Journal of Pioneering Medical Sciences
Received: March 25, 2026 | Accepted: May 20, 2026 | Published: July 05, 2026
Volume 15, Issue 06, Pages 236-240

DOI https://doi.org/10.47310/jpms2026150630

The Effect of Some Biochemical Parameters in Children with Jaundice

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Abstract **Objective:** This study aims to evaluate the biochemical parameters associated with jaundice in children and to examine their relationship with liver functions in order to determine their role in the early diagnosis of the disease. **Methods:** One hundred blood samples were collected from children with jaundice at the Children's Teaching Hospital in Karbala Governorate between January and February 2026 and serum was separated, after which biochemical tests were performed, including the measurement of total bilirubin and liver enzymes (ALT, AST). **Results:** The results showed an increase in bilirubin levels in children with jaundice, as the mean Total Bilirubin (TB) level was 1.26 mg/dL, with a relative increase in liver enzymes, where the mean ALT = 22.09 U/L and the mean AST = 34.86 U/L. The results also showed a positive correlation between elevated bilirubin levels and enzyme levels, as the correlation value between AST and TB was ($r = 0.334$, $p<0.05$), indicating an effect on liver function. In addition, a significant difference was observed in the incidence rate between males and females, with males accounting for 64% compared to 36% for females (p-value = 0.045). **Conclusion:** The study indicates that biochemical parameters, particularly bilirubin and liver enzymes, are important indicators in the diagnosis of jaundice and the evaluation of its severity and they contribute to making appropriate therapeutic decisions and reducing potential complications.

Key Words Jaundice, Total Bilirubin, ALT, AST, Kerbala

INTRODUCTION

Jaundice is one of the most common health problems among newborns. It usually appears within the first few days of life as a noticeable yellowing of the skin and whites of the eyes due to elevated levels of bilirubin in the blood [1]. This substance is produced from the breakdown of red blood cells and the liver normally eliminates it after converting it into an excretable form. However, the immaturity of the newborn's liver can lead to its accumulation and the appearance of jaundice [2].

Jaundice is observed in approximately 60% of full-term infants and 80% of premature infants during the first week of life, making it a problem that requires medical monitoring to avoid serious complications such as kernicterus, which can cause brain damage if bilirubin levels become extremely high [3]. Newborn jaundice can be classified into two main types:

- Physiological jaundice, which occurs naturally in most infants and is not a cause for concern
- Pathological jaundice, which appears early, within the first few hours of birth or persists for an extended period and requires diagnosis and treatment [4]

The causes of pathological jaundice are attributed to several factors, including:

- Blood type incompatibility between mother and child
- Deficiencies in certain enzymes
- Infections
- Genetic disorders affecting liver function or the breakdown of red blood cells [5]

Biochemical tests are among the most important diagnostic tools used by physicians to determine the type and severity of jaundice. These tests include measuring levels of direct and indirect bilirubin, liver enzymes such as AST and ALT, as well as assessing blood functions and proteins [6].

Studying biochemical parameters in infants with jaundice is of great importance, as it helps differentiate

between the various types of jaundice and identify the underlying cause, thus enabling the selection of the appropriate treatment at the right time. Laboratory values differ between jaundice caused by increased destruction of red blood cells (hemolysis) and jaundice caused by liver dysfunction or bile duct obstruction [7]. Analyzing these parameters also contributes to monitoring the child's health progress and response to treatment such as phototherapy or exchange transfusion in severe cases [8].

Several studies have shown that measuring indirect bilirubin levels is a reliable indicator of physiological jaundice, while elevated direct bilirubin is often associated with medical conditions requiring urgent intervention [9]. Liver enzymes, along with protein tests such as albumin, are also important indicators in assessing liver function in newborns [10].

Given the medical and diagnostic importance of biochemical parameters in the early detection and classification of jaundice, this study aims to highlight the most prominent of these parameters in infants with jaundice. The goal is to support early diagnostic procedures and identify the most appropriate treatment methods, thereby improving the quality of healthcare provided to newborns and reducing potential complications of the disease.

METHODS

Sample Collection

One hundred blood samples were collected from children with jaundice at the Children's Teaching Hospital in Karbala Governorate between January and February 2026, with the consent of the patients' families and in accordance with the approved medical protocols for the treatment and follow-up of jaundice in children [11]. Three to five ml of venous blood were drawn using gel tubes to obtain serum. The samples were allowed to coagulate for 15 minutes at room temperature, then centrifuged at 3000 rpm for 10 minutes to separate the serum. The serum was then stored at -20°C until biochemical analysis [12-14].

Biochemical Tests

Total Bilirubin Measurement: Bilirubin was estimated using the colorimetric method, which is standard practice in studies of jaundice in children [15].

GPT (ALT) Enzyme Measurement

GPT was measured using the kinetic method with absorbance readings at 340 nm. This is a common test for assessing liver function in children with jaundice [16].

GOT (AST) Enzyme Measurement

This test was performed using the same method as for GPT measurement and in accordance with clinical guidelines for liver function in cases of jaundice [17].

Measurement of ALP (Alkaline Phosphatase) Enzyme

ALP was measured using the colorimetric method at 405 nm, an important test in evaluating liver disorders in children [18].

Measurement of Total Protein

Protein was measured using the Biuret method at 540 nm, a method documented in clinical medicine for assessing protein status in liver diseases [19].

Statistical Analysis

The data collected using the above equipment and instruments were entered into SPSS software version 24 for analysis. Appropriate statistical tests were used depending on the type of data, such as the t-test for comparing two groups and the chi-square test for analyzing the relative distribution of variables. A p-value <0.05 was considered statistically significant.

RESULTS AND DISCUSSION

The study results show that the percentage of males with jaundice was 64% compared to 36% for females, with a p-value of 0.045. This indicates that the difference between the sexes is statistically significant and therefore, sex can be considered a major factor in the occurrence of jaundice in children (Figure 1). However, a slight predisposition to males can be observed, which may reflect the influence of hormonal or genetic factors on liver function. Previous studies have also indicated a difference in immune response between the sexes and its effect on the severity of jaundice.

The results also did show significant differences between males and females despite the high percentage of males (64% versus 36%), as the value of p = 0.045 was higher than the significance level (0.05), indicating that there is no significant effect of gender in the incidence of jaundice and that the difference may be due to non-real factors such as sample size or environmental conditions [20].

The study results in Table 1 showed that the mean age of the children was 5.79 years. It is observed that younger children usually exhibit higher levels of indirect bilirubin due to immature liver function, which explains the elevated TB levels in some children in the sample.

Regarding liver function tests, the results showed elevated mean liver enzymes: ALT = 22.09 U/L and AST = 34.86 U/L. This elevation indicates dysfunction or stress in liver cells. ALT is a more specific indicator of liver damage, while AST can also be elevated due to muscular or cardiac causes. However, its elevation alongside ALT, as seen in these results, indicates direct liver involvement due to jaundice or its underlying cause.

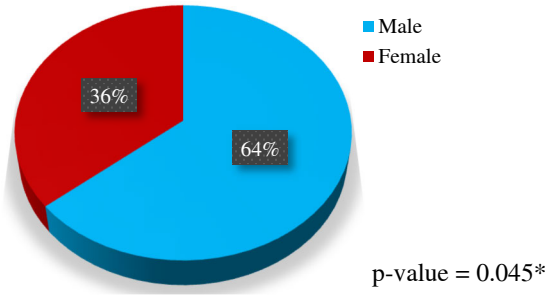

Figure 1: The Distribution of Children Patients with Jaundice According to Sex

As for bilirubin, the mean Total Bilirubin (TB) was 1.26, the primary indicator of jaundice. Elevated TB reflects bilirubin accumulation in the blood, which may result from impaired bilirubin conjugation within the liver or a bile secretion disorder (Table 1).

Elevated ALT and AST levels with TB in most cases reflect a direct correlation between the severity of liver damage and the level of jaundice, supporting the hypothesis that a combined assessment of these indicators provides an accurate picture of the child's health status. From a clinical perspective, these findings highlight the importance of:

- Close monitoring of all children with jaundice, especially those with elevated ALT and AST, to detect any deterioration in liver function
- Combining laboratory tests with clinical observation to determine disease severity and the need for early intervention
- Identifying children at higher risk of complications by analyzing enzyme-bilirubin interactions, enabling clinicians to develop preventative and therapeutic strategies

These values indicate a relative elevation in liver enzymes and bilirubin in some cases, reflecting impaired liver function and variations in the severity of the condition among children. Furthermore, the elevated bilirubin levels, along with the elevated liver enzymes, confirm a correlation between liver cell damage and bilirubin accumulation in the blood.

Jaundice is a common clinical condition observed in children, characterized by yellowing of the skin and mucous membranes due to elevated bilirubin levels in the blood. Bilirubin is a natural byproduct of hemoglobin breakdown in red blood cells. It is continuously produced in the body and then transported to the liver for metabolism and excretion via bile. Any disruption to this process, whether due to increased red blood cell breakdown, impaired liver function or bile duct obstruction, leads to elevated bilirubin levels in the blood, resulting in jaundice [21].

Based on the results in Table 1, which details the study parameters, the mean age in the sample was 5.79 years, indicating that the cases included children of varying ages. This suggests that younger children are more susceptible to jaundice due to the immaturity of the liver enzyme systems responsible for bilirubin metabolism [22]. The results also indicate that age plays a significant role in the severity of the condition, as the immaturity of the UDP-glucuronyl transferase enzyme in children leads to impaired bilirubin conjugation and elevated blood levels [23].

Table 1 also shows elevated liver enzyme levels, with mean ALT at 22.09 and AST at 34.86. These enzymes are important indicators of liver function, as they are found inside liver cells. When these cells are damaged or stressed, they leak into the blood, leading to elevated levels. Biochemically, elevated ALT and AST levels reflect damage to liver cells due to increased cell membrane permeability or intracellular stress, resulting in enzyme leakage into the bloodstream [24].

It is noted that the ALT enzyme is more closely associated with the liver, so its elevation more accurately indicates liver cell damage. In contrast, the AST enzyme is found in multiple tissues, such as the liver, heart and muscles, so its elevation may not be specific to the liver [25].

Table 1 also shows that the mean Total Bilirubin (TB) level was 1.26, indicating its elevation in children with jaundice, which is the primary indicator used in diagnosing the condition [26]. These results indicate that elevated liver enzymes are associated with impaired bilirubin metabolism within the liver, leading to its accumulation in the blood, a finding corroborated by previous studies [27].

Furthermore, the variation in values among children suggests differences in the severity of the condition or in the underlying causes of jaundice, such as viral infections, hemolytic disorders or genetic factors [28,29]. Total bilirubin is a key diagnostic indicator, as elevated indirect bilirubin often indicates impaired conjugation within the liver, while elevated direct bilirubin suggests biliary obstruction [30,31]. The results also confirm that genetic factors such as Gilbert's syndrome or Crigler-Najjar syndrome can directly affect bilirubin metabolism and cause varying degrees of elevation [32,33].

Furthermore, the correlation coefficient results in Table 2 showed a positive correlation between liver enzymes and TB bilirubin levels, with a correlation coefficient (r) of 0.334. This is statistically significant, as no other correlations were found among the studied parameters.

Table 1: Mean and Standard Deviation of Parameters of Children Jaundice Patients

Parameter	No.	Mean	Standard Deviation
Age	100	5.79 years	4.17
ALT	100	22.09 U/L	17.14
AST	100	34.86 U/L	17.84
TB	100	1.26 mg/dL	1.04

Table 2: Correlation (r) Between the Studied Parameters

Parameter	Age	ALT	AST	TB
Age	1	-0.047	-0.127	-0.239
ALT	-	1	0.268	0.106
AST	-	-	1	0.334*
TB	-	-	-	1

*Indicates a significant positive correlation

This indicates that elevated liver enzymes are associated with increased blood bilirubin levels, reflecting the impact of liver dysfunction on bilirubin metabolism and the development of jaundice. This relationship can be explained by the fact that any damage to liver cells leads to the release of liver enzymes into the bloodstream and an increase in unconjugated bilirubin, thus increasing the severity of jaundice (Table 2).

Based on these results, it can also be concluded that elevated liver markers are directly associated with jaundice levels and that statistical analysis of the correlation between AST and TB (r = 0.334) provides scientific confirmation of this association.

The correlation between ALT and TB (r = 0.106) was weaker, suggesting that AST may be more sensitive in detecting a direct relationship with bilirubin, while ALT shows less of an effect, although it remains an important indicator of liver cell damage. Finally, combining these statistical results with previous information on age, sex, nutrition, genetic and environmental factors and viral infections provides a comprehensive picture of jaundice in children and a strong basis for evidence-based clinical decision-making. This allows for individualized follow-up of affected children based on the severity of their ALT, AST and TB levels.

Upon further examination of the study results, it can be observed that elevated liver enzymes with a positive correlation to bilirubin not only reflect liver dysfunction but also indicate the degree of disruption to metabolic processes within liver cells. The liver plays a pivotal role in the metabolism of substances such as bilirubin; therefore, any disruption to these processes leads to noticeable changes in biochemical indicators. The elevated ALT and AST levels in this study not only indicate liver cell damage but also reflect increased permeability of the liver cell membrane, allowing enzymes to leak into the bloodstream. This is in addition to oxidative stress within liver cells resulting from inflammation or infection, as well as mitochondrial dysfunction, particularly concerning the AST enzyme, which is partially located within mitochondria. This explains why AST was more closely associated with bilirubin in this study, reflecting deeper damage within the liver cell itself, not just in the cytoplasm.

The correlation value between AST and TB (r = 0.334) represents a moderately strong and statistically significant positive relationship, indicating that elevated AST is associated with increased bilirubin levels in the blood. The correlation between ALT and TB (r = 0.106) is a weak positive relationship but it suggests a less pronounced correlation compared to AST. The results also showed a correlation between ALT and AST (r = 0.268), indicating a relative correlation between the two liver enzymes due to the impact on liver function, this suggests that AST may be more sensitive in reflecting the severity of jaundice associated with liver damage.

Regarding the correlations in Table 2, the results showed a positive correlation between AST and TB (r = 0.334), indicating that increased liver cell damage leads to elevated bilirubin levels in the blood. While the correlation between ALT and TB was weaker (r = 0.106), it still indicates a positive association between the two variables.

Clinically, the correlation between physical examination and laboratory indicators helps determine disease severity, with jaundice and eye discoloration being key signs that support the test results [34,35]. Statistical data analysis, such as mean, standard deviation and correlation (r), is essential for accurate scientific interpretation of the results and determining the strength of the relationship between variables [36,37].

Finally, close monitoring of biochemical markers such as ALT, AST and TB aids in early diagnosis and assessment of disease severity, contributing to reduced complications and improved clinical outcomes for children with jaundice [38,39].

CONCLUSIONS

This study emphasizes the importance of early detection and regular follow-up for children with jaundice, as this plays a significant role in reducing complications and improving long-term health outcomes.

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