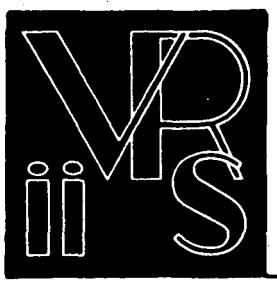


Technical Papers

Number 71
December 1997

ESTIMATING THE COMPLETENESS OF UNDER-5 DEATH REGISTRATION IN EGYPT

International Institute for Vital Registration and Statistics
9650 Rockville Pike
Bethesda, Maryland 20814-3998
U.S.A.

FOREWORD

In order to provide reliable vital statistics, the acceptable level of completeness of registration coverage is is considered to be 90 percent or more. However, the measurement of registration coverage, especially of deaths, is not an simple matter. Therefore, such measures are not frequently available. Yet, knowledge of the level of registration coverage is important in evaluating national health programs which use mortality rates as targets for attaining health goals.

In this study, members of families that reported deaths of children under 5 in two national surveys were re-interviewed to obtain particulars about the death. This information was used in the search of the death record on file in the registration office.

This paper was previously published in Demography, Vol.33, No.3,329-339, August 1996. It is presented in this series by the kind permission of the journal Demography.

The views expressed in this report are those of the authors and do not necessarily reflect those of the IIVRS.

The program of the International Institute for Vital Registration and Statistics, including the publication and distribution of the Technical Papers, is supported by a grant from the United Nations Population Fund.

ESTIMATING THE COMPLETENESS OF UNDER-5 DEATH REGISTRATION IN EGYPT*

STAN BECKER, YOUSSEF WAHEEB, BOTHAINA EL-DEEB, NAGWA KHALLAF, AND ROBERT BLACK

To evaluate the completeness of registration of infant and child deaths in Egypt, reinterviews were conducted with families who had reported a death of a child under age 5 in the five years before the survey for two national surveys recently conducted in Egypt: the United Nations PAPCHILD survey of 1990–1991 and the Egyptian Demographic and Health Survey (EDHS) of 1992. The survey instrument included questions regarding notification of the death at the local health bureau. If the family said the death had been notified, separate employees searched the health bureau records for the registration. Overall 57% of infant deaths were reported as notified and 68% of those death reports were found; the corresponding figures for child deaths were 89% and 74%. Using the percentage reported as notified as an estimate for completeness of registration, we adjusted upward the national infant and child mortality rates from registration data, giving values of 73 per 1,000 for infant mortality and 99 for ${}_5q_0$ for the period 1987–1990. These values are approximately 20% above the corresponding direct estimates from the PAPCHILD and EDHS surveys.

In contrast to the situation on other continents, vital registration systems in most African nations are below 90% coverage, the lower limit of "complete" as defined by the United Nations (1994). Egypt is one exception: Egyptian law states that deaths must be registered at the local health bureau by the deceased person's next of kin before the burial. A copy of the death record is eventually sent to the capital of the governorate. From that office, tallies of deaths (e.g., by month and age) are sent to the Central Agency for Public Mobilization and Statistics (CAPMAS); the latter produces statistical reports at the national level.

From analyses of a dual record system in 1974–1975, the Egyptian birth and death registrations were estimated respectively to be 95% and 87% complete (CAPMAS 1976; National Academy of Sciences 1982). The estimate of completeness of registration for infant deaths was 67%. Since that time, the completeness has been estimated through indirect estimation techniques (United Nations 1983) using census data of 1976 and 1986 and then comparing the indirect estimates of mortality with the direct estimates. In 1986 coverage was estimated to be 86% and 74% respectively for male and female infant deaths (El-Deeb 1990); coverage of deaths for all ages combined is higher. The precision of these values is unknown, although it is clear that different assumptions in the indirect techniques can yield quite different estimates. For example, the estimate of infant mortality varies according to the choice of model life table family. Also, indirect estimates based on woman's age differ from those based on marital duration (National Academy of Sciences 1982:41–43).

The objectives of this study were twofold: first, to determine levels and possible trends and differentials in completeness of registration of infant and child deaths in Egypt, and second, to use these estimates to adjust reported levels of infant and child mortality for the nation.[1]

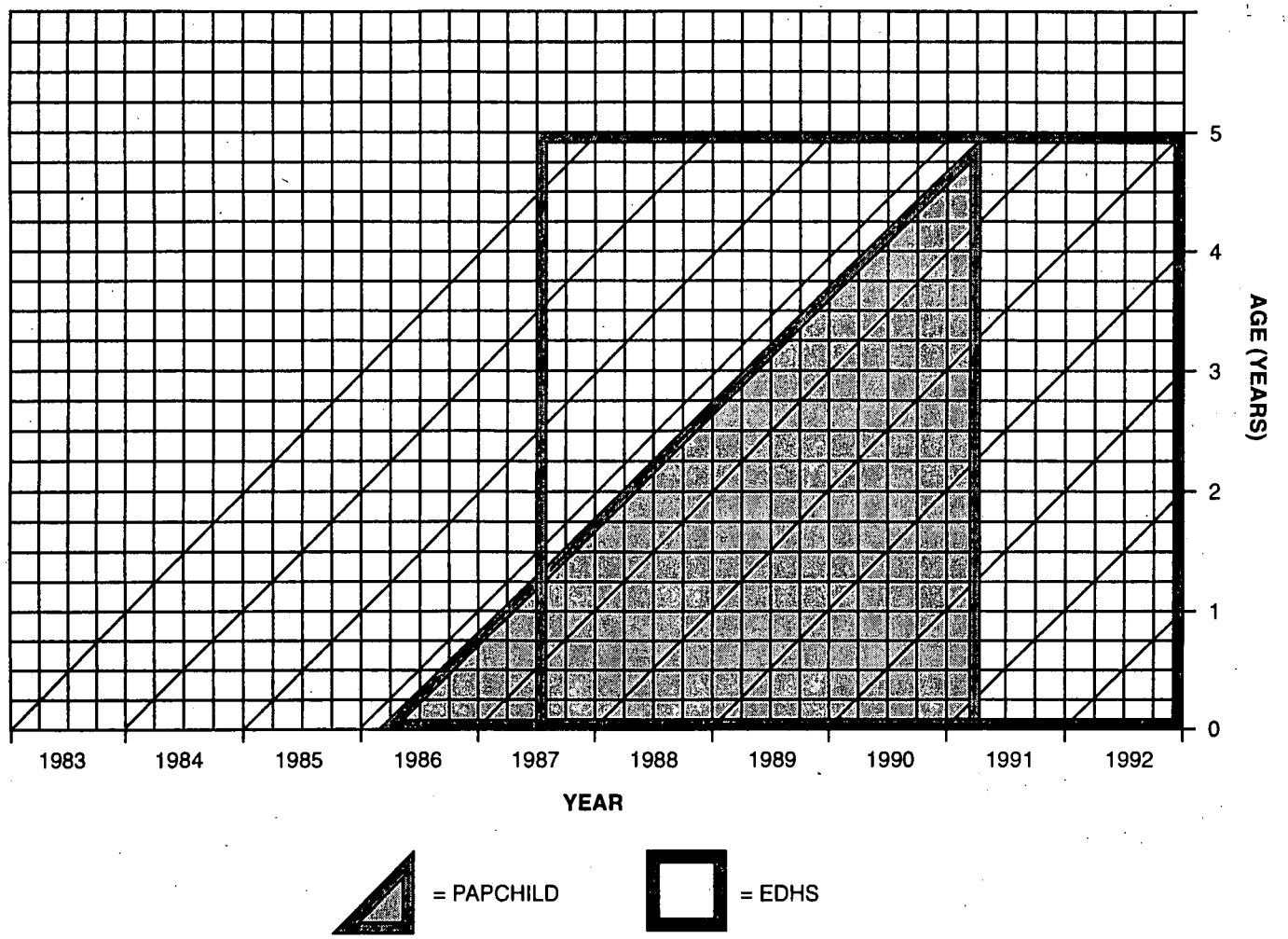
In 1990–1991 a national household survey (11,074 households) was conducted in Egypt under the auspices of the United Nations and the Pan Arab Project for Child Development (Abdel-Azeem, Farid, and Khalifa 1993). (Henceforth we refer to this as the PAPCHILD survey.) In the survey questionnaire a complete birth history was administered to women of reproductive age, and the survival status of each child was determined. In late 1992 another national survey, the Egyptian Demographic and Health Survey (EDHS), was conducted in 10,760 households (El-Zanaty et al. 1993). This survey also included a complete birth history for married women of reproductive age and thus obtained information on infant and child deaths.

These two surveys provided an ideal opportunity for a project to achieve the objectives stated above without mount-

*Stan Becker, Department of Population Dynamics, Johns Hopkins School of Public Health, 615 North Wolfe Street, Baltimore, MD, 21205-2179; e-mail: sbecker@phnet.sph.jhu.edu. Youssef Waheeb, Department of Community Medicine, Suez Canal University; Bothaina El-Deeb, Child and Women Research Division, Central Agency for Public Mobilization and Statistics (CAPMAS); Nagwa Khallaf, ARI Division, Child Survival Project, Ministry of Health; and Robert Black, Department of International Health, Johns Hopkins School of Public Health, Baltimore. The authors would like to thank the several scores of CAPMAS staff members who did the interviewing, health bureau searches, and coding of the data used for this study. Staff members of the Child Survival Project also worked diligently on this project. In particular, Dr. Samy El-Ansary handled administrative matters to make the study possible, and Mariam Samir and Mohie Din El-Khateeb did much of the data entry and programming. This study was funded by the U.S. Agency for International Development through the Technical Assistance Contract of Clark Atlanta University with the Ministry of Health Child Survival Project in Cairo, Egypt. Dr. Fatma El-Zanaty, director of the EDHS, and Dr. Hoda Rashad, director of PAPCHILD, made possible the extraction of the data from the respective surveys. We would like to thank Professors Henry Mosley, Bob Schoen, and Ismail Sirageldin and anonymous reviewers for helpful comments on an earlier draft. Professor Ken Hill provided the indirect estimates used in Figure 3.

1. A third objective was to use a verbal autopsy questionnaire to determine the causes of these deaths and to compare these with causes assigned in the health bureaus. The verbal autopsy methods and results on causes of death will be reported in a subsequent paper.

FIGURE 1. LEXIS DIAGRAM SHOWING AGE AND TIME PERIOD OF PAPCHILD AND EDHS SAMPLE DEATHS



ing either a huge and expensive dual-record system or a prospective study. It was possible to estimate the completeness of registration by revisiting the households in the PAPCHILD and DHS surveys where a child death in the recent period had been reported, by asking whether the death had been registered, and, if so, by searching for that record in the local health bureau. We also administered a verbal autopsy questionnaire while in the field. We then used the estimates of completeness to adjust published mortality rates from registered deaths.

METHODS

Selection of Cases

The PAPCHILD and EDHS surveys were both national in scope.[2] From the PAPCHILD survey we selected all deaths of children reported as born in the five years before the interview date. We chose this cutoff because the quality of reporting of deaths is known to decline with time since the event (Sullivan, Bicego, and Rutstein 1990) and because our interest focused on mortality in the recent period. With this procedure, deaths to persons age 4 are available only for the year before the survey, while infant deaths are available for each year; thus the age distribution of deaths is weighted toward infants. To adjust mortality under age 5, we stratified the data by age group. The criterion used for selection of deaths from the EDHS survey was slightly different: From this survey we selected all deaths in the five years before the survey for all children under age 5. Figure 1 is a Lexis diagram showing the age groups and time periods covered for the selected deaths from the two surveys. The wider criterion used for selection from EDHS data allowed for the greatest possible overlap with PAPCHILD data, and thus for the largest possible sample size for 1987–1990.

2. Actually the frontier provinces, which have a very small population (1% of the national total), were excluded from both.

When the study was proposed in early 1992, it was estimated that the data from the two surveys (627 deaths in PAPCHILD and approximately 800 in DHS) would provide a 95% confidence interval of ± 0.02 around the observed proportion registered. Estimates for subgroups by age, region of residence, and other characteristics would have wider confidence limits, so we considered the combined data from the two surveys to be essential. For selected deaths, we prepared lists from the original survey questionnaires with information on name of the deceased, the parents' names, the address, dates of birth and death, and age at death.

Study Instruments

The pretested questionnaire included verbal autopsy modules for each major cause of death.[3] Age at death was asked and recorded in days for ages under one month, in months for ages under one year, and then in years. The interviewers then inquired whether the death had been notified; if so, they asked whether the death certificate was available. If the certificate was produced, the registration data were copied, including the address of the health bureau where the event was recorded. Even when there was no death certificate, however, if the parent or caretaker said that the death was registered, the interviewers asked the date of the registration and the address of the health bureau. This information was essential for searching the registration record in the second phase of the work.

We designed a special form for checking vital registration. The top section contained information from the survey questionnaire that was necessary for locating the record, including the name of the deceased child, the names of the mother and father, the date of death, and the office where the event was reported as registered. The bottom section was completed if the registration record was located; this portion included dates of death and registration, sex of the child, place of registration, and the registered cause of death.

Interviewers and Fieldwork

We selected 24 female CAPMAS staff members with experience in fieldwork as well as eight field supervisors, a field coordinator, and a technical supervisor. The preferred respondent in a household was the mother of the deceased child. Training for the verbal autopsy was conducted over a two-week period.

For the work of searching vital registration after the collection of the survey data was complete, we trained eight male supervisors and one female; because the visits involved health bureaus rather than households, male staff members were preferred.[4] We prepared a list of cases in which the mother or caretaker reported notifying a health bureau of the death. The interviewers were trained to search using the name of the deceased child, mother's and father's names and date of death. Interviewers searched through records within one year of the reported date of death, and often searched more widely. If the record was located, the interviewer completed the special registration form described above.

The fieldwork began in November 1992; a total of 627 PAPCHILD and 774 EDHS questionnaires were sent into the field. The searches for records in health bureaus began in August 1993; 434 visits in all were made to the health bureaus in attempts to trace 810 death records. Although the supervisors were not instructed to revisit the household of the deceased child if they could not locate the record they were seeking in the health bureau, they did so in many cases to ask whether the death in fact had been notified or whether the registration actually had taken place in a different office. In some cases the supervisors were given the name of another health bureau and found the death registered there; in other cases they did not. Unfortunately the data collection system did not capture details of these multiple searches, so it is impossible to quantify them.

Reinterviews

In early 1994 we attempted reinterviews for a purposive sample of 498 cases. We did this in order to allow more precise classification of cause of death for cases with ambiguous information in the verbal autopsy portion of the questionnaire. In addition, the reinterviewer asked again about notification status of the death. In cases where the mother alone was the respondent in the original interview, the reinterviewer interviewed both the father and the mother together, if possible, or the mother and some other adult family member. This was done because we had observed in preliminary tabulations that the reported notification rate was lower if only the mother was present at the interview than if both parents were present. (See below.)

Data Processing, Definition of Completeness, and Statistical Analyses

Data entry from the questionnaires, the health bureau forms, and the reinterviews was conducted with the EPI-INFO computer program (Dean 1990). We made range and consistency checks; a unique identifier for each case allowed matching of the separate files. Data on three maternal characteristics—age, parity, and years of schooling—were obtained from the PAPCHILD and DHS survey organizations. From the original and reinterview data we computed consistency of reports on notification of the death.

For the analysis, as the estimate of completeness of registration, we choose to use the percentage of deaths reported as notified rather than the percentage of deaths with confirmed registration. We do so because a death report might not have been located for multiple reasons: The respondent might have named the wrong health bureau, the reported date of death and/or name of the deceased might have been far from the actual date and/or name, and so on. Because the percentage of events reported as notified is uniformly higher than the percentage with confirmed registration, use of the

3. We conducted a one-week pretest of the questionnaire in Cairo using 10 interviewers; the questionnaire subsequently was modified for the main survey. The Arabic and English versions of the final questionnaires are available from the authors.

4. Because the work involved travel alone in all parts of the country, it was felt inappropriate to have female staff in these positions.

TABLE 1. SUMMARY RESULTS (COUNTS) FOR THE PAPCHILD AND EDHS DEATHS

Item	Survey		
	Both Surveys	PAPCHILD	EDHS
Deaths Given for Interview	1,401	627	774
Excluded Cases	107	56	51
Family not located	31	20	11
Age out of range	24	11	13
Discovered to be stillbirth	37	12	25
Refusal	2	0	2
Injury deaths that were not asked about notification	13	13	0
Cases Available for Analyses	1,294	571	723
Percentage of Total Cases	(92)	(91)	(93)

former could be interpreted as placing an upper bound on the level of registration. (Consequences of this choice are considered in the "discussion" section.) Henceforth we abbreviate "reported notified" as "notified."

Covariates chosen for study of possible association with levels of notification include age of the child at death, year of death, sex of the child, place of residence (urban or rural), region of residence (Upper Egypt, Lower Egypt, or Urban Governorates), and three maternal characteristics: age (< 30 and 30+), parity (1, 2–3, and 4+), and schooling (none, some). For statistical testing we employed simple chi-square statistics for cross-tabulations and z-tests for differences in proportions of deaths notified.[5] Logistic regression was used to estimate adjusted linear effects of selected covariates on the log odds of the probability that the death was notified (SAS Institute 1990). Variables showing a significant bivariate association were included in the initial model; to assess the significance of each variable we used the chi-square test for the difference of log likelihoods for models fit with and without the variable. Interaction terms for all pairs of significant variables were tested in an analogous fashion. We calculated odds ratios and their 95% confidence intervals in the usual manner (Hosmer and Lemeshow 1989).

5. The PAPCHILD sample was self-weighting; the EDHS was not. When we compared the distributions of characteristics in Table 2 using both the weighted and unweighted samples, however, the distributions were close. Using the weighted sample changed the estimate of the overall proportion notified by less than .5%; thus to simplify data processing, we give the unweighted results. Also, though the PAPCHILD and the EDHS employed cluster samples, we safely ignored cluster effects because the number of cases per cluster was very small relative to the number of clusters. In the EDHS, for example, each of the 266 PSUs had one to nine deaths, or an average of only three deaths per cluster.

RESULTS

With the selection criteria described above, 1,401 infant and child deaths were available for study (Table 1). Eight percent of these cases were excluded from the analyses for reasons shown,[6] so most analyses covered 1,294 cases.

Table 2 shows the distribution of the deaths included in the study according to selected characteristics. By design (Figure 1) the PAPCHILD deaths occurred earlier in calendar time than the EDHS deaths. More than three-quarters of the deaths were to infants; as noted above, however, this is an overestimate of the proportion of infant deaths to all deaths under age 5 in a birth cohort because the design used for the selection of PAPCHILD deaths oversampled infants. (See Figure 1.) Sixty percent of the deaths occurred in Upper Egypt, and 67% of the mothers had no schooling. In contrast with these figures, only 35% of the surveyed population of women lived in Upper Egypt, and only 52% of all ever-married women in the surveys had no schooling (Abdel-Azeem et al. 1993; El-Zanaty et al. 1993).

Deaths Reported as Notified and Records Found in the Health Bureaus

In only 64% of the cases did respondents say that they had notified the authorities of the death (Table 3). Only 18% of these respondents were able to produce a copy of the death certificate. In some cases, particularly among early neonatal deaths, the respondent said that there was neither a birth nor a death registration. The percentage of notified deaths increased slightly but not significantly for years closer to the present. The levels of notification of male and female deaths did not differ significantly.

We found a marked difference, however, in the percentage of deaths notified by age at death (Figure 2): Only 35% of neonatal deaths were notified, in contrast to about 90% of deaths above one year of age. We also found large and significant differences in notification rates according to place of residence. The lowest rates were found in rural areas and in Upper Egypt. Levels of notification differed significantly by mother's educational level and age; more highly educated and older women had higher notification rates. Most (77%) of the respondents were mothers of the deceased children. The percentage of deaths reported as notified was lower in such cases than when the father alone or both the father and

6. We excluded 107 cases for the following reasons: (1) The interviewers were unable to locate the family (n = 31), presumably because a migration had taken place or because the address specified on the original survey form was incomplete; (2) The child was found to be born before the beginning of the period of study or to have died at an age above five years (n = 24); (3) The mother at the time of the verbal autopsy interview said that the pregnancy actually terminated in a stillbirth rather than in a live-born child who died soon thereafter (n = 37); (4) Two respondents refused; (5) Because of an error in the skip pattern in the verbal autopsy questionnaire used for the PAPCHILD interviews, mothers of children who were reported to have died because of injury were not asked about notification of the death (n = 13). We corrected this problem before the interviews from the EDHS sample were conducted.

TABLE 2. PERCENTAGE DISTRIBUTION OF DEATHS UNDER AGE 5 FROM PAPCHILD AND EDHS BY SELECTED CHARACTERISTICS

Characteristics	Both Surveys	PAPCHILD	EDHS
All deaths	100	100	100
(No. of deaths)	(1,294)	(571)	(723)
Year of Birth			
< 1987	11	15	7
1987	18	26	11
1988	22	22	22
1989	20	21	19
1990	16	15	17
1991	10	1	17
1992	4	0	7
Year of Death			
1986	4	10	0
1987	11	19	5
1988	22	24	20
1989	22	23	21
1990	21	21	21
1991	12	3	19
1992	8	0	14
Age at Death			
Infant	78	83	75
Neonatal	[39]	[43]	[36]
Post-neonatal	[39]	[40]	[39]
1 year	13	23	14
2 years	4	3	5
3 years	3	1	4
4 years	2	1	2
Place of Residence			
Urban	23	21	25
Rural	77	79	75
Region of Residence			
Upper Egypt	60	61	58
Urban Governorates	9	6	12
Lower Egypt	31	33	30
Parity of Mother			
1	20	20	20
2–3	34	31	38
4 or more	45	49	42
Age of Mother			
< 30	50	53	48
30+	50	47	52
Schooling of Mother			
None	67	71	64
Some	33	29	36

the mother were respondent(s), though the differences were not statistically significant ($p = .08$).

Of the deaths that were reported as notified, the interviewers were able to trace only 69% in the health bureau that the respondent(s) indicated as the place of registration (last two columns of Table 3). Neonatal deaths were the least likely to be found. The percentage of events notified in urban areas was higher than in rural areas, whereas the percentage of notified deaths that could be traced was lower in urban areas. Also, younger women had a significantly lower rate of notification than older women, but the percentage of notified events that were found was significantly higher for younger women; thus the overall percentage of deaths with confirmed registration was virtually the same for the two age groups.

We fit a logistic regression model to predict the odds of notification, using the five significant predictors from Table 3: age at death, place of residence, region of residence, mother's age, and mother's schooling. Four of these had significant effects in the final model (Table 4); none of the interactions was significant. Among the covariates, residence in an urban governorate is associated with the greatest increase in the odds of notification (odds ratio = 3.45). The coefficient for child's age applies to each month. Thus, for example, to estimate the odds ratio of notification for the death of an 18-month-old relative to the odds for the death of a one-month-old, we find $\exp[.16(18 - 1)] = 15.2$. This estimate matches closely the observed crude odds ratio of notification for deaths at 12–59 months versus neonatal deaths from Table 3 (i.e., (.89/.11)/(.35/.65) = 15.0).

Reinterviews

Ninety-seven percent of the 498 attempted reinterviews were completed. Although 92% of reports on notification were consistent, in 26 (of 243) cases the respondents said in the original interview that they had *not* notified the death, but said in the reinterview that they *had* done so; parallel to this discrepancy, 12 of 241 respondents changed their responses in the opposite direction (first line of Table 5). Yet, when the interviewer searched different health bureaus for eight of the 26 new reports of notification, not one record was found.

Sixty percent of the reinterviews were held with different respondent(s) than in the original interview; often this was done by design, as noted in the "methods" section. Mothers alone constituted 93% of those with the same respondent(s) each time. The responses on notification were less consistent if the respondents were not the same in the two interviews (96% versus 87%). The responses were slightly more consistent for infant deaths than for deaths of children age 1–4 years. Statistical tests are inappropriate because the reinterviews were a nonrandom sample.

Using the original and the reinterview data, one can derive several revised estimates of the completeness of death reporting. At the one extreme, any report of notification could be assumed correct. At the other, only cases with reports of notification at both interviews could be considered accurate. Another alternative is to restrict consideration to

TABLE 3. PERCENTAGE OF DEATHS NOTIFIED AND PERCENTAGE FOUND IN THE HEALTH BUREAUS, BY SELECTED CHARACTERISTICS

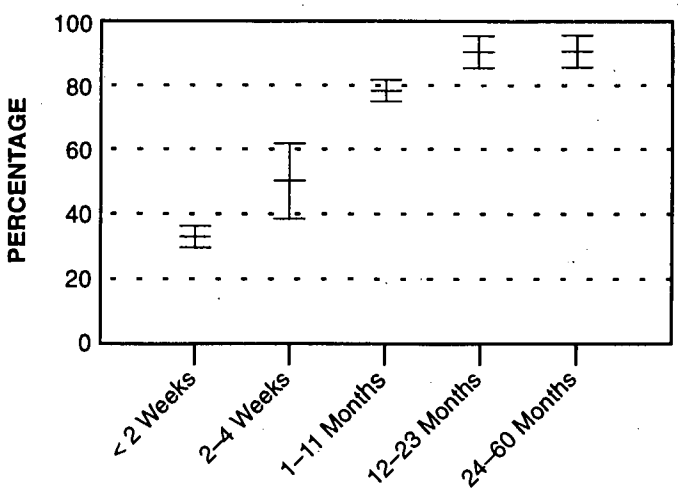
Characteristics	No. of Deaths	Percentage Reported as Notified	Percentage Found in Bureaus of Notified Deaths	Overall Percentage Confirmed Registration
All Deaths	1,294	64	69	44
Year of Death				
< 1988	199	57	66	35
1988	285	61	73	43
1989	282	66	68	42
1990	270	65	66	42
1991	154	62	72	43
1992	104	75	76	55
Sex of Infant				
Male	665	62	71	42
Female	62	66	68	42
Age at Death				
Infant	1,015	57**	68**	37**
Neonatal	[506]	[35]	[52]	[17]
Postneonatal	[509]	[78]	[74]	[56]
12–59 months	279	89	74	62
Place of Residence				
Urban	301	81*	65	47
Rural	993	58	71	41
Region of Residence				
Upper Egypt	770	58*	69	39
Urban Governorates	121	88	58	41
Lower Egypt	403	67	73	49
Respondent				
Mother alone	999	63	69	43
Father alone	45	67	75	49
Mother and father	141	72	75	54
Other	109	58	61	35
Parity of Mother[a]				
1	164	59	68	40
2–3	424	63	72	46
4 or more	626	66	63	42
Age of Mother[a]				
< 30	618	60**	70*	42
30+	596	67	64	43
Schooling of Mother[a]				
None	789	60**	65	39*
Some	425	71	70	49

*$p < .05$ for test of null hypothesis of homogeneous percentages

**$p < .01$ for test of null hypothesis of homogeneous percentages

[a]For 80 cases it was impossible to match parity, age, and education.

FIGURE 2. PERCENTAGE OF DEATHS NOTIFIED BY AGE GROUP



cases with consistency in reports between the original interview and the reinterview. A final alternative, attractive for its simplicity, is to ignore the reinterview and merely use reports of notification from the original survey. These varying methods produce the different estimates of completeness shown in Table 6.[7] The estimates based on consistent reports are quite close to the estimates based on data from only the original survey. Thus we use the latter for the adjustment of mortality described below.

Mortality

Estimates of infant mortality from national vital registration data are displayed in the first column of Table 7. We used results from the present study to generate the estimates in the second column. Because we did not find a significant time trend in the percentage of deaths notified, the adjustment of mortality in each year is the same.

The direct estimates of mortality from the PAPCHILD and EDHS surveys were 59 and 62 per 1,000 respectively; the average of these estimates is 21% below the level estimated in this study.[8]

Estimates of child mortality ($_4M_1$) and the probabilities of death ($_4q_1$ and $_5q_0$) are shown in Table 8. Because the notification rate for child deaths is higher than the rate for infant

7. The methods for deriving revised estimates of completeness with the interview-reinterview results are illustrated by giving the calculations for infants. The data are taken from Table 5. Under the assumption that any report of notification in *either* interview is correct, 63% = 57% × [(164 + 6 + 19)/394]/(170/394). For the estimate with only consistent reports, 59% = 57% × (164/369)/(170/394). When only reports of notification at *both* interviews are taken, we have 55% = 57% × (164/394)/(170/394).

8. If only consistent reports are used for the adjustment, then the average of the PAPCHILD and the EDHS estimates falls 17% below the adjusted mortality level.

TABLE 4. ODDS RATIO ESTIMATES FROM LOGISTIC REGRESSION FOR PREDICTION OF NOTIFICATION OF THE INFANT OR CHILD DEATH

Variable and Category	Coefficient	Odds Ratio	
		Point Estimate	95% Confidence Interval
Region of Residence (Ref = Upper Egypt)			
Urban Governorates	1.25	3.45	(1.76, 6.93)
Lower Egypt	0.45	1.56	(1.17, 2.08)
Place of Residence (Ref = Rural)			
Urban area	0.82	2.27	(1.52, 3.39)
Education of mother (Ref = No Schooling)			
Some schooling	0.43	1.54	(1.15, 2.06)
Age at Death (in Months)	0.16	1.17	(1.14, 1.20)
Constant	–0.74	0.48	(0.38, 0.60)

[a]The difference in –2 log likelihood between the model with only the intercept and the model with the intercept and covariates is 293.4 (df = 5), so $p < .001$ for the test of the null hypothesis of no covariate effects.

deaths, the CAPMAS child mortality estimates are closer to the adjusted estimates than are those for infant mortality. The average adjusted value is 17% above the CAPMAS estimate and 14% above the average of the estimates from EDHS and PAPCHILD. The estimates for ${}_5q_0$ combine the infant and child mortality rates. During the four year period, the adjusted estimate of ${}_5q_0$ is 50% above the CAPMAS estimate and 20% above the average of the direct estimates from the two surveys.

DISCUSSION

Egypt is fortunate to have estimates of infant and child mortality from a variety of sources including national surveys, vital registration, and indirect estimates from census data on numbers of children ever born and children surviving. Figure 3 shows various estimates for the period 1970–1991: direct estimates from three national demographic surveys (PAPCHILD, DHS-1, and EDHS), indirect estimates from the same surveys (and the World Fertility Survey of 1980),[9] unadjusted vital registration, and vital registration adjusted by factors derived from the current study.[10] The general downward trend in mortality is clear. As is evident from the figure, vital registration estimates are far too low; this is due to underregistration of deaths. The direct and the indirect survey estimates are close. The adjusted registration estimates from the present study are slightly above those from the EDHS for the most recent period and are considerably above those from the PAPCHILD survey.[11]

TABLE 5. CONSISTENCY OF REPORTS IN THE ORIGINAL AND IN REINTERVIEW, REGARDING NOTIFICATION OF THE DEATH, BY RESPONDENT(S) AT THE TWO INTERVIEWS AND AGE OF THE DECEASED

	All Reports	Reports on Notification			
		Consistent Reports		Differing Reports	
		Yes-No	No-No	Yes-No	No-Yes
All Reinterviews	484	229	217	12	26
Respondents at the Two Interviews					
Same respondent	197	121	69	3	4
Different respondent	287	108	148	9	22
Age of the Deceased					
Infant	394	164	205	6	19
1–4 years	90	65	12	6	7

An objective of this study was to document the levels and differentials of underregistration of deaths in the country. We found a marked pattern by age: Only 35% of neonatal deaths were reported as notified. Earlier investigations at the national level had only estimated completeness for all infant deaths. A study in Fayoum Governorate in Upper Egypt, however, found a 27% completeness rate of vital registration for neonatal deaths by checking with prospective records collected by traditional birth attendants (Mohamed 1990). The same study found 87% completeness for postneonatal deaths; the national estimate for this age group, based on the present study, was 78%. In another study, conducted in Menofia Governorate, a check of civil registrations for prospectively identified deaths showed that 16 of 17 neonatal deaths and

9. We derived indirect estimates as follows: The ratio of the mean number of children dead to the mean number of children born for women age 30–34 in each of the surveys was converted to an estimate of ${}_5q_0$ by using the Trussel variation of the Brass method (United Nations 1983). We used the West Model Life Tables of Coale and Demeny for sexes combined to find the corresponding level of ${}_1q_0$ after interpolation between levels. The ${}_5q_0$ estimates were provided by Ken Hill (Hill, Pande, and Jones forthcoming).

10. Other authors have calculated adjustment factors for rates from vital registration using indirect estimates derived from the census data of 1976 and 1986 (Bucht and El-Badry 1986; CAPMAS 1989; National Academy of Sciences 1982). These estimates, however, typically suffer from inaccuracies in age reports and omission of deaths in the census reports; thus they yield low estimates (e.g., an infant mortality rate of 60 per 1,000 in 1987) relative to indirect estimates derived from the survey data.

11. All of the direct estimates from the surveys may be too low because of heaping of age-at-death reports at 12 months, outside the infant category. In DHS-2 for example, the counts of deaths reported at 11, 12, and 13 months were 65, 458, and 23 respectively.

TABLE 6. ESTIMATES OF PERCENTAGE COMPLETENESS USING DIFFERENT METHODS FOR UTILIZING INFORMATION FROM THE INTERVIEW-REINTERVIEW MATCHED DATA[a]

	Data Used to Estimate Level of Notification (Completeness)			
Age Group	Notification Reports from Original Survey Only	Report of Notification in Either Interview	Only Consistent Reports	Only Reports of Notification at Both Interviews
Infants	57	63	59	55
1–4 Years	89	100	95	81

[a]See footnote 7 for details of the methods for deriving the estimates.

TABLE 7. INFANT MORTALITY RATES (PER 1,000) FROM REGISTERED DEATHS, ADJUSTED RATES USING RESULTS FROM THE PRESENT STUDY, AND DIRECT ESTIMATES FROM RECENT SURVEYS

Year	CAPMAS Unadjusted IMR[a]	Adjusted by the Present Study[b] (57%)	Direct Survey Estimates
1987	45	79	
1988	43	76	59[c]
1989	40	70	62[d]
1990	38	66	
Average	42	73	61

[a]From CAPMAS tabulations (CAPMAS 1993).

[b]Using reports of notification at the first interview.

[c]PAPCHILD estimate for 1986–1991.

[d]EDHS estimate for 1988–1992.

25 of 95 under-5 deaths were not registered (Langsten and Hill 1994). For children age 1–4 years at death in our study, 89% were reported as notified. Thus all three studies show that vital registration estimates of neonatal mortality need a much larger adjustment factor than do estimates of mortality for later ages.

Two other factors must be considered in judging the accuracy of the adjusted estimates of infant and child mortality from the present study: underregistration of surviving births and omission of deaths in the PAPCHILD and EDHS surveys.[12] Insofar as surviving births are underregistered, the mortality estimates presented here will be high. It is widely accepted by Egyptian demographers, however, that birth registration is virtually complete for those who survive the first month of life. Thus such an adjustment is probably no more than 1 to 3%.[13]

Regarding the second factor, namely missed deaths in the PAPCHILD and EDHS surveys, the adjusted mortality estimates presented here would still be accurate if the probability that the event was registered was identical for the omitted deaths and for those found in the survey. On the other hand, the estimates would be too low if the omitted deaths were *also* more likely not to have been registered than the deaths that were reported in the surveys. Because early neonatal deaths are most likely to be missed in demographic surveys and because we have seen that a disproportionate fraction of neonatal deaths were not notified, the second condition is more likely to be true. This is the classical situation of the Chandra-Sekar Deming technique, in which the probabilities that an event is missed are not independent in the two separate recording systems (Chandra-Sekar and Deming 1949).

Under the extreme assumption that all of those missed in the survey were also missed by the registration system, the factor for additional adjustment of the mortality rate is equal to the reciprocal of the proportion found by the PAPCHILD and EDHS surveys: For example, if 10% are missed by the survey, the factor is 1.0/0.9. It is uncertain how far mortality needs to be further adjusted upward because of this underreporting in both the surveys and the registers, but it seems doubtful that the surveys missed more than 5% of deaths; thus the additional adjustment would be minor.

One could argue that the adjustment factor for mortality should be even higher than that given here because only 69% of the deaths reported as notified were actually found in the health bureaus. Without a computerized system of death registration, however, an exhaustive search for death records was impossible; therefore, not finding the death record in the health bureau does not necessarily imply an omission. Consequently, to be conservative in estimating underregistration, we accepted the family's report of notification as the level of registration. In this regard, a consistent report on notification was given in the reinterview for 92% of deaths. This proportion is quite high when we consider that the interviews were conducted four to seven years after the event. Also, the reinterviews were held 4 to 14 months after the first interview, and were conducted with the same respondents only 40% of the time.

In the other direction, it is possible (though unlikely) that the level of registration is higher than the reported level of notification. Some households may have registered the death, but the mother and/or father or caretaker did not understand the question in the interview or did not know that the death had been registered.[14] Given the high interview-

12. The effects of misreporting of age must also be considered. We used age at death reported in the survey in conjunction with notification status to adjust age-specific mortality from vital registration. A matched comparison of ages of death reported in the survey with those reported in the registers ($n = 551$) shows that 90% of those classified as infant deaths in the survey were so classified in the registers. Similarly, 90% of infant deaths according to the registers were also classified as infant death in the survey.

13. For example, the National Academy of Sciences (1982, Table 7) estimated all births (including those dying in infancy) to be 96.4% complete for the nation for the period 1972–1975.

14. Unfortunately we did not collect information on who reported the death to the health office.

TABLE 8. CHILD AND UNDER-5 MORTALITY (DEATHS PER 1,000) ESTIMATED FROM REGISTRATION DATA, FROM ADJUSTMENTS OF THE PRESENT STUDY, AND FROM DIRECT ESTIMATES OF RECENT SURVEYS

	Child Mortality Rate		Estimated $_4q_1$[a]			Estimated $_5q_0$		
Year	CAPMAS Unadjusted	Adjusted by Present Study	CAPMAS Unadjusted	Adjusted by Present Study	Direct Survey Estimates	CAPMAS Unadjusted	Adjusted by Present Study	Direct Survey Estimates
1987	7.4	8.3	29	33	24.3	73	109	
1988	6.7	7.5	26	29	24.8	68	103	84.8
1989	6.1	6.9	24	27		63	95	81.9
1990	4.9	5.5	19	22		56	87	
Average	6.3	7.1	24	28	24.6	65	99	83.4

[a]Values of $_4q_1$ are derived by using the equation $_4q_1 = 4 \times {}_4M_1/[1 + 4 \times (1 - {}_4a_1) \times {}_4M_1]$, where $_4a_1$ has the value of .4 (Chiang 1984).

FIGURE 3. INFANT MORTALITY ESTIMATES FOR EGYPT OVER TIME, BY SOURCE OF ESTIMATE

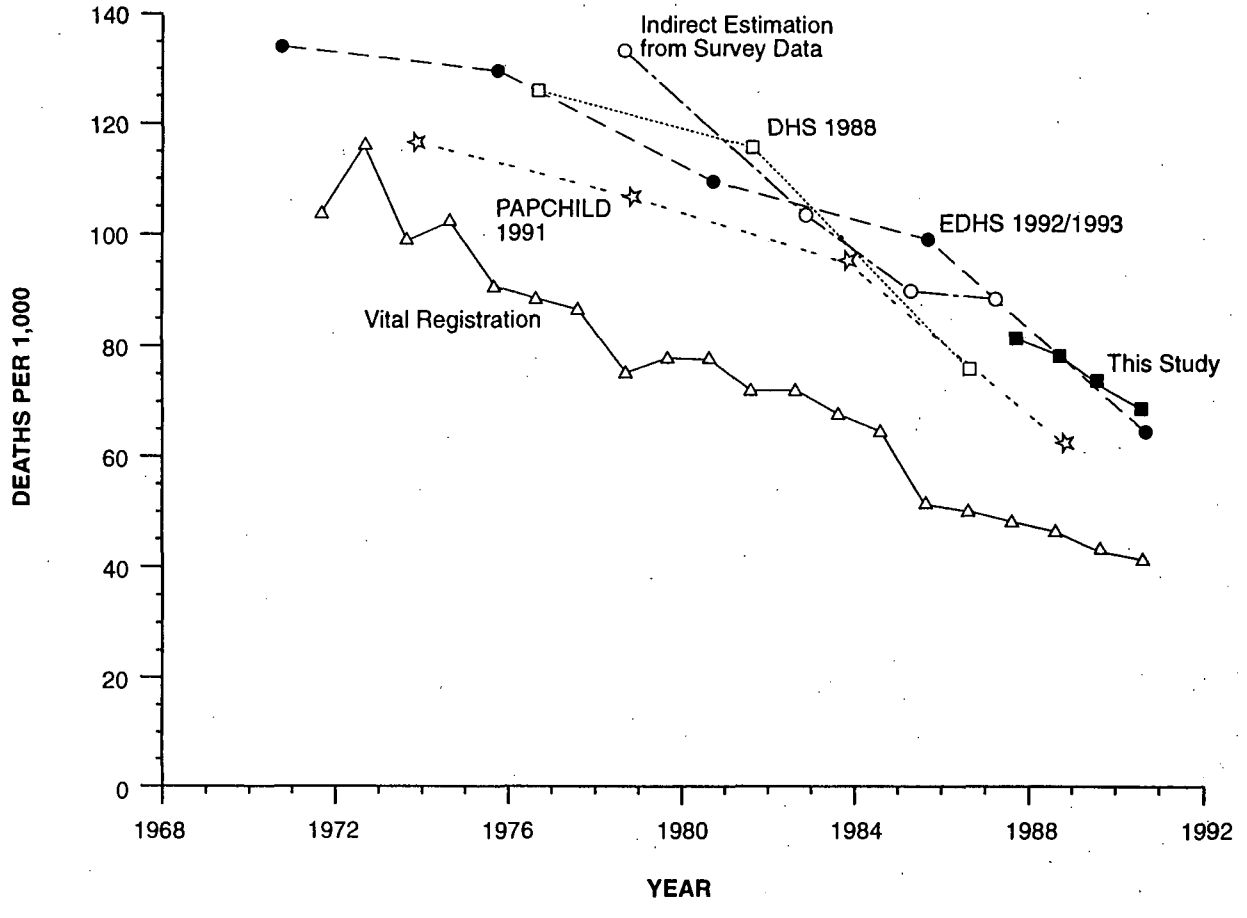
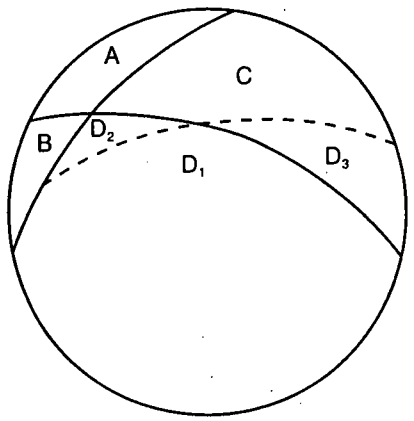


FIGURE 4. DIAGRAM SHOWING POSSIBLE OUTCOMES FOR ALL UNDER-5 DEATHS TO WOMEN IN THE PAPCHILD AND DHS SURVEYS IN RELATION TO DEATH REPORTS IN VITAL REGISTRATION, THE SURVEYS, AND THE FOLLOW-UP VERBAL AUTOPSY INTERVIEW



KEY

A	Deaths that were neither registered nor reported in the survey
$B + D_1 + D_2$	Registered deaths
$\underline{C + D_1 + D_2 + D_3}$	Deaths reported in the survey
B	Registered deaths not reported in the survey
C	Deaths reported in the survey but neither registered nor reported as notified in the verbal autopsy interview
$\underline{D_1}$	Deaths registered, reported in the survey and reported as notified in the verbal autopsy interview
D_2	Deaths registered and reported in the survey but not reported as notified in the verbal autopsy interview
$\underline{D_3}$	Deaths reported in the survey and reported as notified but not actually registered
$\underline{D_1 + D_3}$	Deaths reported as notified in the verbal autopsy interview

*Underlined quantities were estimated directly in this study.

reinterview consistency, however, this effect probably would be small, if it exists.

As a summary, Figure 4 shows the possible categories in regard to reporting for under-5 deaths to women who took part in the PAPCHILD and EDHS surveys. The figure includes the distinction between whether or not deaths reported in the original surveys were reported as notified in the follow-up verbal autopsy interview. The diagram is useful for conceptualizing the possible outcomes, but because most of the quantities were unobserved, the relative sizes (areas) of the components remain unknown.

Neonatal deaths are grossly underregistered in the Egyptian vital registration system. Because these constitute a large proportion of infant deaths and are often due to congenital causes, birth trauma, or tetanus, both the level and the cause-of-death distribution for registered infant deaths are distorted. To increase coverage of these deaths, innovative approaches are needed. As the proportion of births delivered in health facilities increases above 25% (El-Zanaty et al. 1993), the level of registration of infant deaths will improve.

Infant death registration in Egypt is listed as complete (above 90% coverage) by the United Nations (1994). The data presented here, however, lead us to question this classification. The age pattern of underregistration documented in this study is common in developing nations. A study in Thailand (Lumbiganon et al. 1990), for example, found 45% of infant deaths missed by the registration system; in most of these cases the death occurred before the birth had been registered. Registration of neonatal deaths must be improved.

Accurate mortality data in developing nations are needed for evaluation of health intervention programs (e.g., Foster 1993). In Egypt the national programs for controlling diarrheal diseases and acute respiratory infections both rely on mortality data to judge their effectiveness (e.g., El-Rafia et al. 1990; Rashad 1992). Typical demographic and health surveys can provide reasonable estimates of infant and child mortality, but sample sizes are far too small to allow detection of changes in cause-specific mortality; for this purpose we need rates based on registered events. From this perspective, further efforts to improve coverage of vital registration are clearly warranted.

REFERENCES

Abdel-Azeem, F., S.M. Farid, and A.M. Khalifa. 1993. *Egypt Maternal and Child Health Survey 1991*. Cairo: Pan Arab Project for Child Development.

Bucht, B. and M.A. El-Badry. 1986. "Reflections on Recent Levels and Trends of Fertility and Mortality in Egypt." *Population Studies* 40:101–14.

CAPMAS, 1976. "Underregistration in Vital Event Surveys." Mimeographed document, CAPMAS.

———. 1989. *Infant and Child Mortality Rates in Egypt 1980–87*. Cairo: CAPMAS.

———. 1993. "Tabulations of Mortality by Cause and Governorate." Unpublished document, CAPMAS.

Chandra-Sekar, C. and W.E. Deming. 1949. "On a Method of Estimating Birth and Death Rates and the Extent of Registration." *Journal of the American Statistical Association* 44:101–15.

Chiang, C.L. 1984. *The Life Table and Its Applications*. New York: Wiley.

Dean, A.G. 1990. *Epi Info: Version 5*. Stone Mountain, GA: USD, Inc.

El-Deeb, B. 1990. "The Level of Completeness Among Infant Deaths in Egypt." Unpublished document, Population Council.

El-Rafie, M., W.A. Hassouna, N. Hirschhorn, S. Loza, P. Miller, A.

Nagaty, A. Nasser, and S. Riyad. 1990. "Effects of Diarrheal Disease Control on Infant and Child Mortality in Egypt." *Lancet* 335:334–38.

El-Zanaty, F., H.A.A. Sayed, H.H.M. Zaky, and A.A. Way. 1993. *Egypt Demographic and Health Survey 1992*. Cairo: National Population Council.

Foster, S.O. 1993. "Monitoring Child Survival Programs in Africa: The African Child Survival Initiative: Background." *International Journal of Epidemiology* 22(1):S2–7.

Hill, K., R. Pande, and G. Jones. Forthcoming. *Trends in Infant and Child Mortality 1960–1995*. New York: UNICEF.

Hosmer, D. and S. Lemeshow. 1989. *Applied Logistic Regression*. New York: Wiley.

Langsten, R. and K. Hill. 1994. "Diarrhoeal Disease, Oral Rehydration, and Childhood Mortality in Rural Egypt." *Journal of Tropical Pediatrics* 40:272–78.

Lumbiganon, P., M. Panamonta, M. Laopaiboon, S. Pothinam, and N. Patithat. 1990. "Why Are Thai Official Perinatal and Infant Mortality Rates So Low?" *International Journal of Epidemiology* 19:997–1000.

Mohamed, T. 1990. "Registration of Births and Infants' Deaths in Demo Village in Fayoum Governorate." *Journal of the Egyptian Public Health Association* 65:207–20.

National Academy of Sciences, 1982. *The Estimation of Recent Trends in Fertility and Mortality in Egypt*. Washington, DC: National Academy Press.

Rashad, H. 1992. "The Mortality Impact of Oral Rehydration Therapy in Egypt: Re-Appraisal of Evidence." Pp. 135–60 in *Child Health Priorities for the 1990s*, edited by K. Hill. Baltimore: Johns Hopkins University, Institute for International Programs.

SAS Institute. 1990. *SAS/STAT User's Guide*, Vols. 1 and 2, Version 6. 4th Ed. Cary, NC: SAS.

Sullivan, J.M., G.T. Bicego, and S.O. Rutstein. 1990. "Assessment of the Quality of Data Used for the Direct Estimation of Infant and Child Mortality in the Demographic and Health Surveys." Pp. 115–37 in *An Assessment of DHS-I Data Quality*. Columbia, MD: Institute for Resource Development.

United Nations. 1983, *Manual X: Indirect Techniques for Demographic Estimation*. New York: United Nations.

———. 1994. *Demographic Yearbook 1992*. New York: United Nations.

PUBLICATIONS OF THE IIVRS TECHNICAL PAPERS

1. A Programme for Measurement of Life and Death in Ghana, D.C. Mehta and J.B. Assie, June 1979
2. Vital Statistics System of Japan, Kozo Ueda and Masasuke Omori, August 1979
3. System of Identity Numbers in the Swedish Population Register, Karl-Johan Nilsson, September 1979
4. Vital Registration and Marriage in England and Wales, Office of Population Censuses and Surveys, London, October 1979
5. Civil Registration in the Republic of Argentina, Jorge P. Seara and Marcelo E. Martin, November 1979
6. Coordinating Role of National Committees on Vital Health Statistics, World Health Organization, Geneva, January 1980
7. Human Rights and Registration of Vital Events, Nora P. Powell, March 1980
8. The Organization of the Civil Registration System of the United States, Anders S. Lunde, May 1980
9. Organization of Civil Registration and Vital Statistics System in India, P. Padmanabha, July 1980
10. Registration of Vital Events in Iraq, Adnan S. Al-Rabie, September 1980
11. Generation of Vital Statistics in Mexico, General Bureau of Statistics, Mexico, November 1980
12. Age Estimation Committee in Qatar, Sayed A. Taj El Din, December 1980
13. The Development of the Vital Statistics System in Egypt, Gamal Askar, January 1981
14. Vital Statistics Data Collection and Compilation System: Hong Kong, Donna Shum, March 1981
15. Major Obstacles in Achieving Satisfactory Registration Practices and Vital Events and the Compilation of Reliable Vital Statistics, IIVRS, May 1981
16. Methods and Problems of Civil Registration Practices and Vital Statistics Collection in Africa, Toma J. Makannah, July 1981
17. Status of Civil Registration and Vital Statistics in El Salvador, Enrique Olmado Sosa, July 1982
18. Recommendations from Regional Conferences and Seminars on Civil Registration and Vital Statistics, IIVRS, September 1982
19. Potentials of Records and Statistics from Civil Registration Systems for Health Administration and Research, Iwao M. Moriyama, September 1982
20. Improving Civil Registration Systems in Developing Countries, Forrest E. Linder, October 1982
21. Social Indicators Derived from Vital Statistics, Nora P. Powell, November 1982
22. The Operation of the Vital Statistics System of the United States of America, Anders S. Lunde, April 1983
23. Demographic Information from Vital Registration Offices in Mexico, 1982, Juan Carlos Padilla, Jose Garcia Nunez and Jaime Luis Padilla, June 1983
24. General Description of Population Registration in Finland, Hannu Tulkki, July 1983
25. The National Importance of Civil Registration and the Urgency of Its Adaptation to a Modern Society, Committee on Legal and Organizational Requirements for a Civil Registration System in Latin America, August 1983
26. Study of A Civil Registration System of Births and Deaths—An Experiment in Afghanistan, B.L. Bhan, October 1983
27. Actions for the Improvement of Civil Registration and Vital Statistics, IIVRS, December 1983
28. Urgently Needed Reforms in Civil Registration in Asian Countries, IIVRS, October 1986
29. Organization and Status of Civil Registration and Vital Statistics in Various Countries of the World, IIVRS, December 1986
30. The Status of Civil Registration and the Collection of Vital Statistics through Alternative Sources in Papua New Guinea, M.L. Bakker, July 1987
31. Organization and Status of Civil Registration in Africa and Recommendations for Improvement, IIVRS, April 1988
32. Registration of Vital Events in the English-speaking Caribbean, G. W. Roberts, June 1988
33. Organization and Status of Civil Registration and Vital Statistics in Arab Countries, IIVRS, October 1988
34. Recommendations from Regional Conferences and Seminars on Civil Registration and Vital Statistics: An Update, IIVRS, November 1988
35. Health Data Issues for Primary Health Care Delivery Systems in Developing Countries, Vito M. Logrillo, N.Y. State Department of Health, May 1989
36. Considerations in the Organization of National Civil Registration and Vital Statistics Systems, Iwao M. Moriyama, July 1989
37. Approaches to Data Collection on Fertility and Mortality for the Estimation of Vital Rates, December 1985, United Nations Statistical Office, September 1989
38. Publicity Plans for Registration Promotion, K. K. Rastogi, Office of Registrar General, India, November 1989
39. Some Observations on Civil Registration in French-speaking Africa, Michel Francois, Institut National de la Statistique et des Etudes Economiques/Centre Francais sur la Population et le Developpement, February 1990
40. Automation of Vital Registration Systems in the United States; A Summary of Selected States' Activities, Vito M. Logrillo, N.Y. State Department of Health, April 1990
41. The Development and Organization of Civil Registration in Sri Lanka, D.S. Munasinghe, July 1990
42. Computerisation of the Indexes to the Statutory Registers of Births, Deaths, and Marriages in Scotland, David Brownlee, October 1990
43. Measurement of Birth and Death Registration Completeness, Iwao M. Moriyama, November 1990
44. Reforms in the Civil Registration and Vital Statistics Systems of Morocco, Violeta Gonzales-Diaz, United Nations Statistical Office, April 1991
45. The Impact of Cause-of-Death Querying, H.M. Rosenberg, Ph.D., National Center for Health Statistics, U.S.A., June 1991
46. Incomplete Registration of Births in Civil Systems: The Example of Ontario, Canada, 1900-1960, George Emery, Department of History, University of Western Ontario, August 1991

47. The Vital Registration and Statistics Systems in Libya and its Improvement, Dr. Abdus Sattar, Census and Statistics Department, Libya, September 1991
48. Proceedings of International Statistical Institute Session on Recent Actions to Improve Civil Registration and Vital Statistics, Cairo, September 1991, November 1991
49. Completeness and Reliability of Birth and Death Notifications in Kuwait, Nasra M. Shah, Ali Mohammad Al-Sayed, Makhdoom A. Shah, Kuwait, March 1992
50. Automation of Mortality Data Coding and Processing in the United States of America, Robert A. Israel, National Center for Health Statistics, USA, June 1992
51. Approaches to the Measurement of Childhood Mortality: A Comparative Review, Kenneth Hill, Johns Hopkins University, School of Hygiene and Public Health; September 1992
52. Proceedings of the IAOS Third Independent Conference Session on Civil Registration and Vital Statistics, Ankara, Turkey, September 1992; December 1992
53. Measurement of Adult Mortality in Less Developed Countries: A Comparative Review, Ian M. Timaeus, Centre for Population Studies, London School of Hygiene & Tropical Medicine, February 1993
54. Death Registration and Mortality Statistics in Colombia, Francisco Z. Gil, Departamento Administrative Nacional de Estadistica (DANE), Colombia, November 1992; April 1993
55. Historical Development of Cause of Death Statistics, Iwao M. Moriyama, September 1993
56. Correcting the Undercount in Maternal Mortality, M. S. Zdeb, V. M. Logrillo, M. A. Ellrott, New York State Department of Health, U. S. A., November 1993
57. Techniques for Evaluating Completeness of Death Reporting, Eduardo E. Arriaga and Associates, Center for International Research, U. S. Bureau of the Census, June 1993; June 1994
58. Are Live and Stillbirths Comparable All Over Europe? Legal definitions and vital registration data processing. Catherine Gourbin and Godelieve Masuy-Stroobant, Institute de Démographie, Université catholique de Louvain, 1993; August 1994
59. An Evaluation of Vital Registers as Sources of Data for Infant Mortality Rates in Cameroon, Isaiah Ndong, Stephen Gloyd and James Gale; International Journal of Epidermiology, Vol 23 No. 3, June 1994, October 1994
60. The Estimation of Fertility from Incomplete Birth Registration Data for Indian Towns and Cities, G. S. Somawat, Demography India, Vol 19, No. 2 (1990) pp. 279-287; February 1995
61. The Evaluation of the Completeness of Death Registration in the Presence of High Net Out-Migration: The Case Example of Mauritius, Salaiman Bah, Population Studies Programme, University of Zimbabwe, 1995
62. Comparative Analysis of Deaths Registered in the Civil Registration of Cameroon: The Case of the Mayoralties of Yaoundé (1986 - 1993), Samuel Kelodjoue, October 1995
63. Organization of National Civil Registration and Vital Statistics Systems: An Update. IIVRS December 1995
64. Comparability of the Birth Certificate and 1988 Maternal and Infant Health Survey, Kenneth C. Schoendor, M.D., M.P.H., Jennifer D. Parker, Ph.D., Leonid Z. Batkhan, Ph.D., John L. Kiely, Ph.D., Division of Analysis, National Center for Health Statistics, 1993; 1996
65. The Impact of Computerization on Population Registration in Sweden, Ingrid Svedberg, Swedish Tax Administration, 1996
66. The Civil Registration System in Denmark, Casper Malig, Central Office of Civil Registration, Denmark, 1996
67. Role of Technology in the Civil Registration Process, Vito M. Logrillo, IIVRS, June 1997
68. Comparability of the Death Certificate and the 1986 National Mortality Followback Study, Gail S. Poe, Eve Powell-Griner, Joseph K. McLaughlin, Paul J. Placek, Gray B. Thompson, and Kathy Robinson, October 1997
69. Organizational Structure for Civil Registration and Vital Statistics Systems, Vito Logrillo, October 1997
70. Legal Aspects of Civil Registration in the Philippines, Jose C. Sison, Rene L. Cayetano, and Rene A. V. Saguisag, October 1997
71. Estimating the Completeness of Under-5 Death Registration in Egypt. Stan Becker, Yousseff Waheeb, Bothaina El-Deeb, Nagwa Khallaf, and Robert Black. Demography Vol. 33-No. 3, August 1996