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Maternal Knowledge of Neonatal Jaundice among Mothers Attending Maternal and Child Health Centers in Derna, Libya: A Cross-Sectional Study

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معرفة الأمهات المترددات على مراكز صحة الأم والطفل في درنة، ليبيا، حول اليرقان الوليدي: دراسة مقطعية

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Abstract:
Neonatal jaundice is common during the neonatal period and is usually benign; however, severe hyperbilirubinemia can result in acute bilirubin encephalopathy, kernicterus, permanent neurological impairment, and death. This study was done to assess maternal knowledge regarding neonatal jaundice and identify factors associated with knowledge level among mothers in Derna, Libya. A descriptive cross-sectional study was conducted among 96 mothers of infants aged six months or younger who had a previous history of neonatal jaundice. Data were collected using a structured Arabic self-administered questionnaire using 24 questions, with one point awarded for each correct response. Knowledge scores were categorized as poor (<50%), moderate (50–74%), or good (≥75%). Most mothers (84.4%) had poor knowledge regarding neonatal jaundice. The mean knowledge score among mothers with poor knowledge was 8.68 ± 1.54, compared with 12.73 ± 1.10 among those with moderate knowledge. Recognition of yellow discoloration of the skin and/or eyes was relatively high (78.1%), as was knowledge that early initiation and frequent breastfeeding may reduce the risk of jaundice (92.7%). However, major gaps were observed in recognizing other signs as pale stools (8.3%), breast milk jaundice (7.3%), dark urine (13.5%), seizures (14.5%), permanent hearing or neurological problems (25.0%), prolonged jaundice requiring evaluation (28.1%), and the potential for severe jaundice to cause death (28.1%). In conclusion maternal knowledge of neonatal jaundice was inadequate among the studied mothers in Derna. Health education should focus on clinically important warning signs, prolonged jaundice, complications, appropriate treatment, and the need for timely professional evaluation.

Keywords: neonatal jaundice; maternal knowledge; hyperbilirubinemia; mothers; newborn; health education; Libya; Derna.

الملخص:
يُعد اليرقان الوليدي حالة شائعة خلال فترة حديثي الولادة وعادة ما يكون حميداً؛ ومع ذلك، فإن فرط بيليروبين الدم الشديد قد يؤدي إلى اعتلال الدماغ الحاد الناجم عن البيليروبين، واليرقان النووي، واعتلال عصبي دائم، والوفاة. أُجريت هذه

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الدراسة لتقييم مستوى معرفة الأمهات بشأن اليرقان الوليدي وتحديد العوامل المرتبطة بمستوى المعرفة لدى الأمهات في مدينة درنة، ليبيا. شملت الدراسة الوصفية المقطعية 96 أماً لأطفال رضع تبلغ أعمارهم ستة أشهر أو أقل، ممن لديهن تاريخ سابق لحالة يرقان وليدي. جُمعت البيانات باستخدام استبيان مقنن باللغة العربية يُعبأ ذاتياً، وتضمن 24 سؤالاً، حيث مُنحت نقطة واحدة لكل إجابة صحيحة. وصُنفت درجات المعرفة إلى: ضعيفة (أقل من 50%)، ومتوسطة (50-74%)، وجيدة (75% أو أكثر). أظهرت النتائج أن غالبية الأمهات (84.4%) كان لديهن مستوى معرفة ضعيف بشأن اليرقان الوليدي؛ إذ بلغ متوسط درجة المعرفة لدى الأمهات ذوات المعرفة الضعيفة 8.68 ± 1.54، مقارنة بـ 12.73 ± 1.10 لدى ذوات المعرفة المتوسطة. كانت نسبة التعرف على علامة اصفرار الجلد و/أو العينين مرتفعة نسبياً (78.1%)، وكذلك المعرفة بأن البدء المبكر بالرضاعة الطبيعية وتكرارها قد يقلل من خطر الإصابة باليرقان (92.7%). ومع ذلك، لوحظت فجوات كبيرة في المعرفة بعلامات أخرى، مثل شحوب البراز (8.3%)، ويرقان حليب الأم (7.3%)، والبول الداكن (13.5%)، والنوبات التشنجية (14.5%)، والمشاكل السمعية أو العصبية الدائمة (25.0%)، واليرقان المستمر الذي يتطلب تقييماً طبياً (28.1%)، واحتمالية تسبب اليرقان الشديد في الوفاة (28.1%). وفي الختام، تبين أن معرفة الأمهات في درنة بشأن اليرقان الوليدي كانت غير كافية؛ لذا ينبغي أن يركز التثقيف الصحي على العلامات التحذيرية المهمة سريرياً، واليرقان المستمر، والمضاعفات، والعلاج المناسب، وضرورة الحصول على تقييم مهني في الوقت المناسب.

الكلمات المفتاحية: اليرقان الوليدي؛ معرفة الأمهات؛ فرط بيليروبين الدم؛ الأمهات؛ حديثو الولادة؛ التثقيف الصحي؛ ليبيا؛ درنة.

Introduction

Neonatal jaundice, clinically manifested by yellow discoloration of the skin and sclerae due to elevated bilirubin concentrations, is one of the most common conditions encountered during the neonatal period. Although jaundice is frequently transient and physiological, some newborns develop significant or severe hyperbilirubinemia requiring timely assessment and treatment. Neonatal jaundice is very common during the first week of life, particularly among preterm infants, although the reported frequency varies according to gestational age, population, and the method used to assess jaundice. [1–3].

The clinical importance of neonatal jaundice is primarily related to the potential consequences of severe hyperbilirubinemia. Excessive unconjugated bilirubin may cross the blood–brain barrier and cause acute bilirubin encephalopathy and, in severe or untreated cases, kernicterus. These complications may result in permanent neurological impairment, including cerebral palsy, sensorineural hearing loss, developmental disability, and, in the most severe cases, death [3–5]. Although improvements in screening and treatment have reduced bilirubin-related neurological injury in many high-resource settings, severe neonatal jaundice remains an important cause of preventable morbidity and mortality in low- and middle-income countries [5,6].

Early recognition is particularly important because jaundice may become more apparent after discharge from the maternity facility, placing mothers and other caregivers in an important position for detecting changes in the newborn. Current clinical guidance recommends systematic assessment of newborns for jaundice, appropriate bilirubin measurement when jaundice is suspected, and prompt evaluation of infants with early, severe, or prolonged jaundice [1,7]. Importantly, visual inspection can identify jaundice but cannot reliably determine the underlying bilirubin concentration or the severity of hyperbilirubinemia [7]. Consequently, mothers need sufficient knowledge to recognize jaundice, understand its potential seriousness, identify warning signs, and seek appropriate medical care without delay. The World Health Organization also emphasizes information, counselling, and support for parents and caregivers as important components of quality postnatal care [8].

Maternal knowledge may therefore contribute to timely recognition and appropriate care-seeking for neonatal jaundice. Mothers may need to distinguish normal neonatal changes from potentially significant jaundice, recognize clinical features requiring urgent evaluation, understand the importance of adequate feeding, and avoid inappropriate or potentially harmful home and traditional practices. Evidence from maternal education and care-seeking studies indicates that improving mothers' understanding of neonatal jaundice may facilitate earlier recognition and more appropriate responses to the condition [9,10]. However, knowledge is not necessarily equivalent to awareness: a mother may have heard of neonatal jaundice or recognize yellow discoloration while having limited understanding of its causes, danger signs, complications, treatment, or appropriate preventive measures.

Neonatal jaundice is also an important clinical problem in Libya. Evidence from different Libyan healthcare settings has documented substantial morbidity associated with neonatal jaundice. In Tripoli, Walli et al. reported that among 72 hospitalized neonates with jaundice, 43% were admitted because of jaundice alone, while sepsis and respiratory distress were important coexisting conditions. The study also identified associations with gestational age and blood-group characteristics [11]. More recent evidence from Zawia Medical Center further demonstrated the continuing burden of neonatal jaundice among neonatal admissions and identified prematurity, neonatal sepsis, and birth asphyxia among the important associated factors [12]. In addition, a recent study conducted in two hospitals in Tripoli among 200 neonates with jaundice found that most cases developed during the first five days of life and reported associations with newborn feeding patterns, maternal health conditions,

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and family history [13]. Together, these findings indicate that neonatal jaundice remains a clinically relevant neonatal health problem in different regions of Libya.

However, evidence describing the clinical burden of neonatal jaundice in Libya does not necessarily indicate how well mothers recognize or understand the condition. In particular, the available Libyan studies identified above have primarily examined the occurrence, clinical characteristics, risk factors, and outcomes of neonatal jaundice rather than maternal knowledge of its manifestations, risk factors, complications, treatment, and prevention [11–13]. Thus, there is an important gap in evidence regarding maternal knowledge of neonatal jaundice in Libya, particularly in eastern Libya and the city of Derna.

Evidence from other Arab and Middle Eastern populations suggests that substantial gaps in maternal knowledge may exist despite relatively widespread awareness of neonatal jaundice. In Egypt, Moawad et al. found that 52.3% of mothers had adequate knowledge regarding neonatal jaundice, while maternal employment and urban residence were associated with higher knowledge levels. The study also demonstrated the continuing influence of traditional beliefs and practices on mothers' perceptions and management of neonatal jaundice [14]. Similarly, a study among parents in Bisha, Saudi Arabia, identified important gaps in knowledge regarding neonatal jaundice and its complications, with only a minority considering themselves sufficiently knowledgeable about the condition [15]. Studies from other regional settings have likewise demonstrated that mothers may recognize the characteristic yellow discoloration while having inadequate knowledge regarding causes, complications, danger signs, and appropriate management. These findings suggest that maternal knowledge should be assessed within the specific sociocultural and healthcare context of each population rather than assumed from general awareness of the condition.

Assessing maternal knowledge is particularly relevant because knowledge gaps may represent modifiable targets for health education. Identifying which aspects of neonatal jaundice are poorly understood can help healthcare providers develop focused counselling and educational interventions during antenatal care, maternity services, postnatal contacts, breastfeeding support, and child-health visits. Such interventions may improve mothers' ability to recognize potentially serious jaundice and seek timely professional assessment.

Despite the documented clinical importance of neonatal jaundice in Libya, evidence regarding maternal knowledge of the condition remains limited, particularly in eastern Libya and Derna. Available studies have primarily focused on the clinical characteristics, risk factors, and outcomes of neonatal jaundice rather than mothers' knowledge and understanding of the condition. Therefore, the present study aimed to assess maternal knowledge regarding neonatal jaundice and to identify factors associated with the level of knowledge among mothers in Derna, Libya. Specifically, the study evaluated mothers' knowledge of the signs and symptoms, risk factors, natural course, treatment, complications, and prevention of neonatal jaundice, and examine the association between selected sociodemographic characteristics and maternal knowledge level.

Material and methods

Study design and setting

A cross-sectional study was conducted among 96 mothers of infants six months or younger. Participants were recruited from Maternal and Child Health (MCH) centers in Derna.

Study population

The study included mothers aged 18 years or older; who had an infant six months of age or younger with a previous history of neonatal jaundice. All mothers who are included were able to read and understand Arabic and complete the questionnaire and agreed to participate in the study and provided informed consent.

Sampling

The required sample size was calculated using the formula for estimating a single population proportion in a cross-sectional study:

$$n = \frac{Z^2 P(1-P)}{d^2}$$

where n is the required sample size, Z is the standard normal deviate corresponding to a 95% confidence level (1.96), P is the expected proportion, and d is the desired absolute precision.

In the absence of reliable local data regarding the proportion of mothers with adequate knowledge of neonatal jaundice, an expected proportion of 50% was assumed. This value provides the maximum sample size when the expected proportion is unknown. An absolute precision of 10% was used. Accordingly:

$$n = \frac{(1.96)^2(0.50)(0.50)}{(0.10)^2}$$

$$n = 96.04$$

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Thus, the minimum required sample size was approximately 96 mothers. A total of 96 eligible mothers were ultimately included in the study.
A non-probability consecutive sampling technique was used. Eligible mothers attending the selected MCH centers during the study period were approached and invited to participate. Mothers who met the eligibility criteria and provided informed consent were enrolled consecutively until the required sample size of 96 participants was reached.

Data collection
Data were collected using a structured, self-administered questionnaire designed to assess mothers' knowledge regarding neonatal jaundice. The questionnaire was prepared in Arabic and consisted of two main sections.
The first section collected sociodemographic characteristics of the mother and infant, including maternal age, infant age, place of residence, educational level, employment status, and perceived household income.
The second section assessed maternal knowledge regarding neonatal jaundice across several domains, including general knowledge about the condition, signs and symptoms, risk factors, clinical course, treatment, complications, and prevention. The knowledge items addressed mothers' understanding of the clinical manifestations of jaundice, factors associated with its occurrence, the expected course of the condition, appropriate treatment and healthcare-seeking, potential complications of severe jaundice, and measures that may contribute to its prevention. Items addressing common misconceptions and traditional beliefs related to neonatal jaundice were also included to identify potentially inappropriate beliefs that may influence maternal responses to the condition.

Definition of key terms
For the purposes of this questionnaire, neonatal jaundice refers to yellow discoloration of the skin and/or sclera resulting from elevated serum bilirubin levels during the neonatal period. Physiological jaundice refers to the common, generally self-limiting form of unconjugated hyperbilirubinemia occurring after the first 24 hours of life in otherwise well newborns. Significant jaundice refers to jaundice associated with bilirubin levels requiring clinical assessment and/or treatment according to the newborn's age, gestational age, and clinical condition. Severe neonatal jaundice refers to marked hyperbilirubinemia that poses a risk of acute bilirubin encephalopathy, kernicterus, or other serious complications. The questionnaire also assessed maternal knowledge of breastfeeding-associated jaundice, including jaundice related to inadequate milk intake and breast milk jaundice.
The questionnaire was developed based on a review of the relevant literature and previously published instruments assessing maternal knowledge, beliefs, and practices related to neonatal jaundice, with modifications made to suit the local context. [14]
The content validity of the questionnaire was assessed through review by experts in relevant fields to evaluate the relevance, clarity, and comprehensiveness of the items. A pilot test was subsequently conducted among a small group of mothers who met the study eligibility criteria to assess the clarity and comprehensibility of the questionnaire and to identify any ambiguities in wording. Necessary modifications were made before the final administration, and mothers included in the pilot testing were not included in the final study sample. The internal consistency of the knowledge items was assessed using Cronbach's alpha coefficient which was 0.72, indicating acceptable internal consistency for the study instrument.
Participants completed the questionnaire independently after receiving an explanation of the study and instructions for completing the questionnaire. The questionnaire was completed anonymously, and each participant was assigned a study identification code to maintain confidentiality. For mothers unable to read, the questionnaire was administered by a trained researcher who read the questions verbatim without explaining, paraphrasing, or prompting responses.

Statistical analysis
Data were coded, entered, and analyzed using IBM SPSS Statistics, version 25. Categorical variables were presented as frequencies and percentages. Quantitative variables were summarized using means and standard deviations for approximately normally distributed data, and medians with interquartile ranges for non-normally distributed data.
Maternal knowledge was assessed using 24 questions. Each correct response was assigned one point, whereas incorrect and "don't know" responses were assigned zero points. The total knowledge score ranged from 0 to 24, with higher scores indicating better knowledge. Based on the classification adopted from a previously published study [16], knowledge was categorized as poor (<50%), moderate (50–74%), and good (≥75%). Thus, scores of 0–11, 12–17, and 18–24 represented poor, moderate, and good knowledge, respectively.
The association between maternal sociodemographic characteristics and knowledge category was assessed using the chi-square test. Fisher's exact test or the Monte Carlo exact test was used when the assumptions for the chi-square test were not adequately met because of small expected cell frequencies. Maternal age categories were

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collapsed into two groups (<30 and ≥30 years) to ensure adequate cell frequencies for statistical comparison given the small number of mothers with moderate knowledge.
All statistical tests were two-tailed, and a p-value <0.05 was considered statistically significant.

Ethical Approval and Participants' Consent

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Ethical approval was obtained from the faculty of medicine at University of Derna research ethics committee prior to commencement of the study. Permission to conduct the study was also obtained from the administration of the selected Maternal and Child Health (MCH) centers in Derna.
Before participation, each eligible mother was informed about the purpose and procedures of the study, the voluntary nature of participation, and her right to decline participation or withdraw at any time without any consequences. Oral informed consent was obtained from all participants before data collection. No personally identifying information was collected, and the confidentiality and privacy of participants were maintained throughout the study.

Results and discussion

Table 1 shows that the majority of mothers were aged 25–<30 years (31.3%), followed by those aged 35–<40 years (29.2%) and 30–<35 years (27.1%). Only 3.1% of mothers were aged 18–<25 years, while 9.4% were aged ≥40 years.
Regarding infant age, the vast majority of infants were younger than one month (82.3%), whereas 9.4% were aged 1–<2 months and 8.3% were aged 2–6 months.
Most mothers resided in Derna (86.5%), while smaller proportions were from Benghazi (7.3%), Al Bayda (3.1%), Tripoli (2.1%), and Tobruk (1.0%). Regarding educational level, the overwhelming majority of mothers had university education (92.7%), compared with 6.3% who had secondary education and 1.0% who were illiterate. Most mothers were working (70.8%), while 29.2% were not working.
Concerning monthly income, the majority of mothers reported an income of 1000–2000 LD (80.2%), followed by those earning <1000 LD (13.5%), while 6.3% reported an income >2000 LD.

Table 1 Sociodemographic Characteristics of the Studied Mothers and Their Infants (n=96)

Maternal age (years)	**n**	**%**
18- <25	3	3.1
25-<30	30	31.3
30- <35	26	27.1
35-<40	28	29.2
≥40	9	9.4
Residence	**n**	**%**
Derna	83	86.5
Benghazi	7	7.3
Al Bayda	3	3.1
Tripoli	2	2.1
Tobruk	1	1.0
Educational level	**n**	**%**
Illiterate	1	1.0
Secondary	6	6.3
University	89	92.7
Employment status	**n**	**%**
Not working	28	29.2
Working	68	70.8
Income (LD)	**n**	**%**
<1000	*13*	*13.5*
1000-2000	*77*	*80.2*
>2000	*6*	*6.3*

Table 2 shows a marked variation in maternal knowledge across the different domains. Knowledge was relatively good for the visible characteristic of jaundice and breastfeeding-related prevention, but substantial gaps were evident regarding warning signs, risk factors, prolonged jaundice, treatment, and complications.

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Table 2 Maternal knowledge regarding neonatal jaundice: distribution of correct and incorrect/don't know responses among the study participants (n=96)

	Correct answer n (%)	Incorrect answer/ don't know n (%)
Signs and Symptoms		
Neonatal jaundice is characterized by yellow discoloration of the skin and/or eyes.	75(78.1)	21 (21.9)
Some cases of neonatal jaundice can be serious and require prompt medical evaluation.	43(44.8)	53(55.2)
A newborn with severe jaundice may become unusually sleepy or difficult to wake.	23(24.0)	73(76.0)
A newborn with significant jaundice may have difficulty feeding or breastfeeding.	27(28.1)	69(71.9)
Dark urine in a jaundiced newborn may indicate a more serious form of jaundice.	13(13.5)	83(86.5)
Pale or whitish stools in a jaundiced newborn may indicate a serious liver or bile-flow problem.	8(8.3)	88(91.7)
Risk factors		
Prematurity (preterm birth) increases the risk of significant neonatal jaundice.	64(66.7)	32(33.3)
Neonatal infection can increase the risk of significant neonatal jaundice.	32(33.3)	64(66.7)
Inadequate breastfeeding or poor milk intake can increase the risk of neonatal jaundice.	59(61.5)	37(38.5)
Breast milk jaundice can occur in an otherwise healthy, adequately breastfed infant and may persist beyond the second week of life	7(7.3)	89(92.7)
Course of the condition		
Frequent and adequate breastfeeding can help shorten the duration of jaundice caused by inadequate milk intake.	64(66.7)	32(33.3)
Jaundice persisting for more than two weeks in a term newborn requires medical evaluation.	27 (28.1)	69 (71.9)
Jaundice that becomes more severe or spreads to the lower parts of the body may indicate a more serious condition.	33(34.4)	63 (65.6)
Most mild physiological jaundice improves gradually without complications.	58 (60.4)	38 (39.6)
Treatment of the condition		
Physiological neonatal jaundice may require phototherapy if the bilirubin level is sufficiently high.	38(39.6)	58(60.4)
Increasing breastfeeding is the only treatment needed for all cases of neonatal jaundice.	30 (31.3)	66 (68.7)
Sunlight exposure is a safe substitute for medical phototherapy in newborns with jaundice.	22 (22.9)	74 (77.1)
Complications		
Severe untreated neonatal jaundice can cause permanent brain damage.	36 (37.5)	60 (62.5)
Severe untreated neonatal jaundice can be life-threatening and may cause death.	27(28.1)	69 (71.9)
Severe neonatal jaundice can cause permanent hearing or neurological problems.	24(25.0)	72 (75.0)
Severe untreated neonatal jaundice may cause seizures.	14 (14.5)	82 (85.5)
Prevention		
Early initiation and frequent breastfeeding can help reduce the risk of neonatal jaundice.	89 (92.7)	7 (7.3)
All cases of neonatal jaundice can be prevented by breastfeeding.	34 (35.4)	62 (64.5)
Early assessment of a newborn with jaundice can help prevent serious complications.	47 (48.9)	49 (51.1)

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The strongest areas were:

- Recognition of jaundice as yellow discoloration of the skin/eyes (78.1%).
- Early initiation and frequent breastfeeding as a preventive measure (92.7%).
- Recognition that inadequate breastfeeding/poor milk intake increases the risk (61.5%).
- Recognition that prematurity increases risk (66.7%).
- Recognition that mild physiological jaundice usually improves gradually (60.4%).

The largest knowledge gaps were particularly striking for:

- Pale/whitish stools as a potentially serious sign (8.3% correct).
- Breast milk jaundice (7.3% correct).
- Seizures as a complication of severe jaundice (14.5%).
- Dark urine as a potentially serious sign (13.5%).
- Permanent hearing/neurological problems (25.0%).
- Prolonged jaundice requiring evaluation (28.1%).
- The fact that increasing breastfeeding is not the only treatment for all cases (31.3%).
- Severe jaundice potentially causing death (28.1%).

Table 3 shows that the majority of mothers had poor knowledge regarding neonatal jaundice (84.4%), with a mean knowledge score of 8.68 ± 1.54 (median = 9.00; IQR = 8.00–10.00; range = 5.00–11.00). Only 15.6% of mothers had a moderate level of knowledge, with a mean score of 12.73 ± 1.10 (median = 12.00; IQR = 12.00–13.00; range = 12.00–15.00). No mothers were classified as having good knowledge.

Table 3 Distribution of mothers according to knowledge level regarding neonatal jaundice

Knowledge level	**n**	**%**
Poor	81	84.4
Mean± SD	8.68±1.54	
Median	9.00	
IQR	8.00-10.00	
Min-max	5.00-11.00	
Moderate	15	15.6
Mean ±SD	12.73± 1.10	
Median	12.00	
IQR	12.00-13.00	
Min-max	12.00-15.00	

SD: Standard deviation IQR: Inter-Quartile Range.

Table 4 shows that there was no statistically significant association between maternal knowledge about neonatal jaundice and any of the studied sociodemographic characteristics, including maternal age, employment status, and income ($p>0.05$). Poor knowledge predominated across all categories. The proportion of mothers with moderate knowledge was slightly higher among mothers aged ≥30 years (17.5%) compared with those aged <30 years (12.1%), among working mothers (19.1%) compared with non-working mothers (7.1%), and showed little variation across income categories; however, none of these differences reached statistical significance.

Table 4 Association between maternal sociodemographic characteristics and knowledge about neonatal jaundice

	Poor knowledge		**Moderate knowledge**		**p-value**	**Test of sig**
	n	**%**	**n**	**%**		
Maternal age *(years)						
<30	29	87.9	4	12.1	0.494	Chi Square $X^2 = 0.468$
≥30	52	82.5	11	17.5		
Employment status						
Not working	26	92.9	2	7.1	0.142	Fisher's Exact $X^2 = 2.157$
Working	55	80.9	13	19.1		
Income (LD)						
<1000	11	84.6	2	15.4	0.997	Monte Carlo $X^2 = 0.006$
1000-2000	65	84.4	12	15.6		
>2000	5	83.3	1	16.7		

*Maternal age categories were collapsed into two categories (<30 and ≥30 years) to compensate for the small number of mothers with moderate knowledge and ensure adequate cell frequencies for statistical analysis.

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Discussion

This study assessed maternal knowledge of neonatal jaundice among mothers of infants aged six months or younger attending Maternal and Child Health (MCH) centers in Derna, Libya. Overall, knowledge was inadequate: 84.4% of mothers were classified as having poor knowledge, 15.6% had moderate knowledge, and none had good knowledge. Mothers were relatively familiar with the characteristic yellow discoloration of jaundice and the importance of early and frequent breastfeeding, but substantial gaps were identified regarding danger signs, risk factors, prolonged jaundice, treatment, and complications. No statistically significant associations were found between knowledge level and maternal age, employment status, or income.

These findings are important because, although neonatal jaundice is often transient, severe hyperbilirubinemia can progress to acute bilirubin encephalopathy, kernicterus, permanent neurological impairment, hearing loss, and death when not recognized and treated promptly [17]. Current guidance emphasizes systematic assessment of newborns, appropriate follow-up after discharge, and timely evaluation of infants with suspected significant jaundice [18,19]. Maternal knowledge should therefore be considered part of a broader system of early recognition, referral, and clinical management rather than as an isolated determinant of outcomes.

The high proportion of mothers with poor knowledge contrasts with findings from Egypt, where 52.3% of mothers were reported to have adequate knowledge of neonatal jaundice [14]. Differences in study populations, questionnaire content, scoring systems, educational backgrounds, and healthcare settings may partly explain this variation. Despite 92.7% of mothers in the present study having university education, knowledge remained poor, suggesting that formal educational attainment does not necessarily translate into adequate knowledge of a specific neonatal health problem. Access to appropriate health information, previous experience, counselling, and the timing and quality of communication with healthcare providers may also influence mothers' understanding.

The present findings are nevertheless consistent with evidence from other settings. A 2025 study in Ghana found sufficient knowledge in only 31.5% of mothers [20], while Egyptian evidence on neonatal danger signs has also demonstrated variation in knowledge according to education, antenatal follow-up, and sources of health information [21]. These findings support the need for targeted education rather than assuming that general contact with healthcare services is sufficient.

An important finding in the present study was the difference between recognition of jaundice itself and recognition of potentially serious features. Although 78.1% of mothers correctly identified yellow discoloration of the skin and/or eyes, considerably fewer recognized unusual sleepiness or difficulty waking (24.0%), feeding difficulty (28.1%), dark urine (13.5%), or pale/whitish stools (8.3%) as concerning findings. Visual recognition of jaundice alone cannot determine bilirubin concentration or reliably indicate disease severity [18,19]. The particularly poor recognition of dark urine and pale stools is important because these findings may indicate cholestatic or hepatobiliary disease rather than uncomplicated physiological jaundice. Similarly, poor feeding and marked lethargy are important neonatal danger signs. Maternal education should therefore move beyond recognition of a “yellow baby” to recognition of symptoms requiring prompt professional assessment.

Knowledge of risk factors was variable. Two-thirds of mothers recognized prematurity as a risk factor (66.7%), while 61.5% identified inadequate breastfeeding or poor milk intake; however, only 33.3% recognized neonatal infection. Current guidance emphasizes consideration of gestational age, bilirubin level, postnatal age, and clinical risk factors in assessment and management [22]. Maternal education should communicate these risks in simple terms without encouraging mothers to make clinical diagnoses themselves.

Knowledge of breast milk jaundice was particularly limited, with only 7.3% answering correctly. This may reflect the complexity of distinguishing breast milk jaundice from jaundice associated with inadequate milk intake. Mothers should receive clear counselling that prolonged jaundice in an otherwise well, adequately feeding infant still requires appropriate assessment before being considered benign, and that breastfeeding should not be stopped automatically.

Knowledge of the natural course of jaundice was also incomplete. Although 60.4% knew that mild physiological jaundice usually improves gradually, only 28.1% recognized that jaundice persisting for more than two weeks in a term newborn requires medical evaluation. Similarly, only 34.4% recognized increasing severity or spread of jaundice as potentially concerning. These findings suggest that some mothers may understand the general concept of physiological jaundice but have difficulty identifying when its course becomes atypical.

Treatment-related knowledge revealed additional misconceptions. Only 39.6% knew that phototherapy may be required when bilirubin reaches an appropriate treatment threshold, 31.3% correctly rejected the belief that increasing breastfeeding is the only treatment for all cases, and only 22.9% rejected sunlight exposure as a safe substitute for medical phototherapy. Current management of neonatal hyperbilirubinemia is based on bilirubin levels, postnatal age, gestational age, and clinical risk factors, with phototherapy initiated according to established treatment thresholds [22]. Mothers therefore need to understand that breastfeeding is supportive and important, but does not replace appropriate medical treatment when significant hyperbilirubinemia is present.

Knowledge of complications was another major weakness. Only 37.5% recognized that severe untreated jaundice may cause permanent brain damage, 28.1% recognized the possibility of death, 25.0% recognized

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permanent hearing or neurological problems, and 14.5% recognized seizures as a possible complication. Similar gaps in maternal recognition of neurological complications have been reported elsewhere [23]. Since the major concern is failure to identify and treat severe hyperbilirubinemia, information about its potential complications should be an essential component of maternal counselling.

In contrast, knowledge related to breastfeeding was relatively stronger. More than 90% of mothers recognized early initiation and frequent breastfeeding as potentially reducing the risk of jaundice, and 66.7% recognized that adequate breastfeeding may help shorten jaundice related to inadequate milk intake. This may reflect the emphasis placed on breastfeeding within maternal and child health services. However, only 35.4% rejected the statement that all neonatal jaundice can be prevented by breastfeeding, indicating that an important misconception remains. Mothers should therefore be encouraged to breastfeed while also understanding that not all neonatal jaundice is preventable through feeding practices alone.

No statistically significant associations were found between knowledge and maternal age, employment status, or income. Although moderate knowledge was somewhat more common among mothers aged ≥30 years and among working mothers, the differences were not statistically significant. These findings should be interpreted cautiously because the sample was small and only 15 mothers were classified as having moderate knowledge. The absence of statistical significance therefore should not be interpreted as evidence that sociodemographic factors have no relationship with maternal knowledge. The results also differed from those of Moawad et al., who reported higher knowledge among employed mothers and urban residents [14], and from evidence from Ghana in which maternal characteristics were associated with jaundice-related knowledge and practices [20]. Contextual differences in healthcare access, information sources, culture, and study populations may contribute to these variations. In the present study, the predominance of university-educated mothers (92.7%) also limited variation in education and prevented meaningful assessment of its influence.

The findings have practical implications for maternal and newborn health services in Derna. Neonatal jaundice education should be integrated into routine antenatal, maternity, postnatal, breastfeeding, and MCH services rather than left to mothers to obtain independently. WHO emphasizes information, counselling, and support for parents and caregivers as important components of quality postnatal care [18]. Key messages should include recognition of jaundice, danger signs such as poor feeding and excessive sleepiness, the importance of assessment when jaundice is early or prolonged, the role of adequate breastfeeding, the limitations of visual assessment, and the need for professional evaluation rather than reliance on home remedies.

Evidence from intervention studies supports the potential value of structured education. A 2024 study in Uganda demonstrated a substantial improvement in maternal knowledge following a postnatal neonatal jaundice education package, with the mean knowledge score increasing from 10.02 before the intervention to 14.61 after the intervention [18]. Similarly, a cluster-randomized trial in rural Bangladesh reported improved maternal knowledge and attitudes following prenatal sensitization regarding neonatal hyperbilirubinemia management [24]. A recent systematic review and meta-analysis also found that structured newborn-care education can improve mothers' knowledge and confidence [25]. These findings support consideration of locally adapted Arabic-language educational materials, reinforced through antenatal clinics, maternity facilities, MCH centers, and community-based services.

The current study adds a maternal-knowledge perspective to the growing evidence on neonatal jaundice in Libya. Previous Libyan studies have mainly addressed the occurrence, clinical characteristics, risk factors, and outcomes of neonatal jaundice [11–13], whereas the present study identifies specific knowledge gaps among mothers in Derna. The findings suggest that improving maternal recognition of clinically important jaundice should complement clinical efforts aimed at early detection, referral, and treatment.

Overall, the principal issue identified in this study was not simply lack of awareness of neonatal jaundice, but limited understanding of its clinical significance. Mothers were generally able to recognize yellow discoloration, but many were unable to identify warning signs, complications, prolonged jaundice, or the circumstances requiring medical evaluation. Health education should therefore emphasize actionable knowledge and danger-sign recognition rather than awareness of the condition alone.

Strengths and limitations of the study

This study has several strengths. First, it addresses an important but relatively understudied aspect of neonatal health in Libya by focusing specifically on maternal knowledge of neonatal jaundice in Derna. Second, the questionnaire assessed multiple domains of knowledge, including signs and symptoms, risk factors, clinical course, treatment, complications, and prevention, allowing identification of specific knowledge gaps rather than relying only on an overall awareness measure. Third, the questionnaire was developed from the relevant literature and previously published instruments and was adapted to the local context. Its content validity was reviewed by experts, and pilot testing was undertaken before the main study. The knowledge scale demonstrated acceptable internal consistency, with a Cronbach's alpha of 0.72. Fourth, the study recruited mothers whose infants had a previous history of neonatal jaundice, representing a population with direct experience of the

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condition and therefore providing a clinically relevant assessment of knowledge. Finally, the study provides locally relevant findings that can inform health education within Maternal and Child Health services in Derna.

Several limitations should be considered when interpreting the findings. First, the cross-sectional design does not allow determination of temporal relationships or causal associations between maternal characteristics and knowledge. Second, the sample size was relatively small (n=96), which limited statistical power, particularly for detecting associations between knowledge and sociodemographic characteristics. This limitation was reflected in the small number of mothers classified as having moderate knowledge and the absence of mothers in the good-knowledge category. Third, consecutive non-probability sampling of mothers attending selected MCH centers may have introduced selection bias, and the findings may not be generalizable to all mothers in Derna or Libya, particularly mothers who do not attend MCH services.

Fourth, the study population was highly educated, with 92.7% of mothers having university education, resulting in limited variability in educational attainment and preventing meaningful assessment of education as a determinant of knowledge. Fifth, knowledge was assessed using a self-administered questionnaire and may therefore be affected by recall, interpretation, or social desirability bias. Sixth, the study assessed knowledge but did not directly assess actual care-seeking behavior, health-service utilization, or neonatal outcomes; therefore, the relationship between knowledge and timely management of jaundice cannot be established from these data.

Conclusion

Maternal knowledge regarding neonatal jaundice was poor among the studied mothers in Derna, Libya. Although most mothers could recognize the characteristic yellow discoloration of jaundice and were aware of the importance of early and frequent breastfeeding, substantial knowledge gaps were identified concerning danger signs, prolonged jaundice, treatment, and potentially serious complications.

These findings highlight the need to strengthen maternal education about neonatal jaundice within antenatal, maternity, postnatal, and Maternal and Child Health services. Educational messages should emphasize recognition of clinically important warning signs, the need for prompt medical assessment of early, severe, or prolonged jaundice, the potential neurological and life-threatening complications of severe hyperbilirubinemia, and the limitations of home remedies such as sunlight exposure. Future studies should evaluate structured educational interventions and determine whether improvements in maternal knowledge translate into earlier care-seeking and improved neonatal outcomes.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare that they have no conflict of interest.

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