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Neonatal Mortality Rate in Al-Ramadi Teaching Hospital for Maternity and Childhood from 2018-2020

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KEYWORDS
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ABSTRACT:
The first 28 days of life – the neonatal period – is the most vulnerable time for a child's survival. Children face the highest risk of dying in their first month of life at an average global rate of 17 deaths per 1,000 live births in 2019. Neonatal mortality is a core indicator for neonatal health and wellbeing and is becoming a prominent component of overall under-five mortality. It is therefore receiving particular attention from health authorities. The aim of our study to neonatal mortality rate at Al-Ramadi Teaching Hospital for Maternity and Childhood, 2018-2020. Our study conducted retrospectively in Neonatal Intensive Care unit during a period of six months from October 2020 till the end of March 2021. It included 15686 neonates admitted to the inborn and outborn Neonatal Intensive Care unit and collected from the archive's files during the years 2018, 2019, and 2020. Any newborn who died was recorded as an outcome. Our Results: In this study, neonatal mortality rate was (9.2%)92/1000 in 2018, decreased to(3.79%)37.9/1000 in 2019, then slightly increased to become (4.49%)44.9/1000 in 2020. the overall neonatal mortality rate in Neonatal Intensive Care Unit was (5.32%)53.2/1000. Sepsis was the leading cause of death, followed by extreme prematurity. Independent and un-confounded risk factors for neonatal deaths were birthweight < 1500g (OR= 4.86), birth asphyxia (OR= 3.99), lower educational level of mothers (OR= 3.05), and the delivery at home (OR= 2.84).The Conclusion of our study are prevalence of neonatal death is still very high at rate (5.32%) 53.2/1000 although it has decreased in the last two years and the most common cause of death is sepsis. The most important risk factors for neonatal mortality are low birthweight, birth asphyxia cause for NICU admission, illiteracy and low education of mothers, and home deliveries.

1. Introduction

Newborn is defined as an infant in the first 28 days after birth and newborn health has an important role in child's survival and health. Classification of a child's life into well-defined periods has become an important standardization to determine the care and interventions necessary to increase the chances of child survival. The neonatal period is recognized as the most vulnerable time in an infant's life [1, 2].

neonatal mortality, defined as death within the first 28 days of life, is a core indicator for neonatal health and wellbeing and is becoming a prominent component of overall under-five mortality [3]. It is therefore receiving particular attention from health authorities. The leading causes of neonatal death in 2013 globally were preterm birth complications, intrapartum related complications (neonatal encephalopathy from birth asphyxia/trauma), and neonatal sepsis and other neonatal infections including pneumonia, tetanus and diarrhea [4]. Even though the under-5 mortality rate dropped by 47% (from 9.9 million to 5.6 million children) from 2000 to 2016 globally, the neonatal mortality rate only fell by 39% over the same period [5, 6]. One of the goals of the Millennium Development Goals was to reduce the under-five mortality by two-third by the year 2015. Afterward, in the Sustainable Development Goals the target is repeated under the third goal "Ensure healthy lives and promote well-being for all at all ages". Since about two third of the infant mortality and about half of the under-five mortality occur in the neonatal period, to attain this target, countries must focus on reducing the neonatal mortality rate [7, 8]. The causes of environmental

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and social barriers prevent access to basic medical resources and thus contribute to an increasing neonatal mortality rate; 99% of neonatal deaths occur in developing countries, and 86% of these deaths are due to infections, premature births, complications during delivery, and perinatal asphyxia and birth injuries [9, 10]. Greatest percentage reduction of neonatal mortality occurs in countries that already have low rates of infant mortality. Common causes are preventable with low-cost measures [9]. Preventive measures to reduce mortality rates of neonates include Policy [11, 12]and Prenatal care and maternal health [13, 14]. The of aim of our study to estimate mortality rate at Al-Ramadi Teaching Hospital for Maternity and Childhood, from 2018-2020.

2. ATIENTS AND METHODS

2.1. Study design, setting and data collection time

this was a cross sectional study conducted retrospectively in Neonatal Intensive Care Unit (NICU) at Al-Ramadi Teaching Hospital for Maternity and Childhood during a period of six months from October 2020 till the end of March 2021.

2.2. Studied patients and sample size

the study included 15686 neonates admitted to the inborn and outborn NICU and collected from the archives files of Al-Ramadi Teaching Hospital for Maternity and Childhood during the years 2018, 2019, and 2020.

all newborns delivered and admitted to the NICU within the initial 28 days of life following delivery from January 2018 to December, 2020 were involved in this study.

any newborn who died was recorded as an outcome.

2.3. Data collection tools

Appendix was applied to collect the needed information. It was developed by the researcher (after thorough review of literatures) and revised by the supervisor. It includes questions to gather the following information:

- **Parents' information**
  - Age, residence, educational level, and occupation.
  - Number of children and number of previously died children.
  - Number of previous abortions of mother.
- **Pregnancy information**
  - Mode of delivery (NVD or C/S).
  - Site of delivery (Hospital or home).
  - Number of antenatal care visits.
  - Complications during pregnancy (Bleeding, HTN, or DM, … etc.).
  - Complications during labor.
- **Babies' information**
  - Birthweight.
  - Gender
  - Gestational age (calculated from last menstrual period or an early U/Sduring pregnancy).
  - Cause of NICU admission.
  - Outcome (died or discharged home).
  - Age of neonate when died
  - Cause of death.

2.4. Ethical considerations and official approvals

The information were anonymous. Names were removed and replaced by identification codes. All information kept confidential in a password secured laptop and data used exclusively for the research purposes.

Administrative approvals were granted from the following

1. The Council of Arab Board of Medical Specialization.
2. Approval and agreement from Al-Ramadi Teaching Hospital for Maternity and Childhood.

2.5. Statistical analysis

the data analyzed using Statistical Package for Social Sciences (SPSS) version 26. the data presented as mean, standard deviation and ranges. Categorical data presented by frequencies and percentages. Chi square test was used to assess the association between provisional diagnosis and certain information. Logistic regression analysis applied, using the presence of neonatal outcome as the dependent variable and the variables that were found significant in the binary analysis were included in the model as the independent variables. A level of P – value less than 0.05 was considered significant.

3. RESULTS

Total of 15686 neonates were the subjects of this study. All of them were admitted to the NICU (inborn & out born) in 2018, 2019, and 2020.

3.1. Neonates characteristics

age of the recruited neonates ranged from 1 – 26 days with a mean of 13.42 days and a standard deviation (SD) of ± 6.2 days. The highest proportion of neonates 9433 (60.1%) aged < 7 days (Figure 3.1). Regarding gender, proportion of females was higher than males (53.9%

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versus 46.1%) with a male to female ratio of 1:1.16. About half of the recruited neonates 7941 (50.6%) were weighing between 2.5 – 4 kg at birth, and 7549 (48.1%) of them were delivered with GA of ≥ 37 weeks. Prematurity was the most common cause of NICU admission, recorded among 4518 (28.8%), followed by TTN, RDS, and jaundice that recorded among 3372 (21.5%), 2975 (19%), and 2227 (14.2%), respectively (Table 3.1).

Figure 3.1: Distribution of the study patients by age

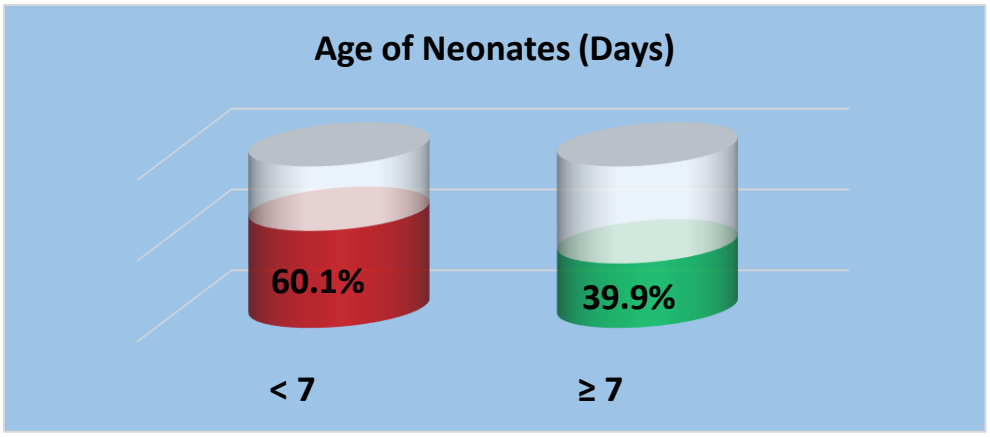

Table 3.1: Distribution of the study neonates by certain characteristics

Variable	No. (n= 15686)	Percentage (%)
Gender		
Male	7231	46.1
Female	8455	53.9
Birth weight (gm)		
< 1500	342	2.2
1500 - 2499	6822	43.5
2500 - 4000	7941	50.6
> 4000	581	3.7
GA at Delivery (Week)		
< 32	2411	15.4
32 – 36^{+6}	5726	36.5
≥ 37	7549	48.1
Cause of Admission to NICU		
Prematurity	4518	28.8
TTN	3372	21.5
RDS	2975	19.0
Neonatal Jaundice	2227	14.2
Birth Asphyxia	1490	9.5
Congenital Anomalies	376	2.4
Others	728	4.6

3.2. Certain characteristics of the parents

Age of the mothers ranged from 18 to 46 years with a mean of 28.33 ± 9.12 years. The highest proportion of mothers 9097 (58%) was found in the age group of (20 – 30) years, 9882 (63%) finished primary or secondary school, 12110 (77.2%) housewives, 12172 (77.6%) live in urban area, 8063 (51.4%) had three or more children, and 14745 (94%) didn't loss child previously. Regarding

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mode and site of delivery, 9882 (63%) of the recruited mothers delivered their last child through NVD, and 14933 (95.2%) delivered at hospital. During their last pregnancy, 2353 (15%) of the enrolled mothers received complete antenatal care (4 visits or more), while 5098 (32.5%) suffered from complications as HTN, DM, or anemia (Table 3.2).

Table 3.2: Distribution of mothers' certain characteristics

Variable	No. (n= 15686)	Percentage (%)
Mother's age (Year)		
< 20	1882	12.0
20 - 30	9097	58.0
> 30	4707	30.0
Mother's education		
Illiterate	1413	9.0
Primary or Secondary School	9882	63.0
College or Higher Education	4391	28.0
Mother's occupation		
Housewife	12110	77.2
Employee	2917	18.6
Student	659	4.2
Residence		
Urban	12172	77.6
Rural	3514	22.4
Number of Children		
One	1663	10.6
Two	5960	38.0
≥ Three	8063	51.4
Previously Dead Children		
Yes	941	6.0
No	14745	94.0
Mode of delivery		
VD	9882	63.0
C/S	5804	37.0
Place of delivery		
Hospital	14933	95.2
Home	753	4.8
Antenatal Care Visits		
No	910	5.8
1 - 3	12423	79.2
≥ 4	2353	15.0
Complication during pregnancy		
No	10588	67.5
HTN	2761	17.6
DM	1051	6.7
Anemia	925	5.9
Others	361	2.3

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In this study, more than two thirds of fathers 10557 (67.3%) finished primary or secondary school, and 7686 (49%) of them were employees (Table 3.3)

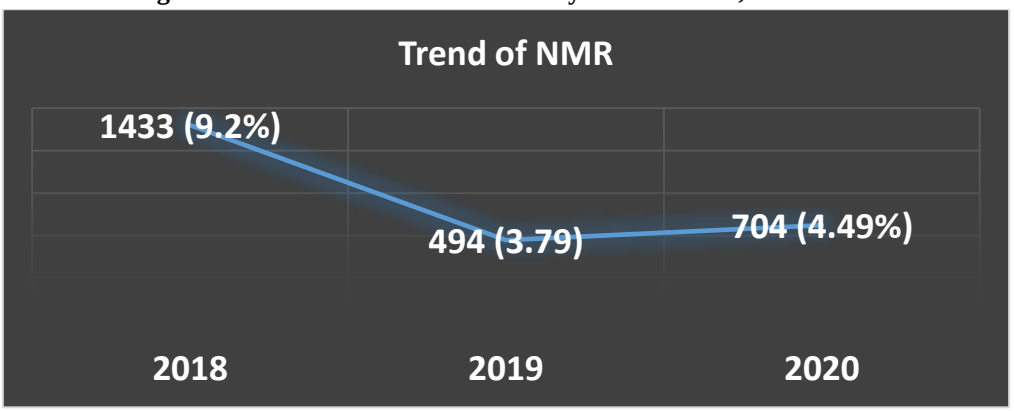
Table 3.3: Distribution of fathers' certain characteristics

Variable	No. (n= 15686)	Percentage (%)
Father's education		
Illiterate	894	5.7
Primary or Secondary School	10557	67.3
College or Higher Education	4235	27.0
Father's occupation		
Not Employee	5741	36.6
Employee	7686	49.0
Student	2259	14.4

3.3. Neonatal death

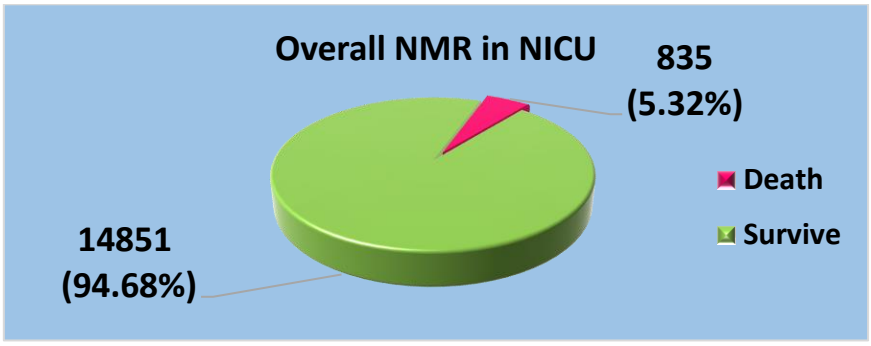
The neonatal mortality rate was (9.2%)92/1000 in 2018, decreased to (3.79%)37.9/1000 in 2019, then slightly increased to become(4.49%)44.9/1000 in 2020 (Figure 3.2).

Figure 3.2: Trend of neonatal mortality rate in NICU, 2018 - 2020



During the period of the current study, the total number of NICU admission was 15686 and the total number of neonatal deaths was 835. So, the overall neonatal mortality rate in NICU was (5.32%)53.2/1000 (Figure 3.3).

Figure 3.3: prevalence of neonatal mortality in NICU, 2018 - 2020



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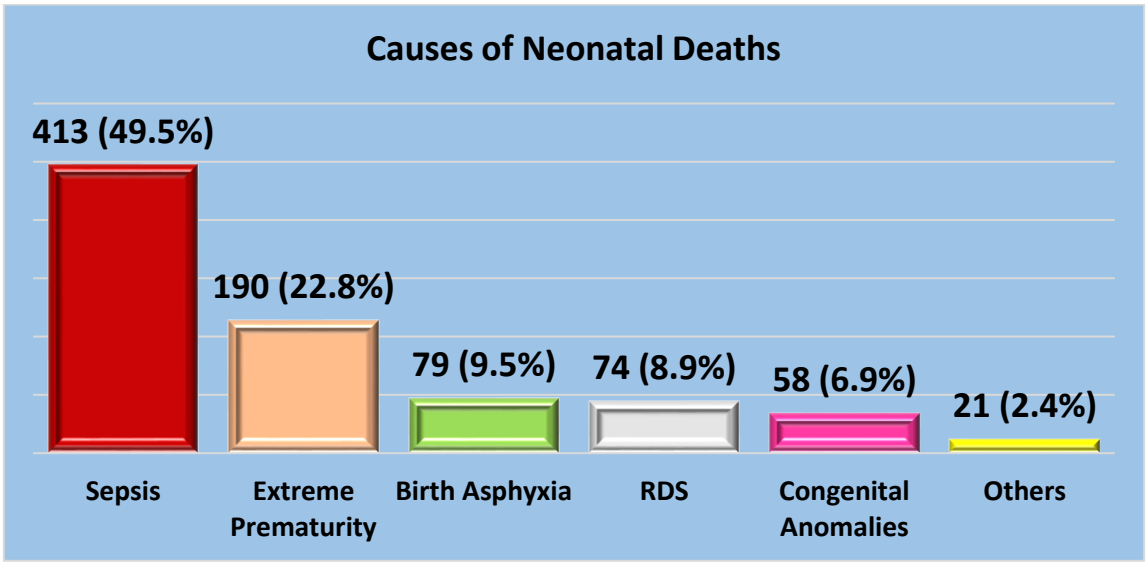
Concerning the causes of neonatal deaths in NICU, sepsis was the leading cause of death, reported in about half of the enrolled neonates 413 (49.5%), followed by extreme prematurity 190 (22.8%), birth asphyxia 79 (9.5%), RDS 74 (8.9%), congenital anomalies 58 (6.9%), and other causes 21 (2.4%) (Figure 3.4).

Figure 3.4: Causes of neonatal deaths in NICU



In this study, there was a statistically significant association between the neonatal deaths and the age of neonates, gender, birth weight, GA at delivery, and the cause of admission to NICU. The proportion of neonatal deaths was significantly higher among neonates who aged < 7days (6.4%, P= 0.001), females (6.5%, P= 0.001), had birth weight of < 1500g (35.4%, P= 0.001), delivered with GA of < 32 weeks (35.4%, P= 0.001), and those who complained from birth asphyxia (11.3% P= 0.001) (Table 3.4).

Table 3.4: Distribution of neonatal outcome in neonatal care uint by certain characteristics of the studied patient

Variable	NICU Outcome		Total (%) n= 15686	P - Value
	Died (%) n= 835	Survived (%) n= 14851		
Age (Days)				
< 7	599 (6.4)	8834 (93.6)	9433 (60.1)	**0.001**
≥ 7	236 (3.8)	6017 (96.2)	6253 (39.9)	
Gender				
Male	283 (3.9)	6948 (96.1)	7231 (46.1)	**0.001**
Female	552 (6.5)	7903 (93.5)	8455 (53.9)	
Birthweight (gm)				
< 1500	121 (35.4)	221 (64.6)	342 (2.2)	**0.001**
1500 - 2499	392 (5.7)	6430 (94.3)	6822 (43.5)	
2500 - 4000	308 (3.9)	7633 (96.1)	7941 (50.6)	
> 4000	14 (2.4)	567 (97.6)	581 (3.7)	
GA at delivery				
< 32	186 (7.7)	2225 (92.3)	2411 (15.4)	**0.001**

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32 – 36^{+6}	267 (4.7)	5459 (95.3)	5726 (36.5)	
≥ 37	382 (5.1)	7167 (94.9)	7549 (48.1)	
Causes of NICU Admission				
Prematurity	257 (5.7)	4261 (94.3)	4518 (28.8)	**0.001**
TTN	114 (3.4)	3258 (96.6)	1490 (21.5)	
RDS	145 (4.9)	2830 (95.1)	2975 (19.0)	
Neonatal Jaundice	72 (3.2)	2155 (96.8)	2227 (14.2)	
Birth Asphyxia	169 (11.3)	1321 (88.7)	1490 (9.5)	
Congenital Anomalies	38 (10.1)	338 (89.9)	376 (2.4)	
Others	40 (5.5)	688 (94.5)	728 (4.6)	

Regarding the association between the neonatal deaths and certain risk factors of the parents, found that neonatal deaths was significantly associated with residency, educational level of mothers, place of delivery, antenatal care, and suffering from complications during the last pregnancy. The proportion of neonatal deaths was significantly higher among neonates who where living in rural area (6.7%, p= 0.001), their mothers of low educational level or illiterate (11.7%, P= 0.001), delivered at home (13.1%, p= 0.001), didn't receive antenatal care and suffered from complications during the last pregnancy (18.2%, P= 0.001, and 7.3%, P= 0.001, respectively) (Table 3.5).

Table 3.5: Distribution of neonatal outcome in NICU by certain characteristics of the parents

Variable	NICU Outcome		Total (%) n= 15686	P - Value
	Died (%) n= 835	Survived (%) n= 14851		
Mother's age (Year)				
< 20	101 (5.4)	1781 (94.6)	1882 (12.0)	**0.217**
20 - 30	463 (5.1)	8654 (94.9)	9117 (58.0)	
> 30	271 (5.8)	4416 (94.2)	4687 (29.0)	
Mother's education				
Illiterate	166 (11.7)	1247 (88.3)	1413 (9.0)	**0.001**
Primary or Secondary school	494 (5.0)	9388 (95)	9882 (63.0)	
College or Higher education	175 (4.0)	4216 (96)	4391 (28.0)	
Mother's occupation				
Housewife	567 (4.7)	11543 (95.3)	12110 (77.2)	**0.055**
Employee	180 (6.2)	2737 (93.8)	2917 (18.6)	
Student	88 (13.4)	571 (86.6)	659 (4.2)	
Residence				
Urban	598 (4.9)	11574 (95.1)	12172 (77.6)	**0.001**
Rural	237 (6.7)	3277 (93.3)	3514 (22.4)	
Number of Children				
One	95 (5.7)	1568 (94.3)	1663 (10.6)	**0.084**
Two	262 (4.4)	5698 (95.6)	5960 (38.0)	
≥ Three	478 (5.9)	7585 (94.1)	8063 (51.4)	
Previously Dead Child				

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Yes	40 (4.3)	901 (95.7)	941 (6.0)	**0.130**
No	795 (5.4)	13950 (94.6)	14745 (94.0)	
Mode of Delivery				
VD	522 (5.3)	9360 (94.7)	9882 (63)	**0.765**
C/S	313 (5.4)	5491 (94.6)	5804 (37)	
Place of Delivery				
Hospital	736 (4.9)	14197 (95.1)	14933 (95.2)	**0.002**
Home	99 (13.1)	654 (86.9)	753 (4.8)	
Antenatal Care Visits				
No	166 (18.2)	744 (81.8)	910 (5.8)	**0.001**
1 - 3	567 (4.6)	11856 (95.4)	12423 (79.2)	
≥ 4	102 (4.3)	2251 (95.7)	2353 (15.0)	
Complication during pregnancy				
Yes	371 (7.3)	4727 (92.7)	5098 (32.5)	**0.001**
No	464 (4.4)	10124 (95.6)	10588 (67.5)	
Father's education				
Illiterate	54 (6.0)	840 (94.0)	894 (5.7)	**0.203**
Primary or Secondary school	539 (5.1)	10018 (94.9)	10557 (67.3)	
College or Higher education	242 (5.7)	3993 (94.3)	4235 (27.0)	
Father's occupation				
Not Employee	316 (5.5)	5425 (94.5)	5741 (36.6)	**0.062**
Employee	422 (5.5)	7264 (94.5)	7686 (49.0)	
Student	97 (4.3)	2162 (95.7)	2259 (14.4)	

By logistic regression analysis, a significant, independent and un-confounded risk factors for neonatal deaths were birth weight < 1500g (OR= 4.86), birth asphyxia (OR= 3.99), lower educational level of mothers (OR= 3.05), and the delivery at home (OR= 2.84) (Table 3.6).

Table 3.6: Determinants of neonatal deaths in NICU by logistic regression analysis

Variables	Odd's ratio	95% C.I for odd's ratio	P - Value
Birthweight (gm)			
< 1500	4.86	1.18 – 7.15	**0.001**
Reference (2500 – 4000)			
Cause of Admission			
Birth Asphyxia	3.99	1.49 – 6.32	**0.001**
Mother education			
Illiterate or primary school	3.05	1.02 – 5.76	**0.024**
Reference (Higher education)			
Place of Delivery			
Home	2.84	1.44 – 5.51	**0.001**

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4. DISCUSSION

In the current study, 15686 neonates were the subjects of this study. All of them were admitted to the NICU in 2018, 2019, and 2020.

By comparison to an Iraqi study conducted by Hunnosh et al in 2017, a different finding reported when they compare the neonatal mortality rate of the first and second stages of the 11 studied years. They observed that the highest rates of the whole 11 years was recorded in the first stage in 2006 (36.8/1000) and then declined to reach lowest rate which was in second stage in 2012 (21.3/1000) [15]. This result was compared to Tanzanian study done by Mangu et al in 2020, in which mortality rate was 3.7/1000 during 2006–2010 and 10.4/1000 during 2011–2015, both periods indicating a stagnant trend in the years between [16].

the different trend in the mortality rate is multifactorial, it's may have related to neonatal causes as, high rate of perinatal mortality, low birth weight, premature, and births defect associated deliveries, or related to obstetrical causes necessitate admission to NICU, as premature rupture of membrane, pre-eclampsia or eclampsia, placental abnormalities. also, the health care provided to mother and fetus, in addition to circumstances of each country, may play an essential role in the neonatal mortality rate.

in Iraq, for example, the mortality rate affected for nearly two decades ago, most probably because of the invasion of Iraq by the Coalition forces militaries by 2003 and despite the lifting of sanction, the invasion added a disastrous destruction of the remaining weak infrastructure and health facilities, causing further loss of health services, resources, and security conditions. After the invasion of ISIS to some areas of Iraq and obvious destruction of infrastructure and health facilities provided to patient, there were a clear improvement in health care provided followed the liberation of these area from ISIS, including the availability of supplies, equipment, human resources, funding and medicines as well as an effective coverage of services targeting neonatal survival.

This study revealed that total number of NICU admission was 15686 and the total number of neonatal deaths was 835. So, overall mortality rate in NICU was 5.32%.

By comparison to a local study done in Al-Ramadi , Iraq, a higher percentage observed by Shitran et al study in 2020, as found that 3654 neonates were admitted to NICU, of them 336 died (9.2%) [17], while in Turkish study in 2021, Yüzügüllü and colleagues, they observed according to data of 35 227 live births and 288 infant deaths during the year, the infant mortality rate of Adana province was 8.2 per thousand [18].

Moreover, in a study conducted in Saudi Arabia at 2020 by Al-Mouqdad and colleagues, the mortality rate among 755 premature infants who were less than or equal to 32 weeks' gestation, mortality reported in 32.5% of them [19].

The current results was agreed to that conducted in Ethiopia in 2018 by Abdifatah et al, in which found that mortality rate among neonate was 5.7% [20]. Another higher mortality rate was found in Fonsecaet al study in 2017, in which throughout the period (2004–2010), 1,445,342 newborns were studied, of which 11,694 evolved to neonatal death (8.09%) [21].

The reason behind the differences among above studies could be related to the different number of enrolled patients, different management of conditions of labor, intra-partum dealing with infants and the immediate newborn care practices.

This study observed that causes of neonatal deaths in NICU were sepsis, which was the leading cause of death, that reported in about half of neonates (49.5%), followed by extreme prematurity (22.8%), birth asphyxia (9.5%), RDS (8.9%), congenital anomalies (6.9%), and other causes (2.4%). As compared to other studies, in Iraq, Shitran et al study in 2020 observed that the most comment cause of mortality was sepsis which was prevalent in more than half of neonates (53.9%), followed by extreme prematurity (14.9%), with least found in other causes (1.5%) [17], while in Tanzania, Mangu et al study in 2020 found that leading causes of early neonatal mortality were birth asphyxia (22.3%) and respiratory distress (20.8%), while those of late neonatal death were sepsis (29.1%) and respiratory distress (20.0%) [16].

Different finding reported in Debelew et al in 2014, described that causes of neonatal mortality were perinatal asphyxia in 47.5% of patients, neonatal infections, in 34.3%, and prematurity-related conditions, in 11.1% [22]. In the same different manner, a hospital-based study, in which Sônia Lansky et al in 2014, as they identified that one-third of deaths were attributed to prematurity, then to congenital malformations (22.8%), infections (18.5%), and asphyxia (7%) [23].

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This difference may be explained by, in addition to sample size, the different proportion of home deliveries in the absence of skilled attendants. Knowledge and skill deficiencies in prevention, diagnosis and management by unskilled attendants might have contributed to perinatal complications, the pre-existed comorbidities, the maternal obstetrical history, which contribute to the occurrence of neonatal mortality.

In fact, Prematurity is the leading cause of neonatal mortality worldwide, causing > 1000000 deaths annually and accounting for >25% of neonatal deaths. Prematurity and birth asphyxia are closely linked to maternal health [(24)].

Furthermore, the present work reported a significant association between neonatal mortality and the age, gender, birth weight of neonates, GA at delivery, and the cause of admission to NICU (P<0.05). The current findings agreed to that observed by Shitran et al study in 2020, in which neonatal mortality was significantly related to age at admission, gender, birth weight (P<0.05), but disagreed in that gestational age was not significantly related to the neonatal mortality (P=0.401) [(17)]. In the same manner, Hunnosh et al study in 2017, in which they found that neonatal death was significantly related to gender, as male was more affected than female (P <0.01) and also significantly related to the residency, in which mortality was more prevalent in rural patients (P <0.01) [(15)]. Moreover, Al-Momani et al study in 2020 observed that neonatal mortality was significantly related to the birth weight and to the gestational age (P<0.05) [(25)]. This study observed an association between neonatal mortality and parents risk factors, as found that mortality was significantly related to residency, educational level, place of delivery, antenatal care, and complications of last pregnancy (P<0.05).

In Shitran et al study in 2020, neonatal death and educational level of parents was significantly related, in which mortality was significantly high in the illiterates' mother or those completed the primary school only (p=0.024). In addition, despite home deliveries were in small percentages, but the neonatal death were significant in home deliveries (p=0.001) [(17)]. In the same manner, Ajaari et al study reported in their study that Childbirth in institution health presented via a trained medical crew significantly minify maternal and neonatal death-rate and morbidity compared to births in the home (P <0.001) [(26)]. Akter et al study in 2015, showed that the odds of the under-five mortality were 38% lower for the children with mother having secondary education, compared to the children with uneducated mother [(27)]. In the same accordance, Fonsecaet al study in 2017, found that neonates of mothers in the extremes of age and with low education levels presented approximately 1.7 times greater chance of evolving to neonatal death, when compared to the children of mothers between 20–34 years old and with education ≥ 4 years (P<0.05) [(21)]. Gakidou et al study, found a significant effect of mother's education on under-five mortality in 175 countries [(28)]. Moreover, Debelew et al study in 2014 observed that having ANC visit and giving birth at health center were found to decrease neonatal mortality significantly. This is consistent with previous study conducted in Indonesia by Titaley et al [(29)] and in India by Arokiasamy et al [(30)]. This may be because; during ANC visits, necessary health condition of mothers can be screened and treated earlier. Moreover, health facility delivery is very necessary in detecting complications earlier and providing clean and safe delivery [(23)]. A potential explanation for this finding is that an inconsistent control of pregnancy leads to missing the diagnosis of maternal or fetal comorbidities that should be managed in a timely manner.

On the other hand, the relationship between neonatal mortality and family education has been shown to hold up even after controlling a range of indicators of income, social status, and access to health services. The reasoning for this comes from the increased consciousness from educated mothers about their own life and the life of their neonates. In most of the developing countries, children having a mother with secondary or higher education were at a lower risk of child mortality compared to children having a mother with no education. There are five potential pathways linking maternal education and child health: (i) improved socio-economic status; (ii) health knowledge; (iii) modern attitudes towards health care; (iv) female autonomy; and (v) reproductive behavior [(30)].

In fact, it had been clearly indicating that delivery outside a health facility is more likely to lead to neonatal death compared with delivery in a health facility; this confirms the role of place of delivery on newborn survival. Place of delivery has consistently been found to be associated with maternal and neonatal outcomes. Childbirth in a health institution attended to accomplished by a trained

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medical staff reduces maternal and neonatal mortality and morbidity compared to home births [31].

Logistic regression analysis of this study reported that a significant, independent and un-confounded risk factors for neonatal deaths were birth weight < 1500g (OR= 4.86), birth asphyxia (OR= 3.99), lower educational level of mothers (OR= 3.05), and the delivery at home (OR= 2.84). In the same accordance, Shitran et al study in 2020, observed that mortality was higher in those with birth weight less than 1.5 kg, which means that low birth weight has higher chance of death with OR and C.I of (3.7 & 2.18– 6.07) respectively. Also mothers with low education levels have higher chance of losing their newborn baby with OR and C.I of (2.56 & 1.06 – 4.29) respectively. Home delivery with midwife interference and sepsis also have strong association with neonatal death with OR (2.15 & 6.82) respectively [10]. In USA, Ramaiya et al study in 2014, found that risk for neonatal mortality is higher in the case of single mothers (OR: 3.6, p≤0.01), low maternal education (p ≤ 0.01) and complications during pregnancy (OR:2.6, p≤ 0.01) [33].

Differently, Lansky and colleagues in 2014 reported a different risk for neonatal death, they found that birth weight < 2500 grams (OR: 5.19, 95% CI: 2.44-11.04), congenital malformations (OR: 16.55, 95% CI: 6.47-42.38), an Apgar score < 7 at 5 minutes (OR: 15.79, 95% CI: 6.54-38.14), and male gender (OR: 1.49, 95% CI: 1.08-2.05) increased the risk for neonatal death [24]. In 2014, Debelew and colleagues reported a different determinants for the neonatal mortality, of these were conditions associated to death were ≤ 4 antenatal care visits (OR: 0.35, 95% CI: 0.18-0.68), birth at a health center (OR: 0.43, 95% CI: 0.17-0.99), gestational age less than 37 weeks (OR: 2.09, 95% CI: 1.03-4.22), obstetric complications during delivery (OR: 6.77, 95% CI: 3.82-12.00), premature rupture of membranes < 12 hours (OR: 7.74, 95% CI: 2.27-26.4), and twin pregnancy (OR:8.21, 95% CI: 3.46-19.47) [22].

Different results among above studies may relate to the different study design or sample size, also it may relate to the different perinatal complication that accompanied mother and fetus during pregnancy, the availability of adequate management in healthcare centers, in addition to the genetic and environmental factors.

According to the World Health Organization, of the 130 million newborns, four million will die during the neonatal period, and half neonatal deaths (i.e., 50%) occur within the first 24 hours of life. Neonatal mortality rate remains a challenge; the risk factors associated with neonatal mortality are considered quality indicators for improving health care provided in NICU, and an indicator of population health and wellbeing [34].

In the present work, age of the mothers ranged from 18 to 46 years with a mean of 28.33 ± 9.12 years, with highest proportion (58%) were found in age group (20 - 30) years, 63% finished primary or secondary school, 77.2% housewives, 77.6% live in urban area, 51.4% had three or more children, and 94% didn't loss child previously.

In comparison to Reyes et al study in 2018, a different finding reported, in which median maternal age was 23 years (max. 45; min 12years); 17.9% of women were single mothers and 35.5% were primi-parous [35].

Regarding mode and site of delivery in this study, 63% had NVD, and 95.2% delivered at hospital. During their last pregnancy, 15% received complete antenatal care (4 visits or more), while 32.5% suffered from complications as HTN, DM, or anemia. Moreover, and in relation to education, 23.7% of mothers had completed just primary education and 2.9% were illiterate [35].

In the current work, mean and a standard deviation (SD) of neonate age was13.42± 6.2 days, ranged from 1 – 26 days with a highest proportion of neonates aged < 7 days (60.1%). Females were more prevalent than males (53.9% versus 46.1%) with a male to female ratio of 1:1.16. About half were weighing between 2.5 – 4 kg at birth (50.6%), and 48.1% were delivered with GA of ≥ 37 weeks. Prematurity was the commonest cause of NICU admission in 28.8%, followed by TTN, RDS, and jaundice that recorded in 21.5%, 19%, and 14.2%, respectively.

In comparison,1247 neonates were enrolled in Al-Momani et al study in 2020; of these, 703 (56.4%) were male and 544 (43.6%) were female, with male to female was 1.3:1. Among those, 776 (62.2%) were full term with the gestational age of ≥37 weeks; the remaining 471 (37.8%) were preterm with the gestational age <37 weeks. The majority of the neonates were delivered via caesarian-section (62.8%), the remaining were delivered normally (37.2%) [25]. Moreover, Reyes et al study in 2018, observed a different finding, during the study period, 9366 live births were recorded; 15% of them were admitted to NICU. Among admitted patients, 54.3% were males and 45.5%, females; 4 patients had

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ambiguous genitalia. Patients' median gestational age was 36.5 weeks (max. 42; min. 24). The gestational age was < 37 weeks in 52.2% and ≤ 32 weeks in 12.8%. Patients' median birth weight was 2360 grams (max. 5380; min 500). Birth weight was less than 2500 grams in 54.5% and 1500 grams or less in 17.5% [35].

Genetic, environmental, socioeconomic factors, in addition to the educational level of the parents, all these factors can have determined the difference observed above.

5. Conclusion

1. The prevalence of neonatal death is still high although it has decreased in the last two years and the most common cause of death is sepsis.
2. The most important risk factors for neonatal mortality are low birthweight, birth asphyxia cause for NICU admission, illiteracy and low education of mothers, and home deliveries.

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