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Original Article

The Egypt National Perinatal/Neonatal Mortality Study 2000

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OBJECTIVES:
To estimate stillbirth, perinatal (PMR) and neonatal mortality rates (NMR) in Egypt and to assign main causes of death.

STUDY DESIGN:
Data were collected from a representative sample of women who gave birth from 17,521 households which were included in the Egypt Demographic and Health Survey (EDHS) 2000. Comparisons were made between three systems for classifying causes of death.

RESULTS:
The NMR was 25 per 1000 live births (17 early and eight late). Half the deaths occurred in the first two days of life. Neonatal causes of death were pre-maturity (39%), asphyxia (18%), infections (7%), congenital malformation (6%) and unclassified (29%). The PMR was 34 per 1000 births, mainly attributed to: asphyxia (44%) and prematurity (21%). The revised Wigglesworth classification agreed well with the physicians except the panel attributed more deaths to infections (20%). The WHO verbal autopsy algorithm left 48% of deaths unclassified.

CONCLUSIONS:
Infant mortality in Egypt is showing an epidemiological transition with a significant decrease in mortality, resulting in a disproportionate percentage of deaths in the first week of life. Infant mortality in Egypt declined 64% from 124 per 1000 between 1974 and 1978 to 44 per 1000 between 1995 and 1999, the decline being greatest among older infants; 55% of all infant deaths occurred during the neonatal period. The neonatal mortality rate in this study was estimated to be 25 per 1000 live births.
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INTRODUCTION

There is great overlap between the risks associated with morbidity and mortality in the perinatal and in the neonatal periods. Yet the data available on perinatal mortality in developing countries are limited and the risk associations are generally poorly described. Many countries do not require registration of stillbirths/perinatal deaths, and even when they do, the data are often incomplete.[1–4] Under such conditions, appropriately designed studies using nationally representative samples may offer a useful alternative.

Over the past quarter century, infant mortality in Egypt has declined by 64% from 124 per 1000 between 1974 and 1978[5] to 44 per 1000 between 1995 and 1999.[6] The decline was greatest among older infants, due to the success of infant immunization programs and to programs targeting infant dehydration (due to diarrheal disease) and acute respiratory infections. As a consequence, deaths occurring in the neonatal period have increased as a proportion of the total. The most recent data indicate that 55% of all infant deaths are in the neonatal period (first month of life).[6] This shift from a greater proportion of infant deaths occurring in the early neonatal period rather than in the postneonatal period is consistent with other demographic changes in Egypt. As of the year 2000 Egypt had nearly passed through the demographic transition as evidenced by the nationwide total fertility rate of 3.2 overall and 2.9 in the urban governorates.[7] As neonatal mortality gains importance as a public health priority, we are faced with a paucity of data available on this aspect of child mortality in Egypt and other developing countries where a large proportion of deliveries occur at home.

Cause of death is not usually available for stillborns and neonates dying at home. Even in deaths occurring within health-care facilities the cause of death is often inadequately documented. A significant obstacle in documenting cause of death in neonates is the overlap in presenting signs of illness in many neonatal diagnoses. This problem makes it difficult to identify the exact cause of death without supporting investigation. In these situations a retrospective (verbal autopsy) technique may be the only suitable method for documenting and analyzing the distribution and significance of different causes of mortality. This method is by no means ideal; recall bias and the time interval between the event and the interview is an important limitation. Furthermore, there is no consensus on the optimal classification instrument for stillbirths/neonatal deaths that can be used effectively in the wide spectrum of perinatal mortality rates (PMR) in developing countries.

The objectives of the *Egypt Perinatal and Neonatal Mortality Study 2000* were to establish the national stillbirth/PMR

and neonatal mortality rates (NMR) for Egypt, and to determine the main causes of death in the perinatal and neonatal periods. This study also compared three methods for classifying the cause of stillbirths and neonatal deaths: the WHO standard verbal autopsy method; a revised version of the Wigglesworth classification; and a panel of two Egyptian neonatologists.

METHODS

The study was conducted under the auspices of the Ministry of Health and Population (MOHP). John Snow, Inc. (JSI), the USAID contractor, provided technical assistance and the study manager while the London School of Hygiene and Tropical Medicine (LSHTM) provided the principal investigator. Technical support for the study was provided by the Healthy Mother/Healthy Child Project with funding provided by the United States Agency for International Development (USAID Project No. 263C-00-98-00041-00), Cairo.

This was a retrospective population-based study of stillbirths and neonatal deaths using data obtained from the *Egypt Demographic Health Survey* in 2000 (*EDHS 2000*).[6] The EDHS covered a nationally representative sample of women who gave birth from 17,521 households. Interviews were made with 15,573 ever-married women aged 15 to 49 years over the period February to May 2000 , collecting in-depth information about 11,467 live births in the 0 to 59 months preceding the survey.

For the *Perinatal and Neonatal Mortality Study* all stillbirths and neonatal deaths (in the first 28 days of life) between January 1998 and April 2000 were identified from the *EDHS 2000*. A randomly selected sample of these was followed up with a second questionnaire administered over a 5-day period in July 2000.[6] Three controls were selected per case. These were matched by the primary sampling unit (but not cluster of the case). Controls were ideally selected within ±6 months of the birth of the case. Detailed information was gathered from the mothers about: gestational age and birth size/weight, maternal health problems, antenatal care, infant health problems, infant health-care-seeking behaviors, and cause of death. The mean time interval between the death event and the detailed interview was 18±8 months. The data were collected by means of interviewer administered questions.

The data from *EDHS 2000* were found to be relatively accurate; only 0.7% of the 1352 spontaneous abortions reported needed to be reclassified as stillbirths at the 6-month gestation cutoff, and only 3.6% if the 5-month gestation cutoff was used. In addition four out of 89 expected stillbirths were reclassified as early neonatal deaths. Pregnancy outcomes were calculated after correction for gestational age in the *EDHS 2000*. Other checks on data quality were conducted to verify internal consistency, with good results.

The cause of death was classified using three methods:

- a computer-driven algorithm for the WHO standard verbal autopsy method for investigating causes of death in infants and children;[8,9] A Standard Verbal Autopsy Method for Investigating Causes of Death in Infants and Children (WHO/CDS/CSR/ISR/99.4)
- a computer-driven algorithm for the revised Wigglesworth[10] classification for verbal autopsy of stillbirth and neonatal death; and
- a consensus approach using a panel of two Egyptian neonatologists who reviewed the responses of mothers describing the circumstances and the symptoms at the time of death.

The WHO algorithms have been validated in Nicaragua, Bangladesh and Uganda, although no neonates were included in the latter.[11] The original Wigglesworth classification is a hierarchical system categorizing perinatal deaths in five mutually-exclusive categories.[7,8] This classification has been modified in a variety of ways, but no reports have been made of its use in combination with verbal autopsy. For this study the algorithm was modified in two ways. First, due to uncertainty about whether a death occurred ante- or intrapartum, a new category was created: ''Time of intrauterine death unclear, possibly asphyxial conditions developing in labor or death before the start of labor''. Secondly, the category ''Other specific condition'' or category 5 in the classification was expanded to include the main causes of neonatal death from the WHO verbal autopsy for infant mortality.

The following were calculated: NMR, stillbirth death rates at both five and six completed months of gestation, and PMR including stillbirths at 5 and 6 completed months of gestation. The data from the questionnaires were entered and edited using the Integrated System for Survey Analysis (ISSA), a software package developed especially for the *EDHS 2000*. Data analysis was also conducted using SPSS (ISPSS Package) and STATA (STATA Package). Unless otherwise specified, results on the prevalence of various variables are presented using weights so as to be nationally representative.

RESULTS

After reclassification based on gestational age, 220 perinatal deaths were identified from the EDHS 2000 survey: 93 stillbirths and 117 neonatal deaths. Three-quarters were early neonatal deaths, within the first week of life (30% in the first 23 hours and 46% between 1 and 6 days), and 24% were late neonatal deaths, between 7 and 28 days of life (Table 1).

Thus, the stillbirth rate was 20 per 1000 at 5 months and 17 per 1000 at 6 months of gestation. PMR was 37 and 34 per 1000 births calculated at 5 and 6 completed months pregnancy, respectively. The NMR was 26 per 1000 live births overall (17 in the early period and eight per 1000 live births in the late period).

In India, the NMR was 47.1/1000 live births in the year 1997.[12] In 2003, WHO reported an NMR of 42/1000 live births in India, 44/1000 live births in Nepal and 39/1000 live births in Bangladesh.[13] In the USA, the NMR was reported to be 4.6/1000

Table 1 Distribution of age at death for neonates

	Early neonatal deaths										Late neonatal deaths	
	Hours				Days						Days	
	<1	1	2–12	13–23	1	2	3	4	5	6	7	8–27
No.	10	7	16	2	8	16	13	6	6	5	9	19
% ($n=117$)	9	6	14	2	7	14	11	5	5	4	8	16
Cumulative %	9	15	28	30	37	51	62	67	72	76	84	100

live births in the year 2000 compared to 4.7/1000 live births in the year 1999.[14]

The mean gestational age of neonates was 8.1±1.1 months overall; 7.9±1.1 months for early deaths (day 1 to 6), and 8.6±0.8 months for late deaths (day 7 to 28). The mean gestational age for stillbirths was 7.9±1.3 months. These differences were statistically significant ($p<0.001$).

In all, 84% of stillbirths were at 6 completed months gestation or more. The number of early neonatal deaths was close to the number of stillbirths calculated at 6 months completed gestation. Male babies were a higher proportion of stillbirths (65%) and early neonatal deaths (64%), and a smaller proportion (43%) of late neonatal deaths ($p<0.001$).

More neonates who died early were delivered in a health-care facility (66%) than those dying late (Table 2). Three-quarters (73%) of stillbirths occurred at a health care facility while the rest occurred in the home. A total of 60% of early neonatal deaths occurred in a health-care facility (45% in hospital, 11% in a clinic, 4% others), whereas only 29% of late neonatal deaths occurred in a facility (18% hospital, 11% clinic) (Table 2). It is important to note that 30% of neonates (11/36) dying at home had been seen in, and usually admitted to, a health-care facility (five of the early neonatal deaths and six of the late neonatal deaths). These were largely private facilities (7/11). Of 64 families suffering a neonatal death who had seen a health professional prior to the death, only 25 (39%) were told the cause of death by the provider.

Using the revised Wigglesworth classification, asphyxia (28%) and deaths associated with immaturity (21%) were determined to be the main causes of perinatal death (Figure 1). Other important categories were antepartum stillbirths (7%) and congenital malformations (7%). Stillbirths with time of death unclear comprised 23% of deaths. If these stillbirths are redistributed in the proportions above, asphyxia becomes the most important cause of perinatal death (44%), followed by prematurity (21%), death before the start of labor (14%), and congenital malformations (7%). According to the revised Wigglesworth classification, prematurity was considered the main cause of neonatal deaths (39%), followed by asphyxia (18%), infection (7%), especially in the late neonatal period, and congenital malformations (6%). A substantial proportion (29%) could not be classified (Figure 2).

Table 2 Comparison between place of delivery and place of death for early and late neonates

	No (%) of deaths			
	Place of delivery		Place of death	
	Home	Facility	Home	Facility
Early neonatal deaths (0–6 days) ($n=89$)	30 (34)	59 (66)	36 (40)	53 (60)
Late neonatal death (7–28 days) ($n=28$)	15 (54)	13 (46)	20 (71)	8 (29)

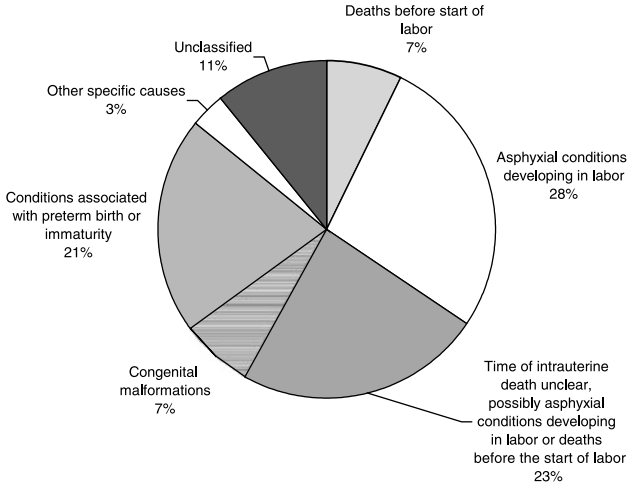

Figure 1. Causes of perinatal death according to revised Wigglesworth classification, Egypt 2000.

Table 3 compares the assignment of neonatal cause of death according to the three classifications used. The WHO verbal autopsy classification had the largest number of unclassified causes (48%) while the physician panel had the lowest (13%). Birth asphyxia and trauma were identified as causes of death in 12% of neonates using the WHO classification, while the revised Wigglesworth and the physician panel agreed on 18%. Infection as a cause of death was assigned to only 7% of the cases using the revised Wigglesworth

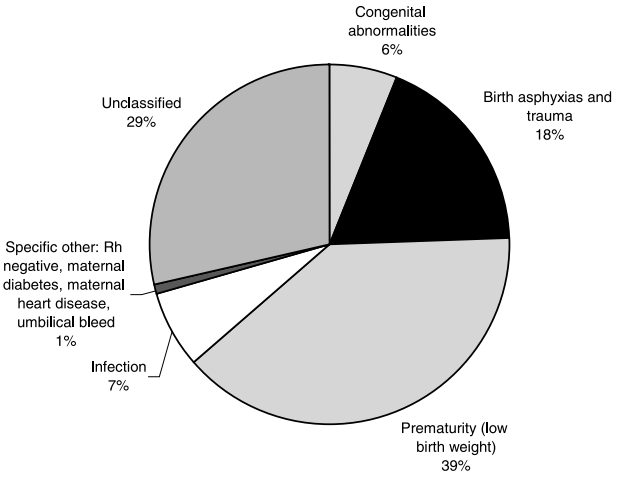

Figure 2. Causes of neonatal death according to revised Wigglesworth classification, Egypt 2000.

classification, compared to 13% using the WHO method, and to 20% using the judgment of the physician panel.
When causes of infant death according to the revised Wigglesworth classification were compared with the global estimates published by the WHO in 1995,[14] prematurity was the main cause of death in Egyptian neonates, while the WHO estimates gave infections, including tetanus, as the main cause (42%) (Table 3).

DISCUSSION

The comparison of the various methods of classification of neonatal mortality in this study showed that the WHO algorithm left 48% of the deaths unclassified. The causal distribution of neonatal deaths in this sample of the Egyptian population when compared to the WHO 1995 global estimates[15] also confirms the suspicion that Egypt has transitioned in to a different epidemiological model where immediate complications of delivery and prematurity have become more significant contributors to neonatal mortality than infection. This is not an isolated situation, since many countries are currently classified by the World Bank as belonging to this category of nations where infant mortality ranges between 40 and 50/1000 live births (http://www.worldbank.org/data/maps/). The high percentage of neonatal deaths with unassigned causes, and the low estimates of prematurity as a cause of death, require an evaluation of the efficacy of the WHO instrument in populations that are epidemiologically transitional. The revised Wigglesworth classification and the panel of neonatologists may be better suited for this population than the WHO verbal autopsy method.

This study estimated the NMR in Egypt as 25 per 1000 live births, the majority of deaths occurring in the first week of life. The largest percentage of deaths (39%) were attributed to prematurity and its complications, followed by birth asphyxia and trauma as major causes; neonatal sepsis was also a factor.

Table 3 Classification of neonatal deaths using WHO verbal autopsy algorithms, the revised Wigglesworth classification and panel of two Egyptian neonatologists (Egypt 2000), compared with WHO global estimates 1995

Verbal autopsy category	WHO verbal autopsy No.	(%)	Revised Wigglesworth No.	(%)	Panel of physicians No.	(%)	Global WHO estimate 1995 %
Congenital abnormalities	12	(9)	7	(6)	9	(8)	11
Birth asphyxias and trauma	16	(12)	21	(18)	21	(18)	—
Birth asphyxia	8	(6)	—	—	19	(16)	—
Trauma	8	(6)	—	—	2	(2)	11
Prematurity (LBW)	34	(25)	45	(39)	48	(41)	10
Infection	18	(13)	8	(7)	23	(20)	42
Meningitis	2	(1)	—	—	—	—	—
Local bacterial	1	(1)	—	—	—	—	—
Tetanus	7	(5)	4	(3)	3	(3)	14
Diarrhea	3	(2)	1	(1)	1	(1)	2
Pneumonia	5	(4)	—	—	3	(3)	19
Jaundice	—	—	—	—	1	(1)	—
Severe sepsis	—	—	3	(3)	15	(13)	7
Specific other*	—	—	1	(1)	2	(2)	—
Unclassified	56	(48)	35	(30)	14	(13)	5
Total	136 cases		117 cases		117 cases		5,000,000

*Rh-negative, maternal diabetes, maternal heart disease, umbilical bleed.

The distribution of time of neonatal mortality in this study showed that 50% of deaths occurred within the first 2 days of life. This could be due to the acute nature of illness in this group of neonates and limitations in the availability of adequate neonatal care. It is also consistent with prematurity being a more important cause of mortality in the early neonatal than late neonatal deaths, as reflected in the lower mean gestational age of early neonates. These findings support the decision to establish and expand neonatal care services that are accessible and capable of providing specialized care to the sick newborn. Cost-effective and life-saving interventions that target he preterm infant, such as ''kangaroo care'',[16] (skin to skin care), are a part of the neonatal protocol. Additional Information, Education and Communication (IE and C) activities are needed to raise community awareness about the availability of neonatal services.

The strong gender bias in mortality in the early versus late neonatal period is consistent with earlier findings in Egypt. Early mortality is greater in boys, which is in line with several studies showing better outcomes in female newborns.[17] The surprising finding is the significantly lower percentage of males among the late neonatal deaths, which could be attributable to a family preference in seeking care for male infants.

It is noteworthy that a majority of families who had seen a health professional prior to the death of the baby were not told the cause of death by the provider. This could be explained by the inability of the provider to identify the cause of death, or by failure of the providers to communicate with the families.

The causal associations between stillbirths and neonatal deaths in this study are similar to those described elsewhere. Using the verbal autopsy technique in assigning the time and cause of stillbirth has some limitations. This is noted in the high percentage (46% of stillbirths) classified as ''time of intrauterine death unclear, possibly asphyxial conditions developing in labor''. When selected characteristics of these births were further examined, such as whether the mother said labor was difficult or whether the infant was covered in meconium, these stillbirths were intermediate between the characteristics of antepartum and intrapartum stillbirths. It may be assumed that the distribution within this category of ''time of intrauterine death unclear'' may be the same as those with a known time of death, namely 30% antepartum and 70% intrapartum deaths.

The availability of antenatal care, and the level of intrapartum care would both be expected to reduce stillbirths through early recognition and optimal management of complicated pregnancies and deliveries. Owing to the larger percentage of these deaths occurring during intrapartum, lack of skilled attendance during delivery must play a significant role. It will be difficult to impact on any of these causes of neonatal/perinatal death without integrating interventions that include obstetric and neonatal components. The reduction that happened in the NMR/PMR can be attributed to a variety of factors, one of which is the perinatal perspective of service delivery that is still very new in Egypt but is becoming a priority in both policy and practice. This approach was adopted by the obstetric and neonatal staff in the facilities with involvement of neonatologists in high-risk deliveries and through the establishment of monthly maternal neonatal morbidity and mortality conferences. Special resuscitation sessions were held for neonatal and obstetric health providers, which had an impact on improvement of clinical practices related to assessment and resuscitation of the infant which was consequently reflected in a decrease in cases of neonatal asphyxia. Improved clinical practice in the area of infection control was achieved through implementation of special infection control activities and proper preparation and administration of intravenous fluids and medications. This helped in reducing cases of sepsis, which is one of the leading causes of morbidity and mortality in Egypt. The national campaign, ''Caring for Mother and Baby'', and other mass media social marketing activities are being implemented to increase awareness of danger signs and the use of neonatal services. Precampaign awareness of danger signs by women was 58.4% while the postcampaign figure was 95%.[18] This change in awareness had an impact on early recognition of danger signs in neonates, increased utilization of neonatal units and on decreased mortality rates.

CONCLUSIONS

Based of the results of the study, the following recommendations/interventions for maternal and child care are being implemented in Egypt as part of the Healthy Mother/Healthy Child Project (which is funded by a Federal grant USAID Project no: 263C-00-98-00041-00):

- Maintenance of successful interventions including family planning, and tetanus toxoid administration during pregnancy. Family planning with counseling can reduce the risk of congential malformations by preventing high-risk pregnancies.
- Improved antenatal care with screening and referral of high-risk cases.
- Increased emphasis on immediate drying, warming, and immediate and exclusive breastfeeding for the newborn.
- Use of a perinatal approach for all complicated deliveries in which a neonatologist and obstetrician are present at the time of delivery.
- Improved clinical practices related to assessment and resuscitation of the infant and the use of APGAR scores to assess the condition of the newborn.
- Continued emphasis on the reduction of maternal mortality. The NMMS 2000 reported that in 50% of the cases where the mother dies, the infant also dies, thus survival of fetuses and infants should increase as the management of mothers during antepartum, delivery and postpartum care improves.

- Implementation of special infection control activities in order to reduce cases of sepsis and in the number of nosocomial infections through proper management of the preparation and administration of intravenous fluids.
- Use of information, education, and communication materials, targeted at the household and community levels, on birth preparedness, recognition of danger signs for mother and newborn, safe deliveries and postpartum care.

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