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Pattern of Morbidity and Mortality in a Neonatal Unit of a Private Paediatric Health Facility in Southern Nigeria

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ABSTRACT

Background: The neonatal period is a critical time for child survival as the risk of death is very high. This study was done to determine the pattern of neonatal morbidity and mortality in a private paediatric health facility in Nigeria.
Methods: A prospective study was carried out over one year from June 2023 to May 2024.
Result: Of 175 neonates admitted, males predominated 114(65.1%). Most were admitted within the 1st 3 days of life 93(53.1%), had normal birth weights 103(58.9%) with mean gestational age of 35.51 ± 4.75weeks. The commonest morbidity observed were neonatal jaundice 93(57.1%), probable neonatal sepsis 93(57.1%) and prematurity 44(27.0%). There were 7 deaths (mortality rate of 4.0%), commonest causes were neonatal sepsis, severe anaemia and hypoglycaemia. Morbidities with the highest case fatality rates were severe anaemia (10.7%) hypoglycaemia (9.5%) and congenital heart disease (8.3%). Neonatal jaundice, low birth weight and respiratory distress syndrome were significantly associated with gestational age <37weeks (*P* value 0.002, <0.001, <0.001, respectively) while perinatal asphyxia was significantly associated with neonates of gestational age >37weeks (*P* value 0.047). Birth weight was significantly associated with survival, *P* value = 0.049.
Conclusion: There was male predominance among admitted neonates with commonest morbidities being neonatal jaundice, neonatal sepsis and prematurity. Mortality rate was 4%, commonest causes were preventable; neonatal sepsis, severe anaemia and hypoglycaemia. Thus, improved obstetric and neonatal care through antenatal care, provision of adequate & quality health care personnel, technological advancement, appropriate/timely referral of sick neonates with adequate transportation would improve neonatal outcomes.

Key words: Pattern, Morbidity, Mortality, Neonatal unit, Nigeria

INTRODUCTION

The neonatal period which refers to the first 28 days after birth is a critical time for child survival [1,2,3]. The risk of death in foetuses and neonates is very high around the time of birth [1,2]. This period of life being very sensitive is attributable to the physiologic adaptation of newborns to extrauterine life

[4]. Neonatal mortality rate (NMR) which is the number of newborn deaths per 1000 live births, an important reflection of the overall child health, is also used to assess social and economic development of a nation [5]. Nigeria unfortunately still has a very high NMR of 34/1000 live births in urban areas and 44/1000 live births in rural areas, one of the highest globally [1,5-9].

The pattern of morbidity among neonates varies from place to place as well as over time even within the same geographic location [10]. It is pertinent to note that the pattern of disease in newborns is an important indicator of the effectiveness of the obstetric and neonatal care services, the availability and utilization of health care personnel and technological advancement [11]. Various researchers [12-15] in Nigeria documented neonatal sepsis, perinatal asphyxia, neonatal jaundice and prematurity as the commonest morbidities observed.

About 8% of global neonatal deaths occur in Nigeria annually [1]. Early neonatal death is often due to obstetric complications whereas intrapartum death may be associated with the place of delivery and the type of neonatal care at delivery [1,5,9,16]. In addition, newborn survival positively correlates with socioeconomic development of the country.

Leading causes of mortality in the neonatal period include neonatal infection, preterm birth, low birth weight and perinatal asphyxia which are largely preventable [5,6, 8].

Mortality rate in the neonatal period has been reported as being between 2.2-19.54%. [1,3,5,6,8,13,16,17] Ullah et al [18] reported 86.6% of all neonatal mortality as occurring within the early neonatal period (first 7 days) with case fatality rates highest in prematurity (28.78%), perinatal asphyxia (21.49%), congenital malformations (26%), sepsis (16.94%), and meconium aspiration syndrome (14.28%).

Many studies have reported varying patterns of neonatal morbidity and mortality across Nigeria [1,3,5-9, 13,16-18]. Majority of this studies however have been in public/tertiary hospitals. Considering the fact that a lot of patients in Nigeria attend private hospitals because of the availability of health insurance coverage amongst other reasons, there is a need to carry out similar studies in the private sector to provide data that may be helpful in policy making.

This study was therefore carried out to determine the pattern of morbidity and mortality in the neonatal unit of a private paediatric facility in southern Nigeria.

MATERIALS AND METHODS

This was a prospective study involving all newborns (aged 0-28 days) admitted into the neonatal unit of a private paediatric hospital in Port Harcourt, Rivers State, over a 1-year period (from 1st of June 2023 to 31st of May, 2024). The study centre was a 38-bedded private paediatric hospital with well-equipped neonatal unit, children's ward, fully functional radiology unit and medical laboratory with attached blood bank services. It also has a fully functional theatre with an ultra-modern paediatric anaesthetic machine, piped oxygen supply, facilities for echocardiography, encephalography and a paediatric ventilator. Overall age group seen was 0-17 years with an average monthly admission rate of 80-90 children per month. Monthly admission rate into the neonatal unit varies, averaging about 10-20 babies per month. The neonatal unit receives babies only from other health facilities as no obstetric care is rendered. This unit consisted of 2 consultant paediatricians, medical officers, nurses as well as other consultants such as paediatric cardiologist, paediatric surgeon etc. The neonatal unit is well equipped with 6 incubators, a transport incubator, 6 cots, piped oxygen supply, 5 CPAP machines and 12 intensive LED phototherapy units etc.

All newborns admitted during the study period were recruited consecutively and a convenient sampling method was employed. The inclusion criteria were all newborn 0-28days old whose parent(s)/caregivers gave consent to participate in the study after the study was explicitly explained to them while infants of parents(s)/caregivers who did not

give consent or who were >28days old were excluded from the study.

A nurse was recruited as a research assistant and was trained thoroughly on the criteria for recruitment before the onset of the study. Data was collected by the researchers and research assistant using a structured pretested proforma. Relevant information was retrieved from the hospitals' Health Management System as well as direct interview of the parent(s)/caregivers of the babies. Information obtained included the baby's age, sex, birth weight, gestational age, diagnosis, treatment given, number and type of transfusions if any, duration of admission and outcome. Outcome measures included discharged, death, discharged against medical advice and referred. Information collected also included mothers' biodata, antenatal care attendance, place and type of delivery, complications if any and treatment given.

All babies recruited were examined head-to toe and diagnosis made either clinically ± investigation results and treatment commenced at once according to the units' standard protocol. Discharged babies were followed up appropriately in the clinics 1-2 weeks later.

STATISTICAL METHOD

Data was recorded in an Excel spreadsheet and analysed using SPSS version 23. Results were presented as frequency, percentages and bar charts. Test of association was done using Chi (χ^2) test while statistical significance was set at *P* value <0.05 at 95% confidence interval.

RESULTS

Characteristics of the study population

Of 175 neonates admitted, males predominated 114(65.1%) with Male: Female ratio of 1.9:1. Majority were admitted within the 1st 3 days of life 93(53.1%), of 1st birth order 79(45.1%), normal birth weights of 2500 – 3999g 103(58.9%) with mean birth weight of 2.64 ± 1.03kg. Most were delivered at gestational age of 37 – 42weeks 104(59.4%), mean of 35.51 ± 4.75weeks and were transported to the health facility for further care via their parent's vehicle 111(63.4%), Table I.

Table I: Characteristics of the study population

Variables	Frequency, n = 175	%
Sex		
Male	114	65.1
Female	61	34.9
Age at presentation (days)		
0-3	93	53.1
4-6	22	12.6
> 6	60	34.3
Birth order		
First	79	45.1
Second	49	28.0
Third and above	47	26.9
Birth weight (kg)		
< 1000	15	8.6
1000 – 1499	17	9.7
1500 – 2499	30	17.1
2500 – 3999	103	58.9
≥ 4000	10	5.7
Gestational age (weeks)		
< 37	71	40.6
37 – 42	104	59.4
Mode of transport to health facility		
Ambulance	40	22.9
Parent's vehicle	111	63.4
Public transport	24	13.7

Maternal socio-demographic characteristics and pregnancy history

Most mothers were ≥ 30years 130(74.3%), had tertiary level of education 148(84.6%) and were involved in business/self-employed 66(37.7%). Majority of mothers had singleton pregnancy 132(75.4%), delivered in private hospitals 113(64.6%) via Caesarean section 94(53.7%) and attended antenatal care 172(98.3%). Of mothers whose pregnancy was < 35weeks, 20(39.2%) received steroids before delivery while 17(23.9%) had previous history of premature births, Table II.

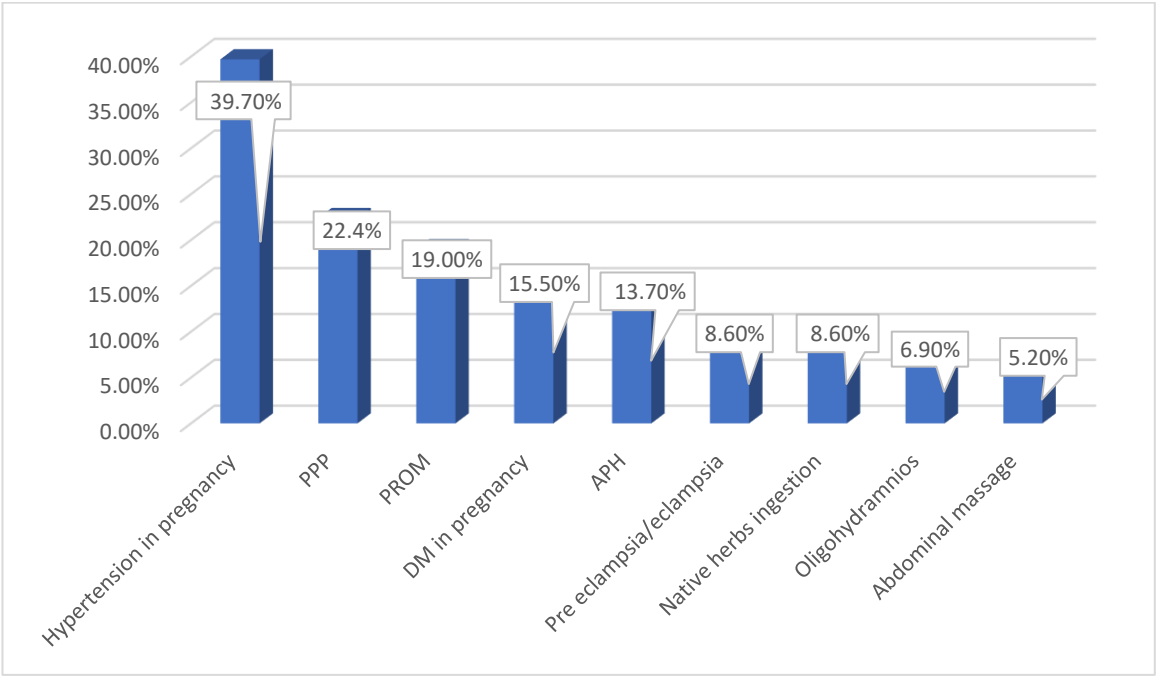
Table II: Maternal socio-demographic characteristics and pregnancy history

Variables	Frequency, n = 175	%
Mother's age (years)		
< 30	45	25.7
≥ 30	130	74.3
Mother's level of education		
Secondary	27	15.4
Tertiary	148	84.6
Mother's occupation		
Civil/public servant	31	17.7
Business/self employed	66	37.7
Professional	28	16.0
House wife/applicant	25	14.3
Not indicated	25	14.3
Pregnancy type		
Singleton	132	75.4
Multiple	43	24.6
Place of birth		
Private hospital	113	64.6
Tertiary hospital	52	29.7
Maternity/TBA	10	5.7
ANC attendance		
Yes	172	98.3
No	3	1.7
Mode of delivery		
SVD	81	46.3
Caesarean section	94	53.7
Received antenatal steroids (< 35 weeks), n=51		
Yes	20	39.2
No	31	60.8
Previous history of premature births, n=71		
Yes	17	23.9
No	54	76.1

TBA = Traditional birth attendants, ANC = Antenatal care, SVD = Spontaneous vaginal delivery

Maternal pregnancy complications

Fifty-eight (31.1%) mothers had pregnancy complications of which the commonest was hypertension in pregnancy 23(39.7%) followed by peripartum pyrexia 13(22.4%), prolonged rupture of membranes > 24hours 11(19.0%) and diabetes mellitus in pregnancy 9(15.5%), Figure 1.



PPP = Peripartum pyrexia, PROM = Prolonged rupture of membranes, DM = Diabetes mellitus, APH = Antepartum haemorrhage

Figure 1: Maternal pregnancy complications

Clinical features in neonates admitted

The commonest clinical feature among neonates admitted was yellowness of the body/eyes 85(50.6%) followed by difficulty in breathing 65(38.7%) and fever 43(25.6%), Figure 2.

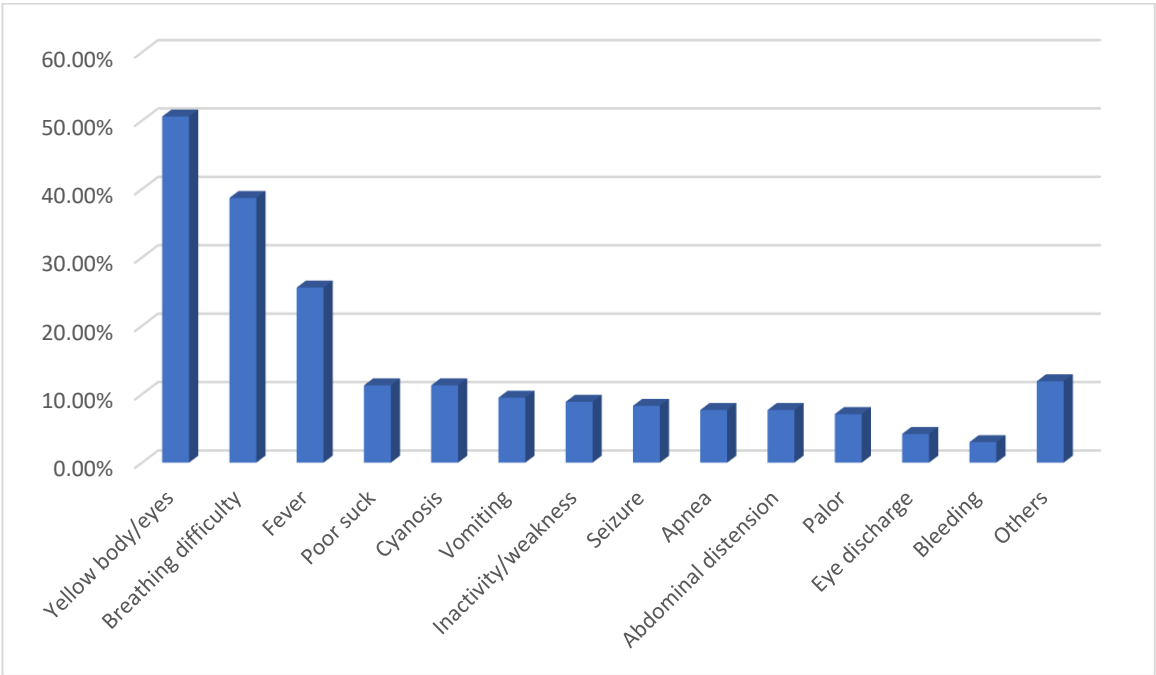
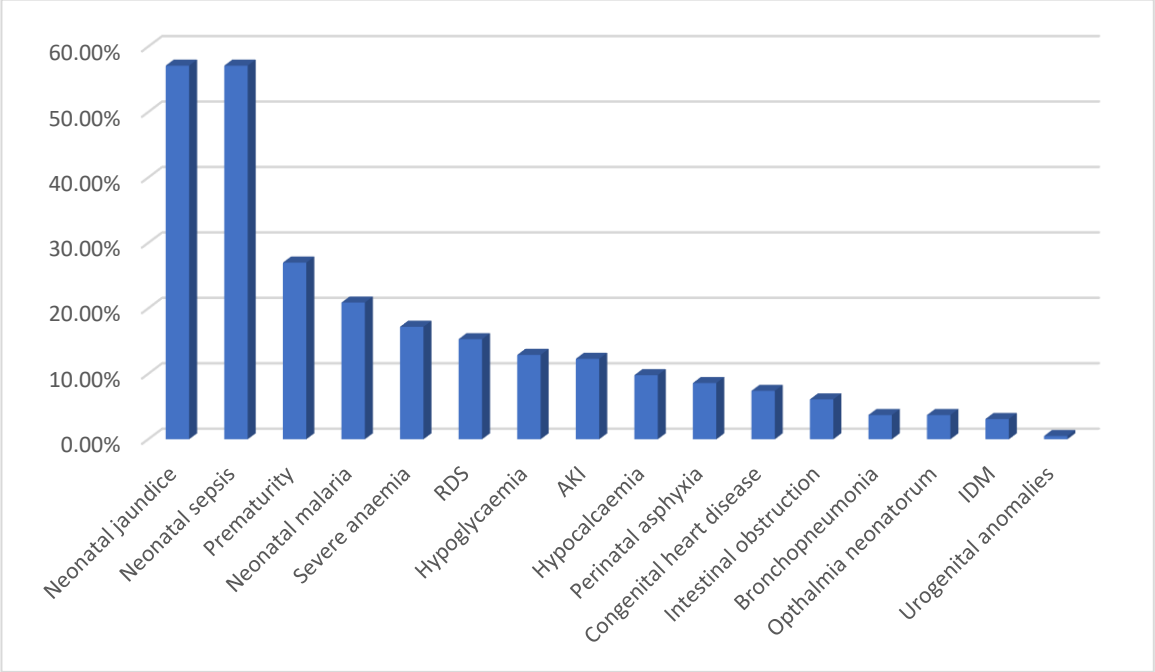


Figure 2: Clinical features in neonates admitted

Pattern of morbidity among neonates admitted

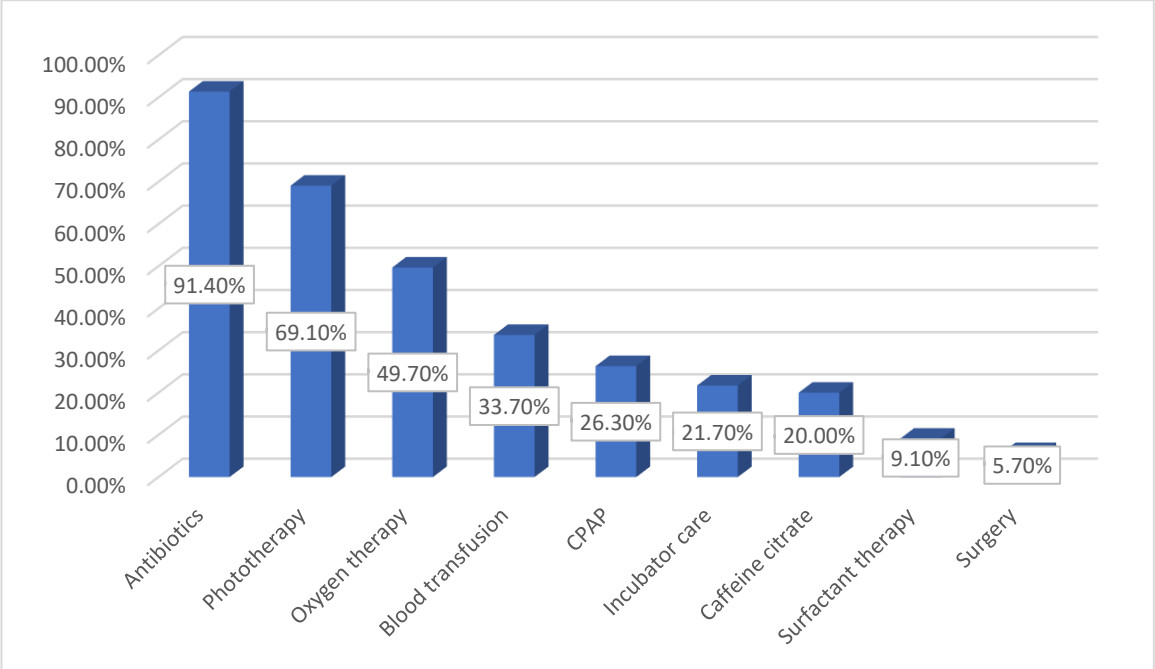
The commonest morbidity among neonates admitted was neonatal jaundice 93(57.1%) and probable neonatal sepsis 93(57.1%) followed by prematurity/low birth weight 44(27.0%) and neonatal malaria 28(20.9%), Figure 3.



RDS = Respiratory distress syndrome, AKI = Acute kidney injury, IDM = Infants of diabetic mothers
Figure 3: Pattern of morbidity among neonates admitted

Treatments administered to neonates admitted

Most neonates received intravenous antibiotics 160(91.4%) followed by phototherapy 121(69.1%) and oxygen therapy 87(49.7%) whereas the least had surgery 10(5.7%). Of 59 neonates who received blood transfusion, 56(94.9%) were top-up transfusion while 3(5.1%) had exchange blood transfusion while of same number, 30(50.8%) were transfused once, 17(28.8%) twice and 12(20.4%) thrice and above, Figure 4.



CPAP = Continuous positive airway pressure
Figure 4: Treatments administered to neonates admitted

Association between preterm babies and the use of surfactant

Preterm infants were 4.2 times more likely to have surfactant therapy compared to non-preterm infants with *P* value of 0.009, Table III.

Table III: Association between preterm babies and the use of surfactant

Variable	Use of Surfactant Yes, n (%)	No, n (%)	Chi-Square	P value	OR (95% CI), *P* value
Preterm					
Yes	7 (43.8)	25 (15.7)	7.642	0.006	4.2 (1.42-12.23), 0.009
No	9 (56.3)	134 (84.3)			

Outcome of treatment and characteristics of mortality cases

Of 175 admitted neonates, 7 died giving a mortality rate of 4.0%.

Of the mortalities, males predominated 4(57.1%), most presented within the 1st 3 days of life 4(57.1%), of 1st birth order 3(42.9%) and had weights 2500-3999g 5(71.4%). Majority had gestational age < 37weeks 4(57.1%), were transported to the health facilities via the parent's vehicles 4(57.1%) and were delivered via CS 4(57.1%), Table IV.

Table IV: Outcome of treatment and characteristics of mortality cases

Variables	Frequency, n = 175	%
Outcome		
Discharged	141	80.6
Died	7	4.0
DAMA	22	12.6
Referred	5	2.8
Characteristics of mortality cases, n=7		
Sex		
Male	4	57.1
Female	3	42.9
Age at presentation (days)		
0-3	4	57.1
4-6	2	28.6
> 6	1	14.3
Birth order		
First	3	42.9
Second	1	14.2
Third and above	3	42.9
Birth weight (kg)		
< 1000	1	14.3
1000-1499	1	14.3
1500-2499	0	0
2500-3999	5	71.4
≥ 4000	0	0
Gestational age (weeks)		
< 37	4	57.1
37-42	3	42.9
Mode of transport to health facility		
Ambulance	2	28.6
Parent's vehicle	4	57.1
Public transport	1	14.3
Mode of delivery		
SVD	3	42.9
CS	4	57.1

DAMA = Discharge against medical advice

Pattern of mortality and Case fatality rates

The commonest causes of mortality were neonatal jaundice, neonatal sepsis and severe anaemia whereas the morbidity with the highest case fatality rate was severe anaemia 10.7% followed by hypoglycaemia (9.5%) and congenital heart disease (8.3%), Table V.

Table V: Pattern of mortality and case fatality rates

Pattern of mortality	Deaths, n=7	%	No admitted	CFR (%)
Severe anaemia	3	42.9	28	10.7
Hypoglycaemia	2	28.6	21	9.5
Congenital heart disease	1	14.3	12	8.3
Perinatal asphyxia	1	14.3	14	7.1
Neonatal sepsis	5	71.4	93	5.4
Prematurity/low birth weight	2	28.6	44	4.5
Respiratory distress syndrome	1	14.3	25	4.0
Neonatal malaria	1	14.3	34	2.9

CFR = Case fatality rate

Association between gestational age and the pattern of morbidity

Neonatal jaundice, low birth weight and respiratory distress syndrome were significantly associated with gestational age < 37weeks (*P* value 0.002, <0.001, <0.001respectively) while perinatal asphyxia was significantly associated with neonates with gestational age > 37weeks (*P* value 0.047), Table III.

Table VI: Association between gestational age and the pattern of morbidity

Morbidity pattern	Gestational age (weeks) < 37, n (%)	37 – 42, n (%)	*P* value
Neonatal jaundice	48 (67.6)	45 (43.3)	0.002*
Probable neonatal sepsis	35 (49.3)	58 (55.8)	0.399
Prematurity/ low birth weight	40 (56.3)	4 (3.8)	<0.001*
Neonatal malaria	16 (22.5)	18 (17.3)	0.391
Severe anaemia	16 (22.5)	12 (11.5)	0.051
Respiratory distress syndrome	23 (32.4)	2 (1.9)	<0.001*
Hypoglycaemia	11 (15.5)	10 (9.6)	0.240
Acute kidney injury	6 (8.5)	14 (13.5)	0.306
Hypocalcaemia	7 (9.9)	9 (8.7)	0.789
Perinatal asphyxia	2 (2.8)	12 (11.5)	0.047*
Congenital heart disease	6 (8.5)	6 (5.8)	0.491
Intestinal obstruction	4 (5.6)	6 (5.8)	1.000
Bronchopneumonia	1 (1.4)	5 (4.8)	0.403
Opthalmia neonatorum	2 (2.8)	4 (3.8)	1.000
Infants of diabetic mothers	4 (5.6)	1 (1.0)	0.160

Factors associated with the survival of neonates admitted

Birth weights 1500 – 2499g and 2500 – 3999g were significantly associated with survival than the other birth weights, *P* value = 0.049, Table VI.

Table VII: Factors associated with the survival of neonates admitted

Variables	Hospital Discharged, n (%)	Outcome Not discharged, n(%)	*P* value
Sex			
Male	90 (63.8)	24 (70.6)	0.458
Female	51 (36.2)	10 (29.4)	
Age at presentation (days)			
0-3	74 (52.5)	19 (55.9)	
4-6	16 (11.3)	6 (17.6)	0.470

> 6	51 (36.2)	9 (26.5)	
Birth order			
First	67 (47.5)	12 (35.3)	
Second	38 (27.0)	11 (32.4)	0.435
Third and above	36 (25.5)	11 (32.4)	
Birth weight (kg)			
< 1000	12 (8.5)	3 (8.8)	
1000 – 1499	10 (7.1)	7 (20.6)	
1500 – 2499	28 (19.9)	2 (5.9)	0.049*
2500 – 3999	84 (59.6)	19 (55.9)	
≥ 4000	7 (5.0)	3 (8.8)	
Gestational age (weeks)			
< 37	53 (37.6)	18 (52.9)	0.102
37 – 42	88 (62.4)	16 (47.1)	
Mode of transport			
Ambulance	29 (20.6)	11 (32.4)	0.297
Parent's vehicle	93 (66.0)	18 (52.9)	
Public transport	19 (13.5)	5 (14.7)	
Pregnancy type			
Singleton	103 (73.0)	29 (85.3)	0.137
Multiple	38 (27.0)	5 (14.7)	
Mode of delivery			
SVD	68 (48.2)	13 (38.2)	0.294
CS	73 (51.8)	21 (61.8)	

SVD = Spontaneous vaginal delivery, CS = Caesarean section

DISCUSSION

The present study revealed a male predominance corroborating all other studies [1,9-15,17,19-27]. This could be related to males having a single X chromosome unlike their female counterparts who have double making males more predisposed to diseases especially infections as the X chromosomes are the sites of immunoglobulin production [28]. Males have also been observed to attract more parental attention than females and thus brought more to health facilities because of cultural and social factors [20,29].

About ½ of the neonates (53.1%) presented within the 1st 72hours of life in the present study. Similar percentages of 50.8% and 56.5% presented within the 1st 24hours of life in Lafia, north central Nigeria [15] and India [27] respectively. Contrary to the present study, 65.4% and 74.0% neonates presented within 72hours in Ethiopia [20] and Pakistan [21] respectively. These variations could be attributed to the type of health institution, whether tertiary, secondary, primary or even private. The present study was a private paediatric health facility and does not conduct deliveries whereas most of the other health facilities were tertiary centres with deliveries carried out and thus presented early. Early presentation could be related to the problems of physiological adaptation of neonates to extrauterine life. It also highlights the severity of the illness as observed by Abolodje [15] in his 1-year retrospective study which showed that neonates admitted on day 1 and days 2-7 were significantly more likely to die than those admitted after day 7. It is also noteworthy that early presentation leads to early intervention which could bring about favourable outcome.

More than ½ (59.4%) of the neonates in the present study were delivered at term (37-42weeks GA) as similarly reported by other researchers in Nigeria [12—15,17], Ethiopia [20], Eritrea [22] and India [26,27]. Similarly, normal birth weights (2500-3999g) predominated in the present study as also observed in other studies in Nigeria [13,14], Ethiopia [20], Pakistan [21,25] and Eritrea [22].

Close to ¾ (74.3%) mothers in the present study were ≥ 30years old. In contrast, younger mothers were documented by Ike et al [13] in Ibadan, southwest Nigeria, 18-34years (80.3%), Demisse et al [20] in Ethiopia reported 18-35years (90.3%) while

Andegiorgish et al [22] in Asmara, Eritrea reported 20-29years (56.4%). This age differences could be due to varying geographic locations and their cultural practices in relation to marriage.

Most deliveries were via Caesarean section (53.7%) in the present study as similarly reported in Pakistan [25]. This was not surprising as more than a ¼ (33.1%) of mothers in the present study had pregnancy complications that could have warranted the choice of operative delivery. Vaginal deliveries however, predominated in other studies. [13,15,20,22,24,27] Andegiorgish et al [22] in Asmara, Eritrea who reported a vaginal delivery rate of 79.1% had 93.9% mothers with nil pregnancy complications unlike in the present study. Geographic locations and difference in standard operating procedures in the various centres could also be responsible.

The commonest morbidity observed in neonates in the present study was neonatal jaundice (57.1%) and probable neonatal sepsis (57.1%) followed by prematurity (27.0%). This was similarly documented in India [26]. Neonatal sepsis was the commonest morbidity reported in other parts of Nigeria [1,9,14,15,17], Ethiopia [20], Eritrea [22] and Vietnam [23] but 2nd commonest in Pakistan [21,25] and India [27]. Neonatal jaundice was also the commonest in the present study and in India [24] but 2nd commonest in studies in Nigeria [12,13], Pakistan [25] and another centre in India [26]. Prematurity which was the 2nd commonest in the present study and in Ibadan [14], southwest Nigeria was the commonest in a study in Pakistan [25] but 3rd commonest in other parts of Nigeria [1,9,17], Pakistan [21] and India [26]. In contrast, perinatal asphyxia was the commonest in some parts of Nigeria [12,13], Pakistan [21] and India [27]. These variations could be attributable to varying geographic locations, varying diagnostic criteria, sample size differences as well as variation over time. In the present study, neonatal sepsis was diagnosed based on either complete blood count, C-reactive protein or serum procalcitonin with or without blood culture positivity whereas some other studies were based on only blood culture positivity.

Most neonates (80.6%) were discharged home with mortality rate of 4.0% in the present study. This mortality rate was higher than the 2.2% reported in a catholic hospital in Ibadan [13] where most critically ill babies were referred to the tertiary centre in the state. The low mortality in the present study centre could also be because, it is a private health facility and not a tertiary centre where most very critical cases are being referred to for expert management. Higher mortality rates of 6.6%, 9.5%, 10.1%, 10.5%, 13.2%, 14.7%, 16.0% and 19.4% were reported in Zamfara [9], Makurdi [17], Ondo [30], Lafia [15], Jigawa [1], Ilorin [12], Umuahia [19] and Jos [14] Nigeria, respectively. High mortality rates of 11.0% and 19.58% were also reported in India [26,27] 14.3% in Ethiopia [20], 11.5% in Asmara [23], Eritrea and 27.0% in Pakistan [21] respectively. These differences could be attributed to the degree of technological advancement of the neonatal unit as well as the quality of staff employed in the care of these neonates. It is noteworthy that these mortality rates are unacceptably high thus efforts must be made by governments to ensure drastic reduction. Governments must rise up to their duty in the provision of adequate and quality manpower to take care of neonates, increase capacity building in training and retraining of health personnel as well as provide necessary equipment such as CPAP, ventilators and various monitors etc.

In the present study and other studies [14,19,23,27,30-32], males predominated in the mortalities. This could be related to the already known male predisposition to infections and diseases due to their genetic makeup [28] It is important to note that the XY chromosomes of males adapts differently to adverse in utero and environmental conditions as compared to the females which thus accounts for the reduced perinatal survival in the presence of maternal insults [33]. In addition, female neonates have been reported to have relatively well-developed lungs than the males at birth contributing to their higher survival [34]. In contrast, Ike et al

[13] reported significant association of males surviving than females in comparison to those that died, DAMA and referred (P = 0.025). The reason could be that the latter study [13] was retrospective and in addition most cases, 6.9% were referred to higher centres while 21.9% were DAMA whereas in the present centre only 2.8% were referred and 12.6% DAMA.

In the present study, the commonest cause of neonatal mortality was probable NNS (71.4%) followed by severe anaemia (42.9%), hypoglycaemia (28.6%) and prematurity/LBW (28.6%). This finding was consistent with studies in India [26,27] which reported NNS as the commonest cause of mortality but contrast studies in other parts of Nigeria [9,12,14,15,19,30], Pakistan [21] and Tanzania [32] where perinatal asphyxia was the commonest cause although one of the least causes of death in the present study centre. Neonatal sepsis being the commonest cause of death in the present study was not surprising as most babies were transported to the health facility either via the parent's vehicles or public transport which could be sources of infection in addition to the various indications for referral. Severe anaemia and hypoglycaemia being common causes of death in the study centre were also not unexpected as only < a quarter (22.9%) neonates were transferred to the health facility using an ambulance. The use of private and public transport systems could lead to delay in getting to the health facility, delay in commencement of treatment and thus, may contribute to mortality. These findings corroborate results by Demisse et al [20] which showed that early onset neonatal sepsis and hypoglycaemia were significantly associated with neonatal deaths. Prematurity/LBW was the 3rd commonest cause of death in neonates admitted in the present study centre but observed to be the commonest in other parts of Nigeria [1,14,31] and Oman [35]. It is pertinent to note that only one neonate died amongst preterms with birth weight <1000g of 15 admitted (6.7%), one with birth weight 1000-1499g of 17 admitted (5.9%) and none with birth weight 1500-2499g. This is not surprising as all preterm neonates were commenced on CPAP therapy once admitted and either prophylactic or rescue surfactant therapy done depending on their weights and gestational ages. There was also the use of caffeine citrate. In contrast, a 12 years prospective study in Ilorin [12] documented a much higher mortality rate of 38% among neonates < 1000g. This difference could be due to the difference in the duration of the study and sample sizes in addition to the level of care available.

Severe anaemia (10.7%), hypoglycaemia (9.5%) and congenital heart diseases (8.3%) had the highest case fatality rates. This insinuates that urgent and appropriate treatment of these cases must be instituted to prevent mortality. Prematurity had the highest CFR of 41.7% in Jos, [14] RDS (31.1%) in Lafia [15] and meningitis (26.3%) in Zamfara [9] Nigeria. This difference could be due to varying geographic locations, disease prevalence as well as varying technological advancement and availability of adequate manpower.

The present study showed that birth weight was significantly associated with survival with weights 1500-2499g and 2500-3999g being significantly associated with survival whereas birth weights of < 1000g, 1000-1499g and ≥ 4000g were significantly associated with mortality. This was consistent with findings by Eke et al [19], Ike et al [13], Aboladje [15] and Andegiorgish et al [22]. Eke et al [19] in addition showed that sex and place of delivery were significantly associated with survival. In these studies, although females survived more than the males, there was no statistically significant difference as also in the present study. In contrast, Ike et al [13] in their 1year retrospective study in Ibadan showed that male neonates survived significantly more than the females (P = 0.025). This variation could be explained by difference in the sample sizes and study design, the latter being retrospective. Although neonates who presented early (0-3 & 4-6 days) were more likely to survive in the present study, this

difference was not statistically significant. Similar result obtained in the study by Aboladje [15] showed statistical significance with $P = 0.010$. The latter study with a sample size of 4 times the present study could have been responsible for this difference.

CONCLUSION

The commonest morbidities observed in neonates were neonatal jaundice, neonatal sepsis and prematurity with male preponderance and mortality rate of 4.0%. The commonest causes of mortality were neonatal sepsis, severe anaemia and hypoglycaemia with severe anaemia, hypoglycaemia and congenital heart diseases having the highest case fatality rates. The survival of newborns was significantly associated with birth weight.

Morbidity and mortality were largely due to preventable causes thus improved neonatal care by the provision of adequate & quality health care personnel, technological advancement, appropriate/timely referral of very sick neonates with adequate transportation would improve neonatal outcomes.

Declaration by Authors

Ethical Approval: Approved

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