INTRODUCTION

Neonatal survival has dramatically improved worldwide over the last three decades, particularly in developed and many rapidly developing countries including Qatar. Since 1980s, most of this improved neonatal survival is the consequence of increasing survival of preterm babies including extremely preterm babies (< 28 weeks) in spite of increasing total number of preterm births. At the same time, preterm births remain the leading cause of neonatal deaths in the developed world. Preterm births are also the leading cause of neonatal deaths in Qatar. Parents of preterm babies are genuinely concerned about the outcome of their untimely born baby. They need to be presented with a realistic outcome profile of their individual baby painted in the light of local gestational age specific neonatal survival data and its comparative analysis with international benchmarks. Hence, for the purpose of parental counseling, which is an essential component of neonatal intensive care worldwide, all tertiary care neonatal units are expected to publish their outcomes data every few years. Qatar's trends in neonatal survival over a period of 30 years, socioeconomic correlates of improved survival and comparative analysis of morbidity outcomes of very preterm (28+1-32 weeks) babies with VON (Vermont Oxford Network) as an international benchmarks have been recently published. However, gestational age specific neonatal survival data from Qatar has never been published before. In order to fulfill this gap, this study was conducted to analyze and compare the current gestational age specific neonatal survival rates between Qatar and international benchmarks, selecting World Health Statistics by WHO (2010), Vermont Oxford Network (VON, 2007) and National Statistics United Kingdom (2006) as international benchmarks for comparative analysis.
METHODOLOGY

This retrospective analytical study was conducted in Women's Hospital Hamad Medical Corporation, Doha, State of Qatar. More than 99% of State's deliveries take place in this hospital and all high risk (≤ 32 weeks) and sick newborn babies are admitted to its NICU. Therefore, for all practical purposes, the neonatal data from this hospital represents Qatar's national data. The study was approved by the Institutional Research Board (Protocol # 8208/08) of Hamad Medical Corporation, which is an organ of Qatar's National Health Authority.

Demographic and neonatal mortality data for six consecutive calendar years (2003-2008) was ascertained from the admissions and discharge registers of NICU and Maternity Unit and double checked with the annual reports published by the Department of Epidemiology Medical Statistics, Hamad Medical Corporation. A large number of pregnant women in the State are followed-up in primary health care centers during early pregnancy from where a complete medical record may not be available at the time of admission for delivery. Therefore, the gestational age is calculated by best obstetric estimate using either last menstrual period or early obstetric ultrasound or both. In case of discrepancy, the neonatal examination using Ballard is taken into account. Year wise mortality data was categorized for each individual ascending week of gestation from 24 weeks till post-term (≥ 42 weeks).

For comparative analysis of Qatar's overall Neonatal Mortality Rates with Gulf countries and developed countries from West (USA, Canada, United Kingdom, Germany, France and Sweden) and East (Japan, Singapore, Australia and New Zealand), World Health Statistics 2010 published by WHO was used.

Data was stratified into three conventional ascending categories of pre term babies: extremely preterm; ≤ 28 weeks, very preterm: 28-32 weeks and moderately preterm babies: 32-36 weeks. Using these three conventional categories, the category wise improvement in survival between 2003 and 2008 were calculated and compared. The relative risk (RR) of death for each category of preterm babies was also calculated in comparison with the full term and immediate higher gestational age group during 2008.

For comparative analysis with international benchmarks, the gestational age categories were stratified in line with the stratification used by Vermont Oxford Network (VON) in its 2007 expanded data base report; (< 27 weeks, 27-29 weeks, 30-32 weeks, 33-36 weeks, 37-41 weeks and ≥ 42 weeks). Neonatal mortality rate (NMR) was defined as the number of deaths of babies born

RESULTS

The total number of births for the study period (2003-2008) were 82,002 and total deaths 398 (Table I). The overall NMR during the six years period of the study (2003-2008) was 4.85/1000. The yearly NMR decreased significantly (p < 0.05) from 6/1000 in 2003 to 4.3/1000 in 2008. Qatar's current NMR was comparable with USA, Canada and New Zealand (Figure 1).

The preterm birth rate in Qatar decreased from 21.45% in 2003 to 8.85% in 2008 (p < 0.05) which was due to a statistically significant decrease (p < 0.01) in moderately preterm birth rate (19.8% in 2003 to 6.8% in 2008). The increase in extremely preterm and very preterm birth rates (0.53% to 0.8% and 1.12% to 1.25% respectively) was statistically insignificant. Describing the same in terms of survival (Table I), between 2003 and 2008, there was significant improvement in overall neonatal survival (from 99.4% to 99.6% p < 0.05). This improvement was mainly due to significant improvement in the survival of extremely preterm babies; from 56.7% in 2003 to 81.6% in 2008 (p < 0.001). The survival of very preterm, moderately preterm and term babies remained static (p > 0.1). The survival increased with increasing gestational age during each year of the study (Table I).

The relative risk (RR) of death decreased with increasing gestational age per 1000 total babies born at that specific gestation. Babies < 24 weeks gestation were excluded from the study, because the official lowest limit of survival in Qatar is 24 weeks. Due to their very small and statistically insignificant number, the home deliveries, any possible home deaths, very late neonatal deaths (> 28 days postnatal age) and babies dying after discharge from the hospital were also excluded from the study. However, babies born with lethal congenital anomalies, very low Apgar scores, extremely preterm (24-28 weeks gestation) and extremely low birth weight (500-1000 g at birth) who had signs of life at birth, but were declared non-viable by the attending clinician and died in the labour room, were included as neonatal mortality.

Data was analyzed in Epi Info version 3.5.1. Frequency with percentage was calculated for number of babies survived among number of births in each category of gestational age. Neonatal mortality rate (deaths per 1000 live births) was calculated for each gestational age category and risk ratio with 95% confidence interval was calculated for each category of gestational age by taking immediately next category as the reference and also by taking full term as the reference category. P-value was calculated through chi square test of significance to compare the improvement in gestational age specific mortality between Qatar, VON and UK. P-value of < 5% was considered significant.
4.28 (95% CI 1.97-9.31; p < 0.0001) among extremely preterm as compared to very preterm which in turn had an RR of 3.60 (1.5-8.7; p < 0.0001) as compared to moderately preterm babies. The RR of death among moderately preterm babies as compared to term babies was 7.32 (3.63-14.75; p < 0.0001).

When compared with babies born at term (Figure 2B), the relative risk (RR) of death was 113.17, (95% CI 64.45-198.7; p < 0.0001) among extremely preterm babies, 26.4 (95% CI 11.91-58.55, p < 0.0001) among very preterm babies and 7.32 (95% CI 3.63-14.75; p < 0.0001) among moderately preterm babies.

The comparative analysis with the international benchmarks (Table II) shows that Qatar has a significantly better outcome of babies < 27 weeks (p=0.01) and babies of 37-41 weeks gestation (p < 0.0001) as compared to VON. For the rest of all gestational age categories, there was no statistical difference in the survival outcome between Qatar and VON. Similarly,
between Qatar and UK, there was no difference in the survival of < 27 weeks (p=0.35), 27-29 weeks (p=0.07) and 30-32 weeks babies (p=0.79). However, the survival of 33-36 weeks, 37-41 weeks and ≥ 42 weeks was significantly better (p=0.01) in UK as compared to Qatar. The pattern of gestational age specific survival is similar between Qatar, VON and UK (Figure 3).

Table III, constructed from our extended unit database, gives analysis of causes of death in 1170 babies over a period of 12 years (1997-2008). Preterm babies are the leading cause of neonatal mortality in Qatar (45%), while lethal congenital anomalies remain the second commonest cause (26.5%).

Table III: Analysis of causes of death for 1170 babies over a period of 12 years in the State of Qatar (1997 to 2008).

<table>
<thead>
<tr>
<th>Cause of death</th>
<th>Number of deaths (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preterm Babies:</td>
<td></td>
</tr>
<tr>
<td>a. Extremely preterm babies.</td>
<td>210 (40%)</td>
</tr>
<tr>
<td>b. Sepsis in preterm babies.</td>
<td>175 (33%)</td>
</tr>
<tr>
<td>c. Intraventricular hemorrhage.</td>
<td>82 (16%)</td>
</tr>
<tr>
<td>d. Chronic lung disease.</td>
<td>57 (11%)</td>
</tr>
<tr>
<td>Lethal congenital malformations:</td>
<td>310 (26.5%)</td>
</tr>
<tr>
<td>Sepsis in term babies</td>
<td>224 (19.15%)</td>
</tr>
<tr>
<td>Hypoxic ischemic encephalopathy</td>
<td>38 (3.25%)</td>
</tr>
<tr>
<td>Persistent pulmonary hypertension</td>
<td>50 (4.27%)</td>
</tr>
<tr>
<td>Others</td>
<td>24 (2.05%)</td>
</tr>
</tbody>
</table>

Gestational age specific neonatal survival

Figure 3: Gestational age specific % survival curves (Qatar 2008, VON 200714 and UK 200615).

DISCUSSION

According to the most recently published data on global burden of neonatal deaths,1,7 the countries constituting Gulf Cooperation Council (GCC), which includes Saudi Arabia, Kuwait, Bahrain, Qatar, United Arab Emirates (UAE) and Oman, have done extremely well over the last four decades in reducing their neonatal mortality rates. Among the GCC countries, the State of Qatar and UAE have achieved neonatal survival rates, which are comparable to many developed world countries.8-10 The State of Qatar stands unique among the world countries by achieving most of its Millennium Development Goals (MDG’s) by 2007,11 half way before the target year 2015. This includes MDG #5 (two thirds reduction in Childhood Mortality Rate). The dramatic changes in obstetric management of preterm births coupled with exponential advances in intensive neonatal care over the last two decades, have contributed significantly towards this achievement.5-6

Gestational age at birth is a very important independent determinant of neonatal survival. Neonatal mortality increases with decreasing gestational age and birth weight.6,15 Each additional week of gestation and 100 gram increase in birth weight results in large reductions in mortality risk.6 The increasing number of preterm births worldwide is paralleled by increasing survival at limits of viability. Like the developed world countries, preterm births are the leading cause of neonatal deaths in Qatar.8 Therefore, knowledge of gestational age and birth weight specific neonatal mortality and morbidity outcomes in individual neonatal units, regions and countries is very important, both from the strategic planning as well as from the consumer satisfaction point of view.

According to World Health Statistics 2010 published by WHO,1 Qatar's NMR was 4/1000 during 2010 which is similar to USA, Canada and New Zealand (Figure 1). This has reconfirmed our previously published finding.8 The current study has shown that in the State of Qatar, in addition to the overall NMR, the gestational age specific neonatal mortality rates have also significantly improved (p < 0.05) between 2003 and 2008. Both overall and gestational specific NMR is now comparable with the international benchmarks. This finding adds strategic value to another of our recently published data which has shown that the morbidity outcomes of moderately preterm (28+1-32 weeks) babies in Qatar are comparable with the international benchmarks.10

Vermont Oxford Network (VON) is a database of more than 800 NICUs worldwide; the majority of these NICUs are located in North America, Europe and Australia.14 Its annual reports have traditionally been used by neonatal units worldwide for comparative analysis and quality control of their mortality and morbidity outcomes. The comparative analysis of gestational age specific neonatal survival rates in the State of Qatar are better than the similar rates reported by VON in 2007. The ≤ 32 weeks gestational age specific survival rates are also similar to the 2006 national neonatal survival rates of United Kingdom.15 Therefore, in spite of differences in socioeconomic, cultural and demographic factors among various regions and countries which contribute data to VON data base, the comparable outcomes indicate that the standards and levels of health care remain very important factors in determining the neonatal outcomes.9

According to the current study, the survival rates of > 32 weeks gestation babies is better in UK (p=0.01). The
difference is partly explained by the higher number of lethal congenital anomalies coupled with low rates of antenatal terminations in Qatar. According to the most recently published March of Dimes (MOD) report on birth defects,16 the Arab countries including Qatar have one of the highest incidences of birth defects in the world. Sudan with a birth defects rate of 82/1000 is on top of the “red zone countries” followed by Saudi Arabia (81.3/1000), United Arab Emirates (75.9/1000), Kuwait (74.9/1000), Bahrain (73.4/1000) and Qatar (73.4/1000). Consanguinity, with its known association with preterm births, congenital anomalies and reproductive wastage, has an incidence of 40-70% in the Arab region.17-19

The United Kingdom has a much lower birth defects incidence (43.8/1000); and hence it is placed in the lower part of the “green zone” in MOD report.16

National policies relating to antenatal screening and terminations of pregnancy (TOP) are another source of variation in the Perinatal and Neonatal mortality outcomes among various countries.20,21 In the Northern region of United Kingdom, TOP accounts for 23.5% of very preterm still births and 5.8% of very preterm live births.21 Sixty eight percent of terminations are carried out at 22 to 23 weeks gestation, 12.5% at 24 to 25 weeks and 18.8% at or after 26 weeks gestation.21 Majority i.e. 84.4% of these terminations are due to congenital anomalies.21 In the Trent region of UK, TOP accounts for 22.4% of very preterm still births and 5.1% of very preterm live births.21 About three quarter i.e. 74.5% of terminations are carried out at 22 to 23 weeks gestation, 17.6% at 24 to 25 weeks and 7.8% at or after 26 weeks gestation.21 Again 91.6% of these terminations are due to congenital anomalies.21 Other regions from UK have similar patterns.22 In the State of Qatar, antenatal anomaly scans are performed before 20 weeks of gestation and elective terminations before 22 weeks of gestation. Some late terminations may be done due to unavoidable circumstances. According to the data from the feto maternal unit of Women’s Hospital, Qatar, the antenatal termination rate was 0.12% per year between April 2003 and December 2008; 84% of these terminations were due to congenital anomalies and 16% due to maternal reasons. 89% terminations were done before 22 weeks of gestation and 11% between 23 and 26 weeks gestation.23 This low antenatal terminations rate translates into the birth of a high number of babies with lethal congenital anomalies; majority of whom are born at term or near term. Hence, lethal congenital anomalies account for one fourth of neonatal deaths in Qatar (Table III).

According to the data published by Qatar’s National Neonatal Screening Programme, the incidence of endocrine and metabolic disorders is 1:901 in Qatar as compared to 1:1728 in Germany.24 The incidence of monogenic metabolic diseases was 1:1327 in Qatar as compared to 1:2517 in Germany.24 According to the 2008 report of the Screening Programme, Qatar has the highest incidence of Homocystinuria in the world. This higher incidence of metabolic disorders coupled with lethal congenital anomalies may account for higher mortality among near term and term babies in Qatar as compared to UK.

The proportion of low birth weight babies (LBW) in Qatar has remained unchanged (8.3 to 9.5%) over the last three decades in spite of the tremendous socio-economic and health care progress in the State.8,9 A study from United Arab Emirates has not only shown a similar constant trend in the prevalence of LBW (8.4%),25 it has also identified low maternal weight and inter pregnancy interval (IPI) of three months or less as significant factors contributing towards low birth weight prevalence. This holds true for the entire Arab region including Qatar where all risk factors for low birth weight are prevalent. Low birth weight and congenital anomalies will remain a challenge for any future research into the neonatal mortality and morbidity and maternal and child health development programme in the region.

CONCLUSION

Qatar’s current overall and gestational age specific neonatal survival are comparable with the international benchmarks. The relative risk of death decreases significantly with increasing gestational age. Persistently high incidence of congenital anomalies, inborn errors of metabolism and low birth weight in the region needs further research.

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REFERENCES


