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Incidence and Risk Factors to Neonatal Jaundice in Jalingo, Taraba State

Modesta Ifeoma Mbah[1,2], Hembafan Emmanuel[2], Mohammed Sani Samari[3], Bakari Tinyang Boshi[3]

[1]Taraba State University, Jalingo, Nigeria
[2]National Open University of Nigeria, Jalingo Study Center, Jalingo, Nigeria
[3]College of Nursing and Midwifery, Jalingo, Nigeria
Email: mdduruoha@gmail.com

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Abstract

This cross-sectional study was aimed to determine the incidence and the significant risk factors to neonatal jaundice in FMC, Jalingo. Four hundred and thirty three neonates admitted to special baby care unit (SBCU) FMC, Jalingo with their mothers were surveyed. Data were collected through a data extraction format looking on the medical records of the neonates (from 1st January, 2021 to 31st August, 2021) and interviewing the mothers. Data were transferred to an Excel data sheet and results were summarized by frequencies and percentages (categorical variables). Logistic regression analysis was used to determine the strength of the risk factors to neonatal jaundice while the significance was tested at p-value ≤ 0.05. The findings revealed that the incidence of neonatal jaundice in FMC Jalingo was 40.18% while the significant risk factors were age group 41 - 50 years (I = 15.01%, OR: 2.970 at 95% CI: 1.566 - 5.634, p = 0.000), spontaneous vaginal delivery (I = 18.01%, OR: 1.382 at 95% CI: 0.940 - 2.033, p = 0.000), premature rupture of membrane (I = 24.94%, OR at: 2.252 at 95% CI: 1.520 - 3.337, p = 0.000), hypertension in pregnancy (I = 21.02%, OR: 1.831 at 95% CI: 1.240 - 2.703, p = 0.002). Others were breech fetal presentation (I = 23.33%, OR: 2.689 at 95% CI: 1.809 - 3.995, p = 0.000), birth asphyxia (I = 22.40%, OR: 3.469 at 95% CI: 2.3105.210, p = 0.000), significant bruising (I = 22.86%, OR: 1.705 at 95% CI: 1.157 - 2.513, p = 0.007), neonatal sepsis (I = 21.02%, OR: 1.688 at 95% CI: 1.145 - 2.488, p = 0.008) and congenital hemolytic anemia (I = 21.71%, OR: 1.723 at 95% CI: 1.169 - 2.540, p = 0.006). Therefore, the need for all concerned to ensure the incidence is reduced and the risk factors identified early and tackled.

Keywords

Neonatal Jaundice, Hyperbilirubinemia, Neonates, Incidence, Risk Factors

1. Introduction

Neonatal jaundice is a leading cause of hospitalization in the first week of life worldwide [1]. It is a major cause of hospital neonatal intensive care unit admission and readmissions during the neonatal period [2]. Jaundice in the newborn has a reported incidence between 60% to more than 90% [3]. Every year, about 1.1 million babies develop severe hyperbilirubinemia with or without bilirubin encephalopathy (which is one of the complications of neonatal jaundice) and the vast majority of these people reside in Sub-Saharan Africa (SSA) and South Asia [4] [5].

Neonatal jaundice (NJ) results when unconjugated bilirubin accumulates to a level that makes the yellow color visible to the eyes [3] [6]. Detection of jaundice requires a trained observer and good lighting. Bilirubin, the molecule that causes the color of jaundice, is the end product of the disassembly of heme-containing molecules, primarily hemoglobin. Therefore, conditions that increase hemolysis will increase bilirubin production and cause jaundice [3]. Jaundice itself is not a disease but rather a symptom or sign of a disease. However, hyperbilirubinemia in the newborn period can be associated with severe illnesses such as hemolytic disease, metabolic and endocrine disorders, anatomic abnormalities of the liver, and infections [6].

High serum levels of bilirubin result in lethargy, poor feeding, and kernicterus in the infant [6]. As bilirubin is not water soluble, it is transferred via the bloodstream from the spleen to the liver, bound to the plasma protein albumin. In this form, it is known as conjugated bilirubin, which is then secreted into the gall. In the gut, it is further metabolized to other gall pigments and then excreted in the faces. But in the newborns bilirubin may have elevated values up to concentrations causing the yellow colouration of skin and mucosae this is due to organs immaturity and inability to cope with the rhythm needed for the bilirubin to be extracted from the organs [7].

Hyperbilirubinaemia, presenting as jaundice, is a ubiquitous and frequently benign condition in newborn babies but is a leading cause of hospitalization in the first week of life. In some infants jaundice can become severe, progressing to acute bilirubin encephalopathy and kernicterus with a substantial risk of neonatal mortality and long-term neurodevelopmental impairments such as cerebral palsy, sensorineural hearing loss, intellectual difficulties, upward gaze palsy, seizure, gross dental dysplasia and developmental delays in the survivors and death [1] [8].

Unlike the developed countries where feto-maternal blood group incompatibilities are the main causes of severe neonatal jaundice, it is mostly prematurity, glucose 6 phosphate dehydrogenase (G6PD) deficiency, infective causes as well as effects of negative traditional and social practices that constitute the etiology in developing countries [9] [10]. Endocrine and metabolic conditions also contribute to neonatal jaundice [3], the most common being maternal diabetes. An increased incidence is seen in infants of Southeast Asian mothers, while African

infants have a lower incidence unless they suffer from G-6-PD-deficiency.

Chime *et al.*, (2012) [11] reported that low educational level (primary school level), low birth weight, ABO incompatibility, sex of the baby and singles and divorced mothers as well as Glucose-6-phosphate deficiency are the predisposing factors of neonatal jaundice. Kolawole *et al.*, (2016) [12] reported that sepsis, prematurity, lack of breast feeding, ABO incompatibility, sex of the baby, and anaemia are the risk factors for neonatal jaundice. According to Lake, E. A. *et al.* [5] being male, maternal "O" blood group, sepsis, and blood type incompatibility were positively associated with neonatal jaundice. Also Asefa, G. G. *et al.* [4] reported that obstetric complications, low birth weight, birth asphyxia, RH-incompatibility, breastfeeding, and polycythemia are the determinants of neonatal jaundice.

Though a lot of authors have reported different determinants/risk factors of neonatal jaundice, there is still a need to find out more risk factors since the incidence is still high. In addition, there has been no known report on the factors that predispose babies to jaundice in the Taraba state and knowing fully well that severe neonatal jaundice (NNJ) is a major cause of preventable brain damage and early death among infants [8], this study is therefore aimed to determine the incidence and the risk factors to neonatal jaundice in Federal medical center (FMC), Jalingo, Taraba state.

2. Methodology

Area of Study

Federal medical center (FMC) Jalingo, a tertiary hospital located in the heart of Jalingo town is the area of study. FMC is one of the two tertiary hospitals in Jalingo. It is highly attended by the residents of Jalingo and its environs. Referrals are made from other hospitals in Jalingo as well as Taraba state to this hospital.

Study design and setting

It was a cross-sectional study of all the neonates admitted in the SCBU of FMC Jalingo from 01/01/2021 to 31/08/2021.

Data Collection

Data were obtained from patient medical records and interviews with the mothers using a structured questionnaire.

Population of the Study

The population included all of the neonates admitted in the SCBU of FMC Jalingo from 01/01/2021 to 31/08/2021.

Inclusion Criteria

Inclusion criteria for the study were:

All neonates admitted in the SCBU of FMC, Jalingo from 1/1/2021 to31/8/2021. Neonates without neonatal jaundice were included as controls. A total of 433 neonates with their mothers (174 cases, 259 controls) were included and all mothers agreed to participate.

Exclusion Criteria

Neonates whose mothers did not give informed consent (all mothers willingly consented).

Neonates whose mothers were not healthy enough to supply the needed information. Neonates who were not admitted in to the SCBU of FMC Jalingo during the period of this study (01/01/2021 to 31/08/2021).

Data analysis

Data were transferred to an Excel data sheet and results were summarized by frequencies and percentages (categorical variables). The variables were also entered in the logical regression analysis. The strength of the association between dependent and independent variables was measured using odds ratio at 95% confidence interval (CI) while p value ≤ 0.05 was used to determine the level of statistical significance.

Diagnostic Criteria for Neonatal Jaundice

The physician's diagnosis was used to identify neonatal jaundice.

3. Results

The odds ratio of mother's age "20 - 30" was 1.8 times more likely to increase the incidence of neonatal jaundice compared to mother's age < 20 years (I = 16.39%, OR: 1.76 at 95% CI: 0.972 - 3.319, p = 0.062) while the odds of mother's age "31 - 40" was 2 times more likely to increase the incidence of neonatal jaundice compared to mothers age < 20 years (I = 4.62%, OR: 1.667 at 95% CI: 0.771 - 3.602, p = 0.194). Also, the odds of mother's age "41 - 50" was 3 times more likely to increase the incidence of neonatal jaundice compared to mothers age < 20 years (I = OR: 2.970 at 95% CI: 1.566 - 5.634, p = 0.001). Meanwhile the odds of Urban resident mothers was 95% less likely to increase the incidence neonatal jaundice compared to rural resident mothers (I = 18.24%, OR: 0.515 at 95% CI: 0.348 - 0.760, p = 0.515). However, the odds of Christain mothers was 93% less likely to increase the incidence of neonatal jaundice compared to mothers of other religious groups (aside Islam) (I = 13.16%, OR: 0.742 at 95% CI: 0.450 - 1.224, p = 0.243) while the odds of Islamic mothers was 1.2 times more likely to increase the incidence of neonatal jaundice compared to the mothers of other religion (aside Christianity) (I = 16.86%, OR: 1.215 at 95% CI: 0.740 - 1.995, p = 0.44). However, the odds of housewives was 94% less likely to increase the incidence of neonatal jaundice compared to mothers of other occupations (I = 9.24%, OR: 0.560 at 95% CI: 0.284 - 1.103, p = 0.094) while the odds of civil servants was 96% less likely to increase the incidence of neonatal jaundice compared to mothers of other occupations (I = 8.31%, OR: 0.411 at 95% CI: 0.209 - 0.808, p = 0.010). However, the odds of business women was 97% less likely to increase the incidence of neonatal jaundice compared to mothers of other occupations (I = 6.70%, OR: 0.312 at 95% CI: 0.156 - 0.623, p = 0.001) while the odds of mothers who were farmers were also 94% less likely to increase the incidence of neonatal jaundice compared to mothers of other occupations (I = 8.78%, OR: 0.575 at

95% CI: 0.290 - 1.142, p = 0.114). Meanwhile, the odds of mothers who were primary school leavers were 92% less likely to increase the incidence of neonatal jaundice compared to mothers who did not have formal education (I = 11.30%, OR: 0.822 at 95% CI: 0.474 - 1.424, p = 0.484) while the odds ratio of mothers who attended tertiary education was 97% less likely to increase the incidence of neonatal jaundice compared to mothers who had no formal education (I = 7.40%, OR: 0.315 at 95% CI: 0.180 - 0.552, p = 0.000). However, the odds of mothers of low social status was 0.7 times less likely to increase the incidence of neonatal jaundice compared to mothers of very low social class (I = 9.70%, OR: 0.697 at 95% CI: 0.401 - 1.211, p = 0.200) while mothers of middle social class was 95% less likely to increase the incidence of neonatal jaundice compared to mothers of very low social status (I = 9.47%, OR; 0.522 at 95% CI: 0.305 - 0.896, p = 0.018). Meanwhile, mothers of high social class was 97% less likely to increase the incidence of neonatal jaundice compared to mothers of very low social status (I = 7.62%, OR; 0.337 at 95% CI: 0.195 - 0.585) as presented in Table 1 below.

The odds of multiparous mothers was 96% less likely to increase the incidence of jaundiced neonates compared to primiparous mothers (I = 16.86%, OR: 0.385 at 95% CI: 0.259 - 0.571, p = 0.000). However, the odds ratio of having gone for antenatal care was 98% less likely to increase the incidence of neonatal jaundice compared non- attendance of ante natal care (I = 7.85%, OR: 0.185 at 95% CI: 0.118 - 0.290, p = 0.000). Also, the odds of spontaneous vaginal delivery was 1.4 times more likely to increase the incidence of neonatal jaundice compared to caesarean section (I = 18.01%, OR: 1.382 at 95% CI: 0.940 - 2.033, p = 0.000) while the odds of normal delivery was 96% less likely to increase the incidence of neonatal jaundice compared to prolonged labour (I = 17.55%, OR: 0.420 at 95% CI: 0.283 - 0.623, p = 0.000). Meanwhile, the odds of premature rupture of membrane (PROM) was 2.5 times more likely to increase the incidence of neonatal jaundice compared to non-PROM (I = 24.94%, OR: 2.252 at 95% CI: 1.520 - 3.337, p = 0.000). However, the odds of spontaneous onset of Labour was 97% times less likely to increase the incidence of neonatal jaundice compared to induced labour (I = 17.32%, OR: 0.383 at 95% CI: 0.258 - 0.569, p = 0.000). Meanwhile, the odds of hypertension in pregnancy was 1.8 times more likely to increase the incidence of neonatal jaundice compared to normal blood pressure in pregnancy (I = 21.02%, OR: 1.831 at 95% CI: 1.240 - 2.703, p = 0.002) while the odds of using traditional medicine during pregnancy was 1.4 times more likely to increase the incidence of neonatal jaundice compared to none use of traditional medicine during pregnancy (I = 21.94%, OR: 1.415 at 98% CI: 0.962 - 2.081, p = 0.078) as presented in Table 2 below

The odds of delivery at term was 93% less likely to increase the incidence of neonatal jaundice compared to preterm delivery (I = 12.70%, OR: 0.682 at 95% CI: 0.408 - 1.042, p = 0.074) while the odds of post term delivery was 96% less likely to increase the incidence of neonatal jaundice compared to preterm delivery (I = 9.47%, OR: 0.370 at 95% CI: 0.229 - 0.599, p = 0.000). However, the

Table 1. Influence of socio-demographic characteristics of mothers on the incidence of Neonatal Jaundice.

Characteristics	Categories	Cases (n = 174)	Control (n = 259)	Incidence	Odd Rati (95% CI)	P-value
Mothers' age	<20 years	18 (10.34%)	51 (19.69%)	4.16%		
	20 - 30 years	71 (40.80%)	112 (43.24%)	16.39%	1.796 (0.972 - 3.319)	0.062
	31 - 40 years	20 (11.49%)	34 (13.13%)	4.62%	1.667 (0.771 - 3.602)	0.194
	41 - 50 years	65 (37.36%)	62 (23.93%)	15.01%	2.970 (1.566 - 5.634)	0.001
Residence	Rural	95 (54.60%)	99 (38.22%)	21.93%		
	Urban	79 (45.60%)	160 (61.78%)	18.24%	0.515 (0.348 - 0.760)	0.515
Religion	Others	44 (25.29%)	63 (24.32%)	10.16%		
	Christianity	57 (32.76%)	110 (42.47%)	13.16%	0.742 (0.450 - 1.224)	0.243
	Islam	73 (41.95%)	86 (33.20%)	16.86%	1.215 (0.740 - 1.995)	0.44
Occupation	Others	31 (17.82%)	23 (8.88%)			
	House wife	40 (22.99%)	53 (20.46%)	9.24%	0.560 (0.284 - 1.103)	0.094
	Civil servant	36 (20.69%)	65 (25.10%)	8.31%	0.411 (0.209 - 0.808)	0.010
	Business women	29 (16.67%)	69 (26.64%)	6.70%	0.312 (0.156 - 0.623)	0.001
	Farmer	38 (21.84%)	49 (18.92%)	8.78%	0.575 (0.290 - 1.142)	0.114
Educational Status	No formal	53 (30.46%)	48 (18.53%)	12.24%		
	Primary	49 (28.16%)	54 (20.85%)	11.30%	0.822 (0.474 - 1.424)	0.484
	Secondary	40 (22.99%)	65 (25.10%)	9.24%	0.557 (0.320 - 0.971)	0.039
	Tertiary	32 (18.39%)	92 (35.52%)	7.40%	0.315 (0.180 - 0.552)	0.000
Social Status	Very low	58 (33.33%)	51 (19.69%)	13.39%		
	Low	42 (24.14%)	53 (20.46%)	9.70%	0.697 (0.401 - 1.211)	0.200
	Middle	41 (23.56%)	69 (26.64%)	9.47%	0.522 (0.305 - 0.896)	0.018
	High	33 (18.97%)	86 (33.20%)	7.62%	0.337 (0.195 - 0.585)	0.000

Table 2. The Influence of Events that occur during pregnancy on the Incidence of Neonatal Jaundice.

Characteristics	Categories	Cases (n = 174)	Control (n = 259)	Incidence	Odd Ratio (95% CI)	P-value
Parity	Multiparous	73 (41.95%)	169 (65.25%)	16.86%	0.385 (0.259 - 0.571)	0.000
	Primiparous	101 (58.05%)	90 (34.78%)	23.33%		
Ante Natal Care	Yes	34 (19.54%)	147 (56.76%)	7.85%	0.185 (0.118 - 0.290)	0.000
	No	140 (80.46%)	112 (43.24%)	32.33%		
Mode of Delivery	Spontaneous	78 (44.83%)	137 (52.90%)	18.01%	1.382 (0.940 - 2.033)	0.100
	Vag. delivery					
	Caesarean section	76 (43.68%)	168 (64.86%)	17.55%		
Duration of Labour	Normal	76 (43.68%)	168 (64.86%)	17.55%	0.420 (0.283 - 0.623)	0.000
	prolonged	98 (56.32%	97 (35.14%)	22.63%		

Continued

Premature rupture of membrane	Yes	108 (62.07%)	109 (42.08%)	24.94%	2.252 (1.520 - 3.337)	0.000
	No	66 (37.93%)	150 (57.92%)	15.24%		
Onset of Labour	Spontaneous	75 (43.10%)	172 (66.41%)	17.32%	0.383 (0.258 - 0.569)	0.000
	Induced	99 (56.90%)	87 (33.59%)	22.86%		
Hypertension in Pregnancy	yes	91 (52.30%)	97 (37.45%)	21.02%	1.831 (1.240 - 2.703)	0.002
	No	83 (47.70%)	162 (62.55%)			
Use of Traditional Medicine	Yes	95 (54.60%)	119 (45.95%)	21.94%	1.415 (0.962 - 2.081)	0.078
	No	79 (45.40%)	140 (54.05%)	18.24%		

odds of being a female neonate was 93% less likely to increase to increase the incidence of neonatal jaundice compared to being a male neonate (I = 18.48%, OR: 0.723 at 95% CI: 0.492 - 1.064, p = 0.100). Meanwhile, the odds of "approximate size of baby to gestational age (3 - 4 Kg)" was 95% less likely to increase the incidence of neonatal jaundice compared to "small size for gestational age (≤2.5 Kg)" (I = 11.78%, OR: 0.490 at 95% CI: 0.307 - 0.782, P = 0.003) while the odds of "large neonate for gestational age" was 97% less likely to increase the incidence of neonatal jaundice compared to "small neonates for gestational age" (I = 8.31%, OR: 0.285 at 95% CI: 0.174 - 0.467, p = 0.000). However, the odds of breech presentation was 2.7 times more likely to increase the incidence of neonatal jaundice compared to cephalic presentation (I = 23.33%, OR: 2.689 at 95% CI: 1.809- 3.995, p = 0.000). Meanwhile, the odds of birth asphyxia was 3.5 times more likely to increase the incidence of neonatal jaundice compared to no birth asphyxia (I = 22.40%, OR: 3.469 at 95% CI: 2.310 - 5.210, p = 0.000). However, the odds of significant bruising was 1.7 times more likely to increase the incidence of neonatal jaundice compared to no significant bruising (I = 22.56%, OR: 1.705 at 95% CI: 1.157 - 2.513, p = 0.007). Also, the odds of neonatal sepsis was 1.7 times more likely to increase the incidence of neonatal jaundice compared to no neonatal sepsis (I = 21.02%, OR: 1.688 at 95% CI: 1.145 - 2.488, p = 0.008). However, the odds of congenital hemolytic anemia was 1.7 times more likely to increase the incidence of neonatal jaundice compared to no congenital hemolytic anaemia (I = 21.71%, OR: 1.723 at 95% CI: 1.169 - 2.540, p = 0.006). Meanwhile, the odds of exclusive breast feeding was 1.1 times more likely to increase the incidence of neonatal jaundice compared to no exclusive breastfeeding (I = 26.10%, OR: 1.091 at 95% CI: 0.731 - 1.629, p = 0.670) as presented in Table 3 below.

Table 3. Common conditions in the neonates that influence the incidence of jaundice.

Characteristics	Categories	Case (n = 174)	Control (n = 259)	Incidence	Odd Ratio (95% CI)	P-value
Gestational age	Preterm (<37 wks)	78 (44.83%)	74 (28.57%)	18.01%		

Continued

	Term (37 - 42)	55 (31.61%)	80 (30.89%)	12.70%	0.652 (0.408 - 1.042%)	0.074
	Post term (>42 wks)	41 (23.56%)	105 (40.54%)	9.47%	0.370 (0.229 - 0.599)	0.000
Gender of neonate	Female	80 (45.98%)	140 (54.05%)	18.48%	0.723 (0.492 - 1.064)	0.100
	Male	94 (54.02%)	119 (45.95%)	21.71%		
Birth weight	Small ≤ 2.5 kg	87 (50.00%)	71 (27.41%)	16.40%		
	Appro size (3 - 4 Kg)	51 (29.31%)	85 (32.82%)	11.78%	0.490 (0.307 - 0.782)	0.003
	Large (>4 Kg)	36 (20.69%)	103 (39.77%)	8.31%	0.285 (0.174 - 0.467)	0.000
Fetal presentation	Breech	101 (58.95%)	88 (33.98%)	23.33%	2.689 (1.809 - 3.995)	0.000
	Cephalic	73 (41.95%)	171 (66.02%)	16.90%		
Birth asphyxia	Yes	97 (55.75%)	69 (27.64%)	22.40%	3.469 (2.310 - 5.210)	0.000
	No	77 (44.25%)	190 (73.36%)	17.78%		
Significant bruising	Yes	99 (56.90%)	113 (45.63%)	22.86%	1.705 (1.157 - 2.513)	0.007
	No	75 (43.10%)	146 (56.37%)	17.32%		
Neonatal sepsis	Yes	91 (52.30%)	102 (39.38%)	21.02%	1.688 (1.145 - 2.488)	0.008
	No	83 (47.70%)	157 (60.62%)	19.17%		
Congenital hemolytic anemia	Yes	94 (54.02%)	105 (40.54%)	21.71%	1.723 (1.169 - 2.540)	0.006
	No	80 (45.98%)	154 (59.46%)	18.48%		
Exclusive breastfeeding	Yes	113 (64.94%)	163 (62.93%)	26.10%	1.091 (0.731 - 1.621)	0.67
	No	61 (35.06%)	96 (37.07%)	14.09%		

4. Discussions

The incidence of neonatal jaundice in FMC was moderate (40.46%). This could have been because some mothers hardly take their neonates to hospitals. They believed a lot in herbalists and regard yellowing of eyes and mucosae as a non hospital case. Though the finding in this study is lower than the report by Hansen, T. W. R. [3] but it is higher than the report by Chime, H. E. *et al.* and Scrafford, C. G. [11] [13].

The significant risk factors among the demographic characteristics of the mothers to neonatal jaundice were revealed in **Table 1** as follows: The odds of mothers' age "41 - 50" was 3 times more likely to increase the incidence of neonatal jaundice compared to age < 20 years (**Table 1**). This could likely be because such mothers though experienced in child care were usually less energetic to do what it takes to keep the incidence of neonatal jaundice low. In addition, most women that were still giving birth at such an age were most probably due to delay in child birth (infertility) and so most must have taken a lot of medicine (both orthodox and otherwise) before and during pregnancy which

must have affected the new borns. The odds of a mother of other/undefined occupation was 96% more likely to increase the incidence of neonatal jaundice compared to being a civil servant (Table 1). The reason is most likely not far from their level of education. However, the odds of mothers of other/undefined occupation was 97% more likely to increase the incidence of neonatal jaundice compared to being a business woman (Table 1). This could be because mothers of other/undefined occupations were likely not as rich as the business women and therefore had not enough money to do whatever it takes to ensure their babies were healthy. Meanwhile, the odds of mothers not having formal education was 94% times more likely to increase the incidence of neonatal jaundice compared to mothers who had secondary education. Also the odds of mothers with no formal education was 97% times more likely to increase the incidence of neonatal jaundice compared to mothers who had tertiary education (Table 1). This could have been because the educated women promptly sought medical attention during pregnancy and labour while the non educated ones hardly did same. The odds of being in a very low social class was 95% more likely to increase the incidence of neonatal jaundice compared to being in the middle social class. Also, the odds of very low social class was 97% more likely to increase the incidence of neonatal jaundice compared to high social class (Table 1). This could have been because such mothers could not afford to pay for all the necessary things (such as antenatal care) that were needed to ensure that their newborns were healthy. The observations made in this study concerning the relationship between social status and level of education with regards to the incidence of neonatal jaundice agree with the report by Scrafford, C. G. *et al.* [13].

The events that occur during pregnancy that were risk factors to neonatal jaundice include primiparity, no ante natal care, prolonged duration of labour, premature rupture of membrane, induced labour and hypertension in pregnancy (Table 2). The odds of primiparity was 96% more likely to increase the incidence of neonatal jaundice compared to multiparity (Table 2). This could be because most of the primiparous mothers had delay in milk let down which led to low calorie intake of the neonates. For some, it could have been because they had nursing difficulty, and for some others, it was doubts about infant feeding. In addition, the length of labour in primiparity is usually longer than in multiparity. This finding supports the report by Bizuneh, A. D. *et al.*, Scrafford, C. G. *et al.*, and Lindblad, V. *et al.* [2] [13] [14]. Meanwhile, the odds of no-antenatal care was 98% times more likely to increase the incidence of neonatal jaundice compared to attending ante natal care (Table 2). This could have been because the cases that would have been detected during regular ante-natal follow-ups and tackled to ensure the newborns were healthy were not attended to. The odds of prolonged labour was 96% more likely to increase the incidence of neonatal jaundice compared to normal duration of labour (Table 2). This probably could have been because longer labour leads to cephalohematoma, which is a known risk factor for severe hyperbilirubinemia. Also, bruising and swelling of the scalp of neonates as a result of excessive pressure applied by birth attendants and/or

midwives while managing prolonged labor could have increased the risk of jaundice by increasing bilirubin levels in the blood. The finding in this study agrees with the report by Scrafford, C. G. *et al.* [13]. The odds of premature rupture of membrane (PROM) was 2.3 more likely to increase the incidence of neonatal jaundice compared to non PROM (**Table 2**). This could have been because PROM allows the amniotic fluid that was meant to protect the foetus to flow out of the uterus thereby exposing the baby to a lot of pressure due to the contraction of the uterus. The odds of induced labour was 96% more likely to increase the incidence of neonatal jaundice compared to spontaneous labour (**Table 2**). This could have been because in induced labour the contraction of the uterus is much more forceful and frequent. Thereby subjecting the foetus to much pressure and more trauma. This observation does not agree with th e report by Brits, H. *et al.* [15]. The odds of hypertension in pregnancy was 1.8 times more likely to increase the incidence of neonatal jaundice compared to non hypertension in pregnancy (**Table 2**). This is most likely because high blood pressure causes premature birth, low birth weight, placental separation (abruption), and other complications.

Other significant risk factors to neonatal jaundice were pre term gestational age, low birth weight, breech fetal presentation, birth asphyxia, significant bruising, neonatal sepsis and congenital haemolytic anemia (**Table 3**). The odds of pre term gestational age was 96% more likely to increase the incidence of neonatal jaundice compared to post-term gestational age. This could possible because the organs such as the liver of the neonate are not as developed in pre terms as they are in post terms. This agrees with the report by Iacob, D *et al.*, and Onyearugha, C. N. *et al.* [7] [10]. However, the odds of small size for gestational age (≤2.5 kg) was 95% more likely to increase the incidence of neonatal jaundice compared to the approximate size for gestational age (3 - 4 Kg). Also, the odds of small size for gestational age was 97% more likely to increase the incidence of neonatal jaundice compared to large size (>4 Kg) for gestational age. Meanwhile, the odds of breech presentation was three times more likely to increase the incidence of neonatal jaundice compared to cephalic presentation. This could have been because malpresentation (breech) makes it more difficult for babies to be delivered vaginally. Thus, the birth attendants in trying to assist the woman to deliver the baby subjects the fetuses to bruises and traumas. However, the odds of birth asphyxia was 3.5 times more likely to increase the incidence of neonatal jaundice compared to no birth asphyxia. The reason could be because asphyxia makes it possible for not enough oxygen to be taken into the various organs and this affects the efficiency of the organs. Thereby making it difficult for the liver not to conjugate bilirubin to the required amount. The finding of this study agrees with the report by Bizuneh, A. D. *et al.* [2]. However, the odds of significant bruising was 1.7 times more likely to increase the incidence of neonatal jaundice compared to no significant bruising. Bruising and birth trauma, through extravasation of blood increased bilirubin production, and jaundice. This finding agrees with the report by Hansen, T. W. R. [3]. The odds of neonat-

al sepsis was 1.7 times more likely to increase the incidence of neonatal jaundice compared to no neonatal sepsis. The reason could be because infection triggers hemolysis in neonates. This finding supports the report by Bizuneh, A. D. *et al.* and Olusanya, B. O. *et al.* [2] [5]. However, the odds of congenital hemolytic anemia was 1.7 more likely to cause neonatal jaundice compared to the absence of congenital haemolytic anemia. This is as a result of hemolysis of red blood cells. This finding supports the report by Kolawole S. E. *et al.* [12].

5. Conclusion

The incidence of neonatal jaundice in FMC Jalingo was moderate. However, the significant risk factors were age of mother (41 - 50 years), not well defined occupation, no formal education and very low social status of the mothers. Others were primiparity, no antenatal care, prolonged duration of labour, premature rupture of membrane, induced labour and hypertension in pregnancy. However, pre-term delivery, low birth weight, breech fetal presentation, birth asphyxia, significant bruising, neonatal sepsis and congenital haemolytic anemia were also implicated. There is therefore the need for the risk factors to be identified early and tackled to ensure the incidence becomes low.

Conflicts of Interest

The authors declare no conflict of interest.

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