WHO EMRO | Risk factors for neonatal intensive care unit admission in Amman, Jordan

PDF version

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عوامل خطر إدخال حديثي الولادة إلى وحدة العناية المركزة في عمّان بالأردن

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: إن فهماً أفضل لعوامل خطر إدخال حديثي الولادة إلى وحدة العناية المركزة يمكنالخلاصة
أن يرشد إلى تدخلات تحسِّن من بقاء حديثي الولادة على قيد الحياة . وقد هدفت هذه الدراسة
إلى بيان حالة مجموعة من حديثي الولادة الذين أدخلوا إلى وحدة العناية المركزة في
عمّان بالأردن، ومقارنتهم مع حديثي الولادة خُرِّجوا إلى المنزل . فتم تسجيل حديثي
الولادة خلال 96 ساعة في مستشفى البشير استباقياً من شباط / فبراير 2010 حتى
حزيران / يونيو 2011. وجُمعت البيانات السكانية والسريرية للأمهات وحديثي الولادة . من
أصل 5466 حديثي ولادة مسجلين تم إدخال 373 (6.8%) إلى وحدة العناية المركزة . وكان متوسط
العمر الحملي للرضع الذين أدخلوا إلى وحدة العناية المركزة 36 أسبوعاً، ووسطي وزن
الوليد 2.2 كجم، ووُلد 49.5% منهم بعملية قيصرية غير انتقائية . انخفاض العمر الحملي
وانخفاض وزن الوليد والولادة بعملية قيصرية والولادة في شهر أيار / مايو كانت عوامل خطر
ذات دلالة إحصائية للإدخال إلى وحدة العناية المركزة . إن عوامل خطر إدخال حديثي
الولادة إلى وحدة العناية المركزة كانت متماشية مع شعوب أخرى في العالم، غير أن متوسط
العمر الحملي ووزن حديثي الولادة كانا أعلى مما هما عليه في البلدان المتقدمة .

ABSTRACT A better understanding of risk factors for neonatal intensive care unit (NICU) admission can inform interventions to improve neonatal survival. This study aimed to describe a population of newborns admitted to a NICU in Amman, Jordan, and compare them with newborns discharged to home. Newborns born within 96 hours at Al-Bashir Hospital were enrolled from February 2010 to June 2011. Demographic and clinical data were collected for mothers and newborns. Of 5466 enrolled neonates, 373 (6.8%) were admitted to the NICU. The median gestational age of NICU infants was 36 weeks, median birth weight was 2.2 kg and

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49.5% were delivered by non-elective caesarean section. Lower gestational age, lower birth weight, delivery by caesarean section and birth in the month of May were statistically significant risk factors for NICU admission. Risk factors for NICU admission were consistent with other populations worldwide; however, median gestational age and birth weight were higher than in developed countries.

Facteurs de risque pour l’admission en unité de soins intensifs néonatals à Amman (Jordanie)

RÉSUMÉ Une meilleure compréhension des facteurs de risque pour l’admission en unité de soin intensifs néonatals permet d’orienter les interventions en vue d’améliorer la survie des nouveau-nés. La présente étude avait pour objectif de décrire une population de nouveau-nés admis en unité de soins intensifs néonatals à Amman (Jordanie) et de mener une étude comparative avec des nouveau-nés rentrés à domicile. Les

nouveau-nés dont la naissance est survenue dans un laps de temps de 96 heures après leur entrée à l’hôpital Al-Bashir ont participé à l’étude entre février 2010 et juin 2011. Des données démographiques et cliniques ont été collectées pour les mères et les nouveau-nés. Sur 5 466 nouveau-nés, 373 (6,8 %) ont été admis en unité de soins intensifs néonatals. L’âge gestationnel médian des enfants admis dans l’unité était de 36 semaines, le poids médian à la naissance était de 2,2 kg et 49,5 % d’entre eux étaient nés par césarienne non élective. Un âge gestationnel plus bas, un poids à la naissance plus faible, une naissance par césarienne et la naissance au cours du mois de mai constituaient des facteurs de risque statistiquement significatifs pour une admission dans l’unité. Ces facteurs de risque coïncidaient avec ceux d’autres populations dans le monde, mais l’âge gestationnel et le poids à la naissance médians étaient plus élevés que dans les pays développés.

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Introduction

Neonatal intensive care has become a cornerstone for treatment of premature infants worldwide. In the United States, for example, wide access to advances in neonatal care such as surfactant therapy and antenatal corticosteroids has resulted in an increase in survival of neonates admitted to NICUs across the country (1). These technological advances have led to an average cohort that would have likely been considered non-viable just a few decades ago. Neonates weighing under 1500 g have shown a steady increase in survival over the past decade, and neonates born at 25 weeks now have a 75% survival rate (2,3). In addition to improvements in survival among the most premature neonates, the United States has seen a steady decrease in its overall neonatal mortality rate (deaths under age 28 days per 1000 live births) and the most current estimate is around 4 per 1000 live births (4).

Globally, childhood mortality is of particular interest as the world strives to meet Millennium Development Goal (MDG) 4: reducing child mortality by two-thirds between 1990 and 2015 (5). Currently, 40% of deaths in children younger than 5 years old occur in the neonatal period, with 99% of neonatal deaths occurring in low- or middle-income countries (6). This represents a 30-fold higher average daily mortality rate during the neonatal period than the post-neonatal period (7). Complications related to preterm birth accounted for the largest fraction (14.1%) of these deaths, followed by intrapartum-related complications (9.4%) and neonatal sepsis or meningitis (5.2%) (8). Though there has been an overall reduction in the under-5 mortality rate (U5MR) by an average of 2.6% per year, the decrease falls short of the 4.4% annual decrease needed to reach MDG 4. Additionally, decreases in U5MR have occurred more rapidly in children outside of the neonatal period, so that the neonatal fraction of deaths increased from 38.2% to 40.3% of deaths between 2000 and 2010 (8). Thus, interventions focusing on reducing neonatal death, particularly those caused by preterm birth, are crucial to achieving MDG 4.

This trend is similar in Jordan, where the U5MR is 21 per 1000 live births (9). During the last two decades neonatal morbidity has grown to represent a larger proportion of overall infant mortality (10), with prematurity as the leading cause of the U5MR (34%), followed by congenital anomalies (21%) and birth asphyxia (12%) (9,11). This calls for a focus on neonatal care to reduce the U5MR and achieve MDG 4. However, neither basic demographic information nor risk factors for admission of infants to NICUs in the Middle East, including Jordan, are well-documented in the current literature. A better understanding of the characteristics of infants requiring care in the NICU can provide direction for interventions that would improve neonatal survival. Therefore, in this study we aimed to describe the demographic and clinical characteristics of mothers and infants admitted to a NICU and to estimate the risk factors for

admission to the NICU of Al Bashir Government Hospital, one of three major hospitals serving Amman, Jordan.

Methods

The study was designed as a retrospective cohort nested within a prospective cohort study. This study was approved by the University of Jordan and the institutional review boards of Vanderbilt University and the Jordanian Ministry of Health at Al Bashir Hospital.

Sample

This study was part of a larger neonatal cohort study that enrolled neonates born at Al Bashir Government Hospital for baseline assessment of their vitamin D levels. If cohort members were subsequently admitted for respiratory illness, another vitamin D level was drawn at that time (12). Female research assistants approached all mothers on the postpartum ward during daytime hours from Sunday to Thursday. Verbal consent was obtained from mothers to obtain heel-pricks for blood from their neonates. Over the period 1 February 2010 to 30 June 2011 all neonates born at the hospital within 96 hours were eligible for inclusion in the study. However, the majority of infants were discharged within 24 hours unless they were admitted to the NICU.

The medical records of neonates from the prospective cohort who were admitted to the NICU were obtained and reviewed retrospectively to collect additional data about NICU admission and outcomes.

Data collection

Using a standardized case report questionnaire, mothers in the prospective cohort study were queried in Arabic by a member of the research team, who subsequently recorded the answers in English. The research assistants all received prior training in the protocol for questionnaire administration to ensure consistency. Parents were asked to provide the nationality of the mother and father, child's date of birth, route of delivery, child's birth weight, mother's vitamin D supplementation history, daily number of hours that mother spends outdoors, mother's clothing practice, whether or not the mother smoked during pregnancy (and if so, which of the trimesters), and if the mother was exposed to smoke in her household during pregnancy. The questionnaire also asked for self-reported diagnoses with medical conditions that may be associated with decreased bone health, including hyperparathyroidism, gestational diabetes, rheumatoid arthritis, and diseases requiring corticosteroid treatment.

For the retrospective data collection an electronic form was used to collect the following

variables for every neonate admitted to the NICU: reason for admission, Apgar score, C-reactive protein measurements, duration of stay in the NICU, presence of complications associated with prematurity, early and late infection status, antibiotic administration, surfactant administration and ventilation strategy. Apgar score was considered low if it was **Statistical analysis**

Descriptive statistics were used to summarize the sociodemographic and clinical characteristics of newborns by NICU admission. A multivariable logistic regression model was used to estimate the association of maternal exposure and birth outcomes with NICU admission. Covariates were identified a priori, and they included: baby's sex, gestational age, birth weight and type of delivery; mother's age, education, prenatal care, clothing practice, hours spent outdoors, exposure to tobacco smoke and any vitamin D supplementation; and baby's date of birth (temporal trend). To account for possible non-linear associations, continuous variables were included in the models using restricted cubic splines (14). Missing values of covariates were accounted for using multiple imputation techniques which used predictive mean matching to take random draws from imputation models; 25 imputation data sets were used in the analysis (15). We employed R statistical software, version 2.15.1 (www.r-project.org) for all data analyses. Analysis scripts are available at http://biostat.mc.vanderbilt.edu/ArchivedAnalyses.

Results

During the 17-month study period, 19 604 babies were born at Al-Bashir Hospital: 2810 non-viable (14.3%) and 16 794 living neonates. Of the living neonates, 3317 (19.8%) were admitted to the NICU.

Characteristics of prospective cohort sample

During that same time period, we approached 6057 mothers of neonates and enrolled 5466 neonates (90%) in our prospective cohort (2697 females and 2769 males) (Figure 1). The neonates in the prospective cohort had a median gestational age of 39 weeks, median birth weight of 3.1 kg and caesarean section delivery rate of 20% (Table 1). All caesarean sections performed were non-elective.

The mothers in the cohort study had a median age of 27 years and 24% had a history of multivitamin use during pregnancy. The vast majority of women were healthy; the two most common medical conditions reported by mothers were rheumatoid arthritis (2%) and gestational hypertension (2%). Although only 7% of mothers reported smoking during pregnancy, 72% reported exposure to tobacco smoke.

Of the 5466 neonates in the prospective cohort, 373 (7%) were admitted to the NICU during the study period (Table 1). Nearly half of these (183/373) were caesarean section deliveries, of which 53 (29%) were for fetal indications and 130 (71%) were for maternal indications.

Newborn characteristics by NICU admission

In the retrospective analysis comparing NICU to non-NICU neonates, NICU neonates had a lower median gestational age (36 weeks versus 39 weeks, P **Multivariable logistic regression analysis of risk factors for NICU admission**

Multivariable logistic regression was employed to estimate neonatal and maternal factors that were independently associated with admission to the NICU (Table 2 , Figure 2). Lower gestational age was associated with NICU admission. Compared with a gestational age of 40 weeks, neonates born at 34 or 36 weeks had a higher risk of NICU admission (OR 8.4; 95% CI: 5.6–12.4 and OR 3.6; 95% CI: 2.7–4.8 respectively). Neonates born weighing 2.5 kg had over 5 times higher odds of NICU admission compared with those with a birth weight of 3 kg (OR 5.39; 95% CI: 4.44–6.55). Delivery by caesarean section had over twice the odds of NICU admission (OR 2.36; 95% CI: 1.71–3.23). Babies born in May 2010 and May 2011 were also more likely to be admitted to the NICU (OR 2.43; 95% CI: 1.45–4.10). No significant associations were detected between NICU admission and maternal factors such as age, education level, location of prenatal care or clothing practice.

NICU patient characteristics and outcomes by delivery type

To further characterize differences of neonates admitted to the NICU, we compared neonates delivered by vaginal delivery or caesarean section (Table 3). Of the 373 NICU neonates, 318 (85%) had charts available for retrospective review. Comparing mode of delivery, children born by vaginal delivery had a significantly higher median gestational age [interquartile range (IQR) 35–37 weeks versus 34–37 weeks, P = 0.016] and higher median birth weight (2.30 kg versus 2.25 kg, P = 0.039) than neonates delivered by caesarean section. Additionally, compared with vaginal delivery, caesarean section was associated with the following characteristics: admission for low Apgar score (11% versus 1%, P

Discussion

This is one of the first studies describing neonates admitted to a NICU in Amman, Jordan and estimating the associated risk factors for NICU admission. In our study, we found that neonates admitted to the NICU had lower birth weight and gestational age compared with neonates not admitted to the NICU. However, the median gestational age of 36 weeks and birth weight of 2.2 kg were higher than median birth weight of 2.0 kg and gestational age of 31–34 weeks among neonates admitted to NICUs in North America and Europe (16–18). The majority of our

neonates would be considered late preterm infants (34–36 weeks). A difference in approach to care at the time of delivery may explain our older NICU cohort. For instance, infants that are extremely premature do not receive the same aggressive resuscitation that they would in developed countries and are considered non-viable. During the study period, the majority of newborns with a gestational age

Although the morbidity and mortality of late-preterm infants has been found to be lower than for those who are extremely premature, this group has a greater need for NICU admission, higher morbidity associated with organ immaturity and more long-term neurodevelopmental problems when compared with term infants (19–27). A recent study at a military hospital in Amman, Jordan found that 72.7% of preterm births were late preterm infants and that these infants experienced significantly higher morbidity and hospitalization than did term infants (28). Factors including male sex, maternal age > 35 years and first birth were associated with preterm birth in a previous study in Jordan (29). However, data on this topic are limited. Therefore, a further understanding of risk factors for preterm births in Amman is needed to reduce the morbidity of this population.

Gestational age, birth weight and delivery by caesarean section emerged as risk factors for admission to the NICU after adjusting for multiple maternal and neonatal factors. These data support studies in other countries, in where preterm delivery, multiple births and caesarean section were found to be associated with NICU admission (30–34). The physiological immaturity associated with young gestational age puts these infants at higher risk of respiratory distress and in greater need for support. Even among neonates delivered by caesarean section, gestational age remains a stronger predictor of NICU admission than rupture of membranes or trial of labour before delivery (35). Maternal factors found to predict NICU admission in other studies include age, race (16), body mass index (36), premature rupture of membranes, antepartum haemorrhage and medical disorders during pregnancy (32,33). Brown et al. suggested that placental ischaemia and endocrine abnormalities associated with these conditions work as biological determinants of preterm birth that act through and with gestational age to produce poor outcomes (34). In our cohort, maternal age and ethnicity were not risk factors for NICU admission.

Interestingly, birth in the month of May was also associated with higher odds of admission to the NICU. No increase in the rate of caesarean sections was noted during this time period, making this unlikely to be the explanation. It is not known why birth in May is a risk factor and therefore this issue merits additional investigation to identify a cause that can be targeted to decrease NICU admission.

In our cohort of NICU admissions, there was a significantly higher caesarean section rate among the neonates admitted to the NICU compared with non-NICU neonates. Our caesarean

section rate of 49% for neonates admitted to the NICU is similar to a study in the United States that found a 50% caesarean section rate in their NICU cohort (24). In our study, median gestational age and birth weight were lower in neonates delivered by caesarean section compared to those born by vaginal delivery. This weight difference persisted 5 days after birth. In addition, neonates born by caesarean section required more intensive treatment, such as use of surfactant, oxygen by nasal cannula and longer courses of antibiotics than neonates born by vaginal delivery. This finding is consistent with Tita et al., who found caesarean section prior to 39 weeks to be associated with an increased risk of adverse neonatal outcomes such as respiratory complications and admission to the NICU (37). However, their study looked at elective caesarean section, while all of the caesarean sections in our study were non-elective. It is currently unclear whether this is the result of an obstetric practice that is quicker to proceed to caesarean section with any sign of distress or because our cohort is composed of higher risk pregnancies. Another Jordanian study concluded that an over-diagnosis of fetal distress and dystocia was one cause of the unnecessarily high caesarean section rate at King Hussein Medical Centre in Amman (38). These data suggest that working to decrease the number of caesarean sections may be an effective way to decrease admission to the NICU and the associated morbidities. Investigators in China implemented a 6-year programme aiming to decrease the number of caesarean sections, through educational sessions for the entire obstetric care staff, removal of financial incentives for performing caesarean sections, daily review of the indications for each case and improvements in monitoring technology. These interventions resulted in a decrease in the primary caesarean section rate by an annual average of 20%, with a significantly lower rate in the post-intervention time period than the pre-intervention period (39). Therefore, further investigation of the indications for caesarean section in Jordan is needed. If it is found that inappropriate indications are used, an effort similar to the Chinese investigators' could be implemented to help reduce unnecessary caesarean sections and the associated neonatal complications.

There were limitations of our study. The most important was that we were unable to obtain complete information on every neonate born during the study period. Some of the mothers we approached to join the prospective cohort chose not to participate, and there were neonates unaccompanied by their mothers who we were unable to enrol. We expect that our study estimate for NICU admission of 6.8% is an underestimate, given that the NICU admission rate for the hospital was much higher at 19.8%. This implies that mothers with infants in the NICU were less likely to enrol in our study. If refusals among this population were random, then our assessment of risk factors would be unbiased. If mothers with sicker babies refused, then our results may be biased towards the null as our study NICU population would be more like the general population. If mothers with sicker babies were more likely to participate, then our results would be biased away from the null as our study NICU population would be much different from the general population. We believe that if a bias exists, it would exist towards the null. However, it is possible that the highest risk neonates were not included in our study. Of note, the NICU was undergoing renovations between May 2010 and July 2011, which decreased the overall birth census during this time period.

Other limitations of our study were that we were unable to obtain the medical record of every neonate that was admitted to the NICU during our study period. The surveys used in prospective data collection relied on maternal self-reporting, making them subject to recall and response bias. Finally, the hospital's use of paper charts rather than electronic medical records resulted in missing data in some of the charts that were retrospectively reviewed. However, the major strength of the study is the inclusion of a large neonatal cohort with both maternal and newborn data.

This study represents the first effort in the Middle East to describe a large cohort of neonates admitted to the NICU and to estimate risk factors for admission. Our results indicate that the majority of neonates in the Al-Bashir Hospital NICU are late preterm infants. Gestational age, birth weight, caesarean section and birth in the month of May were the most influential risk factors for admission to the NICU. Additionally, there was a much higher rate of caesarean section births among the NICU neonates, and these neonates required more intensive care while in the NICU. Thus, further investigation into risks for preterm birth and why births in May was associated with NICU admission are needed. Additionally, addressing obstetric practices to reduce the number of preterm infants delivered by caesarean section may be an important step in reducing neonatal morbidity and mortality in Jordan. These data serve as a starting point and the study highlights the need for a targeted prospective study in the Arab world to understand risk factors for admission to the NICU.

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