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Mortality Levels and Trends in Jordan Estimated from the Results of the 1976 Fertility Survey

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The World Fertility Survey is an international research programme whose purpose is to assess the current state of human fertility throughout the world. This is being done principally through promoting and supporting nationally representative, internationally comparable, and scientifically designed and conducted sample surveys of fertility behaviour in as many countries as possible.
The WFS is being undertaken, with the collaboration of the United Nations, by the International Statistical Institute in cooperation with the International Union for the Scientific Study of Population. Financial support is provided principally by the United Nations Fund for Population Activities and the United States Agency for International Development.
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Preface

One aim of the international programme of research directed by the World Fertility Survey is to study recent levels and trends in fertility. To this end, a standardized questionnaire with a detailed maternity history as its core was designed to be answered by a sample of eligible women in each participating country. It was primarily to facilitate selection of these women for interview that the household questionnaire was developed and used in every country. Subsequently, it became plain that the data for the entire household were themselves of considerable value for demographic estimation and for analyses using socio-economic background factors. On average, the household data include information on about 100 000 individuals (the number varies with household size) which makes the study of regional and socio-economic differentials in fertility and mortality much more reasonable than simply using the much smaller samples of ever-married women.

Whilst some early WFS surveys included only a very basic household questionnaire, later surveys sometimes use a gradually expanded interview schedule which includes the standard retrospective questions on fertility and mortality widely used in many developing countries. As a result of continuing advances in the methodology of estimating standard demographic measures from the responses to these questions, estimates of trends as well as levels of fertility and mortality can be derived.

The Jordan survey is used as an illustration of the application of these estimation techniques to WFS data since it was one of the first to incorporate the expanded form of the household questionnaire. Several other surveys have now incorporated all of the questions included in the Jordan study so that the techniques described here will be applicable to these data and indeed to other surveys and censuses which include the basic questions in the required form. It seems that for the detailed analysis of fertility, the maternity history part of the individual interview will remain the prime source of information. For the measurement of levels and trends in adult and possibly childhood mortality, however, the data in the expanded form of the household questionnaire are likely to remain the best single source although this report demonstrates the value of comparing directly and indirectly estimated mortality measures derived using data from both the household and the individual interviews.

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1 Introduction

This report discusses the possibility of estimating levels and trends in fertility and childhood and adult mortality from responses to simple retrospective questions included in a single census or survey. It also reviews analytic work we have done on the subject. The Jordan Fertility Survey's household data are of special interest, particularly for the estimation of mortality, since a version of the WFS General Mortality Module was incorporated as part of the enquiry. This module has also been used in at least 12 other WFS surveys to data (Scott and Singh 1980). In addition to the usual questions on living children ever born addressed to ever-married women, it includes questions on orphanhood and widowhood and on deaths in the household in the 24 months preceding the survey. These data make it possible to derive overlapping mortality estimates calculated in different ways, providing a basis for assessing the relative reliability of the responses. In addition, we learn something about the sensitivity of different estimation techniques to a variety of possible sources of error.

An extra attraction of the Jordan household survey, like all other such WFS surveys, is its larger sample size, compared to the smaller but more detailed interview for individual women. In Jordan over 14 000 households were interviewed using the household questionnaire. After weighting, we obtained a sample population of 97 028 individuals in 14 068 households; the overall sex ratio was 1.02. With a sample of this size, it is realistic to produce mortality estimates, at least for childhood mortality, for subgroups of the population. This can contribute further to our understanding of the working of the indirect estimation techniques and to the assessment of the quality of the survey results. Some use was also made of the results from the individual interview for direct estimation of levels and trends in childhood mortality.

1.1 THE DATA

For the analysis, the data used were those on the standard recode file produced by the Jordan Department of Statistics and distributed by the World Fertility Survey. Following standard practice, the basic tables were made for all individuals who had slept the previous night in the household selected into the sample. This reduced the weighted totals of individuals from 97 028 to 94 945. Sub-files were created for the population aged ten and over and for all ever-married women. A separate file had to be created for deaths in the 24 months before the survey because of the particular organization of the file. The appropriate sample weights were applied throughout.

Some additional technical details are explained in appendix A which contains a list of all the variables from the file used in the analysis. Appendix B shows the tables constructed. The tables were made at the University of London Computing Centre using the SPSS package, a widely available set of programs in FORTRAN.

2 Estimating Mortality from Survey Data

Before presenting the results of the mortality estimation, we start with a brief review of the methods used and their data requirements. There are several ways in which childhood and adult mortality measures can be estimated from survey data and some brief explanation of the assumptions and requirements of each should help the reader to reconcile the sometimes conflicting results obtained by different routes. A much fuller and more technical presentation of the estimation procedures is available in a compendium of recent work on indirect estimation assembled by the Committee on Population and Demography of the US National Academy of Sciences (National Research Council 1981).

The data useful for mortality estimation which are collected by most WFS-type surveys fall into two principal categories: (1) responses to retrospective questions about all births and deaths of certain relatives or household members in the lifetime experience of individuals up to the time of the survey; (2) complete maternity and marriage histories in which all events and changes of status (marriages, births, deaths, widowhood, etc) are listed and dated.

Both types of information can be used to estimate levels and trends in mortality as well as fertility by direct and indirect methods. In most of the WFS-type surveys, data in the first category come mostly from the household questionnaire although the birth histories on the individual interview can be reorganized to give lifetime measures such as total children ever born and surviving up to the time of the survey. The complete maternity and marriage histories are only collected from eligible women (usually ever-married women aged 15–49) and these histories are the prime source of data for the *direct* calculation of selected mortality as well as fertility measures.

A short clarification of the difference between direct and indirect estimation techniques is probably helpful in understanding the different results presented below. By direct estimation, we mean that the numerators and the denominators of a rate or a probability are taken directly from the survey data. The values may be adjusted for reporting and other errors, but the central feature of this method of deriving the required demographic parameters is that the use of models and model-based assumptions are unnecessary in order to obtain at least the uncorrected measures from the basic data. Thus, infant mortality rates by calendar year of occurrence, for example, can be calculated directly from the birth histories by producing tables of births (the denominators) and deaths of children under age 1 (the numerators) by calendar year periods and relating one to the other in the usual way.

Indirect estimation of mortality (and fertility) from censuses and surveys became a major demographic industry when analysts realized that respondents gave rather poor responses to direct questions put to them about deaths (and births) in specific reference periods. Asking about deaths of household members or relatives is by itself very difficult, essentially because the people about whom information is being sought are not there (they are dead) to answer for themselves. Thus, questions on widowhood and orphanhood have been introduced to supplement the often unreliably answered direct questions on child and adult deaths before the survey. Their introduction has also meant the incorporation of models and accompanying assumptions into the estimation procedures since demographers and planners have been dissatisfied with the raw reports on, for example, the proportions of respondents orphaned by age or the proportions dead of children ever born as measures of mortality, and have demanded conventional life-table measures of survivorship. This has meant the use of model life tables and model fertility schedules in combination, with often unsatisfactory or at least difficult to interpret results. The models themselves are based on average conditions and cannot hope to reproduce the full breadth of demographic experience. It is this gap between the behaviour of real populations and the relationships which can be conveniently incorporated into a model which creates so many difficulties in the field of indirect demographic estimation. Reporting errors confound the situation further so that the identification of problems which arise from the use of a particular set of assumptions or models are not readily distinguished from errors in the original data.

For the estimation of mortality, therefore, our main concern in this paper, we can list the following methods with their data requirements, first for childhood mortality and secondly for adult mortality.

2.1 INFANT AND CHILD MORTALITY

Direct methods

The mortality of infants and children can be estimated directly from the numerators (child deaths) and the denominators (births or living children) obtainable from the birth history data in the manner referred to above. The implicit assumption is that births and deaths are fully reported in the fertility histories. Certainly, the reports are likely to be more complete than the data on children ever born and surviving from the household questionnaire which are often completed by the head of household and not by the woman bearing the children. The careful chronology assembled for each woman in the individual survey is assumed to improve both the overall quality of the reporting (eg fewer events omitted) and the problem of dating these events, referred to in the preceding section. The collection of full maternity histories does not entirely solve the problem of locating these events in time, however, and Potter (1977) and Brass (1977) amongst others have identified systematic biases arising because respondents over- or under-estimate the length of time periods either quite close or quite remote from the date of survey.

Using direct methods and the birth history data, it is possible to produce a series of life-table measures of child survival for single years of age. Thus, in addition to the production of single parameter estimates of trends in child mortality (eg ${}_1q_0$ or ${}_4q_1$), the direct procedures allow the study of the trend in infant mortality in relation to trends in the mortality of older children.

An additional feature of the direct method of estimation is that survivorship for true birth cohorts can be calculated in addition to the conventional period measures. This may be of interest for particular forms of analysis.

Indirect methods

The indirect estimates of childhood mortality are all based on an idea by Brass for converting the proportions dead of children ever born tabulated by age or marriage duration of women into life-table measures of child survival. The assumptions incorporated into Brass's original procedure are considerable; they have been neatly summarized by Garenne (1981) who amongst others, is working to discover the effect of the initial assumptions on the estimates derived. Feeney (1980) developed a way of estimating time trends in child mortality from the same data. Both Sullivan (1972) and Trussell (1975) have indicated some of the implications of using particular model life tables on the results obtained. Despite this work, there is unlikely to be a general solution to the problem that the model life tables built into the commonly used estimation procedures do not fit the data from a particular country very well. Essentially, this is because at the outset, we lack the basic information we need to sharpen our indirectly derived child mortality estimates; the missing information is knowledge of the age pattern of mortality in the study population.

2.2 ADULT MORTALITY

Direct methods

Experience with asking direct questions on deaths of adults in some reference period preceding the census or survey is rather discouraging. Without exception, adult deaths are under-reported for a variety of common sense reasons including the well-known connection between a death of an older adult and household dissolution or reformation. Brass's Growth Balance method is valuable for correcting the observed age-specific adult death rates derived by asking about deaths in the household in the preceding 12 or 24 months. There are often difficulties in estimating a single correction factor, however, usually because one or more of the underlying assumptions are violated. Rachad (1978) showed how distortions in the age distribution of the population such as are introduced by migration can affect the results. Other problems can arise if the completeness of reporting of deaths is age-related or if age misreporting in the distribution of deaths or a population is very severe. One strength of the method is the stress laid on a visual plot of the sectional birth and death rates: irregularities in the graph of the points are a warning that the method is working poorly in that instance.

Indirect methods

Indirect estimation of adult mortality is more complex but the questions posed to surviving respondents are very simple: 'Is your father/mother still alive?' and if ever married, 'Is your first husband/wife still alive?'. From the proportions of respondents widowed or orphaned calculated by age, both conditional and unconditional measures of adult mortality can be derived. By 'conditional', we mean measures of survivorship describing the probability of living from one adult age to a higher one (eg $\ell_{35+N}/\ell_{32.5}$ or $\ell_{40+N}/\ell_{37.5}$). By 'unconditional', we mean methods which produce a single survivorship value such as ℓ_{50} usually by insertion of an independently derived value for childhood mortality such as ℓ_2.

Very recently, Brass has shown that the time location of adult mortality estimates from reports on widowhood and orphanhood can be calculated using assumptions involving a fixed age pattern of mortality and a linear decline in mortality before the survey (Brass and Bamgboye 1981).

With all of these indirect estimation techniques, one or more of the basic assumptions on which the methods are based are liable to be violated in virtually every application. The originators of the methods, especially William Brass, are at pains to indicate the coarseness of the results they produce and the scepticism with which they must be regarded until confirmed by overlapping or, preferably, totally independent data.

3 Quality of Reporting

Before proceeding with the estimation of child and adult mortality, a brief examination of the reliability or consistency of the data is necessary so that irregularities in the results can be anticipated and explained.

3.1 AGE COMPOSITION OF THE SAMPLE AND COMPARISON WITH OTHER SOURCES

The population of Jordan has been subject to several major upheavals associated first with the Arab-Israeli troubles before 1948 and later with the wars of 1967 and 1973. At each date, substantial numbers of refugees and migrants have entered or left Jordanian territory, leaving a recognizable mark on the population's size and age structure. The 1976 Jordan Fertility Survey was conducted only on Jordan's East Bank which is the home of two incomplete populations: the East Bankers or Transjordanians minus the sizeable number of them who have left either temporarily or permanently to live elsewhere; and the Palestinians who migrated to the East Bank without moving further afield.

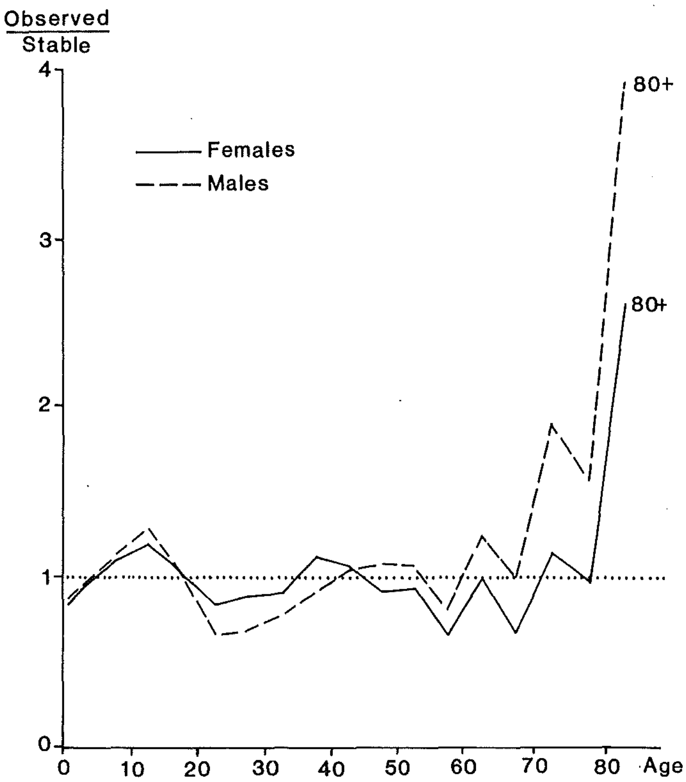

Figure 1 Comparison of observed age distribution with a model stable age distribution,* by sex (1976)

* The model stable population used had a growth rate of 4 per cent, and was level 18 of the Princeton South pattern.

Table 1 Sex ratios (males/females) of reported age distribution by age group, 1976

Age group	JFS 1976
0	1.083
1–4	1.034
5–9	1.059
10–14	1.090
15–19	0.992
20–24	0.794
25–29	0.781
30–34	0.856
35–39	0.814
40–44	0.980
45–49	1.151
50–54	1.088
55–59	1.145
60–64	1.150
65–69	1.226
70–74	1.199
75+	1.187
Total	1.001

As a result of this complex process of in- and out-migration, the population encountered in the survey can be expected to be far from closed and quasi-stable, and in many ways a selected residual of the two larger populations which comprise the East Bank *de facto* population.

If any proof is needed of the irregularity of the age composition of the East Bank population, figure 1 provides it. Clearly visible is the deficit relative to the stable model of young men and women 20–39 years old. The larger deficit of young men is indicative of heavier male out-migration. The imbalance between the sexes can be seen plainly from the table of sex ratios by age (table 1). Other more familiar forms of irregularity in the sample age distribution are also seen on figure 2. Elderly men and women have had their ages exaggerated, and some infants were either omitted or had their ages over-estimated. A marked preference for ages ending in rounded numbers was also widespread amongst the population over age 30. Better education levels and the more common use of written records are both responsible for the improved knowledge of age amongst respondents under age 30.

One of the most difficult decisions to make is whether the 1976 survey interviewed a representative sample of the East Bank population. Since two wars and several political changes which affect the distribution of the Palestinian and Jordanian populations have intervened between the 1961

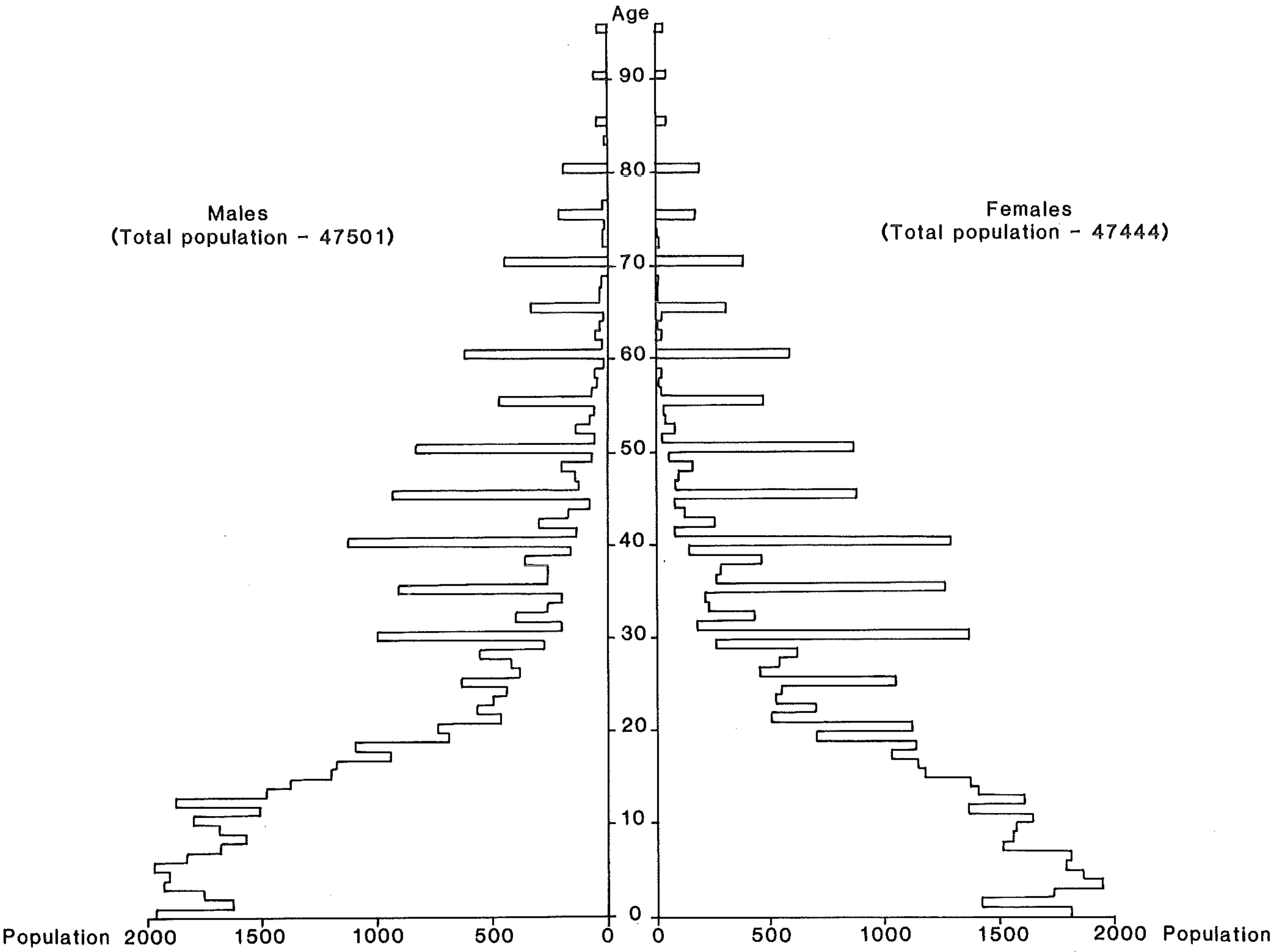

Figure 2 Age–sex distribution (*de facto*) of 1976 survey population, by single years of age

census and the 1976 survey, there is little point in drawing comparisons with the 1961 data. The 1972 survey was also only a sample, based on a less exhaustive frame than the 1976 survey. In fact, the only data of value for comparison are contained in the results of the census of the East Bank held in November 1979.

Some general comparisons of the results from the 1961 census and the 1972 survey indicate that the 1976 results are not out of line with the earlier figures. The proportional age distributions, for instance, suggest that despite the confounding effects of migration, the Jordanian population had become younger in each successive survey (table 2). This is as expected, given other evidence of a steep decline in child mortality and little alteration in the level of fertility. Clearly, in a population affected by both migration and declining mortality, the use of estimation techniques which assume stable population conditions would be wholly inappropriate.

3.2 REPORTING OF CHILDREN EVER BORN AND SURVIVING

As indicated above, the average parities and proportions dead of children ever born by age of mother are of central importance in the indirect estimation of childhood mortality. Whilst it is impossible to verify these data in any rigorous way, some comparisons and consistency checks can be used to indicate any major shortcomings.

First, a comparison of the average parities from the 1976 survey with those from the 1972 survey indicates a general agreement between the results of the two surveys (table 3). One encouraging feature of the 1976 data is that the parity of women 45–49 is higher than that for younger women; reporting of children ever born to older women appears to have been better in 1976 than in 1972. Comparison of the 1976 survey data with the 1961 census results suggests that fertility was measurably higher in 1976 since the parities for young and old women alike (with the exception of 15–19 year olds) are larger (table 3).

A simple check of the consistency of reporting children ever born and surviving is provided by an examination of the sex ratios of the reports shown on table 4. In general, all four series are within the bounds of the errors expected due to sample size alone. There are some indications of poorer reporting of female births and deaths amongst older women but this is not a strong tendency. One figure stands out and that is the sex ratio of 0.882 for dead children reported by women 20–24. This irregularity will affect the reliability of child mortality estimates based on women in this age group.

Table 2 Age and sex distribution of the population of Jordan in 1961, 1972 and 1976 (cumulative per cent)

	1961 census (E & W Banks)		1972 survey (E Bank)[a]		1976 survey (E Bank)	
Age	Females	Males	Females	Males	Females	Males
1	3.8	4.0	4.2	4.0	3.8	4.1
5	17.5	18.3	20.5	20.9	18.5	19.3
10	31.5	33.2	39.3	40.2	35.9	37.7
15	43.6	47.1	53.2	55.2	51.5	54.7
20	54.7	58.0	63.3	64.2	62.4	65.5
25	63.3	65.8	70.9	70.1	69.6	71.2
30	70.7	72.4	77.9	75.7	75.8	76.0
35	76.3	77.4	83.7	80.4	80.9	80.4
40	81.5	81.8	88.4	85.4	86.0	84.5
45	85.3	85.2	92.1	89.9	89.9	88.3
50	88.3	88.1	94.3	92.7	92.6	91.4
55	91.4	91.1	96.3 (55–60)	96.0 (55–60)	94.8	93.8
60	93.2	93.1			96.0	95.2
65	95.6	95.5	100.0	100.0	97.4	96.8
70	96.9	96.9			98.1	97.7
75	98.3	98.3			99.0	98.8
Total	100.0	100.0			100.0	100.0
N	83 8629	86 7597	17 151	18 279	47 444	47 501

[a]Excludes the population resident in the 1967 displaced persons camps, and the nomads.

Table 3 Mean number of children ever born for all women, by age group of mothers for 1961, 1972 and 1976

Age group	1961 census[a]	1972 survey	1976 survey[b] (household interview)
15–19	0.19	0.23	0.18
20–24	1.50	1.76	1.55
25–29	3.23	4.05	3.60
30–34	4.70	5.86	5.66
35–39	6.43	7.26	7.26
40–44	7.04	8.14	8.16
45–49	7.30	7.78	8.39

[a]Corrected for the proportion of women with parity not stated, using the El-Badry method.

[b]Calculated including those ever-married women with parity not stated as childless.

Another interesting comparison for the 1976 household survey data is with the series of reports on fertility and child mortality from the individual interview. These data were collected at the same time as the household data from a subsample of the females whose fertility and child mortality experience was recorded during the household interview. The main difference between the two sources is the method of collection. The household data were collected in the aggregate form (ie *total* males and females ever born and surviving) usually by a male interviewer talking to a male head of household. The individual interview was always conducted with the woman herself by a female interviewer and the information on total children ever born and surviving was obtained with the help of a full maternity history. *Prima facie*, we would expect the data from the individual interview to be of a higher quality than that from the household questionnaire but of course the number of individual respondents is very much smaller. In Jordan, we have data on 13 458 ever-married women aged 15–49 from the household file, and on just 3610 from the individual file.

The reports from the two sources are compared on table 5. Several points are worth noting. First, for women up to age 40, both sets of figures are very similar. Rather surprisingly, it seems that the respondents for the household interview produced good reports on the lifetime fertility and child mortality experience of younger women in their household. For women over 40, the household survey reports are lower indicating some omission of both children ever born and living children. Interestingly, both living children and children ever born appear to have been omitted in about the same proportions, so that the proportions dead of children ever born are rather similar in both series even for women over 40. The reporting of births in the last year in both questionnaires was also very similar. Whilst it is perfectly possible that both sources were in error, the concordance in the results for three main variables (children ever born and surviving, and births last year) is encouraging considering that the data were collected from different respondents in separate interviews.

One final test of the consistency of the reports on children ever born is the comparison of the average parities with those from a model. The relational Gompertz fertility model is a comparatively simple way of transforming an observed set of fertility measures, either average parities or age-specific fertility, so that the transformed values can be linearly related to those from a model. The results, plotted on figure 3, indicate a strongly linear relationship meaning good reporting.

All the above comparisons tell us that the household data from Jordan appear to be of reasonable quality for the estimation of childhood mortality. However, the uneven sex ratios of the reports on children ever born, living children and births last year are a warning that the data from women in the first two age groups (15–19 and 20–24) are less reliable.

The reliability of the individual survey data which are used below for the estimation of childhood mortality is not discussed in this report. A full discussion of these data is available in Abdel-Aziz (1983).

3.3 VARIATIONS IN THE REPORTS DUE TO SAMPLING ERRORS

In most demographic sample surveys, the issue of the effect of sample errors on the results is not seriously considered on the grounds that non-sample errors are generally so much larger and more important. With the more rigorous design of the WFS surveys, it is possible to calculate sample errors for both the individual and the household survey results. The calculations are made more complex by the two-stage cluster design of the surveys but the standard errors for the most important variables have been calculated using a WFS-produced computer program. Summary results appear in most First Country Reports.

The means and standard errors of five important variables from the household survey are shown on table 6. The impressive feature of the table is the small size of the standard errors in the household data, even when these are subdivided by age. Obviously, the standard errors rise when further cross-classifications are introduced (eg children ever born by mothers' age and education) but the larger numbers in the household data make the study of such sub-populations quite feasible.

Table 4 Sex ratios of children ever born (CEB), living and dead children, and births in the preceding 12 months, by age group of mothers (1976)

Age group of mother	Sex ratio of CEB	Sex ratio of living children	Sex ratio of dead children	Sex ratio of births in last 12 months[a]
15–19	0.974	0.967	1.053	0.939
20–24	0.992	1.004	0.882	1.057
25–29	1.069	1.069	1.067	1.040
30–34	1.092	1.099	1.036	1.231
35–39	1.084	1.097	1.010	1.193
40–44	1.063	1.073	1.017	1.294
45–49	1.133	1.127	1.158	1.000

[a]Treating twins as two separate births.

Table 5 Comparison of reports on fertility and child survival from the household and individual interviews

	Children ever born		Living children		Births last year	
Age	(a)	(b)	(a)	(b)	(a)	(b)
15–19	0.18	0.17	0.16	0.16	0.07	0.07
20–24	1.55	1.57	1.41	1.44	0.29	0.30
25–29	3.60	3.71	3.25	3.39	0.35	0.37
30–34	5.66	5.68	5.03	5.12	0.32	0.31
35–39	7.26	7.12	6.23	6.31	0.23	0.24
40–44	8.16	8.44	6.73	7.01	0.11	0.10
45–49	8.39	8.71	6.66	7.20	0.04	0.03
Total fertility					7.1	7.1

(a) = household interview (N = 13 458 ever-married women 15–49).
(b) = individual interview (N = 3 610 ever-married women 15–49).

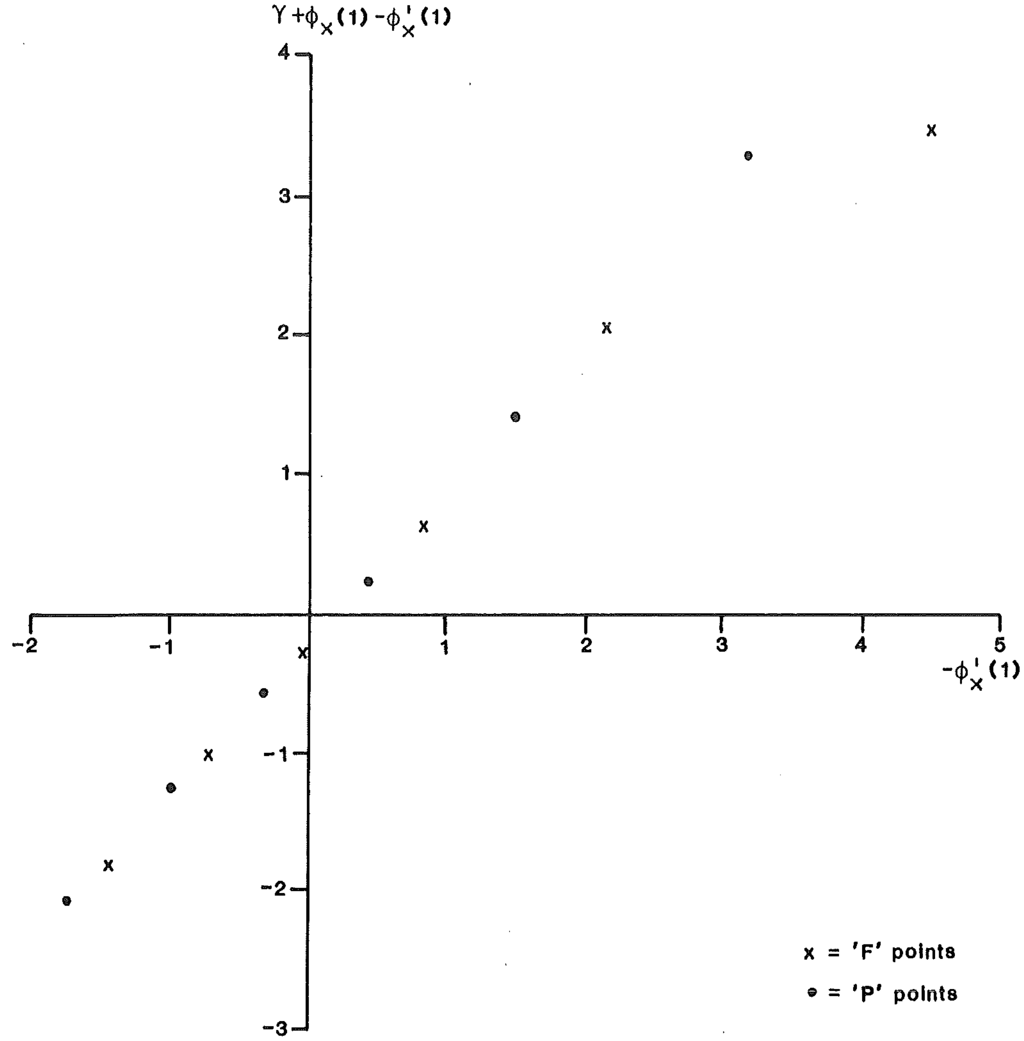

Figure 3 Fitting the relational Gompertz model to past (P) and current (F) fertility reports from the household survey, 1976 (see Zaba 1981 for methodology)

Table 6 Means and standard errors for selected variables from the household survey by age

Age	Number of women	Children ever born		Proportion of children dead		Proportion with father living		Proportion with mother living		Proportion of ever-married women with husband living	
		x̄	SE	x̄	SE	x̄	SE	x̄	SE	x̄	SE
15–19	5 187	0.18	.01	.09	.01	.89	.01	.97	.00	.97	.01
20–24	3 401	1.55	.05	.09	.00	.83	.01	.94	.00	.98	.00
25–29	2 938	3.59	.08	.10	.00	.71	.01	.86	.01	.98	.00
30–34	2 412	5.66	.09	.11	.00	.60	.01	.79	.01	.98	.00
35–39	2 417	7.26	.11	.14	.00	.45	.01	.67	.01	.98	.00
40–44	1 851	8.15	.13	.17	.00	.34	.01	.56	.01	.97	.00
45–49	1 257	8.39	.15	.21	.01	.23	.01	.23	.01	.95	.01
All	19 463	3.79	.07	.14	.00	.07	.01	.81	.00	.98	.00

Source: Jordan Fertility Survey 1976, Principal Report, Vol 1, table III.10

All the above comparisons tell us that the household data from Jordan appear to be of reasonable quality for the estimation of childhood mortality. However, the uneven sex ratios of the reports on children ever born, living children and births last year are a warning that the data from women in the first two age groups (15–19 and 20–24) are less reliable.

The reliability of the individual survey data which are used below for the estimation of childhood mortality is not discussed in this report. A full discussion of these data is available in Abdel-Aziz (1983).

3.3 VARIATIONS IN THE REPORTS DUE TO SAMPLING ERRORS

In most demographic sample surveys, the issue of the effect of sample errors on the results is not seriously considered on the grounds that non-sample errors are generally so much larger and more important. With the more rigorous design of the WFS surveys, it is possible to calculate sample errors for both the individual and the household survey results. The calculations are made more complex by the two-stage cluster design of the surveys but the standard errors for the most important variables have been calculated using a WFS-produced computer program. Summary results appear in most First Country Reports.

The means and standard errors of five important variables from the household survey are shown on table 6. The impressive feature of the table is the small size of the standard errors in the household data, even when these are subdivided by age. Obviously, the standard errors rise when further cross-classifications are introduced (eg children ever born by mothers' age and education) but the larger numbers in the household data make the study of such sub-populations quite feasible.

Table 4 Sex ratios of children ever born (CEB), living and dead children, and births in the preceding 12 months, by age group of mothers (1976)

Age group of mother	Sex ratio of CEB	Sex ratio of living children	Sex ratio of dead children	Sex ratio of births in last 12 months[a]
15–19	0.974	0.967	1.053	0.939
20–24	0.992	1.004	0.882	1.057
25–29	1.069	1.069	1.067	1.040
30–34	1.092	1.099	1.036	1.231
35–39	1.084	1.097	1.010	1.193
40–44	1.063	1.073	1.017	1.294
45–49	1.133	1.127	1.158	1.000

[a]Treating twins as two separate births.

Table 5 Comparison of reports on fertility and child survival from the household and individual interviews

	Children ever born		Living children		Births last year	
Age	(a)	(b)	(a)	(b)	(a)	(b)
15–19	0.18	0.17	0.16	0.16	0.07	0.07
20–24	1.55	1.57	1.41	1.44	0.29	0.30
25–29	3.60	3.71	3.25	3.39	0.35	0.37
30–34	5.66	5.68	5.03	5.12	0.32	0.31
35–39	7.26	7.12	6.23	6.31	0.23	0.24
40–44	8.16	8.44	6.73	7.01	0.11	0.10
45–49	8.39	8.71	6.66	7.20	0.04	0.03
Total fertility					7.1	7.1

(a) = household interview (N = 13 458 ever-married women 15–49).
(b) = individual interview (N = 3 610 ever-married women 15–49).

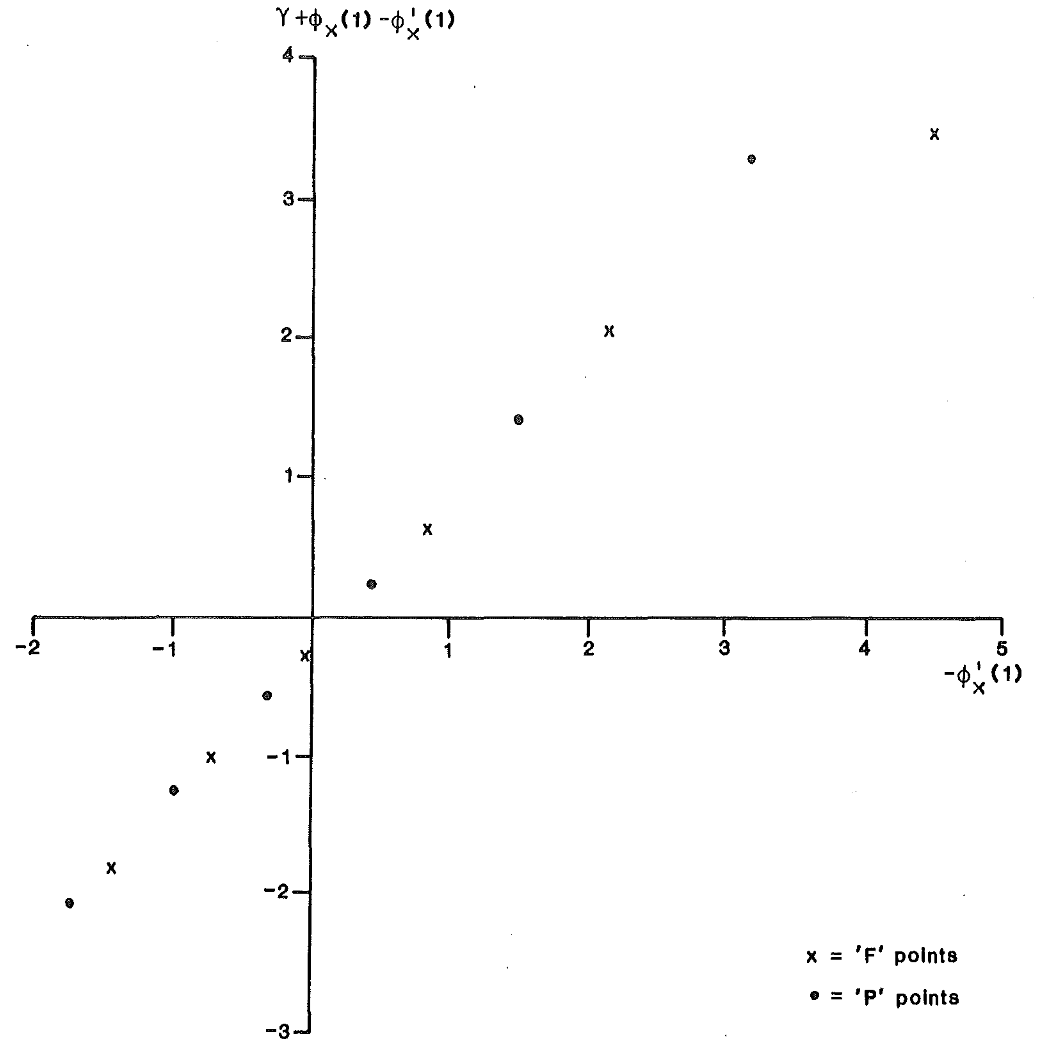

Figure 3 Fitting the relational Gompertz model to past (P) and current (F) fertility reports from the household survey, 1976 (see Zaba 1981 for methodology)

Table 6 Means and standard errors for selected variables from the household survey by age

Age	Number of women	Children ever born		Proportion of children dead		Proportion with father living		Proportion with mother living		Proportion of ever-married women with husband living	
		x̄	SE	x̄	SE	x̄	SE	x̄	SE	x̄	SE
15–19	5 187	0.18	.01	.09	.01	.89	.01	.97	.00	.97	.01
20–24	3 401	1.55	.05	.09	.00	.83	.01	.94	.00	.98	.00
25–29	2 938	3.59	.08	.10	.00	.71	.01	.86	.01	.98	.00
30–34	2 412	5.66	.09	.11	.00	.60	.01	.79	.01	.98	.00
35–39	2 417	7.26	.11	.14	.00	.45	.01	.67	.01	.98	.00
40–44	1 851	8.15	.13	.17	.00	.34	.01	.56	.01	.97	.00
45–49	1 257	8.39	.15	.21	.01	.23	.01	.23	.01	.95	.01
All	19 463	3.79	.07	.14	.00	.07	.01	.81	.00	.98	.00

Source: Jordan Fertility Survey 1976, Principal Report, Vol 1, table III.10

4 Childhood Mortality

In this section, we examine the childhood mortality estimates obtained by applying the methods described in section 2.1 above to the data from both the household and individual interviews of 1976. As far as possible, the same methods are applied to the data from the 1961 census and from the 1972 fertility survey and the results compared. Some differentials in child mortality by mothers' education and region of residence are described.

4.1 INDIRECTLY ESTIMATED MEASURES OF CHILDHOOD MORTALITY, 1976

Both the household and the individual survey data can be analysed using Brass-type methods applied to the proportions dead of children ever born by age of mother. Here, for simplicity and consistency, the Trussell regression equations with the Princeton 'South' model life tables have been used to derive q_x values and estimates of t, the time location of the child mortality measures.

Selected life-table measures of child mortality from both 1976 sources are shown on table 7: the downward trend is readily discerned from the ${}_5q_0$ values. Although the choice of the South pattern of mortality for estimation and extrapolation does influence the results, the measure ${}_5q_0$ is less sensitive to this effect than other values such as ${}_1q_0$. The two series of values estimated by the same methods from almost independent data sources are remarkably similar. The individual survey data produce slightly lower mortality estimates than the household data (table 7): a comparison of the time trends in ${}_1q_0$ from both sources shows this more clearly (figure 4). This is contrary to our expectations since we would expect omission of dead children to be more widespread in the household rather than in the more exhaustive, birth history based interview. We return to this point below.

One peculiarity in both series is the high mortality levels derived from the reports on child survival provided by women 15–19 and 20–24 years old. This commonly seen irregularity is often ascribed to the effects of selection (women marrying young are of low socio-economic status and hence experience higher child mortality) or differential mortality by birth order (higher amongst first born). The data from the individual survey allow us to examine the accuracy of these two explanations and to introduce a third.[1] First, the child mortality experience of women marrying below age 20 in Jordan is significantly worse than those marrying at age 20–29. Very broadly, in the ten years before the survey, infant mortality was about a third higher amongst the earlier marrying group. This factor alone seems capable of producing the irregularity observed on figure 4 but the real factor responsible could still be birth order effects. The results in table 8 effectively squash this suggestion: differences in ${}_1q_0$ between the first and other birth orders are not very large and, if anything, indicate *lower* infant mortality for the first born in the five year period before the survey. Interestingly, the differentials by mothers' education are less pronounced than by age at marriage, indicating some additional contribution of age at marriage (and hence age at delivery) over and above the general socio-economic status effects captured by education.

[1] Dr Shea Oscar Rutstein of WFS kindly produced the detailed tabulations from the individual file for this section.

Table 7 Childhood mortality in Jordan estimated indirectly from the 1976 survey (both sexes)

	Household survey		Individual survey	
X	$1\,000 \cdot {}_1q_0$	$1\,000 \cdot {}_5q_0$	$1\,000 \cdot {}_1q_0$	$1\,000 \cdot {}_5q_0$
1	96	137	92	128
2	101	116	85	96
3	99	105	91	96
5	115	115	102	102
10	147	139	119	113
15	178	161	172	156
20	207	177	175	150
Total number of ever-married women 15–49	13 310		3 612	

NOTE: Calculated using Trussell's regression equations and Princeton South model life tables.

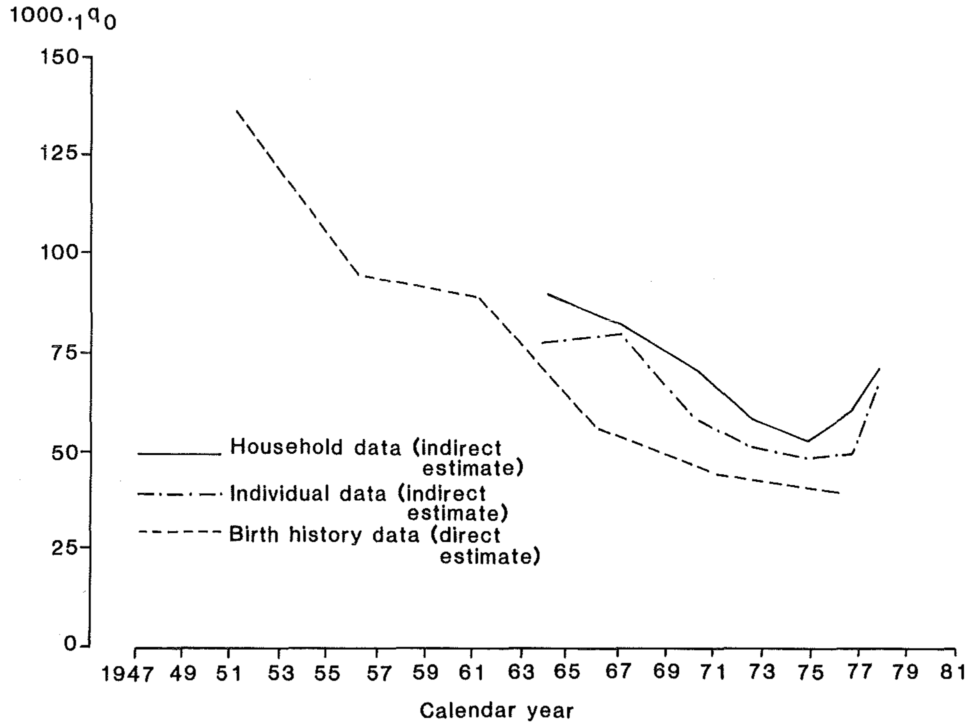

Figure 4 Infant mortality trends in Jordan estimated from different sources

Table 8 Infant death probabilities by period and birth order

Birth order	$1\,000 \cdot {}_1q_0$ Years before the survey 0–4	5–9	10–14	15–19
First birth	52	70	80	(103)
Second or third	71	71	82	116
Fourth to sixth	52	66	68	110
Seventh or higher	80	71	103	(135)

NOTE: Brackets indicate small numbers.
Source: Individual survey data, 1976

An additional factor whose effect on childhood mortality can be examined in the individual survey is the length of the birth intervals. Our expectations are that the survival chances of a baby born very soon after a previous child would be reduced to some unknown extent. This assumption is clearly supported by the data in table 9: infant mortality is two to three times as high for children born within an interval of 24 months as for other children. The magnitude of this effect is enough to influence indirectly derived child mortality estimates for younger women since, on average, birth intervals are shorter amongst younger women. In conclusion, we can say that this effect, coupled with the effect of selection by age at first marriage, is enough to account for the deviations in the generally smooth downward trend in child mortality estimated indirectly from the household or the individual survey data.

4.2 INDIRECT ESTIMATES OF CHILD MORTALITY FROM EARLIER SOURCES

Exactly the same estimation procedures, using Trussell's equations and the South model life table, were applied to the 1961 census data (East Bank only) and to the data from the 1972 fertility survey. The latter source is not exactly comparable with the 1976 survey since the former excluded

Table 9 Infant death probabilities by period and previous birth interval

Birth interval	$1000 \cdot {}_1q_0$ Years before the survey 0–4	5–9	10–14
Less than 24 months interval	80	93	111
24–47 months interval	45	30	40
48 or more months interval	33	34	(30)

NOTE: Brackets indicate small numbers.
Source: Individual survey data, 1976

Table 10 Childhood mortality for the East Bank of Jordan from the 1961 census and the 1972 fertility survey (both sexes)

X	1961		1972	
	$1\,000 \cdot {}_xq_0$	Years before census	$1\,000 \cdot {}_xq_0$	Years before survey
1	158	.9	75	1.0
2	186	2.1	79	2.1
3	209	4.1	115	3.9
5	241	6.5	119	6.1
10	276	9.2	132	8.6
15	306	12.1	167	11.4
20	334	15.3	NA	14.5
Number of ever-married women 15–49	14 8605		5 214	

NOTE: NA = data not available.
Calculated using Trussell's regression equation and the Princeton South model life tables.

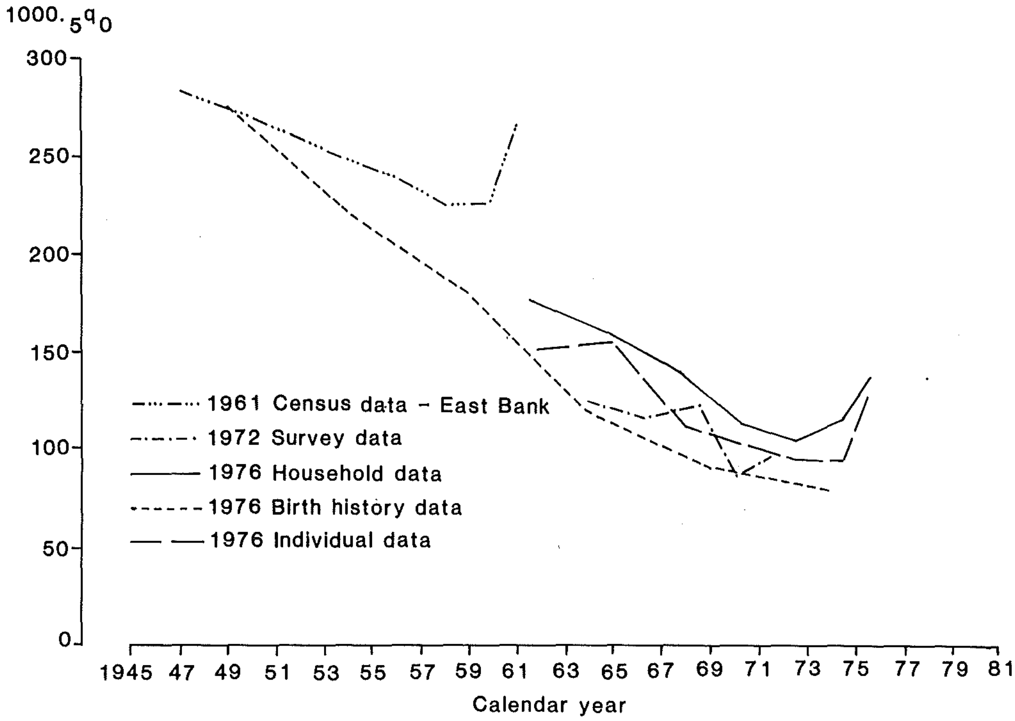

Figure 5 Childhood mortality trends in Jordan estimated from different sources

the post-1967 displaced persons camps and some remote areas from its sample frame. Although it can be argued that data for both East and West Banks should be used to calculate child mortality before 1961 because of the volume of trans-Jordan migration which was especially pronounced after the 1967 war, child mortality on both banks of the Jordan was quite similar during the pre-1961 period.

Summary results for both 1961 and 1972 are shown on table 10. Values of ${}_5q_0$ corresponding to the ${}_xq_0$ s from table 10 were found in the South model life tables and plotted with the same measures for 1976 on figure 5. Overall, the correspondence is extremely close. The 1972 data are a little irregular but this is partly due to small numbers in some age groups. The estimates based on reports by younger women in 1961 are subject to the same kind of irregularities as in 1976 but the general trend, at least for the women over age 25, is compatible with the graph for the 1976 household data (see figure 5). The indicated decline in infant and childhood mortality from the late 1940s to the mid-1970s is extremely steep: specifically, the prob-

Table 11 Infant and child death probabilities by period before the 1976 survey

(Per 1 000)	Years before the survey 0–4	5–9	10–14	15–19	20–24	25–29
$_1q_0$	66	69	82	114	120	162
$_1q_1$	9	17	30	42	59	(82)
$_3q_2$	6	8	17	37	65	(57)
$_4q_1$	15	25	47	77	120	(134)

NOTE: Brackets indicate small numbers.
Source: Individual survey data, 1976

ability of dying between birth and age 5, $_5q_0$, has been reduced to a third of its initial value and infant mortality has fallen from about 160 per thousand in 1950 to about 70 per thousand in 1975.

4.3 CHILD MORTALITY ESTIMATES CALCULATED FROM THE BIRTH HISTORIES

Since details of the dates of birth, dates of death and age at death of children before 1976 are all contained on the birth history file, it is possible to calculate life-table measures of child mortality for blocks of years before the survey. Two ways of calculating the rates are possible. In the first, the survivorship of birth cohorts is calculated simply by following the same individuals and noting the proportions surviving to different ages. The second method, used to obtain proper *period* measures of child survival, is more complex. In practice, the procedure involves relating the proportions of survivors up to different ages to the size of the cohort at risk by chaining together small sections of exposure (birth to one month, one month to three months, three months to six months, etc) and calculating survivorship probabilities to certain ages $_1p_0$, $_1p_1$, $_4p_1$ for example, by multiplying together the survivorship probabilities for small age sections. It is these latter period probabilities of surviving or dying which are considered here.

The results of these calculations are shown in table 11. In the 20–24 years before the survey, infant mortality has been reduced by half and early childhood mortality has fallen even more sharply. This matches experience elsewhere, including some developed countries. Very simply, it seems that early childhood rather than infant mortality is more affected by a reduction in the incidence of the infectious diseases which is usually among the first targets of government health programmes. These changes in infant and childhood mortality are more clearly seen on figures 4 and 5.

In general, the correspondence with the indirectly estimated death probabilities is extremely good although, in both cases, the period rates from the birth histories indicate lower mortality. This divergence is at first puzzling since one would expect better reporting on dead children and hence higher mortality from the birth history data. But even using the same data treated in two different ways, the individual survey results first analysed indirectly and then directly, the birth history based calculations give lower mortality. Rather than invoke errors in the models used for the indirect estimation, it seems more reasonable to attribute the differences to omissions of different kinds. A clue to the contribution of omissions to the two sets of results can be obtained from figures 4 and 5. In general, the $_5q_0$ estimates from both sources are closer than the two infant mortality estimates. More specifically, the birth history based values of $_4q_1$ are very similar to the indirect results whereas the $_1q_0$ values are further apart. What seems to be happening is that a small number of infant deaths omitted from the birth histories produces a larger effect on the child mortality estimates than a few infant deaths omitted from either the *total* children ever born or total surviving children because the latter two are cumulated figures based on the lifetime experience of women and not just experience restricted to a particular period.

4.4 SOME CHILD MORTALITY DIFFERENTIALS

From the lifetime experience of women in the household survey and from the birth history data, we can trace the recent trends in child mortality by the mother's education level or region of residence.

Recent child mortality trends by education are shown in table 12 based on the household data. The child mortality

Table 12 Childhood mortality differentials by mothers' education, 1976

X	$1\,000 \cdot {}_xq_0$ No schooling	Completed primary	Completed preparatory or over
1	111	84	64
2	93	91	56
3	91	86	61
5	99	95	60
10	115	116	66
15	155	107	110
20	195	128	118
Number of women	2 594	4 086	4 874

Source: Household survey data, 1976

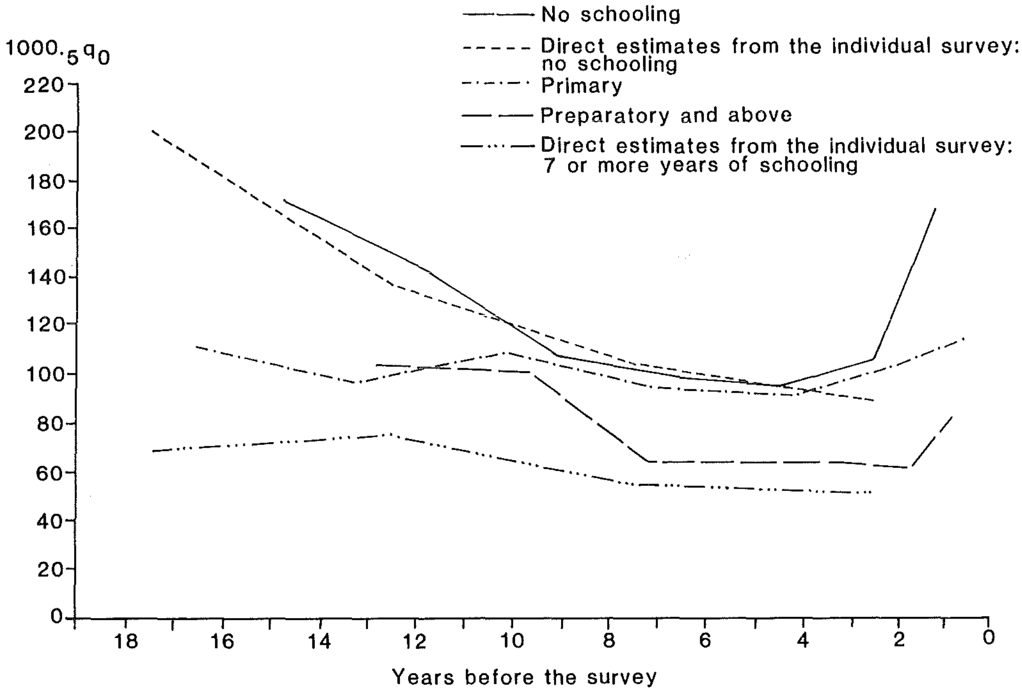

Figure 6 Trends in Jordanian childhood mortality by mothers' education, 1976

experience of women with no schooling improved most rapidly before the survey; for the other education groups, the trend is less marked and possibly horizontal for the group with at least a preparatory level of education (figure 6).

These same trends are borne out by the data from the birth histories analysed directly (table 13). Although the education categories are defined rather differently, it is plain that in both series, the largest improvement in child mortality was felt by the women with no education. A plot of the trend in the $_5q_0$ s over time appears as figure 6. The quite remarkable coincidence of the two sets of results for women with no schooling in particular is very encouraging since the household and the individual data were collected almost independently of each other and were analysed in quite different ways. Even the graphs for the best educated women shown on figure 6 (preparatory and above or more than seven years schooling) are closely matched in the eight years preceding the survey.

By region, the results are less dramatic since the two extremes of the population, residents of Amman and the rural population living in medium and small villages, have experienced broadly similar improvements in child mortality in the 15 or so years before the survey (table 14 and figure 7). In part this is due to migration and the resulting mixing of the population. Within the capital, the well-off and the well-educated live cheek by jowl with poorly housed refugees and displaced persons often drawn from the peasantry of Palestine and the East Bank.

4.5 CONCLUSION

The foregoing analysis has shown how both indirect and direct methods of estimating child mortality can be used in combination to strengthen our knowledge of recent levels and trends in child survivorship. In the Jordan data, the coincidence of the results from two sources analysed separately is encouraging both for the estimation techniques themselves and for the quality of the data. We have shown how the reports from young women are untypical of the entire population when they report on children ever born

Table 13 Infant and child death probabilities by period and mothers' education

	Years before the survey			
(Per 1000)	0–4	5–9	10–14	15–19
A No schooling				
$_1q_0$	70	76	86	127
$_4q_1$	21	31	56	85
B 1–3 years schooling				
$_1q_0$	53	59	91	(142)
$_4q_1$	(11)	(14)	(37)	(114)
C 4–6 years schooling				
$_1q_0$	75	67	66	67
$_4q_1$	7	16	(29)	(37)
D Seven or more years schooling				
$_1q_0$	47	43	(70)	(45)
$_4q_1$	6	(14)	(8)	(26)

NOTE: Calculated from birth history data. Brackets indicate small numbers.

Table 14 Childhood mortality differentials by mothers' place of residence, 1976

	$1\,000\cdot{}_xq_0$			
X	Amman	Zarqa-Irbid	Towns & large villages	Medium & small villages
1	98	79	69	120
2	81	101	111	113
3	81	85	113	117
5	100	95	121	143
10	127	128	165	175
15	155	175	185	209
20	203	196	203	234
Number of women	7 135	3 987	3 997	4 321

Source: Household survey data, 1976

and surviving but otherwise the Brass–Trussell procedures for estimating q_x values and the t_x s give reliable estimates. Even when broken down into educational subgroups, these same indirect methods produce reasonably accurate results, at least by comparison with the direct estimates from the birth history data (figure 6). These latter data are not free from flaws; they appear to under-estimate infant mortality in particular because of the sensitivity of the direct estimates to some small omission of dead infants. However, their great strength is the opportunity they provide to study relative changes in infant and childhood mortality for detailed ages – infants, 1–2 s, 3–4 s, 1–5 s, etc. These results provide us with the only data we have on the relative changes in child survivorship within the younger age groups.

From the tables and graphs, our best estimates of the trend in infant and childhood mortality in the 30 or so years before the 1976 survey are summarized in table 15.

Table 15 Trends in infant and childhood mortality estimated from 1961, 1972 and 1976 data for Jordan's East Bank

Date of estimate	$1\,000\cdot{}_1q_0$	$1\,000\cdot{}_4q_1$
1947–51	160	130
1952–56	120	120
1957–61	115	80
1962–66	95	50
1967–71	80	27
1972–76	70	20

The pace of change in both measures is remarkable, especially $_4q_1$. Even faster rates of change, however, were recorded amongst the Muslim population of Palestine, later Israel. At the end of the second world war, infant and child mortality rates amongst Palestinians and East Bankers were approximately equal – infant mortality rates of around 140–160 per thousand and child mortality ($_4q_1$) around 120 per thousand. By the early 1960s, infant mortality amongst the Muslims in Israel has fallen to around 45 per thousand, 95 per thousand on the East Bank. In the early 1970s, infant mortality amongst Muslims in Israel had dropped slightly to around 40 per thousand whilst the East Bank rate had fallen a little faster to around 70 per thousand (table 15). The mortality rates of children 1–4 fell very steeply amongst Muslims in Israel, to about 10 per thousand in the early 1970s, still about half the East Bank rate. Overall, the impression is that after a slow start in the post-1948 period, infant and child mortality on the East Bank improved relatively slowly, at least in relation to the changes in the Muslim population in Israel, but subsequently the pace of change quickened. The mortality rates of children 1–4 have fallen very quickly by any standards on the East Bank, catching up the very fast rates of change across the Jordan river.

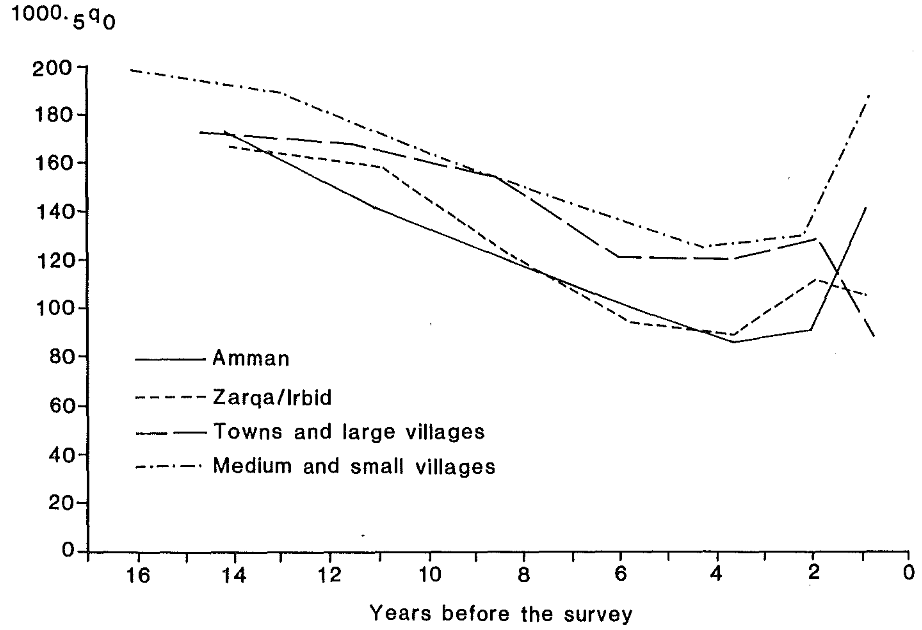

Figure 7 Trends in Jordanian childhood mortality by mothers' place of residence, 1976

5 Adult Mortality

The household schedule included questions on deaths of household members in the 24 months preceding the survey, and on widowhood and orphanhood. In favourable circumstances, all three items of information can be used to produce reliable estimates of adult mortality. This section first reviews the applicable techniques for estimating adult mortality from the 1976 Jordan data. A new procedure for dating the adult mortality estimates from the orphanhood and widowhood data is introduced. Finally, a method for constructing complete life tables from separate estimates of childhood and adult mortality is presented. Life tables are constructed for 1963 and 1975 and the age pattern of mortality compared with selected model life tables.

5.1 THE GROWTH BALANCE METHOD OF ESTIMATING ADULT MORTALITY

This method, invented by Brass (1975) and modified and extended by Rachad (1978), Preston and Hill (1980), Martin (1980), and Preston, Coale, Trussell and Weinstein (1980), adjusts a series of reported deaths, supposedly incomplete, to produce revised age-specific death rates. It assumes approximate stability of the population above each age and that deaths are under-reported by the same proportion at every age. For Jordan around 1976, we have both deaths reported in the 24 months before the survey and deaths by age reported through the vital registration system. Both series are incomplete. The crude death rates from the deaths reported in the survey are 4.4 per thousand for females and 7.2 per thousand for males; the corresponding crude death rates estimated from the vital registration system and a reverse projection of the 1979 census population are 3.3 and 4.2 per thousand. An additional problem with the survey deaths is the small number of total events; with only 1112 reported deaths, several of the five-year age groups contain less than five events.

Application of the Growth Balance technique in its simplest form to the survey deaths produces a very uneven set of points (table 16 and figure 8). None of the possible modifications, such as interpolating between the standard five-year age groups or leaving out the under fives, had any significant effect on the form of the graphs. The small number of deaths virtually precludes the possibility of drawing conclusions, even from the slope of parts of the line indicated by the plotted points. The number of deaths reported in the vital registration system was very much larger and two years' deaths were averaged to reduce the effect of chance variations (table 17). The graph of the resulting points is similarly uneven, making any decision on the completeness of death registration heavily dependent on the choice of the range of points selected and the procedure used for fitting a straight line (figure 9). There are some similarities between the shape of the graphs on figures 8 and 9; on both, there is a pronounced 'S' shape seen in other data but in a much less exaggerated form. There is a strong suggestion that the cause of the difficulties is the unevenness of the survey age distribution due primarily to migration but also to age misreporting. Upward arching of the graph is often caused by net in-migration with out-migration having a reverse effect. Preston *et al* (1980) have illustrated the effects of several individual factors on the shape of the Growth Balance graphs. In the case of Jordan, both in- and out-migration at different ages is probably responsible for several peculiarities in the recorded age distribution. Whilst it is possible to correct for the bias introduced into the sectional birth rates for one factor, it is complex and, in the case of Jordan, virtually impossible since the required information on the numbers and age/sex composition of those arriving or departing before the survey is lacking.

5.2 ADULT MORTALITY FROM DATA ON WIDOWHOOD

In circumstances where marriage is a formal occasion and divorce uncommon, reports by married people on the survival of their first spouses are usually quite reliable, giving good measures of adult mortality levels for a period perhaps 5–15 years before the census or survey. There are several reporting errors which can detract from the value of the reports on widowhood, one of which is the tendency of some respondents to misreport their marital status. In some circumstances, it may be more acceptable to admit to being widowed rather than divorced with the results that the level of mortality estimated is too high. Other difficulties can arise when it is not made clear to the respondent that it is the survival of his or her *first* spouse which is being requested; even then, the respondent may have lost touch with the first spouse entirely.

Despite these difficulties, the procedure is valuable especially for estimating adult male mortality which is more difficult to measure using the orphanhood technique. In Jordan, an extra difficulty arose because of the structure of the questionnaire. By accident, the currently divorced were not asked about the survival status of their first spouse. For men, the problem is not too serious since only 1.7 per cent of men married once only were currently divorced, but for females the figure was 10.4 per cent and the proportions increased sharply with age. In the estimation of adult mortality, it was assumed that divorcees had experienced the same mortality as the rest of the ever-married population, and their reports excluded from both numerator and denominator in the calculation of the proportions widowed.

The proportions of respondents with surviving first spouses in both the household and individual surveys (the latter from female respondents only) are shown in table 18. Both series from the household interview indicate unreason-

Table 16 Population and deaths in the last 12 months, by sex and age, and partial birth and death rates (Brass Growth Balance method, first variant)

Age group x,x+4	Females Population	Females Deaths[a]	Females Partial birth rate $n(x)/N(x^+)$	Females Partial death rate $D(x^+)/N(x^+)$	Males Population	Males Deaths[a]	Males Partial birth rate $n(x)/N(x^+)$	Males Partial death rate $D(x^+)/N(x^+)$
0–4	8 785	88.5			9 175	136.5		
5–9	8 236	13.0	.0440	.0032	8 724	3.5	.0467	.0054
10–14	7 392	4.0	.0514	.0036	8 060	6.0	.0567	.0068
15–19	5 168	2.0	.0546	.0046	5 129	5.5	.0613	.0091
20–24	3 402	1.5	.0480	.0058	2 701	6.5	.0477	.0116
25–29	2 922	1.0	.0438	.0070	2 281	7.0	.0364	.0135
30–34	2 421	2.5	.0464	.0087	2 072	3.0	.0381	.0155
35–39	2 413	1.5	.0531	.0108	1 964	11.0	.0432	.0187
40–44	1 841	3.5	.0635	.0144	1 805	6.0	.0510	.0221
45–49	1 274	4.0	.0642	.0192	1 466	6.0	.0586	.0282
50–54	1 061	6.5	.0652	.0249	1 154	16.5	.0637	.0368
55–59	564	1.5	.0645	.0328	646	4.5	.0608	.0456
60–64	652	12.5	.0622	.0415	750	20.0	.0603	.0564
65–69	349	11.0	.0769	.0526	428	30.0	.0753	.0707
70–74	423	17.0	.0810	.0603	507	22.5	.0823	.0709
75+	530	40.5				58.0		
	47 433	210.5			47 491	342.5		

[a](Deaths 1–24 months before survey)/2; deaths where the age was 'not stated' were excluded from the calculations (there were three such deaths for females, and three for males in the 24 months).

NOTE: Number of persons of exact age x, n(x) = (sum of population numbers in the two adjoining age groups)/10.

Number of persons ages x and over, $N(x^+)$, is the cumulation of the population over age x.

Number of deaths ages x and over, $D(x^+)$, is the cumulation of deaths over age x.

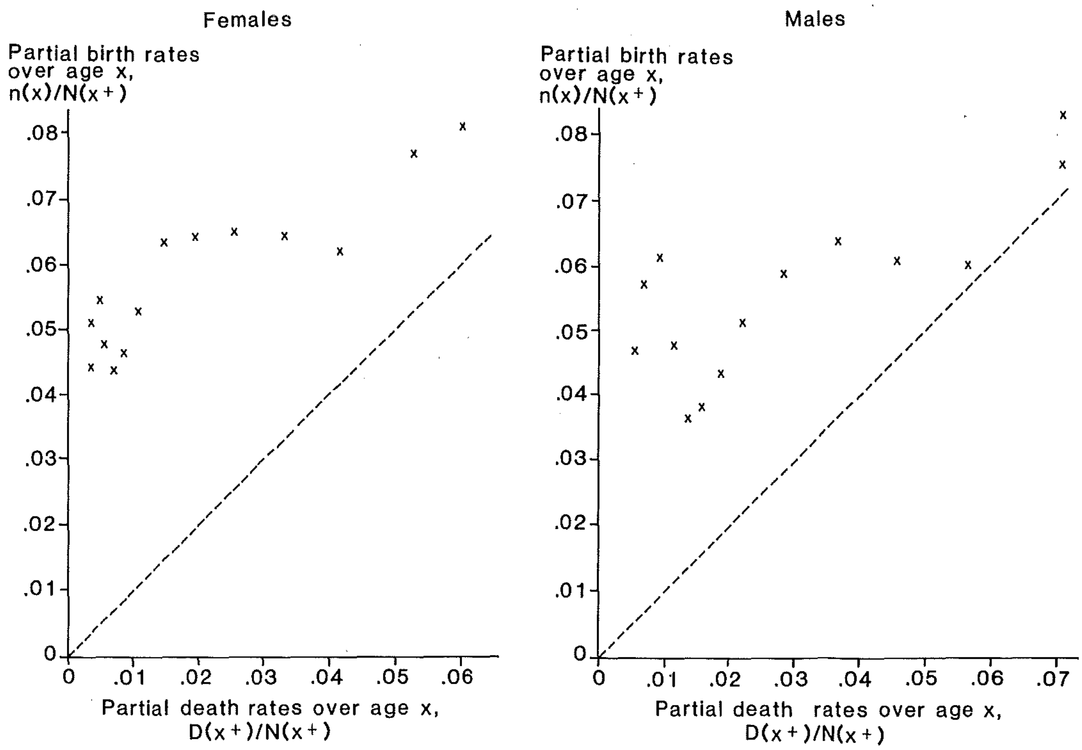

Figure 8 Partial birth and death rates over successive ages by sex (from data on deaths in the last 24 months): Brass Growth Balance method, first variant

Table 17 Population (from the survey) and registered deaths for 1975 and 1976 and partial birth and death rates (Brass Growth Balance method)

Age group x,x+4	Females Population	Females Deaths[a]	Females Partial birth rate p(x)/P(x+)	Females Partial death rate d(x+)/P(x+)	Males Population	Males Deaths[a]	Males Partial birth rate p(x)/P(x+)	Males Partial death rate d(x+)/P(x+)
5–9	8 236	103			8 724	157		
10–14	7 392	50	51.40	1.20	8 060	105	56.71	1.22
15–19	5 168	60	54.58	1.54	5 129	101	61.25	1.62
20–24	3 402	57	48.01	1.91	2 701	76	47.73	2.04
25–29	2 922	52	43.77	2.28	2 281	84	36.34	2.37
30–34	2 421	63	46.34	2.76	2 072	92	38.10	2.75
35–39	2 413	88	53.06	3.35	1 964	110	43.18	3.23
40–44	1 841	57	63.51	4.28	1 805	107	51.04	3.89
45–49	1 274	68	64.17	5.65	1 466	140	58.61	4.90
50–54	1 061	80	65.33	7.27	1 154	183	63.69	6.19
55–59	564	68	64.67	9.67	646	155	60.80	7.79
60–64	652	132	62.38	11.72	750	219	60.43	9.09
65–69	349	125	77.08	15.48	428	214	75.49	11.61
70–74	423	167	80.89	18.36	507	294	82.43	13.51
75–79	185	152	114.60	26.30	250	251	120.12	18.21
80–84	202	174	112.36	31.15	209	230	121.21	21.42
85+	143	333			170	386		
	38 648	1 829			38 316	2 904		

[a](Deaths registered in 1975 and 1976)/2.
NOTE: Since the deaths refer to the whole population (and not just the survey population) proportional death distribution and proportional age distribution have been used in calculations.
Proportion of population at exact age x, p(x) = (sum of population proportions in the two adjoining age groups)/2.
$P(x^+)$ is the proportion of the population aged x and over.
$d(x^+)$ is the proportion of the deaths ages x and over.

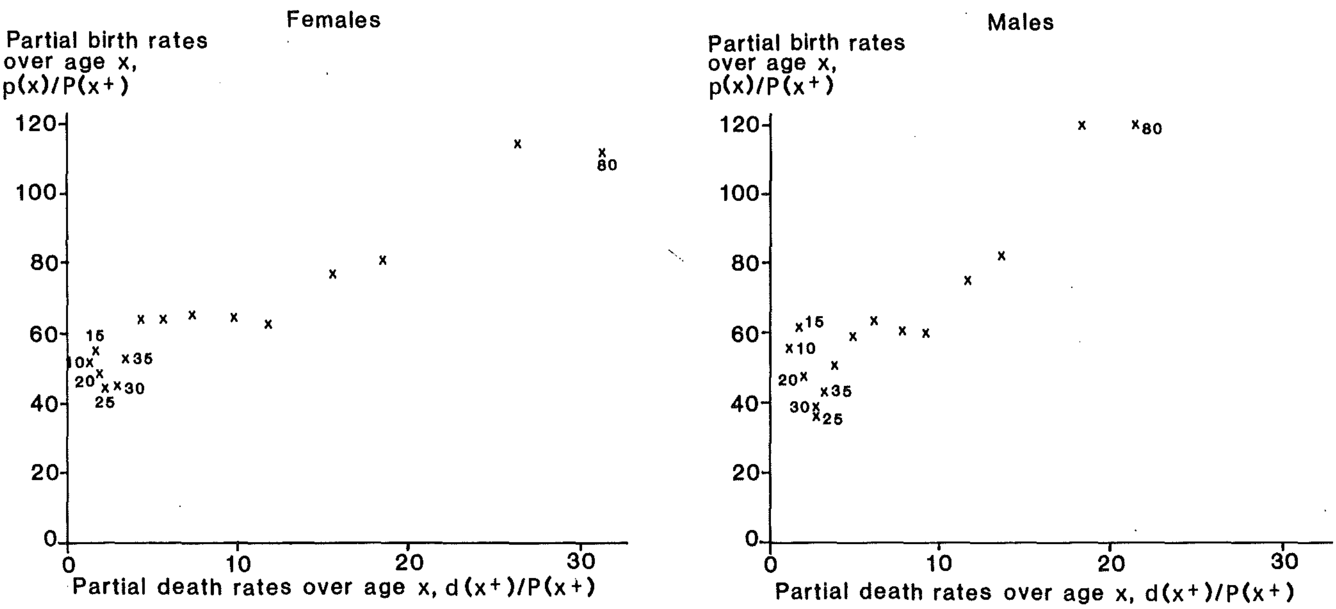

Figure 9 Partial birth and death rates over successive ages by sex (from death registration data for 1975 and 1976): Brass Growth Balance method

Table 18 Data on survival of first spouse for female and male respondents, excluding divorcees

Age group	Prop. of female respondents with surviving first husband: Household	Individual	Prop. of male respondents with surviving first wife: Household
15–19	.975	1.000	.942
20–24	.985	.995	.993
25–29	.983	.977	.987
30–34	.984	.983	.986
35–39	.976	.962	.982
40–44	.968	.911	.964
45–49	.941	.849	.959
50–54	.902	NA	.932
55–59	.895	NA	.890
60–64	.829	NA	.867
65–69	.856	NA	.850
70–74	.700	NA	.762
75+	.633	NA	.708

NOTE: NA = data not available (only ever-married women up to age 50 were interviewed in the individual survey).

Table 19 Estimation of male and female conditional survivorship from proportions widowed (household survey data)

	Male survivorship		Female survivorship	
N	ℓ(N)/ℓ(20)	South mortality level	ℓ(N)/ℓ(20)	South mortality level
25	.982	16.2	.986	16.5
30	.976	18.7	.984	19.4
35	.978	21.2	.982	20.8
40	.973	21.8	.962	19.3
45	.969	22.8	.959	20.5
50	.949	22.5	.931	19.4
55	.922	22.7	.886	18.4
60	.936	*	–	–

* = out of range of model life tables.

NOTE: Divorcees were excluded entirely from the data. The conditional survivorship probabilities were calculated using the South version of the Princeton model life tables throughout. The mean age at marriage used was the singulate mean age, here 21.6 years for females and 26.2 for males.

ably high proportions of men and women widowed in their teens and twenties. Amongst older respondents, the proportions widowed seem extraordinarily low, although the male reports are less affected by this feature. Estimating adult mortality indirectly by converting the proportions widowed into conditional life-table measures of survivorship as recommended by Hill (1977) clearly indicates the shortcomings of these household data (table 19). The results from female respondents show a steadily worsening trend in adult male mortality in the years before the survey; this is quite unacceptable, especially in view of the impossibly good levels of survivorship (all over level 21 in the Princeton South model life tables) indicated for a period 10–15 years before the survey (see below for the time locations of widowhood and orphanhood mortality estimates). The data from male respondents in the household data appear rather better in that the levels of mortality indicated are within the range anticipated and the trend, if any can be discerned from such an uneven set of points, is in broadly the expected direction.

There is one quite effective check we can apply at least to the reports by wives by comparing the proportions with surviving first husbands in both the household and individual surveys. We would expect the individual data to be of better quality since the reports were collected in the form of a full marriage history and the questions were answered by the wife herself. From table 18, it can be readily seen that the data on widowhood from the individual interview are quite different from the reports from the household form. Assuming that the individual survey data are of better quality, we can begin to understand some of the errors which are contained in the household survey data. First, it seems that excessive proportions of young women were indeed reported as widowed, possibly because their husbands or the head of household answering the questions felt that reporting a woman as widowed was socially more acceptable than reporting her as divorced. Secondly, the proportions of older women reporting surviving first husbands in the household survey are much too high, as suggested earlier. Two factors could be responsible. First, as in other surveys, age exaggeration can produce both a downward bias in the proportions widowed in the groups from which the respondents are being transferred and a similar bias in the groups they are joining. However, age reporting in the Jordan household survey is not too badly distorted by reporting errors, as far as we can tell (see section 3.1 above) so that this factor is unlikely to be very important here. A second factor, concerning the reporting of the order of the marriage, seems much more likely to have affected the household reports on widowhood. In the household questionnaire, respondents who reported (or had reported on their behalf) that they were currently married in their first marriage were not subsequently asked the direct question on widowhood. It looks very much as if previous marriages of older women have been under-reported in the household data; this would produce exactly the kind of downward bias in the proportions of older women widowed seen when the household and individual reports are compared (table 18).

In the circumstances, the household data on widowhood must be viewed with some suspicion. Instead, more weight is given to the individual survey data, unfortunately only available for female respondents. In table 20, columns 3 and 4, these data have been used to produce estimates of male survivorship from the usual indirect methods. Sadly, the data are not available for women above age 50 but the mortality levels indicated are more reasonable than those in column 2 derived using the uncorrected household data. Sometimes, tabulation of widowhood reports by marriage duration rather than by age can improve the accuracy of the results because marriage duration is a better measure of the length of the period of exposure to the risk of becoming widowed. The results of calculating adult survivorship this way are shown in columns 5 and 6 of table 20. The series

Table 20 Male adult survivorship estimates from widowhood reports, household and individual survey data

	Household survey data		Individual survey data					
			A		B		C	
N	$\ell(N)/\ell(20)$	Mortality level	$\ell(N)/\ell(20)$	Mortality level	$\ell(N)/\ell(20)$	Mortality level	$\ell(N)/\ell(20)$	Mortality level
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
25	.982	16.2	.991	19.7	.995	21.9	.991	19.8
30	.976	18.7	.969	17.3	.986	20.9	.972	17.9
35	.978	21.2	.978	21.1	.984	22.8	.965	19.2
40	.973	21.8	.958	20.0	.956	19.8	.946	18.8
45	.969	22.8	.910	17.8	.970	22.9	.905	17.4
50	.949	22.5	.855	16.4	.903	19.5	.851	16.1
55	.922	22.7	–	–	–	–	–	–
60	.936	*	–	–	–	–	–	–

* = out of range of model life tables.

NOTE: A = reports by female respondents tabulated by age.
B = reports by female respondents tabulated by marriage duration.
C = based on synthetic cohort proportions widowed.

of estimates is still rather irregular, possibly because of some difficulty respondents had in dating their first marriage.

In an attempt to make full use of the data by age, which on the face of it seem better than the duration data in this instance, proportions not widowed by age were constructed for a synthetic cohort of women. The proportions widowed were tabulated for 1976 and then for a date exactly five years earlier using the marriage history data on the individual file. The two series of proportions were then chained together as if the data had come from two separate surveys conducted five years apart. The resulting proportions widowed are smoother than the series from 1976 alone and the estimated adult survivorship is shown in columns 7 and 8 of table 20. Of the four sets of estimates shown on this table, the latter are the most reasonable and are the preferred figures because they are in general accord with the orphanhood based measures of adult survivorship (see below) and the sketchy information we have on adult mortality from the 1961 corrected registration data used in conjunction with the 1961 census.

Since the data on widowhood on the individual file appear to be of reasonable quality, there is no reason why measures of adult mortality could not be derived in another way from the detailed marriage histories, in effect by calculating the probabilities of widowhood directly from the survey data. This is a more complex task requiring some testing and evaluation of the results from several surveys and is not reported on here.

5.3 ADULT MORTALITY ESTIMATED FROM ORPHANHOOD

Experience elsewhere suggests that estimates of adult mortality from reports on the survival of parents may be more reliable than the results based on widowhood, perhaps because the questions on orphanhood are simpler to define and answer. Of course, care is needed to ensure that the respondent understands that the question refers to the survival of the 'biological' and not the adopted parents but this complication can usually be dealt with by careful interviewing (Blacker 1977) and by not trusting the reports from the youngest respondents. Several biases are implicit in the method itself (multiple reporting of parental survival by several children; the restriction to adults with children) but these are usually not serious.

For Jordan, the reports on orphanhood by both sexes are shown in table 21. The higher proportions of male respondents reporting surviving parents is puzzling; Blacker's explanation of this feature in Africa is that age exaggeration is more pronounced amongst men. Reports on parental survival itself are sometimes thought to be more reliable for females than for males; one reason why this is likely in the Middle East is that women are less mobile than men so that there is a greater chance that daughters will have kept in touch with their families than sons, especially if the sons have been migrants. In addition, it is generally found that

Table 21 Proportion in each age group with mother alive and father alive by sex of respondent, 1976

Age group	Mother alive		Father alive	
	F	M	F	M
10–14	.9840	.9819	.9440	.9478
15–19	.9704	.9741	.8951	.9037
20–24	.9380	.9511	.8316	.8445
25–29	.8593	.8843	.7118	.7242
30–34	.7906	.8137	.6010	.6289
35–39	.6726	.7245	.4496	.5031
40–44	.5622	.5784	.3362	.3629
45–49	.4325	.4625	.2268	.2633
50–54	.3101	.3458	.1489	.1707
55–59	.2181	.2461	.0904	.0991
60–64	.1120	.1280	.0613	.0640
65+	.0645	.0614	.0415	.0409

respondents over-estimate the proportions of their parents still alive and so the series which shows the lower proportions (here, female respondents) is to be preferred. Further, for the estimation of adult mortality from orphanhood data, an estimate of the mean age of childbearing is necessary. This can usually be more accurately calculated for females than for males. Since the ages of fathers at the birth of their children is not on the standard recode file, and therefore could not be directly calculated, the difference between the mean ages of the married population by sex was added to the female mean age of childbearing. As a rough check on the accuracy of the reporting of orphanhood by female respondents, we can compare the number of living children reported by mothers (82 063) with the number of respondents reporting a surviving mother (81 540). The correspondence is encouraging and increases our trust in the reports on orphanhood by females.

There are now several ways of converting the proportions orphaned into life-table measures of adult mortality. Brass and Hill (1973) originally developed a system of weights for balancing the proportions in adjacent age groups having a surviving parent, so that when summed, the weighted proportions equal given life-table survivorship ratios. These ratios were derived from logit life tables and adjustments for the location of the mean age of childbearing incorporated using the Brass fertility polynomial. Male and female survivorship can be estimated in this way. Subsequently, Hill and Trussell (1977) produced a revised version of the original procedure using regression; the results obtained in this way are usually very similar to those obtained from the original procedure but the replacement of the Brass fertility polynomial with the more elaborate Coale–Trussell fertility model may have some merit. Only female survivorship can be estimated using the regression technique.

Both methods produce survival ratios which will usually have to be converted to ordinary life-table measures to be useful. Blacker (1977) recommends calculation of a life table with the radix at 25, 32.5 or 37.5 years but still some independent measure of mortality is necessary to complete the life table. Often, childhood mortality is known quite accurately and the second regression technique proposed by Hill and Trussell (1977) incorporates a value for l_2. Here, our aim is to produce an estimate of adult mortality independent of childhood mortality since at a later stage we want to join the estimates of adult and childhood mortality to produce a complete life table and to learn more about the age pattern of mortality in Jordan. Thus, the level of mortality for adults based on the survival ratios is estimated by assuming the age pattern of mortality contained in the Princeton model life tables, South variant. For comparison, survival ratios derived from the Brass–Hill and the Hill–Trussell methods are presented in table 22. Both methods produce similar results for female survivorship with heavier mortality indicated by the data from female respondents. To complete the picture, male survivorship has been estimated by the same methods (table 23).

Mortality levels corresponding to levels of mortality in the Princeton model life tables, South pattern, have been calculated for the adult mortality ratios (table 24). They indicate a steady improvement in adult mortality in the middle of the age range. The survivorship levels indicated by the reports on orphanhood of younger respondents are unreasonably low, perhaps because of the working of the 'adoption effect'. The reports from the oldest respondents are known to be suspect from a plot of logits of the ratios against those from suitable models.

One modification of the orphanhood method proposed by Hill (1975) was to estimate adult mortality from the reports by oldest children only, eliminating the duplication of reporting by several surviving siblings. Practical difficulties have prevented the use of this correction, mostly because too many respondents report themselves as the eldest child. The Jordanian data apparently contain this flaw, as several pieces of evidence indicate. First, the number of eldest children who were men far outnumbered the women for the age group 60–64, 56.8 per cent of men said they were the eldest surviving child whereas only 46.2 per cent of women made the same assertion. Second, comparison of the proportions reported as the eldest surviving child with a simple model incorporating approximations for the level of fertility and mortality in Jordan revealed greatly inflated reported values. Further, we find that 15 862 ever-married women reported at least one living child whereas 21 940 individuals with mothers alive said they were the eldest

Table 22 Estimation of female survivorship values $\ell(25+N)/\ell(25)$ from information on maternal orphanhood from female and male respondents (using Brass–Hill weighting method and Hill–Trussell regression method[a])

		$\ell(25+N)/\ell(25)$: female respondents		$\ell(25+N)/\ell(25)$: male respondents	
N	25+N	Brass–Hill	Hill–Trussell	Brass–Hill	Hill–Trussell
15	40	.981	–	.980	–
20	45	.968	.973	.972	.977
25	50	.940	.946	.953	.959
30	55	.866	.875	.891	.900
35	60	.808	.816	.827	.841
40	65	.687	.706	.744	.762
45	70	.573	.598	.589	.762
50	75	.422	.457	.453	.491
55	80	.280	–	.313	–

[a]Using M (mean age of mothers at the birth of their children) = 28.13 years.

Table 23 Male survivorship $\ell(35+N)/\ell(32.5)$ from information on paternal orphanhood

Central age N	$\ell(35+N)/\ell(32.5)$ Female respondents	$\ell(35+N)/\ell(32.5)$ Male respondents
15	.924	.930
20	.870	.881
25	.781	.793
30	.649	.670
35	.484	.532
40	.327	.352
45	.185	.225
50	.106	.119

NOTE: The mean age of fathers at the birth of their children = 32.7.

survivor – a substantial discrepancy unlikely to be attributable to sampling variation. For all these reasons, the data on the orphanhood status of the eldest surviving were not used to estimate adult mortality and the original estimates presented above, based on the reports by all respondents, were preferred throughout.

5.4 TRENDS IN ADULT MORTALITY

In the indirect estimation of mortality, the assumption has generally been made that time trends in mortality can be ignored although this was frequently untrue. Recently, Feeney (1980) has shown how the reports on child survival can be adjusted to incorporate changes in adult mortality. Brass has now shown how the time location of adult survivorship can be calculated (Brass and Bamgboye 1981). Here it is only necessary to point out that the time location, T, of the estimates of adult survivorship derived from either widowhood or orphanhood reports, can now be estimated provided that the mean age of the fertility schedule or the mean ages at first marriage are known. The method of deriving the T values depends on a number of assumptions and approximations, the most important of which are the assumption of a linear trend in mortality change and the conformity of the pattern of change to a one parameter logit life-table system. In applications, it emerges that the Ts are sensitive to changes in the age pattern of mortality but that they are much less affected if the other assumptions are violated.

In table 25, we show the time location of the adult mortality estimates presented earlier using data on orphanhood and widowhood. The relationship between these results can be seen more clearly by reference to figure 10 on which trends in childhood mortality (indirectly estimated from the household data) have also been plotted.

Both estimates of levels and trends in male and female survivorship from the orphanhood reports indicate an unreasonably sharp improvement in adult mortality in the 6–12 years before the survey. Reports on the survival of mothers by younger women appear to be particularly in error, possibly due to the working of the 'adoption' effect. Despite our earlier assertion that daughters are probably closer to their mothers than their fathers, in part because of the latters' greater geographical mobility, it looks from our results as if better reports are provided on paternal survivorship. Perhaps this is true of other patrilineal, male-dominated societies: only further study of these differences in reporting of parental survival can answer this.

Although we rejected the widowhood data from the household questionnaire, the data from the individual interview, especially when treated as a synthetic cohort, appear to give good estimates of male adult mortality (figure 10). Unfortunately, we lack the data independently to confirm (or reject) the indirectly derived adult mortality measures so that our judgements must be based on internal consistency and compatibility of results from different

Table 24 Adult survivorship estimates from orphanhood data expressed as levels in the Princeton South model life tables

	Mortality levels					
	Female survivorship: ℓ_{25+N}/ℓ_{25}				Male survivorship: $\ell_{35+N}/\ell_{32.5}$	
	Female respondents		Male respondents		Female respondents	Male respondents
N	(1)	(2)	(1)	(2)	(1)	(1)
15	21.3	21.6	21.3	–	19.0	19.5
20	20.9	20.2	21.5	22.1	18.3	19.0
25	19.7	17.1	20.9	21.5	16.8	17.6
30	16.5	16.4	18.1	18.7	15.0	16.0
35	16.0	14.9	17.0	17.7	13.3	15.4
40	14.1	15.1	16.4	17.2	13.3	14.4
45	14.2	15.6	14.8	15.7	14.2	16.5
50	14.5	–	15.5	16.7	–	–
55	15.8	–	17.1	–	–	–

NOTE: Method (1): Brass–Hill (1973) – weights.
Method (2): Hill–Trussell (1977) – regression.

Table 25 The time location of adult mortality estimates derived from reports on widowhood and orphanhood, 1976 survey

A Male survivorship

	Orphanhood		Widowhood	
N	ℓ(35+N)/ℓ(32.5)	Years before survey	ℓ(N)/ℓ(20)	Years before survey
15	.924	5.8	–	–
20	.870	7.6	–	–
25	.781	9.1	.991	0.4
30	.649	10.5	.972	2.7
35	.484	11.6	.965	5.0
40	.327	12.7	.946	7.2
45	.185	–	.905	9.3
50	.106	–	.851	11.1

B Female survivorship

	Orphanhood	
N	ℓ(25+N)/ℓ(25)	Years before survey
20	.973	7.6
25	.946	9.3
30	.875	10.8
35	.816	11.9
40	.706	13.0
45	.598	13.6
50	.457	13.9

NOTE: Orphanhood estimates based on reports by females.

sources. Thus, it seems to us implausible that adult mortality would improve at a rate much above the quite firmly established changes in child mortality (the dashed line on figure 10), given that child mortality itself improved rather rapidly in the pre-survey period (see section 4.5 above). It is on this basis that the individual survey data on widowhood are judged to give reasonable adult mortality measures. In addition, the widowhood results appear to be reasonably free of the obvious errors in the orphanhood results, namely the impossibly high values of $\mathring{e}_{20}$ indicated for female survivorship by younger women and the very low values of $\mathring{e}_{20}$ obtained for male adult survival from paternal orphanhood reports by older women (see figure 10).

5.5 THE AGE PATTERN OF JORDANIAN MORTALITY

Although the estimates of childhood and adult mortality presented in preceding sections have been derived and expressed in terms of a particular set of model life tables (the Princeton South series), the results themselves are not very strongly affected by the selection of one model pattern rather than another *within* either childhood or adult age range. When extrapolating from childhood to adult mortality for example, the effect of the selected age pattern of mortality is much more pronounced. In the foregoing analysis, this extrapolation of mortality levels in childhood to adulthood and vice versa has been avoided as far as possible. Thus, it is quite reasonable to try and relate levels of childhood mortality to adult survivorship despite the implicit use of a specific set of model life tables to derive the initial mortality estimates.

There are several ways in which child and adult mortality levels can be compared but the graphical illustration of time trends and levels (figure 10) is the simplest to understand.

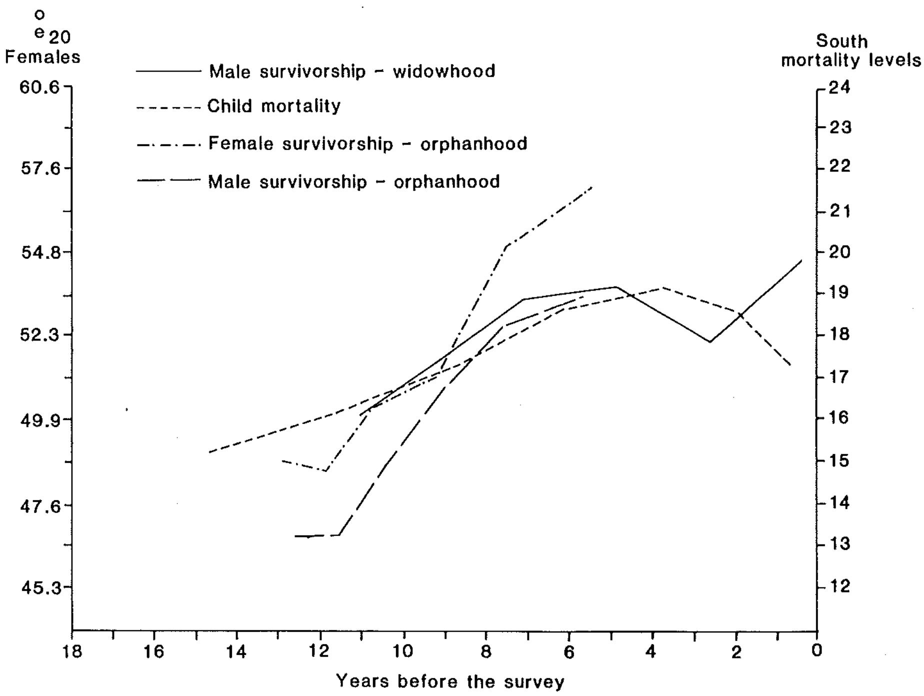

Figure 10 Time trends in mortality estimated from the 1976 survey (orphanhood from female respondents only)

Table 26 Model life-table measures of mortality in Jordan for 1965–7 and 1970–2

Mortality measures	1965–7	1970–2
	Females	
$\overset{o}{e}_0$	60.0	65.0
$\overset{o}{e}_5$	64.6	67.6
$1000 \cdot {}_1q_0$	95	77
$1000 \cdot {}_4q_0$	50	30
l_{25}	0.827	0.874
	Males	
$\overset{o}{e}_0$	56.3	61.2
$\overset{o}{e}_5$	61.3	64.1
$1000 \cdot {}_1q_0$	106	86
$1000 \cdot {}_4q_0$	53	31
l_{25}	0.809	0.859

NOTE: The 1965–7 figures are from the Princeton South model life table, level 17 and the 1970–2 figures, level 19.

From this graph, it seems fair to conclude that about nine years before the survey, child and adult mortality in Jordan were related to each other much as in the Princeton South model life tables, level 17. If, as suggested, we place our trust in the widowhood-based estimates of adult mortality in the more recent period, then it looks as if this general similarity to the Princeton South pattern of mortality has been maintained. On these assumptions, there is little point in preparing new composite life tables for Jordan. A general indication of mortality levels in Jordan say nine to four years before the survey can be obtained directly from the Princeton model life tables themselves for levels 17 and 19 (table 26).

In circumstances where the evidence suggested that adult and childhood mortality levels were far apart, difficult procedures would be necessary to obtain a complete life table or some further information on the indicated age pattern of mortality. Brass's logit life-table system is flexible enough to fit most mortality schedules either by using the two-parameter version in conjunction with different standard patterns or the four-parameter version which in effect varies the standard in a more complex but possibly preferable way (Zaba 1979). Fitting a life table with the logit system does have one great advantage over use of the Princeton life tables in particular: the age pattern of mortality in the Princeton models does vary with levels so that issues involving both level and pattern changes can get confused when comparisons are being drawn. In the logit system, at least the two-parameter version, having selected the standard, it is usually held constant for comparative purposes.

There are some newer model life table systems which may prove of value in certain circumstances. Both the UN and OECD have produced new model life tables using more developing country life tables which could serve as a basis for comparison of adult and child mortality levels estimated for survey data as in the case of Jordan (UN 1979 and OECD 1980). Virtually any model is useful for comparison but the meaning of certain models is more widely understood than others. It was primarily for this reason that the Princeton models were used here (and proved quite appropriate): in other circumstances this might not be true. In addition, some of the additional flexibility of the Brass logit system is offset by the lack of general understanding of the interpretation of the level (alpha) and pattern (beta) parameters.

6 Conclusion

This report has demonstrated that the data collected by most WFS surveys and from the Jordan survey in particular have considerable value as a source of mortality information in addition to the information on fertility. The Jordan survey is not typical of other WFS surveys principally because it is one of a smaller sub-set of surveys which used the extended version of the mortality module. In addition, some of the peculiarities of the age composition of the East Bank population and the migration which affected it undoubtedly had an adverse effect on some of the mortality estimates, notably the Brass Growth Balance correction for deaths reported in the 24 months preceding the survey. However, some general conclusions are probably still applicable to other WFS surveys.

6.1 RELIABILITY OF THE CHILDHOOD MORTALITY ESTIMATES

For the measurement of childhood mortality, the retrospective data from both questionnaires appeared to be of good quality, although the reports on children ever born by older women were more complete in the individual survey (table 5). Both sources gave comparable child mortality estimates because dead children were omitted in about the same proportions as children ever born in the household data. The indirectly estimated child mortality results roughly approximated the findings from the 1972 survey and the extrapolated trend from the 1961 census (figure 5). From all the retrospective sources, the indirectly estimated mortality measures, using reports from women 15–19 and 20–24, are clearly not typical of the population as a whole.

The most encouraging feature of the 1976 survey data is the similarity of the trends in child mortality estimated indirectly from the household data and directly from the birth history material (figure 5). Since experience elsewhere suggests that the indirect methods tend to provide a minimum estimate of child mortality, the suggestion is that near the date of the survey, the direct measures of child mortality are too low probably because of mis-dating of births and child deaths. The mechanisms are complex and beyond the scope of the present paper.

6.2 RELIABILITY OF THE ADULT MORTALITY ESTIMATES

The absence of a firmly established reference is a handicap in assessing the accuracy of the adult mortality data and results but several features are plain. First, the widowhood data from the household survey are of poor quality principally because of inaccurate reporting of marriage order, especially by female respondents. By contrast, the marriage histories from the individual interview produce reasonable reports on widowhood but the reports themselves are of limited value because the questions on the survival of the first spouse were addressed only to women aged 15–49. Nonetheless, these latter data appear to give us the most reasonable estimates of levels and trends in male adult mortality.

Normally, the orphanhood reports are a good source of information on adult mortality but in Jordan reporting errors have adversely affected reports on paternal and maternal survival in different ways. Younger women seem to have over-estimated the survival of their true mothers (the adoption affect) whereas older women over-estimated the survivorship of their fathers. Again, these results probably arise from a combination of reporting errors which are too complex to unravel in detail in this paper.

Finally, in the Jordan survey and probably the same is true of other WFS surveys, the data on household deaths in the preceding 24 months have proved to be of limited value for measuring adult mortality principally because of small numbers. The Brass Growth Balance method of correcting household deaths in any case gives insecure results when the basic assumptions of stability and closure of the population are violated and at present none of the modifications or extensions to this method circumvent these basic problems.

6.3 LEVELS AND TRENDS IN JORDANIAN MORTALITY

By way of conclusion, it may be valuable to produce 'best estimates' of recent trends in childhood and adult mortality in Jordan from the 1976 survey and some earlier sources. Until the 1979 census details are available, the 1976 data will remain the best and most up to date single source of information on Jordanian mortality.

The central findings of this study have already been presented on figures 5 and 10. These results are summarized in tabular form with approximate calendar year references (table 27). Plainly, the improvement in both child and adult mortality has been steady over the 15–20 year period before the 1976 survey. Some closing of the differentials in childhood mortality seems to have taken place (figures 6 and 7) but, overall, child loss is still relatively high compared to adult mortality levels.

Table 27 Levels and trends in Jordanian mortality 1950–75 summarized

Period	Infant mortality rate (per 1000)	$1000 \cdot {}_5q_0$	$\overset{o}{e}_0$ (females)	Crude death rate (per 1000)
1951–55	120	225	–	–
1956–60	115	200	–	–
1961–65	95	150	–	–
1966–70	80	110	60	12.9
1971–75	70	100	65	8.9

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Appendix A — List of Variables Used from the Standard Recode Tape of the Household Survey

Information for each household

CLUSTCDE	Cluster code
HSHLDNO	Household number
WEIGHT	Weight of the household in the sample
REGION	Region
AREA	Area
INTVWMTH	Interview date in months
TOTMALES	Total males in household
TOTFEMS	Total females in household

DTHRLTN	Relationship to head of household	for members of the household who have died in the last 24 months
DTHSEX	Sex	
DTHAGE	Age at death	
DTHMTH	Month of death	
DTHYR	Year of death	

Information for individuals in the household[2]

1 All persons

LINENUMB	Line number on the form
SLEPT	Did this person sleep here last night?
SEX	Is this person male or female?
AGE	How old is he/she?
FATALIVE	Is his/her father still alive?
OLDCFAT	Is he/she the eldest living child of his/her father?
MOTALIVE	Is his/her mother still alive?
OLDCMOT	Is he/she the eldest living child of his/her mother?

2 Persons aged 6 years or above

SCHOOL	Has he/she ever been to school?
EDUC	What is the highest certificate he/she obtained?

[2] If the answer to *both* residence questions (Does this person normally live here? Did this person sleep here last night?) was 'No', no further questions were asked and the person was deleted from the form.

3 Persons ages 13 years or above

EVERMAR	Has he/she ever been married?
MARSTAT	Is he/she now married, divorced or widowed?
MARIPLUS	Has he/she been married more than once?
SPSALIVE	Is his first wife/her first husband alive?

4 Ever-married women

MCHOME	Does she have any children of her own living with her?
FCHOME	How many sons? How many daughters?
MCAWAY	Does she have any children of her own who do not live with her?
FCAWAY	How many sons? How many daughters?
MCDEAD	Has she ever given birth to a child who later died?
FCDEAD	How many sons? How many daughters?
TOTSONS	Male children ever born (MCHOME + MCAWAY + MCDEAD)
TOTDTRS	Female children ever born (FCHOME + FCAWAY + FCDEAD)
LASTCMOB LASTCYOB	In what month and year did your last birth occur?
LASTCSEX	Was that a boy or agirl?
LASTCSUR	Is he/she still alive?

Appendix B — List of Tables Generated from the Household Data

For whole population who slept in the household the previous night

AGE x SEX

AGEFIVE[3] x SEX

AGEFIVE x REGION x SEX

AGEFIVE x EDUC x SEX

For population aged 10 and above who slept in the household the previous night

AGEFIVE x MARSTAT x SEX

AGEFIVE x MARIPLUS x SEX

EVERMAR x MARIPLUS

AGEFIVE x MARSTAT x EDUC } for women only

AGEFIVE x MARSTAT x REGION } for women only

AGEFIVE x FATALIVE x SEX

AGEFIVE x FATALIVE x SEX x OLDCFAT

AGEFIVE x MOTALIVE x SEX

AGEFIVE x MOTALIVE x SEX x OLDCMOT

AGEFIVE x FATALIVE x SEX x EDUC

AGEFIVE x FATALIVE x SEX x REGION

AGEFIVE x MOTALIVE x SEX x EDUC

AGEFIVE x MOTALIVE x SEX x REGION

AGEFIVE x SPSALIVE x SEX (for those married more than once)

AGEFIVE x MARSTAT x SEX (for those married once only)

For ever-married women who slept in the household the previous night

AGEREPR[4] x MCHOME

AGEREPR x MCAWAY

AGEREPR x MCDEAD

AGEREPR x FCHOME

AGEREPR x FCAWAY

AGEREPR x FCDEAD

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[3]Five-year age groups (10–14) . . . (90–94) (95+).
[4]Five-year age groups (10–14) . . . (70–74) (75+).

AGEREPR x TCHOME	(total children living with her)
AGEREPR x TCAWAY	(total children living away)
AGEREPR x TCDEAD	(total children who later died)
AGEREPR x MCEB	(male children ever born)
AGEREPR x FCEB	(female children ever born)
AGEREPR x TCEB	(total children ever born)

Breakdowns of:

TCEB by AGEREPR x EDUC	
TCEB by AGEREPR x REGION	
TCLIVE by AGEREPR x EDUC	(total children alive)
TCLIVE by AGEREPR x REGION	
TCDEAD by AGEREPR x EDUC	
TCDEAD by AGEREPR x REGION	
MCEB by AGEREPR	
FCEB by AGEREPR	
MCLIVE by AGEREPR	(male children alive)
FCLIVE by AGEREPR	(female children alive)
MCDEAD by AGEREPR	
FCDEAD by AGEREPR	

AGEREPR x LLB2[5]	double-weighted for twin births
AGEREPR x LLB2 x EDUC	
AGEREPR x LLB2 x REGION	
AGEREPR x LASTCSEX x LASTCYOB	(for births from 1970 onwards)
AGEREPR x LASTCSEX x LLB2	

Deaths in the household in the last 24 months

AGEFIVE x DTHSEX

AGEFIVE x DTHMBS[6]

AGEFIVE x REGION

AGEFIVE x AREA

AGEFIVE x DTHMBS x DTHSEX

[5]Number of months before the survey of the last live birth.
[6]Number of months before the survey of the death.