Neonatal audit in the United Arab Emirates: a country with a rapidly developing economy

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نظرة على مواليد الإمارات العربية المتحدة: بلد يملك اقتصاداً سريع النمو

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خلاصة: أردنا في هذه الدراسة أن نتبين ما إذا كانت معدلات الوفاة ذات الصلة بالوزن عند الميلاد، وأسباب وفيات المواليد، يمكن أن تحدِّد التدخلات اللازمة لخفض معدلات وفيات المواليد. فتم جمع البيانات من ثلاثة مستشفيات تجري بها 99% من الولادات في منطقة العين الطبية. فكان هناك 8083 مولوداً حياً يبلغ وزن كل منهم 500 غرام أو أكثر، توفي منهم 54 طفلاً (0.67%). وكان معدل الوفيات بين الأطفال ذوي الوزن الشديد الانخفاض، أعلى في هذه المنطقة عنه في المراكز ذات الموارد والتكنولوجيا المتقدمة في مجال رعاية حديثي الولادة. وتبيَّن أن مشاكل الخِداج (الولادات المبتسرة)، والتشوهات المميتة والاختناق قد سبَّبت 95% من الوفيات. كما كان نصف التشوهات متلازمات صبغية جسدية متنحية. وخلاصة القول إن تحسين رعاية المواليد ذوي الوزن المنخفض عند الميلاد ومعالجة حالات الاختناق وتوفير التوعية الوراثية، من شأنها أن تؤدي إلى مزيد من الانخفاض في معدلات وفيات حديثي الولادة.

ABSTRACT We aimed to determine whether birth-weight-specific mortality rates and causes of neonatal death could identify interventions needed to reduce neonatal mortality rates. Data were collected from three hospitals responsible for 99% of births in Al-Ain Medical District. There were 8083 live births weighing ≥ 500 g, of which 54 (0.67%) died. The mortality rate among very low-birth-weight infants was higher in this district than from centres with more advanced neonatal technology and resources. Problems of preterm births, lethal malformations and asphyxia accounted for 95% of deaths and half of the malformations were autosomal recessive syndromes. Improved management of lower-birth-weight infants, asphyxia and genetic counselling could lead to a further decline in neonatal mortality rates.

Enquête analytique néonatale aux Emirats arabes unis, pays en plein essor économique
RESUME Notre but était de déterminer si les taux de mortalité spécifiques selon le poids de naissance et les causes de mortalité néonatale permettraient d'identifier les interventions requises pour réduire les taux de mortalité néonatale. Les données ont été recueillies dans trois hôpitaux où ont lieu 99% des naissances dans le District médical Al-Ain. Il y a eu 8083 enfants nés vivants dont le poids était égal ou supérieur à 500 g, parmi lesquels 54 (0,67%) sont décédés. Le taux de mortalité chez les nourrissons ayant un très faible poids de naissance était plus élevé dans ce district que dans les centres disposant de ressources et de techniques néonatales plus modernes. Les problèmes des naissances avant terme, de malformations létales et d'asphyxie représentaient 95% des décès et la moitié des malformations étaient des syndromes autosomiques récessifs. Une meilleure prise en charge des nourrissons présentant une insuffisance pondérale à la naissance, de l'asphyxie ainsi que le conseil génétique pourraient permettre de réduire encore la mortalité néonatale.

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Introduction

The infant mortality rate (IMR) is used throughout the world as an important health indicator. A reduction in IMR is accepted as an indication of improvement in socioeconomic status and provision of health care in a community [*1*]. Efforts to reduce infant mortality, however, must focus on the pattern and causes of neonatal deaths since neonatal mortality accounts for about 50%–70% of deaths in infancy [*2*]. Reports of neonatal mortality suggest that there are differences between industrialized and developing nations, and within developing nations in both the neonatal mortality rate (NNMR) and the causes of neonatal death [*1–7*]. However, few of the reports from developing nations are from countries with rapidly developing economies such as the United Arab Emirates (UAE) [*4,7*]. Furthermore, the published data from the rapidly developing nations have been based on data from individual hospitals rather than community-based or multicentre studies [*4,7*].

Due to improvement in the economy and health care facilities in the past decade, IMR in the UAE has declined by 20%, but neonatal and perinatal mortality rates have not changed [*8*]. Despite concern over the lack of a significant reduction in NNMR, a detailed community study to assess birth-weight-specific mortality rates and causes of neonatal death has not been reported from the country. Previously published community data on neonatal statistics did not give causes of death [*9*]. Neonatal audits, which include birth-weight-specific mortality rates and causes of death, do provide information on the quality of neonatal intensive care and identify preventable causes of death [*3,4*]. Therefore, this prospective multicentre neonatal audit, involving almost all the births in a medical district of the UAE, was undertaken. We hoped to determine whether birth-weight-specific mortality rates and causes of neonatal death could identify interventions required to achieve a further decline in NNMR in this predominantly Arab community with a rapidly developing economy. The data could be used for comparative analysis of causes of neonatal death in industrialized and developing nations as well as for assessment of the impact of future interventions.

Subjects and methods

All infants with a birth weight of ≥ 500 g who were born in Al-Ain (A), Tawam (B) and Oasis (C) hospitals in Al-Ain, UAE between 1 January and 31 December 1991 were studied. About 99% of all births in the medical district occur in these three hospitals [*8*]. The district has a population of 300 000, of which 60% of the obstetric population are Arabs, 30% are Asians (Indians and Pakistanis) from the Indian subcontinent and 10% are of other nationalities. Al-Ain hospital is a non-referral institution that provides perinatal and long-term neonatal intensive care to UAE and non-UAE nationals. Tawam hospital has more neonatal care resources and provides perinatal and neonatal intensive care to UAE nationals and cases referred from the other two institutions. It also accepts referrals for neonatal intensive care from other Emirates. Oasis hospital is a semi-private institution that provides modern perinatal care and short-term neonatal intensive care support for UAE nationals and non-nationals. Infants requiring long-term intensive care from the unit are transferred to Tawam and occasionally to Al-Ain hospitals. Infants born outside the district during the study period were not included in the study.

Each infant was examined at birth by a paediatrician and seen before discharge or at death by at least one of the investigators. Gestational age was not always available for all infants. Normal-weight infants without complications were admitted to postnatal wards for routine care and discharged on the second or third postnatal day. Admission criteria of high-risk infants to special-care baby units or neonatal intensive care units were similar to international recommendations [*10*]. In general, the care of high-risk infants included provision of a thermoneutral environment, maintenance of metabolic and electrolyte balance and provision of nutrition, which included the use of parenteral nutrition. Respiratory care consisted of oxygen therapy for hypoxaemia and long-term mechanical ventilation for infants with respiratory failure. Surfactant therapy was not available in any of the units and prenatal steroid therapy was not widely adopted during the study period.

Death in the first 28 days of life was classified as a neonatal death. All neonatal deaths among infants born in the hospitals during the study were ascertained from hospital registers. All deaths either before or after discharge from the hospital were included. The NNMR was calculated as the number of neonatal deaths of infants weighing ≥ 500 g divided by the total number of live births weighing ≥ 500 g. The corrected NNMR was estimated by excluding deaths due to lethal malformations. Since birth weight was available for all infants, birth-weight-specific mortality rates were also calculated.

Causes of death were based on clinical diagnosis supplemented by relevant laboratory or radiological investigations because an autopsy is not usually permitted in the UAE, as in most other countries of the area. The diagnoses were reviewed and recorded for each month. The deaths were classified according to accepted medical criteria [*11*]. Immaturity was defined as gestation of < 24 weeks or birth weight of < 600 g. Respiratory distress syndrome (RDS), based on clinical and radiological criteria, was regarded as a cause of death if it was severe enough to require high mechanical ventilator support [*12*]. Sepsis was proven by positive blood cultures in the presence of appropriate clinical features, and necrotizing enterocolitis (NEC) was confirmed by radiological evidence of pneumatosis and/or bowel perforation. Asphyxia was accepted as the cause of death if it was severe enough to be classified as grade III hypoxic ischaemic encephalopathy [*13*]. Intraventricular haemorrhage (IVH) was documented by cranial ultrasonography. The results of birth-weight-specific mortality rates and causes of death were compared with studies from industrialized countries using the chi-squared test and when indicated the Fisher exact test. A P-value ≤ 0.05 was considered significant.

Results

There were 8083 live births (LB) weighing ≥ 500 g in the three institutions during the study period. Of these, 4540 (56%) were delivered in hospital A, 1611 (20%) in hospital B and 1932 (24%) in hospital C. There were 54 neonatal deaths giving an overall crude NNMR of 6.7 per 1000 LB. The result was compared with figures from both industrialized and developing countries and is summarized in Figure 1 [*2*]. Fifty-two (52) of the deaths occurred before hospital discharge, while two deaths occurred among those readmitted to the hospital. If the 20 infants with lethal congenital malformations were excluded, the corrected mortality rate was 4.2 per 1000 LB.

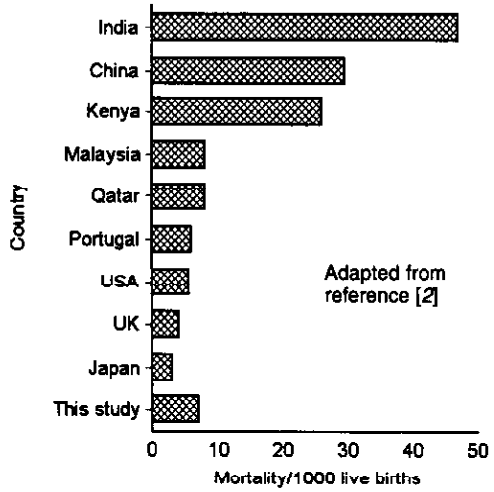

Figure 1 **Comparison of neonatal mortality rates in selected countries**

NNMRs among UAE nationals, other Arabs, Pakistanis, Indians and other nationality groups were 5.8, 6.1, 13.4, 4.4 and 5.3 per 1000 LB respectively. The NNMR for Pakistanis was significantly higher when compared with all the other ethnic groups combined ($\chi^2 = 6.88$, $P < 0.016$).

We found 541 (6.7%) of the births were of low birth weight (LBW) and the overall mortality among LBW infants was 57 per 1000 LB. Birth-weight-specific neonatal mortality rates were compared with results from a regional centre in the United States of America (USA) and are summarized in Table 1 [*14*]. As expected, mortality was inversely related to birth weight. Mortality rates among extremely LBW (< 1000 g), very LBW (1000–1499 g) and moderately LBW (> 1500 g) infants were 50.0%, 20.0% and 3.1% respectively. A mortality rate among LBW infants (< 2499 g) of 5.7% was 20-fold higher than the figure of 0.28% among normal weight infants (> 2500 g). When compared with results from centres with more advanced neonatal technology, the low-birth-weight-specific mortality rates in this study were significantly higher (Table 1).

Because of small numbers, birth-weight-specific mortality rates in the three institutions were classified into 3 categories (< 1499 g, 1500–2499 g and > 2500 g) and are summarized in Table 2. The crude mortality rates were lower in hospital A than the two referral institutions. The mortality rate for each birth-weight category was almost two-fold higher in hospital B than C. The differences persisted after excluding infants with congenital malformations.

The causes of death are summarized in Table 3. Three conditions accounted for about 95% of the neonatal deaths. These

Table 1 **Birth-weight-specific neonatal mortality rates in Al-Ain, UAE and Maine, USA**

Birth weight (g)	Al-Ain (1991)		Maine (1990–91)[a]		*P*-value
	Live births	Mortality (%)	Live births	Mortality (%)	
500–745	5	80.0	35	40.0	NS
750–999	11	36.0	57	11.0	0.05
1000–1499	40	20.0	116	4.0	0.005
1500–2499	485	3.1	1180[b]	2.2	NS
≥ 2500	7542	0.28	25 280[b]	0.17	NS

[a] *See reference [14]* [b] *includes period 1982–1991* *NS = not significant*

Table 2 **Neonatal mortality at three institutions in Al-Ain, UAE, 1991**

Birth weight (g)	Oasis			Al-Ain			Tawam			All		
	Live births	Deaths	Mortality (%)	Live births	Deaths	Mortality (%)	Live births	Deaths	Mortality (%)	Live births	Deaths	Mortality (%)
500–1499	9	0	0	29	12	41.4	18	4	22.2	56	16	28.6
1500–2499	125	1	0.8	240	11	4.6	120	3	2.5	485	15	3.1
≥2500	1798	3	0.2	4271	18	0.4	1473	2	0.1	7542	23	0.3
Total	1932	4	0.2	4540	41	0.9	1611	9	0.6	8083	54	0.7
Excluding lethal malformations	1928	0	0	4527	28	0.6	1609	6	0.4	8063	34	0.4

were problems associated with premature birth (extreme immaturity, RDS and associated complications, septicaemia and NEC), which occurred in 44% of the cases, lethal malformations in 37% and asphyxial conditions (hypoxic ischaemic encephalopathy and meconium aspiration) in 15% of the deaths. In all, 33 (61%) neonatal deaths were LBW infants. The problems associated with preterm births accounted for 82% of the deaths in this group. All infants of normal birth weight (> 2500 g) died of either malformations or asphyxia. At the time of the study, 38 (70%) deaths were considered preventable either by accepted modern medical care or genetic counselling with appropriate interventions.

Table 3 **Causes of neonatal death in Al-Ain, UAE, 1991**

Category	No.	% of total
Problems of preterm birth	21	39
Pulmonary immaturity (< 600 g)	2	
RDS ± IVH[a]	17	
Necrotizing enterocolitis[a]	2	
Congenital malformations[b]	20	37
Multiple	9	
Central nervous system	4	
Lung	3	
Cardiac	3	
Others	1	
Asphyxial conditions	7	13
Hypoxic ischaemic encephalopathy[a]	4	
Meconium aspiration[a]	3	
Other specific conditions	5	9
Septicaemia[a]	3	
Hydrops fetalis	2	
Unknown	1	2
Total	54	100

[a]*possibly preventable*
[b]*including 9 autosomal syndromes considered preventable*
RDS = respiratory distress syndrome
IVH = intraventricular haemorrhage

A comparison of the proportions of major factors contributing to death with results of studies from industrialized countries revealed that the distributions of these factors were similar [*14*]. However, there were significant differences in the components of the various factors as shown in Table 4. For example, the frequencies of RDS ± IVH and NEC as well as multiple malformations were significantly higher in our study. Furthermore, 9 (45%) of the 20 cases of malformations were syndromes with autosomal recessive mode of inheritance which included the following recognized syndromes: Ellis-van Crefeld (1 case), osteogenesis imperfecta type IIB (1), Meckel–Gruber syndrome (1), Joubert syndrome (1), familial microcephaly with encephalocele (1), and chondrodysplasia punctata (1). There was also one case with agenesis of corpus callosum with macrocephaly and one affected sibling, and one with multiple malformations with two affected siblings. These infants were born to consanguineous parents of Arab nationality. The central nervous system malformations included two cases of anencephaly and severe spina bifida with hydrocephalus.

Discussion

This is the first detailed prospective study of neonatal vital statistics in the UAE. It included all hospital births which account for almost all births in the medical district.

Table 4 Proportion of factors associated with neonatal death in Al-Ain and Maine, USA

Category	Al-Ain (UAE)		Maine (USA)[a]		*P*-value
	No.	%	No.	%	
Problems of preterm births	21	100	161	100	NS
Extremely LBW (< 750 g)	4	20	96	60	0.001
RDS ± IVH	15	70	65	40	0.007
Necrotizing enterocolitis	2	10	0	0	0.01
Congenital malformations	20	100	119	100	NS
Multiple	7	35	12	10	0.008
Central nervous system	4	20	11	9	NS
Lung	3	15	27	23	NS
Cardiac	3	15	40	34	NS
Others	3	15	27	23	NS
Asphyxial conditions	7	100	29	100	NS
Hypoxic ischaemic encephalopathy	4	57	17	59	NS
Meconium aspiration	3	43	9	31	NS
Intracranial haemorrhage	0	0	3	10	NS
Miscellaneous	6	100	37	100	NS
Bacterial sepsis	3	50	9	24	NS
Hydrops fetalis	2	33	12	33	NS
Others	1	17	16	43	NS
Total	54		375		

[a]*See reference [14]*
LBW = low birth weight *RDS = respiratory distress syndrome*
IVH = intraventricular haemorrhage *NS = not significant*

Since all neonatal deaths before and after discharge from hospitals were included, the neonatal mortality figures in this study closely resemble community figures in this environment. The uncorrected NNMR of 6.7 per 1000 LB is similar to figures from some European and North American countries and member countries of the Gulf Co-operation Council, significantly lower than figures from many developing nations, but higher than figures from other industrialized countries such as the United Kingdom (UK) and Japan (Figure 1). The differences in mortality rate among the ethnic groups would indicate a need to report ethnic-specific NNMR and to identify possible risk factors for such differences.

When viewed against a background of rapidly improving economic indicators, such as per capita gross national product (GNP) and increasing health expenditures of GNP, the relatively low NNMR may be a reflection of improved socioeconomic conditions and health care facilities [*15*]. However, the LBW-specific mortality rates that reflect the quality of neonatal intensive care provided are higher than figures from centres with more advanced technology (Table 1). It is reasonable to suggest that a further decline in NNMR may require a concomitant increase in neonatal intensive care resources in the district as well as the country in general [*16*]. This is achievable in view of the awareness to accord priority to funding perinatal and neonatal care in the country [*16*].

The frequency of the major causes of death in our study was similar to the findings in industrialized countries, but differed from those reported from other developing nations. For example, bacterial infections, which accounted for less than 10% of the deaths in our study as well as in reports from industrialized [*3,14*] and other rapidly developing nations [*4*], was responsible for 20%–40% of neonatal deaths in studies from India and Nigeria [*5,6*]. These differences probably reflect suboptimal perinatal care and unhygienic umbilical cord care practices in the latter communities, and would indicate a different neonatal care priority when compared to countries with rapidly developing economies.

Comparison of the causes of death with results of studies from an industrialized nation identified some differences that are of epidemiological importance [*14*]. It also noted that an optimal standard of care could have reduced the number of neonatal deaths. For example, the proportions of deaths from RDS and its complications could have been reduced with a wider application of therapies such as prenatal steroid and surfactant replacement in infants with RDS [*14*]. The availability and accessibility of modern therapies should, however, be combined with a commitment of more resources for advanced neonatal intensive care of very LBW infants in order to improve both the short- and long-term outcome. In this context, the differences in hospital-specific mortality rates could be accounted for partly by differences in neonatal care resources. This supports the need for equal opportunity high quality neonatal care for all high-risk infants born in the district. Judging by the total number of births in the district, this is best achieved by regionalization of perinatal and neonatal care facilities. This has been shown to be associated with optimal use of resources, improved quality of care and lower mortality rate among LBW infants [*17,18*]. The development of a regionalization programme has been in progress since the completion of this study, and its impact on neonatal care and infant survival will be assessed in a future audit.

The second most common cause of death in this study was lethal malformation.

It was responsible for 70% of deaths in normal-weight infants. Although the proportion of neonatal deaths due to malformations is similar to those reported from European and North American countries [*14,19*], there is an interesting difference between the finding in the American study and this predominantly Arab population. Almost half of the lethal malformations in our study were multiple anomalies that were due to specific autosomal recessive syndromes. This is similar to the finding of a previous prospective study on the pattern of malformations in this community [*20*]. In that study, most of the multiple malformations were due to specific syndromes with autosomal recessive mode of inheritance, and were associated with a high prevalence of consanguinity among parents. Almost all the infants with syndromic lethal malformations in our study were born to Arab or Asian consanguineous parents. Similar findings have been reported among UK-born Pakistani babies in whom higher perinatal deaths were associated with syndromes inherited as autosomal recessive [*21*]. Therefore, the pattern of lethal malformations may be influenced by sociocultural factors, especially in communities with high Arab or Asian populations where the rate of consanguineous marriage is high. The need for genetic counselling to improve perinatal and neonatal survival in such communities has been emphasized in our previous publication and is supported by the findings of this study [*20*].

Asphyxia was the second most common cause of death in normal-weight infants. Recent studies from European and North American countries suggest that the contribution of meconium aspiration and asphyxia to neonatal mortality has declined significantly, accounting for less than 8% of neonatal deaths [*14,21*]. This is due to improvement in the management of pregnancies at risk of perinatal asphyxia. The higher frequency of asphyxial conditions associated with neonatal deaths in this study underscores the need for further improvement in surveillance and a combined perinatal–neonatal resuscitation programme.

Conclusion

LBW is a recognized major determinant of infant survival. It accounted for 61% of neonatal deaths in this study. Therefore, a reduction in the incidence of LBW and preterm births should be part of the overall preventive strategy towards reducing neonatal mortality. After the completion of this study, we investigated obstetric and sociobiologic risk factors for LBW in this community [*22,23*]. Public health and obstetric interventions using some of the available epidemiological data may lead to a reduction in the incidence of LBW in the community and needs to be studied.

This study, from a nation with a rapidly developing economy, shows that the neonatal mortality figures are similar to figures from some European and North American countries, while the mortality rates among very low-birth-weight infants were higher than figures from centres with more advanced neonatal technology and resources. It also highlighted interethnic and interhospital differences in neonatal mortality, as well as some important differences in the patterns of death when compared with reports from European and North American countries. In particular, it emphasized the contribution of inherited lethal congenital malformations in communities with a high consanguineous marriage rate. Follow-up quantitative studies are in progress to assess the impact of various interventions identified from the study.

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There are direct links between economic performance and health indicators such as life expectancy. Some variables, such as geography and demography, indirectly link health with economic growth. Geography, particularly tropical location, is highly correlated with disease burden, which in turn affects economic performance. Demography, on the other hand, is determined in part by health status, and has a direct effect on economic growth through the age structure of the population, in particular the ratio of the working age to the total population.

Source: The World Health Report, 1999. Making a difference. *Geneva, World Health Organization, 1999. Page 8.*