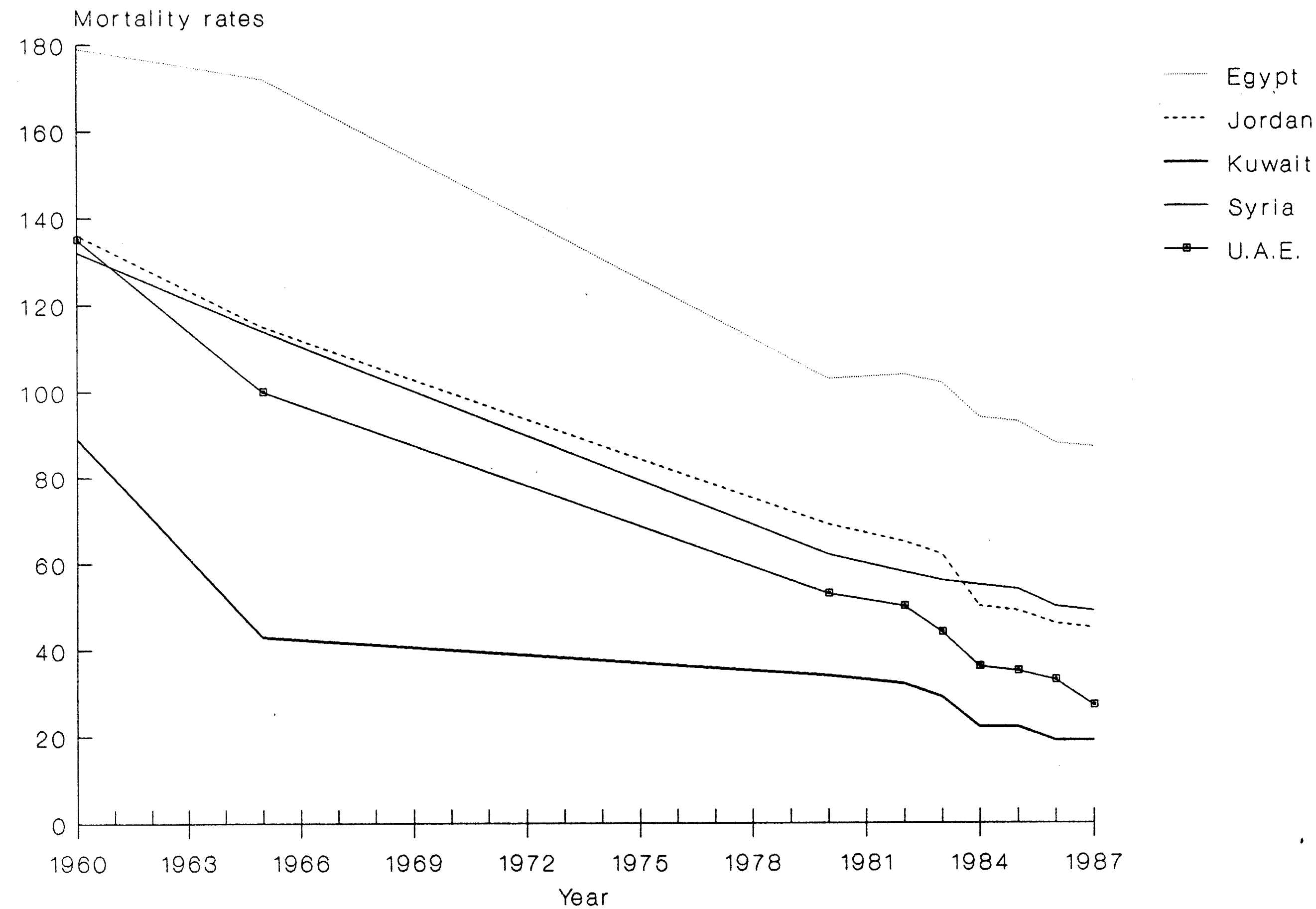


**Figure 7. Infant mortality in six Arab countries : 1960-1987 , World Bank estimates.**

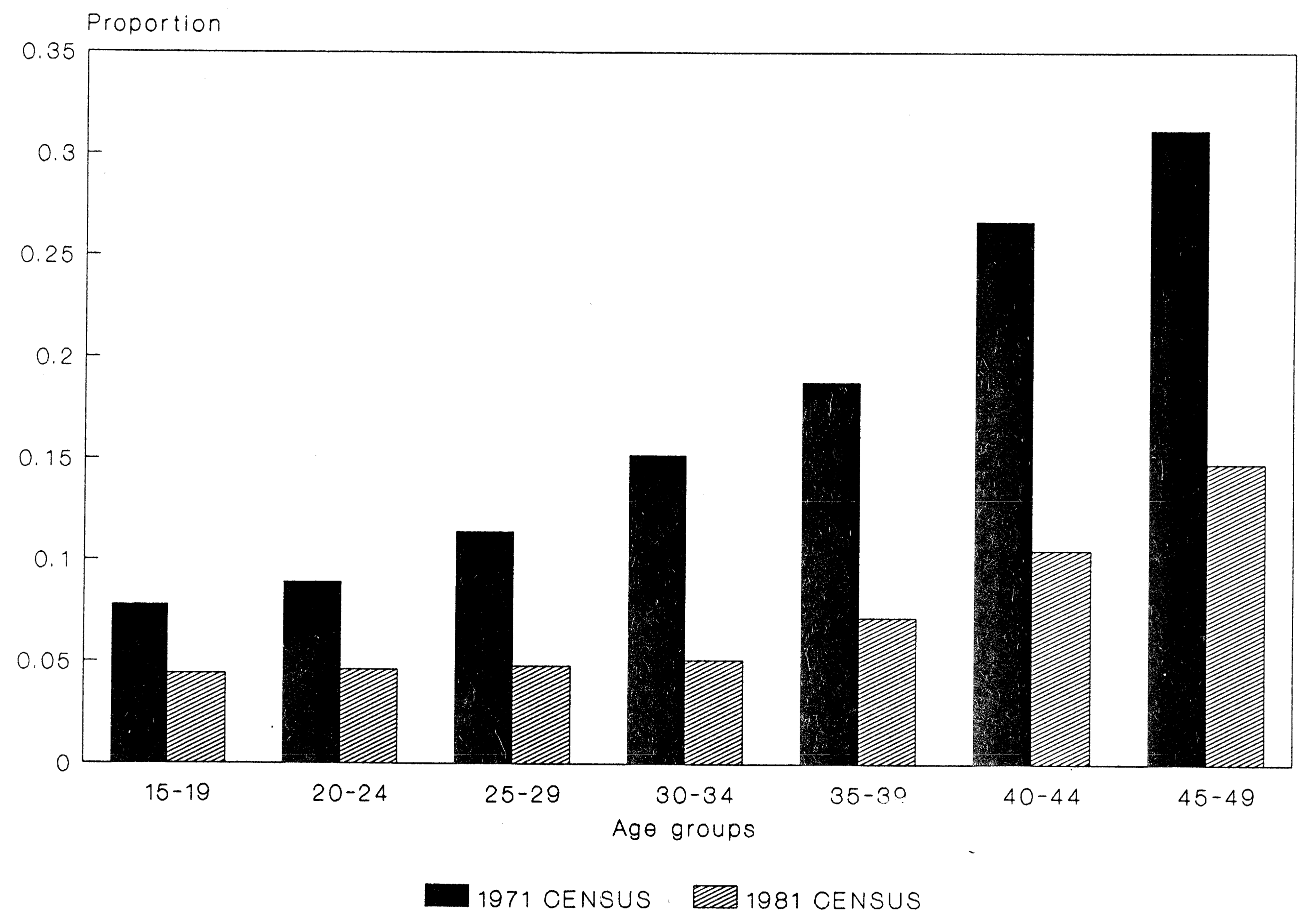


**Figure 8. Proportion of dead children in Bahrain by age group of woman.**

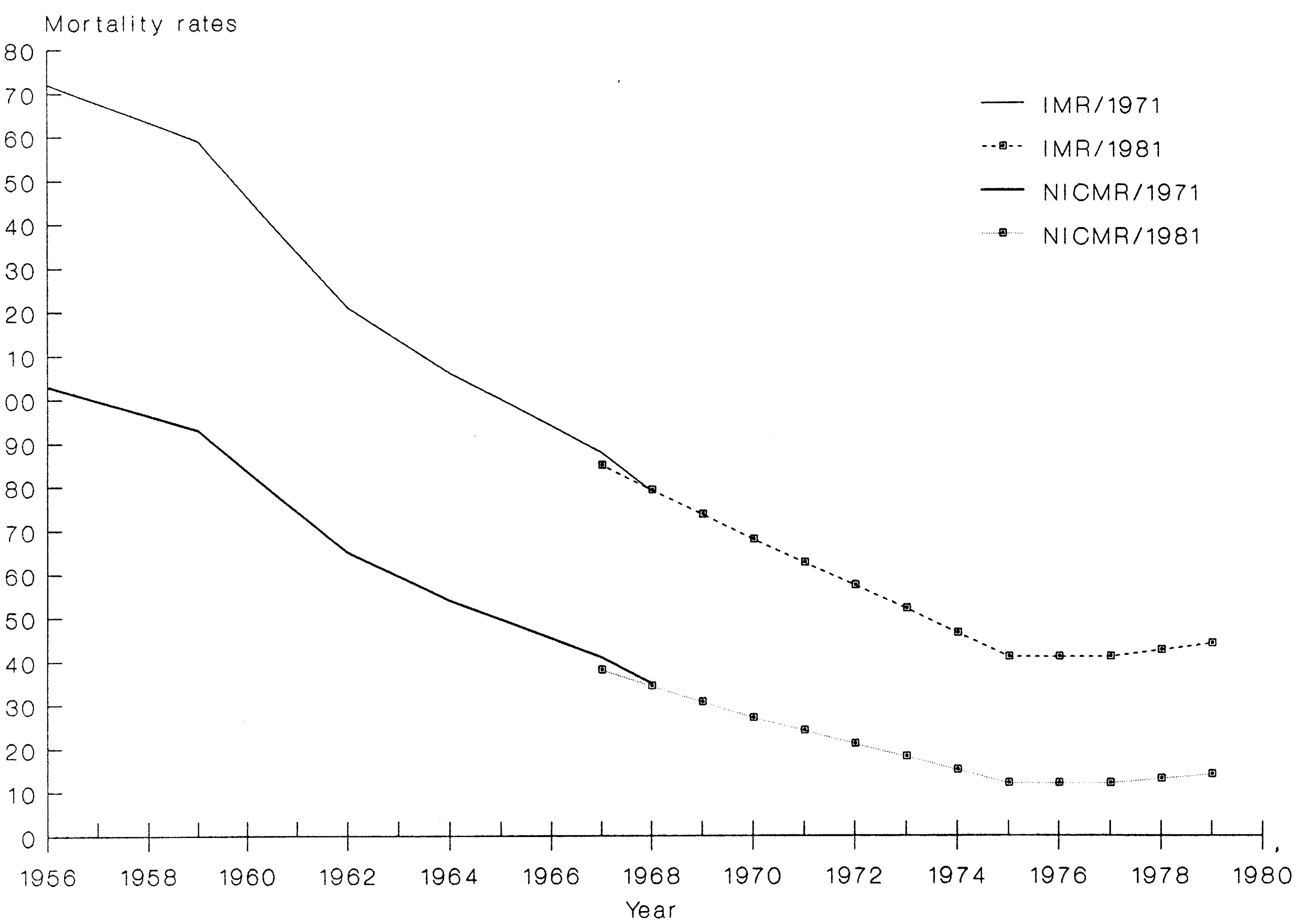


**Figure 9. Infant and non-infant child mortality in Bahrain : 1956-1979, indirect estimates.**

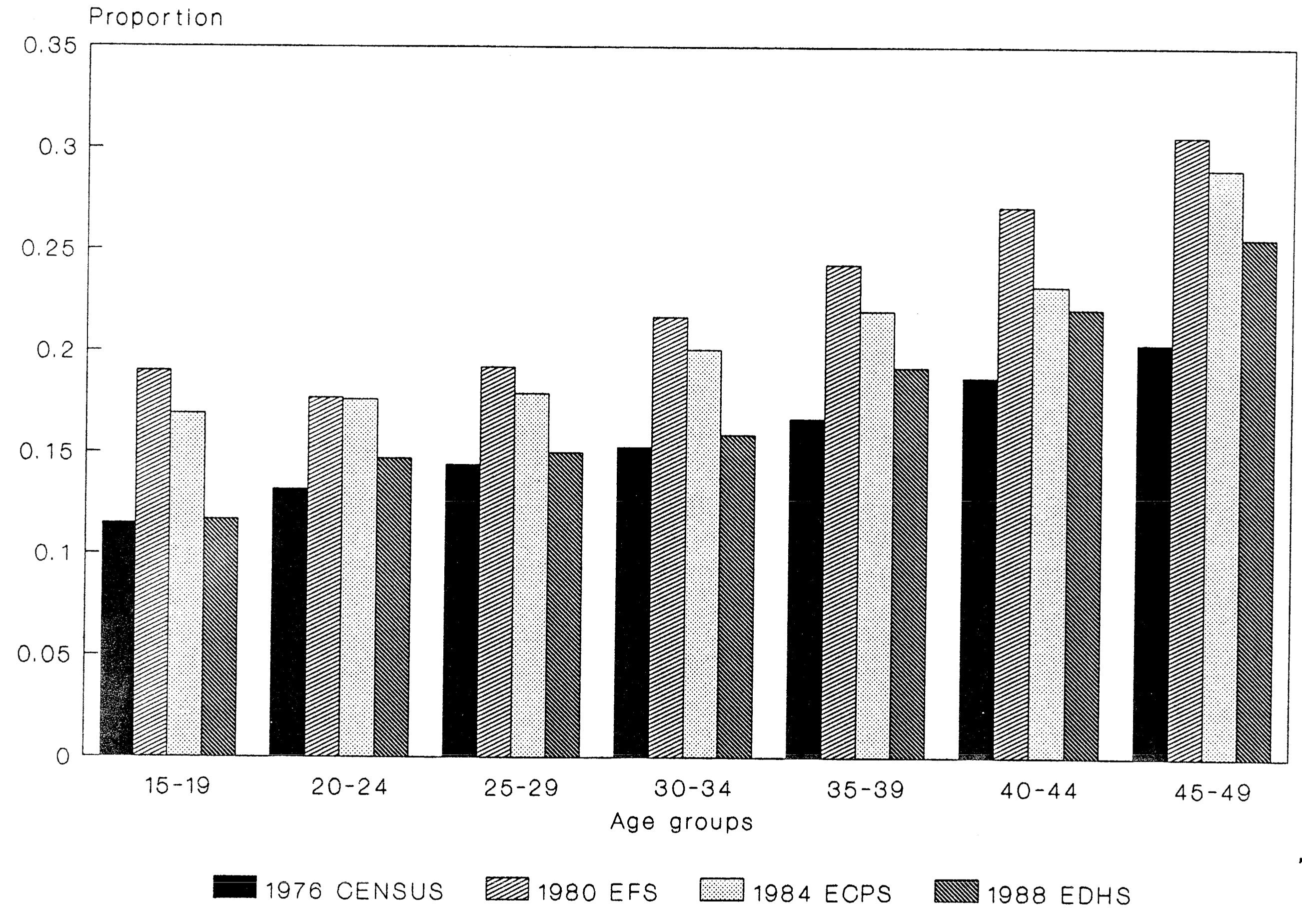


**Figure 10. Proportion of dead children in Egypt by age group of woman.**

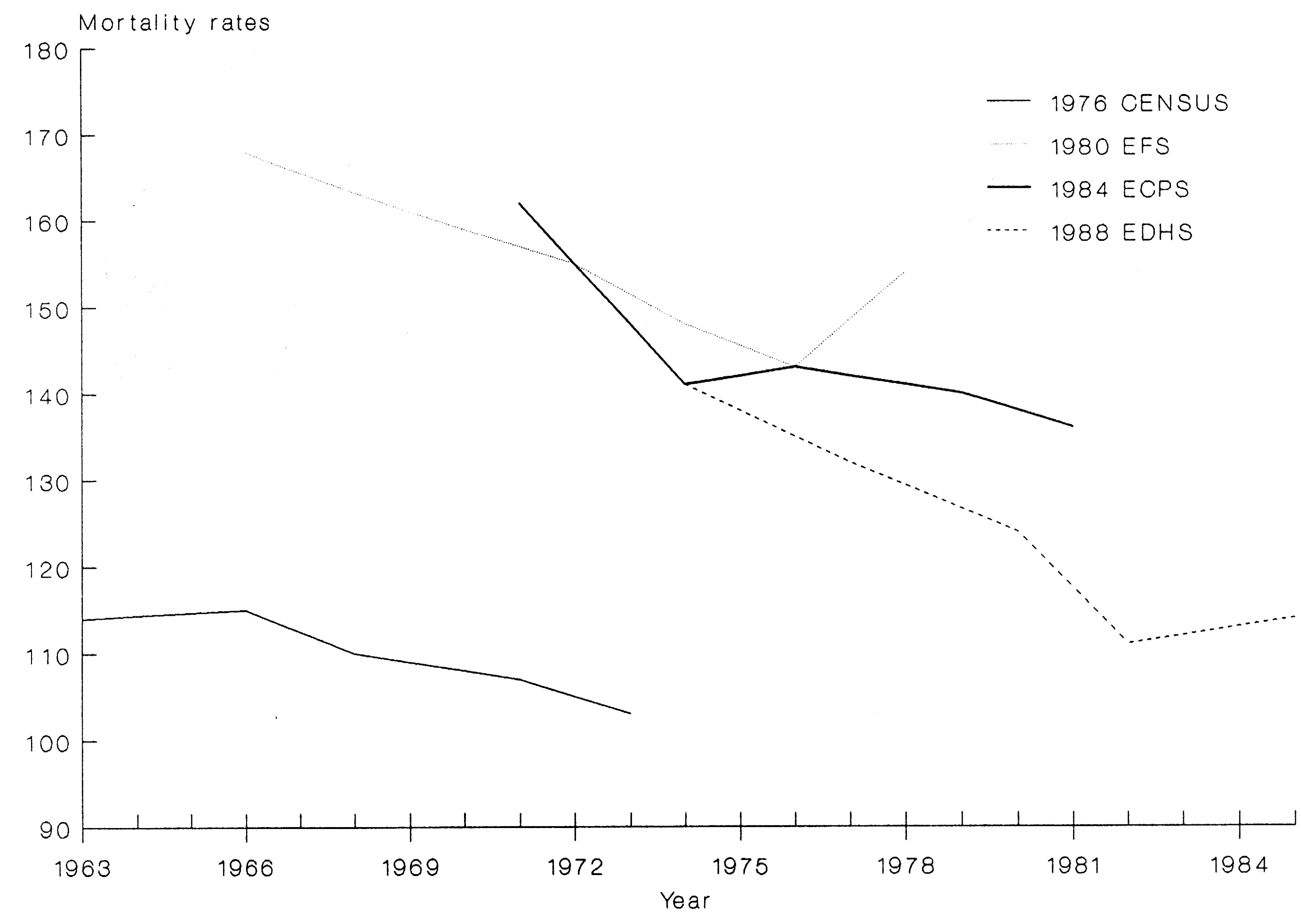


**Figure 11. Infant mortality, Egypt : 1963-1985, indirect estimates.**

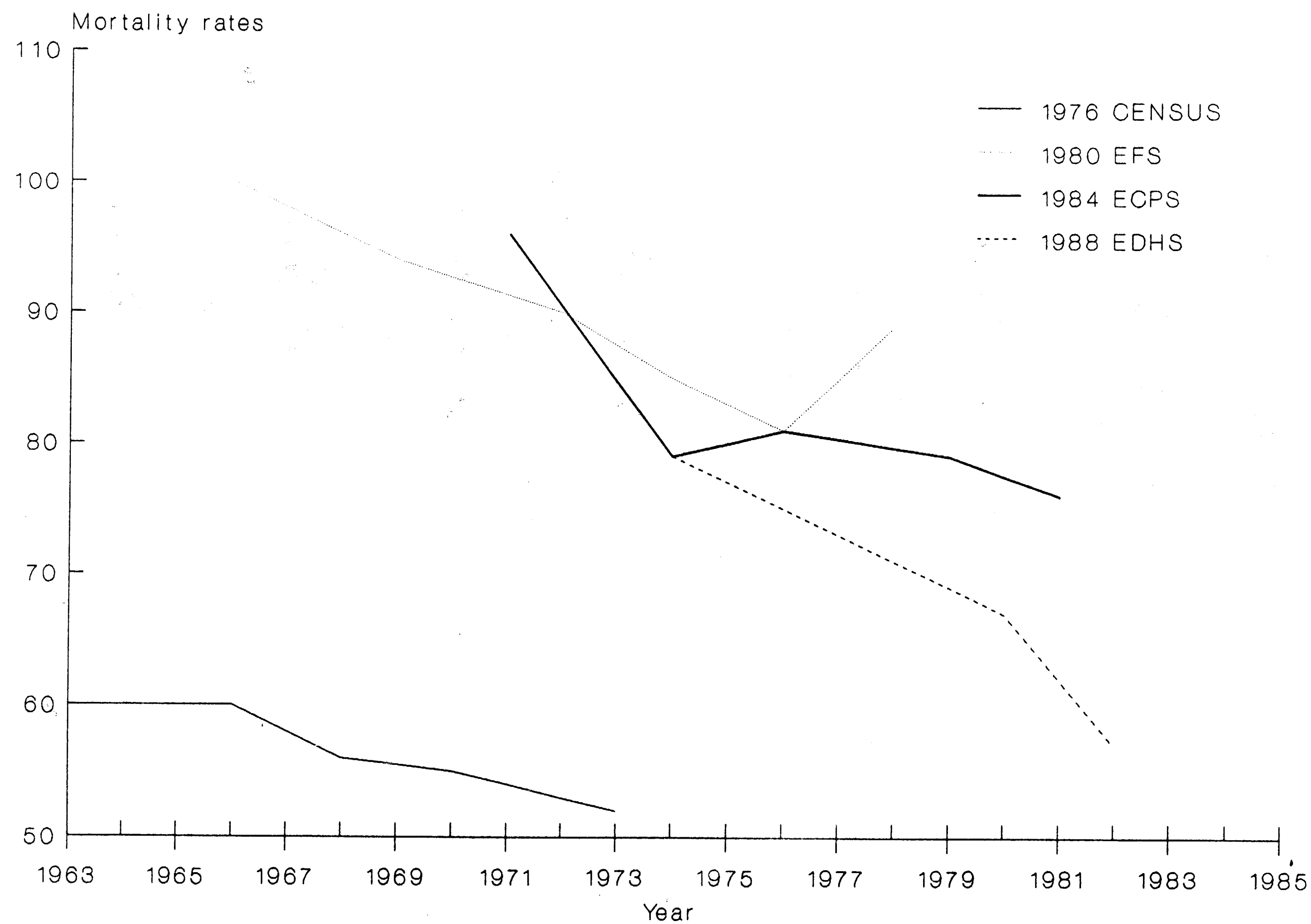


Figure 12. Non-infant child mortality in Egypt : 1963-1985, indirect estimates.

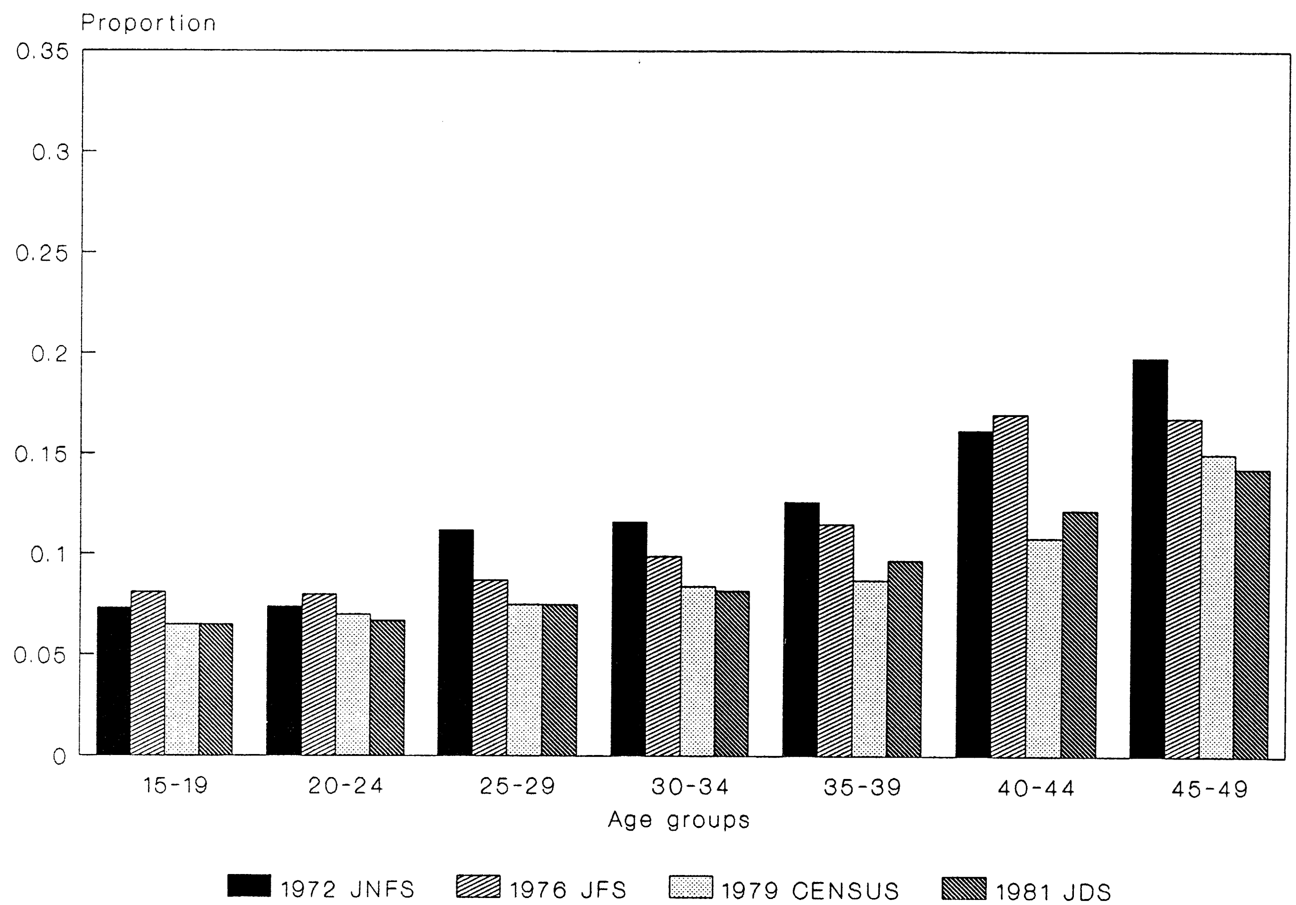


Figure 13. Proportion of dead children in Jordan by age group of woman.

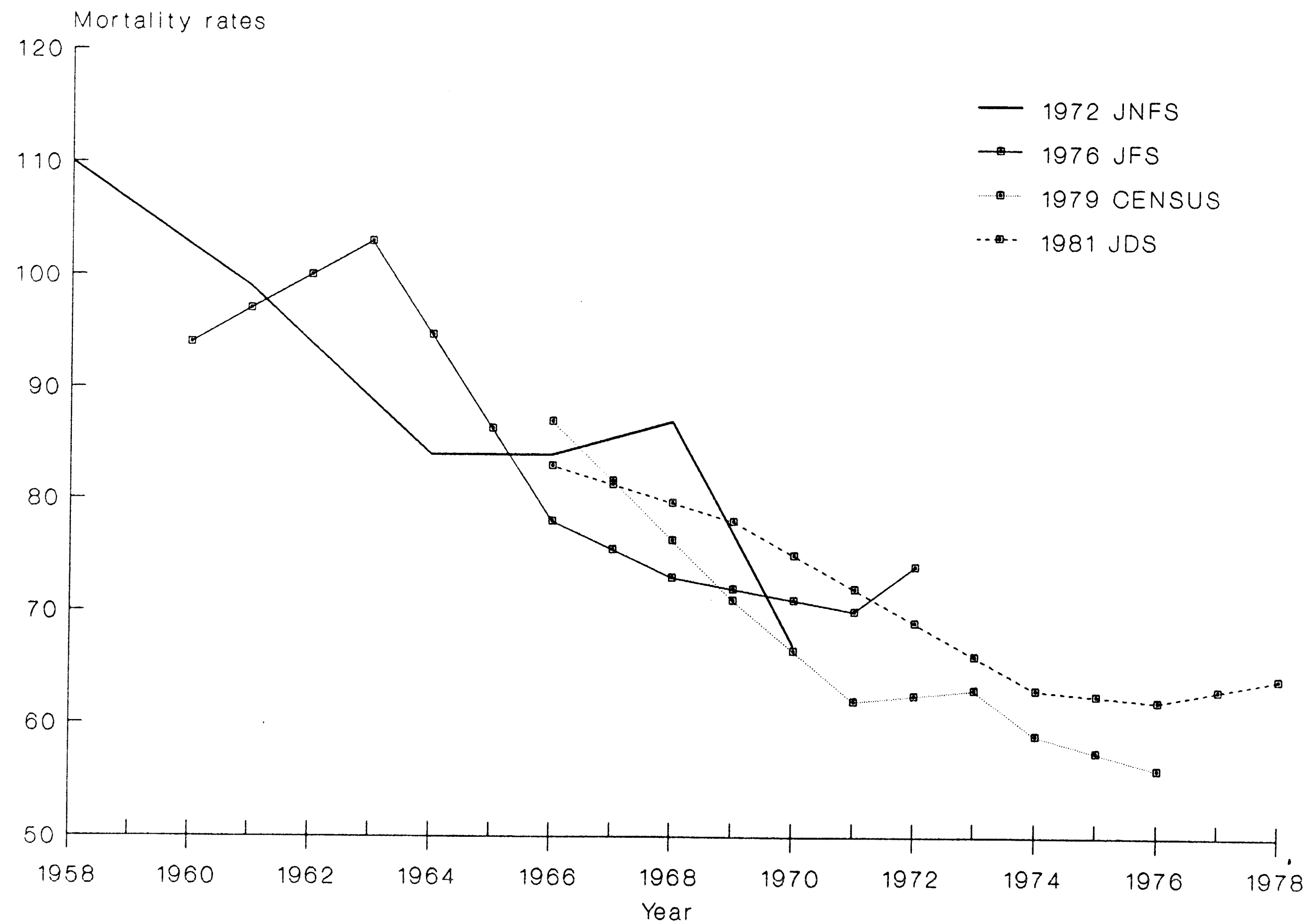


Figure 14. Infant mortality, Jordan : 1958- 1978, indirect estimates.

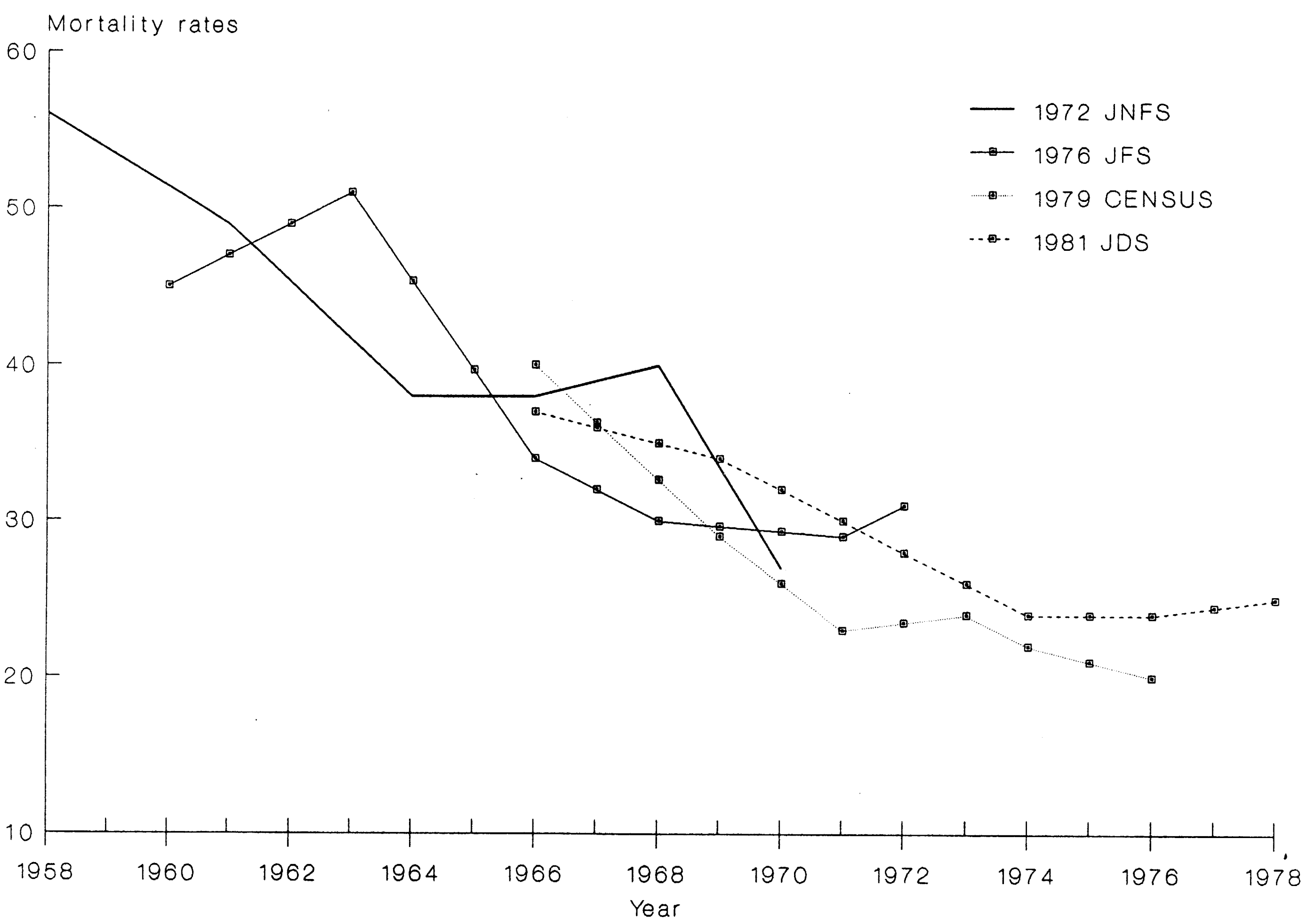


**Figure 15. Non-infant child mortality in Jordan : 1958-1978, indirect estimates.**

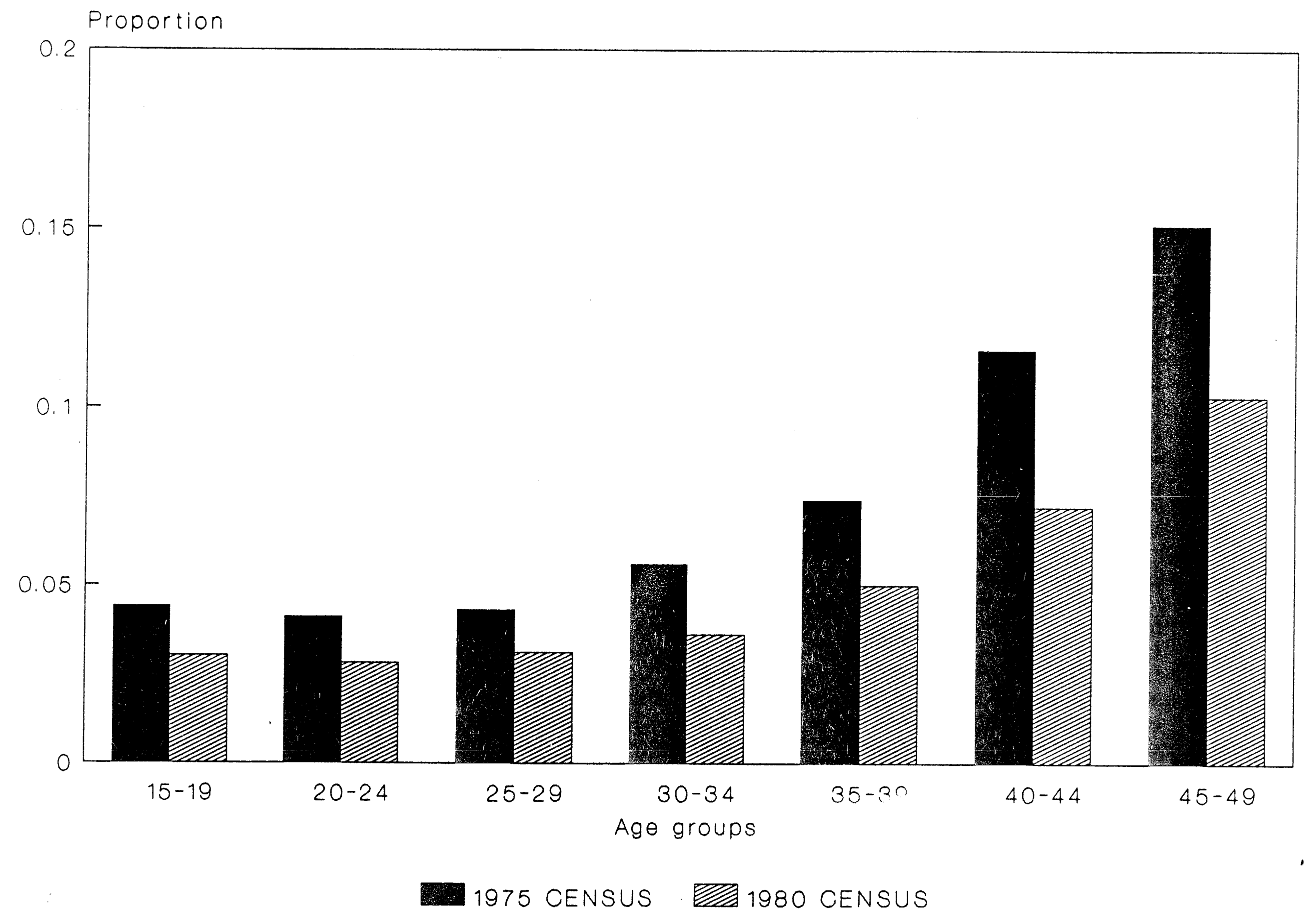


**Figure 16. Proportion of dead children in Kuwait by age group of woman.**

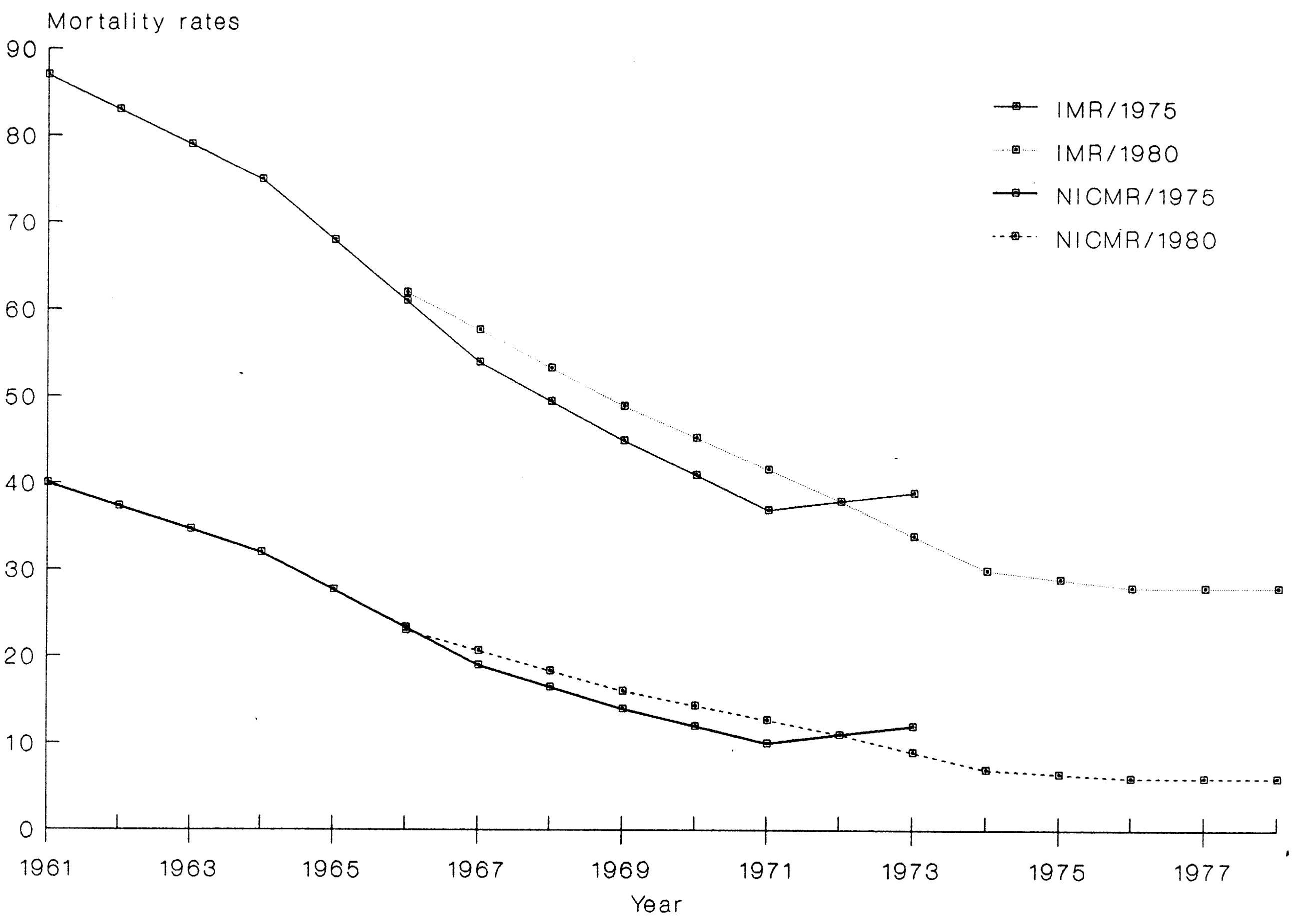


**Figure 17. Infant and non-infant child mortality in Kuwait : 1961-1978, indirect estimates.**

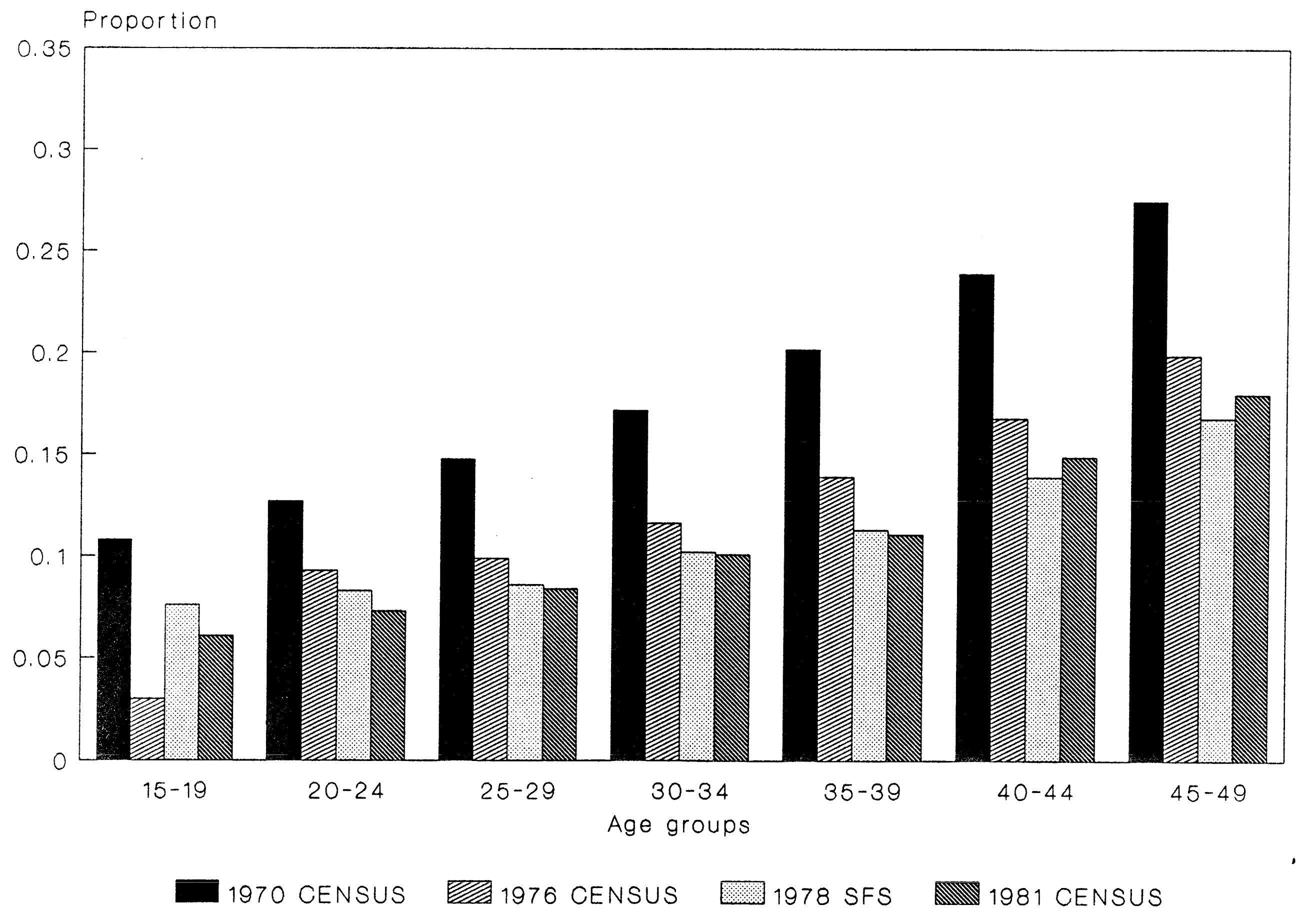


**Figure 18. Proportion dead children in Syria by age group of woman.**

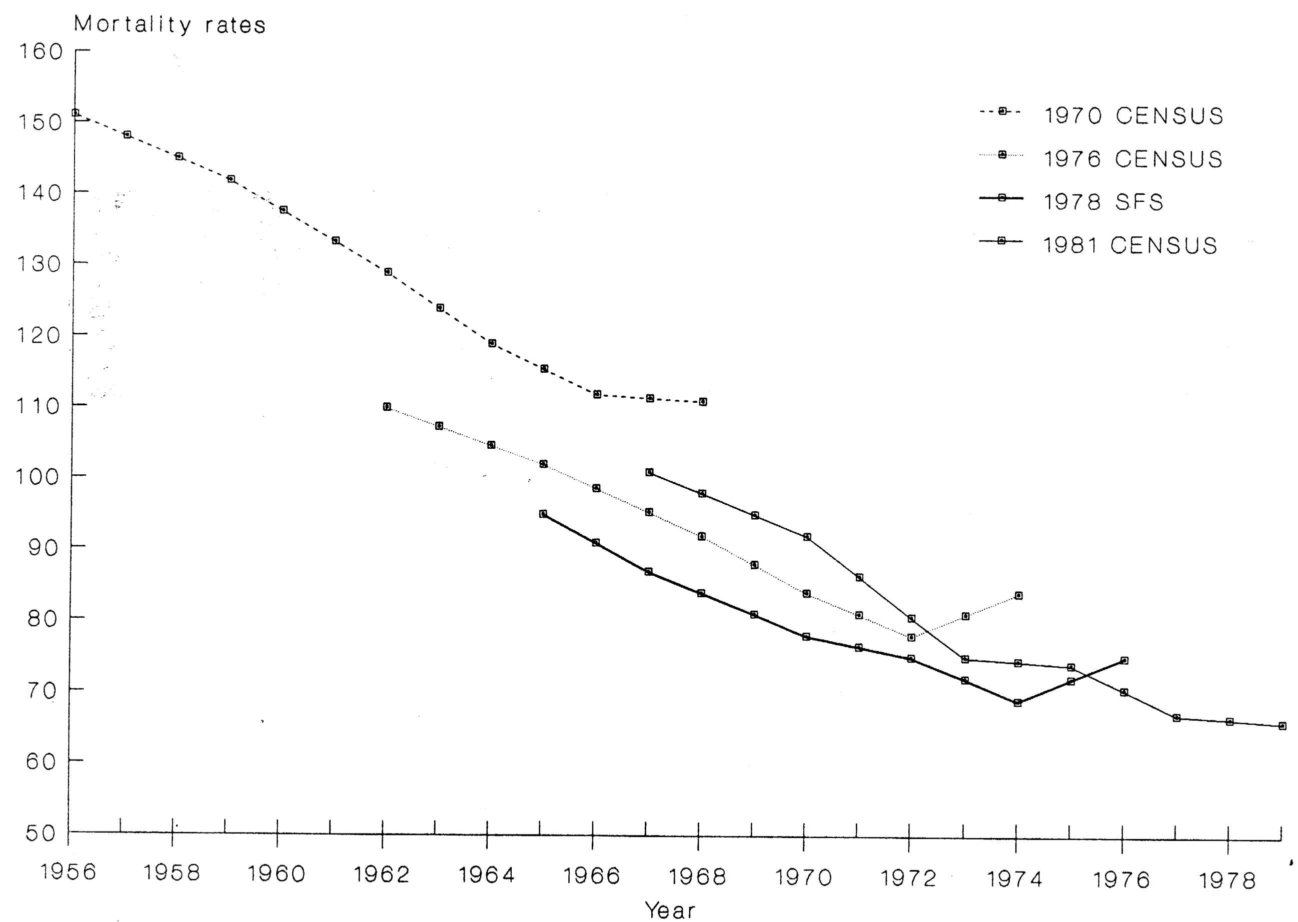


**Figure 19. Infant mortality, Syria : 1955-1979, indirect estimates.**

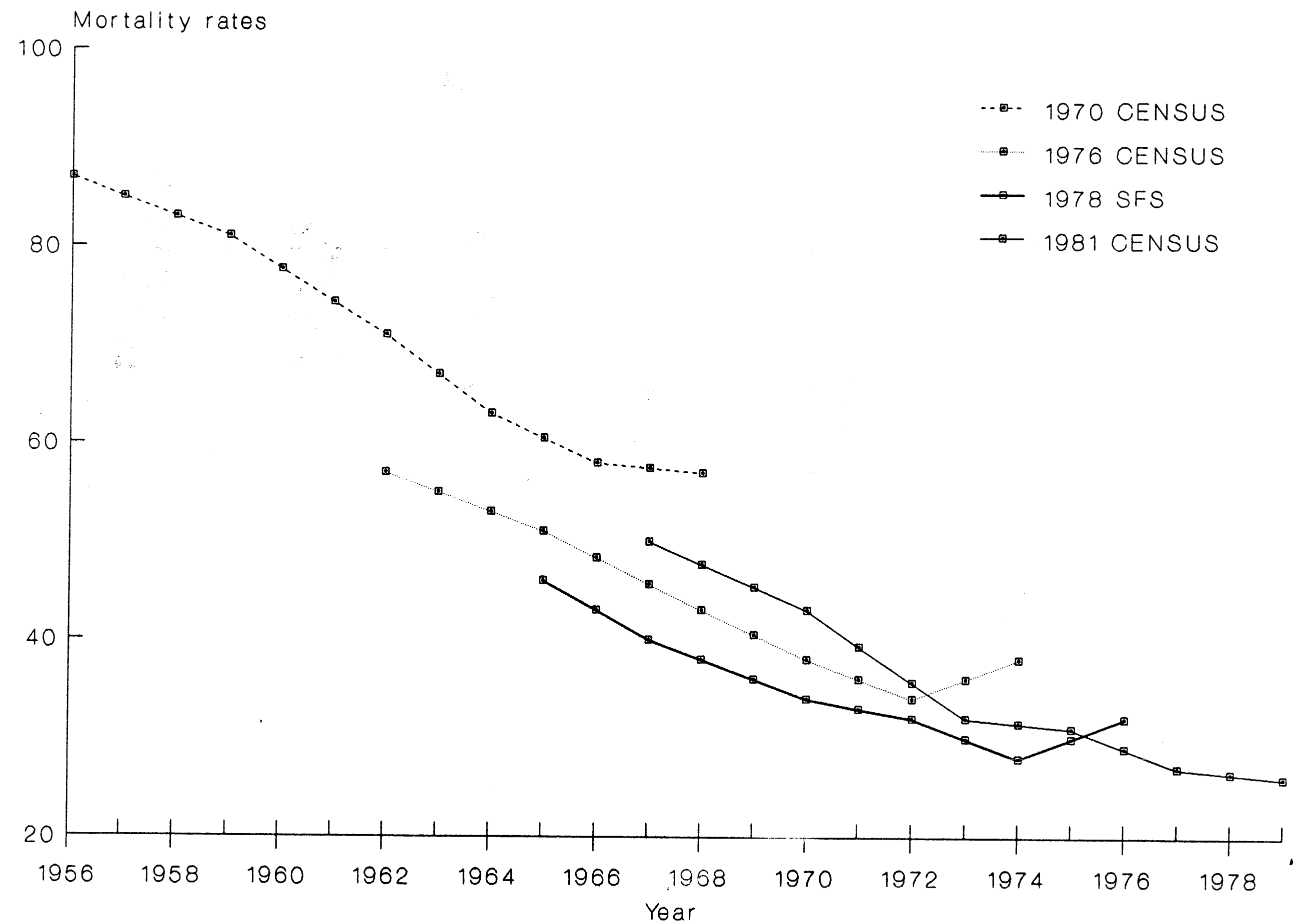


**Figure 20. Non-infant child mortality, Syria : 1956-1979, indirect estimates.**

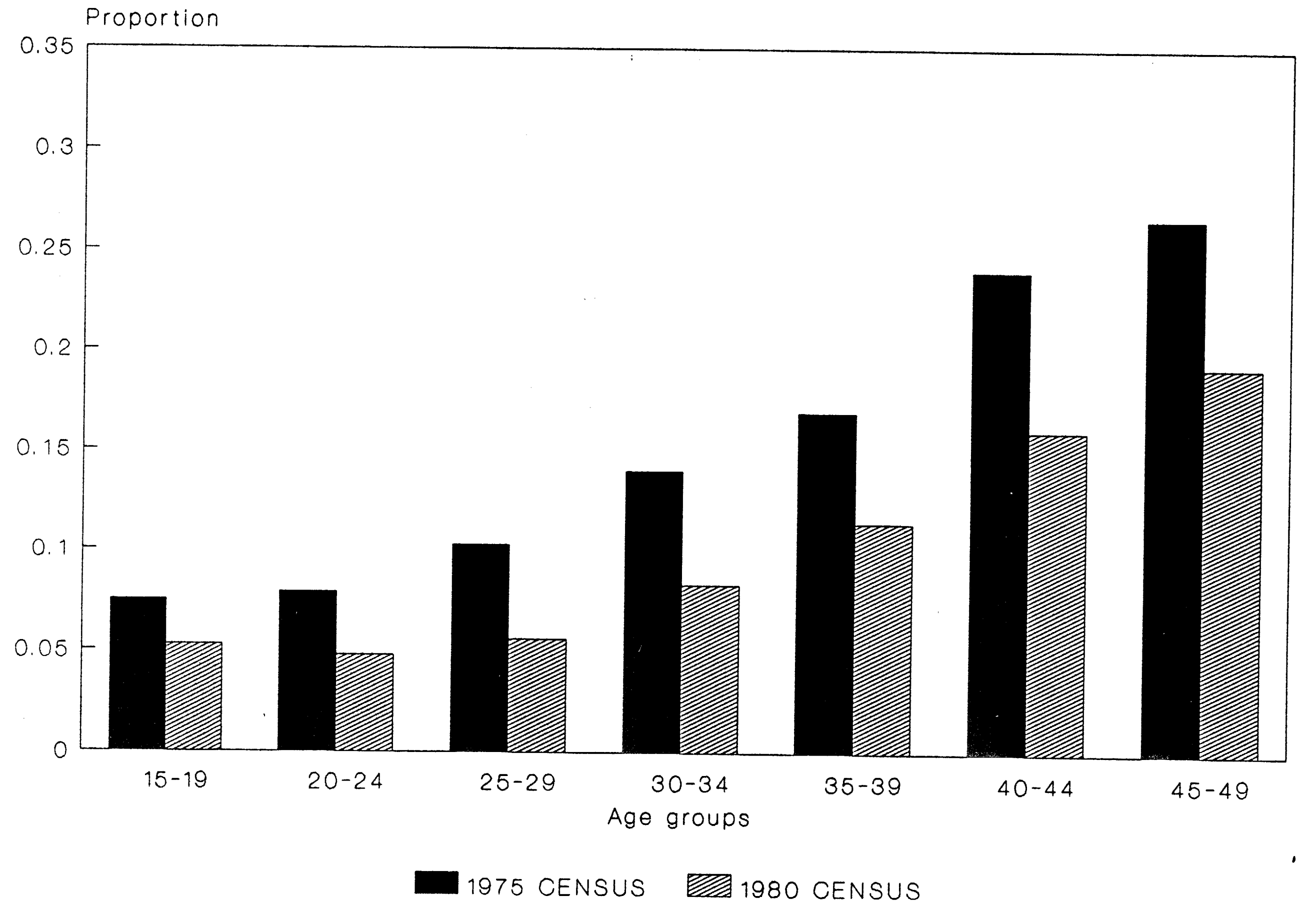


**Figure 21. Proportion of dead children in the U.A.E. by age group of woman.**

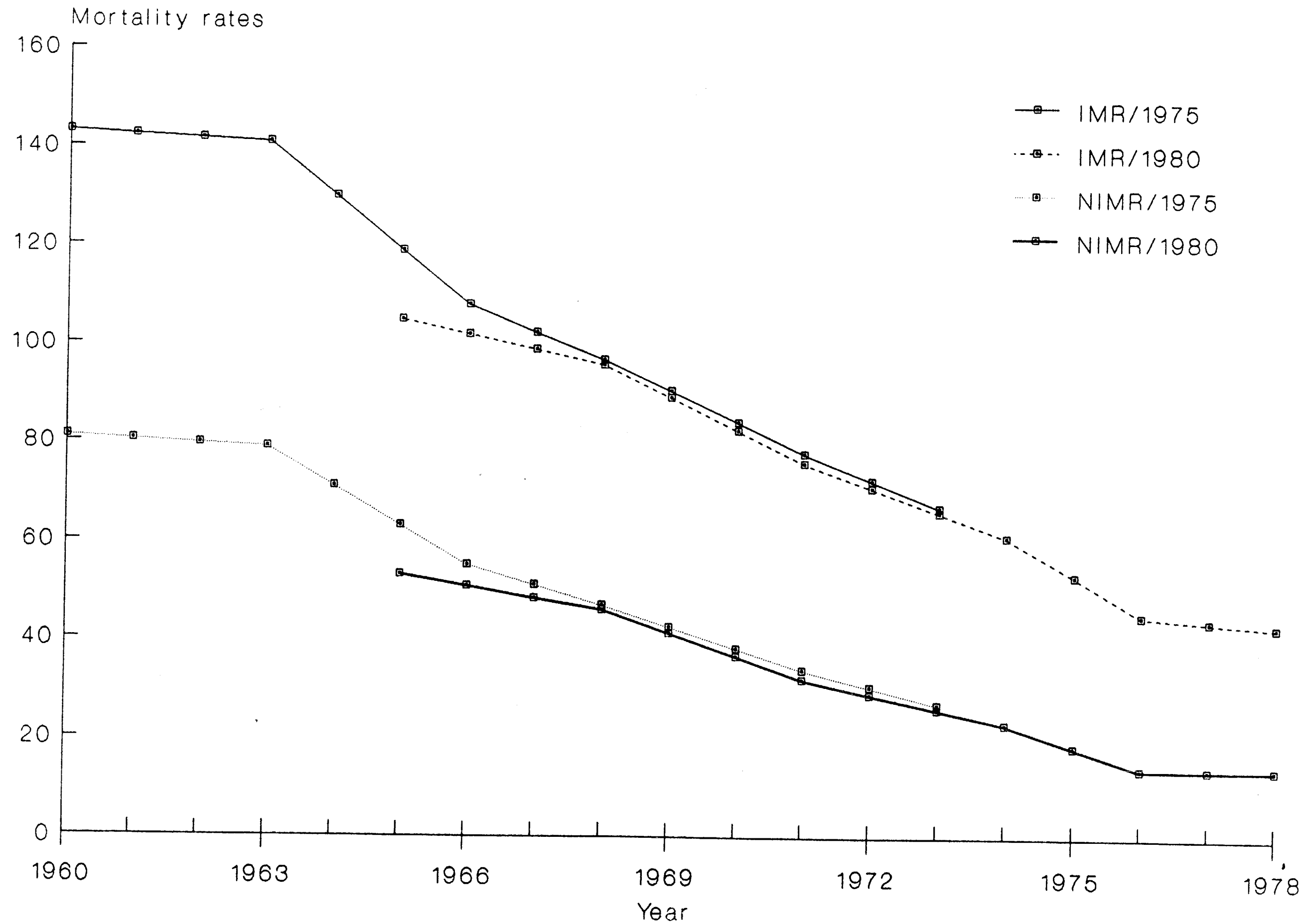


**Figure 22. Infant and non-infant child mortality, U.A.E. : 1960-1978, indirect estimates.**

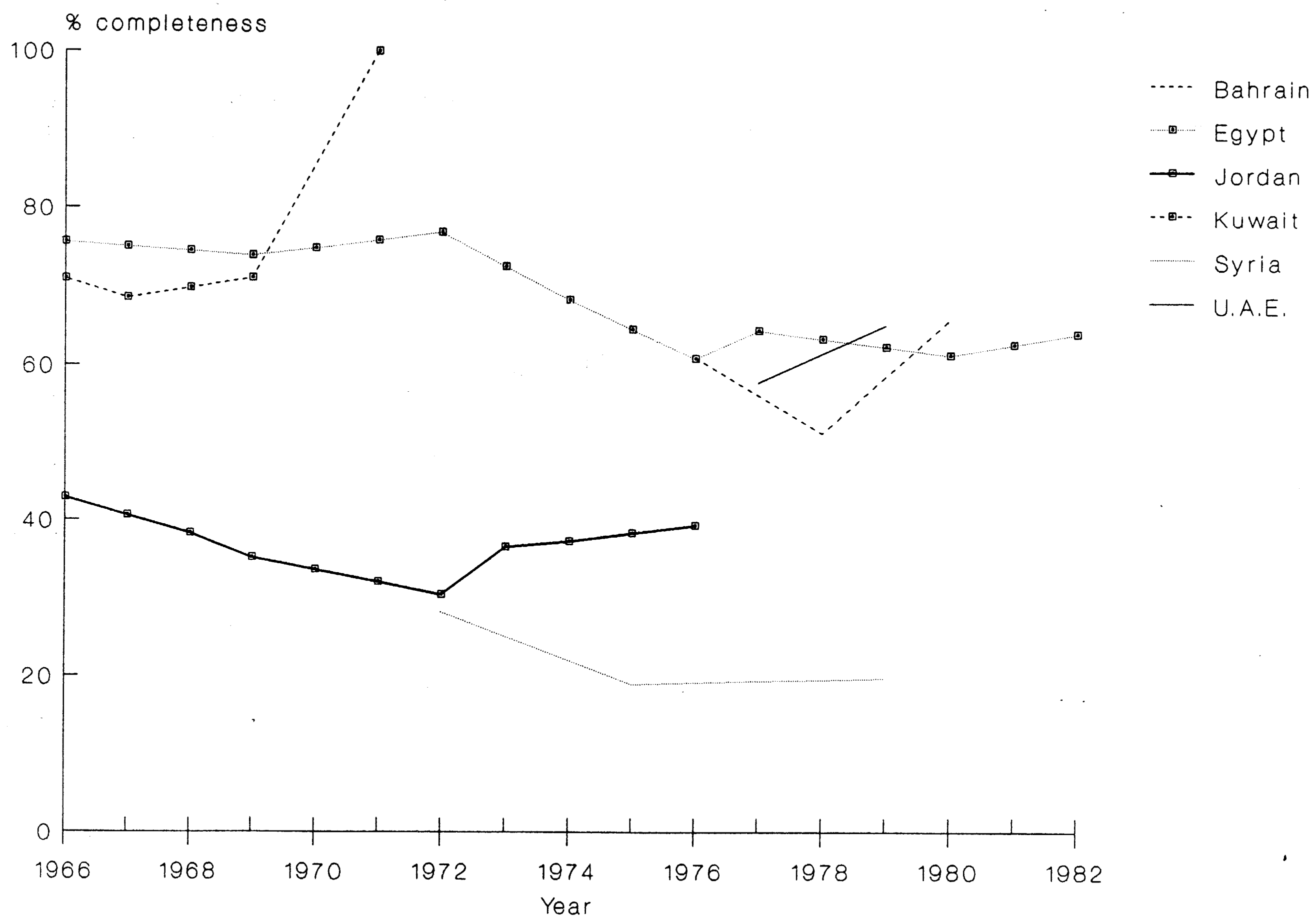


**Figure 23. Completeness of infant death registration in six Arab countries : 1966-1982.**

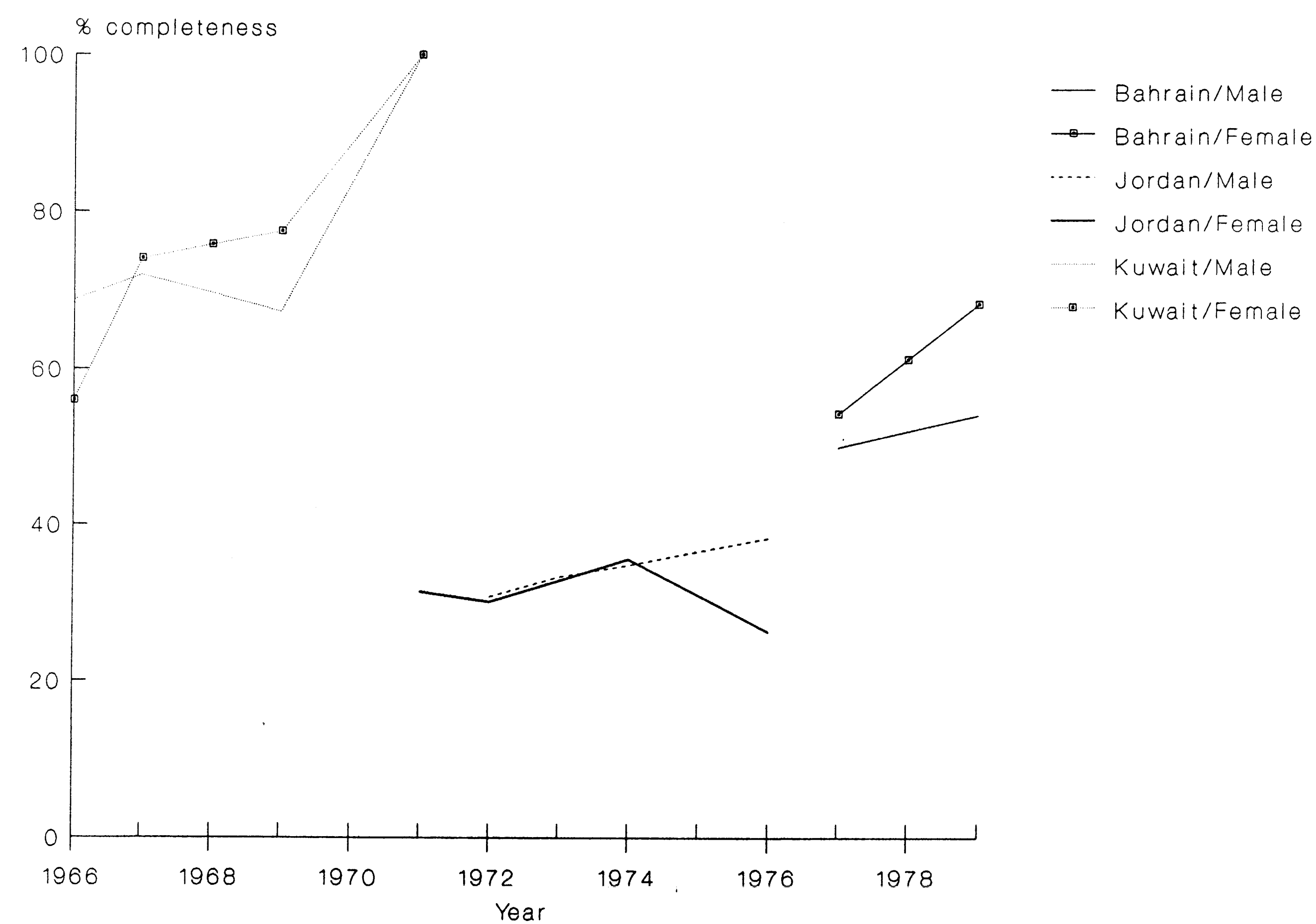


**Figure 24. Completeness of infant death registration by sex : 1966-1979.**

# SOCIO-ECONOMIC DIFFERENTIALS IN CHILD MORTALITY : THE CASE OF JORDAN

SOCIO-ECONOMIC DIFFERENTIALS IN CHILD MORTALITY :
THE CASE OF JORDAN

**CONTENTS**

FIGURES

## SOCIO-ECONOMIC DIFFERENTIALS IN CHILD MORTALITY : THE CASE OF JORDAN

### 1. INTRODUCTION

This study of socio-economic differentials in childhood mortality in Jordan, is one of a series of such studies using similar data and analytical methods carried out under the auspices of the United Nations Population Division and covering countries from all regions of the developing world. The objective of a set of studies using similar data and methods across regions and, where possible, across time periods, is to identify categories of children at high risk of child mortality, to investigate patterns of differentials in childhood mortality in diverse national contexts, and to see how such patterns are changing over time.

Jordan has been chosen as the representative of the Western Asia region in this project largely because of the existence of data for Jordan from two broadly similar household surveys, conducted respectively in 1976 and 1981, both of which collected information on child mortality and on a range of household and individual characteristics. Jordan is also of interest in its own right, because of the rapid social and economic changes that have been taking place over the last two decades. Child mortality has fallen rapidly since the 1950's, and it is of considerable interest to examine the extent to which this decline can be accounted for by largely social and economic factors, and the extent to which the decline has occurred independently of socio-economic change.

The second section of this study will examine levels and trends of child mortality in Jordan, following which the conceptual framework of these studies will be reviewed. The data sets used in this study will then be described in more detail, and data quality will be assessed. The multivariable model used to examine relations between child mortality and selected socio-economic variables will then be described briefly, concentrating mainly on the differences between the model used here and those being used in other studies in this series. Results of the model will then be presented and discussed, and the final section will consider the implications, particularly for policy, of the main findings.

### 2. LEVELS AND TRENDS IN CHILDHOOD MORTALITY

Birth and death registration in Jordan is not sufficiently complete to provide a satisfactory basis for measuring either levels or trends in infant and child mortality. Child mortality estimates for the Kingdom have therefore been derived from census and survey data. Fortunately, a number of censuses and surveys have been carried out since the early 1960's, so it is possible to track levels and trends of child mortality from the 1950's to the late 1970's with some confidence.

The 1961 and 1979 censuses both collected information on children ever born and children surviving for all ever-married women. The proportions dead of children ever borne by women classified either by five year age group (e.g. 15 to 19, 20 to 24, etc.) or by five year duration of marriage group (e.g. 0 to 4 years, 5 to 9 years, etc.) provide estimates of probabilities of dying by exact ages of childhood and approximate point reference dates for those estimates (Brass, 1964; United Nations, 1983). Similar data were also collected by the 1976 Jordan Fertility Survey (JFS), part of the World Fertility Survey program, and by the 1981 Jordan Demographic Survey (JDS). Two additional surveys, the 1972 National Fertility Survey and the 1983 Fertility and Family Health Survey, also collected the necessary data, but give rise to unacceptably low estimates of child mortality; these two sources have thus not been used further. The 1976 JFS also collected complete maternity histories from each ever-married woman, including the date of each live birth, and the age at death of any children who had subsequently died. Such data permit the calculation of direct estimates of child mortality through life table methods.

The United Nations (1983) methods for estimating child mortality from proportions dead of children ever born require the prior selection of an appropriate pattern of child mortality from the Coale-Demeny (1966) families of model life tables. For Jordan, this selection has been guided by the life table estimates of child mortality available from the 1976 JFS for five year calendar periods (Rutstein, 1983). Figure 1 shows the relationship between the probability of dying by age one (the life table infant mortality rate ${}_1q_0$) and the probability of dying between exact ages one and five (${}_4q_1$) for each five year period. Also shown are the corresponding relationships for each Coale-Demeny family of model life tables. At first sight, the JFS relationships seem to change from a 'North' pattern in 1955-59 to a 'South' or 'East' pattern in the early 1970's. However, maternity history estimates of ${}_1q_0$ and ${}_4q_1$ are strongly affected by heaping of age at death on age one. Such heaping certainly affected the JFS maternity histories, and assuming that some part of the heaping results from ages at death below one year being reported as one year, the resulting ${}_1q_0$ will be biassed downwards while the resulting ${}_4q_1$ will be biassed upwards. If the points in Figure 1 were moved upwards and to the left to adjust for such bias, they would follow a pattern very similar to that of the 'South' family as mortality declines from period to period. The 'South' pattern has therefore been chosen for the analysis of proportions dead among children ever born. Each proportion dead is then converted into a probability of dying by an exact age of childhood, and a point time reference is estimated for each such probability. To simplify presentation and comparison, each probability of dying is then converted into a standard form, the probability of dying by exact age five, ${}_5q_0$, again using the 'South'

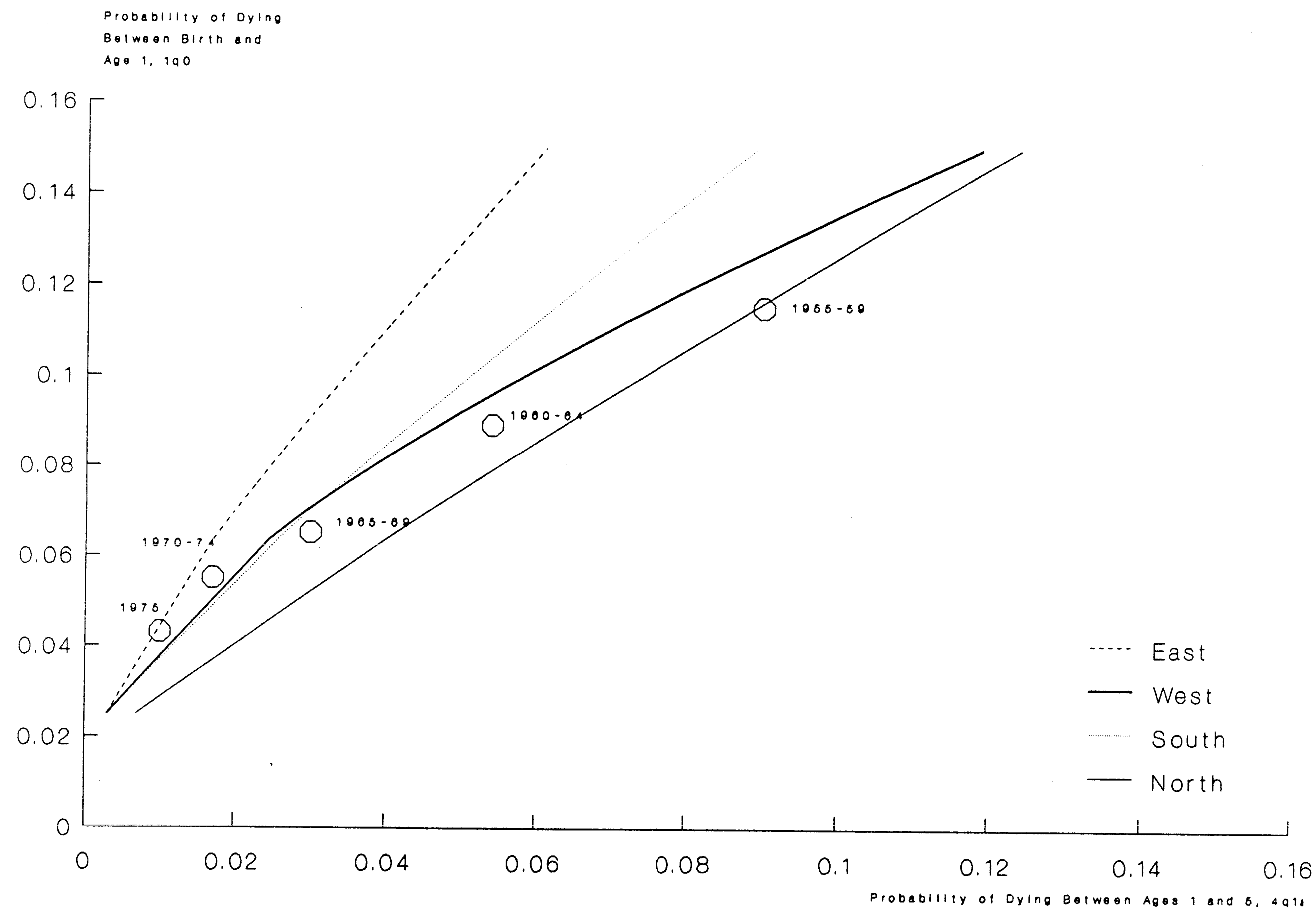


Figure 1. Age Patterns of Child Mortality as Observed by the 1976 JFS Compared with Patterns from Coale-Demeny Model Life Tables.

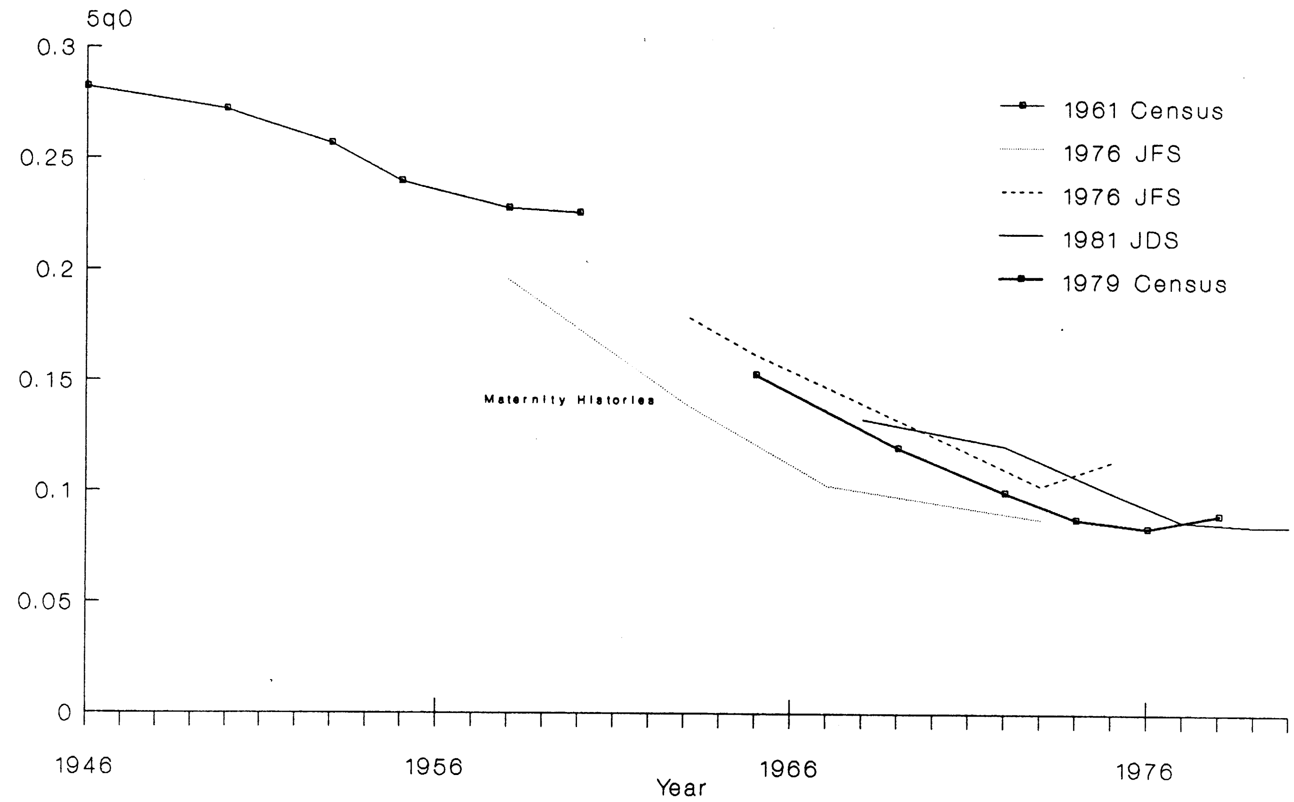


**Figure 2. Indirect Estimates of the Probability of Dying by Age 5, 5q0; Jordan, East Bank.**

family of model life tables.

Figure 2 shows the resulting estimates of $_5q_0$ from each data source, using proportions dead calculated by age group of mother, plotted against time. Also shown are the direct estimates of $_5q_0$ by time period obtained from the JFS. The resulting indirect estimates show a high degree of consistency, indicating satisfactory data comparability between surveys, and in all probability reasonable data accuracy also. The direct estimates from the JFS indicate somewhat lower child mortality than the indirect estimates; it is possible that the former are somewhat too low, as a result of over-reporting of age at death in the maternity histories, or that the latter are somewhat too high, as a result of mis-specification of the age pattern of fertility through the use of ratios of average parities for successive age groups. Be that as it may, there can be no doubt that child mortality has fallen sharply in Jordan since the early 1950's, the decline in $_5q_0$ being approximately linear through the 1950's, 1960's and first half of the 1970's. The probability of dying by age 5 fell from approximately 270 per thousand live births around 1950 to about 90 per thousand live births by 1975, a decline of two thirds in a period of 25 years. Some indication from Figure 2 of a slowdown in the pace of decline in the late 1970's may be due more to shortcomings in the indirect methodology being used than to an actual slowdown in the pace of child mortality decline.

## 3. CONTEPTUAL FRAMEWORK

The conceptual framework for these studies has been described in detail elsewhere (Behm,1987), so it will only be outlined here. Child mortality is seen as the final outcome of a continual interaction between the child and its environment. At birth, a child has a certain stock of viability, determined by genetics, conditions of gestation and circumstances surrounding the birth. As age increases, the stock of viability is gradually incremented through adequate nutrition and growth, and occasionally acutely decremented by infections, or chronically decremented by malnutrition. If, at some point, the stock of viability falls to zero, the child dies. More normally, the stock of viability gradually increases, despite occasional setbacks, and the severity of the setbacks decreases as resistance to common infections builds, such that, by around age five, the risks of child death fall to relatively low levels.

In this very simple framework, the input to viability is essentially nutrition, and through nutrition, growth. On the negative side, decrements due to infection will depend on exposure and resistance, itself partly a function of viability, while decrements due to malnutrition will be associated with growth faltering. A very large number of background factors will affect the process. Nutrition is likely to be determined by the economic conditions of the household, by cultural factors and tastes, and by ecological conditions in the area; in early childhood, factors affecting breastfeeding, largely cultural but also including the nutritional status of the mother, will predominate. Exposure to disease will depend at the household level on hygienic and disease avoidance practices, likely to be affected by the educational levels of those providing child care, and by housing conditions such as water supply and toilet facilities; community and ecological conditions will also influence the prevalence of infectious agents and the likelihood of transmission. Resistance to infection will depend on current viability, as well as on specific prevention practices such as immunizations. The severity of the effects on viability of an infection will depend on present viability, and also on specific curative or palliative practices. Both resistance and severity are likely to be affected by the degree of motivation of those responsible for child care, and are thus likely to be affected by parental education, among other things.

The overall process whereby childhood mortality is determined is thus an extremely complex one, involving social, economic, cultural and medical factors at the household and community level. The specification and estimation of a model that captures the full complexity of the process is, though theoretically feasible (The Cebu Study Team, 1988), beyond the scope of most data collection and analysis exercises. In this study, for want of suitable data, we have eliminated consideration of what Mosley and Chen (1984) describe as the proximate determinants of child mortality. Instead, we will look at the relationship between social and economic factors which the framework would lead us to expect to be important determinants of the proximate determinants and indicators of child mortality. In so doing, we fail to investigate the mechanisms through which the factors investigated operate, but we still identify risk factors which can serve as policy targets. Our model is further limited by its failure to identify or incorporate many community level factors expected to be important in child mortality risks. Given these limitations, we will now review the roles in determining child mortality of the variables we have been able to include.

(a) Type of Place of Residence.

Urban and rural areas differ in many respects relevant to childhood mortality. Urban areas generally enjoy better economic conditions, and educational standards are almost universally higher. Better economic conditions may not always imply better health, however. Disease transmission rates may be higher as a result of higher population density, nutrition may be worse as a result of shorter breastfeeding and reliance on market purchase rather than subsistence production, and a poorly-run water system may be more hazardous than a rural well. On the credit side, access to health services, and the quality of such services, will generally be superior in urban rather than rural areas. Overall, on a bivariate basis, we would expect child mortality to be lower in urban rather than rural areas, but on a multivariate basis, once education and income are controlled for, we would not expect to see such large differences.

(b) Parental Education.

Higher levels of parental education may be expected to be associated with lower child mortality, working through all the processes reviewed above. Exposure to disease may be reduced by better hygienic practices and other behaviour, resistance may be increased by better nutrition (though countered by possible reductions in breastfeeding) and greater use of immunizations, and severity may be reduced by the appropriate use of curative or palliative measures. If household income is adequately controlled for, we should probably expect mother's education to be relatively more important than father's education, since in most societies it is the mother who has more immediate involvement in child care. However, if income is not adequately controlled for, father's education and household income are likely to be strongly related, and father's education may appear to be highly important. In some societies in which the possibilities for independent female action are limited, husband's education may also be of importance to determining the use or otherwise of preventive and curative health services.

(c) Household Income.

We expect household income to be inversely related to child mortality through lower exposure (more hygienic living conditions), greater resistance (better nutrition and use of immunization), and reduced severity (better nutrition and use of curative services). However, in this study we do not have direct measures of household income; we have thus used less satisfactory proxies such as occupation of father or source of household income. Though broadly related to household income, these proxies will clearly catch only part of the true variability in such income.

(d) Housing Conditions.

Housing conditions are likely to be associated primarily with exposure to infection. As indicators of such conditions, we use the source of water, probably directly related to exposure risks, and source of light, a broader indicator of availability of electricity and thus of housing conditions.

(e) Age at First Marriage.

Childbearing in early adolescence is regarded as a risk factor for the child, presumably operating through incomplete physical development of the mother reducing intrauterine growth and increased risk of complications of delivery. Early pregnancy may also halt maternal development, and thus contribute to higher mortality risks for subsequent children also. We have no measure of age at first birth, but it should be closely related to age at first marriage, which is incorporated in the model.

## 4. DATA SOURCES

As indicated earlier, this study uses data on child mortality and family and household factors expected to influence such mortality from two sample surveys, the 1976 Jordan Fertility Survey (JFS) and the 1981 Jordan Demographic Survey (JDS). Though rather similar data sets have been extracted from the two surveys, there are some important differences in survey procedures between the two.

(a) Sampling.

The JFS sample was intended to cover five per cent of households, in one in four of which ever-married women aged 15 to 49 would be selected for detailed interview including a full maternity history. The design was intended to produce some 4,000 completed detailed interviews. The data set used here is based on the responses to the detailed interviews. The sampling frame was based on the 1975 Agricultural Census, for want of a recent complete population census, involving seven strata reflecting varying degrees of locality size. Serious problems were encountered with the sample frame in urban areas, and ex post facto weights (also allowing for non-response) were used to try to adjust for the deficiencies of the frame. By comparison with the results of the 1979 Population Census, the weighted JFS data appear to over-represent urban areas other than Amman, at the expense of both Amman and rural areas. Such sampling problems may affect estimates of aggregate levels of child mortality, but should have little effect on estimates of relative differentials.

The JDS sample was based on the results of the 1979 Population Census, using a self-weighting, replicated, multi-stage design. The master design consists of 21 independent replicates, each intended to produce a sample of approximately 1,000 households; the JDS used 14 of the replicates, for an expected sample of about 14,000 households. No problems with the sampling procedure have been reported.

Criteria for inclusion in the survey varied slightly between the two surveys. The 1976 JDS was carried out in two stages; in the first stage, a household questionnaire was used in all sample households on a de facto basis, including all those who slept the night before interview in the household; in the second stage, four to six weeks later, the detailed woman questionnaire was administered to a 25 per cent sample selected in advance from the household listings of eligible women (ever-married and aged 15 to 49) included de facto in the household listing. The data used in this study come from the individual woman questionnaires, and inevitably there was some loss to follow-up from the household to the individual stages of the survey. The 1981 survey, in contrast, was conducted in one step, but on a combined de facto and de jure basis, including both those who slept the night before the survey in the household and those normally resident in the household but temporarily absent at the time of the survey. The data used in this study include both the de jure and the de facto populations.

(b) Questionnaires.

The main difference between the 1976 and 1981 questionnaires, from the perspective of this study, was the use of a full maternity history in the 1976 JFS. Both surveys included questions to ever-married women (aged 15 to 49 in the JFS, 13 and over in the JDS) on numbers of sons and daughters living with the mother and living elsewhere; the 1981 JDS also asked about numbers of sons and daughters that had died, whereas the 1976 JFS asked number of children, of both sexes combined, that had died. Although both surveys used rather similar question sequences to obtain data on lifetime fertility, the 1976 JFS then went on to collect a full maternity history, with the date of birth and, if relevant, age at death of each child; the maternity history and the lifetime summary data would then be reconciled if there was any discrepancy between the two. This reconciliation process used in the case of the JFS but not used with the JDS might result in some differences between the two data sets.

One area where the questionnaires differed substantially was in the collection of information on economic activity. The 1976 JFS collected data on the occupation and work status of both the husband and the mother. The JDS, on the other hand, collected data on the source of income of the family by sector (public, private, agriculture, etc.), but no specific information on occupation. Indicators of economic activity comparable across the two surveys could thus not be constructed, and the basic model excludes these important variables. Separate models for data from each survey do include occupation and source of income variables, however.

Both surveys included questions about date of first marriage, though the 1976 JFS question referred to the month and year when the respondent began living with her first (second, third, ...) husband, whereas the 1981 JDS question referred to the month and year of first marriage. If marriage and cohabitation do not coincide, these two question forms could give systematically different results; in general, in Jordan, marriage ceremony and cohabitation do essentially coincide. If a respondent could not provide the month and year information requested, both surveys asked for age at first marriage instead; if this also was not known, the 1976 JFS asked the number of years ago the marriage took place, whereas the 1981 JDS required the interviewer to arrive at an estimate of age at first marriage.

Most of the other questions from which data are used in this study differed only trivially if at all between the two surveys. Questions on age, education, and type of lighting were essentially the same. Both surveys collected data on water supply; the 1976 JFS categories were running water in the household, running water outside the household, well water and other source; the 1981 JDS used broadly similar categories, private tap, common tap, tanker, well and other, but apparently the Arabic form of the pre-coded answers would include a tap inside a household compound but physically outside the house itself as a common tap, and the word used for 'tanker' was unclear.

One further minor difference of relevance to the study should be noted. The 1976 JFS distinguished between Amman, the city of Zarka, the city of Irbid, other towns, large villages, medium villages, and small villages. The 1981 JDS, on the other hand, used only three classifications, the cities of Amman, Zarka and Irbid, other urban areas, and rural areas. In order to use consistent definitions between the two surveys, in this study we have used a single urban-rural distinction, urban including the three cities and all towns, and rural including villages of all sizes up to a population of 10,000.

(c) Data Quality.

Since this study is concerned with differentials in child mortality, the quality of the information on child mortality is of particular concern. We have already shown that the child mortality estimates derived from the data collected by the 1976 JFS and the 1981 JDS are highly consistent, both with each other and with the estimates from the 1961 and 1979 censuses. This consistency argues strongly for high data quality. However, since the two surveys were carried out five years apart, further consistency checks can be applied by examining the plausibility of cohort changes from one survey to the next. Cohorts, for this purpose, can be defined either in terms of age group at the first survey (for example, the women aged 20 to 24 in 1976 survive to become the women aged 25 to 29 in 1981) or in terms of duration of marriage at the first survey (for example, those first married five to nine years before the 1976 survey survive to become the women first married 10 to 14 years before the second survey). Such comparisons can be made both for the average number of children ever born by women of each cohort, and for the average number of children that have died for such women also, providing an extremely sensitive consistency check on the reporting of both lifetime fertility and child deaths. The comparisons are shown in Table 1.

The average parities in Table 1 show some interesting features. By age group, the 1981 average parities for younger women are considerably lower than the corresponding values from 1976, whereas for short duration of marriage groups the 1981 average parities are higher than the corresponding 1976 values. Age at marriage clearly rose sharply between 1976 and 1981, reducing lifetime fertility at young ages,

TABLE 1 : AVERAGE PARITY AND AVERAGE NUMBER OF CHILDREN DEAD BY AGE AND FIRST MARRIAGE COHORTS; JORDAN, 1976 AND 1981.

(a) Age Cohorts

| Age Group | Average Parity | | | Average Number of Children Dead | | |
|---|---|---|---|---|---|---|
| | 1976 | 1981 | Cohort Increment | 1976 | 1981 | Cohort Increment |
| 15-19 | 0.173 | 0.108 | 0.108 | 0.014 | 0.007 | 0.007 |
| 20-24 | 1.546 | 1.199 | 1.026 | 0.124 | 0.080 | 0.066 |
| 25-29 | 3.703 | 3.395 | 1.849 | 0.322 | 0.254 | 0.130 |
| 30-34 | 5.690 | 5.469 | 1.766 | 0.562 | 0.447 | 0.125 |
| 35-39 | 7.123 | 7.150 | 1.460 | 0.820 | 0.697 | 0.135 |
| 40-44 | 8.428 | 8.256 | 1.133 | 1.429 | 1.005 | 0.185 |
| 45-49 | 8.602 | 8.610 | 0.182 | 1.445 | 1.235 | -0.194 |

(b) Time Since First Marriage Cohorts

| Years Since First Marr. Group | Average Parity | | | Average Number of Children Dead | | |
|---|---|---|---|---|---|---|
| | 1976 | 1981 | Cohort Increment | 1976 | 1981 | Cohort Increment |
| 0- 4 | 1.088 | 1.119 | 1.119 | 0.070 | 0.058 | 0.058 |
| 5- 9 | 3.223 | 3.385 | 2.297 | 0.243 | 0.217 | 0.147 |
| 10-14 | 5.270 | 5.543 | 2.320 | 0.522 | 0.442 | 0.199 |
| 15-19 | 6.917 | 7.229 | 1.959 | 0.713 | 0.704 | 0.182 |
| 20-24 | 8.111 | 8.623 | 1.706 | 1.065 | 0.963 | 0.250 |
| 25-29 | 9.110 | 9.350 | 1.239 | 1.554 | 1.261 | 0.196 |
| 30-34 | 9.613 | 9.580 | 0.470 | 1.809 | 1.473 | -0.081 |

whereas marital fertility probably rose. However, from a data evaluation viewpoint, interest centres on the cohort increments of parity and child deaths. These increments should always be positive, since for the same women neither the average number of children ever born nor the average number of children that have died can decrease.[1]

1. Of course, it is not strictly speaking the same women in the cohort. First, both data sets are from samples, the overlaps between which are probably few. The cohort increments provide a useful test of the broad comparability of the samples. Second, mortality removes a small proportion of women from each cohort, and international migration can add or remove women. The effects of mortality and migration are likely to be negligible.

Both the cohort parity increments and the cohort child death increments should also approximately follow age- or duration-specific patterns of fertility. This is true for parity because each increment represents the additional fertility apparently contributed by five years of additional exposure. It is also approximately true for child deaths because the probability of a child death is greatest by far in infancy and early childhood; average numbers of children dead thus follow average parity fairly closely.

With a couple of exceptions at high ages or durations, the cohort increments follow expected patterns very closely. For age cohorts, the parity increments behave exactly as expected, and sum to 7.5, an estimate of total fertility for the 1976-81 period that agrees closely with other estimates of total fertility for the period. Similarly, the marriage cohort average parity increments show high marital fertility until duration 10 to 14 years, after which marital fertility gradually declines; the sum of the cohort increments is over 11, indicating extremely high fertility within marriage. The children dead increments behave more or less as expected by both age and duration of marriage, except for the negative increase for the highest age and duration cohorts and for the large increase for the age cohort aged 35 to 39 in 1976 relative to the cohort's parity increment. The cohort increments suggest that there may have been some omission of dead children by the oldest women in 1981, but that up to age 35, or duration of marriage 20, the 1976 and 1981 data are remarkably consistent, and in all probability remarkably accurate.

There are some clear data deficiencies, however. Age misreporting, and in all probability duration of marriage reporting also, suffer from very substantial heaping on ages ending in digits 0 and 5 in 1976 (see the First Country Report, Jordan Fertility Survey); age heaping in 1981 is much less pronounced. Such heaping probably has only minor effects on the analysis described here; systematic bias, on which we have no clear measures, would be potentially more serious. No doubt many other pieces of data used in this study, such as educational level, occupation, or work status, suffer from deficiencies to a greater or lesser extent. However, sensitive techniques for the detection of such errors are not as well developed as they are for mortality indicators, so a thorough evaluation is not possible.

Overall, data quality for the dependent variable for this analysis, namely child mortality, appears to be excellent. Known problems affect classifications by type of place of residence, age and, by implication, duration of marriage, and problems of unknown magnitude no doubt affect all the other variables used. However, a soundly-measured dependent variable is a good start, and problems with the other variables are probably no worse than those usually encountered in developing country data sets. In general, definitions used in 1976 and 1981 appear to be highly consistent.

## 5. DIFFERENTIALS IN CHILD MORTALITY

In this study, a multivariable model is used to estimate the relationships between a set of socio-economic indicators and an indicator, standardized for exposure to risk of death, of the child mortality experience of the children of each currently-married woman (the study was limited to currently-married women in order to be able to include variables relating to fathers as well as to mothers). Similar models are estimated using both the 1976 and 1981 data sets in order to explore possible changes in the relationships over time. The basic form of the model assumes that a linear relationship exists between the dependent variable, the standardized indicator of child mortality experience at the individual level, and a number of independent variables representing individual socio-economic characteristics women. The roles of these independent variables have already been reviewed in the conceptual framework; they are often proxies for a number of possible social, economic and cultural factors which are not directly observed, of which household income may be the most important. Further, the model can give no guidance as to the actual effects of such indirectly-captured factors. A number of potentially important factors, particularly community-level factors, may not be captured at all. The model must therefore be regarded as limited and simplified, though even so it should help in disentangling some of the factors associated with child mortality.

The basic form of the model is

$$MORT = b_0 + \sum_{i=1}^{n} b_i X_i + e$$

where MORT is the exposure-standardized indicator of mortality experience at the individual level, $b_0$ is the intercept (the level of MORT when all $X_i$ are equal to zero), and $b_i$ is the incremental effect on MORT over $b_0$ of having a mother with characteristic $X_i$, for n such characteristics. MORT is a continuous variable with a mean of approximately one, whereas the $X_i$ are all categorical variables, the possession or otherwise of the ith characteristic. Calculation of the $X_i$ is essentially straightforward, but the computation of MORT requires further explanation.

(a) Calculation of MORT.

The data sets used here provide information on the number of children ever born, and the number of children that have died, for each currently-married woman in the sample. Thus for each woman, the proportion dead of children ever born can be calculated. For a large group of women, the proportion dead of children ever borne is mainly a function of two factors, the underlying level (and to some extent age pattern) of child mortality, and the average exposure to risk (and to some extent its distribution) of dying of the children. Exposure can be allowed for by classifying women by age group or duration of marriage group, thus making it possible to relate proportions dead to probabilities of dying in childhood. It is this principle that underlies the well-known Brass method for estimating child mortality from proportions dead among children ever borne by women classified by age or duration of marriage (Brass, 1964; United Nations, 1983).

Trussell and Preston (1982) propose using this process in reverse for studying the correlates of child mortality using individual-level data. Given estimates of probabilities of dying in childhood, generally obtained from aggregate-level analysis of proportions dead among children ever borne, the Brass procedure is used in reverse to estimate, for each age or duration of marriage group of mothers, an expected proportion dead among children ever borne. This proportion is thus standardized for the average exposure to risk of the children of mothers in the group, given the overall estimates of child mortality risks. For each women, an expected number of children dead is calculated by multiplying her parity by the standard proportion dead for her group. The indicator MORT is then calculated as the ratio of the actual number of dead children she reports divided by the expected number given her exposure group. Across all women, MORT should average close to unity; for an individual woman, a value above unity indicates a higher than expected number of dead children, whereas a value below unity indicates a lower than expected number of dead children. In a multivariable analysis, each woman is weighted by her number of children ever borne, to convert the unit of analysis from the mother to the child.

(b) Advantages and Disadvantages of MORT as a Dependent Variable.

The great advantage of MORT as a dependent variable is that it is defined for any parous woman, and can thus be used as a dependent variable in an individual level multivariable analysis. Thus widely-available information on children ever born and children dead can be used in individual level analyses of the factors associated with child mortality differentials.

Along with this advantage come a number of theoretical disadvantages. First, the expected proportion of children dead is calculated on the assumption that distributions of children by exposure to risk do not differ systematically with the covariates used within an age or duration of marriage group. When using age groups, this assumption is clearly incorrect. Women of higher socio-economic status usually bear children at later ages than women of lower status, so the children of higher status mothers have on average shorter exposure to risk periods, and thus ceteris paribus lower proportions dead, than the children of lower status women. Thus MORT may be expected to be lower for higher status than for lower status women, not because of lower underlying mortality risks, but rather because of shorter exposure to such risks. Regression analysis will thus give an exaggerated estimate of the reduction in child mortality associated with indicators of higher socio-economic status. This problem is much less severe for data classified by duration of marriage, because patterns of childbearing vary much less by duration of marriage than by age (in fact, the effect could be reversed, if higher status women bear children early in marriage and then stop, resulting in long average exposure of children for a given duration of marriage group, while lower status women continue to bear children steadily throughout marriage). This potential bias is a strong argument for calculating MORT for duration of marriage groups, where reproductive customs are such that almost all childbearing occurs within marriage. Since this latter condition is met in the case of Jordan, we have chosen to work with MORT calculated for currently-married women classified by years since first marriage.

A rather similar problem arises when child mortality has been declining steadily at the same time as socio-economic indicators have been rising. Assuming there has been some exogenous decline in child mortality over, say, 20 years, women in longer exposure groups, whether defined by age or duration, will have above average values of MORT, because their children will have been exposed to higher mortality risks in the past, whereas women in shorter exposure groups will have below average values of MORT. If female education levels have been increasing, the longer exposure groups will have lower education, while the shorter exposure groups will have higher education, and regression coefficients on education will pick up spurious magnitude from the exogenous decline. This problem cannot be resolved by calculating expected proportions dead for each exposure group on the basis of observed trends, because some part of these trends will be associated with endogenous factors (such as rising education levels) and the regression coefficients on such factors would then be biased downwards. Better would be a two-stage approach, first estimating a regression equation across all exposure groups using a single estimate of mortality, and then using the equation obtained to estimate the exogenous mortality level for each exposure group separately, given the structure of the group for the independent variables. Alternatively, an exposure group dummy variable can be included in the regression equation, to pick up trend effects not associated with the independent variables being used. The problem can also be reduced in importance by limiting the range of exposure groups used in the analysis to the fairly recent past, thus limiting the extent of possible exogenous decline. In this study, we have limited analysis to durations of marriage of less than 20 years (a limitation that has the added advantage of excluding information of doubtful quality from the women of long marital duration), and also used dummy variables for duration of marriage group.

A third problem with MORT as a dependent variable in a multivariable regression analysis is that its distribution is far from normal. The value of MORT can vary from zero ( no dead children) to the reciprocal of the expected proportion dead for the exposure group (all children dead). With relatively low child mortality, such as in Jordan, values of MORT can thus vary from zero to upwards of 10, the modal value often being zero. Such a distribution makes it highly unlikely that the error term e in the regression equation will be normally distributed, thus contravening the assumptions of ordinary least squares regression, though the effects are likely to be greater on calculations of significance or variance accounted for than on the regression coefficients themselves, which are the primary interest.

A fourth problem with MORT is that it includes a large random variation component. As a result, multivariable models incorporating MORT as a dependent variable have generally been found to explain a disappointingly small proportion of total variance. The problem can be explained very simply. Since women have a finite (and generally quite small) number of children, and since children die in units of one, most women cannot have the expected number of dead children for their actual parity. Consider, for example, a group of women each with exactly five children ever borne, and an underlying probability of a child death, the same for each woman, of one in ten. Clearly, the expected number of dead children will be one half, but no woman can have exactly the expected number. We would expect the actual number of dead children to follow the binomial distribution, according to which 59 per cent of the women would have no dead children (MORT equals 0.0), 33 per cent would have one dead child (MORT equals 2.0), 7 per cent would have two dead children (MORT equals 4.0), 0.8 per cent would have three dead children (MORT equals 6.0), and very small proportions would have four and five dead children. Thus MORT may vary widely even though the mortality risks are identical; potential variation would be even greater if family size were also allowed to vary. Clearly, MORT is an imperfect measure of the underlying mortality risk.

To test the magnitude of this effect, a model data set was created using the distribution of women by parity from the JFS. The women were divided into two groups, one with children with a probability of dying of 0.1, the other 0.05. The distribution of women by number of dead children was then generated using the binomial distribution, MORT was calculated for each woman, parity weights were applied, and least squares regression was used to estimate the relation between MORT and a dummy variable indicating group membership. The regression estimated the mortality differential reasonably well, but less than four per cent of the variance in MORT was accounted for by the dummy variable. Thus despite a perfect relationship between the dummy variable and the risk, the distributional characteristics of MORT ensure that the amount of variance accounted for will be small.

Yet another shortcoming of MORT is its aggregate nature. It is averaged over children of a wide range of ages, so cannot efficiently identify factors that affect child mortality at only one age range of childhood, or identify at all factors that might have effects in different directions in different age ranges. The factors that are likely to be identified as important correlates of child mortality are those that have approximately constant proportional effects at all ages of childhood.

(c) Results of the Regression Model.

Ordinary least squares regression has been used to estimate the relationship between the child mortality indicator MORT and a number of independent, categorical variables represented by dummy variables. Separate equations have been estimated for each data set, 1976 and 1981.

Values of MORT were calculated for each survey as follows. First, an estimate of the probability of dying by age five, ${}_5q_0$, was obtained by averaging the national level mortality estimates derived from the proportions dead of children ever born by duration of marriage groups 0 to 4, 5 to 9 and 10 to 14 using the Coale-Demeny 'South' family mortality pattern. The values of ${}_2q_0$, ${}_3q_0$, ${}_5q_0$ and ${}_{10}q_0$ corresponding to the estimated ${}_5q_0$ were then found. The estimation equations were then used in reverse, using the observed ratios of average parity by duration group, to estimate expected proportions dead in each duration group. Results are shown in Table 2.

TABLE 2 : STANDARD VALUES OF THE PROBABILITY OF DYING BY AGE 5, ${}_5q_0$, AND THE EXPECTED PROPORTIONS DEAD BY DURATION OF MARRIAGE GROUP; JORDAN, 1976 AND 1981.

| Measure | Duration of Marriage Group 0- 4 | 5- 9 | 10-14 | 15-19 |
|---|---|---|---|---|
| (a) Jordan 1976 | | | | |
| ${}_5q_0$ | 0.093 | | | |
| Expected Prop. Dead | 0.067 | 0.081 | 0.088 | 0.093 |
| (b) Jordan 1981 | | | | |
| ${}_5q_0$ | 0.077 | | | |
| Expected Prop. Dead | 0.056 | 0.068 | 0.072 | 0.076 |

For each woman, the expected proportion dead given her duration of marriage was then multiplied by her number of children ever born to obtain the expected number of children dead. MORT is then calculated as the ratio of actual number of children dead divided by the expected number.

The independent variables used were categorized as follows; the deleted or reference category was the category expected to show the lowest child mortality.

(i) Urban-Rural Residence.

Rural residence was defined as residence in small, medium or large villages of up to 10,000 population. The reference category, urban residence, thus includes residence in Amman, the cities of Zarka and Irbid, and towns with populations ranging from 10,000 upwards.

(ii) Education of Mother and Education of Father.

The education variables were categorized into five categories by years of schooling as zero, one to five years, six to eight years, nine to 11 years, and the reference category of 12 years or more.

(iii) Mother's Age at First Marriage.

The four categories used were under age 16, 16 or 17, 18 or 19, and 20 or over, the reference category.

(iv) Source of Water.

Three categories were used, the reference category being households with a private tap, the second category being households obtaining water from a common tap, and the third category being all other sources, including tankers, wells, and so on.

(v) Source of Light.

Two categories were used, the reference category being households lit by electricity, the other category being houses lit by all other means.

(vi) Duration of Marriage Group.

As an attempted control on trend effects, a variable representing duration of marriage was used. The four categories used were 0 to 4 years (the reference category), 5 to 9 years, 10 to 14 years, and 15 to 19 years.

Regression results are summarized in Table 3, which shows for each survey the population mean for each category (the proportion of the reported children falling in the category) and its coefficient in the regression equation.

Many of the results are in line with expectations. Rural residence is associated with higher child mortality risks; the coefficients on rural residence are significant for both 1976 and 1981, and are of broadly similar magnitude. Thus even after allowing for educational and housing characteristic differences, child mortality is significantly, though not greatly, higher in rural areas than in urban areas.

Education is clearly strongly related to child mortality. The children of mothers or fathers with less than six years of education have clearly higher mortality risks than children with well-educated parents, and the higher mortality risks extend to children of parents with primary and even some secondary schooling, in an attenuated form. The regression coefficients are similar for both surveys, and suggest that a little bit of education has little effect on lowering mortality (the coefficients for education categories zero and

TABLE 3 : SUMMARY RESULTS OF MULTIVARIABLE REGRESSIONS; JORDAN, 1976 AND 1981.

| Variable | 1976 Survey Mean | 1976 Survey Regression Coefficient | 1981 Survey Mean | 1981 Survey Regression Coefficient |
|---|---|---|---|---|
| MORT | 1.031 | n.a. | 1.132 | n.a. |
| <u>Residence</u> | | | | |
| Rural | 0.247 | 0.139* | 0.298 | 0.081* |
| Urban | 0.753 | Reference | 0.702 | Reference |
| <u>Mother's Education</u> | | | | |
| Zero | 0.547 | 0.402* | 0.456 | 0.505* |
| 1 to 5 years | 0.151 | 0.398* | 0.183 | 0.486* |
| 6 to 8 years | 0.200 | 0.053 | 0.194 | 0.247* |
| 9 to 11 years | 0.048 | 0.070 | 0.090 | 0.114* |
| 12 + years | 0.054 | Reference | 0.077 | Reference |
| <u>Father's Education</u> | | | | |
| Zero | 0.141 | 0.354* | 0.191 | 0.392* |
| 1 to 5 years | 0.279 | 0.383* | 0.221 | 0.362* |
| 6 to 8 years | 0.296 | 0.293* | 0.255 | 0.299* |
| 9 to 11 years | 0.121 | 0.078 | 0.140 | 0.216* |
| 12 + years | 0.163 | Reference | 0.193 | Reference |
| <u>Mother's Age at First Marriage</u> | | | | |
| Under 16 | 0.192 | -0.094 | 0.087 | 0.135* |
| 16 and 17 | 0.405 | -0.065 | 0.333 | -0.109* |
| 18 and 19 | 0.195 | -0.192* | 0.237 | 0.014 |
| 20 + | 0.208 | Reference | 0.343 | Reference |
| <u>Source of Water</u> | | | | |
| Other | 0.175 | 0.027 | 0.168 | -0.025 |
| Public Tap | 0.115 | -0.135* | 0.098 | -0.088* |
| Private Tap | 0.710 | Reference | 0.734 | Reference |
| <u>Method of Lighting</u> | | | | |
| Other | 0.258 | -0.000 | 0.192 | 0.000 |
| Electricity | 0.742 | Reference | 0.808 | Reference |
| <u>Duration of Marriage Group</u> | | | | |
| 15 to 19 years | 0.395 | -0.136 | 0.399 | 0.057 |
| 10 to 14 years | 0.313 | -0.028 | 0.333 | -0.029 |
| 5 to 9 years | 0.224 | -0.142 | 0.201 | -0.086 |
| 0 to 4 years | 0.068 | Reference | 0.067 | Reference |
| <u>Constant</u> | | 0.638 | | 0.506 |
| $R^2$ | | 0.028 | | 0.026 |
| Number of Cases (Births) | | 9771 | | 33154 |

* Significantly different from zero at 5% level.

1 to 5 years are similar for both mothers and fathers), that education of mothers and of fathers have independent effects of similar size, that there is no clear evidence that the relation between child mortality and parental education has changed in the recent past, and perhaps that maternal education of between six and 11 years has a slightly greater effect on reducing child mortality than paternal education in the same range.

The remaining variables included in the model are either not significant, are not consistent between surveys, are of mixed sign or are in the reverse of the expected direction. Method of lighting, an indicator of access to electricity, has absolutely no relation to child mortality risks. An age at first marriage of 20 or higher is associated with higher child mortality risks in the 1976 data than earlier ages at first marriage, and in the 1981 data it is only the children of women marrying before age 16 that have significantly higher mortality risks than the children of women marrying at 20 or over. These results could be due to birth interval effects related to age at first marriage. The children of households obtaining water from wells, tankers, streams and so forth apparently have the same mortality risks as the children of households having a private tap, though the children of households getting water from a public tap have lower mortality risks than either, the difference being significant in both 1976 and 1981.

The duration of marriage group variable, introduced to capture possible exogenous trends in child mortality over time, is never significant, but in five out of six cases it is negative. This result may be due to a concentration of high-risk first births in the reference duration group (0 to 4 years), or may suggest that the underlying mortality level, independent of the factors explicitly included in the model, was possibly rising through the last twenty years. However, the coefficients are quite small, and do not show any consistent pattern over time, so no reliance can be put on this latter observation.

It may be noticed that the constant term decreases somewhat between the 1976 and 1981 data; the children of mothers in the supposedly lowest risk reference categories have relatively lower risks in the 1981 data than in the 1976 data, suggesting a widening of the child mortality differentials associated with socio-economic differentials over the recent past. It should also be noticed that the $R^2$ for both equations is very low, 2.8 and 2.6 per cent in 1976 and 1981 respectively. The low proportion of variance of MORT accounted for by the variables in the equation is partly a characteristic of MORT, as pointed out earlier, but it also suggests that factors not included or proxied in the equation may have a substantial impact on levels of child mortality.

The basic model thus identifies two factors significantly associated with child mortality in the expected direction, parental education and urban versus rural education, and one factor, water supply from outside the house or compound, significantly associated with child mortality in an unexpected direction. However, the actual roles of place of residence and parental education per se are not clear, because a number of potentially important variables likely to be proxied by residence and parental education are not included in the model. The most obvious such variable is household income, data on which are not available from either survey. Both surveys did, however, collect information related to occupation and work status, but these variables have not been included in the basic model because the nature of the information varied greatly between the two surveys. Clearly, the variables can be included in survey-specific models, and the effect of including the variables on the coefficients of education and residence can be examined.

Table 4 shows the regression coefficients for models including residence and education variables, and including and excluding respectively occupation indicators. For 1976, these occupation indicators are of the type of work done by the father, for example professional, clerical or skilled manual work. These indicators are likely to be quite strongly associated with father's income, and thus be related strongly to the economic position of the family. The indicators used in 1981, however, are sectoral rather than occupational, distinguishing between public and private sector sources of household income. These indicators may be associated with stability of income flow, but are unlikely to be closely related to the financial circumstances of each household.

Despite the shortcomings of the indicators, there are some interesting patterns in Table 4. The inclusion of father's occupation in the model using 1976 data shows lower child mortality in families with the father working in professional and clerical positions, and higher mortality where the father is working in agriculture or is not working outside the household. The child mortality reducing effects of both maternal and paternal education are substantially reduced in both magnitude and significance, the reduction being somewhat larger for paternal education than for maternal education. The urban-rural differential is also slightly reduced. It seems likely that both education variables in the basic model are picking up effects associated with standard of living rather than education per se. The source of income variable in 1981 behaves very differently. Although each source of income category is significant, and the coefficients have the expected signs, their inclusion has no major effect on the coefficients of education categories. Their inclusion does, however, have an effect on the place of residence variable, with the mortality disadvantage associated with rural residence losing sagnificance and falling almost to zero. It seems likely that the residence variable in the basic equation is largely a proxy for other, uncontrolled variables, rather than an important independent variable in its own right.

It is sometimes suggested in the literature that important interactions exist between place of residence and other variables included in child mortality models. In order to examine this issue in the case of Jordan, the basic model shown in Table 3 has been applied ( without a residence

TABLE 4 : REGRESSION COEFFICIENTS FOR MODELS INCLUDING RESIDENCE AND EDUCATION, INCLUDING AND EXCLUDING OCCUPATION VARIABLES; JORDAN, 1976 AND 1981.

| Variable | 1976 | | | | 1986 | | | |
|---|---|---|---|---|---|---|---|---|
| Model | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| Residence | | | | | | | | |
| Rural | 0.154* | 0.126* | n.i. | n.i. | 0.084* | 0.035 | n.i. | n.i. |
| Urban | Reference Group | | | | | | | |
| Education (years) | | | | | | | | |
| | (Maternal) | | (Paternal) | | (Maternal) | | (Paternal) | |
| 0 | 0.601* | 0.398* | 0.596* | 0.376* | 0.792* | 0.778* | 0.721* | 0.693* |
| 1-5 | 0.583* | 0.409* | 0.583* | 0.376* | 0.708* | 0.715* | 0.634* | 0.646* |
| 6-8 | 0.190* | 0.054 | 0.448* | 0.275* | 0.398* | 0.403* | 0.488* | 0.508* |
| 9-11 | 0.101 | 0.047 | 0.188* | 0.027 | 0.187* | 0.194* | 0.358* | 0.375* |
| 12+ | Reference Group | | | | | | | |
| Father's Occupation | | | | | | | | |
| Professional | n.i. | -0.420* | n.i. | -0.425* | Not Available | | | |
| Clerical | n.i. | -0.254* | n.i. | -0.223* | | | | |
| Sales | n.i. | -0.122 | n.i. | -0.189* | | | | |
| Skilled Manual | n.i. | -0.086 | n.i. | -0.184* | | | | |
| Services | n.i. | -0.024 | n.i. | -0.006 | | | | |
| No work, Household | n.i. | 0.067 | n.i. | 0.021 | | | | |
| Agriculture, Unskilled | n.i. | Ref. | n.i. | Ref. | | | | |
| Source of Income | | | | | | | | |
| Other | Not Available | | | | n.i. | 0.386* | n.i. | 0.434* |
| Agriculture | | | | | n.i. | 0.115* | n.i. | 0.138* |
| Private, Self Employed | | | | | n.i. | 0.050* | n.i. | 0.133* |
| Public Sector | | | | | n.i. | Ref. | n.i. | Ref. |
| Constant | 0.534 | 0.810 | 0.629 | 0.925 | 0.523 | 0.493 | 0.679 | 0.590 |
| $R^2$ | 0.021 | 0.025 | 0.017 | 0.021 | 0.020 | 0.022 | 0.016 | 0.019 |

n.i. Indicates variable not included in equation

* Indicates coefficient significantly different from zero at 5 per cent level.

variable, of course) for urban and rural areas separately. For these applications, separate urban or rural estimates of child mortality, obtained from proportions dead of children ever born to currently-married women classified by duration of marriage, were used to compute the dependent variable. If important interactions exist, we should expect to see substantial differences between urban and rural coefficients. The coefficients are shown in Table 5. A number of points arise from Table 5. First, the 1976 rural model has a negative constant, indicating negative child mortality for the reference group women. The number of women in this model with high education is probably so low that the regression fit has been distorted. Second, the effects of maternal education show no clear pattern for both 1976 and 1981; in 1976, maternal education appears to be more protective of children in rural areas than in urban, but in 1981 the opposite is the case. Third, for paternal education, there does seem to be a pattern; in urban areas, paternal education seems to be protective for 9 or more years of schooling, whereas in rural areas there is little difference by level of schooling until 12 or more years. Age at first marriage shows no consistent pattern, though the association of low child mortality with an age at marriage below 20 appears in both urban and rural areas. Getting water from a public tap rather than from a private tap or from other sources appears to be associated with reduced child mortality risks in both surveys and for both areas of residence, though the coefficients are only significant for rural areas. Access to electricity has no effect in either urban or rural areas. The effects of duration of marriage reverse from 1976 to 1981, such that in 1976 longer marital duration is associated with lower child mortality in urban areas and higher mortality in rural areas, whereas in 1981 the signs are all reversed. Overall, there seems to be no strong evidence for inferring major interactions between place of residence and any of the other variables, except perhaps in the case of paternal education.

One further interaction was examined, that between maternal and paternal education. The specific question considered was whether a large positive or negative difference in education between fathers and mothers reduced the overall effect of education on child mortality. Two dummy variables were specified, one which would be zero unless the mother had an education level at least two categories higher than that of the father, and the second that would be zero unless the father had an education level at least two categories higher than that of the mother. These two variables were included with the other variables found to be consistent and often significant, namely residence, mother's education and father's education. Results are shown in Table 6. In 1981, large differentials in educational levels between spouses do appear to be associated with higher child mortality risks, especially when it is the male who has the higher level of education. Using the 1976 data set, on the other hand, large educational differentials between spouses are associated with lower child mortality risks. The picture is thus not consistent, and given the problems of multicollinearity involved, no conclusions can be drawn.

TABLE 5 : SUMMARY RESULTS OF MULTIVARIABLE REGRESSIONS; JORDAN, 1976 AND 1981.

| Variable | 1976 Survey | | 1981 Survey | |
|---|---|---|---|---|
| | Regression Coefficient | | Regression Coefficient | |
| | Urban | Rural | Urban | Rural |
| MORT | 0.979 | 1.018 | 1.176 | 1.022 |
| $_5q_0$ | 0.091 | 0.113 | 0.069 | 0.097 |
| <u>Mother's Education (years)</u> | | | | |
| Zero | 0.379* | 0.897 | 0.557* | 0.335* |
| 1-5 | 0.377* | 0.999 | 0.515* | 0.343* |
| 6-8 | 0.043 | 0.539 | 0.279* | 0.086 |
| 9-11 | 0.087 | 0.181 | 0.122* | 0.049 |
| 12+ | Reference | Reference | Reference | Reference |
| <u>Father's Education (years)</u> | | | | |
| Zero | 0.311* | 0.378* | 0.395* | 0.398* |
| 1-5 | 0.401* | 0.333* | 0.361* | 0.381* |
| 6-8 | 0.306* | 0.277* | 0.349* | 0.223* |
| 9-11 | 0.008 | 0.411* | 0.155* | 0.366* |
| 12+ | Reference | Reference | Reference | Reference |
| <u>Mother's Age at First Marriage</u> | | | | |
| Under 16 | -0.100 | -0.211* | 0.352* | -0.106 |
| 16-17 | 0.038 | -0.345* | -0.114* | -0.110* |
| 18-19 | -0.132* | -0.391* | 0.074* | -0.093 |
| 20 + | Reference | Reference | Reference | Reference |
| <u>Source of Water</u> | | | | |
| Other | 0.068 | -0.090 | 0.009 | 0.086 |
| Public Tap | 0.060 | -0.248* | -0.041 | -0.227* |
| Private Tap | Reference | Reference | Reference | Reference |
| <u>Method of Lighting</u> | | | | |
| Other | 0.023 | 0.008 | 0.081 | -0.027 |
| Electricity | Reference | Reference | Reference | Reference |
| <u>Duration of Marriage Group (years)</u> | | | | |
| 15-19 | -0.272* | 0.229 | 0.159* | -0.206* |
| 10-14 | -0.141 | 0.260* | 0.036 | -0.229* |
| 5-9 | -0.246* | 0.125 | 0.007 | -0.293* |
| 0-4 | Reference | Reference | Reference | Reference |
| <u>Constant</u> | 0.727 | -0.002 | 0.461 | 0.775 |
| $R^2$ | 0.026 | 0.029 | 0.030 | 0.014 |
| Number of Cases (Births) | 7355 | 2416 | 23277 | 9877 |

* Significantly different from zero at 5% level.

(d) Trends over Time in Child Mortality Differentials.

Comparisons between regression coefficients from the 1976 and 1981 data have been made above from the perspective of assessing the plausibility of the results obtained. The results in Table 3 could also, however, be looked at from the point of view of time trends; sharp changes in differentials over time should appear as large changes from 1976 to 1981 in the regression coefficients in Table 3 (though the potential for such changes is quite small, since both data sets cover all births to the sample women over a common 15 year period).

It is not easy to compare the regression coefficients in Table 3 directly, because the constant values change and because some of the variables included in the model change erratically, confusing the comparison. We therefore consider changes only in mortality risks by residence, maternal education and paternal education, and convert the regression coefficients into estimates of the probability of dying by age five, $_5q_0$. All other coefficients in Table 3 are multiplied by their population means. For the highest risk group, children of rural women who have no education and whose husbands have no education, the probability of dying by age five declines from about 121 per thousand in the 1976 data to about 98 per thousand in 1981, a decline of about 20 per cent in five years. For the lowest risk group, children of urban mothers and fathers both with 12+ years of education, have an estimated q(5) of 41 per thousand from the 1976 data versus 32 per thousand from the 1981 data, for a decline of about 25 per cent. Thus major declines in child mortality risks have occurred within risk groups, as defined here, and the overall change in child mortality in Jordan reflects real declines within groups rather than changes over time in the structure of the population by risk group. The ratio of highest to lowest mortality risk remains about three to one in both surveys.

## 6. IDENTIFICATION OF CHILD SURVIVAL RISK GROUPS

The regression models estimated in the previous section can be used to identify risk groups for children according to the characteristics of their families. In identifying risk groups, we have focussed on two characteristics, place of residence and education of mother, in order to define risk cells with numbers of children in the samples of 100 or more. Table 7 shows risks expressed in terms of the probability of dying by age 5, $_5q_0$, obtained by converting the value of MORT estimated by the relevant regression model into a $_5q_0$ on the basis of the average value of $_5q_0$, the average value of MORT,

TABLE 6 : REGRESSION COEFFICIENTS FOR MODELS INCLUDING RESIDENCE, MATERNAL EDUCATION, PATERNAL EDUCATION AND SPOUSAL EDUCATIONAL DIFFERENTIAL; JORDAN, 1976 AND 1981.

| Variable | Regression Coefficients 1976 Survey | 1981 Survey |
|---|---|---|
| **Residence** | | |
| Rural | 0.132* | 0.075* |
| Urban | Reference | Reference |
| **Mother's Education** | | |
| Zero | 0.532* | 0.325* |
| 1 to 5 years | 0.478* | 0.343* |
| 6 to 8 years | 0.123 | 0.131* |
| 9 to 11 years | 0.064 | 0.056 |
| 12 + years | Reference | Reference |
| **Father's Education** | | |
| Zero | 0.159 | 0.611* |
| 1 to 5 years | 0.174 | 0.555* |
| 6 to 8 years | 0.220* | 0.377* |
| 9 to 11 years | 0.026 | 0.260* |
| 12 + years | Reference | Reference |
| **Mother With Greater Education** | | |
| 2+ Categories | -0.319* | 0.071 |
| Other | Reference | Reference |
| **Father With Greater Education** | | |
| 2+ Categories | -0.205* | 0.212* |
| Other | Reference | Reference |
| **Constant** | 0.541 | 0.437 |
| $R^2$ | 0.027 | 0.024 |

* Significantly different from zero at 5% level.

and the regression coefficients and constant.[2]
The risk categories used are Very High, more than 30 per cent

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2. The mortality risks shown in Table 7 were calculated from regression equations including only the two variables, maternal education and residence, shown in the table. The coefficients for the equations were as follows:

| Variable | 1976 JFS | 1981 JDS |
|---|---|---|
| Constant | 0.534 | 0.523 |
| Residence | 0.154 | 0.084 |
| Education 1-5 | 0.101 | 0.187 |
| Education 6-8 | 0.190 | 0.398 |
| Education 9-11 | 0.582 | 0.708 |
| Education 12+ | 0.601 | 0.792 |

above the national average, High, from 11 to 30 per cent above the national average, Average, from 10 per cent below to 10 per cent above the national average, Low, from 11 to 30 per cent below the national average, and Very Low, more than 30 per cent below the national average.

Using this classification, there are no very high risk mothers or children. The high risk group in 1976 consists of children born to mothers in rural areas with less than completed primary education, comprising a total of 19 per cent of both children born and of women. In 1981, however, this category of high risk also includes the children of women in urban areas with no education, raising the size of the group to 64 per cent of children and 52 per cent of mothers. The average risk group is made up of the children of the remaining women with less than completed primary education. The low risk group consists of the children of rural women with less than completed secondary education, and of urban women with six to eight years of education, accounting for about 20 per cent of all women, but only about 14 per cent of children. The very low risk group is made up of the children of women with completed secondary education or tertiary education, plus those of urban women with 9 to 11 years of education; the children in this category comprise only some six to nine per cent of all children.

The results in Table 7 show that there are large differentials in child mortality risks between different segments of the population of Jordan. However, these differentials are not as large as those found in some other parts of the developing world. For example, in 1976, the risk of death by age five for children born to women in the most disadvantaged group, rural women with no education, was about two and a half times that of the most advantaged group, women with 12 or more years of education living in urban areas. It should also be noted that the actual risk of dying by age five for children in the most disadvantaged group in 1981 was below 100 per 1,000 live births, a relatively low figure for a developing country. On the other hand, structural factors have resulted in a redistribution of children within risk groups, such that the high risk group in 1981 comprises 64 per cent of all children born, an increase from only about 20 per cent in 1976.

## 7. CONCLUSION

This study has explored the factors associated with child mortality differentials in Jordan using data from two household surveys held in 1976 and 1981. These surveys, and other data sources, show that child mortality has been declining rapidly in Jordan from the 1950's to reach quite low levels by developing country standards by the late 1970's, by which time the probability of dying by age five is estimated to have fallen below 90 per 1,000 live births.

The study of mortality differentials by characteristics of the household reveals strong relationships between child

TABLE 7 : CATEGORIES OF RELATIVE CHILD MORTALITY RISK BY RISK FACTOR; JORDAN, 1976 AND 1981.

| Residence Mother's Education | 1976 Survey $_5q_0$ | 1976 Survey Percent of Total Births | 1976 Survey Percent of Total Women | 1981 Survey $_5q_0$ | 1981 Survey Percent of Total Births | 1981 Survey Percent of Total Women |
|---|---|---|---|---|---|---|
| **1. Very High Risk (>30% above national average)** | | | | | | |
| | None | | | None | | |
| **2. High Risk (11% to 30% above national average)** | | | | | | |
| Rural Zero | 0.116 | 18 | 17 | 0.095 | 23 | 20 |
| Rural 1 to 5 | 0.115 | 1 | 2 | 0.089 | 3 | 3 |
| Urban Zero | — | — | — | 0.089 | 38 | 29 |
| **3. Average Risk (90% to 110% of national average)** | | | | | | |
| Urban Zero | 0.102 | 50 | 40 | — | — | — |
| Urban 1 to 5 | 0.101 | 11 | 11 | 0.084 | 13 | 12 |
| **4. Low Risk (11% to 30% below national average)** | | | | | | |
| Rural 6 to 8 | 0.079 | 1 | 2 | 0.068 | 2 | 3 |
| Rural 9 to 11 | 0.071 | <1 | <1 | 0.054 | 1 | 1 |
| Urban 6 to 8 | 0.065 | 12 | 17 | 0.063 | 11 | 14 |
| **5. Very Low Risk (>30% below national average)** | | | | | | |
| Rural 12 + | 0.062 | <1 | <1 | 0.041 | <1 | <1 |
| Urban 9 to 11 | 0.057 | 3 | 5 | 0.048 | 5 | 8 |
| Urban 12 + | 0.048 | 3 | 6 | 0.036 | 4 | 9 |

mortality risks and maternal education, paternal education and urban-rural residence. The magnitude and direction of these relationships were consistent with expectations, internally between groups, and externally between surveys. Perhaps the most interesting feature of the education results is that a small amount of education, either of fathers or of mothers, has little effect on child mortality risks; not until primary school has been completed does education reduce risks appreciably. This finding may suggest that substitutes for formal education, such as adult literacy campaigns, may have little effect on child survival, though it may also indicate merely that a little education is not associated with much income increase, since income is not controlled for. A number of other characteristics were incorporated into the child mortality model, such as age at first marriage, duration of marriage group, type of lighting, and source of water. Results for these other variables were either not consistent with expectations (the role of source of water, for example), or not consistent internally between groups (the role of duration of marriage, for example), or not consistent between surveys (the role of age at first marriage, for example). Perhaps the most surprising result is the apparent protective effect of getting water from a public rather than from a private tap; though the data suffer from definitional problems, this result may indicate possible contamination of household water supplies. The child mortality models accounted for very little of the variance of the mortality indicator being used, but this result is to be expected given the characteristics of the mortality indicator.

The greatest weakness of the models used is the lack of measures of income. Proxies for household income based on information on occupation and work status proved to be significantly related to child mortality risks, and indicated that at least part of the effect of paternal education on child mortality was probably an income effect rather than an education effect.

The results of the analysis revealed the existence of substantial child mortality differentials by urban-rural residence and parental education. The child of a woman with no education living in a rural area, for example, is estimated to have between two and three times the risk of dying of the child of a woman with completed secondary education living in an urban area. The differentials in child mortality risks do not appear to have changed appreciably in the recent past; each risk group appears to have experienced approximately equal percentage declines in child mortality. Only a small part of the national decline in child mortality has been the result of changes in the proportions of children in the various risk categories; more important have been changes in risks within categories, though to what extent these changes are due to, for example, rising income levels within categories, cannot be determined. Although the differentials are not extreme by developing country standards, they do indicate a need to target health services and health information at less educated women, particularly those living in rural areas.

## REFERENCES


Behm, Hugo, 1987. The Determinants of Child Survival: An Analytical Frame of Reference. United Nations meeting on the international collaborative study of geographic and socio-economic differentials in early-age mortality, New York, 7-9 December 1987.

Brass, W. 1964. Uses of Census and Survey Data for the Estimation of Vital Rates. African Seminar on Vital Statistics, Addis Ababa, 14-19 December 1964.

Cebu Study Team. 1988. Underlying and Proximate Determinants of Child Health: The Cebu Study. June 21, Mimeo.

Coale, A.J. and P. Demeny. 1966. Regional Model Life Tables and Stable Populations. Princeton, New Jersey: Princeton University Press.

Mosley, W.H. and L.C. Chen. 1984. An Analytical Framework for the Study of Child Survival in Developing Countries. In Child Survival: Strategies for Research. Edited by Mosley and Chen. New York, USA: The Population Council.

Rutstein, S.O. 1983. Infant and Child Mortality: Levels, Trends and Demographic Differentials. World Fertility Survey Comparative Studies no. 24. Voorburg, Netherlands: International Statistical Institute.

Trussell, J. and S. Preston. 1982. Estimating the Covariates of Childhood Mortality from Retrospective Reports of Mothers. Health Policy and Education. Amesterdam, Netherlands: Elsevier Science Publishers, vol. 3, pp. 1-36.

United Nations, Department of International Economic and Social Affairs. 1983. Manual X: Indirect Techniques for Demographic Estimation. DIESA: Population Studies, no. 81, New York, USA: United Nations Publication.