



Original Research

Care-seeking behavior for neonatal jaundice in rural northern Nigeria

Z. Iliyasu^{a,c,*}, Z. Farouk^{b,c}, A. Lawal^a, M.M. Bello^a, N.S. Nass^a, M.H. Aliyu^d^a Departments of Community Medicine, Kano, Nigeria^b Departments of Pediatrics, Bayero University, Kano, Nigeria^c Centre for Infectious Diseases Research, Bayero University Kano, Nigeria^d Department of Health Policy and Vanderbilt Institute for Global Health, Vanderbilt University Medical Center, Tennessee, USA

ARTICLE INFO

Keywords:

Health seeking behavior
Caregivers
Neonatal jaundice
Nigeria

ABSTRACT

Objective: This study determined the predictors of maternal knowledge and health-seeking behavior for neonatal jaundice in rural Kumbotso, northern Nigeria.

Study design: Cross-sectional survey.

Method: A total of 361 mothers were interviewed using structured questionnaires. Knowledge scores and care-seeking practices were determined. Adjusted odds ratios were generated from logistic regression models.

Results: The proportion of respondents with good, fair and poor knowledge of neonatal jaundice were (46.0%, $n = 166$), (24.1%, $n = 87$) and (30.0%, $n = 108$), respectively. Of the 117 mothers with a jaundiced child, (67.5%, $n = 79$) and (20.5%, $n = 24$) received treatment from health facilities and traditional healers, respectively, whereas (12.0%, $n = 14$) resorted to home remedies. Maternal education Adjusted Odds Ratio (AOR) = 2.39; 95% Confidence Interval (CI): 1.16–4.91 (secondary school versus no formal), source of information on neonatal jaundice (AOR = 11.3; 95%CI: 5.84–21.93) (health worker versus ‘others’), recent delivery in a health facility (AOR = 1.83; 95%CI: 1.06–3.14) and having a previously jaundiced child (AOR = 5.06; 95%CI: 2.76–9.27) predicted knowledge. Preference for health facility treatment was predicted by a previously jaundiced child (AOR = 10.04; 95%CI: 5.73–17.60), antenatal care (AOR = 2.97; 95%CI: 1.43–6.15) (≥ 4 versus 0 visits), source of information on neonatal jaundice (AOR = 2.33; 95%CI: 1.30–4.17) (health worker versus ‘others’), and maternal ethnicity (AOR = 0.36; 95%CI: 0.14–0.96) (Hausa-Fulani versus ‘others’).

Conclusion: Maternal knowledge of neonatal jaundice was sub-optimal. Being educated, health facility delivery, having had a jaundiced child, and receiving information from health workers predicted good knowledge. Having a previously jaundiced child, antenatal care, obtaining information from health workers and maternal ethnicity predicted preference for health facility treatment. Policies and programs should be strengthened to focus on prevention, early detection and prompt management of neonatal jaundice.

1. Introduction

Neonatal jaundice manifests as yellowish discoloration of the skin, sclerae, and mucous membranes, and is caused by unconjugated hyperbilirubinemia due to increased production from relative polycythemia, increased red cell turnover, limited ability to conjugate bilirubin, and/or slow hepatic-enteric clearance of bilirubin [1,2]. Neonatal jaundice commonly manifests 48 h after birth, requiring re-admission and clinical evaluation [3]. Most of the estimated 85% of live births that develop neonatal jaundice resolve spontaneously within 3–5 days. However, a proportion develop extreme hyperbilirubinaemia (total serum bilirubin ≥ 25 mg/dL (428 $\mu\text{mol/L}$)) resulting in neuro-developmental

complications, if improperly managed [4]. Globally, at least 481 000 infants are estimated to develop extreme hyperbilirubinemia each year, causing 114 000 deaths and leaving more than 63 000 survivors with long-term complications [2,4]. More than 75% of affected infants live in low and middle-income countries [5]. Specifically, the Africa region has the highest incidence of severe neonatal jaundice, at 667.8 per 10 000 live births, followed by Southeast Asian, Eastern Mediterranean, Western Pacific, Americas and European regions at 251.3, 165.7, 9.4, 4.4 and 3.7 per 10 000 live births, respectively [4].

In low and middle-income countries, apart from feto-maternal ABO/Rhesus incompatibility, the high prevalence of Glucose-6-phosphate dehydrogenase (G6PD) deficiency, exposure to icterogenic oxidants

* Corresponding author. Centre for Infectious Diseases Research, College of Health Sciences, Bayero University Kano, Nigeria.

E-mail address: ziliyasu@yahoo.com (Z. Iliyasu).

<https://doi.org/10.1016/j.puhip.2020.100006>

Received 15 December 2019; Received in revised form 25 March 2020; Accepted 2 April 2020

Available online 11 April 2020

2666-5352/© 2020 The Author(s). Published by Elsevier Ltd on behalf of The Royal Society for Public Health. This is an open access article under the CC BY-NC-ND

license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

(e.g. mothballs, camphor, dusting powder, henna) [6,7], and use of herbal concoctions during pregnancy are major causes of hemolytic jaundice [8]. In sub-Saharan Africa, some of these factors are rooted in socio-cultural practices [9].

A recent review from Nigeria reported a high prevalence of severe neonatal jaundice and kernicterus associated with a high case fatality rate (CFR) [9,10]. Hospital reports showed that 26.9% of admissions for jaundice had bilirubin levels >20 mg/dl and 14.9% of hospitalized neonates developed acute bilirubin encephalopathy, with a CFR of 13.0% among infants with neonatal jaundice [10]. In two major hospitals in northern Nigeria, 551 neonates had hyperbilirubinemia, of whom 104 (18.8%) developed acute bilirubin encephalopathy [11]. Further, septicemia, neonatal jaundice, and prematurity were among the leading causes of in-hospital mortality in one of the centers [12].

Vigilant mothers and other caregivers are more likely to observe the onset of neonatal jaundice [13]. But adverse outcomes could result in situations where mothers have limited knowledge of neonatal jaundice, its causes, and complications and engage in unhealthy cultural practices and risky delays [14]. Such events are likely to be more common in rural communities, where health facilities are fewer and utilization lower. Most studies of caregiver health-seeking behavior have been in urban hospitals [13–15], with little documentation of maternal knowledge and care-seeking behavior for neonatal jaundice in rural communities. Data on maternal knowledge and care-seeking behavior is important, especially, in northern Nigeria, a region with one of the poorest child health indices globally [16].

To inform prevention, early recognition, prompt and appropriate treatment of neonatal jaundice in rural areas, we assessed the predictors of mothers' knowledge and health-seeking behavior for neonatal jaundice in Kumbotso, a rural community in Kano, northern Nigeria.

2. Methods

2.1. Study area and population

This study was carried out in July 2019 in Kumbotso community, situated 2.5 miles north of Kano City in northern Nigeria (estimated population: 374,200) [17]. Women of reproductive age constitute approximately a quarter of the population [17]. The inhabitants are mostly farmers, petty traders, and entrepreneurs. The predominant ethnic group is the Hausa-Fulani, however, other major Nigerian tribes are represented. The community has 11 wards, a comprehensive primary health centre, two private clinics and four primary health centers.

The study population included women of reproductive age (15–49 years) who delivered ≤ 12 months prior to the study and were resident in Kumbotso for ≥ 6 months. We excluded mentally incompetent mothers, those too sick to be interviewed and those who withheld consent.

2.2. Study design and sampling

The study was cross-sectional. Using Fisher's formula [18], the proportion of mothers with knowledge of neonatal jaundice from a previous study (31.6%) [7], 95% confidence level and 5% margin of error, we obtained a sample size of 335. This sample size was increased by 10% to account for non-response, giving a final sample size of 369.

A multistage sampling method was used. In the first stage, half of the wards were sampled using simple ballot. In the second stage, one settlement was selected from each sampled ward using the same method. Numbers were then allocated to the selected settlements. After household enumeration, a sampling interval was determined. The systematic sampling method was used to select respondents in each settlement. The first household was selected by simple random sampling between 1 and the settlement's sampling interval. Subsequent households were obtained by adding the sampling interval to the preceding household's serial number. Finally, within each sampled household, eligible women were requested to provide consent after detailed explanation about the study. When

more than one eligible respondent was encountered in a household, one respondent was sampled through a simple ballot.

2.3. Data collection

A pre-tested structured questionnaire was developed from previous studies [7,13,19]. The questionnaire had four sections eliciting socio-demographic characteristics and obstetric care, knowledge of neonatal jaundice, care-seeking behavior and perceptions and beliefs about neonatal jaundice.

The first section had 18 items eliciting the socio-demographic characteristics of the mother-infant dyad, including age, marital status, ethnicity, religion, education, partner's education, and occupation. The section also inquired about the obstetric history and care, including parity, age of index infant, antenatal care, place of last delivery, stillbirths and neonatal deaths. The second section had 14 items that assessed maternal knowledge of neonatal jaundice. The section included questions on mothers' awareness of neonatal jaundice, recognition (correct site for recognition of jaundice (eyes/skin), know where and what to look for, the causes (physiological, prematurity, infection, mother-baby blood group incompatibility, and inadequate breastfeeding), and effects and signs of severity (refusal to feed, high pitched cry, arching of body, convulsion, and fever). The section also inquired about knowledge of long term complications (deafness, blindness, physical handicap, mental retardation, growth failure, and seizure disorders), methods of prevention and treatment options (phototherapy and exchange transfusion). Care-seeking behavior was ascertained by the action taken for a previously jaundiced baby and the preferred source of care in the future. After completing the study, all mothers were educated on neonatal jaundice and the steps to take when they notice jaundice in a newborn.

Using a 10% sample, the questionnaire was pre-tested in a similar community, Kura for clarity and cultural sensitivity. Pediatricians and community physicians confirmed the content validity. Reliability was reflected by the Cronbach's alpha values of 0.82, 0.86 and 0.87 for the sections on knowledge, care-seeking behavior and attitude towards neonatal jaundice, respectively.

2.4. Measures

2.4.1. Outcome and explanatory variables

The main outcomes of this study were maternal knowledge and care-seeking behavior for neonatal jaundice. Aspects of knowledge assessed included: the main source of information, recognition, perceived causes, dangers and long term complications, and methods of treatment and prevention of neonatal jaundice. Care-seeking behavior was assessed by inquiring about the action taken, the source of treatment and the modalities among mothers with previous experience with neonatal jaundice. All mothers were asked about their preferred source of treatment for neonatal jaundice in the future. For the knowledge assessment, one point was awarded for correct responses, no points were given for incorrect and don't know responses. Total knowledge scores of 0–6, 7–10 and 11–14 were categorized as poor, fair and good knowledge, respectively, as in an earlier study [14]. This categorization could facilitate targeting, planning, content development and implementation of information, education and communication interventions to address knowledge gaps. For instance, mothers with good knowledge can be trained and recruited to serve as peer educators to mothers with fair knowledge, whereas health workers and community health extension workers could focus on mothers with poor knowledge. Caregivers' preferred source of treatment for neonatal jaundice in the future was classified as health facility, traditional healers and home remedies. The independent variables included sociodemographic factors, maternal age, marital status, education, partner's education, ethnicity, religion, occupation. Others were parity, antenatal care, place of last delivery, stillbirth and neonatal death and knowledge of neonatal jaundice.

2.4.2. Procedures

The protocol was approved by the Aminu Kano Teaching Hospital Research Ethics Committee. Permissions were also obtained from Kumbotso Local government officials, and traditional authorities. Male spouses were informed about the study during Friday prayer sermons and other social events. Using local Hausa language, trained research assistants informed eligible women in sampled households individually about the study objectives, eligibility criteria, sampling process, and what participation entails. Potential participants were also informed that participation was voluntary and withholding of consent had no consequences. Literate women provided signed informed consent, while non-literate ones thumb-printed the consent form before the conduct of interviews. No incentives were given. Mothers that required counseling or health services were referred to the appropriate health facility and all mothers received information on neonatal jaundice after completion of the study. Completed questionnaires were checked in the field by the supervisors and double-entered independently by two data clerks into a password-protected database at the Centre for Infectious Diseases Research. Steps were taken to protect privacy and confidentiality. Research staff members were trained on the protection of human research participants, establishing rapport, obtaining informed consent and interview techniques. Personal identifiers were not collected; participants were identified by serial numbers in the database.

2.4.3. Data analysis

Data were coded, sorted and processed using SPSS software version 22 [20]. Continuous data were described using mean with standard deviation or median and range. Categorical data were summarized as frequencies and percentages. At the bivariate level, Pearson's chi-square or Fisher's exact test were used as appropriate to test the significance of associations, with a $p < 0.05$ considered significant. A binary logistic regression model (stepwise method) was developed for the two outcomes ('Knowledge of neonatal jaundice' and 'preferred source of treatment') with variables that had $p < 0.10$ at the bivariate level or those that were conceptually important, irrespective of significance [21]. The knowledge score was included as an independent variable in the model for 'preferred source of treatment'. Multi-collinearity between independent variables was checked and eliminated using collinearity statistics, with a tolerance value < 0.2 as cut off. Hosmer-Lemeshow statistic and Omnibus tests were used to determine model fitness. Adjusted odds ratios (aOR) and 95% Confidence Intervals were used to measure the strength and direction of effect.

3. Results

3.1. Socio-demographic characteristics

Of the 369 women approached, (97.8%, $n = 361$) completed the interviews. Respondents' and infants' mean ages were 29.5 ± 8.50 years and $7.3 (\pm 5.50)$ months, respectively. Most participants were married (87.5%, $n = 316$), of Hausa-Fulani (90.0%, $n = 325$) ethnicity, and Muslim (95.0%, $n = 343$). Majority of participants (73.1%, $n = 264$) had at least secondary education, while (10.8%, $n = 39$) had primary, and 16.1% ($n = 58$) had no formal education. Over a third of the respondents were homemakers (Table 1). Most respondents, (86.7%, $n = 313$) had antenatal care in the last pregnancy and half (50.1%, $n = 181$) were delivered at home by traditional birth attendants. Previous stillbirths, having a jaundiced child and neonatal deaths were reported by (15%, $n = 54$), (32.4%, $n = 117$) and (11.9%, $n = 43$), respectively.

3.2. Knowledge of neonatal jaundice

Of the 361 respondents, (65.1%, $n = 235$) were aware of neonatal jaundice. Most respondents (28.0%, $n = 101$) received information on neonatal jaundice from health workers. The proportion of respondents with good, fair and poor knowledge of neonatal jaundice were (46.0%, $n = 166$), (24.1%, $n = 87$) and (30.0%, $n = 108$), respectively. Over half (56.8%, $n = 205$) of the respondents claimed they could recognize neonatal jaundice by checking for the yellowish discoloration of the eyes (52.1%, $n = 188$), skin (20.0%, $n = 72$) and fecal color changes (25.2%, $n = 91$) (Table 2). Poor feeding, abnormal crying, and abnormal eye movement were the top three mentioned effects of severe neonatal jaundice. Further, respondents identified brain damage, delayed development, physical disability and death as the major complications. Respondents mentioned infections, malaria/fevers, prematurity, and blood group (ABO/Rh) incompatibilities as the main causes of neonatal jaundice. Finally, most mothers recommended antenatal care and hospital delivery as preventive measures, and phototherapy (32.7%, $n = 118$) and exchange blood transfusion (12.5%, $n = 45$) as treatment options.

Overall, the knowledge score ranged from 2.0 to 10.0 with a mean (\pm SD) of 6.16 ± 1.43 . The lowest mean score (5.64 ± 1.24) was among those reporting family members, friends, radio, television, Internet and

Table 1

Socio-demographic characteristics of respondents, Kumbotso, Nigeria, 2019 ($n = 361$).

Characteristics	Frequency No. (%) N = 361
Age group	
<20	54 (15.0)
20-34	206 (57.0)
≥ 35	101 (28.0)
Ethnicity	
Hausa/Fulani	325 (90.0)
Others*	36 (10.0)
Religion	
Islam	343 (95.0)
Christianity	18 (5.0)
Marital status	
Single	4 (1.1)
Married	316 (87.5)
Divorced/Widowed	41 (11.4)
Education	
No formal	58 (16.1)
Primary	39 (10.8)
Secondary/Post-secondary	264 (73.1)
Husband's education	
No formal	39 (10.8)
Primary	34 (9.4)
Secondary/Tertiary	288 (79.8)
Occupation	
Homemaker	141 (39.1)
Petty trading	75 (20.8)
Farming	16 (4.3)
Civil servant	84 (23.3)
Others**	45 (12.5)
Parity	
1	51 (14.1)
2-4	165 (45.7)
≥ 5	145 (40.2)
Antenatal care during the last pregnancy	
None	48 (13.3)
<4 visits	92 (25.5)
≥ 4 visits	221 (61.2)
Place of last delivery	
Home	181 (50.1)
Health facility	180 (49.9)
Previous Stillbirths	
Yes	54 (15.0)
No	307 (85.0)
Previous child with jaundice	
Yes	117 (32.4)
No	244 (67.6)
Previous neonatal deaths	
Yes	43 (11.9)
No	318 (88.1)

Others* = Kanuri, Igbo and Yoruba.

Others** = restaurateur, salon owner, volunteer community mobilizer, women leader, thrift collector.

Table 2
Maternal knowledge of neonatal jaundice, Kumbotso, Nigeria, 2019 ($n = 361$).

Maternal knowledge	Frequency n (%)
Where to check for jaundice^a	
Eyes	188 (52.1)
Skin	72 (20.0)
Palms/Soles	22 (6.1)
Urine	23 (6.4)
Feces	91 (25.2)
Don't know	81 (22.4)
Perceived main causes of neonatal jaundice	
Infections	60 (16.6)
Malaria/Fever	115 (31.9)
Prematurity	40 (11.1)
Blood group (ABO/Rhesus) incompatibility	33 (9.1)
Enzyme (G6PD) deficiency	10 (2.8)
Others ^b	12 (3.3)
Don't know	91 (25.2)
Danger signs of neonatal jaundice	
Poor feeding	82 (22.7)
Abnormal cry	53 (14.7)
Abnormal eye movement	49 (13.6)
Irritability	46 (12.7)
Abnormal body stretching	29 (8.0)
Don't know	102 (28.3)
Long term complications of neonatal jaundice	
Brain damage	90 (24.9)
Delayed development	78 (21.6)
Physical disability	24 (6.7)
Deafness	17 (4.7)
Convulsion	13 (3.6)
Death	28 (7.8)
None	8 (2.2)
Don't know	103 (28.5)
Treatment of neonatal jaundice	
Exposure to sunlight	23 (6.4)
Exposure to artificial light in the hospital (Phototherapy)	118 (32.7)
Change baby's blood (Exchange blood transfusion)	45 (12.5)
Traditional concoctions or spiritual healing	16 (4.4)
Others ^c	31 (8.6)
Don't know	128 (35.4)
Methods of prevention	
Antenatal care	113 (31.3)
Hospital delivery	70 (19.4)
Good cord care	7 (1.9)
Prompt treatment of infections	20 (5.5)
Avoid hemolytic substances	35 (9.7)
Don't know	116 (32.1)
Future planned action for neonatal jaundice	
Take baby to a health facility	236 (65.4)
Traditional healers	18 (5.0)
Home remedies ^d	107 (29.6)

^a Multiple responses; Others.

^b = Breastfeeding, Breast milk, herbal medicine, Henna, Naphthalene balls; Others.

^c = raw pawpaw, sugar/glucose water, breastfeeding, drop breast milk in the baby's eyes.

^d Raw yellow pawpaw, sugar/glucose water, breastfeeding, drop breast milk in the baby's eyes.

traditional birth attendants as source of information on neonatal jaundice, while the highest score (7.50 ± 0.91) was among those informed by health care workers (Table 3).

3.3. Experience and care-seeking behavior for neonatal jaundice

Nearly a third (32.4%, $n = 117$) of the mothers reported that they had an infant with jaundice prior to the study. In this sub-group, jaundice was first detected mostly by health workers (37.6%, $n = 44$), mother (37.6%, $n = 44$) or family/relatives/friends (24.8%, $n = 29$). Of those with previous experience, (67.5%, $n = 79$) and (20.5%, $n = 24$) received treatment from health facilities and traditional healers, respectively, while (12.0%, $n = 14$) applied home remedies, including exposure to sunlight, raw pawpaw, glucose water, breastfeeding and applying breast milk to

Table 3
Mean knowledge scores by maternal socio-demographic characteristics, Kumbotso, Nigeria, 2019 ($n = 361$).

Characteristics	N	Mean knowledge score \pm SD	Range
Age group			
<20	54	5.96 \pm 1.48	3.0–11.0
20–34	206	6.12 \pm 1.39	3.0–11.0
≥ 35	101	6.34 \pm 1.47	2.0–12.0
Ethnicity			
Hausa/Fulani	325	6.19 \pm 1.42	2.0–11.0
Others ^a	36	5.86 \pm 1.50	3.0–11.0
Religion			
Islam	343	6.17 \pm 1.44	2.0–12.0
Christianity	18	6.00 \pm 1.24	4.0–11.0
Marital status			
Married	316	6.11 \pm 1.46	2.0–11.0
Single/divorced/widowed	45	6.51 \pm 1.12	4.0–12.0
Education			
No formal	58	6.53 \pm 1.13	4.0–12.0
Primary	39	6.89 \pm 1.12	4.0–12.0
Secondary	180	5.78 \pm 1.50	2.0–11.0
Post-secondary	84	6.37 \pm 1.34	4.0–12.0
Occupation			
Home maker	141	6.02 \pm 1.54	2.00–11.0
Petty trading	75	6.47 \pm 1.31	3.0–11.0
Farming	16	5.94 \pm 1.12	4.0–11.0
Civil servant	84	6.27 \pm 1.43	3.0–12.0
Others ^b	45	5.93 \pm 1.25	4.0–11.0
Parity			
1	51	5.69 \pm 1.35	3.0–11.0
2–4	165	6.21 \pm 1.41	3.0–12.0
≥ 5	145	6.27 \pm 1.45	2.0–11.0
Antenatal care during the last pregnancy			
None	48	6.00 \pm 1.22	4.0–11.0
<4	92	5.92 \pm 1.40	2.0–11.0
≥ 4	221	6.29 \pm 1.47	3.0–12.0
Place of last delivery			
Home	181	6.33 \pm 1.43	2.0–11.0
Health facility	180	5.98 \pm 1.41	3.0–12.0
Source of information on neonatal jaundice			
Health workers	101	7.50 \pm 0.91	5.0–13.0
Others ^c	260	5.64 \pm 1.24	2.0–11.0
Previous child with jaundice			
Yes	117	6.98 \pm 1.15	3.0–12.0
No	244	5.76 \pm 1.38	2.0–11.0
Overall	361	6.16 \pm 1.43	2.0–13.0

SD=Standard Deviation.

Others^c = Family members, Friends, Radio, Television, Internet and traditional birth attendants.

^a Kanuri, Igbo and Yoruba.

^b Restaurateur, salon owner, volunteer community mobilizer, women leader, thrift collector.

the baby's eyes. The corresponding proportions that reported planning for similar actions in the future were (65.4%, $n = 236$), (5.0%, $n = 18$) and (29.6%, $n = 107$) (Table 2). Most infants (79.5%, $n = 93$) treated for neonatal jaundice recovered fully; (11.1%, $n = 13$) had long term complications, while (9.4%, $n = 11$) infants died.

3.4. Predictors of knowledge and care-seeking behavior for neonatal jaundice

At the bivariate level, the knowledge of neonatal jaundice was directly associated with maternal and paternal education, source of information, place of last delivery, previous stillbirth, previous neonatal death and previous child with jaundice. Preference for health facility treatment was associated with age group, ethnicity, knowledge of neonatal jaundice, source of information, parity, antenatal care, stillbirth, neonatal death and previous child with jaundice ($p < 0.05$) (Table 4).

After multivariate analysis, maternal education, source of information, place of last delivery and previous child with jaundice independently predicted knowledge of neonatal jaundice (Table 5). Compared to

Table 4
Knowledge and care-seeking practices by maternal characteristics, Kumbotso, Nigeria, 2019 (n = 361).

Characteristics	Frequency No. (%)		Mothers' knowledge of neonatal jaundice Good Fair/Poor		Mothers' preferred source of care for neonatal jaundice Traditional healer/ Home remedies Health facility	
	n (%)	n (%) p value	n (%)	n (%) p value	n (%)	n (%) p value
N						
Age group		0.16		<0.001*		
<20	54	21 (38.9)	33 (61.1)	7 (13.0)	47 (87.0)	
20-34	206	91 (44.2)	115 (55.8)	72 (35.0)	134 (65.1)	
≥35	101	54 (53.5)	47 (46.5)	46 (45.5)	55 (54.5)	
Ethnicity		0.37		0.036*		
Hausa/ Fulani	325	152 (46.8)	173 (53.2)	115 (35.4)	210 (64.6)	
Others ^a	36	14 (38.9)	22 (61.1)	10 (27.8)	26 (72.2)	
Religion		0.54		0.91		
Islam	343	159 (46.4)	184 (53.6)	119 (34.7)	224 (65.3)	
Christianity	18	7 (38.9)	11 (61.1)	6 (33.3)	12 (66.7)	
Marital status		0.09		0.39		
Married	316	140 (44.3)	176 (55.7)	112 (35.4)	204 (64.6)	
Single/ Divorced/ Widowed	45	26 (57.8)	19 (42.2)	13 (28.9)	32 (71.1)	
Education		<0.001*		0.20		
No formal	58	35 (60.3)	23 (39.7)	22 (37.9)	36 (62.1)	
Primary	39	27 (69.2)	12 (30.8)	18 (46.2)	21 (53.9)	
Secondary/ Tertiary	264	104 (39.4)	160 (60.6)	85 (32.2)	179 (67.8)	
Husband's Education		0.008		0.06		
No formal	39	27 (69.2)	12 (30.8)	21 (40.4)	31 (59.6)	
Primary	34	16 (47.1)	18 (52.9)	15 (53.6)	13 (46.4)	
Secondary/ tertiary	288	123 (42.7)	165 (57.3)	76 (32.2)	160 (67.8)	
Occupation		0.13		0.27		
Homemaker	141	63 (44.7)	78 (55.3)	44 (31.2)	97 (68.8)	
Petty trading	75	40 (53.3)	35 (46.7)	29 (38.7)	46 (61.3)	
Farming	16	6 (37.5)	10 (62.5)	6 (37.5)	10 (62.5)	
Civil servant	84	43 (51.2)	41 (48.8)	35 (41.7)	49 (58.3)	
Others ^b	45	14 (31.1)	31 (68.9)	11 (24.4)	34 (75.6)	
Knowledge of neonatal jaundice				<0.001*		
Good	166			81 (48.8)	85 (51.2)	
Fair	87	Not Applicable	Not Applicable	26 (29.9)	61 (70.1)	
Poor	108			18 (16.7)	90 (83.3)	
		<0.001*			<0.001*	

Table 4 (continued)

Characteristics	Frequency No. (%)		Mothers' knowledge of neonatal jaundice Good Fair/Poor		Mothers' preferred source of care for neonatal jaundice Traditional healer/ Home remedies Health facility	
	n (%)	n (%) p value	n (%)	n (%) p value	n (%)	n (%) p value
N						
Source of information on neonatal jaundice						
Health care worker	101	85 (84.2)	16 (15.8)	56 (55.5)	45 (44.5)	
Others ^c	260	81 (31.2)	179 (68.9)	69 (26.5)	191 (73.5)	
Parity		0.009*		<0.001*		
1	51	14 (27.5)	37 (72.6)	5 (9.8)	46 (90.2)	
2-4	165	76 (46.1)	89 (53.9)	54 (32.7)	111 (67.3)	
≥5	145	76 (52.1)	69 (47.6)	66 (45.5)	79 (54.5)	
Antenatal care visits during the last pregnancy		0.28		0.016*		
None	48	20 (41.7)	28 (58.3)	16 (33.3)	32 (66.7)	
<4	92	37 (40.2)	55 (59.8)	21 (22.8)	71 (77.2)	
≥4	221	109 (49.3)	112 (50.7)	88 (39.8)	133 (60.2)	
Place of last delivery		0.001*		0.77		
Home	181	99 (54.7)	82 (45.3)	64 (35.4)	117 (64.6)	
Health facility	180	67 (37.2)	113 (62.8)	61 (33.9)	119 (66.1)	
Previous stillbirth		0.007*		0.004*		
Yes	54	34 (63.0)	20 (37.0)	28 (51.9)	26 (48.2)	
No	307	132 (43.0)	175 (57.0)	97 (31.6)	210 (68.4)	
Previous neonatal death		0.018		0.001*		
Yes	43	27 (62.8)	16 (37.2)	25 (58.1)	18 (41.9)	
No	318	139 (43.7)	179 (56.3)	100 (31.5)	218 (68.6)	
Previous child with jaundice		<0.001*		<0.001*		
Yes	117	89 (76.1)	28 (23.9)	83 (70.9)	34 (29.1)	
No	244	77 (31.6)	167 (68.4)	42 (17.2)	202 (82.8)	

Others^a = Kanuri, Igbo, and Yoruba; Others^b = restaurateur, salon owner, volunteer community mobilizer, women leader, thrift collector; Others^c = Family members, Friends, Radio, Television, Internet and traditional birth attendants *Significant at p < 0.05.

participants without formal education, mothers with secondary education or higher (AOR = 2.39; 95%CI: 1.16–4.91) had over two-fold increased likelihood of having a good knowledge of neonatal jaundice. Similarly, respondents informed by health workers (AOR = 11.3; 95%CI: 5.84–21.93) had over 11-fold increased odds of having good knowledge relative to those informed from other sources. In addition, women who were last delivered in a health facility had 83% increased chance (AOR = 1.83; 95%CI: 1.06–3.14) of having good knowledge of neonatal jaundice

Table 5

Logistic regression model for predictors of maternal knowledge of neonatal jaundice, Kumbotso, Nigeria, 2019 ($n = 361$).

Characteristics	Crude Odds Ratio (95% CI) Mothers' knowledge of Neonatal jaundice (Good versus Fair/poor)	Adjusted Odds Ratio (95% CI) ^a Mothers' knowledge of Neonatal jaundice (Good versus Fair/poor)	<i>p</i> -value
<i>Marital status</i>			
Married	1.85 (0.86–3.99)	1.72 (0.91–3.24)	0.64
Single/ Divorced/ Widowed	Referent	Referent	
<i>Parity</i>			
1	Referent	Referent	
2–4	0.44 (0.23–0.88)	1.20 (0.53–2.72)	0.10
≥5	0.34 (0.17–0.69)	1.23 (0.51–2.98)	0.08
<i>Education</i>			
No formal	Referent	Referent	
Primary	0.68 (0.29–1.60)	1.07 (0.38–3.03)	0.33
Secondary/Post-secondary	2.34 (1.31–4.19)	2.39 (1.16–4.91)	0.027*
<i>Husband's education</i>			
No formal	Referent	Referent	
Primary	1.56 (0.38–4.64)	1.42 (0.47–3.53)	0.22
Secondary/Post-secondary	2.44 (0.54–7.46)	2.14 (0.36–6.46)	0.27
<i>Source of information on neonatal jaundice</i>			
Health workers	11.74 (6.47–21.29)	11.31 (5.84–21.93)	<0.001*
Others ^c	Referent	Referent	
<i>Place of last delivery</i>			
Home	Referent	Referent	
Health facility	2.04 (1.34–3.10)	1.83 (1.06–3.14)	0.031*
<i>Previous stillbirth</i>			
Yes	2.25 (1.24–4.09)	1.38 (0.59–3.24)	0.13
No	Referent	Referent	
<i>Previous neonatal death</i>			
Yes	2.17 (1.13–4.19)	1.08 (0.42–2.76)	0.84
No	Referent	Referent	
<i>Previous child with jaundice</i>			
Yes	6.89 (4.17–11.40)	5.06 (2.76–9.27)	<0.001*
No	Referent	Referent	
Model		DF = 9, $\chi^2 = 9.59$	0.29
Goodness-of-Fit			
Hosmer-Lemeshow test			

Others^c = Family members, Friends, Radio, Television, Internet and traditional birth attendants.

* Significant at $p < 0.05$; OR: Odds Ratio, CI: confidence interval.

^a Logistic model includes the following variables: marital status, parity, maternal education, husband's education, source of information, place of last delivery, previous stillbirth, neonatal death, and previous jaundiced child.

compared to those who delivered at home. Further, having a jaundiced infant prior to the study increased the likelihood of good knowledge over five-fold (AOR = 5.06; 95%CI: 2.76–9.27) (see Table 6).

Preference for health facility treatment was predicted by maternal ethnicity, source of information, previous child with jaundice and antenatal attendance. Hausa-Fulani mothers were 64% less likely to prefer health facility treatment for neonatal jaundice compared to mothers from other ethnic groups (AOR = 0.36; 95%CI: 0.14–0.96). In contrast, mothers who were informed about neonatal jaundice by health care workers were more than two times likely to seek care from health facility compared to those that obtained information from other sources (AOR = 2.33; 95%CI: 1.30–4.17). Having a prior infant with jaundice increased the likelihood of seeking health facility treatment over 10-fold (AOR = 10.04; 95%CI: 5.73–17.60) compared to mothers with no such experience. Finally, antenatal attendance during the last pregnancy increased

Table 6

Logistic regression model for predictors of health-seeking behavior for neonatal jaundice, Kumbotso, Nigeria, 2019 ($n = 361$).

Characteristics	Crude Odds Ratio (95% CI) Mothers' preference for health facility versus traditional healer for the treatment of neonatal jaundice	Adjusted Odds Ratio (95% CI) ^a Mothers' preference for health facility versus traditional healer for the treatment of neonatal jaundice	<i>p</i> -value
<i>Age group</i>			
<20	Referent	Referent	
20–34	3.61 (1.55–8.39)	2.47 (0.64–9.47)	0.19
≥35	5.62 (2.32–13.61)	1.11 (0.53–2.35)	0.78
<i>Ethnicity</i>			
Hausa-Fulani	0.70 (0.33–0.98)	0.36 (0.14–0.96)	0.04*
Others	Referent	Referent	
<i>Husband's Education</i>			
No formal	Referent	Referent	
Primary	3.21 (1.03–6.46)	2.15 (0.90–5.17)	0.09
Secondary/Post-secondary	2.14 (0.89–6.41)	1.93 (0.71–5.26)	0.20
<i>Source of information on neonatal jaundice</i>			
Health workers	3.44 (2.12–5.56)	2.33 (1.30–4.17)	0.035*
Others ^c	Referent	Referent	
<i>Parity</i>			
1	2.48 (1.68–6.91)	1.67 (0.46–6.08)	0.43
2–4	2.39 (1.89–7.46)	1.22 (0.60–2.49)	0.58
≥5	Referent	Referent	
<i>Previous stillbirth</i>			
Yes	0.43 (0.24–0.77)	0.86 (0.38–1.96)	0.72
No	Referent	Referent	
<i>Previous neonatal death</i>			
Yes	0.33 (0.17–0.63)	0.80 (0.32–2.04)	0.64
No	Referent	Referent	
<i>Previous child with jaundice</i>			
Yes	11.74 (6.98–19.74)	10.04 (5.73–17.60)	<0.001*
No	Referent	Referent	
<i>Antenatal visits</i>			
None	Referent	Referent	
<4	1.69 (0.78–3.66)	1.40 (0.60–3.30)	0.44
≥4	0.76 (0.39–1.46)	2.97 (1.43–6.15)	0.003*
<i>Knowledge of neonatal jaundice</i>			
Good	3.27 (2.08–5.15)	0.87 (0.46–1.66)	0.36
Fair/Poor	Referent	Referent	
Model		DF = 10, $\chi^2 = 5.20$	0.74
Goodness-of-Fit			
Hosmer-Lemeshow test			

Others^c = Family members, Friends, Radio, Television, Internet and traditional birth attendants.

* Significant at $p < 0.05$; OR: Odds Ratio, CI: confidence interval.

^a Logistic model includes the following variables: age group, ethnicity, maternal education, husband's education, source of information, parity, previous stillbirth, neonatal death, and previous jaundiced child, antenatal visits and knowledge of neonatal jaundice.

the odds of seeking health facility treatment by three-fold (AOR = 2.97; 95%CI: 1.43–6.15). All models were of good fit, as demonstrated by Hosmer-Lemeshow test results ($\chi^2 = 9.59$ $p = 0.29$ and $\chi^2 = 5.20$, $p = 0.74$ for knowledge and preferred source of treatment, respectively).

4. Discussion

Considering the high incidence of neonatal jaundice and the severe consequences of poorly managed neonatal hyperbilirubinemia, especially in low resource settings, we assessed the determinants of caregiver knowledge and health-seeking behavior for neonatal jaundice. Less than half of the respondents had good knowledge. Although the majority of

the mothers who had jaundiced children sought treatment in health facilities, a sizeable number resorted to home remedies and traditional healers. Maternal education, source of information, recent delivery in a health facility and having a previously jaundiced infant predicted knowledge of neonatal jaundice, while preference for health facility treatment was predicted by maternal ethnicity, source of information, history of a previously jaundiced infant and antenatal care.

4.1. Knowledge of neonatal jaundice

Our findings that over a third of the caregivers were unaware of neonatal jaundice and more than half demonstrated inadequate (fair and poor) knowledge of neonatal jaundice could explain why jaundice in one third of infants were only detected by health workers and another one quarter by family/relatives or friends. Delayed recognition of neonatal jaundice could lead to complications with severe neurodevelopmental consequences. Non-attendance or sub-optimal antenatal care and dominance of home deliveries limits opportunities to educate mothers and screen for risk factors, such as ABO and Rh incompatibility and family history of glucose-6-phosphate dehydrogenase deficiency. Similarly, opportunities for physical examination of the newborn and pre-discharge advice are missed.

Our findings are consistent with most reports from Nigeria [19,20,27], but are at variance with others [7,13,14,22–24]. Similarly, the proportion of caregivers that correctly identified the features of neonatal jaundice was comparable with most earlier reports (23–43%) [14,22,24]. The slight variations could be due to the urban, hospital-based study population in the cited studies, as attendees of urban hospitals are likely to be better-educated and have more media access. Differences in health literacy, study populations, cultural practices, methods, and currency could also explain some of these variations.

4.2. Misconceptions about the causes and treatment of neonatal jaundice

Misconceptions about causes and treatment of neonatal jaundice, including exposure to sunlight, use of raw pawpaw, and applying breast milk to the baby's eyes are rife in Nigeria [7,22]. For instance, mothers in Port Harcourt, south-south Nigeria, believed that mosquito bites, the consumption of peanuts and palm oil during pregnancy caused neonatal jaundice [7,22]. Similarly, over half (58%) of study participants in Lagos, Nigeria held similar beliefs [7]. Previous reports suggest that these notions are not limited to caregivers, as a proportion of health care workers in South Africa expressed similar views [25]. Some of these measures could be rationalized, for instance the exposure of jaundiced infants to solar rays [26], where mothers misconstrue direct solar exposure for phototherapy, unaware that the latter uses specific wavelengths. A recent trial found that with appropriate monitoring, filtered solar rays effectively treated neonatal jaundice in low-resource tropical settings where conventional phototherapy was unavailable [27]. Unripe paw paw turns yellow when it ripens. While one could wonder if the similarity between neonatal skin discoloration with ripe paw paw is the basis for its use, other measures such as applying mother's milk in the infant's eyes defy logic. These practices need to be explored using qualitative enquiry.

4.3. Preferred treatment methods for neonatal jaundice

The proportion of mothers whose jaundiced infants received treatment from health facilities (67.5%) was higher than in some reports (16.2%) [13], but lower than others (90.5%) [7]. In contrast, the percentage that sought help from traditional healers (20.5%) was higher than in previous reports (13.7%) [7]. Regarding the future, the proportion of respondents that prefer treatment in health facilities was lower than among antenatal attendees across Nigeria (70.3%–86.1%) [13]. The use of home remedies and traditional healers by up to one third of mothers in our study portrays the risk faced by newborns in northern Nigeria. Apart from complications due to delayed presentation in health

facilities, some of the treatment methods such as exposure to unfiltered sunlight and herbal concoctions could be harmful to the neonate. Apart from ignorance and cultural factors, treatment choices could be related to accessibility of health facilities, and expenses associated with transportation and hospital fees.

4.4. Predictive role of source of information, obstetric care and previous experience

The predictive role of maternal education on knowledge has been reported in some Nigerian studies [14], but not others [7]. Studies in parts of Africa [28] and Asia [19,26] also reported a positive influence of maternal education on knowledge. Mothers attributing their knowledge of neonatal jaundice to health care professionals could have received more accurate information compared to other sources. Further, in keeping with findings from Benin City, Nigeria, having a previously jaundiced infant enhanced maternal knowledge [14]. While providing treatment, health care workers are expected to inform mothers about the causes, prevention, treatment, and complications of neonatal jaundice. Nevertheless, there is a risk of complacency, if the child had mild jaundice. In addition, mothers who recently delivered in a health facility were more likely to have good knowledge, probably because educated mothers are more likely to deliver in health facilities and have the advantage of receiving additional information regarding features of ill-health in newborns from health care workers [14].

The role of ethnicity on health facility treatment preference was illustrated with decreased odds of Hausa-Fulani mothers seeking treatment in health facilities compared to other tribes could be a reflection of culture and health literacy. In rural northern Nigeria, hospital treatment is often considered as a last resort, partly explaining the high patronage of traditional birth attendants, healers and use of home remedies for neonatal jaundice treatment by a substantial proportion of mothers in our study. This is consistent with a recent review that identified social, cultural and health services factors as strong determinants of decisions to seek care [29]. Source of information, antenatal care and previous experience with a jaundiced child have all been reported as predictors of health facility treatment for neonatal jaundice in Nigeria [7,13,14]. Mothers with previously jaundiced infants are more likely to seek treatment in health facilities, as their experience could heighten awareness of the risk of complications and enhance health literacy [29]. It is also not surprising that antenatal attendees were more likely to prefer health facility treatment, as the antenatal clinic provides an opportunity to educate mothers about the prevention and management of neonatal jaundice.

This study has limitations. First, it was conducted in one rural community in northern Nigeria. Although health literacy, culture, and socioeconomic circumstances could be similar, there is the need for caution when extrapolating the findings to other parts of Nigeria. Similarly, the small number of non-Hausa/Fulani respondents was a limiting factor in making ethnic comparisons. Second, although our research assistants had no direct clinical responsibility, social desirability bias could not be ruled out, as some respondents could view them as health workers. Detailed explanations about the study objectives in an understandable language was meant to minimize such bias. Recall bias is a possibility among mothers whose infants had jaundice much earlier. Similarly, reports of future plans could differ from actions taken when confronted with the reality of a jaundiced newborn. Unmeasured variables such as distance to health facilities and the cost of transportation could also confound the choice of method of treatment, and should be included in future studies. Strengths of our study include the community-based rural setting, probability sampling, and the conduct of interviews in the local language.

In conclusion, care-giver knowledge of neonatal jaundice was inadequate and care-seeking behavior was sub-optimal, with a substantial proportion still resorting to traditional healers or home remedies. Maternal education, source of information, health facility delivery and history of having a previously jaundiced infant predicted maternal knowledge, while preference for health facility treatment was predicted

by maternal ethnicity, history of a previously jaundiced infant and antenatal clinic attendance.

Our findings highlight the need for a review of newborn and child health policy and the design of programs at the national, state and community levels to address neonatal jaundice with a focus on prevention, early detection and prompt management. The knowledge gaps and misconceptions among caregivers suggest that current antenatal programs need to be strengthened. Apart from developing evidence-based antenatal health education interventions, regular group educational sessions on antenatal clinic days can facilitate reaching new attendees. In addition, with a substantial proportion of unbooked pregnant women, community level strategies could include the use of electronic media and innovative cultural channels, such as the use of Hausa film celebrities and trained voluntary community mobilizers, female community health extension workers and community midwives to deliver messages on the prevention, treatment and dangers of neonatal jaundice. Further, mothers with good knowledge could be recruited as peer educators in their communities. Future studies should evaluate the effectiveness of antenatal health education and reasons why certain ethnic groups prefer not to seek care in health facilities.

Ethical approval

This study was approved by the AKTH Research Ethics Committee and informed consent was obtained from subjects before the conduct of the study.

Funding

The authors received no specific funding for this work.

Declaration of competing interest

Dr Iliyasu is an Editorial Board member of Public Health in Practice. The authors have no competing interests to declare.

References

- [1] J.F. Watchko, Recent advances in the management of neonatal jaundice, *Res. Rep. Neonatol.* 4 (2014) 183–193.
- [2] B.O. Olusanya, M. Kaplan, T.W.R. Hansen, Neonatal hyperbilirubinemia: a global perspective, *Lancet Child Adolesc Health* 2 (2018) 610–620, [https://doi.org/10.1016/S2352-4642\(18\)30139-1](https://doi.org/10.1016/S2352-4642(18)30139-1).
- [3] M.J. Maisels, Managing the jaundiced newborn: a persistent challenge, *CMAJ (Can. Med. Assoc. J.)* 187 (5) (2015) 335–343.
- [4] T.M. Slusher, T.G. Zamora, D. Appiah, et al., Burden of severe neonatal jaundice: a systematic review and meta-analysis, *BMJ Paediatr. Open* 1 (2017), e000105.
- [5] S.E. Mir, B.A.M. van der Geest, J.V. Been, Management of neonatal jaundice in low- and lower-middle-income countries, *BMJ Paediatr. Open* 3 (2019), e000408.
- [6] V.K. Bhutani, A. Zipursky, H. Blencowe, R. Khanna, M. Sgro, F. Ebbesen, et al., Neonatal hyperbilirubinemia and Rhesus disease of the newborn: incidence and impairment estimates for 2010 at regional and global levels, *Pediatr. Res.* 74 (suppl 1) (2013) 86–100.
- [7] O.O. Goodman, O.A. Kehinde, B.A. Odugbemi, T.T. Femi-Adebayo, O.O. Odusanya, Neonatal jaundice: knowledge, attitude and practices of mothers in mosan-okunola community, Lagos, Nigeria, *Niger. Postgrad. Med. J.* 22 (2015) 158–163.
- [8] B.O. Olusanya, T.A. Ogunlesi, T.M. Slusher, Why is kernicterus still a major cause of death and disability in low-income and middle-income countries? *Arch. Dis. Child.* 99 (2014) 1117–1121.
- [9] B.O. Olusanya, F.B. Osibanjo, C.A. Mabogunje, T.M. Slusher, S.A. Olowe, The burden and management of neonatal jaundice in Nigeria: a scoping review of the literature, *Niger. J. Clin. Pract.* 19 (2016) 1–17.
- [10] C. Greco, G. Arnolda, N. Boo, I.F. Iskander, A.A. Okolo, R. Rohsiswatmo, et al., Neonatal jaundice in low- and middle-income countries: lessons and future directions from the 2015 don ostrow trieste yellow retreat, *Neonatology* 110 (2016) 172–180.
- [11] Z.L. Farouk, A. Muhammed, S. Gambo, M. Mukhtar-Yola, S. Umar Abdullahi, T.M. Slusher, Slusher. Follow-up of children with kernicterus in Kano, Nigeria, *J. Trop. Pediatr.* 64 (2018) 176–182.
- [12] Z. Iliyasu, I.S. Abubakar, A.U. Gajida, Magnitude and leading causes of in-hospital mortality at Aminu Kano Teaching Hospital, Kano, northern Nigeria: a 4-year prospective analysis, *Niger. J. Med.* 19 (4) (2010) 400–406.
- [13] C.V. Ezeaka, R.O. Ugwu, M. Mukhtar-Yola, E.N. Ekure, B.O. Olusanya, Pattern and predictors of maternal care-seeking practices for severe neonatal jaundice in Nigeria: a multi-center survey, *BMC Health Serv. Res.* 14 (2014) 192.
- [14] B.A. Egube, A.N. Ofili, A.R. Isara, Onakewhor JU, Neonatal jaundice and its management: knowledge, attitude, and practice among expectant mothers attending antenatal clinic at University of Benin Teaching Hospital, Benin City, Nigeria, *Niger. J. Clin. Pract.* 16 (2) (2013) 188–194.
- [15] T.A. Ogunlesi, A.R. Abdul, Maternal knowledge and care-seeking behaviors for newborn jaundice in Sagamu, Southwest Nigeria, *Niger. J. Clin. Pract.* 18 (1) (2015 Jan-Feb) 33–40.
- [16] R. Burstein, N.J. Henry, M.L. Collison, L.B. Marczak, A. Sligar, S. Watson, N. Marquez, M. Abbasalizad-Farhangi, M. Abbasi, F. Abd-Allah, et al., Mapping 123 million neonatal, infant and child deaths between 2000 and 2017, *Nature* 574 (2019) 353–358.
- [17] Population Council, Report of Nigeria's national population commission on the 2006 census, *Popul. Dev. Rev.* 33 (1) (2007) 206–210.
- [18] Lwanga SK, Lemeshow S. *Sample Size Determination in Health Studies: A Practical Manual* 1991; vols. 29–32. Geneva, Switzerland: World Health Organization.
- [19] B. Aggarwal, A. Agrawal, P. Chaudhary, G. Gupta, S. Rana, S. Gupta, Neonatal Jaundice: knowledge, attitude beliefs, and practices of postnatal mothers in a tertiary care hospital in Uttarakhand, India, *Indian J. Child Health* 4 (4) (2017) 603–608.
- [20] IBM Corp. Released in 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.
- [21] M.H. Katz, *Multivariable Analysis-A Practical Guide for Clinicians and Public Health Researchers*, Cambridge University Press, Cambridge, U.K., 2011, pp. 45–51.
- [22] O.B. Ogunfowora, P.O. Adefuye, M.B. Fetuga, What do expectant mothers know about neonatal jaundice? *Int. Electron. J. Health Educ.* 9 (2006) 134–140.
- [23] T.A. Ogunlesi, F.B. Ogunlesi, Family socio-demographic factors and maternal obstetric factors influencing appropriate health-care seeking behaviors for newborn jaundice in Sagamu, Nigeria, *Matern. Child Health J.* 16 (2012) 677–684.
- [24] A.U. Eneh, R.O. Ugwu, Perception of neonatal jaundice among women attending children outpatient and immunization clinics of the UPTH Port Harcourt, *Niger. J. Clin. Pract.* 12 (2009) 187–191.
- [25] Sonal Shah, C. Nigel, Rollins and ruth blanda for the child health group. Breastfeeding knowledge among health workers in rural South Africa, *J. Trop. Pediatr.* 51 (1) (2005) 33–38.
- [26] N.Y. Boo, C.Y. Gan, Y.W. Gian, K.S. Lim, M.W. Lim, H. Krishna-Kumar, Malaysian mothers' knowledge and practices on care of neonatal jaundice, *Med. J. Malaysia* 66 (2011) 239–243.
- [27] T.M. Slusher, H.J. Vreman, B.O. Olusanya, R.J. Wong, A.M. Bearley, Y.E. Vaucher, D.K. Stevenson, Safety and efficacy of filtered sunlight in treatment of jaundice in African neonates, *Pediatrics* 133 (6) (2014) e1568–e1574.
- [28] Z.S. Lassi, P. Middleton, Z.A. Bhutta, C. Crowther, Health care-seeking for maternal and newborn illnesses in low- and middle-income countries: a systematic review of observational and qualitative studies, *F1000Research* 8 (2019) 200.
- [29] M.M. Simieneh, M.Y. Mengistu, A.A. Gelagay, M.T. Gebeyehu, Mothers' health care seeking behavior and associated factors for common childhood illnesses, Northwest Ethiopia: community-based cross-sectional study, *BMC Health Serv. Res.* 19 (1) (2019) 59.