

Study of Some Factors Affecting Jaundice in Newborns at the Children's Hospital in Kirkuk Governorate, Iraq

Reham Layth Sami¹, Zaid Hassan Ali², Mohammed Rashed Abdul³

¹Department of Biology, College of Science, University of Kirkuk, Kirkuk, Iraq

²Department of Forensic Science, College of Science, University of Kirkuk, Kirkuk, Iraq

³Optometry Techniques Department, Polytechnic College Hawija, Northern Technical University, Kirkuk, Iraq.

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Corresponding Author:

Reham Layth sami

Email: rehamlayth@gmail.com

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ABSTRACT

This study aimed to evaluate the impact of different factors (such as: sex, birth weight, blood group compatibility between the infant and the mother and type of feeding) on serum bilirubin levels in neonates with jaundice. A total of 72 newborns (aged 3–12 days) were picked and divided into two groups (A group of healthy neonates (12 newborns), A jaundiced group (60 newborns). Comparison between the groups showed a significant elevation in total serum bilirubin ($P \leq 0.01$) in jaundiced neonates compared to the healthy ones. Regarding the effect of sex and weight on bilirubin levels in the jaundiced group, no significant differences were detected or shown. However, neonates with incompatible blood group and RH to the mother had a higher incidence of hyperbilirubinemia (Jaundice) compared to those with matched blood types. Additionally, the study shows that breastfed infants had higher bilirubin levels compared to those on mixed feeding, whereas no significant difference was shown between breastfed and formula-fed infants.

INTRODUCTION

Neonatal jaundice is the yellow discoloration of a newborn's skin and eyes, caused by an excess amount in the blood of a yellow-brown pigment called Bilirubin. This pigment is formed as a result of the continuous breakdown of aged red blood cells [1], which in turn reach the liver through the blood and are then processed by metabolism, where it becomes soluble and is excreted through the bile ducts into the intestine so the body can eliminate it with stool. Jaundice is considered a common condition, especially in infants born in week 38 of pregnancy (preterm), as 60% of newborn infants and 80% of premature babies develop jaundice [2]. In some cases, jaundice occurs in newborn infants because the child's liver is not mature enough to eliminate bilirubin from the bloodstream, where an abnormally high level of bilirubin in the blood may lead to the risk of permanent brain damage in the newborn, which can affect various brain functions [3]. The fetus may also suffer neurological damage resulting from elevated levels of unconjugated

bilirubin transferred through the placenta from the pregnant mother who has hyperbilirubinemia due to hemolytic anemia or liver disease [4] [5] .

The normal level of bilirubin in newborn infants is less than 5.2 mg/dl or about 5 mg/dl, but many newborns have some level of jaundice with bilirubin higher than 5 mg/dl during the first few days after birth, and this condition is called neonatal jaundice. The normal serum bilirubin levels are: total about 0–1 mg/dl, indirect bilirubin 0–0.2 mg/dl, and direct bilirubin 0–0.8 mg/dl [6]. Several types of jaundice may affect newborn infants, including physiological jaundice, which is the most common and appears in the first few days. This condition lasts for days or weeks until the excess fetal red blood cells are eliminated without the need for treatment. Another type is breast milk jaundice, which occurs due to proteins in breast milk that prevent the infant's liver from breaking down bilirubin and eliminating it, resulting in its accumulation and deposition in the skin. In some cases, breastfeeding may be suspended until recovery. Hemolytic jaundice is an inherited disease caused by a genetic disorder in the red blood cell membrane, and its symptoms include anemia, yellowing of the skin and eyes, and enlargement of the spleen. Pathologic jaundice occurs due to abnormal breakdown of red blood cells and may appear in the infant during the first day after birth [7]. There are several causes of jaundice, including physiological ones (immaturity of the liver), where the breakdown of aged red blood cells produces an excess amount of bilirubin beyond the liver's ability to metabolize it. Pathological causes may include viral hepatitis, obstruction of the bile ducts, disorders of the red blood cell membrane, or incompatibility between the mother's and child's blood [8].

There are several symptoms through which jaundice can be diagnosed, including yellowing of the skin and the sclera, usually starting at the head and then spreading to the rest of the body [9], pale-colored stool, dark urine, diarrhea and rectal bleeding, general weakness and weight loss, swelling of the legs with abdominal distension [9]. The diagnosis of jaundice depends on the clinical examination of the above symptoms [10] measurement of unconjugated bilirubin concentration, where its elevation indicates hemolysis, liver enzyme tests, which reveal hepatitis or obstruction of the bile ducts, and abdominal ultrasound imaging to detect gallstones, liver tumors, or bile duct obstruction [11]. Jaundice is treated in several ways, including continuing breastfeeding to stimulate the intestines and eliminate bilirubin, placing the infant under specific lighting known as phototherapy, and blood exchange transfusion in the absence of compatibility between the mother's and child's blood [12].

METHODOLOGY

Serological Tests

Total Serum Bilirubin (TSB) Serum total bilirubin is quantified using a Bilimeter, according to the method described in [13]. Several risk factors associated with neonatal jaundice were discovered through a structured questionnaire (as per Appendix 1) for each case. These factors included sex, type of feeding, weight, and blood group compatibility between the infant and the mother. Then the percentage of each factor was calculated. The results were statistically analyzed using a T-test (because of unequal group sizes) and the Chi-square test to compare categorical variables among neonates with jaundice. Data analysis was performed using the SAS statistical software [14]

Tools and devices used in the procedure

Fresh blood sample from the neonate, Capillary tube, Distilled water, Lancet , Centrifuge , Spectrophotometer , cotton and alcohol , microscopic slide , Wooden stick , Reagents for blood types: Anti-A, Anti-B, Anti-D.

Procedure for Total Serum Bilirubin

1-The puncture site (for example, the infant's heel/foot) is disinfected with cotton and alcohol before the collection

2-A blood sample is collected using a capillary tube

3-The capillary tube is centrifuged to get the serum

4-A capillary tube containing D.W. is placed in the spectrophotometer to calibrate (zero) the device at 11.3

5- The tube containing the serum is then inserted and the result shown is noted down

Results were expressed in mg/dL-tsb

Procedure for Blood Group Typing

1-The puncture site is disinfected, and blood is obtained by lancet prick

2-Three drops of fresh blood are placed onto a clean slide

3-Anti-D reagent is added to the first drop, Anti-B to the second, and Anti-A to the third 4-Each drop of blood is mixed with its reagent using a wooden stick

5-The slide is gently rocked for 2–3 minutes

6-If Agglutination occurs, that indicates a positive reaction, and results were recorded accordingly (based on Agglutination)

RESULTS AND DISCUSSION

The results showed a clear and highly significant increase ($P \leq 0.01$) in the total bilirubin levels in children with jaundice compared to healthy children. When looking at the effect of gender on bilirubin levels in sick children, no significant difference was found between males and females. The study also showed that bilirubin levels were higher in babies who were exclusively breastfed compared to those on mixed feeding, while no difference was seen between breastfed and formula-fed babies. Regarding birth weight, no significant effect was noticed at the level of probability ($P \leq 0.05$). In addition, the results indicated that the risk of jaundice was higher in babies whose blood type did not match their mother's, compared to those with compatible blood types. [15]

Table (1) Comparison between the group of healthy and sick children in terms of bilirubin levels (mean \pm standard error)

Group	Bilirubin
HEALTHY	2.17 \pm 0.57
Patient	10.72 \pm 0.40
$P \leq 0.01$	

The averages that carry different letters vertically indicate a comparison between the groups.

The averages that carry different letters differ significantly from each other at a probability level ($P \leq 0.01$) according to the Chi-square test.

The statistical analysis results (Table 1), when comparing healthy children with sick children in terms of bilirubin levels, showed highly significant differences ($P \leq 0.01$). Bilirubin levels were higher in sick children compared to healthy ones, with the average bilirubin level in healthy children being 2.17 ± 0.57 , compared to 10.72 ± 0.40 in sick children. The higher bilirubin levels

in sick children compared to healthy ones are due to increased breakdown of red blood cells (RBCs) that occurs after birth. Bilirubin is a yellow pigment, about 80% of which comes from heme, a component of hemoglobin released when red blood cells are destroyed. These cells are removed from circulation by the reticuloendothelial system of the liver. Therefore, increased breakdown leads to higher bilirubin production, which is normally excreted in bile [16]. However, the liver of newborns is still immature and cannot process such high amounts, leading to elevated bilirubin levels in the blood. Another possible reason is the reduced activity of the liver enzyme Glucuronyl transferase, which converts unconjugated bilirubin (produced from heme breakdown) into conjugated bilirubin stored in bile [17].

Therefore, the increase in total bilirubin levels results from the accumulation of both conjugated and unconjugated bilirubin. These findings agree with the results reported by [18] [19].

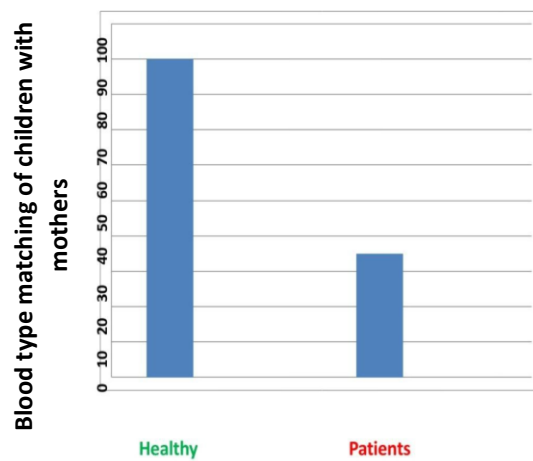
Table No. (2) shows the effect of gender, breastfeeding and weight of affected children on the percentage of bilirubin pigment (mean \pm standard error)

Adjectives	Sex		Lactation			Body weight (kg)		
	Male	Female	Normal	Artificial	Mixed	< 3	3-4	>4
Bilirubin	0.81 \pm 0.57 a	10.59 \pm 0.58 a	0.48 11.25\pm a	9.92 \pm0.90 ab	8.9\pm0.99 8 b	\pm 0.65 0.64 a	\pm0.55 0.81 a	9\pm0.40 .67 a
	NS		• *($p \leq 0.05$)			NS		

The study results showed no significant effect ($P \leq 0.05$) of the gender of sick children on bilirubin levels, even though there was a clear numerical difference, as bilirubin levels were higher in males (10.81 \pm 0.57) compared to females (10.59 \pm 0.58) (Table 2). Regarding the effect of feeding type on bilirubin levels, Table (2) shows a significant difference, with higher bilirubin levels in exclusively breastfed babies compared to mixed feeding. However, mixed feeding did not differ from formula feeding, and formula feeding did not differ from breastfeeding. On the other hand, there was no significant effect of birth weight on bilirubin levels at the probability level ($P \leq 0.05$) (Table 2). The clear numerical increase in bilirubin levels in males compared to females may be linked to the role of Glucose-6-phosphate dehydrogenase (G6PD), which is considered one of the important pathological causes of neonatal jaundice. According to data from a series of studies, about one-third of male newborns with jaundice suffer from G6PD deficiency [20].

G6PD deficiency is also an important risk factor for the development of severe hyperbilirubinemia [21] Another possible explanation is that the hormone testosterone reduces the activity of the enzyme Uridine diphosphate- glucuronoxylan transferees' family 1 member A1 (UGT1A1), which normally helps in breaking down bilirubin, leading to its accumulation. This finding agrees with the study conducted by [22].

The higher bilirubin levels in exclusively breastfed infants compared to mixed feeding may be due to the presence of unsaturated fatty acids in breast milk, which inhibit glucuronic transferees, leading to an increase in bilirubin levels in the blood [23] [24]. This is supported by a study conducted in Nigeria, which showed that 90.4% of infants with jaundice were exclusively breastfed [25] [26]. The lack of difference in bilirubin levels based on the weight of sick children is consistent with the study conducted by Anand and colleagues [27] which demonstrated that birth weight has no effect on bilirubin values. [28]



From figure 1), we notice that among children with jaundice, the rate of blood group compatibility with their mothers was (35%), while in healthy children, the figure shows a much higher compatibility rate of (90%).

This agrees with the findings of [29], which indicate that blood group incompatibility occurs when the mother's blood type is O and the newborn's blood type is A or B. Blood group incompatibility between mother and child is considered one of the causes leading to increased red blood cell breakdown in newborns [30] [31]

CONCLUSION

From this study, we conclude that the highest incidence of neonatal jaundice is linked to certain risk factors, such as exclusive breastfeeding and blood group incompatibility between the child and the mother, which play an important role in raising bilirubin levels in the blood serum of infants with neonatal jaundice

RECOMMENDATIONS

Based on the results of this study, we recommend controlling the problem of blood group incompatibility between the mother and the child by giving the mother medications that prevent the formation of antibodies and, consequently, the breakdown of red blood cells. We also recommend relying on mixed feeding to ensure the infant receives an adequate amount of nutrition..

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