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IMNCI Classification of Neonatal Jaundice and Its Relation to Cause of Jaundice at Neonatology Unit, CMC-SMBBMU Larkana

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ABSTRACT

Neonatal jaundice significantly impacts neonates' health and mortality, leading to frequent hospitalizations. The IMNCI classification improves early diagnosis, treatment, and outcomes. **Objective:** To classify jaundice based on IMNCI classification and evaluate its etiology across different severity levels. **Methods:** A cross-sectional study was conducted in the Neonatology unit at CMC-SMBBMU Larkana from July 2022 to January 2024, involving 147 neonates aged 0 to 28 days with jaundice, using a non-probability, consecutive sampling technique. **Results:** The study examined 147 neonates, with 81 (55.1%) males and 66 (44.9%) females. Most had a birth weight between 2000g to 2499g, with 36.1%, while only 14(9.5%) weighed 3500g or more. In gestational age 93(63.26) % were born at term, 46(31.29%) preterm, and 8(5.44%) post term. Delivery methods varied, with 81(55.1%) vaginally, 49(33.33%) C-section, and 17(11.56%) instrumented. The IMNCI classification revealed that 78.91% of neonates had jaundice, while 21.09% had severe jaundice, highlighting that gender (p=0.03), residence (p=0.04), aetiology (p=0.001), gestational age (p=0.04), and birth weight (p=0.01) all significantly influence the severity of jaundice and highly significant association in post-term neonates and those with lower birth weights are at a higher risk of severe jaundice. Data was input and examined using the SPSS version 26.0 software. **Conclusions:** Neonatal jaundice severity is influenced by gestational age, birth weight, and delivery mode, with post-term and low-birth-weight neonates at higher risk. Early identification and targeted interventions are crucial, and improving maternal education and healthcare accessibility, especially in rural areas, can reduce jaundice incidence and severity.

INTRODUCTION

Jaundice refers to the yellowish discoloration of the skin, sclerae, and mucous membranes caused by the accumulation of bilirubin in the tissues[1, 2]. Hyperbilirubinemia can be either safe or dangerous, depending on the cause and elevation. Some jaundice causes are hazardous regardless of bilirubin level, but reaching a certain level becomes a concern [3]. The bilirubin levels rise to the 95% percentile in 8 to 11% of infants [4]. Only 2% of term neonates experience severe hyperbilirubinemia (total serum bilirubin > 20 mg/dl), but because it can advance to kernicterus and cause long-term neurodevelopmental problems, all neonates must be thoroughly evaluated for hyperbilirubinemia [5]. Early indications of kernicterus include lethargy, inability to feed,

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loss of moro reflexes, which is frequently followed by severe weakness, worsening in deep tendon reflexes, respiratory distress, occasional opisthotonos, a bulging fontanelle, a loud cry, and aberrant facial and extremity movements. [5]. Predischarge screening for severe neonatal hyperbilirubinemia identifies infants who need phototherapy. Infants with the aforementioned neurological abnormalities often pass very young, and those who survive face a higher risk of suffering severe brain impairment [3]. Neonatal jaundice, affecting over a million newborns annually, increases hospitalization, disability, and death rates, particularly in low and middle-income countries, due to inadequate detection and treatment [4, 6]. Globally, Jaundice is prevalent in newborn babies, affecting 60% of full term and 80% of premature babies in the first week, causing a significant concern in Pakistan with a 39.7 per 1000 live births prevalence It is predicted that 6 out of every 10 newborns suffer jaundice, with 8 out of 10 babies delivered prematurely before the 37th week of pregnancy. However, only around one out of every twenty newborns has a blood bilirubin level that requires therapy. Physiological jaundice was seen in 162 (40.5%) of all patients. The most common causes were ABO incompatibility (20%), Rh incompatibility (16.5%), sepsis (8%), idiopathic (5%), and 10% of instances respectfully [10]. A study carried out a regional analysis involving 114 infants diagnosed with hyperbilirubinemia and found that jaundice, fever, and feeding refusal were the most frequently noted clinical signs occurring in 75%, 25.4%, and 21.4% of the newborns, respectively [11]. A comprehensive overview of neonatal jaundice, covering its causes, clinical features, diagnosis, and management, in the StatPearls medical reference [12]. Long-term neurodevelopmental consequences for babies that survive include cerebral palsy, sensorineural hearing loss, intellectual impairments, and significant developmental delays [13, 14]. In this study, the objectives are to classify neonatal jaundice based on the IMNCI classification and to evaluate its etiology across different severity levels as defined by IMNCI. According to IMNCI Classification neonatal jaundice was classified according to the IMCI guidelines into two categories Jaundice and severe Jaundice. Whereby: patients were labeled as having jaundice of the presented with only skin or eyes yellow. However, we labeled the patients as having severe jaundice if they presented with palms and /or soles yellow, yellow skin in age less than 24 hours. Kernicterus is a prevalent cause of avoidable brain injury that may be easily diagnosed in IMNCI as severe jaundice.

The study's goal was to determine the degree and causation of neonates jaundice in accordance with the IMNCI categorization.

METHODS

A cross-sectional study was conducted in the Neonatology Unit of CMC-SMBBMU Larkana, Sindh, from July 2022 to January 2024. The study was approved by the Institutional Ethical Review Committee letter no. SMBBMU OFF/ERC 175, dated November 14, 2021 and informed parents/guardians of all participants. A study enrolled 147 neonates with jaundice in the neonatal ward, emergency, or outpatient department. The sample size was estimated using a formula, considering a 11% prevalence for hyperbilirubinemia with yellow skin discoloration and a margin of error of 5%. A non-probability, consecutive method was applied [4].

$SS = Z^2 x\, p\, x(1-p) \div e^2$

$$\text{Formula} = SS = \frac{Z^2 * (P) * (1-P)}{C^2}$$

$SS = 1.96^2 x(0.11)x(1-0.11) \div 0.005$

$SS = 150$

The study included neonates aged 0 to 28 days with jaundice, both male and female and birth weight over 2000 grams. This study involved neonates whose parents or guardians were willing to participate. The study excluded neonates who had undergone phototherapy or had congenital anomalies. A detailed history and physical examination were conducted, followed by routine laboratory investigations including CBC, TSH, Serum bilirubin, blood grouping, and abdomen ultrasonography. The study also included a detailed history of jaundice and associated symptoms. The mother's blood group was collected, and neonates underwent various tests including Rh factor, full blood picture, blood grouping, serum bilirubin, abdominal ultrasound, and chest X-ray. The etiology and appearance of newborn jaundice were documented. All neonates were treated according to hospital guidelines, including phototherapy, medication therapy, and exchange transfusions. The study used SPSS version 26.0 for statistical analysis, calculating qualitative data like age, weight, and gestational age. Qualitative characteristics like gender, delivery method, etiology, and presentation were analyzed for frequencies and percentages. Effect modifiers like age, gender, weight, and birth method were managed using stratification. A p-value of < 0.05 was considered significant.

RESULTS

In the study, the descriptive statistics of age 6 ± 4.7 days, with a range of 03 days to 27 days and provided data on neonatal weight and maternal age, as shown in Table 1.

Table 1: The Descriptive Statistics of different variables

Variables	Mean ± SD	Min	Max
Age (Days)	06 ± 4.7	3	27
Neonatal Age Weight: (Grams)	2630 ± 167.5	2000g	4250g
Maternal Age (Years)	24.3 ± 3.1	17	46

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The study involved 81 (55.1%) male and 66 (44.9%) female neonates, with their weights divided into four categories, the majority 53 neonates weighed between 2000g to 2499 g, 42(28.5%) neonates weighted between 2500g to 2999g, 38(25.9%) neonates calibrated between 3000g to 3499 g and remaining 14(9.5%) neonates were above 3500g. The study analysed maternal gestational age, revealing that 46(31.3%) of mothers had preterm deliveries, 93(63.26%) delivered term babies, and 8(5.44%) had post term babies and the proportion of mothers 47(31.97%) were aged between 21 years to 25 years, followed by mothers aged between 26 to 30 years 34 (23.13%). However, mother aged below 20 years were 12.24 % in proportion while mother aged above 41 years were only 09 (6.12%). Over half of mothers delivered their babies through normal vaginal deliveries 81(55.1%), while (33.33%) delivered with C-section 49(33.33%), and 17(11.56%) went through instrumented deliveries (11.66%). The majority of mothers delivered their babies through normal vaginal deliveries. Table 02

The study examined the education status of mothers, revealing that 38.78% had primary education, nearly two-fifths were uneducated, and only 8(5.44%) had intermediate/above education. The majority of mothers 86(56.5%) were from rural areas, while 61(41.5%) were from urban areas. The majority of mothers were from rural areas, while regarding to neonates based on the IMNCI classification of jaundice, revealing 116 (78.91%) neonates with jaundice and 31 (21.09%) neonates with severe jaundice (Table 2).

Table 2: Demographic Characteristics of Participants or Neonates (n=147)

Variables	Categories	Frequency (%)
Gender	Male	81 (55.10)
	Female	66 (44.90)
Weight of the Neonate	2000g to 2499 g	53 (36.10)
	2500g to 2999 g	42 (28.50)
	3000g to 3499 g	38 (25.90)
	3500g and above	14 (09.50)
Gestational Age in Weeks	Preterm (<37 weeks)	46 (31.29)
	Term (37 to 42 weeks)	93 (63.26)
	Post Term >42 Weeks	08 (05.44)
Age of the Mother (years)	Less than 20	18 (12.24)
	20 to 25	47 (31.97)
	26 to 30	34 (23.13)
	31 to 35	22 (14.97)
	36 to 40	17 (11.56)
	41 and above	09 (06.12)
Mode of Delivery	NVD	81 (55.10)
	C-Section	49 (33.33)
	Instrumented	17 (11.56)
Education Level	No Education	61 (41.50)
	Primary	57 (38.78)
	Secondary	21 (14.29)
	Intermediate above	08 (05.44)
Residence of mother	Rural	86 (58.50)
	Urban	61 (41.50)
IMNCI Classification	Jaundice	116 (78.91)
	Severe Jaundice	31 (21.09)

The IMNCI classification showed 51 (43.97%) cases of physiological jaundice, 36 (31.03%) cases of idiopathic jaundice, 14 (12.07) cases of ABO incompatibility, 6.03% of Rh incompatibility, 4.31% of cephalhematoma, and 2.59% of G-6-P-D Deficiency (Figure 1).

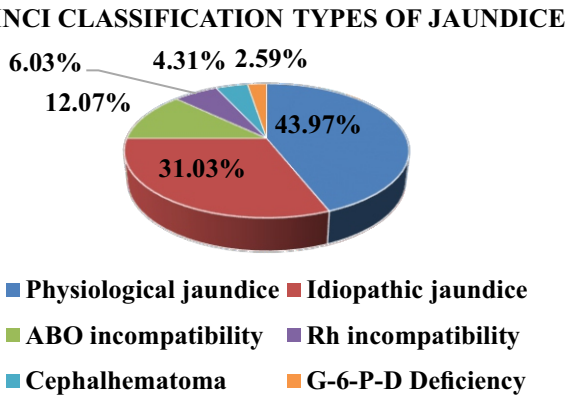

Figure 1: IMNCI Classification Types of Jaundice

This study also recorded the presentation of the neonatal jaundice, the neonates presented with variety of presenting complaints. 64.6% presented with yellow discoloration, 28.57% presented with fever, 19.73% with refusal to feed, 6.12% with fits, 11.56% with no cry after birth, 9.52% with vomiting, 10.88%, 7.48%, 15.65%, and 23.13 % with abdominal distension, not passing stool/urine, bluish hands and lips, and loose motions respectively (Figure 2).

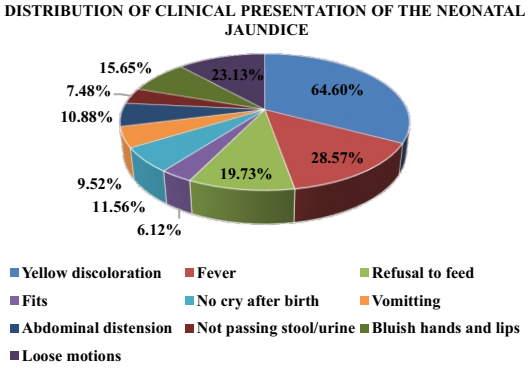

Figure 2: Distribution of Clinical Presentation of the Neonatal Jaundice

In the present study the association between gender of the neonate and severity of the neonate was evaluated. It was observed that the gender of the neonate was significantly associated with the jaundice with p-value 0.03. The association between gestational age of the neonate and severity of jaundice the neonate was evaluated. It was

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observed that the residence of the neonate was significantly associated with the jaundice with p-value 0.04. In this study, the association of etiology of jaundice with the IMNCI classification of the jaundice was determined. It was observed that the severity of jaundice was significantly associated with the etiology of the jaundice with p-Value 0.001. The present study evaluated the association between gestational age and severity of the jaundice. It was observed that the gestational age was significantly associated with the severity of jaundice with p-value 0.04. In this study, the association of the Birth weight of the neonate with the severity of jaundice was determined; it was observed that the neonatal birth weight was significantly associated with the severity of jaundice p-value 0.01. This cross-sectional study examined 386 neonates and found significant associations between maternal age, delivery mode, low birth weight, and IMNCI-based classification of jaundice.

Table 3: Distribution of Neonates According to the Imnci Classification Association of Severity of Jaundice with Different Variables(n=116)

Variables	Categories	Severity of Jaundice		
		Jaundice Frequency (%)	Severe Jaundice Frequency (%)	p-value
Gender	Male	67 (82.71)	14 (17.28)	0.03*
	Female	49 (74.24)	17 (25.75)	
Residence	Rural	76 (88.37)	10 (11.62)	0.04*
	Urban	40 (65.57)	21 (34.42)	
Etiology of Jaundice	Idiopathic	36 (31.03)	05 (16.12)	0.001*
	Physiological Jaundice	51 (43.96)	12 (38.70)	
	ABO Incompatibility	14 (12.06)	07 (22.58)	
	Rh Incompatibility	07 (06.03)	04 (12.90)	
	Cephalhematoma	05 (4.310)	02 (06.45)	
	G-6-P-D Deficiency	03 (02.58)	01 (03.22)	
Gestational Age	Preterm (<37 weeks)	32 (69.56)	14 (30.43)	0.04*
	Term (37 to 42 weeks)	76 (81.72)	17 (18.27)	
	Post term (>42 Weeks)	01 (12.50)	07 (87.50)	
Weight of neonate	2000g to 2499 g	36 (67.92)	17 (32.07)	0.01*
	2500g to 2999 g	34 (80.95)	08 (19.04)	
	3000g to 3499 g	34 (89.47)	04 (10.52)	
	3500g and above	12 (85.71)	02 (14.28)	

Indicates the statistical significance with p-value ≤0.05

DISCUSSION

Neonatal jaundice is a serious and widespread illness that affects 50-60% of full-term newborn and over 80% of preterm infants. In many parts of the world, NNJ has a major impact on infant morbidity and mortality. NNJ can result in several serious consequences, including permanent brain damage, and in some extreme situations, it can even result in death [15]. The present study enrolled the neonates who presented with jaundice at the Neonatology Unit-1, CMC-SMBBMU Larkana. A similar hospital-based retrospective descriptive study was conducted from January 2016 to December 2020 at the Neonatology Unit of the Regional Hospital Bamenda, in the North West Region of Cameroon. The study enrolled neonates of 0 to 28 days, admitted for neonatal jaundice [16]. In the present study, it was observed that there were 81 (55.1%) male and 66 (44.9%) female neonates in the study, which is reasonably different from the figures reported by Israel-Aina and Omoigberale, in their study where males were predominant with a sex ratio of 2.35 [16]. A nearly similar gender ratio was reported in another study conducted at the University of Benin Teaching Hospital, Benin City that reported 42.8% females and 57.2% males [17]. Males were marginally higher in proportion to the study conducted by Lake EA *et al.*, who reported 60.8% males and 39.2% females [18]. The minimum age recorded in the study was 03 days, the age ranged from 03 days to 27 days. Comparatively, Israel-Aina and Omoigberale, reported that most (52.6%) of the study subjects were aged between 1-5 days [16]. In the present study, the mean age of the neonates was 6 ± 4.7 days, however, Omekwe DE *et al.*, reported a 2.47 ± 2.48 mean age in their study [17]. On the other hand, Lake EA *et al.*, reported that the majority (41.2%) of the neonates were aged between 1 to 2 days in their study [18]. Diala *et al.*, (2023) conducted a systematic review and meta-analysis to estimate the global prevalence of severe neonatal jaundice among hospital admissions, highlighting significant regional disparities and burden [19]. In the present study, the neonatal weight ranged from 2000g to 4250g with mean and SD 2630 ± 167.5, however, Omekwe DE *et al.*, reported that the mean neonatal birth weight was 2,980 ± 700g [17]. In the present study, we observed that most of the mothers 47 (31.97%) were aged between 21 years to 25 years, followed by mothers aged between 26 to 30 years 34 (23.13%). However, mothers aged below 20 years were 12.24 % in proportion while mothers aged above 41 years were only 09 (6.12%). Similar findings were reported by Israel-Aina and Omoigberale, where the majority of the mothers (51.0%) were aged between 20 to 30 years [16].In this study, the maternal age ranged from 17 years to 46 years, and with a mean and standard deviation of 24.3 ± 3.1, relatively older mothers were part of the study where Omekwe DE *et al.*, reported that the mean maternal age of mothers was 30.44 ± 5.63 years [17]. In this study, there were more than half of the mothers delivered their babies through normal vaginal deliveries accounting for 81(55.1%), one-third of the mothers (33.33%) delivered babies with C- Section, and 17 (11.56%) mothers went through instrumented deliveries. Compared to these findings most of the mothers. In this

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study, vaginal delivery was commonest with 55.1%, however, according to the findings of Israel-Aina and Omoigberale, vaginal delivery was the most frequent mode of delivery in 90% of women [16]. In the present study, More than half of the mothers had a primary level of education, nearly one-fifth were uneducated, and only 13 (8.84%) mothers had an intermediate/above level of education. On the other hand, a similar study reported that most 135(53.8%) of mothers had a secondary level of education, and 60.8% of mothers had a secondary level of education [16, 18]. In this study, the neonates were classified according to the IMNCI classification of jaundice, we observed that there were 116 (78.91%) neonates with some jaundice and 31 (21.09%) neonates with severe jaundice. Comparatively, a study conducted at the neonatology unit of the Regional Hospital Bamenda, in the North West Region of Cameroon reported that the hospital incidence of neonatal jaundice was 19.7% [16]. In this study, there were 51 (43.97%) cases of physiological jaundice, followed by 36 (31.03%) cases of idiopathic jaundice, 14 (12.07) cases of ABO incompatibility, 7 (6.03%) cases of Rh incompatibility, 5 (4.31%) cases of cephalhematoma and 3 (2.59%) cases of G-6-P-D Deficiency.While the main etiologies reported by Israel-Aina and Omoigberale, were infection (70.9%), physiologic (14.3%) and ABO incompatibility (10%) [16]. Likewise this study, ABO incompatibility was reportedly 7.6% in the study conducted by Omekwe DE *et al* [17]. ABO incompatibility occurs in 15-20% of pregnancies and hemolytic disease of newborn develops in 10% of these instants [20].This study also recorded the presentation of neonatal jaundice, the neonates presented with a variety of presenting complaints. 64.6% presented with yellow discoloration, 28.57% presented with fever, 19.73% with refusal to feed, 6.12% with fits, 11.56% with no cry after birth, 9.52% with vomiting, 10.88%, 7.48%, 15.65%, and 23.13 % with abdominal distension, not passing stool./urine, bluish hands and lips, and loose motions respectively. However, in the findings of Israel-Aina and Omoigberale, fever was the most frequent (64.5%) among all the symptoms [16]. An Ethiopian study findings revealed that maternal age over 35 years, residing in urban areas, male gender, prematurity, and ABO incompatibility were significant determinants of neonatal jaundice [21]. The study found that the aetiology of jaundice was significantly associated with its severity, with gestational age, neonatal birth weight, and gender also having significant associations. The prevalence of newborn jaundice among infants was significant, with factors such as labor duration, delivery time, neonate sex, infection, maternal blood group, and blood type incompatibility being significantly linked [14].

CONCLUSIONS

Neonatal jaundice is a common disorder affecting neonates, with neonatal infections being the most common cause. Early identification and management of this condition is crucial to prevent severe neurological complications or even death. Pregnant and postpartum women should be educated on early signs of neonatal infections and jaundice, enabling early diagnosis and management to prevent fatal complications.

Authors Contribution

Conceptualization: BB
Methodology: DB
Formal analysis: VK
Writing, review and editing: M, FSJ, LN
All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

All the authors declare no conflict of interest.

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