Evaluation of child deaths registration in a Jordanian community

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تقييم تسجيل وفيات الأطفال في مجتمع أردني

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الخلاصة: أُجريت دراسة مسح سكانية منزلية في منطقة دير الله خلال الفترة من تموز/يوليو إلى آب/أغسطس 2002 بهدف التعرُّف على مدى النقص في تسجيل وفيات الأطفال والإملاص (الوِلْدان الذين ولدوا موتى)، وتقدير معدل وفيات الرضَّع والأطفال دون 5 سنوات، والتعرُّف على العوامل التي تؤثِّر في نقص التسجيل. وقد قابَلَ الباحثان 1024 امرأة تراوحت أعمارهن بين 15 و49 عاماً وسألاهن عن الوفيات في الولادات الثلاث الأخيرة. وتم استخدام إخراجة معدَّلة من استبيان وقائع وفيات المواليد. وقد وجد الباحثان أن 72.2٪ من وفيات الأطفال، بما في ذلك الخمسة والأربعون وليداً الذين وُلدوا أمواتاً، لم يتم تسجيلهم. كما وجدا أن نقص التسجيل ارتبط أساساً بعمر الطفل عند الوفاة، وأن المعطيات الخاصة بالمواليد الذين ولدوا موتَى والرضَّع الموتَى الذين تقلّ أعمارهم عن سنة واحدة، لا تسجل على الأرجح. ولذلك فإن المعدَّل المعلَن عنه رسمياً لوفيات الرضَّع لا يُعَدّ مؤشراً يمكن الوثوق به.

ABSTRACT A retrospective population-based household survey was conducted in Deir-Alla district during July–August 2002. The aim was to determine the extent of under-registration of child deaths and stillbirths, estimate infant mortality and under-5 mortality rates and identify factors affecting under-registration. We interviewed 1024 women aged 15–49 years about deaths in the last 3 children born. A modified version of the preceding birth mortality questionnaire was used. We found 72.2% of child deaths, including all 45 stillbirths, were unregistered. Under-registration was significantly related to child's age at death, stillbirths and dead infants < 1 year being more likely to be unregistered. The officially published infant mortality rate is not a credible indicator of infant deaths.

Évaluation de l'enregistrement des décès d'enfants dans une communauté jordanienne

RÉSUMÉ Une enquête rétrospective sur les ménages dans une population définie a été réalisée dans le district de Deir Alla en juillet et août 2002. L'objectif était de déterminer l'ampleur du sous-enregistrement des décès d'enfants et des mortinaissances, d'estimer les taux de mortalité infantile et des moins de 5 ans et d'identifier les facteurs qui affectent le sous-enregistrement. Nous avons interrogé 1024 femmes âgées de 15 à 49 ans en ce qui concerne les décès survenus chez leurs trois derniers enfants nés. Une version modifiée du questionnaire sur la mortalité selon la technique de la naissance précédente a été utilisée. Nous avons trouvé que 72,2 % des décès d'enfants, y compris l'ensemble des 45 mortinaissances, n'étaient pas enregistrés. Le sous-enregistrement était significativement associé à l'âge de l'enfant au moment du décès - les mortinaissances et les nourrissons décédés avant l'âge d'un an étant plus susceptibles de ne pas être enregistrés. Le taux de mortalité infantile officiellement publié n'est pas un indicateur crédible des décès infantiles.

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Introduction

The study area was Deir-Alla district, population 49 000, in Balqa governorate, located in the central part of the Jordan Valley about 50 kilometres west of Amman. The population structure, marital status, housing and socioeconomic characteristics of people in Deir-Alla are similar to those of Jordan in general [*1*].

Like all other districts and governorates in Jordan, Deir-Alla has its own civil register office, the Directorate of Civil Status, which is linked with the central Department of Civil Status in Amman. One of the duties of the Directorate of Civil Status is the documentation of all births and deaths that occur in the district. According to Law of Civil Status No. 34 of 1973, notification should be done within 30 days of the event. The notification procedure for deaths in Jordan is free of charge and requires only completion of the notification form by the closest relatives of the deceased.

In countries where data on infant deaths and births are complete, the infant mortality rate can be calculated directly. When such data are not available from registration systems, the infant mortality rate and child (under-5) mortality rate can be calculated through indirect or modelling methods, based on specific questions asked in retrospective surveys [*2*]. For this purpose, the Brass method and the preceding birth technique were developed to measure childhood mortality, especially in developing countries.

Since the Brass method is not the perfect measurement of probability of dying by age 1 because of the very small, unrepresentative percentage of ever-married women 15–19 years—age at marriage (Jordan included) is generally later—it is better to calculate the probability of dying by age 1 year (infant mortality rate) and by age 5 years (under-5 mortality rate) using the preceding birth technique [*3*].

Using the preceding birth technique, which depends on the survival of the children from preceding births, makes up for faulty and incomplete registration of child mortality and at the same time can easily pick up mortality changes (A.G. Hill, H. Rashad, unpublished report, 1988) [*4*]. This widely used technique has the special attraction of simplicity [*5*]. The key question put to mothers with at least 1 previous delivery is whether their previous liveborn child is living or dead at the time of the interview [*2,6*]. Total births rather than live births are used to express mortality estimated by this method (A. Alkafajei, C.N. Alzubaidi, unpublished report, 1996) [*7,8*].

The preceding birth technique was tested in many developing countries. In our Region, a survey using the technique was conducted in Iraq in 1994 in which probability of dying by age 1 was calculated to be 62 per 1000 births and probability of dying by age 5 was 100 per 1000 births (A. Alkafajei, C.N. Alzubaidi, unpublished report, 1996). Ministries of health, in close cooperation with the United Nations Children's Fund, conducted another 3 surveys in the Syrian Arab Republic, Egypt and Jordan in the 1980s for the review of the Expanded Programme on Immunization in which questions about the survival of children were included [*3*].

According to the data produced by the Department of Statistics in Jordan, the crude birth rate for Deir-Alla district is identical to that of the whole country (29/1000) [*1*]. The infant mortality rate for Jordan (2000) is 31.3 per 1000 live births, while the under-5 mortality rate is reported to be 33 per 1000 live births [*9,10*]. About 24% of deliveries in Jordan happen at home [*11*].

A fertility survey is periodically conducted in Jordan by the Department of Statistics in cooperation with the Ministry of Health, but neither the proportion of unregistered deaths nor the effectiveness of the vital register has been investigated by these surveys [*12,13*]. The current household survey is an attempt to fill this gap. The results should be used to initiate steps towards promoting the development of vital registration in Jordan with a view to producing a complete register of vital events. Our findings could be used as a basis for informed decision-making in the process of health care planning in Jordan.

The goal of this study was to evaluate the registration status of stillbirths and child deaths in Deir-Alla district. Specific objectives were to determine the extent of underregistration of child deaths and stillbirths, to estimate infant and under-5 mortality rates and to identify factors affecting the underregistration of stillbirths and child deaths.

Methods

Retrospective population-based survey

In order to achieve the set objectives, the following 2 methods were used: the preceding birth technique, recommended by the World Health Organization and the United Nations Children's Fund for the estimation of mortality rates using a retrospective population-based survey, and a review and analysis of births and child deaths officially registered at Deir-Alla office of civil status over the 5 years prior to the survey (1 January 1998 to 13 July 2002).

A modified version of the preceding birth technique mortality questionnaire, module A, was used to obtain data about child deaths in a period close to the date of the survey [*3*]. The questionnaire was translated into simple Arabic from the English version. Then another translator translated it back into English and a final Arabic version was adopted.

Keeping the core mortality module as it was, the modified version of the questionnaire had 4 parts in addition to the introductory paragraph. The first part included general information about the interview. The second part, which was introduced for the purposes of the current study, included questions about sociodemographic attributes of the woman being interviewed and her husband (age, level of education and occupation). The third part of the questionnaire consisted of 8 questions about children born to the woman being interviewed (liveborn and stillbirths). The fourth part asked for information about the woman's last 3 births (preceding birth questions) beginning with the last (youngest) child, then the second last then the third last. This information included name, sex, date of birth, place of birth (added in the current study) and survival status of each child. If the child was dead or stillborn, then the interviewer asked about the child's age at death, registration status of the child's death (added in the current study) and availability of the death certificate if the death was registered. Where no birth certificate or death certificate was available, the mother was asked to estimate the most accurate month and year of birth and death.

Sampling technique

Ever-married women of reproductive age (15–49 years) in Deir-Alla district were considered eligible women (index women). A household in which at least 1 eligible woman was living was considered a unit of study.

The first stage was to calculate the sample size. Adopting the formulae recommended by the World Health Organization, the required sample was calculated to be

1024 [*14*]. In Jordan, the proportion of ever-married women in the age group 15–49 is estimated at 55% [*15*]. Dividing the sample size (1024 index women) by 0.55, we would need to visit a total of 1862 women to get the required number of index women (1024). Since each household contains at least 1 eligible woman, a total of 1862 households had to be visited in order to accomplish the required number of interviews.

The second stage of sampling was to determine the number of clusters of households to be selected. For this purpose, the total number of households to be visited (1862) was divided by the mean number of interviews to be done in 1 day. The team of 3 interviewers could accomplish 75 interviews per day. The required number of clusters would be 1862/75 = 25.

The third stage was selecting clusters. The clusters in Deir-Alla were assigned by the Department of Statistics in Amman, based on the framework provided by the 1994 population census. For this purpose, population settlements in the study area were classified into 2 strata: urban (settlements of ≥ 5000 inhabitants) and rural (settlements of < 5000 inhabitants) [*12*]. Taking into consideration population size and geographic location, settlements in the 2 strata were divided into 100 clusters. Then the clusters were ordered according to the number of families, lowest to highest. Using a systematic sampling technique (every 4th cluster) primary sampling units of 25 clusters with a total number of 1865 families were selected.

A further stage was to select households to be interviewed inside each cluster. The number of households needed in each cluster was calculated by probability proportionate to size as follows. Selected clusters were put in ascending order. The first cluster contained 17 families (households), 1% of the 1865. The number of interviews to be done within this cluster should thus be 1% of the sample size, i.e. 1% of 1024, 10 completed interviews. The proportion of families in the second cluster comprised 2.5% of the total number of families in the 25 clusters. So the same proportion of women were to be interviewed; 2.5% of 1024, i.e. 26 completed interviews, were done within this cluster, and so on for the remaining clusters achieving a total number of 1024 interviews.

Data collection

Three qualified nurses were selected from the local community and trained to perform interviews. These nurses were familiar with the people and geography of Deir-Alla. They completed a 1-day field training course before conducting the pilot study, which was also an opportunity for further training. Field data collection took place during July and August 2002 and lasted for 17 working days. Interviews were conducted in the afternoon to ensure that almost all target women were at home.

Data analysis

Data entry and analysis was carried out using *SPSS*. Correlation between the dependent variable, i.e. registration of child death, and variables such as child's sex, child's age at death, place of birth and mother's and father's attributes was assessed using chi-squared tests. The survival status according to birth order (last, second last and third last) was assessed by chi-squared test for linear trend. *P*-value ≤ 0.05 was considered significant.

For the purpose of calculating the probability of dying by age 1 (infant mortality), 2 and 5 years the steps adopted in the previous birth technique were used [*3*].

Results

Survival status

Survival status of children according to mother's age is shown in Table 1. Because of the small number of women in this age group who were married, an extremely small number of children (6) were born to women aged 15–19 years. Women in this age group reported no dead children. The highest number of children born (1358) was reported for women 45–49 years. The mean number of children born was 8.5/woman. Mothers who had completed their reproductive life (45–49 years) had the highest child mortality. There was a small excess risk of child deaths among younger mothers, age 20–24 years, compared to the 3 succeeding age groups.

Out of the total 4963 children born, 2511 (50.6%) were male, and 2452 (49.4%) were female, giving a male to female ratio of 1.02:1. The total number of children who had died, including stillbirths, was 484 (9.8%).

The distribution of the last 3 children born according to survival status is shown in Table 2. The total for last child born was less than 1024 because 101 of the women interviewed had no children. There was a significant (increasing) linear trend in deaths according to birth order. There were more deaths for the third last children born than for the second last, for whom, in turn, there were more deaths than the last-born children. A significant reversed trend was observed regarding the living children. No such trend was noted for stillbirths.

The number of children who died after birth among the last 3 births was 99. Dividing this number by the total liveborn children (2417) gives a probability of dying of 41.0 per 1000 live births.

The total number of stillbirths for the last 3 births was 45, 18.3 per 1000 total births (2462 stillbirths plus live births).

Registration status

The registration status of deaths for the last 3 children born combined is shown in Table 3. Of 144 dead children in the last 3 births (stillbirths included), 104 (72.2%) were unregistered. All 45 stillbirths were unregistered.

A comparison between child deaths registered at the civil register office in Deir-Alla district over the 5 years 1998–2002 (61 children) and children who died among the last 3 children born (90 children) investi-

Table 1 **Children born by age of women surveyed**

Mother's age (years)	Births No.	Sons living No.	%	Daughters living No.	%	Sons dead No.	%	Daughters dead No.	%
15–19	6	2	33.3	4	66.6	0	–	0	–
20–24	202	101	50.0	83	41.1	13	6.4	5	2.5
25–29	427	215	50.4	180	42.2	19	4.4	13	3.0
30–34	989	492	49.7	414	41.9	46	4.7	37	3.7
35–39	893	380	42.6	438	49.0	40	4.5	35	3.9
40–44	1088	483	44.4	496	45.6	59	5.4	50	4.6
45–49	1358	571	42.0	620	45.7	90	6.6	77	5.7
Total	4963	2244	45.2	2235	45.0	267	5.4	217	4.4

Table 2 **Survival status of children for the last 3 children born**

Status	Last child		Second-to-last		Third-to-last		*P*-value[a]
	No.	%	No.	%	No.	%	
Living	883	95.7	782	94.4	653	91.8	0.004
Dead	26	2.8	29	3.5	44	6.2	0.001
Stillborn	14	1.5	17	2.1	14	2.0	0.667
Total	923	100.0	828	100.0	711	100.0	

[a]*Using chi-squared test for linear trend.*

gated during our study (stillbirths excluded) regarding their age at death is shown in Table 4. For this purpose, age at death was classified into 3 categories: neonatal deaths (1–30 days), post-neonatal deaths (31–364 days) and child deaths (≥ 365 days). Neonatal deaths comprised 59.8% of deaths in our study but only 26.2% of deaths on the civil register. The difference was statistically significant ($P < 0.001$). Almost 84% of deaths in our study were infants (post-neonatal deaths) while infants constituted about 66% of the deaths on the civil register; again the difference was statistically significant ($P = 0.011$).

Factors affecting under-registration of deaths

Analysis of the effect of selected variables was done for 96 dead children and 45 stillbirths (Table 5). Age at death was the only variable significantly associated with non-registration.

Table 3 **Registration status of deaths for the last 3 children born**

Status	No. of children		
	Dead	Stillborn	Total
Registered	37	–	37
Unregistered	59	45	104
Unknown	3	–	3
Total	99	45	144

We analysed the influence of the mother's and father's characteristics on registration of deaths among the last 3 children born. No statistical association was found between under-registration of child deaths and parents' age, level of education or occupation status.

Calculation of child mortality rates

The previous birth technique was used to calculate probability of dying by age 1 year, 2 years and 5 years in Deir-Alla [*3*].

For the calculation of overall probability of dying for the preceding child, only women who had given birth in the past 2 years and had at least 1 preceding birth were included in the analysis. It was found that 302 women had had a preceding birth (in addition to the most recent birth); 282 of the children born were living, giving an

Table 4 **Proportion of deaths in children who were born alive according to age at death: comparison of officially registered deaths and those detected during the current study**

Age at death (days)	Proportion of total deaths (%)	
	Current study (*n* = 90)	Civil register (*n* = 61)
1–30	59.8	26.2
31–364	23.9	39.4
≥ 365	16.3	34.4
Total	100	100

Table 5 **Registration of child deaths according to selected variables**[a]

Variable	Total No.	Unregistered No.	%	*P*-value
Age at death[b] *(days) (*n *= 90)*				
1–30	45	34	75.6	< 0.001
31–364	30	17	56.7	
≥ 365	15	2	13.3	
*Sex (*n *= 141*[c]*)*				
Male	75	57	76.0	0.519
Female	66	47	71.2	
*Place of birth (*n *= 96)*				
Hospital	66	42	63.6	0.515
Home	30	17	56.7	
*Place of birth for stillborn babies (*n *= 45)*				
Hospital	31	31	100	N/A
Home	14	14	100	

[a] *Three deaths where the registration status was unknown were omitted from analysis.*
[b] *Six children of unknown age at death have been excluded.*
[c] *Liveborn children who have died plus stillbirths.*
N/A = not applicable.

overall probability of dying for the second last child of 0.066.

We calculated of the mean age (a) of last-born children [living and dead (age at death)] up to the date of the survey. Mean age of the last-born child (a) = sum of ages of all last-born children/total number of last-born children = 256.7/302 = 0.85 years = 10.2 months.

We then calculated the mean age to which the probability of dying, q(x), for the preceding child refers for the survey sample using the following equation:

$$x = (0.8 \times i) + a$$

Where x = mean age to which the probability of dying refers in the survey sample; i = mean birth interval (months) between the last and the preceding birth (because this value was not calculated in the current study, it was decided to use 24 months, the value calculated in the Jordan Fertility Survey conducted in 1986); a = mean age of last-born child in months. Thus, x = 2.45 years (≈ 2.5 years). Therefore, probability of dying by age 2.5 years, q(2.5), = 0.066.

The next step was to choose one of the model life tables established by the United Nations that fitted the probability of dying for the preceding child. For this purpose we chose one of the tables for probability of dying between birth and exact age x as a standard. We used Table A.II.15 "General model values for probabilities of dying q(x), both sexes combined" because it was the most compatible with the Mediterranean region [*2*]. The probability of dying of 0.06802 was the closest to the value estimated for our study, i.e. 0.066.

From this table, it can be seen that:

- probability of dying by age 1 year, q(1), is 0.054,
- probability of dying by age 2 years, q(2), is 0.063
- probability of dying by age 5 years, q(5), is 0.073.

To calculate T(x), the mean time before the survey to which our mortality estimates refer, the following equation, recommended by the World Health Organization, was used [8]:

$$T(x) = (0.667 \times i) + a$$

Where i = mean birth interval for this study, taken as 24 months as for the previous equation; a = mean age of last child born, calculated to be 10.2 months. Then, T(x) = 26.208 months

This means that mortality estimates, namely probability of dying by age 1 year (54 per 1000 total births) for the sample

under study, refer to a time approximately 26 months (≈ 2 years) before the survey, i.e. the year 2000.

Discussion

The preceding birth technique

The use of the preceding birth technique permitted the calculation of child mortality estimates for Deir-Alla district 2 years before the survey was carried out. Getting these recent estimates was possible because of the relatively short birth interval (estimated via the present study) in Jordan of about 24 months.

The mean number of children born to women during their entire childbearing period in the present study was 8.5. A comparable figure (7.3) is reported in *the Jordan annual fertility survey* in 2000 [*13*].

Our study showed a rather unlikely trend in child mortality according to age of mother, showing excess risk of child deaths for younger mothers. Aguirre and Hill also reported excess risk of child deaths amongst younger mothers in a study in Bamako, Mali [*4*]. Their study and other technical work elsewhere have shown that the preceding birth technique is quite robust to errors associated with age of the mother (A. Alkafajei, C.N. Alzubaidi, unpublished report, 1996) [*3*]. These studies also showed that the technique is not greatly affected by mean birth interval if it is not exactly 30 months, as suggested in the original model. Other possible biases that might be associated with the application of the preceding birth technique, such as the effect of previous child death on the length of the succeeding birth interval and omission of women with only 1 birth, have also been shown to be unimportant (A.G. Hill, H. Rashad, unpublished report, 1988) [*4, 16*].

Under-registration of child deaths

A marked consistency was noted between the age structure of ever-married women interviewed during our study and that of women interviewed for *the Jordan annual fertility survey* in 2000 [*13*]. The highest proportion of ever-married women fell in the age group 30–34 years.

Despite the fact that registration of child deaths in Jordan is free of charge and is an easy procedure, our study revealed that more than two thirds (72.2%) of child deaths and stillbirths were not registered at the department of civil status, indicating a serious gap in the reporting of child deaths. Several studies have established that the phenomenon of under-registration of child deaths is a common trait in both developing communities and industrialized countries. In Egypt, the under-registration of infant deaths was estimated at 43% [*17*], while the under-registration rate of infant deaths in Thailand reported in 1990 was 45% [*18*]. The under-registration rate found in our study is slightly lower than that reported by a study conducted in Jamaica in 1993 which revealed an under-registration rate for infant deaths of 75% [*19*]. A much higher under-registration rate for infant deaths (96%) was reported by a study conducted in Cameroon in 1991–92 [*20*].

Under-registration of deaths has also been reported in industrialized countries, although at lower rates. A study conducted in 1993 reported that perinatal deaths in France were underestimated by 28% [*21*]. In another study conducted in the Netherlands during 1983–92, 20 out of 242 perinatal deaths were not registered [*22*].

Child mortality rates

When comparing mortality estimates obtained in the current study (54/1000 for

infant mortality rate and 73/1000 for under-5 mortality rate) with those obtained in the Jordan Expanded Programme on Immunization survey conducted in 1988 using the preceding birth technique (infant mortality rate 33/1000 and under-5 mortality rate 52/1000) a difference is noticed [*6*]. The lower estimates made in the Expanded Programme on Immunization survey might be attributable to several factors, e.g. misunderstanding among both interviewers and mothers about the need to list all recent births even if the child had died, and the confusion caused by the Arabic translation of "live birth" and "living child". Jordan programme officials used Expanded Programme on Immunization-style listing forms rather than individual preceding birth technique questions as originally proposed, which proved to be unsatisfactory for recording dates of births and deaths.

Comparing our findings with those from official statistics for the year 2000, our estimated infant mortality rate for Deir-Alla district is about twice the officially published infant mortality rate for Jordan as a whole and 4 times that estimated from registered infant deaths in Deir-Alla. For comparison, the infant mortality rate estimated from child deaths which were registered in Deir Alla civil register over the period 1998–2002 is 13.5 per 1000 live births. The official infant mortality rate published by the Ministry of Health for Jordan for the year 2000 is 31.3 per 1000 live births and the under-5 mortality is 33.0 per 1000 live births [*13,15*].

Comparable disparities have been reported in other studies. In a study conducted in Taiwan in 1998, the estimated infant mortality rate was 9.72 per 1000 births, which was almost twice the officially registered rate (5.71 per 1000 births) [*23*]. The same study reported an estimated neonatal death rate of 6.68 per 1000 while the official one was only 1.94 per 1000 births. Estimates of infant mortality in South Africa based on a survey conducted in 1993 and 1994 varied from 11 per 1000 births to 81 per 1000 births depending on the province surveyed, while infant mortality published in the vital register for the same period varied from 40 per 1000 births to 71 per 1000 births [*24*].

Stillbirth rate

The proportion of stillbirths in our study (18.3 per 1000 births) is similar to that reported in a study on perinatal mortality conducted in Cape Province in South Africa in 1989–91, in which stillbirths comprised 17.9 per 1000 births [*25*].

Like the Thai study, in which researchers found that the under-registration of stillbirths was 100% [*18*], our study also revealed 100% under-registration of stillbirths. In comparison, a cross-sectional study in Jamaica revealed that under registration of stillbirths was 87% [*19*].

Factors affecting under-registration of child deaths

Analysis of factors associated with under-registration of stillbirths and infant deaths showed that registration was not related to the sex of the child. The proportion of unregistered deaths among those born in hospitals was higher than those who were at home. Analysis of stillbirths showed that all stillbirths, whether they were born in hospital or at home, were not registered. This indicates that hospitals had no influence on registration and notification of child deaths. The Jamaican study concluded worse results than those revealed in our study: deaths for hospital births were less likely to be registered than deaths in those born in the community, as registrars were not automatically notified of these deaths.

The 100% under-registration of stillbirths compared to 59.6% for children who died after being born alive suggests that people give the registration of stillbirths little attention. Records of the Directorate of Civil Status in Deir-Alla showed no entry for stillbirths for a period of 5 years, 1998 to 2002.

People are obliged by law to register their children when they die after birth. Neonatal deaths were more likely to be unregistered than infant deaths, while infant deaths, in their turn were more likely to be unregistered than deaths happening in children > 1 year of age: the older the child at time of his death, the greater the chance of being registered. This is probably related to the registration of a child's birth to start with. It is common practice for people in Jordan not to register their children immediately after birth; instead, they usually postpone it for days, or maybe weeks or months. If the parents register their child's birth initially, they are required by law to register his death, otherwise they face legal consequences.

The absence of a significant relationship between registration of child death and characteristics of the parents indicates that people behave equally concerning registration of children's deaths, regardless of their age, occupation and education. The high under-registration rate of child deaths found among parents of all ages, all levels of education and of various professions is probably due to causes other than the socio-demographic characteristics of parents. Besides the level of public awareness, the accuracy and completeness of vital registration depends on the effectiveness of the registration system and the mechanism of notification [*26–29*]. The reasons for the high degree of under-registration manifested in our study may be related to the system of notification and registration of child deaths itself.

Conclusions and recommendations

Child mortality estimates made in the current study can, with caution, be generalized to the entire country. These estimates can, however, be reasonably generalized to regions similar in their sociodemographic and economic characteristics to that of Deir-Alla district.

Our finding of child mortality rates higher than those officially published suggests that health planners and decision-makers should consider the officially published child mortality rates underestimates of the actual rates. It is recommended that the stillbirth rate should be published alongside the other officially published child mortality rates.

The high rates of under-registration of stillbirths and infants deaths coupled with the absence of any association between under-registration and parents' characteristics is indicative of pitfalls in the notification and registration system itself. It is recommended that there should be a systematic review with a view to improving the registration system, possibly including the compulsory involvement of hospitals and other health facilities.

Because there was a complete absence of registration of stillbirths and a high neonatal death rate, and because stillbirths and neonatal deaths usually occur in hospitals, it is recommended that hospitals be involved in the notification and registration of stillbirths.

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