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Exploring Risk Factors and Outcomes of Low-Birth-Weight Infants in the Misurata Medical Center NICU - A Retrospective Analysis (2022)

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Abstract: Objective: To examine the characteristics and outcomes of low-birth-weight (LBW) newborns admitted to the NICU at Misurata Teaching Hospital in 2022, and to identify key factors influencing their survival.

Patient's and methods: a retrospective descriptive study included 199 LBW newborns (<2.5kg) admitted to the NICU during the study period. Data were collected from medical records and analyzed using descriptive statistics.

Results: Maternal factors: Mothers aged 30-35 years had the highest mortality burden. Clear amniotic fluid was associated with the highest death rate, despite being the most common finding. Gestational age showed a clear inverse relationship with survival, with mortality reaching 100% for infants born before 28 weeks. Low APGAR scores were a significant predictor of mortality. RDS and sepsis were the most common diagnoses, with RDS having the highest mortality rate. Elective caesarean section had the lowest mortality rate, while normal vaginal delivery and urgent C-section had higher rates. Cephalic presentation, though most common, had a higher mortality rate than breech presentation.

Conclusion: LBW newborns in Misurata Teaching Hospital faced a complex interplay of maternal, neonatal, and delivery-related factors influencing their survival. Further investigation into maternal factors and individualized delivery management is warranted to improve the prognosis of LBW newborns in this population.

Keywords: Low-Birth-Weight Infants, Neonatal Intensive Care Unit, Maternal Factors, Neonatal Factors.

استكشاف عوامل الخطروالنتائج للأطفال الذين يولدون بوزن منخفض في وحدة العناية المركزة للأطفال الرضع في مستشفى مصراتة - تحليل استرجاعي (2022)

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المستخلص: الهدف: دراسة خصائص ونتائج الأطفال حديثي الولادة منخفضي الوزن عند الولادة (LBW) الذين دخلوا قسم العناية المركزة لحديثي الولادة بمستشفى مصراتة التعليمي عام 2022، وتحديد العوامل الرئيسية المؤثرة على بقائهم على قيد الحياة.

طريقة المرضى والأساليب: شملت الدراسة الوصفية الاستعادية 199 من الأطفال حديثي الولادة منخفضي الوزن عند الولادة (<2.5 كجم) تم إدخالهم إلى قسم العناية المركزة لحديثي الولادة خلال فترة الدراسة. تم جمع البيانات من السجلات الطبية وتحليلها باستخدام الإحصاءات الوصفية.

النتائج: عوامل الأم: كان لدى الأمهات في سن 30-35 عامًا أعلى نسبة وفيات. ارتبط السائل الأمنيوني الصافي بأعلى معدل وفيات، على الرغم من أنه الاكتشاف الأكثر شيوعًا. أظهر عمر الحمل علاقة عكسية واضحة مع البقاء على قيد الحياة، حيث وصل معدل الوفيات إلى 100٪ للرضع الذين ولدوا قبل 28 أسبوعًا. كانت درجات APGAR المنخفضة مؤشرًا مهمًا على الوفيات. كان متلازمة الضائقة التنفسية والإنتان أكثر التشخيصات شيوعًا، وكان معدل الوفيات الأعلى لمتلازمة الضائقة التنفسية. كان معدل الوفيات أقل مع الولادة القيصرية الاختيارية، بينما كان معدل الوفيات أعلى مع الولادة الطبيعية المهبلية والولادة القيصرية العاجلة. كان العرض الرأسي، على الرغم من كونه الأكثر شيوعًا، يرتبط بمعدل وفيات أعلى من العرض المقعدي.

الخلاصة: واجه الأطفال حديثي الولادة منخفضي الوزن عند الولادة في مستشفى مصراتة التعليمي تداخلًا معقدًا بين العوامل المتعلقة بالأم والطفل الوليد والولادة التي تؤثر على بقائهم على قيد الحياة. يلزم إجراء المزيد من التحقيقات حول عوامل الأم وإدارة الولادة الفردية لتحسين تشخيص الأطفال حديثي الولادة منخفضي الوزن عند الولادة في هذا المجتمع.

الكلمات المفتاحية: رُضّع منخفضو الوزن عند الولادة, قسم العناية المركزة لحديثي الولادة, عوامل الأم, عوامل الأطفال حديثي الولادة.

1. Introduction:

Low birth weight (LBW), defined as infants weighing less than 2,500 grams at birth (1), is a major public health concern worldwide as it doesn't only markedly contribute to the overall childhood death rates, but it was also recently linked to the etiology of chronic dietary illnesses such adult-onset obesity, diabetes, and cardiovascular diseases, while high prevalence of stunting was also observed in LBW babies in low-income countries. (2). These neonates face increased morbidity and mortality rates compared to normal birth weight infants. Several risk factors have been identified which contribute to mortality in LBW neonates, encompassing both maternal and neonatal factors, as well as environmental factors. These factors vary greatly between low- and high-income countries. (1-3)

Over 20 million low birthweight babies are born each year in the world, with the majority occurring in low- and middle-income countries and 95.6% occur in developing nations. (1,3) The most recent regional estimates of low birth weight (LBW) vary from 28% in South Asia, to 13% and 9% in Sub-Saharan Africa and Latin America, respectively (4).

Whereas preterm birth accounts for the majority of LBW in high-income countries, IUGR accounts for the majority of LBW in low-income countries (2). Prematurity accounts for nearly 36% of neonatal deaths among LBW infants globally (5) and can have a variety of causes, some of which are unclear in many cases but may include maternal high blood pressure, acute infections, strenuous physical work, parity, stress, anxiety, or

other psychological issues, and maternal age (either young or advanced age). In the other hand, IUGR can be the result of mother's low nutritional status at conception, low weight gain during pregnancy as a result of insufficient food intake or extra calorie expenditure (hard work), anemia, acute and chronic infections that may cause undernutrition, and inadequate prenatal care. (2)

As for the neonatal factors associated with mortality in LBW neonates include birth defects, low Apgar scores, multiple births (e.g., twins or triplets), and sex. Studies have found that congenital anomalies were a leading cause of mortality in LBW (6). Similarly, studies have reported a higher mortality rate among LBW male infants compared to females. (7) whereas in Libya, LBW represented 22.9% of neonatal deaths with females representing the majority of cases and respiratory distress syndrome being the most common cause. (8)

Moreover, environmental factors contribute significantly to the mortality risk in LBW neonates, particularlyin low-resource settings. Limited access to quality healthcare services, inadequate sanitation, and the lack of clean water exacerbate the vulnerability of LBW infants. A study recent study highlighted that neonatal mortality rates were higher in low-income countries with limited resources and inadequate healthcare infrastructure. (9)

Although a number of studies were done in Libya regarding this topic (8,10), researches are still scanty. As neonatal outcome is a crucial indicator for obstetrics and health care, it is predicted that up to 70% of neonatal mortality worldwide could be avoided with the efficient implementation and proper interventions.

(11)Therefore, understanding these risk factors is key for developing targeted interventions and policies to reduce mortality rates and improve the survival chances of LBW neonates.

2. Patients and Methods:

Study Design: This was a retrospective descriptive study which included all infants with low-birth-weight (LBW) admitted to the neonatal intensive care unit (NICU) in Misurata Teaching Hospital between January 1st 2022 until December 31st 2022.

Settings and Duration: Data were collected from medical records of LBW newborns admitted to the NICU during the study period. Variables such as maternal age, parity, amniotic fluid characteristics, birth weight categories, duration of mechanical ventilation and CPAP, surfactant use, diagnoses, complications, congenital anomalies, gender, APGAR score, presenting part, mode of delivery, gestational age, and maternal risk factors were extracted.

Patients: The study included all LBW newborns defined as birth weight less than 2.5kg grams who were admitted to the NICU during the specified period and met the inclusion criteria. The perinatal period was defined as the period from the 22nd week of gestation until the end of the first week after birth. The neonatal period was defined as the period from birth and until the end of the 4th week after birth (28 days).

Statistical Analysis: The data was collected and analyzed using SPSS 25 for Windows. Descriptive statistics were used to summarize the data. Frequencies and percentages were calculated for categorical variables, while means or medians were calculated

for continuous variables, as appropriate. Tables and figures were generated to present the results.

3. Results and discussion:

The study included a total of 199 admissions of neonates. Mothers aged 30-35 years comprised the largest group with 65 cases (32.7%), followed by mothers under 25 years at 42 cases (21.1%). The youngest and oldest age groups (20 and under and 40+) saw the fewest cases, at 8 (4.0%) and 38 (19.1%) respectively. Interestingly, the highest number of deaths (14) occurred among the 30-35 age group (Table 1).

Primigravida mothers (first pregnancy) accounted for 38 cases (19.1%), while those with 1-5 previous pregnancies formed the largest group at 98 cases (49.2%). Mothers with more than 5 previous pregnancies had the fewest cases (13, 6.5%). The highest number of deaths (31) was observed in the 1-5 pregnancies group (Figure 1).

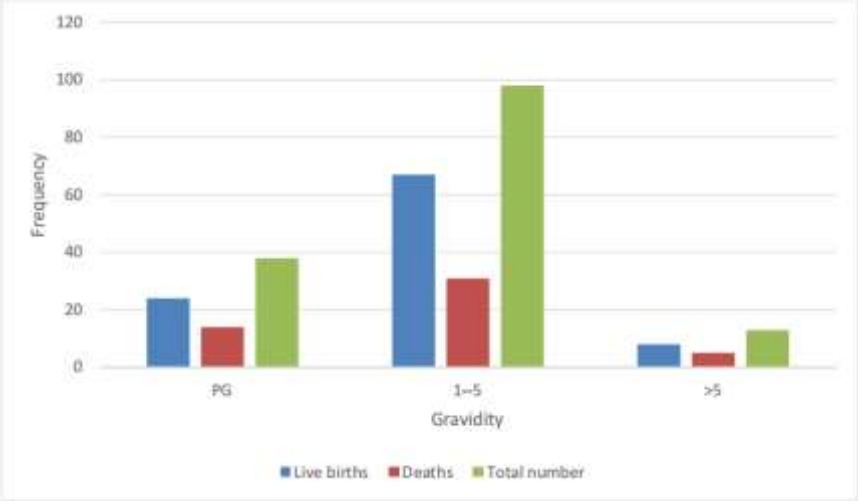

Figure 1 Distribution of Case and Mortality Rates by Maternal Gravidity

The majority of the cases had a clear amniotic fluid at birth (137, 68.9%), followed by meconium-stained amniotic fluid with 9 cases (4.5%). Other complications, like bleeding, accounted for only 3 cases (1.5%). Notably, the highest death rate (46) occurred in the clear amniotic fluid group (Table 2).

LBW infants showed a distinct seasonal pattern in cases, with January leading the way with 40 cases (20.1%). March and September followed with 32 (16.1%) and 23 cases (11.6%), respectively. The lowest number of cases was observed in May (2, 1.0%), July (9, 4.5%), and August (8, 4.0%). The highest number of LBW deaths (11)occurred in March (Figure 2).

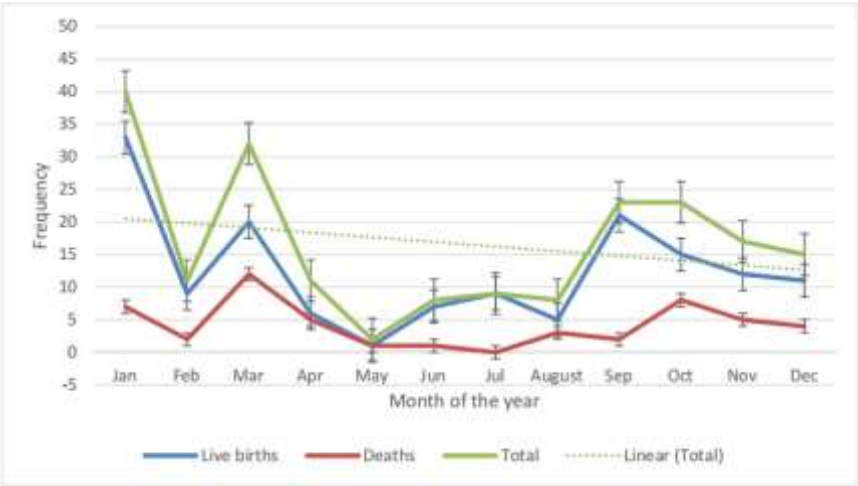

Figure 2 Distribution of the Cases According to the Time of the Year

Most cases (43, 21.6%) required mechanical ventilation for less than 5 days, followed by 6 cases (3.0%) for 5- 10 days and only 2 cases (1.0%) for over 10 days. Notably, the highest number of deaths (41) occurred in the shortest ventilation duration group (Table 3).

Cases requiring CPAP were categorized by duration: less than 3 days (10, 5.0%), 3-7 days (21, 10.6%), and more than 7 days (5, 2.5%). The highest death rate (4) occurred in the shortest CPAP duration group (Figure 3).

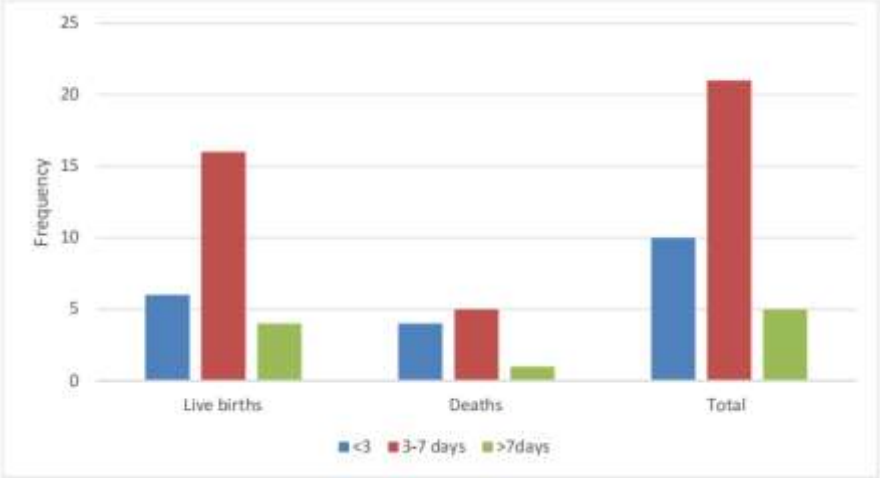

Figure 3 Distribution of Cases Requiring CPAP by Duration and Death Rates

Surfactant Use: The majority of cases (6, 3.0%) received a single dose of surfactant, with no cases requiring multiple doses.

Respiratory distress syndrome (RDS) was the most common diagnosis, affecting 83 cases (41.7%), followed by sepsis at 72 cases (36.2%). Other diagnoses like CHD, pneumothorax, and IVH were less frequent. RDS also had the highest death count (43) (Figure 4).

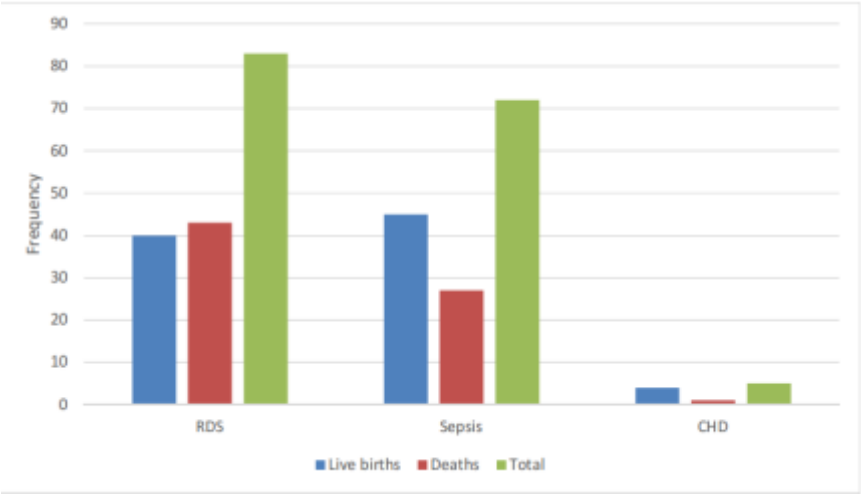

Figure 4 Distribution of the Cause of Admission Death Counts for Each Cause (RDS: Respiratory Distress Syndrome, CHD: Congenital Heart Disease)

Pneumothorax, pulmonary hemorrhage, and interventricular hemorrhage (IVH) were the most common complications in the study, with 3, 2, and 2 cases respectively. There was a very high mortality rate among the complicated cases – 6 out of the 7 complicated cases died.

A total of 24 cases (12.1%) were associated with congenital anomalies. Dysmorphic features (5 cases, 2.5%) were the most frequent, followed by encephalocele and left polycystic kidney (both 2 cases, 1.0%). The highest death rate (4) occurred in the dysmorphic baby category. The distribution is shown in (Table 4).

52.1% (104) of newborns were male and 47.9% (94) were female. Among them, 25.96% (27) of the males and 24.47% (23) of the females died, with survival rates of 74.04% (77) and 75.53% (71), respectively.

APGAR score also played a significant role. Newborns with scores below 7, representing 11.5% (23) of cases, had a high mortality rate of 84% (20), with only 16% (3) surviving. In contrast, those with scores of 7 or higher, comprising 77.7% (155) of cases, had a lower mortality rate of 14.79% (23) and a survival rate of 85.15% (132) (Figure 5).

The presenting part also had an impact. Cephalic presentation, the most common at 79.7% (159), had a mortality rate of 27.01% (43) and a survival rate of 72.99% (116). Breech presentation, with 6.8% (13) of cases, had a lower mortality rate of 20% (3) and a higher survival rate of 80% (10) (Table 5).

The mode of delivery showed distinct differences. Normal vaginal delivery (NVD), at 27.3% (54) of cases, had a higher mortality rate of 38.33% (21) compared to elective cesarean section (C/S) with 2.56% (1) mortality among its 17.8% (35) of cases. Urgent C/S, with 22.7% (45) of cases, had the highest mortality rate of 52% (23) (Table 6).

Gestational age was crucial. Newborns born at or before 24 weeks, constituting 0.9% (2) of cases, all died. Mortality rates increased and survival rates decreased with decreasing gestational age, reaching 100% death rates for those born before 28 weeks (Figure 6).

Maternal risk factors also influenced outcomes. Diabetes mellitus (DM) had a mortality rate of 10% (1) among its 4.6% (9) of cases. Hypertension (HTN) had a 14.29% (3) mortality rate among 9.5% (19) of cases. Drug use during pregnancy had an 18.60% (8) mortality rate among 19.7% (39) of cases (Table 7).

Other risk factors, including polyhydramnios, urinary tract infections, antepartum hemorrhage, and premature rupture of membranes, also showed varying mortality and survival rates (Table 8).

Finally, among Low-birth-weight newborns, 51.5% (17) of deaths occurred within the first day of life.

Birth Weight: LBW infants (159 cases, 79.9%) dominated the birth weight categories, followed by VLBW infants (28 cases, 14.1%) and extreme LBW infants (5 cases, 2.5%).

4. Discussion:

This retrospective study delved into the characteristics and outcomes of LBW newborns admitted to the NICU at Misurata Teaching Hospital in 2022. The findings paint a vivid picture of the complex interplay between maternal, neonatal, and delivery-related factors influencing the vulnerability of this at-risk population.

Our study revealed a distinct pattern in LBW cases and mortality rates among mothers of different ages. Mothers aged 30-35 years (32.7%) comprised the largest group and also suffered the highest mortality burden (14 deaths). The median and average maternal age in Libya is generally higher compared to what it used to be decades earlier, and to the maternal age in the neighboring countries (12). However, maternal age and LBW has been described by Workicho, A et al., (13). Their work suggests that the maternal age effect on the infant is not direct but rather confounded by the mother's nutritional status.

Parity also revealed a nuanced relationship with LBW outcomes. While primigravida's (19.1%) and mothers with 1-5 previous pregnancies (49.2%) constituted the majority of cases, the latter group experienced the highest number of deaths (31). This association has been reported in a systematic review conducted by Kozuki et al. (14). Even though the study included a significantly larger data pool from 14 different studies, mothers of 3 or more parties were at higher odds of adverse pregnancy outcomes and infant mortality. Again, this association was confounded by maternal age this time. As the study found that the risk increased for mothers aged 35 and more. It is worth noting however, that even if maternal age and high parity is shown here (and in the above-mentioned studies) to be associated with higher odds of adverse outcome, larger scale epidemiological studies clearly show that lower parity at younger age 18 years or less, are at the highest risk. This is perhaps is irrelevant given that higher maternal age in Libya.

The characteristics of amniotic fluid emerged as another intriguing aspect. Clear amniotic fluid, the most prevalent finding (68.9%), paradoxically harbored the highest mortality rate (46 deaths). This is consistent with the findings of Lavie et al (2023) (15). Their study looked into the association between MSAF and maternal and neonatal outcomes and mortality, and found no significant correlation between MSAF and neonatal mortality.

Gestational age played a central role in our study, showcasing a clear inverse relationship with survival rates. As gestational age decreased, mortality rates climbed alarmingly, reaching 100% for infants born before 28 weeks. Prematurity is a leading cause of death among infants worldwide (1). And even when adjusted for gestational age, this is still considered a high mortality rate. This is likely due to the fact that all the patients included in the study are of low-birthweight. This study didn't include the weight for gestational age which might mask a potential association between mortality in premature infants to their weight for gestational age.This association is indeed established in the literature and studied in detail (16).

APGAR scores also emerged as a significant predictor of mortality. Lower scores, representing 11.5% of cases (23 cases), were associated with a high mortality rate of 84% (20 deaths), further emphasizing the role of this assessment in evaluating immediate neonatal health at birth. Similar findings have been reported by Thavarajah et al. (2017) and underscore the importance of prompt resuscitation measures for newborns with low APGAR scores to improve their prognosis (17).

Presenting part exhibited an interesting association with mortality. Cephalic presentation, the most common (79.7%, 159 cases), had a higher mortality rate (27.01%, 43 deaths) compared to breech presentation (20%, 3 deaths). Cephalic presentation is traditionally considered the safest and the least complicated presentation in the literature, with significantly lower mortality rates (18). This discrepancy in our study could be attributed to several factors. Firstly, a large proportion of the cephalic presentation cases might have been delivered through C-section, potentially masking cases that would have otherwise presented as non-cephalic. Additionally, other contributing factors not analyzed in this study may have played a role. Therefore, the underlying mechanisms for this disparity need further investigation to determine the need for individualized delivery management based on both fetal presentation and other relevant factors.

Mode of delivery also displayed distinct consequences. Elective caesarean section, chosen for 17.8% (35 cases) of cases, had the lowest mortality rate (2.56%, 1 death), while NVD (27.3%, 54 cases) and urgent C/S (22.7%, 45 cases) had higher rates (38.33%, 21 deaths and 52%, 23 deaths, respectively). Milio M. et al. looked into the perinatal mortality and mode of delivery in ELBW (19). Their study concluded that the mode of delivery was significantly associated with a higher mortality rate in specific cases, but overall also associated with lower long-term complications.

Diagnoses like RDS and sepsis, affecting 41.7% (83 cases) and 36.2% (72 cases) of cases respectively, represented the most common challenges in our study population. RDS also had the highest mortality rate (43%, 43 deaths), highlighting the severity of this condition in LBW neonates. Maternal factors such as pre- eclampsia are reported to increase the risk of RDS in LBW infants (20). Their risk, being particularly higher if they were premature and small for their gestational age (21).

Complications further added to the vulnerability of LBW infants. Pneumothorax, pulmonary hemorrhage, andIVH emerged as the most frequent, all exhibiting high mortality rates. Although, they are very few cases – 7 in total -, agreeing with the data reported in the literature (22), IVH is a very serious complication and highly deadly in low birthweight infants (22).

5. Disclaimer

The article has not been previously presented or published, and is not part of a thesis project.

6. Conflict of Interest

There are no financial, personal, or professional conflicts of interest to declare.

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Supplementary material and data in journal articles

Tables

Table 1 Distribution of Newborn Cases and Mortality Rates by Maternal Age Group

Maternal age	Live births	Deaths	Total number
≤20	4	4	8
-25	31	11	42
-30	51	14	65
-35	30	9	39
-40	28	10	38
>40	3	1	4
Others	2	1	3

Table 2 Distribution of the Cases According to the Amniotic Fluid Appearance

Amniotic fluid appearance	Live births	Deaths	Total number
Clear	91	46	137
MSAF	7	2	9
Others (bleeding)	1	2	3

MSAF: Meconium-stained amniotic FluidTable 3 Distribution of CPAP duration

CPAP duration	Live births	Deaths	Total
<3	6	4	10
3-7 days	16	5	21
>7days	4	1	5

CPAP: Continuous Partial Airway Pressure

Table 4 Distribution of Cases with Congenital Anomalies and Death Rates

Amniotic fluid appearance	Live births	Deaths	Total number
Omphalocele	0	1	1
Ambiguous genitalia	0	0	0
Dysmorphism	1	4	5
Arthrogiposis	1	0	1
Encephalocele	1	1	2
Hydrocephaly	0	1	1
Hypospadias	2	0	2
Left polycystic kidney	2	0	2
Bilateral hydronephrosis	0	1	1
Bifid thumb	0	1	1
Anencephaly	0	1	1
Micrognathia	0	1	1
Lung hypoplasia	0	2	2

Table 5 Distribution of Live Births and Deaths by Presenting Part

Presenting Part	Live Births	Deaths	Total
Cephalic	127	47	174
Breech	22	3	25

Table 6 Distribution of the Cases According to the Delivery Mode

Mode of delivery	Live births	Deaths	Total
NVD	37	23	60
Instrumental delivery	0	0	0
Elective C/S	38	1	39
Urgent C/S	24	26	50

NVD: Normal Vaginal Delivery

Table 7 Distribution of Live Births and Deaths by Maternal Condition

Maternal Condition	Live Births	Deaths	Total
DM	9	1	10
HTN	18	3	21
Drugs	35	8	43
Polyhydramnios	2	5	7

Maternal Condition	Live Births	Deaths	Total
UTI	11	9	20
APH	10	10	20
Maternal Condition	Live Births	Deaths	Total
SROM	37	18	55

DM: Diabetes Mellitus, **HTN:** Hypertension, **UTI:** Urinary Tract Infection, **APH:** Ante-partum Hemorrhage, **SROM:** Spontaneous Rupture of Membranes

Table 8 Distribution of Live Births and Deaths by Maternal Condition

Perinatal Condition	Live Births	Deaths	Total
Liquor	6	3	9
Fracture Hip	0	0	0
Chest Infections	0	0	0
Hypothyroidism	2	0	2
High Liver Enzymes	0	0	0
ICSI	3	1	4
Changes in CTG	3	1	4
Primary Infertility	5	0	5
Secondary Infertility	1	3	4
Multiple Pregnancy	36	5	41
Received Dexamethasone	3	1	4
Received Blood	3	1	4
Addison	1	0	1
Bronchial Asthma	2	0	2
Anemia & Vitamin Deficiency	1	0	1
Low Platelet	1	0	1

ICSI: Intra-Cytoplasmic Sperm Injection, CTG: Cardio-Toco Graph

Figures:

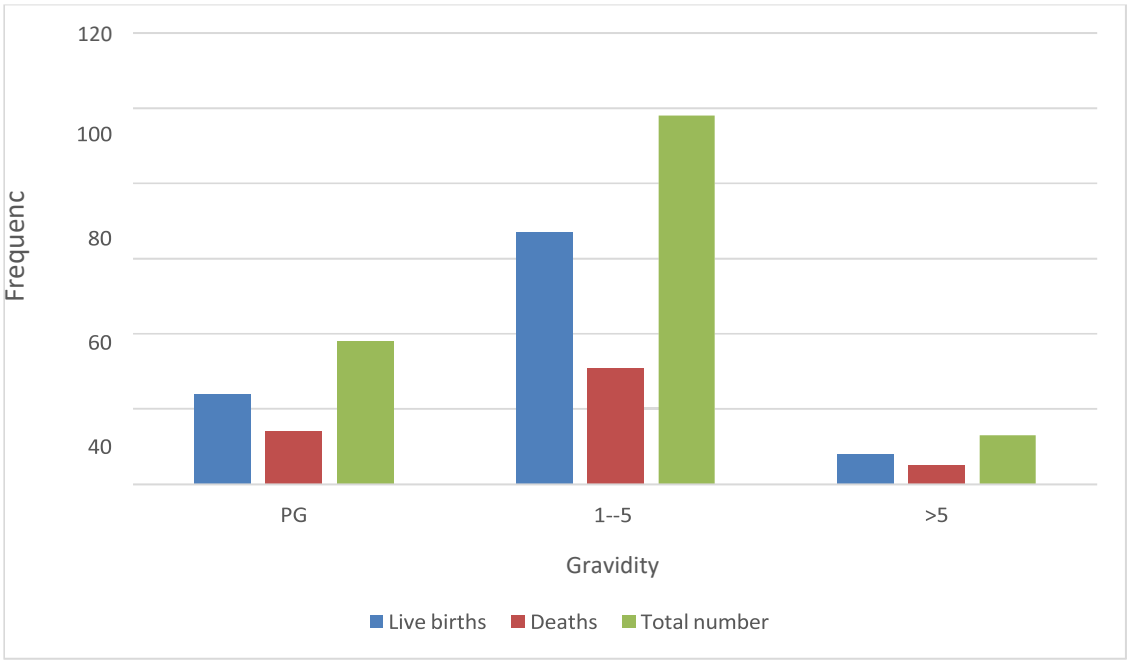

Figure 1 Distribution of Case and Mortality Rates by Maternal Gravidity

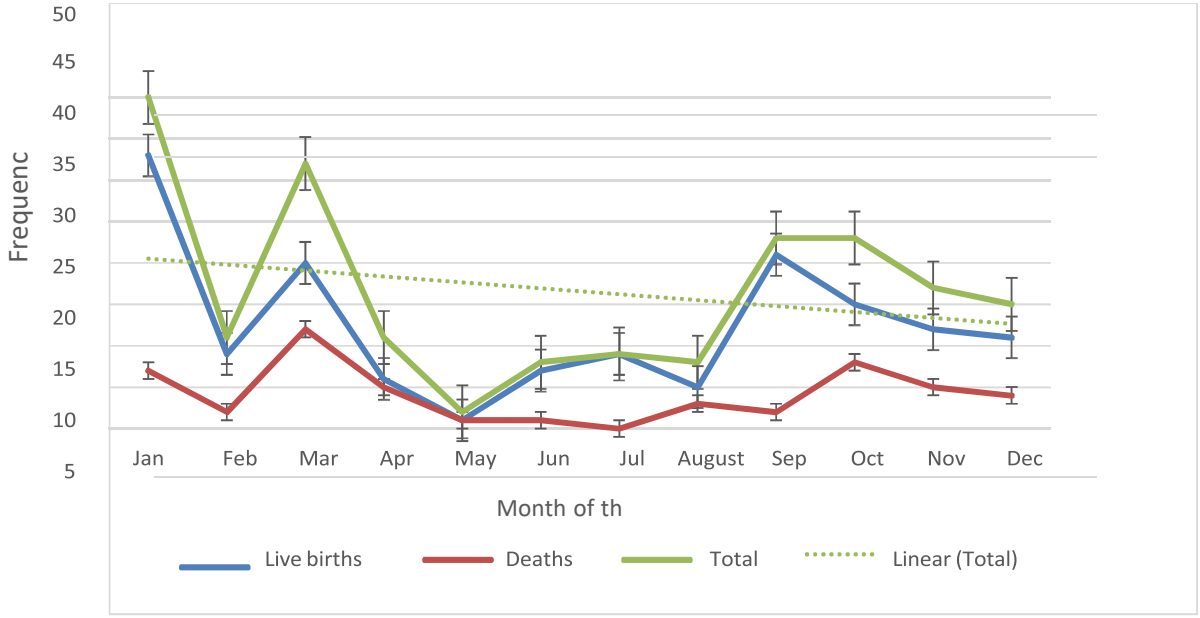

Figure 2 Distribution of the Cases According to the Time of the Year

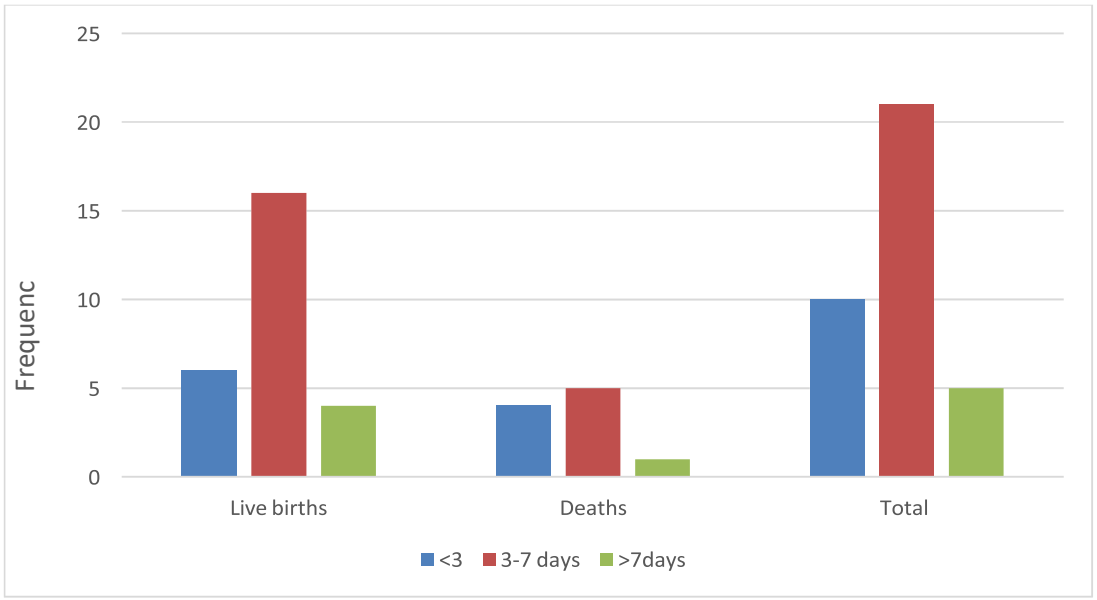

Figure 3 Distribution of Cases Requiring CPAP by Duration and Death Rates

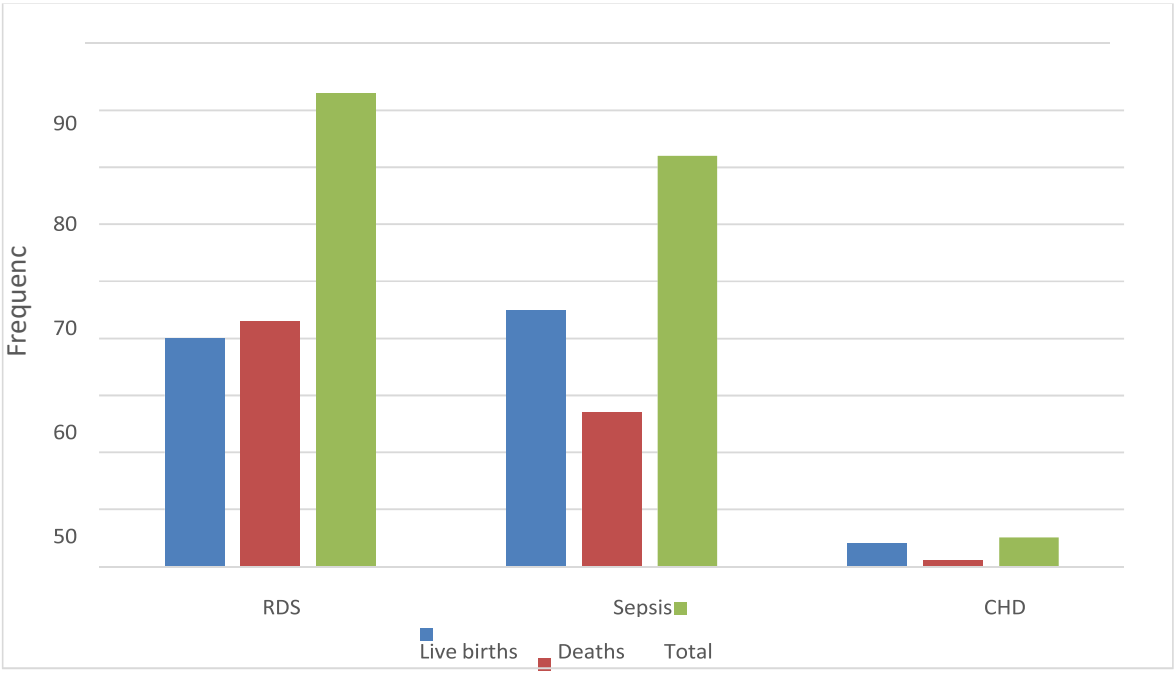

Figure 4 Distribution of the Cause of Admission Death Counts for Each Cause (RDS: Respiratory Distress Syndrome, CHD: Congenital Heart Disease)

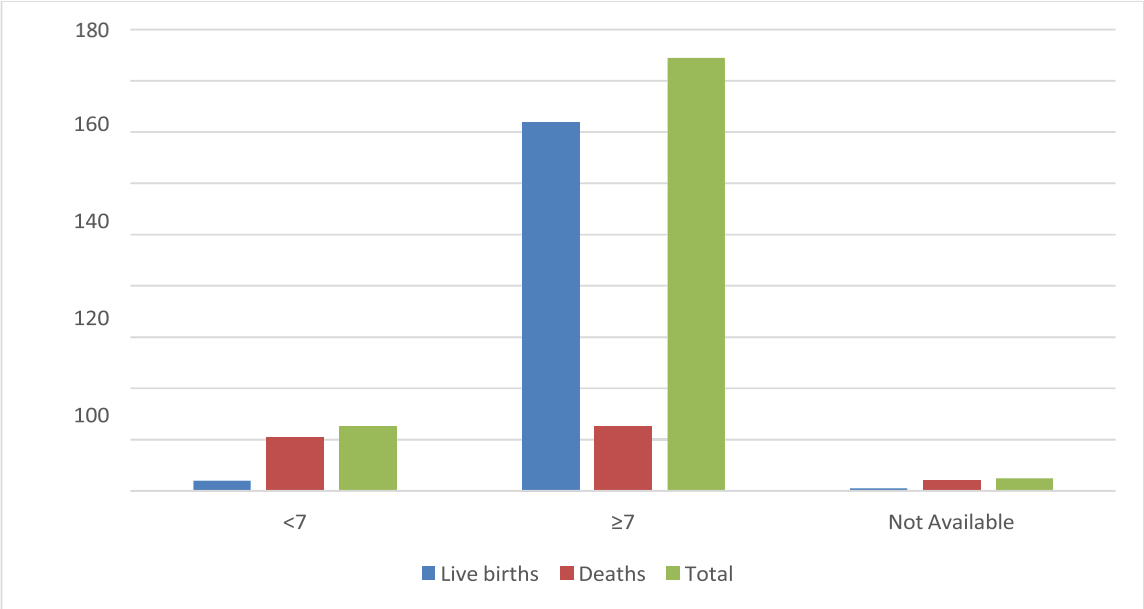

Figure 5 APGAR Score Levels

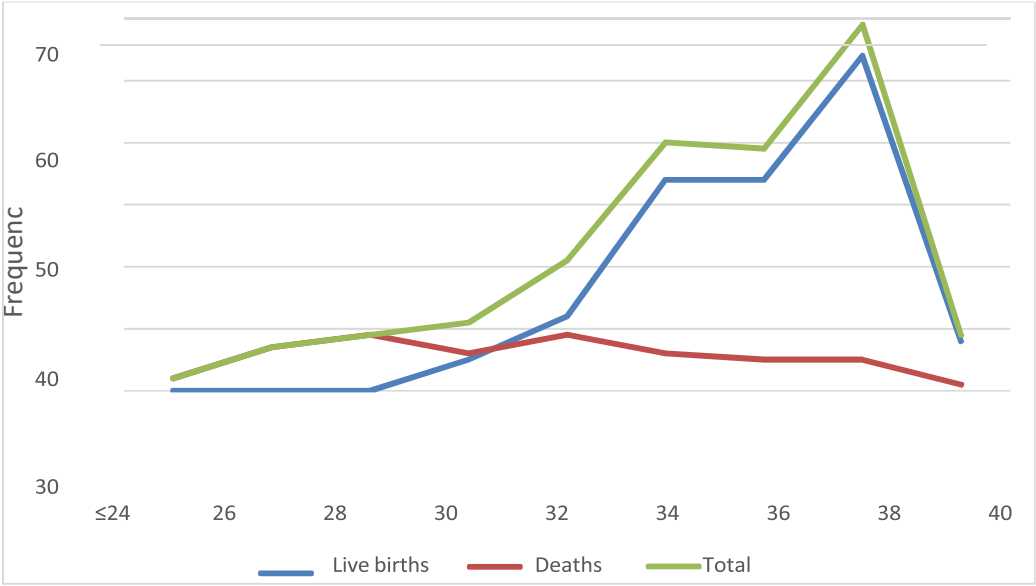

Figure 6 Distribution of Cases Plotted Against the Gestational Period