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Socioeconomic Risk Factors for Hospital-based Neonatal Death: A Population-based Study

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Abstract

Introduction: The aim of this study to review the socioeconomic determinants of neonatal death compared to living infants in a multinational's population.

Methods: A retrospective data analysis of 58,990 births. Population-based Cohort study retrieved from the perinatal registry for the 4 years period. We compared socio-economic factors in cases of neonatal death [NND] who died in the hospital with infants who have discharged alive from the hospital [AL]. Socioeconomic factors including nationality, religion, marital status, level of education, parents' occupation, family income, consanguinity, early childbearing, smoking, assisted conception, antenatal care, and place of delivery.

Results: There were 336 cases of ND and 58,654 of AL. The prevalence of NND was 5.7/1000 births. There were more neonatal deaths among uneducated mothers with P-value < 0.0003, and OR=2.0, mothers with low income (P=0.0008, CI=1.34-3.16, OR=2.07), families living in a shared houses (P=0.008, CI=1.23-3.19, OR=1.34), consanguinity (P=0.005, CI=1.13-2.0, OR=1.5), unemployed father (P=0.027, CI=1.24-4.28, OR=2.4), father's education (P=0.017, CI=1.065-1.92, OR=1.4), assisted conception (P= 0.0001, CI=2.99-5.46, OR=4.04) and those mothers with no antenatal care (P=0.0001, CI=2.54-4.48, OR=3.37). Preterm birth in a referral/tertiary hospital was significantly high. There was no negative impact of nationality, mother's occupation, maternal age, gravidity, or smoking. Comparing means among maternal and neonatal outcome categories showed no negative impact of crowding index (family members/number of rooms), number of rooms, number of family members, number of children in the house, or number of parties.

Conclusion: In this study, antenatal care, parent's education, father's unemployment, low income of the mother, poor housing, consanguinity, assisted conception, and preterm birth were all associated with in-hospital neonatal death.

Keywords

Socioeconomic, Hospital Neonatal Death, Maternal, Newborn, Outcome

Abbreviation

NND: Neonatal Death; AL: Alife

Introduction

The last 20 years were characterized by, among other things, a marked improvement in the overall health status of the maternal and neonatal population living in the state of Qatar and a corresponding pronounced decline in mortality rates. These developments have been most dramatic concerning infants, as described in the WHO report, where some countries have done extremely well [1]. This includes the six countries that comprise the Gulf Cooperation Council [GCC], Qatar, Bahrain, United Arab Emirates, Oman, Kuwait, and Saudi Arabia.

In May 2010, The *Lancet* published a 28-year review [1980–2008] of world maternal mortality in 181 countries [2] and a 40-year review [1970–2010] of neonatal, postnatal, childhood, and under-five mortality in 187 countries [3]. These excellent reviews have shown that Qatar and other Gulf states have achieved a remarkable maternal and childhood mortality rate, which are comparable with those in most of the developed countries [4-8]. Some recent studies have documented the continued existence of an inverse association between infant mortality and various indicators of socio-economic status [9]. However, still, other studies have challenged both the universality and the strength of the relationship [10].

Despite this overall remarkable decline, it has long been known that there are substantial and significant differences in newborn mortality rates among the various segments of the population. In particular, the findings of many studies over the years have consistently shown that certain socio-economic factors in any society may long be characterized by an extremely pronounced disadvantage when it comes to the chances that a newborn infant will survive the first year of life [3]. Although studies have shown that the specific nature and magnitude of this relationship has varied over time and from place to place [4,5].

Almost 99% of neonatal deaths occur in low- and middle-income countries, yet most epidemiological and other research focuses on only the 1% of deaths that occur in rich developed countries [5,6]. The main causes of neonatal death include preterm birth, sepsis, and asphyxia. We aimed in our study to review the socio-economic data which had relations to early neonatal death that occurred inside hospitals before discharge in comparison to living infants in our population. Taking socio-economic data into consideration that in the state of Qatar, almost all deliveries occur inside hospitals. It is very rare to deal with planned home delivery.

Methods

This is a retrospective data analysis of 58,990 births retrieved from the PEARL registry for 4 years. The PEARL registry is a population cohort, neonatal-perinatal registry funded by the Qatar National Research Fund (QNRF). This registry was conducted in two phases. The first phase covered deliveries during the years 2011 and 2012. The second phase was to cover the years 2017 and 2018. All mothers and their newborns delivered during this time were registered both clinically and socially. Social data were collected through a face to face interview with the mother while filling a questionnaire. Mothers/ newborns data were stored and analyzed by the Dendrite® program. We compared neonatal death cases (NND) died in the hospital with those who were discharged alive from the hospital (ALO) regarding socioeconomic factors. Each factor was divided into an optimum socio-economic environment (control) and a less favorable environment (exposed to risk factor). The socioeconomic factors were: maternal nationality (nationals vs. residents); religion (Muslims vs. non-Muslims); the level of education (high vs. low); mother's occupation (housewife vs. working); family income (high vs. low); housing (separate vs. shared); the number of the family members, consanguinity (no vs. yes); early childbearing (older than 20 years vs. younger); high-risk pregnancy (no vs. yes); smoking [no vs. yes]; assisted conception (no vs. yes); antenatal care (yes vs. no); and place of delivery (referral vs. secondary).

Statistical analysis included the Fisher and mid-p exact tests, chi-squares, odds ratio, and maximum likelihood odds ratio estimate. P-values < 0.05 were considered significant with 95% confidence interval. Quantitative determinants used an independent t-test to compare means among maternal and neonatal outcome categories using independent t-test Mann

Whitney for skewed data.

The study was approved by the IRB of the medical research center in Hamad Medical Corporation who granted a waiver of consent to collect the patient electronic data.

Results

There were 336 ND cases and 58,654 AL cases. The prevalence of NND was 5.7/1000 births. There were more neonatal deaths among uneducated mothers with P-value < 0.0003, and OR=2.0, mothers with low income (P=0.0008, CI=1.34-3.16, OR=2.07), families living in shared house (P=0.008, CI=1.23-3.19, OR=1.34), consanguinity (P=0.005, CI=1.13-2.0, OR=1.5), unemployed father (P=0.027, CI=1.24-4.28, OR=2.4), father's education (P=0.017, CI=1.065-1.92, OR=1.4), assisted conception (P=0.0001, CI=2.99-5.46, OR=4.04) and those mothers with no antenatal care (P=0.0001, CI=2.54-4.48, OR=3.37). Preterm birth in a referral/tertiary hospital was significantly high. There was no negative impact of nationality, mother's education, mother's occupation, maternal age, gravidity, or smoking (**Table-1**). Comparing means among maternal and neonatal outcome categories showed no negative impact of crowding index (family members/number of rooms), number of rooms, number of family members, number of children in the house, or number of parities (**Table-2**). In this study, a mother's length of stay was significantly longer when the baby died (P-value of 0.008). There was no significant impact when looking at the occupational or educational difference between father and mother.

Table-1: Impact of Socio-Economic Variable on Early Neonatal Death [336/58990]

Socio-economic factors	Outcome of the baby				p - value CI OR
	Died in the hospital		Discharged alive		
	No.	%	No.	%	
Nationality					p=0.824
Qatari §**	99	0.6	16958	99.4	CI=0.8 -1.3
Non-Qatari§	237	0.6	41696	99.4	OR=1.027
Marital Status					p=0.612
Married**	257	0.5	47460	99.5	CI=0.73-1.67
Single, divorced & separated§	25	0.6	4159	99.4	OR=1.11
Father's education					
Illiterate §	5	0.8	656	99.2	p=0.017
Elementary§	13	0.6	2338	99.4	CI=1.065-1.92
Secondary/high school§	72	0.5	14792	99.5	OR=1.432
University or above**	86	0.4	24351	99.6	
Mother's education					
Illiterate§	13	0.7	1851	99.3	p=0.0003
Elementary§	20	0.8	2335	99.2	CI=1.3-2.9
Secondary/high school**	63	0.4	15149	99.6	OR=1.997
University or above**	88	0.4	23101	99.6	

Father's occupation Full-time worker* Unemployed§	166 12	0.4 0.9	40770 1171	99.6 99.1	p=0.0275 CI=1.25-4.26 OR=2.3
Mother's occupation Full-time worker§ Housewife**	75 155	0.4 0.5	17090 31833	99.6 99.5	p=0.553 CI=0.7-1.2 OR=0.92
Father's income Less than 10 thousand § More than 10 thousand ^	70 77	0.4 0.4	16527 20381	99.6 99.6	p=0.22 CI=0.89-1.669 OR=1.21
Mother's income Less than 10 thousand § More than 10 thousand *	70 30	0.4 0.5	7141 6353	99.6 99.5	p=0.0008 CI=1.34-3.16 OR=2.07
Housing Owned** Rented house§	54 124	0.4 0.5	14236 27309	99.6 99.5	p=0.270 CI=1.35-3.19 OR=2.0
Type of house Shared house§ Separate House*	47 133	0.5 0.4	8764 33307	99.5 99.6	p=0.008 CI=0.96-1.87 OR=1.34
Cultural Norms/ Fertility Behaviors					
Consanguinity No* Yes§	109 76	0.4 0.6	28748 13171	99.6 99.4	p=0.0051* CI=1.13-2.0 OR=1.5
Early childbearing Mother < 20 years§ Mother 20+ years**	13 323	0.6 0.9	1384 57408	99.4 99.1	p=0.068 CI=0.95-2.9 OR=1.66
High risk pregnancy Yes§ No**	74 262	0.7 0.5	10983 47809	99.3 99.5	p=0.117 CI=0.94-1.6 OR =1.2
Gravidity* 0-3** High gravidity [>3] §	215 121	0.6 0.6	38472 20293	99.4 99.4	p=0.585 CI=0.85-1.33 OR=1.06

Habits/ Behaviors					
Smoking Yes§ No**	0 234	0 0.5	293 50048	100 99.5	p=0.475 CI=0.02-5.8 OR=0.363
Health Care Service Utilization					
Pregnancy mode Assisted§ Spontaneous**	52 268	2.4 0.6	2128 44338	97.6 99.4	p< 0.0001* CI=2.99-5.46 OR=4.042
Place of Delivery Referral hospitals§ Other hospital	315 21	0.6 0.2	49824 8898	99.4 99.8	p< 0.0001* CI=1.7-4.16 OR=2.6
Antenatal care [ANC]					p< 0.0001*
Yes** No§	273 59	0.5 1.7	54897 3515	99.5 98.3	CI=2.54-4.48 OR=3.37
Prematurity Yes	227	0.04	5203	0.96	p<0.0001 CI=15.5-24.2
No [full-term] §	120	0.02	53440	0.98	OR=19.4

*Gravidity is defined as the number of times that a woman has been pregnant. Parity is defined as the number of times a woman give birth to a live newborn more than 24 weeks gestation.

**Control population with expected good outcome. § Risk population with expected poor outcome

The significance threshold was defined for P<0.05. 95% Confidence interval [CI] Odds ratio [OR].

The odds ratio [OR], its standard error and 95% confidence interval are calculated according to Altman [15,16].

Test of significance. the P-value is calculated according to Sheskin. [17]

Discussion

Neonatal death has dramatic repercussions on the family and community. Several factors have been attributed to neonatal deaths. The most common are pure medical causes like congenital anomalies, infections, prematurity, and rare diseases. While this is true, socio-economic elements remain an important background of all this drama.

In this study, we looked at the most common socio-economic elements that play important roles in advancing or regressing maternal health and can be blamed for neonatal death. In Qatar, the maternal health system mandates hospital deliveries for all pregnancies, while accidental home deliveries should be transferred to hospital facilities. This study found that maternal illiteracy and low levels of education have a significant impact on neonatal death (P=0.0003, CI=1.3-2.9, and OR=2.0). Neonatal death was 1.8% in illiterate and elementary school graduate mothers, while it was 0.4 % in the group with higher levels of education. Unemployed fathers also affected significantly (6.4% versus 0.4%), with a P-value of 0.02 and OR=2.3. This could be attributed to reduced antenatal care visits, less adherence to doctors' advice, transport limits to community health care facilities, and poor maternal nutrition. Such a conclusion is consistent with published literature, in which low

education levels, no antenatal care, assisted conception, consanguinity, and father unemployment are all factors associated with neonatal death. Assisted conception and its link to increasing multiple gestations rate carry the risk of neonatal death. It is known to lead to an increased chance of having premature deliveries, with all its complications, and an increased rate of morbidity and mortality [8,11].

In this study, the NND was greater in women who had assisted conception (2% versus 0.6% in mothers with spontaneous pregnancy). The absence of antenatal care is a crucial factor that determines pregnancy outcomes. Clearly, neonatal deaths are higher among those mothers with poor antenatal attendance (1.6% versus 0.4%, with a p-value of 0.0001 and OR of 3.4) [12,13]. Kim et al demonstrated that even within both the United States and other developed countries, the evidence in two-thirds of studies suggests that low income, unemployment, poor neighborhood status, limited access to the health care system, and little or no antenatal care all play a role in infant mortality and neonatal outcome [14]. Although marital status was one of the participating factors in fetal and neonatal mortalities, in our report it was of little influence on neonatal mortality [7,8].

The degrees of social support, trust, networks, and connectedness characterizing a neighborhood or maternal and family lifestyle could influence health through the diffusion of knowledge on healthy behaviors, and/or collective action leading to policies that provide health-promoting public goods. The high rate of deaths in women's hospital as a major referral health facility was noted, which can be explained by the in-utero transfer of high-risk mothers [preterm, multiple conceptions in-utero diagnosis of any pathology] and sick newborns to deliver in a tertiary hospital. The current study could not identify the major impact of the father's income, nationality, religion, household income, gravidity, or smoking. As well, there was less impact of crowding score, number of family members, number of parity as well as there is no impact of education or income differences between mother and father (**Table-2**).

Table-2: The Means of the Following Quantitative Variables were tested for Neonatal

	Final outcome of the baby	N	Mean	Std. Deviation	p-value CI
Male-female education [educational difference]	Died in hospital	173	0.1387	1.25446	0.925 -0.16- 0.18
	Discharged alive	41471	0.1304	1.16066	
male-female income [income difference]	Died in hospital	59	0.4576	1.4893	0.266 -0.45 - 0.12
	Discharged alive	14031	0.2952	1.11745	
Crowding index*	Died in hospital	171	1.8569	0.92368	0.804 -0.19 to 0.15
	Discharged alive	40722	1.8359	1.10516	
Number of rooms	Died in hospital	172	3.49	1.862	0.586 0.23 to 0.41
	Discharged alive	40848	3.58	2.165	
Number of family members	Died in hospital	178	6.37	5.833	0.6632 0.92 to 0.56
	Discharged alive	42246	6.19	5.134	
Number of children at home	Died in hospital	172	2.53	2.556	0.774 -0.3 to 0.45
	Discharged alive	40752	2.59	2.703	
Parity*	Died in hospital	336	1.66	1.956	0.402 0.11-0.27
	Discharged alive	58753	1.74	1.744	

Crowding index (family members/number of rooms)
Independent t-test to compare means among maternal/neonatal outcome categories

Conclusion

Socio-economic variables (e.g., place of residence, religion, marital status, education, occupation, family income, household income, etc.) reflect the socio-economic status of a community and have a high influence on morbidity and mortality level. A parent's occupation determines the economic status, nutrition and housing condition, access to health care, and clothing of a family. Infant and child mortality reflects a country's level of socio-economic development and quality of life. From our study, we observe that the mother's education, occupation, and type of housing are the influential factors of neonatal deaths. Hence, the following recommendations could help planners and policymakers to take appropriate decisions to reduce infant and child mortality of not only the study area but also the whole country:

1. Both male and female education participation needs to increase because it consequently brings an improvement in the infant and child mortality situation.
2. Sanitation facilities families should improve.
3. Antenatal care public enforcement is a free health service for all pregnant mothers irrespective of their residency status.
4. Developing structured social programs to help and support single mothers who get pregnant.

Conflict of Interest

All authors have read and approved the final version of the manuscript. The authors have no conflicts of interest to declare.

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