# A Retrospective Analysis of Neonatal Mortality at the Main Children's Hospital in Aden

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## Abstract

**Introduction:** Neonatal mortality is a serious health issue, especially in developing countries where vast majority of neonatal deaths (NND) occur and accurate data are sparse. This study aimed to determine the major causes of hospital NND in relation to certain maternal and neonatal factors.

**Methods:** A retrospective analysis of all NND in the neonatal care unit at Al-Sadaqa Teaching Hospital, over one-year period (2017). Data extracted from clinical records include: age, sex, birth weight, gestational age, mode/place of delivery, twin status, parity, maternal age, antenatal care, residency, diagnosis, duration of hospital stay, time and cause of death. The cause of death was based on physician judgment and major causes were classified according to the Global Network Cause of Death algorithm. Data analysis were executed using SPSS version 20.

**Result:** Of 1565 sick neonates, 283 were died giving a hospital neonatal mortality of 18.1%. Males outnumbered females (59.0% vs. 41.0%, $p$=0.002) and majority of patients (77.5%) were admitted during their first 24 hours of life. Neonates born at the hospital maternity (in-born) were 161 (56.9%); the rest were out-born (43.1%). Majority of neonates (92.2%) were singleton, and 7.8% were twins. Vaginal delivery occurred in 82.0% whereas 18.0% were delivered by cesarean section. There were 35.0% primipara and 65.0% multiparous mothers. Early NND occurred in 83.0%, and was significantly higher than late new natal death ($p$<0.001). Just more than half (59.5%) were preterms and 67.8% were of low birth weight. The primary causes of death were prematurity (52.3%), followed by birth asphyxia/injury (19.4%), neonatal infections (17.3%) and congenital malformations (8.5%).

**Conclusion:** Neonatal mortality in Al-Sadaqa hospital remains unacceptably high. Prematurity and its complications, birth asphyxia and sepsis were the main causes of death. Early NND comprises a significant proportion of deceased infants. Effective interventions to improve perinatal care are crucial.

**Keywords:** Neonatal death, Gestational age, Birth weight, Cause of death, Retrospective Survey.

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# تحليل استرجاعي لوفيات حديثي الولادة في المستشفى الرئيس للأطفال في عدن

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**ملخص الدراسة**

**المقدمة:** تعتبر وفيات الأطفال حديثي الولادة مشكلة صحية خطيرة، لا سيما في البلدان النامية، حيث تحدث الغالبية العظمى من هذه الوفيات مع ندرة في البيانات الدقيقة. تهدف هذه الدراسة إلى تحديد الأسباب الرئيسه لوفيات الأطفال حديثي الولادة بالمستشفى وعلاقتها ببعض العوامل ذات العلاقة بالأم والوليد.

**المنهجية:** أجري تحليل استرجاعي لجميع وفيات حديثي الولادة في وحدة رعاية الأطفال حديثي الولادة في مستشفى الصداقة التعليمي، على مدى سنة كاملة (2017) . تشمل البيانات المستخرجة من السجلات السريرية: العمر، الجنس، الوزن عند الولادة، عمر الحمل، الوضع / مكان الولادة، التوأم، عدد الولادات، عمر الأم، رعاية ما قبل الولادة، الإقامة، التشخيص، مدة الإقامة في المستشفى، وقت وسبب الوفاة. وقد استند سبب الوفاة إلى تقدير الطبيب وتم تصنيف الأسباب الرئيسية وفقًا لخوارزمية سبب الوفاة على الشبكة العالمية. تم تحليل البيانات باستخدام SPSS الإصدار 20.

**النتائج:** من بين 1565 حديثي ولادة ، توفى في المستشفى 283 بنسبة وفيات 18.1%. تجاوز عدد الذكور عدد الإناث (59% مقابل 41%،0.002=$p$) ، وقد تم ترقيد غالبية الحالات (77.45%) خلال أول 24 ساعة من حياتهم. تمت ولادة 161 في قسم الولادة داخل المستشفى (56.9%)؛ أما الباقون فكانوا من مواليد خارج المستشفى (43.1%). غالبية المواليد (92.2%) كانوا منفردين، و (7.8%) توائم.  كانت الولادة طبيعية لـ 82% من المواليد مقابل 18% عن طريق الولادة القيصرية. كانت 35% من الولادات ولادة أولى مقابل65% من الولادات متعددة. حدثت الوفيات المبكرة للمواليد بنسبة 83%، وبفارق ذو دلالة إحصائية (0.001>$p$) عن الولادات المتأخرة. كان أكثر من نصف الوفيات قليلاً (59.5%) من الخدج و67.8% من ذوي الوزن المنخفض عند الولادة. تعود الأسباب الرئيسة للوفاة للولادة المبتسرة (52.3%)، تليها اختناق / إصابة أثناء الولادة (19.4%)، والتهابات الأطفال حديثي الولادة (17.3%) والتشوهات الخلقية (8.5%).

**الاستنتاج:** لا يزال معدل وفيات حديثي الولادة في المستشفى مرتفعًا بشكل غير مقبول. وقد كان السبب الرئيسي للوفاة هو الخداج ومضاعفاته واختناق الولادة والإنتان. شكلت الوفيات المبكرة نسبة عالية من حديثي الولادة المتوفين. لذا، فان التدخلات الفعالة لتحسين الرعاية قبل وأثناء وبعد الولادة أمر بالغ الأهمية.

**الكلمات المفتاحية:** وفيات حديثي الولادة، عمر الحمل، وزن المولود، سبب الوفاة، مسح بأثر استرجاعي.

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## Introduction

In developing countries, neonatal mortality remains a serious health issue, where vast majority of NND occur and most of these deaths can be easily prevented or treated [1]. Globally, estimated neonatal mortality rates range as high as 40-50 per 1,000 live births in low resource settings, which is almost 10 times higher in compared to about 2-4 per 1,000 live births in high income countries [2].

The infant mortality rate (IMR) quantifies the deaths of children under one year of age and is a classic indicator of the socioeconomic and health status of the population. The IMR is divided into three periods: the early neonatal (death occurred within the first 7 days postpartum); late neonatal (death occurred from 8 to 27 days postpartum) and post neonatal (death occurred from 28 to 365 days postpartum) [3]. In 2017, 2·5 million newborn deaths occurred globally, accounting for 47% of deaths in children younger than 5 years. Slightly more than a third of these deaths resulted from preterm-related causes [4].

However, information on cause of death is lacking for most NND that occur in countries with inadequate civil registration. Causes of death in neonate have been estimated worldwide by analyzing the data of vital registration and reports of research studies [2].

According to 2013 global estimates, preterm birth accounts for 35.7% of total NND, intrapartum complications for 23.4%, sepsis or pneumonia for 20.5%, congenital abnormality for 10.5%, neonatal tetanus for 1.7%, diarrhea for 0.6%, and other causes for 7.5% [5]. However, these estimates are based on limited datasets as most births and NND occur in the home or outside formal health settings in developing countries.

Low birth weight (LBW; <2,500 gm) is one of the strongest predictors of neonatal mortality, data is routinely collected and reported in health literature, and is associated with a complex set of fetal and maternal characteristics [6]. On the other hand, advances in obstetric and neonatal care have led to increased survival in premature infants in developed countries, but this progress is difficult to be achieved in low income countries [4,7].

There is a need to explore the factors that contribute to the diminished acceleration in the reduction of IMR. Knowledge about the cause of death and cause-specific contributions to infant mortality is important for selecting strategies to further reduce infant mortality [8]. Furthermore, health care providers and health policy makers need updated and valid information regarding causes of death for the development of health care facilities, directing primary prevention, assigning funds, and promoting public health. Therefore, the aim of this study is to determine the frequency, pattern and major causes of neonatal hospital death in relation to certain associated maternal and neonatal factors.

## Methods

### Study design
This study is a retrospective analysis of hospital neonatal mortality in relation to some associated maternal and neonatal factors using routinely collected data documented in the clinical case records.

### Study Setting
The study site was the neonatal unit at Al-Sadaqa Teaching Hospital, the main pediatric and maternity hospital in Aden, South Yemen. This hospital is a public health facility serving peoples from Aden and adjacent governorates. The neonatology unit receives babies born within the hospital (in-born) and referrals from other health facilities or home deliveries (out-born). The number of admitted neonates varies from time to time, with an average annual admission rate being 1340. The neonatology unit consists of 21 total bed capacity, 5 of them deliver neonatal intensive care units (NICU) care. The unit is equipped with 22 incubators, 4 resuscitation kits, 5 radiant heaters, 20 Phototherapy machines, 6 pulse oximeter, 5 intensive monitors, 2 ventilators / continuous positive airway pressure (CPAP), 6 infusion pumps, 6 syringe pumps and 3 scales (weighting machines). The service is taking care by 6 specialist doctors, 17 pediatric residents and trainers and 33 nurses.

### Participants
All neonates from birth to 28 completed days of life who were hospitalized and died in the unit between 1st January to 31st December 2017 were included.

### Data collection
The admission files of all death cases over one-year period were reviewed thoroughly and relevant information were extracted using structured proforma specially designed for this purpose. The following data were noted: age, sex, birth weight, gestational age, mode/place of delivery, twin status, parity, maternal age, antenatal care, residency, diagnosis, duration of hospital stay, time and cause of death. Birth weight was classified into five categories, extremely low birth weight (ELBW) (<1000 gm), very low birth weight (VLBW) (1000-1499 gm), LBW (1500-2499 gm), normal birth weight (2500-3999 gm) and macrosomia (≥4000 gm). When birth weight was not known, particularly for those born at home, body weight at time of admission was recorded taking in consideration the 10% loss in body weight during the early neonatal period. Preterm was consider as live born neonate before 37 completed weeks. Gestational age was based on date of last menstrual period, antenatal ultrasonography or clinical assessment. The cause of death was based on physician judgment as written in the patient's record and a single most primary cause was assigned and major causes were classified according to the Global Network Cause of Death algorithm, which specially designed to be suitable for use across low-resource settings [9].

### Statistical analysis
The data collected was analyzed using SPSS for Windows version 20. Descriptive statistics are presented as frequency and percentage of various clinical characteristics. Quantitative variable was presented as mean and SD or median and range as

appropriate. Categorical variables were analyzed using the Chi–square test and the level of significance was set as *p*-value less than 0.05.

### Ethical clearance

Permission for this study was obtained from the hospital management as it reserves the right to own the patient's medical records. Informed consent was not required since the study was retrospective and performed by chart review without any potential risk. De-identification and anonymity were maintained all throughout.

## Results

Over a year period, there were 1565 sick neonates admitted to the neonatal unit, of them 283 died in the course of hospitalization, giving a hospital neonatal mortality of 18.1%. The sex distribution of the deceased neonates was 167 (59.0%) males and 116 (41.0%) females, giving a male/female ratio 1.3:1. This sex difference is statistically significant (*p*=0.002). Majority of cases (77.4%) were admitted during their first 24 hours of life and the average duration of hospital stay was 23 hours (range 0.5-648 hours). The percentage of those referred from other health facilities or private clinic was 15.2%, compared to 27.9% delivered at home. The mean gestational age was 33.8±5.5 weeks (ranged 24-43 weeks) and just more than half of death cases (59.3%) were preterm whereas 38.2% were term, with a significant difference (*p*=<0.001). The average birth weight was 1800 gm (ranged 500-6700 gm) and about two-third were below normal birth weight (67.8%), compared to 30% with normal birth weight, and only 2.1% of macrosomic weight. Neonates born at the maternity hospital (in-born) was 56.9%; the rest were out-born (43.1%). Spontaneous vaginal delivery was the mode of delivery in 82% and there were 18% cesarean deliveries; 45 performed in hospital and 6 in other health facilities. Majority of the study neonates (92.2%) were singleton, and 7.8% were twins. Out of 283 neonates, 242 had their maternal age recorded. This age ranged between 16-47 years with a mean of 27.7±6.7 year. Most of them (49.6%) were aged between 20-35 years, only 8.3% and 18.6% were below 20 and above 35 years of age, respectively. There were 35% primipara and 65% multiparous mothers. Of them; 31.1% had four or more antenatal care visits during their pregnancy, while 36% denied any sort of antenatal care. The highest percentage (62.5%) had urban residency. General characteristics of mothers and neonates are summarized in Table 1.

**Table 1:** General Characteristics of NND and Their Mothers (n=283)

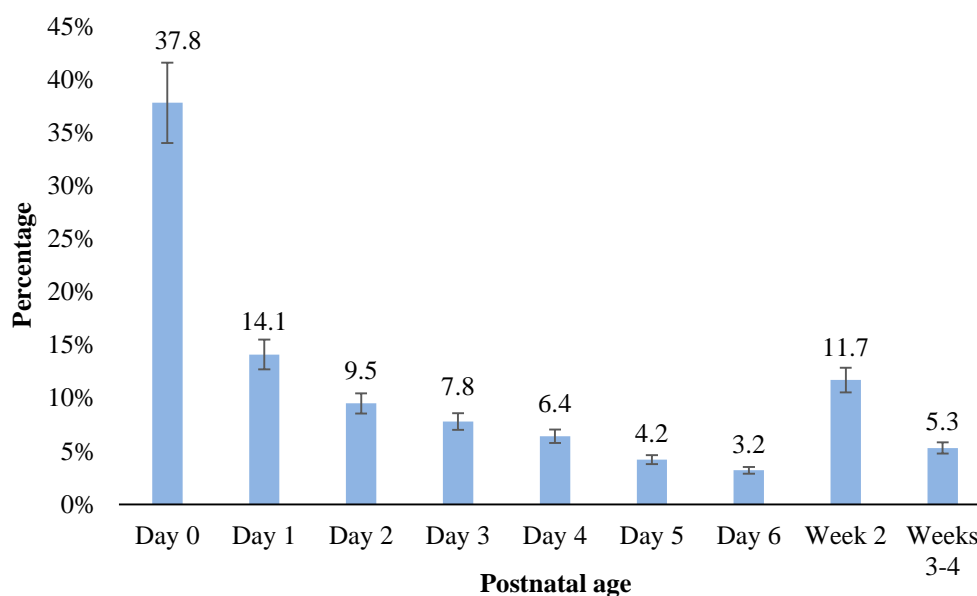| Variable | Male | | Female | | Total | |
|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % |
| **Age on admission** | | | | | | |
| 0-<24 hrs | 128 | 45.2 | 91 | 32.2 | 219 | 77.4 |
| 1-7 days | 31 | 10.9 | 20 | 7.1 | 51 | 18.0 |
| 8-28 days | 8 | 2.8 | 5 | 1.8 | 13 | 4.6 |
| **Gestational age (weeks)** | | | | | | |
| Preterm (<37) | 89 | 31.4 | 79 | 27.9 | 168 | 59.3 |
| Term (37-41) | 73 | 25.8 | 35 | 12.4 | 108 | 38.2 |
| Post-term (≥42) | 5 | 1.8 | 2 | 0.7 | 7 | 2.5 |
| **Birth weight (grams)** | | | | | | |
| ELBW (<1000) | 12 | 4.2 | 16 | 5.6 | 28 | 9.8 |
| VLBW (1000-1499) | 41 | 14.5 | 33 | 11.7 | 74 | 26.2 |
| LBW (1500-2499) | 53 | 18.7 | 37 | 13.1 | 90 | 31.8 |
| Normal (2500-3999) | 57 | 20.1 | 28 | 9.9 | 85 | 30.0 |
| Macrosomia (>4000) | 4 | 1.4 | 2 | 0.7 | 6 | 2.1 |
| **Place of delivery** | | | | | | |
| Hospital maternity | 97 | 34.3 | 64 | 22.6 | 161 | 56.9 |
| Private/other health facility | 25 | 8.8 | 18 | 6.4 | 43 | 15.2 |
| Home | 45 | 15.9 | 34 | 12.0 | 79 | 27.9 |
| **Mode of delivery** | | | | | | |
| Vaginal delivery | 136 | 43.15 | 96 | 33.3 | 232 | 82.0 |
| Cesarean section | 31 | 11.0 | 20 | 7.1 | 51 | 18.0 |
| **Number of fetuses** | | | | | | |
| Single | 158 | 55.8 | 103 | 36.4 | 261 | 92.2 |
| Multiple | 9 | 3.2 | 13 | 4.6 | 22 | 7.8 |
| **Maternal age (years)   n=242** | | | | | | |
| <20 | 8 | 2.83 | 12 | 4,2 | 20 | 8.3 |
| 20-24 | 33 | 11.7 | 24 | 8.48 | 57 | 23.5 |
| 25-35 | 80 | 28.2 | 40 | 14.1 | 120 | 49.6 |
| >35 | 18 | 6.4 | 27 | 9.5 | 45 | 18.6 |
| **Parity** | | | | | | |
| Primi (1) | 56 | 19.8 | 43 | 15.2 | 99 | 35.0 |
| Multi (2-4) | 83 | 29.3 | 49 | 17.3 | 132 | 46.6 |
| Grandmulti (5-7) | 24 | 8.5 | 15 | 5.3 | 39 | 13.8 |
| Grandgrandmulti (>8) | 4 | 1.4 | 9 | 3.2 | 13 | 4.6 |
| **Antenatal care visits** | | | | | | |
| 1-3 | 63 | 22.3 | 30 | 10.6 | 93 | 32.9 |
| 4-5 | 27 | 9.5 | 23 | 8.1 | 50 | 17.7 |
| > 5 | 20 | 7.1 | 18 | 6.4 | 38 | 13.4 |
| no ANC | 57 | 20.1 | 45 | 15.9 | 102 | 36.0 |
| **Residency** | | | | | | |
| Urban | 102 | 36.7 | 73 | 25.8 | 177 | 62.5 |
| Rural | 63 | 22.3 | 43 | 15.2 | 106 | 37.5 |

Most of the NND (83.0%) occurred early in the first 7 days of life (about half of them (51.9%) in the first 24 hours of life, and (31.1%) were between day 2 to 7 days. A smaller portion (17.0%) died between second and four weeks. Difference between overall early and late NND was statistically significant ($p$=<0.001), although more males (59.0%) than females (41.0%) were died, the sex distribution in relation to early or late death showed no significant difference ($p$=0.270). Table 2 and Figure 1 illustrate details of NND by time of occurrence.

**Table 2:** Distribution of Early and Late NND by Sex

|  | Male | | Female | | Total | |
|---|---|---|---|---|---|---|
|  | No. | % | No. | % | No. | % |
| Early NND | 143 | 50.5 | 92 | 32.5 | 235 | 83.0 |
| Late NND | 24 | 8.5 | 24 | 8.5 | 48 | 17.0 |
| Total | 167 | 59.0 | 116 | 41.0 | 283 | 100 |



**Figure 1:** Distribution of Overall Neonatal Deaths by Postnatal Age

The primary causes of neonatal hospital mortality were dominated by prematurity and its complications (52.3%), followed by birth asphyxia/injury (19.4%), neonatal infections (17.3%) and congenital malformations (8.5%) as shown in Table 3.

**Table 3:** Primary Causes of NND by Time of Occurrence

| Diagnosis/cause of death | Early NND | | Late NND | | Total | % |
|---|---|---|---|---|---|---|
| | No. | % | No. | % | | |
| Prematurity complications | 134 | 47.3 | 14 | 4.9 | 148 | 52.3 |
| Birth asphyxia/injury | 50 | 17.7 | 5 | 1.8 | 55 | 19.4 |
| Sepsis/pneumonia | 30 | 10.6 | 19 | 6.7 | 49 | 17.3 |
| Congenital malformations | 15 | 5.3 | 9 | 3.2 | 24 | 8.5 |
| Others | 6 | 2.1 | 1 | 0.4 | 7 | 2.5 |
| Total | 235 | 83.0 | 48 | 17.0 | 283 | 100 |

## Discussion

The present study found NND at 18.1% of the total admissions into the neonatal care unit during one year. This finding is slightly lower than 22.9% [9] and 23.1% [10] had previously reported from the same unit, and similar to other facility based studies in Iraq (18.5%) [11], Saudi Arabia (17.4%) [12], and Iran (19.2%) [13], but lower than 29.1% and 22.1% respectively reported from Egypt [14] and Libya [15]. However, the figure of the present study still remains unacceptably high, in comparison to 6.4% and 10% respectively reported from other developing countries such as Pakistan [16] and Cameroon [17].

Males mortality was higher than females in this study with a ratio of 1.3:1, which is similar to 1.36:1 reported from Cameroon [18]. Male predominance is attributed to biological advantages enjoyed by female infants and to increased vulnerability of males in early life to sepsis and respiratory distress [19]. In the present study, no difference was detected between early and late NND in relation to gender. This is in contrast to a Pakistani study, with more female deaths observed in the late neonatal period [20].

The present study found a higher percentage (83.0%) of early NND, and more than half of them (51.9%) occurs in first day of life. This is closely similar to 83.3% and 85.7% reported from Cameron [18] and Baghdad, Iraq [11]. According to global estimates, early NND represents 73% of all newborn infants who die worldwide each year and a compiled data from the European Perinatal Health Report showed 61-85% of NND occurred during the first week of life [21]. In a prospective study conducted in six low and middle income countries, more than half of all NND occurred within the first day of life and 81% during the first week [2]. Early neonatal period is a critical time of transition and adaptation between intrauterine and extra-uterine environment. it is associated with low immunity status and higher exposure to stresses, makes newborn more vulnerable with limited capacity of competent response [22]. If interventions to reduce early NND have to be succeeded, it must be targeted to improve delivery management as well as immediate care at early neonatal period.

In the present study, prematurity and its complications were the primary cause of death in 59.5% which is nearly similar to 60.1% locally reported [10] and comparable to

52.3% and 69% reported by studies done in Cameroon [18] and East Africa [23]. Although death in neonates is generally multi-factorial and diverse, preterm birth is a leading cause of neonatal mortality and a direct cause of death that aggravates the effect of many other risk factors. Estimations indicated that more than 75% of deaths in preterm can be prevented by essential perinatal care include antenatal corticosteroid, antibiotic prophylaxis, surfactant replacement therapy, ventilatory support and other newborn basic care such as thermal care, feeding care, safe oxygen use and strict infection control [24].

Regarding birth weight, 67.8% of deceased neonates were less than 2.5 kg, a result similar to 67.7% and 62.7% reported by others [25,26]. LBW can be a consequence of preterm birth or small for gestational age or both and factors lead to preterm birth may contribute independently to mortality. Relatively high death rate (31.8%) in subgroup of BW (1500-2499 gm) is in line with 43.7% reported from Western Ethiopia [27] and could be arise from overlapping between LBW and prematurity as heavier baby is not necessarily more mature, or due to other unmeasured confounding factors that cannot be ascertained.

The percentage of neonates born at the maternity hospital (inborn) was 59.9% and out born was 53.0%, which is similar to 58.2% and 41.8% reported respectively from central Vietnam [26]. On the other hand, home delivery occurred in 27.9%. This finding is comparable to 30.1% reported from Ethiopia [27]. Birth at home with unskilled birth attendant, lack of sterilization, warming, resuscitation and other essential resources is a high-risk factor related to neonate death.

The current findings show that birth asphyxia formed 19.4% of deaths. This is corresponding with 19% and 15.8% reported respectively from Mozambique [28] and Libya [15]. High levels of birth asphyxia/injury underscore the need for further improvement of pregnancy and intrapartum care, immediate neonatal resuscitation and early referral.

Sepsis/pneumonia as a cause of death occurred in 17.3%. This is comparable to 18.5% and 19.0% reported elsewhere [15,29]. However, the rate of sepsis in this work might be under estimated due to misclassification of cases and lack of proper microbiological facilities for culture and sensitivity and the diagnosis was based solely on clinical ground.

Death from congenital malformations composed 8.5%, which is concordant with 8.0% and 10.1% reported from Pakistan [20] and Eritrea [29]. Some authors observed higher rates; 19.6% in Libya [15] and 42.0% in the United Arab Emirates [30]. The incidence of congenital anomalies is influenced by socioenvironmental factors and frequency of consanguineous marriages, and found to be higher among offspring of related parents, particularly autosomal recessive conditions. However, it is well known that neonates in developed countries usually die from unpreventable causes such as congenital abnormalities, while majority of infants in developing countries die from preventable conditions, including infections, birth asphyxia, and prematurity [20].

In this study, NND was high in multiparous (46.6%) than primiparous (35%). A possible explanation is that a high parity with short inter-pregnancy interval is likely to increase the risk of preterm delivery and multiparous mothers may also have had a bad obstetric history due to unidentified factors that may persist in subsequent pregnancies.

Slightly more than a third (36.0%) of mothers had no antenatal care visit. This is lower than 41.5% reported from Ethiopia [27]. Antenatal care has been recommended as it improves pregnancy outcomes by identifying and managing most pregnancy complications and during antenatal care visits pregnant women receive counseling about the importance of safe delivery practices and early management of neonatal conditions.

## Conclusions

The current study demonstrated that neonatal hospital mortality remains unacceptably high and majority of NND occurred in the first week of life with high male to female ratio. Primary causes of death were prematurity, LBW, birth asphyxia, sepsis and congenital malformations. As prematurity was the principle contributor of death, substantial efforts to improve perinatal care, with early identification, prevention and treatment of preterm birth complications could help to reduce the burden of neonatal hospital mortality. Continuous training program of health personnel in the delivery room and in the neonatology, unit should be implemented. Evaluation and reporting of causes and rate of deaths in hospital neonatal

care unit are essential for identification of various deficiencies in the management process of sick neonates and executive of effective heath interventions with monitoring of progress in our hospital and all over the country.

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