ORIGINAL ARTICLE

Factors associated with neonatal jaundice in a regional high-altitude hospital: a cross-sectional study

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ABSTRACT

Neonatal jaundice is a condition characterized by elevated bilirubin levels in newborns, which, if left untreated, can lead to serious neurological complications. This study aimed to identify factors associated with neonatal jaundice in newborns at a regional referral hospital located at a high altitude (4338 meters above sea level) in Peru. A cross-sectional observational study was conducted, reviewing the medical records of 206 newborns treated during the last half of 2022. Factors associated with neonatal jaundice were evaluated using logistic regression, and odds ratios (OR) were calculated as measures of association. Significant associations were found between neonatal jaundice and male gender (OR = 2.01; 95 % CI = 1.05-3.83; p = 0.034), preterm gestational age (OR = 2.91; 95 % CI = 1.41-6.00; p = 0.003), dystocic delivery (OR = 3.81; 95 % CI = 1.95-7.42; p = 0.001), A+ blood group and Rh factor (OR = 2.90; 95 % CI = 1.16-4.22; p = 0.019), and low birth weight (OR = 2.38; 95 % CI = 1.19-4.74; p = 0.012). Future studies should include larger cohorts and further explore the impact of high-altitude geography on the development of neonatal jaundice.

Keywords: Jaundice, Neonatal; Altitude; Infant, Newborn; ABO Blood-Group System (Fuente: MeSH)

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Factores asociados con la ictericia neonatal en un hospital regional a gran altitud: un estudio transversal

RESUMEN

La ictericia neonatal es una patología caracterizada por la elevación de los valores de la bilirrubina en los recién nacidos. De no ser tratada, la ictericia neonatal puede tener repercusiones importantes a nivel neurológico. El objetivo principal de este estudio fue determinar los factores asociados a la ictericia neonatal en recién nacidos de un hospital regional de referencia del Perú ubicado a gran altura (4338 metros sobre el nivel del mar). Se desarrolló un estudio observacional de corte transversal. Se revisaron las historias clínicas de 206 recién nacidos atendidos durante el último semestre del 2022. Se evaluaron los factores asociados a la ictericia neonatal mediante regresión logística y se obtuvieron odds ratio (OR) como medida de asociación. Se encontró una asociación significativa entre el género masculino (OR = 2,01; IC 95 % = 1,05-3,83; p = 0,034), la edad gestacional pretérmino (OR = 2,91; IC 95 % = 1,41-6,00; p = 0,003), el parto distócico (OR = 3,81; IC 95 % = 1,95-7,42; p = 0,001), el grupo sanguíneo y factor Rh del recién nacido A+ (OR = 2,90; IC 95 % = 1,16-4,22; p = 0,019) y el bajo peso al nacer (OR = 2,38; IC 95 % = 1,19-4,74; p = 0,012), con la ictericia neonatal. A futuro, se sugiere plantear estudios que incluyan una cohorte más grande de recién nacidos y exploren con mayor detalle el rol de la altitud geográfica en el desarrollo de la ictericia neonatal.

Palabras clave: Ictericia neonatal; Altitud; Recién Nacido; Sistema del Grupo Sanguíneo ABO (Fuente: DeCS)

INTRODUCTION

Neonatal jaundice (NJ) is a common condition in newborns, characterized by yellowing of the skin and mucous membranes due to bilirubin accumulation (1). NJ is the leading cause of hospitalization and readmission in neonates (2), affecting 60% of term infants and 80% of preterm infants (3). In developed countries, the prevalence of NJ exceeds 50%, while in developing countries, it reaches 70% (4). In Peru, the incidence has been reported as 39 cases per 1,000 live births (5).

NJ is classified as physiological or pathological based on clinical and laboratory characteristics. Persistent or severe NJ can lead to neurological damage, manifesting early as poor sucking, lethargy, and hypotonia and later as involuntary movements, sensory deficits, and cerebral palsy (6–9). In severe cases, untreated NJ can be fatal (6–9). Therefore, identifying potential risk factors is critical for timely management.

Visible jaundice typically occurs when total serum bilirubin exceeds 5 mg/dL. In infants with darker skin, scleral examination is essential. NJ accounts for most term infant hospitalizations, and prolonged jaundice lasting more than 14 days is a defined category (10–12).

Previously reported risk factors include male sex, gestational age, and mode of delivery. Prematurity (<37 weeks) and cesarean birth confer higher NJ risk (13, 14). Blood group incompatibilities (e.g., maternal type O with infant A, B, or AB blood types, particularly with Rh factor differences) can lead to hemolysis and jaundice (15–17). Birth weight is also pivotal: low birth weight (<2,500 g) correlates with increased neonatal morbidity and mortality (18–20), while macrosomia (>4,000 g) can also elevate NJ risk (21–24).

This study aimed to assess whether factors including sex, gestational age, delivery type, newborn and maternal blood type/Rh factor, and birth weight are associated with NJ among infants born in a high-altitude hospital. Given the accessibility of this demographic and clinical data, it may guide early monitoring and management of neonatal jaundice to reduce adverse outcomes.

METHODS

Study design

An observational, cross-sectional study was conducted using secondary data extracted from clinical records.

Setting and participants

The study took place at Daniel Alcides Carrión Regional Hospital in Cerro de Pasco (4,338 m above sea level). All infants born between July and December 2022, meeting inclusion criteria, were enrolled via convenience sampling.

Selection criteria

This study included hospital delivery records that contained comprehensive data for all relevant variables of interest. Non-institutional births and infants transferred to intensive care units were excluded from the analysis.

Data collection

Following ethical approval and hospital permission, neonatal records were reviewed in the neonatal unit, and data were collected using a standardized form.

Variables

The outcome variable was neonatal jaundice, identified by the ICD-10 code P59 and a total serum bilirubin level greater than 5 mg/dL. The independent variables comprised sex (male/female), gestational age (term, preterm, post-term), delivery mode (vaginal, cesarean), newborn blood type (A, B, AB, O), Rh status (positive/negative), and birth weight category (low, normal, macrosomic). Maternal blood group and Rh status were also recorded.

Data analysis

Data entry was performed using Microsoft Excel, and analysis was conducted with IBM SPSS v27. Descriptive statistics are reported as frequencies and percentages. Inferential analysis employed univariate logistic regression to calculate odds ratios (OR) and 95% confidence intervals (CI), with significance set at $p < 0.05$.

RESULTS

Of the 206 neonates included, 62 (30.1%) were diagnosed with NJ. Table 1 summarizes the neonatal characteristics: 127 (61.6%) were male, 166 (80.6%) were term, 112 (54.4%) were delivered via cesarean section, 177 (85.9%) had O+ blood type, and 158 (76.7%) had a normal birth weight.

Significant associations with NJ were found for male sex (OR=2.01; 95% CI 1.05-3.83; p=0.034), preterm birth (OR=2.91; 95% CI 1.41-6.00; p=0.003), cesarean delivery (OR=3.81; 95% CI 1.95-7.42; p=0.001), A+ blood type (OR=2.90; 95% CI 1.16-4.22; p=0.019), and low birth weight (OR=2.38; 95% CI 1.19-4.74; p=0.012) (Table 2).

DISCUSSION

The present study found a statistically significant association between male sex and NJ. This finding suggests that male newborns are approximately twice as likely to develop jaundice compared to females. Several studies confirm this association. For example, Boskabadi et al. (25) and Daza-Calixto et al. (28) indicated that the probability of developing NJ increases in male newborns. Belay et al. (26) corroborated this finding, reporting an OR of 4.53 (95% CI = 3.39-6.07) for male sex. Additionally, Birhanu et al. (27) documented a relative risk (RR) of 5.2 (95% CI = 3.5-7.3) for the same factor. These findings reinforce the consistency of this association across different settings and populations.

Regarding gestational age, a statistically significant association was observed between prematurity and NJ, with small effect sizes. This finding indicates that preterm infants are nearly three times more likely to develop NJ compared to term infants. This result is consistent with other studies, highlighting the vulnerability of preterm newborns to this condition (25, 28–30).

Table 1. Characteristics of the newborns included in the study

Variable	n	%
Sex		
Male	127	61.7
Female	79	38.3
Gestational age		
Term	166	80.6
Pre-term	38	18.4
Post-term	2	1.0
Delivery mode		
Vaginal	94	45.6
Caesarean section	112	54.4
Blood group & Rh		
A+	21	10.2
B+	7	3.4
AB+	1	0.5
O+	177	85.9
Birth weight		
Appropriate weight	158	76.7
Low birth weight	44	21.4
Macrosomia	4	1.9
Neonatal jaundice		
Yes	62	30.1
No	144	69.9

Concerning the type of delivery, a statistically significant association was found between cesarean birth and NJ. This finding suggests that neonates delivered by cesarean section are about four times more likely to develop jaundice than those born via vaginal delivery. Boskabadi (25) reported similar results. However, other studies (27, 31, 32) did not find a significant association between cesarean delivery and NJ, which could indicate variability in results depending on sample characteristics or contextual factors. In contrast, Brits (33) found a significant relationship between vaginal delivery and NJ ($p = 0.04$), which may be related to uncontrolled factors in those studies.

With respect to the newborn's blood group and Rh factor, a statistically significant association was found between the A+ blood group and NJ. This finding suggests that newborns with this blood type are nearly three times more likely to develop jaundice. Maldonado (15) also found that both the Rh factor (OR = 8.365; $p = 0.005$) and the blood group (OR = 8.361; $p = 0.003$) of the newborn were significantly associated with NJ, supporting our findings. In contrast, other studies found no statistically significant association between these variables (9, 11, 27, 31, 32), which may reflect differences in the populations studied or in the analytical methods used.

Regarding birth weight, our findings showed a statistically significant association between low birth weight and NJ,

Table 2. Factors associated with neonatal jaundice among newborns at Daniel Alcides Carrión Regional Hospital in Pasco

Variable	Without neonatal jaundice		Neonatal jaundice		OR (95 % CI)	p
	n	%	n	%		
Sex						
Female	62	30.1	17	8.3	Ref.	
Male	82	39.8	45	21.8	2.01 (1.05-3.83)	0.034
Gestational age						
Term	123	59.7	43	20.9	Ref.	
Pre-term	19	9.2	19	9.2	2.91 (1.41-6.00)	0.003
Post-term*	2	1	0	0		
Delivery mode						
Vaginal	79	38.3	15	7.3	Ref.	
Cesarean section	65	31.6	47	22.8	3.81 (1.95-7.42)	0.001
Blood group & Rh factor						
O+	128	62.1	49	23.8	Ref.	
A+	10	4.9	11	5.3	2.90 (1.16-4.22)	0.019
B+*	5	2.4	2	1		
AB+*	1	0.5	0	0		
Birth weight						
Appropriate weight	116	56.3	42	20.4	Ref.	
Low birth weight	24	11.7	20	9.7	2.38 (1.19-4.74)	0.012
Macrosomia*	4	1.9	0	0		

** Not included in the model due to lack of outcome data and model convergence*
NJ: neonatal jaundice; OR: odds ratio; CI: confidence interval; Ref: reference category

with small effect sizes. This result indicates that newborns with low birth weight are approximately 2.4 times more likely to develop jaundice compared to those with normal birth weight. Boskabadi et al. (25), Belay (26) (adjusted OR = 5.12; 95% CI = 3.11-8.72), Carrasco (31) (crude OR = 0.088; 95% CI = 0.03-0.20; p = 0.001), and Maldonado et al. (30) (p = 0.039) reported similar results, confirming the relevance of birth weight as a risk factor for NJ. However, Mojtahedi et al. (29) and Vera et al. (32) reported no association between these variables, which may be due to differences in inclusion criteria or measurement techniques.

Finally, no statistically significant association was found between the maternal blood group or Rh factor and NJ. This finding is consistent with the results of Carrasco et al. (31) and Vera et al. (32). However, Birhanu et al. (27) documented a significant association between maternal blood group O and NJ (RR = 4.5; 95% CI = 3.4-10.3), suggesting that additional unmeasured factors may influence this relationship.

The main limitations of this study include the small sample size, which limits the generalizability of the findings. Future studies should involve larger populations to improve the extrapolation of results. Another significant limitation is that, despite being conducted in a high-altitude city, the study did not account for whether the mother remained in the city throughout pregnancy. It also did not consider whether the parents were originally from a high-altitude city or had migrated from lower-altitude areas. Despite these limitations, the study contributes to the scientific literature by providing and corroborating previously published information.

This study identified statistically significant associations between male sex, preterm gestational age, cesarean delivery, A+ blood group, and Rh factor in the newborn, as well as low birth weight, with NJ. No significant association was observed between the maternal blood group or Rh factor and NJ. Future studies on NJ in newborns from high-altitude cities are recommended to include larger cohorts and further investigate the impact of geographic altitude on the development of this condition.

Author contributions

The author was responsible for study conception and design, data collection, analysis, interpretation, and manuscript preparation.

Conflicts of interest

The author declares no conflicts of interest

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This study was self-funded.

Ethical considerations

The study received institutional ethics approval, and data confidentiality was strictly maintained. Since the study utilized anonymized secondary data, informed consent was not required.

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