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Research Article

Maternal Nutritional Status and Treatment Outcomes among Neonates Admitted with Jaundice at the Federal Teaching Hospital, Katsina: A Descriptive Cross-Sectional Study

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ABSTRACT

Neonatal jaundice is a condition in newborns, characterized by yellow discoloration of the skin and sclera due to elevated serum bilirubin levels. Maternal nutritional status is an important component of maternal health and provides valuable information on the nutritional characteristics of mothers of neonates admitted with jaundice. This study described the maternal nutritional status and treatment outcomes among neonates admitted with neonatal jaundice at Federal Teaching Hospital, Katsina. The study was a hospital-based cross-sectional study conducted among 172 neonates with jaundice and their mothers. Maternal nutritional status was assessed using socio-demographic characteristics, anthropometric indices, and dietary patterns obtained through a food frequency questionnaire. Neonatal clinical characteristics, treatment modalities, and outcomes were extracted from the hospital's medical records. Most mothers were aged 20–34 years (73.8%) predominantly Hausa, Muslim, with the majority residing in urban areas. Majority of the mothers had normal body mass index (57.0%) and mid-upper arm circumference (84.8%). However, 65.0% of mothers had poor dietary diversity, with diets predominantly cereal-based and limited intake of animal-source foods. Most neonates were male (57.6%), delivered at term (84.9%), and presented within the first five days of life (61.0%). Treatment outcomes were generally favourable, with most neonates discharged without complications however, a mortality rate of (4.1%) was recorded. Despite generally acceptable maternal nutritional status, inadequate dietary diversity was common, highlighting the need for improved dietary assessment and nutritional support among mothers.

Keywords: *Neonatal jaundice; Maternal nutrition; Dietary diversity; Phototherapy; Treatment outcomes; Anthropometric...*

INTRODUCTION

The term jaundice originates from the French word *jaune*, meaning yellow. It is characterized by yellow discoloration of the skin, sclerae, and mucous membranes due to excessive accumulation of bilirubin, resulting from increased production or impaired excretion (Imdad and Amara, 2024). In prolonged cases, the discoloration may become greenish due to biliverdin accumulation (Joseph *et al.*, 2024). Neonatal jaundice is a common clinical concern amongst neonates, with about 50%–60% of term infants and 80% of preterm infants developing jaundice within 1 week after birth (Joseph *et al.,* 2024). As reported by Iliyasu *et al.,* (2020), globally an estimated 481,000 infants develop extreme hyperbilirubinemia each year, with many at risk of long-term complications. The Global Burden of Disease study ranks severe neonatal jaundice among the top 5–10 causes of neonatal mortality in countries with the highest rates of new-born deaths (Diala *et al.,* 2023).

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Maternal nutritional status has a significant influence on neonatal jaundice and influences both the risk and severity of neonatal jaundice. Poor maternal nutrition is associated with low birth weight and prematurity, both of which are independent risk factors for neonatal jaundice due to the neonate's immature liver function (Kumar *et al.,* 2019). Study done by El-Mazary *et al.,* (2014), demonstrated that neonates born to malnourished mothers are more likely to develop hyperbilirubinemia. Therefore, the risk of neonatal jaundice is significantly higher in neonates born to undernourished mothers, particularly in low resource settings (Olusanya *et al.,* 2015).

Management of neonatal jaundice primarily involves phototherapy, with exchange transfusion or intravenous immunoglobulin reserved for severe or immune-mediated cases (Olusanya *et al.,* 2016). Phototherapy involves exposing the baby's skin to special blue light which converts unconjugated bilirubin into water-soluble forms that can be excreted without conjugation and is commonly used for moderate to severe jaundice. In cases where phototherapy is ineffective or the bilirubin levels are dangerously high, exchange transfusions may be necessary to rapidly lower bilirubin levels (Imdad and Amara 2024). However, delayed or inadequate treatment may lead to acute bilirubin encephalopathy or kernicterus, resulting in surviving infants acquiring long term neurodevelopmental sequelae such as cerebral palsy, hearing loss, intellectual difficulties or developmental delays (Olusanya *et al.,* 2016). The Global Burden of Disease Study indicates that while the incidence of kernicterus has decreased in high income countries, it remains a significant cause of neonatal morbidity and mortality in low- and middle-income countries owing to limited access to early diagnosis and treatment (Olusanya *et al*., 2018).

Although similar studies have been conducted in other parts of Nigeria and in some countries, such data are lacking in the Federal Teaching Hospital, Katsina (FTHK). Therefore, there is a need to conduct this study to contribute to existing knowledge, guide nutritional interventions during pregnancy, and ultimately improve outcomes for newborns affected by jaundice. Therefore, the research aimed to describe the maternal nutritional status and treatment outcomes among neonates admitted with neonatal jaundice at the Federal Teaching Hospital, Katsina, by assessing maternal dietary patterns, anthropometric indices, treatment modalities, and outcomes of neonates with jaundice.

MATERIALS AND METHODS

Study design and location

The study was a hospital-based, cross-sectional study at Federal Teaching Hospital Katsina (FTHK) involving 172 participants with the sample size calculated using Cochran's formula based on an estimated prevalence of neonatal jaundice of 15.0% from the study by Olatubi *et al.,* (2021). The study was conducted from April to July 2025, during this period, 710 neonatal admissions were recorded, of which 246 were diagnosed with neonatal jaundice. Eligible neonates with jaundice and their mothers were recruited using convenience sampling based on their availability during the researcher's presence at the hospital until 172 mother–neonate pairs were attained

Study participants (Inclusion and Exclusion Criteria)

The study population comprised of neonates admitted with a clinical diagnosis of neonatal jaundice, where jaundice was the primary diagnosis requiring evaluation and or treatment. Neonates whom jaundice was documented only as a concomitant condition secondary to another primary diagnosis were excluded. Parents of the new-borns who did not give consent to participate in the study, and mothers unwilling or unable to provide informed data were also excluded.

Ethical clearance

The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki (2013 Revision) regarding research involving human subjects (World Medical Association 2013). Ethical approval for the study was obtained from Katsina state Ministry of Health, with approval No. FTHKTHREC. REG. 24/06/22C/217.

All participants were informed of the purpose, procedures, potential risks, and benefits of the study. Written informed consent was obtained from the mothers of participating neonates in either English or Hausa, according to their preferred language. For participants who preferred Hausa, the consent information was explained verbally in Hausa using a translated version of the English consent form, and consent was documented using the approved consent form. Confidentiality of personal and medical information was strictly maintained

Anthropometric measurement

Weight was measured using an MJK-C mechanical bathroom scale (Yongkang Nengzhi Industry and Trade Co., Ltd., China) with participants barefoot and wearing light clothing, while height was measured using an SECA 213 Stadiometer (SECA GmbH & Co. KG, Hamburg, Germany) with participants standing upright without shoes. BMI was calculated as weight in kilograms divided by the square of height in meters (kg/m^2) and mid upper arm circumference (MUAC) using a MUAC tape were obtained according to the guidelines described in the Food and Nutrition Technical Assistance (FANTA) Guide (Tang *et al.*, 2016).

Data collection

Maternal nutritional status and dietary intake during pregnancy was assessed using a Food Frequency Questionnaire (FFQ), which asked mothers to recall the frequency of consumption of specified food groups during pregnancy. Mothers were interviewed on admission which was within 1-7 days after delivery to minimize the recall interval. Questions were framed around food consumption during pregnancy and distinguished from current

postpartum dietary intake and since dietary information was recalled after delivery, the possibility of recall bias was acknowledged.

Dietary diversity was assessed using the food frequency questionnaire based on the consumption of approximately 10 predefined food groups. Each food group consumed during pregnancy was assigned a score of 1, while a score of 0 was assigned when the food group was not consumed. The scores were summed to obtain an individual Dietary Diversity Score (DDS), ranging from 0 to 10. Information on neonatal risk factors, including birth weight, prematurity, gender and complications during pregnancy, were also obtained. Data on management such as phototherapy and EBT, and treatments outcomes such as, BIND I and II, and mortality were gathered from the hospital's medical database.

Data analysis

The quantitative data were analysed using Microsoft excel 2024 MSO (Version 2608 Build 16.0.20326.20072), demographic data presented as frequencies and results were presented as Mean ± SD.

RESULTS

Socio-demographic characteristics of mothers of neonates with neonatal jaundice in Federal Teaching Hospital Katsina.

The socio-demographic of the 172 mothers and their neonates in Table 1 revealed that most mothers were aged 20–34 years, predominantly Hausa and Muslim, with the majority residing in urban areas. Most had at least secondary education and were housewives. The majority reported no pregnancy-related complications. Most neonates were delivered at term, with males slightly more represented than females. Most admissions occurred within the first five days of life, and the majority of neonates had normal birth weight, while over one-third were of low birth weight.

Table 1: Socio-Demographic Characteristics of Mothers of Neonates Admitted with Neonatal Jaundice in FTHK (n=172)

Variables (n=172)		Frequency	Percentage (%)
Maternal age	<20	19	11.1
	20–34	127	73.8
	⩾35	26	15.1
Ethnicity	Hausa	143	83.1
	Yoruba	7	4.1
	Others	22	12.8
Religion	Muslim	151	87.8
	Christian	21	12.2
Residence	Rural	57	33.1
	Urban	115	66.9
Education status	No Formal Education	7	4.1
	Primary Education	29	16.9
	Secondary/ Post-secondary Education	136	79.0
Occupation	Small Business Owner	65	37.8
	Civil Servant	14	8.1
	Housewife	93	54.1
Complication during pregnancy	No Complication	151	87.8
	Hypertension	7	4.1
	Gestational Diabetes	14	8.1
Gestational age	Preterm	26	15.1
	Term	146	84.9
Gender	Male	99	57.6
	Female	73	42.4
Age at admission	< 5 days old	105	61.0
	5 days or older	67	39.0
Birth weight	< 2.5 kg	62	36.1
	⩾ 2.5kg	110	63.9

Nutritional status of the mothers of neonates based on BMI (kg/m^2)

Table 2 presents the BMI distribution of mothers of neonates with jaundice. This indicates that most mothers were within a healthy weight range.

Table 2: Nutritional Status of the Mothers of Neonates with Neonatal Jaundice Based on BMI (kg/m^2)

Categories	Mean ± SD	Frequency (n=172)	Percentage (%)
Underweight	17.8±0.52	14	8.1
Normal weight	21.6±1.77	98	57.1
Overweight	26.9±1.27	46	26.7
Obese	31.0±0.92	14	8.1

Where, Underweight = < 18.5, Normal weight = 18.5 – 24.9, Overweight = 25.0 – 29.9 and Obese = ⩾ 30.0, SD = standard deviation, BMI= Body Mass Index.

Nutritional status of the mothers of neonates based on MUAC (cm)

Table 3 shows the nutritional status of the mothers of neonates with neonatal jaundice based on MUAC (cm). This also indicates that most mothers had adequate nutritional status.

Table 3: Nutritional Status of the Mothers of Neonates with Neonatal Jaundice Based on MUAC (cm)

Categories	Mean ± SD	Frequency (n=172)	Percentage (%)
Normal nutritional status	26.9±3.01	146	84.8
Moderate undernutrition	21.4±0.46	24	14.0
Severe undernutrition	18.3±0.14	2	1.2

Where, Severe under-nutrition = <18.5, Moderate under-nutrition =18.5 - 21.9, Normal nutritional status =22.0- 40.5, SD= Standard Deviation, MUAC= Mid Upper Arm Circumference.

Food frequency of food consumption of mothers of neonates with neonatal jaundice during pregnancy

Table 4 illustrates the frequency of maternal consumption of various food groups. Cereals and grains were the most frequently consumed food group, followed by fruits, fats and oils, and other vegetables, which were commonly eaten daily. Legumes and nuts were mainly consumed several times per week, while dark green leafy vegetables showed varied consumption patterns. Animal-source foods, including meat, fish, eggs, organ meats, and dairy products, were consumed less frequently. Tubers were predominantly consumed once weekly, indicating moderate intake across this food group.

Table 4: Frequency of Food Consumption of Mothers of Neonates with Neonatal Jaundice During Pregnancy (n=172(%))

Variables	Never or less than once a month%	1-3 times per month%	Once a week%	2-4 times per week%	Once a day%	2-3 times per day%
Cereals and grains	0.0	0.0	1.2	2.9	63.4	32.6
Legumes and nuts	0.0	0.6	19.2	50.6	20.9	8.7
Dark green leafy veggies	0.0	1.7	30.2	20.4	34.9	12.8
Other veggies	0.0	0.0	14.5	16.3	29.7	39.5
Tubers	1.7	14.5	33.1	20.4	18.7	11.6
Meat and fish	10.5	13.4	11.6	16.3	23.8	24.4
Milk and products	11.1	13.9	15.7	20.4	26.2	12.7
Eggs and organ meat	6.9	15.7	23.3	22.1	20.4	11.6
Fruits	0.0	0.0	9.3	17.4	44.2	29.1
Fats and oil	0.0	0.0	8.1	14.6	46.5	30.8

Dietary diversity adequacy of the mothers of neonates with neonatal jaundice

Table 5 shows the dietary diversity adequacy of the mothers and most of the mothers (65.0%) had inadequate dietary diversity, consuming fewer than five food groups, while only 35.0% achieved adequate dietary diversity (≥5 food groups).

Table 5: Dietary Diversity of the Mothers of Neonates with Neonatal Jaundice in FTHK (n=172)

Dietary diversity Adequacy (DDS)	Frequency (n=172)	Percentage (%)
Adequate (>=5)	60	35.0
Inadequate (<5)	112	65.0
Mean dietary diversity score	4.1	
SD	2.0	

Management of neonatal jaundice amaong neonates admitted in FTHK

From Table 6 phototherapy was the most administered treatment, with 85.5% of neonates receiving it. Exchange blood transfusion (EBT) was performed in 20.4% of cases. Antibiotics were administered to 33.7% of neonates, while intravenous fluids were given to 31.4%, and only 1.16% of neonates received additional supportive care measures.

Table 6: Management of Neonatal Jaundice among Neonates Admitted in FTHK

Variable		Frequency	Percentage (%)
Phototherapy	Yes	147	85.5
	No	25	14.5
EBT	Yes	35	20.4
	No	137	79.6
Antibiotics	Yes	58	33.7
	No	114	66.3
IV fluids	Yes	54	31.4
	No	118	68.6
Supportive care	Yes	2	1.2
	No	170	98.8

EBT= Exchange blood transfusion, IV= intravenous

Treatment outcomes among neonates admitted for neonatal jaundice

Table 7 presents treatment outcomes for neonates with jaundice based on different therapeutic interventions. Phototherapy alone and in combination with IV fluids resulted in the highest discharge rates without complication

Table 7: Treatment Outcome of Neonatal Jaundice among Neonates in FTHK n=172(%)

Treatment type	No Neonates Treated(n)	Discharged n (%)	BIND I/II n (%)	Absconded n (%)	Mortality n (%)
PT	52	52 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)
PT + IV fluids	54	54 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)
PT + antibiotics	26	23 (88.5)	2 (7.7)	1 (3.8)	0 (0.0)
EBT + PT	9	5 (55.6)	2 (22.2)	0 (0.0)	2 (22.2)
EBT + antibiotics	7	4 (57.1)	1 (14.3)	0 (0.0)	2 (28.6)
EBT + PT + antibiotics	22	11 (50.0)	6 (27.3)	2 (9.1)	3 (13.6)
Supportive care	2	2 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)

P. T=phototherapy, I. V= Intravenous, EBT= Exchange blood Transfusion

DISCUSSION

The socio-demographic characteristics of the 172 mothers and their neonates in this study showed that most mothers were within the age range of 20–34 years. This finding is consistent with the study by Joseph *et al.* (2024) conducted in Owerri, where 63.7% of participants were within 25–34 years. Similarly, Kebede *et al.* (2023) and Oladokun *et al.* (2009) also reported a predominance of mothers aged 25–34 years, accounting for 83.4% and 64.6% of their study populations, respectively. However, Scrafford *et al.* 2013 observed a higher probability of neonatal jaundice among mothers younger than 20 years of age which differs from the pattern observed in the present study. These differences may reflect differences in study populations, socio-demographic differences, and possible underlying biological or environmental factors.

Ethnically and religiously, the present study was predominantly Hausa and Muslim, which is consistent with findings by Iliyasu *et al.,* (2020), who reported a predominantly Hausa-Fulani and Muslim population in Kano state. In contrast, Joseph *et al.,* (2024) reported a predominantly Igbo population in Owerri, while Olatubi *et al.,* (2019) found a predominantly Yoruba population in Ondo State. These differences largely reflect the cultural, ethnic, and geographical composition of the respective study areas rather than a biological predisposition to neonatal jaundice.

The present study found that most mothers had attained at least secondary education and were predominantly housewives, which is consistent with findings by Iliyasu *et al.,* (2020). In terms of residence, the present study had a predominantly urban population, contrasting with Bante *et al.,* (2024) in southern Ethiopia, where rural dwellers constituted the majority. These differences may reflect variations in the socio-demographic characteristics and settings of the study populations.

The present study found that most mothers had no complications during pregnancy, which is consistent with findings by Boskabadi *et al.* (2013). However, the proportions of gestational diabetes and hypertension observed in the present study were lower than those reported by Boskabadi *et al.* (2011) in Iran, where maternal hypertension and diabetes were more common among mothers of neonates with jaundice. These differences may be related to variations in maternal characteristics and study populations.

Most neonates in the present study developed jaundice within the first five days of life, which is consistent with the findings of Osuorah *et al.* (2018) in south-eastern Nigeria, who reported a similar early age at presentation. The predominance of neonates with normal birth weight was also comparable to findings by Osuorah *et al.* (2018) and Belay *et al.* (2023) in Ethiopia. In contrast, Sisay *et al.* (2023) reported a higher proportion of low-birth-weight neonates. These differences may reflect variations in the characteristics and settings of the study populations.

Most neonates in the present study were born at term, which is consistent with findings by Oluwafemi *et al.* (2019) in south western Nigeria, who also reported a predominance of term neonates. In contrast, Ochigbo *et al.* (2024) found that most jaundiced neonates were preterm, highlighting prematurity as an important risk factor. The predominance of male neonates in the present study was also consistent with findings reported by Ochigbo *et al*. (2024), Sisay *et al.* (2023), Awe *et al*. (2021), and Idowu *et al*. (2024). These findings suggest that neonatal jaundice occurs across gestational categories but may be more frequently observed among male neonates.

The present study found that most mothers had a normal BMI, which is consistent with findings by Kalk *et al*. (2009). Similarly, MUAC assessment showed that the majority of mothers had normal nutritional status, in line with findings by Vasundhara *et al*. (2009), where most mothers also had normal nutritional status. These findings suggest that normal maternal nutritional status was predominant across the study populations.

The present study found that mothers predominantly consumed cereals and grains, with regular intake of fruits, fats and oils, and vegetables, while animal-source foods were consumed less frequently. Similarly, Chia *et al.* (2019) characterized a healthy dietary pattern by higher consumption of vegetables, fruits, whole grains, low-fat dairy, and lean protein foods. Regarding dietary diversity, the present study found that most mothers had inadequate dietary diversity, which is consistent with Tareke *et al*. (2024). These findings suggest that limited dietary variety may be influenced by socioeconomic conditions, cultural food preferences, and access to diverse food sources.

Phototherapy was the most commonly administered treatment in the present study, consistent with findings by Oluwafemi *et al*. (2019), and Kebede *et al.* (2023), who similarly reported phototherapy as the predominant treatment modality. Exchange blood transfusion was less frequently used, while antibiotics and intravenous fluids were also commonly administered, comparable to findings by Musa *et al.* (2024) and Olatubi *et al.* (2019). Regarding outcomes, most neonates in the present study were

discharged without complications, with favorable outcomes also reported by Oluwafemi *et al.* (2019), Kebede *et al.* (2023), and Bante *et al*. (2024). However, the present study recorded lower mortality compared with Osuorah *et al.* (2018) and Awe *et al.* (2021), who reported higher case-fatality rates. Overall, 7 neonatal deaths (4.1%) were recorded among the 172 neonates included in the study. These differences may reflect variations in treatment practices, severity of jaundice, referral patterns, and characteristics of the study populations. Although differences in treatment outcomes were observed across the various management combinations in the study, the treatments were not randomized as treatment decisions were likely influenced by the clinical condition and severity of jaundice of individual neonates.

CONCLUSION

Neonatal jaundice in this study predominantly affected term male neonates who presented within the first week of life. Most mothers were within the reproductive age group, had no pregnancy complications, and demonstrated normal nutritional status by BMI and MUAC. However, dietary diversity was largely inadequate, with diets mainly based on cereals and limited animal source foods. Phototherapy was the most administered form of treatment while exchange blood transfusion was reserved for severe cases. Based on the findings, strengthening early detection and timely management of neonatal jaundice is recommended to enhance neonatal outcomes.

AUTHORS' CONTRIBUTIONS

FA: Conceptualization, methodology, data curation, literature review, statistical analysis and writing original draft. IAU: Conceptualization, methodology, supervision and review and editing. IHK: Literature review, and supervision. BM: Clinical supervision, patient recruitment, and clinical data acquisition. All authors have read and agreed to the published version of the manuscript.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the publication of this paper

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Data Availability Statement

The datasets generated and/or analyzed during the current study are not publicly available due to privacy and confidentiality considerations but may be available from the corresponding author upon reasonable request and subject to appropriate ethical approval.

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