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Identifying Modifiable Socio-demographic Risk Factors for Severe Hyperbilirubinaemia in Late Preterm and Term Babies in Abuja, Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Author LIA designed the study, wrote the protocol and wrote the first draft of the manuscript. Author ABM managed the literature searches, proofread and corrected the final manuscript. Authors ATO and LJM were responsible for data analysis. Authors RMN, VEN and YW managed data collection and entry. All authors read and approved the final manuscript.

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ABSTRACT

Background: Severe neonatal hyperbilirubinaemia remains an important cause of neonatal admissions in Nigeria, often giving rise to irreversible neurotoxicity. Access to effective phototherapy is restricted to a few centers while salvage therapy with exchange blood transfusion may occur too late to reverse acute bilirubin encephalopathy (ABE).
Aim: We set out to identify modifiable socio-demographic risk factors for severe neonatal jaundice in babies of ≥34 week gestation at the National Hospital Abuja.
Methodology: Late preterm and term babies admitted into Special Care Baby Unit (SCBU) with

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jaundice from April 2014 to May 2015 were consecutively recruited into the study with parental consent. Socio-demographic information, history of common risk factors for neonatal jaundice and results of laboratory investigations were obtained for statistical analysis. Jaundice was classified as severe (≥ 20 mg/dl) or non-severe (10-19 mgdl). Bivariate and multiple logistic regressions were carried out to determine the significance of associations between risk factors and severity of jaundice.

Results: A total of 123 babies were seen with an Inborn/Out born ratio of 1:2.3. Eighty two percent were term. Severe Jaundice accounted for 43(35%). The mean TSB for babies with severe jaundice was 29.1(9.6) mg/dl while that of controls was 16.9(5.9) mg/dl, (p=0.000). There was no significant difference in the distribution of primary risk factors (ABO/Rh incompatibility, sepsis, G6PD deficiency and concealed haemorrhage) among severe and non-severe groups. Among investigated secondary risk factors, late presentation (P=0.043), being out born (OR=0.164 95% CF=0.054-0.504), vaginal delivery (p=0.012), prematurity (OR=2.233 95% CF=1.051-4.740) and maternal education (p=0.017) were significantly associated with severe jaundice. Over 98% of the mothers had antenatal care while 91% delivered in hospitals/clinics. Thirty two (26%) had signs of acute bilirubin encephalopathy and exchange blood transfusion was done in 50 (40.7%) babies.

Recommendation: There is a need to refocus preventive strategies on modifiable risk factors, increasing awareness about the consequences of neonatal jaundice and the essence of early identification as well as prompt hospital presentation.

Keywords: Risk factors; severe neonatal jaundice; Nigeria.

1. BACKGROUND

Hyperbilirubinaemia remains an important cause of neonatal admissions in Nigeria [1,2]. When severe, it causes irreversible neurotoxicity resulting in death or long term neurological disabilities such as choreo-athetoid cerebral palsy, sensory-neural deafness and developmental delay [3]. This is of particular concern because severe hyperbilirubinaemia is substantially preventable [3] as evidenced for example, by the decline in hospitalization for neonatal jaundice, exchange blood transfusion (EBT) rate and incidence of Kernicterus in the United States following the 1994 publication of the AAP guideline on hyperbilirubinaemia [4].

Widely acknowledged primary aetiologic risk factors such as Rhesus incompatibility, glucose 6 phosphate dehydrogenase (G6PD) deficiency, sepsis, concealed haemorrhage and prematurity tend to give rise to various degrees of hyperbilirubinaemia in the newborn [5,6]. However, modifiable socio-demographic characteristics such as home delivery or delivery outside public hospitals, late presentation and maternal religion [7,8] low parental educational status and suboptimal health worker knowledge [9,10,11,12] modulate the disease often resulting in severe and extreme elevations in serum bilirubin in neonates.

Phototherapy, which is the mainstay of management of neonatal jaundice, is not usually available in many health facilities in Nigeria and where available, do not meet the recommended standards [13]. Its clinical efficacy is compromised because of prolonged use of fluorescent bulbs beyond their effective life span leaving them with low levels of efficacy [14].

Neonates with severe jaundice inevitably arrive at referral centers at a time exchange blood transfusion (EBT) remains the only salvage therapy. Although prompt intervention with EBT has the potential to reverse acute and intermediate phase encephalopathy [15,16], immediate access to appropriate blood for urgent EBT may be a mirage in our setting for several familiar reasons, (Parents not fit to donate and unable to pay for commercial blood donor, prohibitive cost of blood screening for infections). EBT is also reportedly associated with complications such as thrombocytopenia, metabolic complications (acidosis, hyperglycaemia rebound hypoglycaemia, hypocalcaemia and hypernatraemia), cardiac arrhythmias, necrotizing enterocolitis, portal vein thrombosis, graft-versus-host disease [16,17] and death [14], some of which are potentially avoidable [18]. Precautions are taken to minimize occurrence of these complications and these include; ensuring that only properly grouped and cross-matched fresh whole blood (<48hours) is used and baby is closely monitored during and after the procedure. Intravenous immunoglobulin (IVIG) is an effective and safe therapeutic option in neonatal jaundice resulting from ABO or Rh

incompatibility. Its use has reportedly resulted in significant reduction in the need for exchange blood transfusion [19].

Prevention of severe jaundice by early identification of neonates at risk of developing neurotoxic levels of hyperbilirubinaemia and ensuring prompt intervention is therefore imperative [20]. In a resource-limited country like Nigeria, where Rh immune globulin is not within the reach of the poor, there is no routine G6PD screening policy and universal implementation of infection control measures is precluded by ignorance and poverty, a search for modifiable risk factors for severe jaundice that can be addressed at minimal cost is therefore justified. Regional variations in the distribution of these modifiable factors calls for region specific preventive interventions to reduce the burden of kernicterus as well as mortality associated with neonatal hyperbilirubinaemia [8]. The aim of this study was therefore to identify modifiable risk factors in neonates with severe unconjugated hyperbilirubinaemia presenting at the newborn unit of the National Hospital Abuja.

It was hoped that the findings would provide the substrate for specific recommendations for the prevention of jaundice related neonatal death/brain injury in this part of the country.

2. METHODOLOGY

This study was conducted at the National Hospital Abuja, a tertiary referral health center located within the Federal Capital Territory. The newborn unit with a capacity for 30 babies (incubators and cots) has facilities for phototherapy, exchange blood transfusion, non-invasive respiratory support and parenteral nutrition. The staff compliment consists of 4 neonatal paediatricians, 3 senior and 6 junior resident doctors and 30 Paediatric nurses. Of the approximately 1,200 annual neonatal admissions, about 55% are out born referred from other hospitals (private and government hospitals) within the Federal Capital Territory and from neighbouring states. All babies with clinically obvious jaundice on the first day of life as well as babies with total serum bilirubin ≥10 mg/dl beyond 24 hours postnatally are admitted routinely for further evaluation and management. For late preterm (gestational age 34weeks-36 weeks$^{+6/7}$) and term babies, a total serum bilirubin (TSB) level of 20 mg/dl (predominantly unconjugated) or more, defined as severe hyperbilirubinaemia is an indication for EBT.

From April 2014 to May 2015, babies who met the following criteria; Postnatal age of 0-14 days, gestational age of 34 weeks to 42 weeks (late preterm and term), admitted into Special Care Baby Unit of the National Hospital Abuja with a TSB level of 20 mg/dl, were consecutively recruited into the study after obtaining parental consent. All other babies in the same gestational age category whose TSB levels were < 20 mg/dl, treated in the same ward during this period were recruited as controls with parental consent. Excluded were babies with level of conjugated bilirubin >2 mg/dl, (20) gestational age <34 weeks and those whose parents declined participation.

Socio-demographic information (antenatal care, referral source, infant feeding practice, place of residence), mode of delivery, place of delivery, and history of common aetiologic risk factors for neonatal jaundice were obtained as well as parental blood group, use of camphor/ naphthalene balls, and breastfeeding practice. For the purpose of this study, any district within Abuja town (Maitama, Wuse, Asokoro, Garki and Apo,) was classified as urban while the immediate bordering settlements (Kubwa, Nyanya, Gwarimpa Lugbe and Bwari) were classified as suburban and others at the outskirt of the city (Karimo, Gwagwa, Maraba, and Deidei) were classified as rural. It was assumed that this residential classification would reflect differences in the availability of health care services as well as accessibility to neonatal care. Tertiary and secondary hospitals with neonatal care services are available only in the urban settlements.

Each baby was clinically examined to establish the presence of jaundice as well as identify and document the presence of signs suggestive of acute bilirubin encephalopathy (poor feeding, lethargy, tone abnormality, abnormal rhythmic movements of the limbs, retrocollis, opisthotonus, high-pitched cry, seizures and apnea [18] or signs of sepsis. To minimize inter-observer variability, each baby was independently examined by any two of the research team and the findings were reconciled. All babies had the following investigations: Total Serum bilirubin (analyzed in the Chemical Pathology laboratory of the hospital using Cobas C311 analyzer), full blood count and differentials, blood group (baby and mother), electrolytes, urea and creatinine levels. Additional investigations included, blood cultures (for suspected sepsis), direct coombs test (in

ABO/Rh incompatibility settings) and qualitative G6PD assays (when reagents were available in the laboratory). The history of contact with an icterogenic substance such as camphor or menthol containing Dusting powder was carefully sought and this was taken as an important clinical proxy for G6PD assay that could not be done on all babies. Similarly babies were classified as either exclusively breastfed (breast milk only) or not exclusively breastfed (breast milk with formula feeds or formula feeds alone).

Jaundice was classified as non-severe (10 - < 20 mg/l or 170 - < 340 µmol), and severe (≥ 20 mg/dl or ≥ 340 µmol/l). However, for the purpose of treatment according to our Unit protocol, the presence of signs of ABE is taken as an indication of severe neonatal jaundice irrespective of the serum bilirubin level. Following our departmental protocol, serum bilirubin was assessed 12 hourly until a significant reduction was observed after which SB was done daily until discharge. All babies with jaundice were treated with phototherapy while babies with severe jaundice had double-volume (170 mls/kg) exchange blood transfusion with fresh whole blood. Any associated morbidity such as sepsis was also treated.

Data was analyzed using SPSS version 20 software. Frequency table was generated for the socio-demographic variables. Risk factors for jaundice were noted and the difference in the frequencies between the two groups was compared using the X^2 test while bivariate analysis was used to determine the association of risk factors with jaundice severity. Those with a significant level of association ($P<0.05$) were further analyzed by multiple logistic regression to eliminate confounders and determine risk factors that may be predictive of severe neonatal jaundice.

The study was approved by the ethics committee of the National Hospital Abuja.

3. RESULTS

During the study period a total of 558 [235(42.1%) inborn and 323 (57.9) out born] late preterm and term babies were admitted into the unit. A total of 128 jaundiced babies were seen, 5 were excluded; 3 because conjugated fraction was >10% of total or > 2 mg/l while the parents of 2 babies did not give consent for participation (Figure 1). One hundred twenty three jaundiced babies were therefore analyzed; 68(55.3%) of who were males and 55(44.7%) were females.

Table 1. General characteristics of babies with hyperbilirubinemia

Variable	Frequency (%)
Number of babies studied	123
Severe jaundice	43
SB≥20 mg/dl with ABE	32
SB≥20 mg/dl without ABE	11
Non severe jaundice	80
SB<20 mg/dl with ABE	0
SB<20 mg/dl without ABE	80
Gender	
Male	68 (55.3)
Female	55 (44.7)
Place of delivery	
Inborn	37 (30.1)
Out born	86 (69.9)
Antenatal booking status	
Booked	121 (98.4)
Not booked	2 (1.6)
Gestation	
Term	101 (82.1)
Preterm	22 (17.9)
Mean serum bilirubin	
All jaundiced babies	21.2 (9.3) mg/dl
Severe jaundice	29.1 (9.6) mg/dl
Non severe jaundice	16.9 (5.9) mg/dl

The Inborn/Out born ratio was 1:2.3. Inborn babies (37) were babies delivered in the labour ward/theater of the National hospital, initially nursed with the mother and were transferred to the newborn unit when jaundice was clinically observed. Out born babies (86) were classified on the basis of place of birth [public general hospitals (49), private hospitals (22), primary health center (10) and home (5)]. Parents of 22, 80 and 21 babies were resident in urban, suburban and rural areas respectively. One hundred and one babies (82%) were term, 22(18%) were late preterm, 44(35.8%) were delivered by caesarean section (C/S) and 79(64.2%) spontaneously per vagina (SVD).

Severe hyperbilirubinaemia accounted for 43(35%) of all jaundiced babies. The mean serum bilirubin level for all babies studied was 21.2(9.3) mg/dl with a range of 10 mg/dl-56 mg/dl. The mean TSB for babies with severe jaundice was 29.1(9.6) mg/dl and this was significantly higher than that of controls; 16.9(5.9) mg/dl, ($p=0.000$). Over 98% of the mothers had antenatal care; 40(32.5%) booked in the 1st trimester while 69(56.1%) and 12(9.8%) booked in the 2nd and 3rd trimester respectively and all except 5(4.1%) were delivered in the hospital.

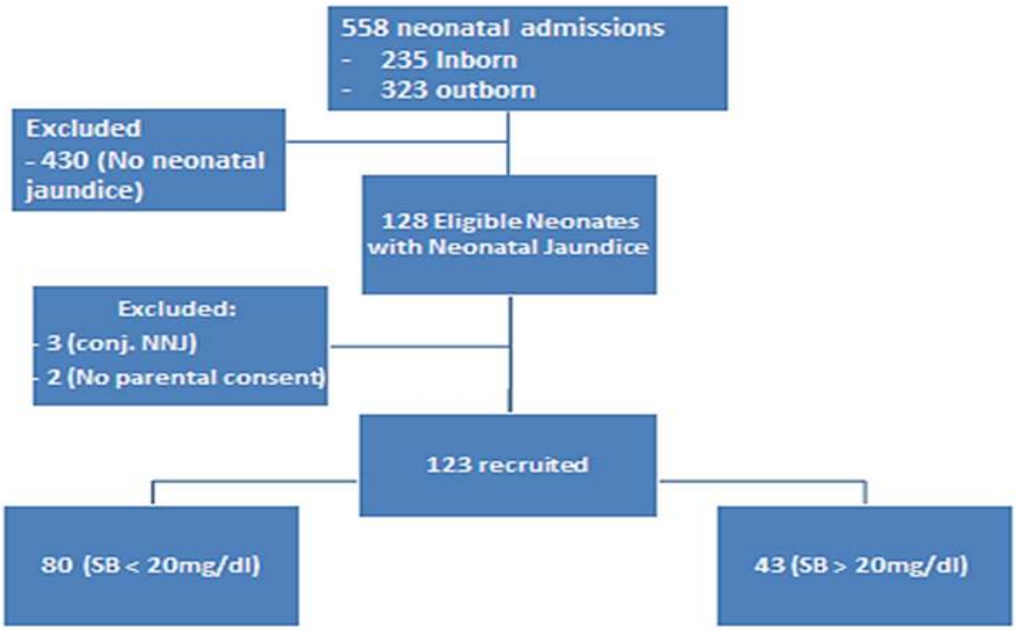

Figure 1. Flow chart of patient recruitment

Some primary risk factors occurred in isolation; Sepsis (18), cephalhaematoma (6), ABO incompatibility (5) and G6PD deficiency (2) while in over 50% of the babies a combination of identifiable risk factors were documented. For instance, 42 babies (13 cases and 29 controls) had ABO incompatibility with sepsis while 11(4 cases and 7 controls) had Rh incompatibility with sepsis. There were no isolated cases of Rh incompatibility. Only twelve (16.9%) of the 71 cases of suspected sepsis were culture positive. Six additional cases (3 from each group) with leukocytosis and neutrophil toxic granulations were included in the analysis as shown in Table 2, while the others were suspected on the basis of clinical signs. Among 64 babies (cases =15, controls =39) who were exclusively breastfed, 10 (cases =1, controls =9) had no other identifiable risk factors. There was no statistically significant difference in the distribution of these primary risk factors between cases and controls.

As shown in Table 3, being out born (P=0.001), delayed presentation (P=0.001) maternal level of education (paternal P=0.000, maternal P= 0.017), vaginal delivery (P=0.012) and prematurity (P=0.032) were associated with increased risk of severe jaundice. Gender, maternal parity and place of residence had no significant effect on the severity of jaundice. Multiple logistic regression analysis showed that being out born, prematurity and vaginal delivery were highly predictive of severe jaundice (Table 4).

Only 5 (12.5%) of the babies with severe jaundice came directly from home, the others were referred from other hospitals for lack of treatment facilities 10(25%), failure to respond adequately to phototherapy 15(37.5%) or lack of admission space 10 (25%). The exact number of babies who were being readmitted after the initial discharge from hospital could not be computed because the information was not adequately captured in a large number of the babies. However, two of 3 inborn babies with severe jaundice were admitted into SCBU from the postnatal (maternity) ward while one was readmitted 2 days after discharge.

Thirty two babies (26%) all in the severe group, had signs of acute bilirubin encephalopathy. Exchange blood transfusion was done in 50 (40.7%) babies; these included all babies with serum bilirubin ≥20 mg/dl (43) and 7 other ill babies with sepsis but whose serum bilirubin levels ranged between 16 mg/dl and 19 mg/dl. Eleven babies with severe jaundice died (25.5%) while 5(6.3%) babies died in the control group. The difference in the mortality rate between cases and controls was statistically significant P = 0.007.

Table 2. Risk factors for jaundice

Risk factor	Severity		df	P
	<20 mg/dl	>20 mg/dl		
ABO incompatibility	4 (5.0)	1 (2.3)		
Sepsis	10 (12.5)	8 (18.6)		
Cephalhematoma	4 (5)	2 (4.7)		
G6PD deficiency	2 (2.5)	0 (0.0)		
EBF	9 (11.2)	1 (2.3)	7	.466
Intestinal obstruction	1 (1.3)	1 (2.3)		
IDM	1 (1.3)	0 (0.0)		
Multiple risk factors:	49 (61.3)	30 (69.8)		
-Rh + Sepsis	4	7		
-ABO+Sepsis+EBF	29	13		
-G6PDdeficiency+cephalhematoma	7	2		
-EBF + cephalhematoma	3	0		
-Intestinal obstruction + Sepsis	3	2		
-EBF + G6PD deficiency	3	6		
Total	**80 (100)**	**43 (100)**		

Key: EBF exclusive breastfeeding, IDM infant of diabetic mother

Table 3. Bivariate analysis: Covariates of severe neonatal jaundice

Variable	Controls: TSB 10-19 mg/dl	Subjects: TSB=>20 mg/dl	df	P
Age group - mean age at presentation (days)				
1-3	49 (61.2)	11 (25.6)		
4-7	19 (23.8)	28 (65.1)	3	.043
8-14	10 (12.5)	3 (7.0)		
>14	2 (2.5)	1 (2.3)		
Total	**80 (100**	**43 (100)**		
Source of referral (SOR) - n (%)				
Inborn	34 (42.5)	3 (7.0)		
Out born	46 (57.5)	40 (93.0)	3	.000
Total	**80 (100)**	**43 (100)**		
Odds ratio = 0.164 (95% CF=0.054,0.504)				
Gender - n (%)				
Male	49 (61.2)	19 (44.2)	1	.052
Female	31 (38.8)	24 (58.5)		
Total	**80 (100)**	**43 (100)**		
Odds ratio = 0.721 (95% CF=0.494-1.053)				
Place of Delivery - n (%)				
National hospital	34 (42.5)	3 (7.0)		
Public general hospitals	24 (30)	25 (58.1)	4	.001
Primary health centers	7 (8.8)	3 (7.0)		
Private hospitals	13 (16.2)	9 (20.9)		
Home	2 (2.5)	3 (7.0)		
Total	**80 (100)**	**43 (100)**		
Mode of Delivery - n (%)				
EMCS	14 (17.5)	9 (20.9)		
ELCS	19 (23.7)	2 (4.7)	3	.012
SVD	47 (58.8)	32 (74.4)		
Total	**80 (100)**	**43 (100)**		

Variable	Controls: TSB 10-19 mg/dl	Subjects: TSB=>20 mg/dl	df	P
Gestational age				
<37 weeks	10 (12.5)	12 (27.9)		
>37 weeks	70 (87.5)	31 (72.1)	1	.032
Total	**80 (100)**	**43 (100)**		
Odds ratio = 2.233				
(95% CF=1.051-4.740)				
Maternal parity				
0-3	70 (87.5)	40 (93.0)		
4-6	10 (12.5)	3 (7.0)	1	.802
Maternal level of education				
Nil	2 (2.5)	2 (4.6)		
Primary	2 (2.5)	8 (18.6)		
Secondary	22 (27.5)	15 (34.9)	3	.017
Tertiary	54 (67.5)	18 (41.9)		
Total	**80 (100)**	**43 (100)**		
Outcome				
Discharged	73 (91.2)	30 (69.8)		
Died	5 (6.3)	11 (25.5)	2	.007
LAMA	2 (2.5)	2 (4.7)		
Total	**80 (100)**	**43 (100)**		

ELCS: Elective caesarean section. EMCS: Emergency caesarean section. SVD: Spontaneous vaginal delivery

Table 4. Multiple logistic regressions

Variable	B coefficient	df	F	P
Age at presentation	0.229	1	0.703	.403
Source of referral	0.402	1	12.132	.001
Place of delivery	0.159	4	3.481	.010
Gestational age	0.220	1	6.791	.010
Mode of delivery	0.192	2	6.131	.003
Maternal educational status	0.271	2	10.437	.000

4. DISCUSSION

Our study has demonstrated a high prevalence of neonatal jaundice in Abuja, accounting for 22% of all admissions during the study period and 35% of these babies had severe jaundice. While the primary risk factors identified in this study reflected previously documented risk factors (ABO/Rh incompatibility, sepsis, G6PD deficiency and concealed haemorrhage), the presence of these factors was not necessarily predictive of jaundice severity. They were equally distributed among the cases and controls. On the other hand, modifiable factors such as place of delivery, mode of delivery and maternal educational level were significantly associated with severe jaundice. In a systematic review and meta-analysis by Olusanya et al. [8], pooled data from the Nigerian studies showed that out born infants were at increased risk of severe hyperbilirubinaemia. This was the strongest predictor of severe hyperbilirubinaemia in our study. Being out born is associated with delayed identification of jaundice often culminating in late presentation at the hospital where appropriate care is available. It is worthy of note that 58% of babies with severe jaundice were referred from other government owned hospitals. An additional worrisome observation is that a substantial proportion of deliveries reported in this study took place in health facilities. Okperi [21] in an earlier study reported that 75% of health workers including doctors interviewed in the Southern part of Nigeria believed strongly in the efficacy of exposure to early morning sun as well as glucose water and Ampiclox in the treatment of neonatal

jaundice. Babies in the care of such health workers are therefore at risk of missed opportunity for prompt effective treatment and will inevitably develop severe jaundice. This underscores the need to target health workers in the drive towards elimination of severe neonatal jaundice in our setting. The association of late presentation with higher peak levels of serum bilirubin was also demonstrated in Canada. This was however seen among babies who were readmitted after birth discharge [22].

Some out born babies referred from other hospitals had received phototherapy before referral. Although we did not assess how long this treatment had been administered prior to referral, failure of this important therapy is an indication of the quality of phototherapy units in those health facilities. Owa et al. [23] and Cline et al. [24] had shown that most phototherapy units in Nigeria delivered low irradiance and were therefore of low efficacy. These babies were therefore likely to present late at the tertiary hospital with high levels of serum bilirubin.

In contrast to the findings of Olusanya et al. [7], gender was not a significant risk factor in this study. Increased risk of hyperbilirubinaemia associated with the male sex is presumably a function of the higher incidence of G6PD deficiency in males. The low prevalence of G6PD deficiency encountered in this study may be the reason for our finding.

This study clearly shows that vaginal delivery is a significant risk factor for severe neonatal jaundice. There had been previous observations on the effect of mode of delivery on serum or transcutaneous bilirubin levels in babies, within the first few days of life**.** For instance, while some authors noted significantly higher levels of serum bilirubin among babies delivered per vagina compared to caesarean section (C/S) babies [25,26,27], others reported that C/S was a risk factor for neonatal jaundice [28,29]. Yamauchi et al. [27] attributed the higher level of serum bilirubin among vaginally delivered babies to placenta-to-baby transfusion as a result of delayed cord clamping, while the effect of C/S on neonatal jaundice was attributed to the activity of some anaesthetic drugs (bupivacaine and levo-bupivacaine) on red cell membrane resulting in reduced red cell lifespan [28]. Bilgin et al. [30], while investigating factors affecting bilirubin levels in healthy term babies within 48 hours of life noted however that mode of delivery was not related to early bilirubin levels. This was similar to the findings of Agarwal et al. [31]. It is noteworthy that none of these studies examined the role of mode of delivery on severe neonatal jaundice as was the case with our study. We believe that beyond the poorly defined effects of mode of delivery on serum bilirubin levels in early neonatal life as noted in the studies above, vaginal delivery increases the risk of progression to severe jaundice irrespective of the primary cause. This may not be unconnected with the tendency for early discharge in a setting devoid of both routine pre-discharge risk assessments for jaundice and post-discharge follow up plans. On the other hand, a baby delivered by C/S remains in hospital until mother is fit for discharge (3-4 days) allowing for early detection of jaundice and prompt evaluation for appropriate treatment.

Despite excluding early preterm babies (<34 weeks) that are notably more vulnerable to neonatal jaundice, our study demonstrated a significantly higher risk of severe jaundice among late preterm than their term counterparts. The increased vulnerability of late preterm babies to common neonatal conditions, including neonatal jaundice has been described [32] and this is thought to be due to immaturity of bilirubin metabolic pathways as well as delayed lactogenesis in the mothers of these babies [33]. Although late preterm babies may not be easily physically distinguishable from their term counterparts and are often treated as such, our finding confirms their higher physiologic vulnerability underscoring the need for a specific management policy guideline for this group of babies [34].

Our study showed a significant maternal educational level with severe neonatal jaundice. Mothers with higher educational level had a lower risk of severe neonatal jaundice. This agrees with the findings of Ogunlesi et al. [35] who had shown from the Western part of Nigeria that mothers with tertiary education had good knowledge of neonatal jaundice as well as appropriate health seeking behavior and their babies were less likely to present with kernicterus.

We had assumed that residing in a rural area would be an indication of low socioeconomic status with poor access to good health care services. There was however no significant difference in the risk for severe jaundice between rural and urban dwellers in this study. Perhaps the limited number of residential accommodation

within the urban districts of Abuja had resulted in a drift of workers towards the suburban and rural areas irrespective of their socioeconomic status.

One limitation of this study is the limited scope of socio-demographic factors studied. We however believe that the study identified potent factors that are easily modifiable to effect the much needed reduction in the prevalence of severe neonatal hyperbilirubinaemia. We also did not explore the contribution of early hospital discharge to development of severe jaundice in our babies. Other than the presence of temperature instability, the signs attributed to sepsis could not be differentiated from those of acute bilirubin encephalopathy and this may have accounted for the high number of 'suspected sepsis' in this study. The mortality rate was significantly higher in babies with severe jaundice than in the controls. However the extent to which hyperbilirubinaemia contributed to the mortality in the two groups was not analyzed.

5. CONCLUSION

Late prematurity, vaginal delivery, low maternal educational level and being born in public secondary and private hospitals (out born) are associated with increased risk of severe neonatal jaundice. The impressive rate of antenatal contacts as well as hospital deliveries provides a potential opportunity to deliver appropriate health information to address the high burden of severe neonatal jaundice in our setting.

6. RECOMMENDATIONS

Health care providers would need to be constantly reminded about the risks involved in delayed identification and prompt referral of babies with neonatal jaundice.

All babies delivered vaginally should be carefully monitored for jaundice before discharge from hospital. Post-natal pre-discharge education for mothers should contain clear messages on detection of jaundice and prompt presentation in hospital to avoid severe jaundice and its attendant complications.

There is a need to upgrade the infrastructures in other government hospitals to enable them deliver effective phototherapy.

CONSENT

All authors declare that 'written' informed consent was obtained from mothers before their babies were recruited into the study.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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