International Journal of Health Sciences and Research
Volume 14; Issue: 9; September 2024
Website: www.ijhsr.org
Original Research Article *ISSN: 2249-9571*

Maternal and Neonatal Factors Associated with the Incidence of Acute Bilirubin Encephalopathy in Nigerian Population

Joel-Medewase Victor Idowu,[1] Adebami Olusegun Joseph,[2] Alabi Ayobami Oyetunji,[1] Adetoye Mayowa Mary,[3] Ashaolu Oluwakayode Joseph[3]

[1]Department of Paediatrics and Child Health, College of Health Sciences, Ladoke Akintola University of Technology, Ogbomoso, Nigeria.
[2]Department of Paediaatrics and Child Health, Osun State University
[3]Department of Paediatrics and Child Health, LAUTECH Teaching Hospital, Ogbomoso, Nigeria.

Corresponding Author: Prof. Olusegun Joseph Adebami

DOI: https://doi.org/10.52403/ijhsr.20240903

ABSTRACT

Background: Acute bilirubin encephalopathy (ABE) is still a common cause of morbidity and mortality in developing countries despite the availability, and efficacy of phototherapy and exchange blood transfusion. The prevalence of kernicterus has not shown any significant reduction in low and middle-income countries (LMICs) because many neonates with jaundice present very late with overt features of ABE.
Objective: The study was done to determine maternal and neonatal factors associated with ABE and factors responsible for the late presentation of neonatal jaundice among the patients presenting with this condition in our health facility.
Methods: All newborns presenting with ABE at the special care baby unit of Sacred Heart Hospital, Abeokuta, Nigeria were prospectively studied over 3 years. ABE was diagnosed clinically based on a bilirubin-induced neurologic dysfunction score of ≥1.
Results: One hundred and seventy-eight neonates with hyperbilirubinaemia of whom sixty-three (35.4%) had ABE were studied. Forty-two (56.7%) of the 63 babies with ABE were male, and the male-to-female ratio 2:1. Forty-eight (76.2%) of babies who had ABE at presentation were (outborns), while 15 (23.8%) were inborns. Eight (12.7%) of the inborn babies with ABE were readmitted following early discharge before 36 hours of life and 3 (4.8%) initially discharged against medical advice while the 4 (6.3%) were on admission before they developed ABE. Twenty –six (41.3%) of the mothers saw at least one health worker more than 24 hours before presentation. Leading causes of jaundice were septicaemia, G-6-PD and deficiency. while maternal factors associated with ABE were low socio-economic status and teenage deliveries. Multivariate analysis showed that outside delivery and weight < 2.5 kg were the only predictors of ABE in this cohort of neonates.
Conclusion: The identified factors of ABE are modifiable, there is a need to increase the awareness in the community of the occurrence and dangers of neonatal jaundice and its appropriate treatment. Health workers themselves need education and training in the early recognition and treatment of neonatal jaundice.

Key words: Acute bilirubin encephalopathy, kernicterus, late presentation, maternal factors, preventive measures, Nigeria

INTRODUCTION

Acute bilirubin encephalopathy (ABE) is still a major and common complication of neonatal hyperbilirubinaemia in the developing countries and it is a preventable cause of neonatal mortality and childhood morbidity.[1]. It results from the toxic effect of free (unconjugated) bilirubin on the brain cells especially in the regions of the basal ganglia, hippocampus, substantia nigra, and brain stem nuclei causing irreversible brain damage. This occurs when there is severe hyperbilirubinaemia especially in the presence of factors like infections, hypothermia, acidosis, hypoglycaemia, hypoalbuminaemia, and prematurity which compromise the brain or increase the permeability of the brain to bilirubin.[1] This may result into death in the acute phase or various manifestations like hearing loss, cerebral palsy, and seizure disorders in the chronic phase.[2 3]

In high resource and technologically advanced countries, ABE is rarely encountered due to effective preventive measures including pre-discharge risk assessment, stringent observance of the treatment guidelines, and effective treatment modalities like intensive phototherapy. [4 5 6] In developing countries like Nigeria, the prevalence of ABE and kernicterus has not shown any reduction despite the proven efficacy of phototherapy and exchange blood transfusion (EBT), and most cases are unreported. [7] Most of the cases in the developing countries occur among the outborn and the babies usually present very late in established kernicterus,[2,8] often, jaundiced neonates are brought for consultation when they stopped sucking.[8 9] Yet, ABE can be prevented by using phototherapy and if need be, EBT. Phototherapy has even found a more efficacious and powerful use in reducing the frequency of EBTs in the developed countries.[6] However, babies must be seen early before they develop ABE to maximally benefit from the interventions. The aim of this study is to determine the maternal and neonatal factors associated with the development of ABE and the factors responsible for late presentation among the neonates presenting with this condition in our health facility.

The Sacred Heart Hospital, Lantoro, Abeokuta, Nigeria where this study was carried out is the first Nigerian hospital which was established in 1895 by the Catholic Church Mission. It is a 300 bedded secondary level hospital that offers level 2 care; general, and specialist services in medicine, surgery, paediatrics, obstetrics and gynaecology. The Paediatric department has Special care baby (Neonatal) unit manned by a Senior Registrar in Family Medicine and 2 Junior Medical Officers. The unit is supervised by 2 Visiting Consultant Paeditricians. The Neonatal unit is equipped to manage neonatal hyperbilirubinaemia. It has at least 6 baby incubators, 3 radiant warmers, 10 phototherapy lamps (fluorescent blue lights), t and trained personnel for appropriate management of neonatal jaundice, including EBT. However, the Neonatal unit does not have transcutaneous bilirubinometer nor intensive phototherapy lamps.

MATERIALS AND METHODS

This prospective study was carried out at the Neonatal Ward (NW) of the Sacred Heart Hospital, Lantoro, Abeokuta, Nigeria between January 2017 and December 2020. Newborn infants suspected of having ABE were admitted into the neonatal ward and were studied. Institutional ethical approval was obtained and the babies who met the inclusion criteria were enrolled after the parents or care givers had given consent. The diagnosis of ABE was made clinically if there were or have been neurological symptoms and signs of abnormality associated with hyperbilirubinaemia i.e. bilirubin-induced neurologic dysfunction

(BIND). These include decreased alertness/lethargy, high-pitched cry, hypotonia, fever, poor feeding or hypertonia of the extensor muscles, retrocollis (backward arching of the neck), opisthotonus (backward arching of the back), or both; hypertonia and any abnormal movements.[10] Information obtained from the mothers or informants include gender, age at observation, birthweight, weight on admission, place of delivery, when and who noticed the jaundice, contact with any health facility and/or health worker in the preceding 48 hours before the abnormalities were noticed and the details of treatment received before presentation, and the prescriber of such treatments, interval between noticing jaundice and refusal to suck was noted. Delay in presentation was defined as interval between observation and documentation of jaundice > 47 hours. Maternal bio-social parameters like age, parity, and highest educational qualification were also recorded. The socio-economic classes of the mothers were derived from the occupation and the educational levels of parents as described by Oyedeji.[11]

Investigations like serum bilirubin concentration (total and conjugated), full blood count, Coomb's test, quantitative G-6-PD assay, blood group of mother and baby, lumbar puncture, electrolytes and urea, blood glucose, and blood cultures were done as indicated. Total and conjugated bilirubin was estimated using Van den Bergh reaction.[12 13] All patients were treated with phototherapy and EBT and other necessary forms of treatment such as antibiotics if infection was suspected or confirmed.

Data obtained were entered into a computer and analyzed using SSPS for Windows version 21. Means and SDs were determined for continuous variables such as weight and these were compared between the babies who had ABE and other babies with significant jaundice (hyperbilirubinaemia)[14] without ABE using analysis of variance and Student's t tests. Clinically significant jaundice (hyperbilirubinaemia) for this study is defined as jaundice in which immediate treatment with phototherapy or EBT is indicated. Proportions and percentages were compared using x° test; $P<0.05$ was taken as statistically significant. Multiple linear regression analysis was also used to determine the independent effects of each of the factors of place of birth, sex, weight, outcome and maternal factors like age and social class.

RESULTS

General Characteristics

One hundred and seventy-eight neonates with significant hyperbilirubinaemia were admitted between January 2017 and December 2020 in the neonatal ward. They comprised 119 (66.9%) males and 59 (33.1%) females, male-female-ratio 2:1. Eighty-eight (49.4%) were inborn while 90 (50.6%) were referred (outborn). The 63 (35.4%) babies who presented with acute bilirubin encephalopathy (ABE) form the subjects for this study. They comprised of 42 males and 21 females with a male-to-female ratio 2:1. Forty-eight (76.2%) babies with ABE were hospitalized with features of ABE while the remaining fifteen (23.8%) developed ABE after hospitalization. Places of birth among the 48 outborns were Primary health care centres, Traditional birth attendant centres, Home delivery, Church mission houses, Private hospitals, State hospitals in fifteen (31.3%), nine (18.8%), eight (16.7%), six (12.5%), six (12.5%), and four (8.3%) babies respectively. Among the fifteen inborn babies, 8 were discharged 24 to 36 hours after birth and rehospitalized between 48 hours and 4 days post-discharge, no jaundice was noticed in them at the time of discharge. Three babies were discharged against medical advice after they had been diagnosed to have significant hyperbilirubinaemia, they were readmitted in the second week of life. The parents of 3 babies refused to give consent for their babies to receive EBT because of their religious belief (Jehova Witness). The remaining inborn baby was a very low birthweight who could not receive EBT due to failed cannulation for the procedure

Prevalence of ABE in relation to maternal and neonatal characteristics.

Sixty-three (35.4%) babies had ABE while 115 (64.6%) did not. Table 1 describes the univariate analysis of the prevalence of ABE in relation to neonatal clinical characteristics. The prevalence of ABE was significantly higher among babies aged more than 168 hours (85.0%), outborn babies (58.5%), babies delivered per vagina (SVD) (43.3%) (p at least <0.006).

Table 1 Comparison of selected neonatal factors between babies with and those without acute bilirubin encephalopathy.

	ABE (n=63)	Without ABE (n=115)	Total (n=178)	χ^2	p-value
Age (hours)					
≤ 48	12 (13.0)	80 (87.0)	92 (51.7)		
49 – 168	34 (51.5)	32 (48.5)	66 (37.1)		
> 168	17 (85.0)	3 (15.0)	20 (11.2)	49.12	< 0.001
Sex					
Male	42 (35.3)	77 (64.7)	119 (66.9)		
Female	21 (35.6)	38 (65.4	59 (33.1)	0.002	0.969
Admission Weight					
< 2500g	27 (40.9)	39 (59.1)	66 (37.1)		
≥ 2500g	36 (32.1)	76 (67.9)	112 (62.9)	1.396	0.237
Place of delivery					
Inborn	15 (15.6)	81 (84.4)	96 (53.6)		
Outborn	48 (58.5)	34 (41.5)	82 (46.1)	35.61	< 0.001
Mode of delivery					
SVD	52 (43.3)	68 (56.7)	120 (67.4)		
CS	11 (19.3)	46 (80.7)	57 (32.0)		
Ventouse	0	1 (100)	1 (0.6)	10.31	0.006
Outcome					
Well	12 (10.1)	107 (89.9)	119 (66.9)		
Well with obvious complication	45 (90.0)	5 (10.0)	50 (28.1)		
Died	6 (66.7)	3 (33.3)	9 (5.1)	102.39	< 0.001

Admission age, weight and mode of delivery

The admission ages ranged between 24 hours and 12 days of life with a mean age of 5.21 (SD 3.028) days. Sixteen (25.4%), 30 (47.7%) and seventeen (27.0%) babies were aged < 72 hours, 4 – 7 days and above 1 week respectively. The weight of the babies ranged between 1.10 and 4.05 kg, the mean weight was 2.49 (SD 0.76) kg. Twenty-seven (42.9%) babies weighed < 2.5 kg and 36 (57.1%) weighed ≥2.5 kg. Fifty-two (82.5%) of the 63 babies were delivered by spontaneous vertex, 11 (17.5%) by caesarean section and one (1.6%) by vacuum extraction.

Age at which jaundice was first noticed

The age at which jaundice was noticed ranged from 24 hours to 9 days, mean 3.49 (SD 1.77) days. In 28 (44.4%) babies, jaundice was first noticed more than 72 hours before presentation, in fifteen (23.8%) between 48 hours and 72 hours, in nine (14.3%) it was noticed 24 to 48 hours prior to presentation while it was noticed in 11 (17.5%) in less than 24 hours prior to presentation or at the presentation in the hospital. Thus, 52 (82.5%) mothers had noticed the jaundice in their babies at least 24 hours before the time of presentation with features of neurological abnormalities in the health facility.

Aetiology of jaundice and associated factors

The main causes of jaundice were septicaemia, in 38(60.3%), low birthweight 34(54.0%), G-6-P-D deficiency 21(33.3%), ABO incompatibility 8(12.7%), prematurity 7(11.1%), and Rhesus isoimmunization 1(1.6%), multiple aetiological factors were

responsible for the jaundice in more than 50 percent of the babies.

Maternal factors

Table II shows a comparison of selected baby and maternal factors between babies with ABE and those without ABE. The prevalence of ABE was higher among babies of mothers aged > 34 years (42.9%), mothers with primary or no education (40.0-50.0%), though not at significant level (p>0.05).

Social classes of mother

Mothers of babies with ABE were found in all socio-economic classes. Thirteen mothers were in socio-economic class I, six mothers in class II whilst 25 were in class III; 14 in class IV and 5 in class V. Forty-four (69.8%) of the babies with ABE were born by mothers in middle and lower socio-economic class III, IV and V.

Age of mothers

The age of the mothers ranged between 18 and 40 years with a mean age of 30.16 ± 5.53 years. Two (3.2%) were aged 18 years, 43 (68.3%) were 20 to 34 years-old, and 18 (28.6%) were 35 years and above.

Parity of mothers

Mothers' parity ranged between one and four. The mean parity was 1.90 ± 0.64. Fifteen (23.8%) mothers were primiparous and thirty-six (57.1%) were secundiparous. Ten (15.9%) and two (3.2%) of the mothers were of parity 3 and 4 respectively.

Marital status of mothers

Thirty-six (57.i%) mothers were legally married and live together with the fathers, 19 (30.2%) mothers were not legally married but co-habiting with the fathers, 5 (7.9%) mothers were not married but maintained casual relationship with the fathers (not living together), the remaining 3 (4.8%) mothers were living with their own parents; two were teenagers and students and the third had paternity dispute.

Table II Comparison of selected maternal factors between babies with and those without acute bilirubin encephalopathy.

Maternal age					
< 20	2 (33.3)	4 (66.7)	6 (3.4)		
20 -34	43 (33.1)	87 (66.9)	130 (73.0)		
> 34	18 (42.9)	24 (57.1)	42 (23.6)	1.339	0.512
Parity					
1	15 (34.9)	28 (65.1)	43 (24.2)		
2	36 (34.6)	68 (65.4)	104 (58.4)		
3	10 (40.0)	15 (60.0)	25 (14.0)		
4	2 (33.3)	4 (66.7)	6 (3.4)	0.276	0.965
Social class					
I	13 (46.4)	15 (53.6)	28 (15.7)		
II	6 (28.6)	15 (71.4)	21 (11.8)		
III	25 (36.2)	44 (63.8)	69 (38.8)		
IV	14 (29.8)	33 (70.2)	47 (26.4)		
V	5 (38.5)	8 (61.5)	13 (7.3)	2.639	0.620
Maternal Education					
No formal education	2 (40.0)	3 (60.0)	5 (2.8)		
Primary	15 (50.0)	15 (50.0)	30 (16.9)		
Secondary	23 (39.7)	35 (60.3)	58 (32.6)		
Tertiary	23 (27.1)	62 (72.9)	85 (47.8)	5.888	0.117

Maternal previous experience with jaundiced/kernicteric baby

Nineteen (30.2%) of the 63 mothers had previously had babies with neonatal jaundice treated with home remedies. The home remedies were glucose water, multivitamin drops, Paracetamol syrup, and oral antibiotics. One mother had a 7-year male sibling with kernicterus. The index patient was her third born who is also a boy and G-6-PD deficient.

Initial treatment of jaundice before presentation and sources of prescriptions

Twenty six (41.3%) of the 63 mothers saw at least a health worker more than 24 hours before presentation. Twelve (19.0%) mothers had written prescriptions given at the places of delivery, while 12 (19.0%) had verbal prescriptions recommended by some neighbors working in various hospitals: 6 (9.5%) in Private hospitals, four (6.3%) in State hospitals and 2 (3.2%) in Private maternity centres. Two (3.2%) mothers were wrongly reassured that the jaundice did not require treatment. The medications prescribed included Oral antibiotics (Ampicillin-Cloxacillin combination) for 12 (19.0%) babies, Haematinics (multivitamins, vitamin C for 15 (23.8%) babies, Paracetamol drop/syrup was prescribed for nine (14.3%) babies whose jaundice was associated with fever. Herbal solutions made from (i) pawpaw (Carica papaya) leaves in water and (ii) naphthalene balls in water were topically applied to the bodies of 4 (6.3%) and 3 (4.8%) babies respectively. In addition to the drugs, exposure to early morning sunlight was also recommended to twenty (31.7%) babies.

Laboratory tests and course in hospital

Serum bilirubin concentrations

The total serum bilirubin concentration in babies with ABE ranged between 7.29 mg/dl and 72.60 mg/dl with a mean of 34.95 ± 14.72 mg/dl. The conjugated serum bilirubin ranged between 0.60 mg/dl and 34.00 mg/dl with a mean of 7.59 ± 7.00 mg/dl. The unconjugated (free) serum bilirubin ranged between 6.69 mg/dl and 40.30 mg/dl with a mean of 27.37 ± 7.72 mg/dl. The admission serum bilirubin concentration for the 48 outborn babies who presented with ABE ranged between 18.00 mg/dl and 72.60 mg/dl with a mean of 39.94 ± 13.61 mg/dl. Among the 115 babies with significant hyperbilirubinaemia without ABE, the total serum bilirubin ranged between 0.80 mg/dl and 36.88 mg/dl with a mean of 16.48 ± 6.79 mg/dl. The conjugated serum bilirubin ranged between 0.05 mg/dl and 18.65 mg/dl with a mean of 2.88 ± 2.85 mg/dl. The unconjugated serum bilirubin ranged between 0.75 mg/dl and 18.23 mg/dl with a mean of 13.60 ± 3.94 mg/dl.

The haematocrit of the 63 babies with ABE ranged between 14 to 61 percent with a mean of 38.0 ± 9.8 Percent. None of the patients had polycythaemia at the time of admission. Twenty-five (39.7%) had anaemia (packed cell volume ≤ 35%) while 38 (60.3%) had packed cell volume > 35%.

Fifty-nine (93.7%) babies had EBT, one baby could not have EBT due to failed cannulation for the procedure and the patient was given plasma transfusions four times. Three (4.8%) babies did not receive EBT because their parents refused to give consent for the treatment on account of their religious belief (Jehova Witness). The 39.7 percent babies with severe anaemia (PCV < 35%) were also given top-up whole blood transfusion (10mls/kg) immediately after the EBT. Eighteen (28.6%) babies had EBT twice while 1 (1.6%) baby was exchanged 3 times. All the babies diagnosed with ABE had phototherapy before EBT while preparing for the procedure and after the EBT.

Blood sugar on Admission

The blood sugar concentration on admission ranged between 4.2 mg/dl and 198.0 mg/dl with a mean of 64.89 ± 34.26 mg/dl. Twenty-six (41.3%) babies had hypoglycaemia (blood sugar ≤ 50.0 mg/dl) while 37 (58.7%) babies had blood sugar level of > 50.0 mg/dl. Fifty-seven (90.5%) babies survived while a total of six (9.5%0) died. No postmortem examination was done because parents were not willing to give consent.

Table III shows the estimate of regression coefficients in the multivariate analysis of ABE. Multivariate analysis of the data suggests that place of birth, admission weight and age at admission played independent significant roles in the late presentation and development of ABE in this cohort of babies.

Table III: Estimates of regression coefficients in the multivariate analysis of acute bilirubin encephalopathy

Independent variables	Odd Ratio	95% Confidence Interval		p-value
		Lower	Upper	
Sex (male)	1.155	0.465	2.872	0.756
Age (≤ 48 hours)	0.016	0.003	0.094	<0.001*
Age (48 – 168 hours)	0.195	0.043	0.889	0.035*
Admission weight (< 2500g)	3.707	1.271	10.813	0.016*
Place of Delivery (inborn)	0.379	0.147	0.976	0.045*
Mother's Age < 20	0.097	0.004	2.331	0.150
Mother's Age (20 – 34)	0.23	0.046	1.147	0.073
Mother's Parity = 1	4.029	0.167	97.178	0.391
Mother's Parity=2	3.355	0.179	62.723	0.418
Mother's Parity=3	1.449	0.06	34.715	0.819
Socio-economic Status (Class I)	2.069	0.379	11.29	0.401
Socio-economic Status (Class II)	0.193	0.024	1.519	0.118
Socio-economic Status (Class III)	0.995	0.221	4.486	0.995
Socio-economic Status (Class IV)	0.912	0.185	4.505	0.910
Mother education (primary)	1.866	0.109	31.845	0.666
Mother education (secondary)	1.265	0.078	20.398	0.868
Mother education (Tertiary)	0.535	0.033	8.681	0.660

* = significant

DISCUSSION

The present study showed that most of the babies with severe hyperbilirubinaemia and ABE presented in our hospital between the third and seventh days of life and were mostly outborns who unfortunately had obvious features of ABE at the point of admission. This is similar to the findings of previous researchers in Nigeria.[2 3 8 9] The prevalence rate of ABE of 35.4% at the point of admission recorded in this study is unacceptably high because the disease, though preventable, results in permanent brain damage, high neonatal mortality and childhood morbidity including deafness, cerebral palsy, and mental retardation.[15] This justifies the relevance of this study in this part of the world. The prevalence rate of 35.4% in this study is lower than the 49.3% previously reported by Ogunlesi et al[16] in 2011, 46.7% reported from Ibadan, Nigeria in the 1980s[17] but remarkably higher than the 2.8% reported by Adebami[9] working in tertiary hospital in Southwest Nigeria, about a decade before the present study. The above 3 studies were conducted in tertiary hospitals in the same geographical (south-west) region but with significant differences in subject selection, places of delivery of the babies and the available facilities for the management of neonatal jaundice when compared with the present study.

Almost all the babies with ABE in the present study were brought to our hospital after the onset of neurological dysfunction, therefore, we consider the possibility of delay in seeking appropriate medical care as the major reason behind the high prevalence of ABE in this cohort of babies, in agreement with previous reports.[2 9 16] The reason for higher frequency of ABE among the outborn babies can be inferred. This includes higher prevalence of bacterial infection, poorer follow up after birth, and inadequate laboratory support (especially in determining the level of bilirubin), outside (non teaching hospital) units. Most of the outside units, including the government health centres have inadequate facilities to care for jaundiced neonates. Only six (12.5%) referred babies with ABE came with evidence of serum bilirubin estimation.

The four babies who developed neurological dysfunction while on admission could not be appropriately managed. Exchange blood transfusion could not be carried out in one baby due to inability to establish good intravenous access, and refusal to give consent for EBT by parents of 3 babies on account of their religious belief. ABE could have been prevented in these babies if

facilities for intensive phototherapy were available. Unfortunately, our practice is still mainly limited to the use of conventional phototherapy and this, coupled with frequent power outages make intensive phototherapy hardly possible in resource-poor countries. The inborn babies who were readmitted with ABE were those who had been discharged from the hospital within 24 to 36 hours of delivery and before the peak of their jaundice. This has been shown to be main reason for the resurgence of kernicterus in developed world[18]and it is important that developing countries must learn from this error. Currently, ABE and kernicterus have virtually disappeared from the clinical scene in developed countries due to the regular implementation of primary preventive measures for jaundice in the management of newborn babies.[4 5 6 19] The fact that a significantly high proportion of the babies without ABE presented within the first 48 hours of life compared to those with ABE also corroborated the possibility of delay in seeking appropriate care being the bane of prevention of ABE among these infants. Similarly, a significantly high proportion of babies with ABE delayed for well over 48 hours from the onset of jaundice before presentation in our facility. This is similar to the findings by previous workers.[9 16] Delay in seeking appropriate medical care has been shown to be an important problem in child health in Nigeria like other parts of the developing world.[20]

In our study, 66.7% of our subjects were males. This is similar to previous reports, which showed that more males than females were affected. Among infants reported in the United States of America kernicterus registry, 67% of the patients were males.[21] Several studies in Nigeria also reported male preponderance [3 8 9 16] The reason why more males were affected in the present study is multifactorial. More males were affected by septicaemia, G-6-PD deficiency, and ABO incompatibility. Male sex is a known risk factor for sepsis. The reason is not fully understood, the location of immunoglobulin modulator on the X-chromosome has been postulated. Male neonates have also been found to have lower numbers of white blood cells and polymorphonuclear neutrophils leucocytes, lower numbers of CD4 cells, higher numbers of CD8 and natural killer cells.

The main causes of jaundice and ABE found in our study are not different from previous reported findings [2 3 8 9 16 17 22] and are mainly preventable.

Although, no socio-economic group was spared in the development of ABE in the babies, the maternal factors identified as predisposing factors to the development of ABE in the babies were young age, low parity, and maternal low socio-economic class. The subjects are therefore babies of high-risk mothers who have insufficient motherhood experience and are prone to increased risk of exposure to icterogenic agents. Some of the mothers in this study applied Robb and Mentholatum ointments to keep the babies' limbs warm, the mothers also applied the ointments to their own bodies as well. Quite often, the predisposing factors co-exist, necessitating a simultaneous discussion of their roles. For example, teenage motherhood, low parity, and low socio-economic status are intertwined. Low parity and teenage mothers have reduced ability to pay for health care and may present in hospital late. Low socio-economic status had been associated with poor knowledge about childhood illnesses and poor health care-seeking behavior.[23] Their babies could be predisposed to infections too because of poor hygiene and inadequate motherhood experience.

This study shows that 52 (82.5% of the babies were noticed by their mothers or relatives to have developed jaundice at least 24 hours before presentation or development of ABE. This is similar to the findings by Adebami.[9] However, recognition of jaundice in neonates at home by untrained mothers and relatives cannot be expected to be as prompt as in the hospitals by trained staff. Timely phototherapy and if need be, EBT could have prevented the development of ABE in some of them since the efficacy of

phototherapy in reducing bilirubin level within 24 hours has been acknowledged.[8]

In this study 57.1% of parents were married and living together as a family while 42.9% were not really committed to each other by marriage which may lead to faulty family dynamics. The family functioning and family socio-economic class are both important components of family dynamics that can determine an individual's health care-seeking behavior and practice. These factors can influence how early a neonate with hyperbilirubinaemia or any other illness is brought to the hospital by the family for medical care.[24]

The finding of a mother having an older sibling with cerebral palsy due to kernicterus is of great concern and calls for more aggressive and all-embracing preventive approach to the management of neonatal jaundice to prevent the complication of bilirubin encephalopathy. Further enquiries about events surrounding the birth of this older sibling from the mother revealed that he was delivered in a TBA centre, developed jaundice within 72 hours of delivery which was managed with herbal remedies until he could no longer suck well from the breast before he was taking to the hospital on the fifth day of life. Kuti et al,[25] in 2014 reported a case of kernicterus in a mother and her child in Ile-Ife, Nigeria which occurred due to delay in presentation for the management of neonatal hyperbilirubinaemia (in both mother and child).

Inappropriate treatment and ignorance of many health workers on the dangers of hyperbilirubinaemia and its treatment in the newborn is a major factor militating against the prevention of ABE in Nigeria.[7-9] This should be corrected by suitable workshops and in-service education programmes. Such programmes should focus on the subjects of early recognition of jaundice and the need for prompt referral of affected babies to centres that are adequately equipped for the management of severe hyperbilirubinaemia.[26, 27] Health workers should also be educated on the need to avoid ineffective and dangerous treatments like prescription of herbs and icterogenic agents observed in the present study. Mothers education on early detection and recognition of jaundice in their newborn infant is desired and should be incorporated into routine counseling during ante-natal care visits.[28]

A significantly high proportion of babies with ABE presented with total serum bilirubin (TSB) in the high-risk zones on the prediction normogram for severe hyperbilirubinaemia.19 This implies that the affected babies might not develop severe hyperbilirubinaemia if they were assessed with the age-related TSB values prior to discharge from the nursery and appropriate care was instituted. Unfortunately, most of the babies were delivered at centers devoid of the appropriate health care services (recommended protocols).

The presence of 39.7% of severe anaemia and 41.3% of hypoglycaemia are important co-morbidities that predispose neonates with hyperbilirubinaemia to the development of early kernicterus.[1 10] Our observation has been reported by previous workers.[9 16] The presence of severe anaemia among babies with ABE may suggest the role of hemolytic disease in the aetiology of the hyperbilirubinaemia in this cohort of babies.

CONCLUSION

The triad of ignorance, poverty, and poor socio-economic status constitutes the predisposing background factors to ABE and it should be countered with appropriate interventions like women education and empowerment, improved maternal access to healthcare, and general improvement of socio-economic levels. The identified risk factors for ABE are potentially modifiable and the findings in our study are applicable to other parts of the developing world where ABE still constitutes a major child health problem. Medical practitioners in the developing world are therefore encouraged to define and adapt to their local practices, specific criteria for the screening of newborn infants presenting with jaundice. This would facilitate early commencement of appropriate therapy and prevent

development of ABE among high-risk babies.

Limitations of the study: Some of the babies could not be extensively investigated to determine all possible aetiologies of their jaundice due to lack of Health Insurance to take care of medical bills and limitation of facilities for comprehensive laboratory investigations in the hospital. Postmortem was not done for patients that died because parents refused to give consent for the investigation/service.

The family functioning and dynamics was not adequately studied to know how much it has affected the health care-seeking behaviour of the mothers of babies with ABE in relation to the pattern of presentation for the management of neonatal jaundice.

Declaration by Authors

Acknowledgements: We express our sincere gratitude to all the studied babies and their parents for their co-operation. The assistance of all the health care staff providing care to all the babies in the neonatal ward of Sacred Heart Hospital Hospital, Lantoro, Abeokuta is appreciated. The contribution of Prof. Olusola Oyedeji is highly appreciated.

REFERENCES

1. Shaughnessy EE, Goyal NK. Jaundice and Hyperbilirubinaemia in the Newborn. In: Nelson Textbook of Pediatrics 21st ed. 2020. P. 953-960.
2. Ogunlesi TA, Dedeke IO, Adekanmbi AF, Fetuga MB, Ogunfowora OB. The incidence and outcome of bilirubin encephalopathy in Nigeria: a bi-center study. Niger J Med 16 (2007), 354-359.
3. Farouk ZL, Muhammed A, Gambo S, Mukhtar-Yola M, Abdullahi SU, Slusher TM. Follow-up of children with kernicterus in Kano, Nigeria. J Trop Pediatr, 2018, 64, 176-182.
4. Bhutani VK, Johnson L, Sivieri EM. Predictive ability of predischarge hour-specific serum bilirubin for subsequent significant hyperbilirubinaemia in healthy term and near-term newborns. Pediatrics. 1999 Jan; 103(1):6-14.
5. Maisels MJ. Screening and early postnatal management strategies to prevent hazardous hyperbilirubinaemia in newborns of 35 or more weeks of gestation. Semin Fetal Neonatal Med. 2010 Jun; 15(3): 129-35.
6. Brown AK, Kim MH, Wu PY, Bryla DA. Efficacy of phototherapy in prevention and management of neonatal hyperbilirubinemia. Pediatrics. 1985; 75(2 Pt 2):393-400. [PubMed].
7. Olusanya BO, Osibanjo FB, Mabogunje CA, Slusher TM, Olowe SA. The burden and management of neonatal jaundice in Nigeria: a scoping review of the literature. Niger J Clin Pract. 2016; 19(1):1-17.
8. Owa JA, Ogunlesi TA. Why we are still doing so many exchange blood transfusions for neonatal jaundice in Nigeria. World J Pediatr 2009; 5:51-55.
9. Adebami OJ. Factors associated with the incidence of acute bilirubin encephalopathy in Nigerian population. J Pediatr Neurol 9 (2011)347-353.
10. Springer SC, Rosenkrantz T. Kernicterus. eMedicine https://emedicine.medscape..com/article/975276. Updated: February 14, 2024. Assessed on 09 May, 2024.
11. Oyedeji GA. Socio economic and cultural background of hospitalized children in Ilesa. Niger J Paediatr 12 (1985), 111-117.
12. Van den BERGH, Muller P. Uber eine directe und eine indirekte diazoreaktion auf bilirubin, Biochem Z77 (1916), 90 (in German).
13. Wong RJ, Stevenson DK, Ahlfors CE, Vreman HJ. Neonatal jaundice: Bilirubin physiology and clinical chemistry, NeoReviews 8 (2007), 58 – 67.
14. Ipek IO, Bozaaykut A. Clinically significant neonatal hyperbilirubinaemia: an analysis of 646 cases in Istanbul. J Tropic Pediatr, 54 (2008) 211-213. https://doi.org/10.1093/tropej/fmm115.
15. Usman F, Dialla UM, Shapiro S, Le Pichon JB, Slusher TM. Acute bilirubin encephalopathy and its progression to kernicterus: current perspectives. Research and reports in neonatology (2018), 8: 33-44.
16. Ogunlesi TA, Ogunfowora OB. Predictors of acute bilirubin encephalopathy among Nigerian term babies with moderate-to-severe hyperbilirubinaemia. J Tropic Pediatr 2011, (57), 2: 80-86

17. Owa JA, Dawodu AH, Familusi JB. Kernicterus in Nigerian infants. West Afr J Med 1987;6: 11-20.
18. Ebbesen F. Recurrence of kernicterus in term and near-term infants in Denmark. Acta paediatr 2000;89: 1213-1217.
19. American Academy of Pediatrics Subcommittee on Hyperbilirubinaemia. Management of hyperbilirubinaemia in the newborn infant 35 or more weeks of gestation, Pediatrics 2004; 114: 297-316.
20. Ogunlesi TA, Runsewe-Abiodun TI, Olanrewaju DM. Health care-seeking behaviours for childhood illnesses in a resource-poor setting. J Pediatr Child Health 2010;46: 238-42.
21. Johnson Lh, Buthani VK, Brown AK. System-based approach to management of neonatal jaundice and prevention of kernicterus. J Pediatr 2002; 140: 396-403.
22. Ogunlesi TA, Ogunfowora OB, Ogundeyi MM, Ayeni VA. Jaundice among hospitalized newborn infants in Sagamu: Observations on aetiology and clinical course. Niger J Paediatr 2009; 36(3&4): 72-79.
23. Ogunlesi TA, Olanrewaju DM. Socio-demographic characteristics and appropriate health care-seeking behaviours for childhood illnesses, J Trop Pediatr 2010.DOI:10.1093/tropej/fmq009.
24. Ezeaka CV, Ugwu RO, Mukhtar-Yola M, Ekure EN, Olusanya BO. Pattern and predictors of maternal care-seeking practices for severe neonatal jaundice in Nigeria: a multi-centre survey. BMC Health Serv Res 2014; 14(1).
25. Kuti BP, Ogundele T, Adeniyi AT, Kuti DK. Kernicterus in two generations: a need for more aggressive preventive measures. Iranian J Neonatology 2014;5(2): 33 - 36
26. Ogunlesi TA. The pattern of utilization and delivery services in Ilesa, Nigeria. Internet J Epidemiol 2 (2005), 2.
27. Ogunfowora OB, Daniel OJ. Neonatal jaundice and its management: Knowledge, attitude and practice of community health workers in NIGERIA. Bmc Public Health6 (2006),19.
28. Wennberg RP, Oguche S, Imam Z, Farouk ZL, Abdulkadir I, Sampson PD et al. Maternal instruction on neonatal jaundice: what can we learn from the stop kernicterus in Nigeria (SKIN) experience. J Pediatr 2020, (2021):7-8 https://doi.org/10.1016/j.jpeds.2020.02.021

How to cite this article: Joel-Medewase Victor Idowu, Adebami Olusegun Joseph, Alabi Ayobami Oyetunji, Adetoye Mayowa Mary, Ashaolu Oluwakayode Joseph. Maternal and neonatal factors associated with the incidence of acute bilirubin encephalopathy in Nigerian population. *Int J Health Sci Res.* 2024; 14(9):14-24. DOI: *10.52403/ijhsr.20240903*

******