

# Epidemiological Investigation of Neonatal Jaundice in Tikrit City: Assessing Neonatal Risk Factors from 2022 to 2023

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## Abstract

**Objectives:** This study aimed to assess the prevalence of neonatal jaundice and explore associated risk factors in Tikrit City, Iraq.

**Methods:** The current study was a cross sectional study involved 312 neonates (204 of them with jaundice and 108 without jaundice), attending Salahaddin General hospital from 1st October 2022 to 30th January 2023. The Study sample was convenient. Jaundiced and Non-jaundiced neonates were enrolled into the study when they enter the wards of pediatrics and neonatal intensive care units in Salahaddin General Hospital and those visits outpatient clinics of pediatricians and the general population during a free neonatal jaundice screening campaign in Tikrit City.

**Results:** The prevalence of neonatal jaundice is (9.2%). The most frequent cases was having total serum bilirubin (TSB) level  $\leq 18$  milligram/dc liter (mg/dl) (84.8%). The mean  $\pm$  standard deviation (SD) of hyperbilirubinemia level is  $(15 \pm 3.366$  mg/dl) and the high TSB level was reported among male gender (58.3%). The percent of preterm babies was (33.3%) of total sample. The most cases had normal weight (66.7%) at time of delivery, mean  $\pm$  SD of weight is  $(2698.5 \pm 693.54$  gram) and had no bruises or hematoma as cephalohematoma (89.2%). There was no blood diseases in about (72.5%) of total sample and no history of infection in (68.1%) of cases. The most frequent methods of feeding was breast feeding (39.7%). Regarding to time of appearance of jaundice, the most frequent cases were among those with age group ( $\leq 5$  days) (89.7%). The mean  $\pm$  SD for age of neonate at time of admission is  $(6.2 \pm 3.6$  day). Blood group incompatibility (ABO incompatibility) was found in (60.8%) of cases with TSB level  $\leq 18$  mg/dl and (11.3%) of cases of TSB level  $< 18$  mg/dl. While Rhesus incompatibility (Rh incompatibility) was found in (13.2%) of cases with TSB level  $\leq 18$  mg/dl.

**Conclusion:** This study highlights a prevalence of 9.2% for neonatal jaundice in Tikrit City and identifies important risk factors such as blood group incompatibility and preterm birth. Early detection and appropriate management of neonatal jaundice are crucial to prevent potential complications and ensure optimal neonatal care.

**Keywords:** Jaundice, neonatal, epidemiology, Iraq

## Introduction

Neonatal jaundice or neonatal hyperbilirubinaemia results from elevated total serum bilirubin (TSB) and clinically manifests as a yellowish discoloration of the skin, sclera, and mucous membrane. The term jaundice derives from the French word “jaune”, which means yellow. It is the most commonly encountered medical problem in the first two weeks of life and a common cause of readmission to the hospital after birth.<sup>1</sup> The primary cause of jaundice is an imbalance between bilirubin production and conjugation, which raises bilirubin levels.<sup>2-5</sup> Neonatal jaundice often appears on the second day of life and is not hazardous. It is also a self-limiting disorder that usually gets better on its own without therapy once the level of bilirubin is back to normal. However, extremely high levels of bilirubin can cause kernicterus, which is permanent brain damage.<sup>6</sup> Jaundice often appears in neonates when bilirubin levels reach 5–10 mg/dl.<sup>7</sup>

### Aim of the Study

To study the epidemiology of neonatal jaundice in Tikrit city according to neonatal risk factors.

### Objectives of the Study

1. To determine the frequency of jaundice in neonates attending in Salahaddin General hospital.
2. To determine the frequency of jaundice in neonates according to neonatal causes (age, gender, hyperbilirubinemia type, gestational age, feeding type, weight, infection, Rh and blood group).

## Patients and Methods

The current study was a cross sectional study involved 312 neonates (204 of them with jaundice and 108 without jaundice), attending Salahaddin General hospital from 1st October 2022 to 30th January 2023. The Study sample was convenient. Jaundiced and Non-jaundiced neonates were enrolled into the study when they enter the wards of paediatrics and neonatal intensive care unites in Salahaddin General Hospital and those visits outpatient clinics of pediatricians and the general population during a free neonatal jaundice screening campaign in Tikrit City. Ethical Considerations : The Salahaddin General Hospital, Tikrit University's higher education and scientific research ministry, the Iraqi Scientific Council of Family and Community Medicine, and the study's participants were all informed about the study and given the opportunity to give their consent. Inclusion Criteria : age  $< 28$  days; appearance of jaundice for jaundiced neonates and no jaundice for others non-jaundiced neonates. While exclusion criteria : neonates with or without jaundice that did not have complete necessary information from their mothers or in the hospital records. The informations regarding disease was obtained according to well design questionnaire. The pilot study was done in Salahaddin General Hospital's pediatric wards, a pilot research involving 35 newborns was carried out in October 2022. Around 4–6 newborns on average visited the hospital each day at this time, primarily between the hours of 9 AM and 1 PM. The survey should take you around 10 minutes to complete. This study's modification of the questionnaire, which substituted

sociodemographic, medical, and surgical history questions for time-consuming opinion questions, was a benefit. Statistical Analysis:- All data were sorted in frequencies because the variables under study were qualitative, and the chi-square test was used to see whether there were any connections between the variables. *P*-values of less than or equal to 0.05 were regarded as significant.

## Results

The prevalence of neonatal jaundice in Tikrit city (9.2%) and the percent of neonate without jaundice was (90.8%) (Figure 1).

The most frequent cases was among those with TSB  $\leq 18$  mg/dl (84.8%) while the cases of TSB level  $>18$  mg/dl (15.2%) (Figure 2 and Table 1).

Jaundice is more commonly found in those With TSB level  $\leq 18$  mg/dl (84.8%). The high TSB level was among male gender (58.3%) while female gender (41.7%) with no significant difference. Regarding to the gestational age the most recurrent cases were full term babies (66.7%) with no significant difference and about neonatal weight, the high TSB level was among cases of normal weight (66.7%) with no significant difference. About presence of hematoma or bruises in the body of neonates, the most frequent cases were had no bruises or hematoma (89.2%) with no significant difference and the most cases had no blood disease (72.5%) with significant difference. About infection, the high level of TSB was among neonates with no history of infection (68.1%) with no significant difference. The most frequent methods of feeding was

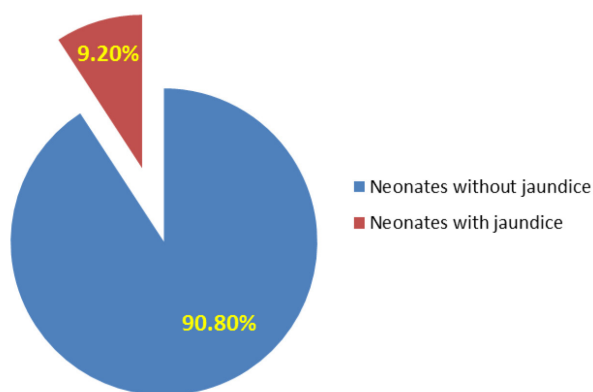


Fig. 1 The prevalence of neonatal jaundice in Tikrit city.

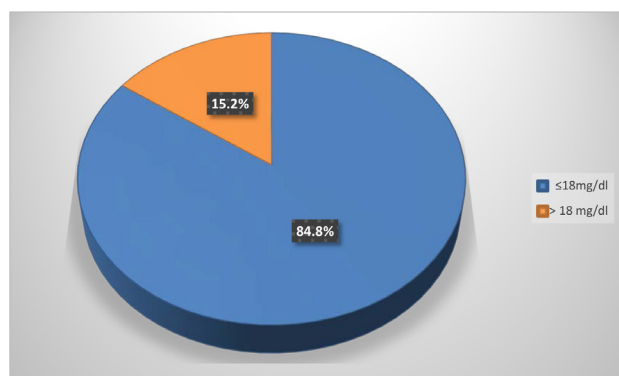


Fig. 2 Distribution of neonatal jaundice according to TSB level.

breast feeding (39.7%) followed by artificial methods (32.3%) then mixed type of feeding (28%) with no significant difference. Regarding to time of appearance of jaundice the most frequent cases were among those with age group ( $\leq 5$  days) (89.7%) with no significant difference.

The newborn jaundice is more commonly found in neonate age group 1–5 days (51.5%) and among male gender (58.8%) with no significant difference (Table 2).

The mean  $\pm$  SD of hyperbilirubinemia level is ( $15 \pm 3.366$  mg/dl), the highest level was 26 mg/dl and the lowest level is (7.2 mg/dl). Mean  $\pm$  SD of weight is ( $2698.5 \pm 693.54$  g), the highest value is (4200 g) and the lowest weight is (1100 g). Mean  $\pm$  SD for age of neonate at time of admission is ( $6.2 \pm 3.6$  day), the highest value is (27 day) and the lowest age is (2 day) (Table 3). The most frequent cases of neonatal jaundice according to TSB  $\leq 18$  mg/dl was among those with blood group incompatibility with their mothers 124 (60.8%) from 204 cases and Rh compatibility with their mothers 146 (71.6%) from 204 cases. While the most frequent cases of neonatal jaundice according to TSB  $>18$  mg/dl was among those with blood group incompatibility with their mothers 23 (11.3%) and Rh compatibility with their mothers 27 (13.2%) (Figure 3).

Table 1. Distribution of neonatal jaundice cases according to level of total serum bilirubin and certain factors

TSB level	Certain risk factors	$\leq 18$ mg/dl	$>18$ mg/dl	Total	Chi square test at <i>P</i> value $< 0.05$
Neonate gender	Male	99	20	119 (58.3%)	<i>P</i> -value is .44. It is not significant.
	Female	74	11	85 (41.7%)	
	Total	173	31	204 (100%)	
Gestational age	Preterm	55	13	68 (33.3%)	<i>P</i> -value is .27. It is not significant
	Full	118	18	136 (66.7%)	
	Total	173	31	204 (100%)	
Neonate weight	Under	56	12	68 (33.3%)	<i>P</i> -value is .49. It is not significant
	Normal	117	19	136 (66.7%)	
	Total	173	31	204 (100%)	
Bruises or hematoma	Yes	16	6	22 (10.8%)	<i>P</i> -value is .09. It is not significant
	No	157	25	182 (89.2%)	
	Total	173	31	204 (100%)	
Blood disease	Yes	43	13	56 (27.5%)	<i>P</i> -value is .049. It is significant
	No	130	18	148 (72.5%)	
	Total	173	31	204 (100%)	
Infection	Yes	56	9	65 (31.9%)	<i>P</i> -value is .713. It is not significant
	No	117	22	139 (68.1%)	
	Total	173	31	204 (100%)	
Feeding type	Breast	70	11	81 (39.7%)	<i>P</i> -value is .149. It is not significant
	Artificial	59	7	66 (32.3%)	
	Mixed	44	13	57 (28%)	
	Total	173	31	204 (100%)	
Jaundice appearance	$\leq 5$ days	171	29	200 (98%)	<i>P</i> -value is .0501. It is not significant
	$>5$ days	2	2	4 (2%)	
	Total	173	31	204 (100%)	

Table 2. Distribution of Neonatal Jaundice Cases According to Neonatal Gender and Age Group

Age Gender	1–5 days	6–10 days	>10 days	Total
Male	65	44	11	120 (58.8%)
Female	40	36	8	84 (41.2%)
Total	105 (51.5%)	80 (39.2%)	19 (9.3%)	204 (100%)

The chi-square statistic is 0.9012. The *P*-value is 0.637249. The result is not significant at *P* < 0.05.

Table 3. Mean, Standard deviation and Range of (TSB level, Weight and Age of Neonates)

Variables	Mean ± SD
TSB level mg/dl	Mean = 15, SD = 3.366, Range = 7.2–26
Weight/Kg	Mean = 2698.5, SD = 693.54, Range = 1100–4200
Age of neonates/day	Mean = 6.2, SD = 3.6, Range = 2–27

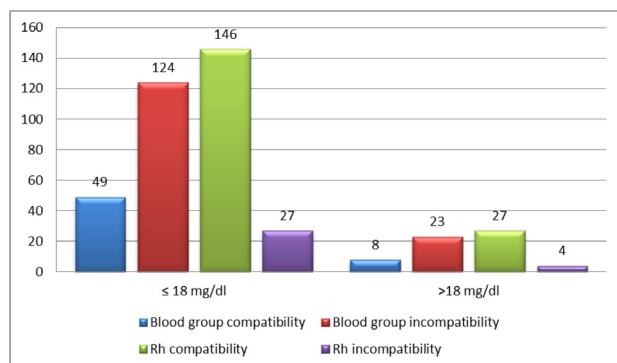


Fig. 3 Distribution of neonatal jaundice cases according to hyperbilirubinemia level and blood compatibility (neonates with their mothers).

## Discussion

A marked variation in the prevalence of neonatal jaundice was noted in the present study (9.2%) compared with that reported in Nigeria (15%),<sup>8</sup> Nepal (31%),<sup>9</sup> South Africa 55.2%.<sup>10</sup> This variation could be due to differences in socio-economic and cultural factors, the level of obstetric care and the study setting.<sup>11,12</sup> In the current study, the most frequent cases were coming from those with TSB ≤ 18 mg/dl (84.8%). While the cases of TSB level > 18 mg/dl was (15.2%). The mean ± (SD) of hyperbilirubinemia level is 15 ± (3.4) mg/dl. This level is similar to a result from Baghdad, that mean ± (SD) was 15.4 ± (3.6) mg/dl.<sup>13</sup> In many studies the mean of serum bilirubin was different from other studies. In Iranian study was done by Kavehmanesh et al., (2008), the mean ± (SD) was 17.9 ± (3.7) mg/dl.<sup>14</sup> In Mousl, the level of bilirubin as mean ± (SD) was 13.67 ± (4.80) mg/dl.<sup>15</sup> Regarding to neonatal gender, male was (58.3%) and had higher risk than female (41.7%) and there is no significant difference. This result is in line with many studies. In Baghdad (59%) of sample size were male.<sup>13</sup> In Al-Najaf, also the percent of male (59%) was more than female (41%).<sup>16</sup> In Bahrain the male gender was about (51.7%) and

female (48.3%).<sup>17</sup> Also a study from Ethiopia was found that male gender (58.4%) and female gender (41.6%).<sup>18</sup> About gestational age the most recurrent cases were full term babies (66.7%) then preterm babies (33.3%) with no significant difference. This in agreement with other studies. A study about risk factors related to neonatal jaundice in Baghdad, (75%) of total sample were term, so the remaining sample (25%) were pre-term.<sup>13</sup> A study in Al-Najaf province show increase the percent of neonatal jaundice rate with increase the gestational age, gestational age group > 36 week (60.4%) more than group = < 35 week (39.6%), but the gestational age wasn't effected (no significant differences) of TSB and study parameters levels between two groups.<sup>16</sup> In Kirkuk city a study had shown that jaundiced neonates were (77.1%) term and (22.8%) preterm.<sup>19</sup> In Mousl, (82%) term and (18%) preterm.<sup>15</sup> In Bahrain, cross-sectional study on neonates with indirect hyperbilirubinemia resulted that jaundiced neonates were (78.2%) term and (21.8%) preterm.<sup>17</sup> A study from Northern Ethiopia was found that term (48.3%) and preterm (38.3%).<sup>18</sup> About neonatal weight, in the current study the high TSB level was coming from cases of normal weight (66.7%) with no significant difference. The mean ± (SD) of neonatal weight is 2.698 kg ± (693 g). Many studies was found the same result of our study. In Baghdad, on admission the average newborn body weight was 2.922 kg ± (493 gm). Neonatal weight at admission and total serum bilirubin had a slight, positive connection that was statistically insignificant (*r* = 0.133, *n* = 160, *P* = .095).<sup>13</sup> A study from Mousl city in Iraq had shown that the mean of neonatal weight was 2.674 kg ± (570.35 mg) and the percent were normal weight (63%) and low body weight (34%).<sup>15</sup> A study from India show that the mean of body weight was (2.949 kg).<sup>20</sup> Regarding to the presence of bruises or hematoma in the body of neonate, there is no significant variation in the current study and the most frequent cases were had no bruises or hematoma (89.2%) while the cases with presence of bruises or hematoma as cephalohematoma (10.8%). This is in agreement with Iranian study, nearly 3% of jaundice patients included a cephalohematoma.<sup>21</sup> In these cases red blood cell lysis in these extravascular areas causes jaundice.<sup>22</sup> About blood disease and it is association with neonatal jaundice. There is a significant difference in current study, the most cases had no blood disease (72.5%). In Iranian study, the average newborn reticulocyte count suggested that the reticulocyte was not significantly connected with the incidence of jaundice at the different levels of bilirubin (*P* = 0.079) following the assessment of blood in various levels of bilirubin. The mean of Hb value in relation to bilirubin level showed that the neonate's Hb was significantly correlated with jaundice (*P* = 0.389). Infant mcv did not significantly differ between levels of bilirubin, according to analysis of the mean of mcv by bilirubin level (*P* = 0.107). Jaundice and the mean of PLT and WBC had a strong correlation (*P* = 0.192; (*P* = 0.370). The connection between the mean of Hct neonates and hyperbilirubinemia was substantial (*P* = 0.704). G6PD deficiency was one of the leading causes of jaundice the total prevalence was (9.4%). Although G6PD deficiency has been linked to newborn hyperbilirubinemia, its pathogenesis is yet unknown.<sup>21,23</sup> These newborns' jaundice is most likely caused by reduced hepatic conjugation rather than increased bilirubin generation as a result of hemolysis.<sup>21</sup> Regarding infection, there is no significant variation in the current study. The most recurrent cases were neonates with no history of infection (68.1%). While the percent of cases with infection

was (31.9%). According to a research from Nigeria, which supports the current findings, infection was the single most prevalent known cause of cancer (47%).<sup>24</sup> Another research from Nigeria came to the conclusion that septicemia was the main cause of newborn jaundice (32.5%).<sup>25</sup> In other Nigerian study sepsis was a significant condition recognized as the root of newborn jaundice in (45%) of the study population.<sup>26</sup> A study from Baghdad had shown that Sepsis was noticed in (23.1%) of cases.<sup>13</sup> Sepsis was shown to be a significant risk factor in (52%) of kernicterus patients, according to a Pakistani study.<sup>27</sup> In the evaluated papers from the majority of Iranian research, (13.7%) of newborns had infection as the etiologic cause of their jaundice.<sup>23,28</sup> Other study from Iran about causes of neonatal jaundice had shown that the percentage of Sepsis was (8.5%).<sup>29</sup> In disagreement with these studies and the current study, a Taiwanese research, found that only 3 out of 413 cases of hyperbilirubinemia were caused by sepsis.<sup>30</sup> About the association of feeding types with neonatal jaundice, there is no significant variation in the current study. The most frequent methods of feeding was breast feeding (39.7%) followed by artificial methods (32.3%) then mixed types of feeding (28%). This result is in agreement with many studies that found the most frequent method of feeding between neonatal jaundice cases was exclusively breastfed. According to a Nigerian study, the majority of newborns with jaundice (90.4%) were exclusively breastfed.<sup>25</sup> The Taiwanese study had revealed that exclusive breastfeeding (38.5%) was the most frequent cause.<sup>30</sup> In Baghdad, the percentages were (45%) exclusively breast feeding, (15%) bottle feeding, (40%) mixed feeding.<sup>13</sup> In Mosul, the results were (88%) exclusively breast feeding, (6%) bottle feeding, (6%) mixed feeding.<sup>15</sup> Jaundice has historically been a major indicator of infants receiving just breast milk, while the mechanism behind this link is unclear.<sup>31</sup> Although

unsaturated fatty acids or a lipase that inhibits glucuronyl-transferase have been hypothesized, it is unknown what is in breast milk that causes severe jaundice.<sup>32</sup> Regarding to time of appearance of jaundice, the most frequent cases were among those with age group ( $\leq 5$  days) (89.7%) with no difference in the current study. In Bahrain, the result according to age at presentation of jaundice was in agreement with our result, within 24 hours of age (37.15%), 1–5 days (57%) and  $>5$  days (5.9%).<sup>17</sup> Neonatal age at admission ranging from 2–27 days and there is no difference in the current study. The most frequent cases of neonatal jaundice was comes from neonate age group 1–5 days (51.5%), the Mean  $\pm$  (SD) =  $6.2 \pm (3.6)$  days. This is a same results to Baghdad study, the mean of age of neonates with jaundice was ( $6.2 \pm 3.6$  days).<sup>13</sup> According to hyperbilirubinemia level and blood compatibility (neonates with their mothers), the most frequent cases of neonatal jaundice according to TSB  $\leq 18$  mg/dl was come from those with blood group incompatibility with their mothers (60.8%) and Rh compatibility with their mothers (71.6%). While the most frequent cases of neonatal jaundice according to TSB  $>18$  mg/dl was come from those with blood group incompatibility with their mothers (11.3%) and Rh compatibility with their mothers (13.2%). There are many studies support a result of the current study that neonatal hyperbilirubinemia is most frequently caused by ABO incompatibility, according to reports. The most frequent reasons, according to an Iranian study, were ABO and Rh incompatibility (38.1% and 16.1%, respectively).<sup>29</sup> The most frequent etiology or risk factor identified, according to research from Turkey<sup>33</sup> and India,<sup>34</sup> was ABO incompatibility and according to a research from India, hyperbilirubinemia in (14.16%) of newborns was caused by ABO incompatibility.<sup>35</sup> In Baghdad, the study had resulted that ABO and Rh incompatibility were noticed in (23.1%) of cases.<sup>13</sup> ■

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