Have neonatal mortality rates in the state of Qatar become static? A PEARL study analysis

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هل أصبحت معدلات الوفيات بين الولدان ثابتة في قَطَر؟ تحليل لدراسة PEARL

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الخلاصة: تهدف الدراسة للتعرُّف على المعدّل الوطني للوفيات بين الولدان في قَطَر خلال الربع الأول من عام (1 كانون الثاني/ يناير– 31 آذار/ مارس 2011)، وقد أجرَى الباحثون دراسة استباقية ارتيادية وبائية وطنية، فجمعوا المعطيات حول الولادات والوفيات بين الولدان باستخدام استبيان منسَّق تم تصميمه قبل الدراسة. وقد استخدم الباحثون المعطيات حول المراضة لدى الولدان للفترة 2008–2011، والمستمدَّة من قاعدة معطيات وحدة الولدان في مستشفى النساء، والتقرير السنوي لمؤسسة حَمد الطبية، والمعطيات المنشورة، حول وفيات الولدان لعام 2010 من أجل التحليل المقارن، بقصد إجراء تحليل للاتجاهات على مدى السنوات الأربع السابقة (2008–2011). وقد شملت الدراسة 4909 من المواليد و21 وفاة بين الولدان سجلت خلال فترة الدراسة، وبلغ معدّل الوفيات بين الولدان 4.28 بكلّ ألف مولود حي (بعد التصحيح 2.85 لكل ألف مولود حي) وكان معدّل الوفيات الباكرة بين الولدان 1.84 بكلّ ألف مولود حي، ومعدّل الوفيات المتأخرة بين الولدان 2.44 بكلّ ألف مولود حي. وكان 15 وفاة من بين 21 وفاة بين الولدان لدى غير القَطَريين، مما يوضح التوزُّع السكاني. إن معدّل الوفيات بين الولدان في قَطَر قد انخفض انخفاضاً ضئيلاً بين 2008 والربع الأول من عام 2011.

ABSTRACT To ascertain the national neonatal mortality rate in Qatar during the first quarter of 2011 (1 January–31 March), we carried out a prospective pilot national epidemiologic study. Nationwide birth and neonatal mortality data were collected using predesigned, structured questionnaires. To analyse trends over the previous 4 years (2008–2011) we used neonatal mortality data for 2008–2010 from the database of the neonatal unit at the Women's Hospital, annual reports of Hamad Medical Corporation, and published neonatal mortality data for 2010 for comparative analysis. A total of 4909 live births and 21 neonatal deaths were recorded during the study period. The neonatal mortality rate was 4.28 /1000 live births (corrected neonatal mortality rate 2.85 /1000). The early neonatal mortality rate was 1.84 /1000 and the late neonatal mortality rate was 2.44/1000 live births. Fifteen of the 21 neonatal deaths were in non-Qatari babies, reflecting the ethnic distribution in the population. Neonatal mortality rates in Qatar declined very little between 2008 and the first quarter of 2011.

Les taux de mortalité néonatale dans l'État du Qatar stagnent-ils ? Analyse de l'étude PEARL

RÉSUMÉ Pour évaluer le taux de mortalité néonatale national au Qatar pendant le premier trimestre de 2011 (1er janvier–31 mars), nous avons mené une étude épidémiologique pilote prospective au niveau national. Les données nationales sur la mortalité à la naissance et la mortalité néonatale ont été recueillies à l'aide de questionnaires préétablis et structurés. Pour étudier les tendances des quatre dernières années (2008–2011), nous avons utilisé les données sur la mortalité néonatale de 2008 à 2010 tirées de la base de données du service des soins néonatals du *Women's Hospital* (hôpital des femmes), des rapports annuels de la *Hamad Medical Corporation* et les données sur la mortalité publiées pour 2010, à des fins d'analyse comparative. Au total, 4909 naissances vivantes et 21 décès néonatals ont été enregistrés pendant la période de l'étude. Le taux de mortalité néonatale était de 4,28 pour 1000 naissances vivantes (taux de mortalité néonatale corrigé 2,85/1000). Le taux de mortalité néonatale précoce était de 1,84 pour 1000 et le taux de mortalité néonatale tardive était de 2,44 pour 1000 naissances vivantes. Quinze décès néonatals sur vingt-et-un concernaient des enfants qui n'étaient pas Qataris, reflétant la répartition ethnique de la population. Les taux de mortalité néonatale au Qatar ont très peu diminué entre 2008 et le premier trimestre de 2011.

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Received: 09/08/11; accepted: 04/10/11

Introduction

Qatar, like other Gulf Cooperation Council countries, has been going through an exponential socioeconomic change over the last 3 decades. The current total population (May 2011) is 1.69 million [1], with approximately 65% expatriate economic migrants. The vast majority of expatriates are from the Middle East, South and South-East Asia, but almost every country in the world is represented in Qatar's population. Qatar had the highest per capita gross domestic product in the world during 2010 (US$ 90 149) [2]. The country has a strong political commitment to its development [3]. Reduction in poverty, very high rates of female literacy and investment in maternal and child health care have contributed significantly to the improvement of maternal and neonatal survival [4].

Recent data on the global burden of neonatal deaths suggest that most of the countries constituting the Gulf Cooperation Council, which includes Saudi Arabia, Kuwait, Bahrain, Qatar, the United Arab Emirates and Oman, have done extremely well over the past 4 decades in reducing their neonatal mortality rates [5,6]. Among the Gulf Cooperation Council countries, Qatar and the United Arab Emirates have achieved neonatal survival rates which are comparable to those in many developed countries [4,7,8]. Qatar is unique in the world since it had achieved most of its Millennium Development Goals by 2007 [9], halfway towards the target year, 2015. This includes Millennium Development Goal 4 (two-thirds reduction in childhood mortality rate). With the rapid expansion in the population and also in health care facilities in Qatar over the last 4 years, the proportion of deliveries in public and private secondary care facilities increased to 17.2% in 2011. Therefore there is a need to ascertain the true national neonatal mortality rate and the most recent trends.

The objectives of the current study were to: ascertain the true national neonatal mortality rate in Qatar during the first quarter of 2011; analyse any changes in trends in the neonatal mortality rates between 2008 and 2011; and identify the predominant causes of neonatal mortality.

Methods

The PEARL Study (Perinatal Neonatal Outcomes Research Study in the Arabian Gulf) is a 3-year prospective, national, perinatal, epidemiologic study. The PEARL Study is a collaborative project between Hamad Medical Corporation, Doha, Qatar and the University of Gloucestershire, Gloucester, United Kingdom. The project aims to build a National Neonatal Perinatal Registry for Qatar called Q-Peri-Reg. The pilot phase of the PEARL Study (1 January–31 March 2011) aimed to: test the data collection tools, methodology and processes; train the research team; develop a tailor-made registry software; and establish a baseline national neonatal, perinatal and maternal mortality and morbidity profile. The current study is a part of this pilot phase. The data were collected prospectively by a full time research team comprising 7 full time physicians: 1 research fellow, 1 research associate and 5 research assistants.

The PEARL study is approved by the Institutional Research Ethics Committee of Hamad Medical Corporation, Qatar (protocol #9211/09).

PEARL Study definitions

The limit of viability in Qatar is 24 completed weeks of gestation and/or weight ≥ 500 g at birth. Since a reliable birth weight is available for all live and stillbirths in Qatar, PEARL Study uses the following WHO definitions, based on ICD-10, to ascertain, analyse and report its neonatal perinatal data [10].

- Live Birth for reporting purposes: The birth of a fetus with a birth weight of ≥ 500 g, or if missing, ≥ 22 completed weeks of gestation, or if missing, crown heel length ≥ 25 cm, which after separation from his/her mother, has any signs of life.
- Live Birth for international comparison: The birth of a fetus with a birth weight of ≥ 1000 g, or if missing, ≥ 28 completed weeks of gestation, or if missing, crown heel length ≥ 35 cm, which after separation from his/her mother, has any signs of life.

The neonatal mortality in babies born at term (≥ 37 weeks gestation) was defined as death between day 0 and day 27 of life. For preterm babies (born at ≤ 36 weeks gestation), we used adjusted neonatal mortality rates, calculating day 28 of life after first adjusting the gestational age at birth to term (37 weeks). For example, for a baby born at 24 weeks gestation, a death within 118 days of birth (90 days to term plus 28 days) was classified as neonatal death. From day 119 onwards, we classified the death as post-neonatal death, even if the baby died in the neonatal intensive care unit.

Neonatal death before day 7 of life (between day 0 and day 6 irrespective of gestation at birth) was defined as early neonatal death, while death between day 7 and 27 (adjusted in preterm babies) was defined as late neonatal death.

The corrected neonatal mortality rate was calculated after excluding babies with lethal congenital anomalies and babies with declared futility before or after birth.

We calculated neonatal mortality rate per 1000 using the number of live births during the study period (1 January–31 March 2011) as the denominator and total neonatal deaths during the study period as numerator. This included babies born before the study period who died during the study period as neonates and excluded babies born during the study period but who died as neonates after the study period. Therefore our neonatal mortality rates represent period

neonatal mortality and not cohort neonatal mortality.

Data collection

The birth and neonatal mortality data were collected from the maternity units in Qatar hospitals, including all public and private facilities (3 public and 3 private), from 1 January 2011 until 31 March 2011. The research team collected data on a daily basis, including weekends, on predesigned, structured questionnaires ensuring no new birth or death went unrecorded. Informed consent was obtained from the families on a pre-approved form that was used only for collecting sociodemographic data. Routine medical data were taken from the perinatal registry.

Comparative analysis

For comparative analysis, data for 2008–2010 were ascertained from the annual reports of the Neonatal Unit at the Women's Hospital and the annual reports of the Department of Medical Statistics and Epidemiology at Hamad Medical Corporation, Qatar, which are published on behalf of the National Health Authority (Department of Health). We compared the neonatal mortality data of the first quarter of 2011 with the yearly data of 2008, 2009 and 2010. We also compared the neonatal mortality data of the first quarter of 2011 with the neonatal mortality data of first quarter of each of 2008, 2009 and 2010. The neonatal mortality data were also stratified and analysed by birth weight and by gestational age. For inter-country comparative analysis of neonatal mortality, we used the *World Health Statistics* for 2010 [6].

Statistical analysis

Data were entered into *Epi Info*, version 3.08, and analysed using *SPSS*, version 18.09. *P*-value < 0.05 was considered significant. Mean and standard deviation (SD) were calculated for continuous scale variables, and frequencies with percentage were computed for categorical variables. The continuous variables were compared using student *t*-test. The chi-squared test of significance was used to assess any differences between the categorical variables. The relative risk of mortality was calculated using 2008 data as reference.

Results

Table 1 shows the national birth and death data during the study period, expressed as live births and total neonatal deaths in each individual obstetric facility. Table 2 depicts the characteristics of each neonatal death which occurred during the study period. The total number of live births during the study period was 4909 (Table 1): of these, 4286 (87.3%) were in the public sector and 623 (12.7%) in the private sector. In terms of hospital, 4063 (82.76%) births took place in the Women's Hospital, which is the only tertiary care maternity and neonatal centre in Qatar. The remaining 846 (17.24%) births occurred in secondary care centres. The total number of neonatal deaths was 21, 4 of which were labour room deaths due to futility. Parents of 2 of these futile babies had received antenatal counselling and a joint decision of "Do not resuscitate" (DNR) was reached before birth while the 2 remaining babies were declared DNR by the attending physician following clinical assessment after birth (Table 2). Three more babies who died in the neonatal intensive care unit were also declared futile and declared DNR following parental consent: the first had anencephaly (died on day 2 of life in low dependency unit); the second was born extremely premature at 23 weeks (died on day 1 in low dependency unit); and the third had Potter Syndrome (died on day 1 of life in the neonatal intensive care unit).

Table 1 Births and neonatal mortality in each facility, Doha, January–March 2011

Facility	Live births[a]	Neonatal deaths		
		Total	Early	Late
Women's Hospital[b]	4063	19	9	10
Hamad General Hospital[b,c]	0	2[d]	0	2
Al Khor Hospital[b]	223	0	0	0
Al Ahli Hospital[d]	435	0	0	0
Doha Clinic Hospital[d]	94	0	0	0
Al Emadi Hospital[d]	94	0	0	0
Total	4909	21	9	12
Neonatal mortality rate (per 1000 live births)		4.28	1.84	2.44

[a]Home births constitute only 0.5% of total births; they are included in the Women's Hospital data where they have to be reported for mandatory birth registration and hence are also included in the total.
[b]Public hospitals.
[c]There is no maternity ward in Hamad General Hospital, hence no births were recorded here but it has Qatar's only paediatric intensive care unit, where 2 neonatal deaths were recorded.
[d]Private hospitals.

Table 2 Characteristics of early and late neonatal deaths, Qatar, January–March 2011

Sex	Nationality	Gestation (weeks)	Birth weight (g)	Alive (days[a])	Place of death	Cause of death/comments
			Early neonatal death			
M	Jordanian	23	570	11 h	NICU	Extreme prematurity, postnatal DNR
M	Palestinian	39	790	2	NICU	Severe IUGR, severe renal and pulmonary hypoplasia,
F	Indian	29	1250	45 min	LR	Potter syndrome, pulmonary hypoplasia
F	Jordanian	30	1730	30 min	LR	Holoprocencephaly; multiple congenital anomalies
M	Palestinian	32	1830	1	NICU	Potter syndrome, bilateral multicystic kidneys, pulmonary hypoplasia
M	Saudi Arabian	38	2160	2	NICU	Anencephaly
F	Syrian	38	2190	35 min	LR	Meckle–Gruber syndrome, antenatal DNR
F	Pakistani	40	2950	2	NICU	Diaphragmatic hernia, lung hypoplasia, PPHN
F	Pakistani	23	545	4 min	LR	Extreme prematurity
			Late neonatal death			
M	Syrian	23	610	45	NICU	Extreme prematurity, CLD, bacterial & fungal sepsis, endocarditis
F	Qatari	24	640	89	NICU	Extreme prematurity, severe sepsis
M	Yemeni	24	780	40	NICU	Extreme prematurity, NEC, sepsis
F	Filipino	24	810	16	NICU	Extreme prematurity, septic shock
F	Ghanaian	26	840	16	NICU	Extreme prematurity
M	Jordanian	29	1210	35	NICU	Prematurity, pulmonary interstitial emphysema, fulminant sepsis
F	Saud Arabian	39	1545	8	NICU	IUGR, PPHN, sepsis
M	Philippino	36	1895	8	Surgical theatre	Congenital anomalies, CHD, TEF, dysplastic left kidney
F	Qatari	37	1950	10	NICU	Congenital diaphragmatic hernia, hypoplastic lungs, severe PPHN
F	Qatari	40	2370	19	NICU	Hypoplastic left heart syndrome
M	Qatari	37	2570	8	PICU	Fulminant sepsis, DIC
F	Qatari	38	3300	9	NICU	Meconium aspiration syndrome, severe PPHN

[a] *Unless otherwise indicated.*

M = male; F = female; NICU = neonatal intensive care unit; DNR = do not resuscitate; IUGR = intrauterine growth restriction; LR = labour room; PPHN = persistent pulmonary hypertension of the newborn; CLD = chronic lung disease; NEC = necrotizing entercolitis; CHD = congenital heart disease; TEF = tracheo-oesophageal fistula; PICU = paediatric intensive care unit; DIC = disseminated intravascular coagulopathy.

Low birth weight (≤ 2500 g) was noted in 17 of the babies who died; 6 of these were term babies with intrauterine growth restriction. The mean birth weight of the babies who died was 1599.5 g (range 570–3300 g; SD 843.17) (Figure 1A). Prematurity accounted for 11 of the 21 neonatal deaths, including 6 with extreme prematurity (≤ 28 weeks gestation). The mean gestational age of the babies who died was 32 (range 23–40, SD 6.53) weeks (Figure 1B).

Congenital anomalies were found in 10 babies; these included 7 with declared futility on antenatal ultrasound scan. Among the dead babies, 15 were non-Qatari and 9 were males (Table 2). All neonatal deaths occurred in tertiary care neonatal and paediatric intensive care units of Hamad Medical Corporation. There were no neonatal deaths in the private facilities nor in any secondary care unit.

The neonatal mortality rate was 4.28/1000 live births during the study period and the corrected neonatal mortality rate (calculated after excluding lethal congenital anomalies and futility) was 2.85 /1000 live births. The early neonatal mortality rate was 1.84/1000 live births and late neonatal mortality rate 2.44/1000 live births (Tables 1 and 3). The neonatal mortality rate declined steadily (Figure 2) from 2008 till the first quarter of 2011 (relative risk 0.94; 95% confidence interval 0.85–1.04). However, the decline was not statistically significant ($P < 0.05$). The early neonatal mortality rate also showed a non-significant decline ($P < 0.05$). The late neonatal mortality rate, however, remained static.

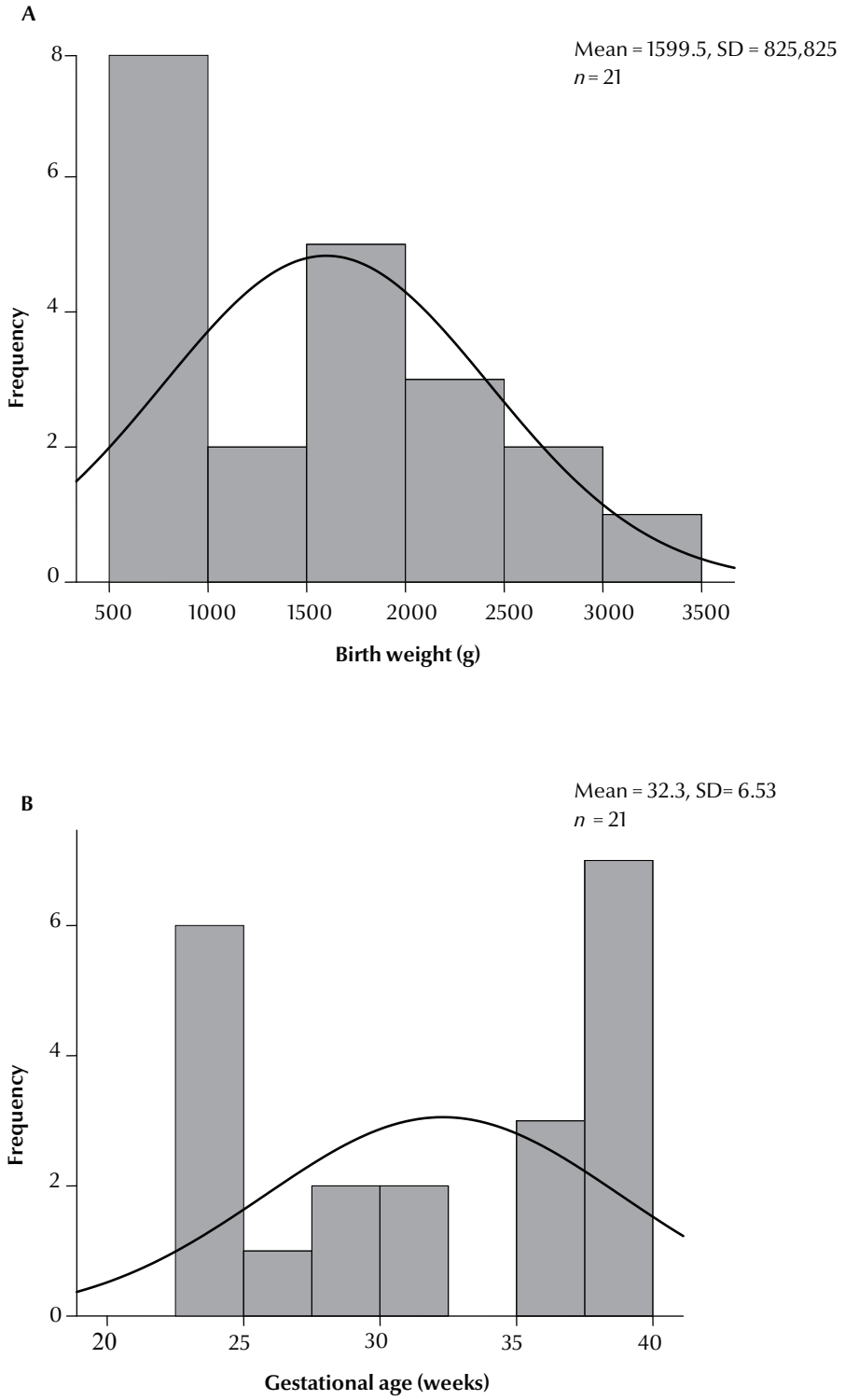

Figure 1 **Birth weight (A) and gestational age (B) curves among neonatal deaths, Doha, 2011**

Discussion

Qatar's sociodemographic and health services profile is changing very fast due to the recent economic boom. Over the past 4 years, with increasing population and expanding health care services, many secondary care maternity and neonatal units have been established across the country. Women Hospital's share of national births has now dropped from 98.0% during 1977–2007 to 82.76% owing to the shift of low risk deliveries to secondary care facilities; consequently, the number of deliveries in public and private secondary care hospitals increased, from ≤ 1.0% to 17.24%.

Table 3 Trends in neonatal mortality rates in Qatar, 2008–2011

Variable	Year				*P*-value	RR (95% CI)
	2008	2009	2010	2011		
Comparison of annual neonatal mortality rate (2008–2010) with first quarter neonatal mortality rate (2011)						
Live births	14899	15531	16416	4909		
Neonatal deaths	80	65	79	21		
Neonatal mortality rate[a]	5.4	4.3	4.11	4.28	0.269	0.94 (0.85–1.04)
Early neonatal deaths	31	34	38	9		
Early neonatal mortality rate[a]	2.5	2.2	1.94	1.84	0.537	0.95 (0.81–1.11)
Late neonatal deaths	49	31	42	12		
Late neonatal mortality rate[a]	2.9	2.1	2.17	2.44	0.356	0.94 (0.83–1.06)
Comparison of first quarter neonatal mortality rate (2008–2010) with first quarter neonatal mortality rate (2011)						
Live births	3498	3660	3777	4909		
Neonatal deaths	19	21	19	21		
Neonatal mortality rate[a]	5.4	5.7	5.0	4.28	0.36	0.8 (0.4–1.4)
Early neonatal deaths	11	12	11	9		
Early neonatal mortality rate[a]	3.1	3.3	2.9	1.84	0.15	0.5 (0.2–1.3)
Late neonatal deaths	8	9	8	12		
Late neonatal mortality rate[a]	2.3	2.5	2.1	2.44	0.88	1.1 (0.4–2.6)

[a] *Per 1000 live births.*
RR = relative risk of mortality between 2008 (reference) and 2011.
CI = confidence interval.

Our study shows that Qatar's neonatal mortality rate had a persistent but very slow downward trend between 2008 and 2011. The same trend was experienced in many developed countries during the 1990s [11,12]. This suggests that neonatal mortality rates have a limit to improvement, after which they become static. This is probably due to the fact that the unexpected birth of babies with lethal congenital anomalies or acquired problems like fulminant sepsis and severe perinatal asphyxia will never become zero. Qatar's 2011 neonatal mortality rate (4.28/1000) is the best among the Gulf Cooperation Council countries, and is similar to the 2010 neonatal mortality rate in the United States of America, Canada and New Zealand [6]. Although some countries, e.g. Sweden, Japan and Singapore, have much better neonatal mortality rates [6], in-depth analysis of causes of neonatal deaths, difference in social and cultural values directing obstetric practices, and the method of reporting of deaths reduces this gap considerably.

The ethnic distribution of neonatal mortality between Qatari and non-Qatari babies in our study reflects the general ethnic distribution in the population. Hence, the neonatal mortality rate appears to be independent of ethnicity.

Low birth weight (≤ 2500g) is the major cause of neonatal deaths in Qatar. In our study 81% of neonatal deaths were among low birth-weight babies. This included preterm babies who were otherwise appropriate for gestational age, as well as term and preterm babies who had intra uterine growth restriction. Term intrauterine growth restriction constituted 35% of total low birth weight babies. The birth weight distribution curve for our dead babies is markedly skewed to the left compared with the gestational age distribution curve for the same babies. This pattern is in marked contrast to the developed world countries in which prematurity with birth weight appropriate for gestational age constitutes the major cause of neonatal deaths [6].

Prematurity was the second biggest cause of neonatal deaths in our study. Since the mid-1990s, Qatar has had a very busy and active assisted reproductive unit. Hence, similar to the pattern in developed world countries, assisted reproduction has resulted in increased numbers of preterm and multiple births over the last 2 decades [7]. Therefore the trend of increasing numbers of preterm births accompanied by a parallel increase in preterm mortality at the limits of viability and an attending increase in morbidity will continue despite rapidly advancing neonatal intensive care technology. This is the profile of neonatal survival shared by all developed and rapidly developing countries.

Lethal congenital anomalies were the third leading cause of neonatal mortality in our study. According to the most recent global report, the Arab countries have the highest incidence of birth defects in the world [13]; the reported incidence in Qatar is 74 per 1000 births. Consanguinity may be an underlying reason of high incidence of birth defects. The overall incidence of consanguinity is 40%–70% among Gulf Cooperation Council countries [14], and the incidence can be very high in

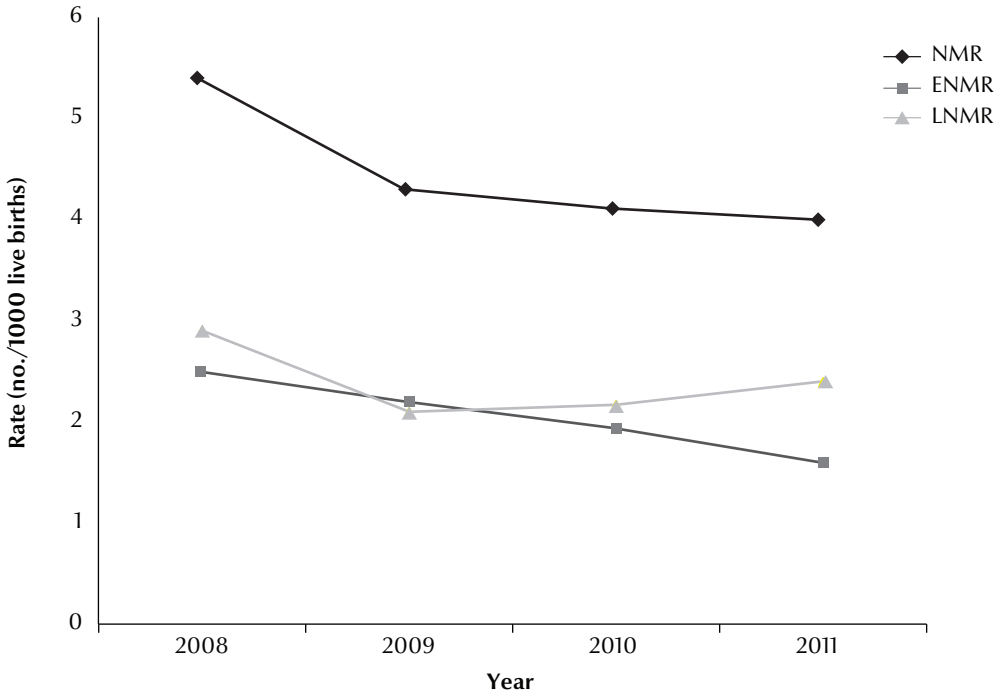

Figure 2 Trends in neonatal mortality rate (NMR), early neonatal mortality rate (ENMR) and late neonatal mortality rate (LNMR) in Qatar 2008–2011

some individual tribes. The incidence of consanguinity in Qatar is 54% [14]. Consanguinity has a known association with preterm births [15], as well as with perinatal wastage [16]. In our study, 35% of babies with congenital anomalies had declared futility on antenatal ultrasound scan.

The parents of 5 of the babies who died in our study had consented to a "do not resuscitate" policy during antenatal counselling. Because of local sociocultural conventions and religious beliefs, the parents preferred this approach rather than termination of pregnancy. With the same antenatal scenario in the more developed countries, these pregnancies would have been terminated and would never have been counted or included in the neonatal mortality rates. This point was highlighted pertinently in a recent report on the impact of varying practices of termination of very preterm pregnancies among European countries on neonatal mortality rates [17]. According to this report, most terminations were due to congenital anomalies and contributed substantially to overall fetal mortality rates during the second trimester [17]. If Qatar had a similar rate of antenatal terminations of congenital anomalies during the second trimester, the neonatal mortality rate would have been 1–2/1000, similar to that of Japan and Singapore, which have the best numerical neonatal survival outcomes [6]. Therefore it is extremely important to document the background, sociocultural situation and religious beliefs which drive obstetric practice in each society before comparing numerical achievements of health indicators. The same points were highlighted in a 2003 study reviewing the heterogeneous composition, practices and reporting systems across Europe [18].

Sepsis was associated with 35% of deaths in our study and was the fourth most common cause of neonatal mortality; about three-quarters of the cases of sepsis were associated with prematurity. Two babies delivered at term had very severe early-onset sepsis of perinatal origin. Both died on day 8 of life despite full intensive care support. In most developed countries, prematurity is the first and sepsis the second most common cause of neonatal death [7].

The health care arena in Qatar is changing swiftly. Qatar provides universal health cover for all its citizens, irrespective of ethnicity. Maternal and neonatal health care in Qatar is not only expanding horizontally; it is also developing vertically. Our study has shown that all neonatal deaths took place in neonatal and paediatric intensive care units of the only tertiary care facility in the country. This is because all mothers with high-risk pregnancies are usually transferred before delivery to tertiary care hospitals. Any high risk babies delivered in secondary care hospitals are transferred to tertiary care hospital. Our findings have also shown that the contribution of private hospitals and public sector secondary care units has now increased to 17.24% of total deliveries. This trend is likely to increase further in near future. Neonatal mortality among high risk babies is known to be lower

when they are born in hospitals with tertiary care obstetric and neonatal intensive care facilities [19]. As with other successful regionalized perinatal systems, e.g. in British Colombia, Canada [20], an authentic reporting of maternal, perinatal and neonatal outcome indicators in Qatar will be markedly facilitated by the development of a prospective national electronic perinatal registry.

Conclusion

The State of Qatar has achieved neonatal mortality rates comparable to the rates in most developed countries of the world; both in the west and east. Qatar's neonatal mortality rates seem to have reached a plateau. Any further improvement in neonatal survival will require reduction in the number of lethal congenital anomalies and improved care of preterm and low birth weight babies.

Funding

The Perinatal Neonatal Outcomes Research Study in the Arabian Gulf (PEARL Study) has been exclusively funded by Qatar National Research Fund (www.qnrf.org) [the research funding body of Qatar Foundation (www.qf.org.qa)] through the third cycle of its National Priorities Research Programme; grant number QNRF-NPRP-09-390-3-097.

Acknowledgements

We thank Dr Emirah A. Latiph-Tamano, Dr Faiza Rani, Ms Rabia Aman (PEARL Study research assistants), Mariam Abdel Hafez (PEARL Study secretary) and the management of all public and private maternity hospitals in Qatar for their support in assembling the national births and neonatal deaths data for Qatar's Perinatal Registry (Q-Peri Reg).

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