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Foetomaternal outcomes in intrahepatic cholestasis of Pregnancy: Correlation with serum bile acid levels

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Abstract

Background: Intrahepatic cholestasis of pregnancy (ICP) is characterized by pruritus of the hand and sole with abnormal liver function test and increased bile acid levels and presents during second and third trimesters of pregnancy and usually resolves after delivery. The present study was done to find out relationship between maternal outcomes in intrahepatic cholestasis of pregnancy (ICP) and serum bile acid levels.

Methods: A prospective observational study was conducted among Women beyond 28 weeks of gestation visiting ANC OPD or delivering in the maternity ward at St Stephen's Hospital, Delhi, India over a period of two years February 2023 to February 2025. The study included 125 pregnant women with the complaint of pruritis in the palm and sole after 28 weeks of pregnancy and diagnosed with intrahepatic cholestasis of pregnancy after investigations.

Results: Maternal and fetal outcome data included parameters gestational age at delivery, incidence of preterm birth, mode of delivery, postpartum hemorrhage, low birth weight, NICU admissions, IUD and maternal morbidity. Serum bile acid concentrations were measured and correlated with recorded maternal and fetal outcomes. A positive correlation between higher bile acid levels and unfavorable maternal outcomes, with significant associations noted for increased rates of induced labor, higher mean hospital stay, low birth weight and lower APGAR score at 1 and 5 minutes. No statistically significant difference was found in preterm birth, meconium-stained liquor and NICU admissions among the two groups.

Conclusion: Severe ICP is associated with adverse pregnancy outcome especially low birth weight, lower APGAR scores, fetal distress and neonatal mortality with severe ICP. Thus serum bile acid quantification may serve as a valuable biomarker for risk stratification and management planning in ICP cases, emphasizing the importance of early detection and targeted monitoring for improved pregnancy care.

Keywords: Bile acids, Feto-maternal outcome, ICP, Pregnancy, Pruritus, Preterm

Introduction

Intrahepatic cholestasis of pregnancy (ICP) is a liver disorder unique to pregnancy, typically presenting in the second or third trimester, characterized by pruritus and elevated serum bile acid levels ^[1]. It results from impaired bile flow, leading to the accumulation of bile acids in the maternal bloodstream, which can adversely affect both the mother and fetus ^[2]. Although the condition usually resolves spontaneously after delivery, it carries significant clinical implications, including increased risks of preterm labor, meconium-stained amniotic fluid, fetal distress, and, in severe cases, stillbirth ^[3]. However, its pathophysiology remains incompletely understood, involves a complex interplay of genetic predisposition, hormonal changes, and environmental triggers ^[4]. Studies suggest that elevated oestrogen and progesterone metabolites contribute to impaired bile flow, leading to bile acid accumulation in the maternal bloodstream that consequently disrupt placental function, impair oxygen and nutrient exchange, and induce oxidative stress ^[5]. Globally, the prevalence of ICP shows marked variation, ranging from 0.2% to 15% of pregnancies ^[6]. Risk factors for ICP include a personal or family history of the condition, multi fetal gestation, and underlying liver disorders ^[7]. The clinical presentation of ICP, while dominated by pruritus especially on the palms and soles and may also include dark urine, pale stools, and occasionally jaundice however diagnosis is based on laboratory findings, particularly elevated serum bile acid levels, often accompanied by Increased Alanine Aminotransferase (ALT) and Aspartate Aminotransferase (AST) ^[7].

Maternal outcomes in ICP are influenced by the degree of bile acid elevation, as higher concentrations have been shown to correlate with more severe disease manifestations.

Understanding this relationship is essential for optimizing management strategies and predicting clinical outcomes. Even greater concern lies in the potential impact on foetal health, as elevated serum bile acid levels have been strongly associated with adverse perinatal outcomes that may include spontaneous preterm birth, meconium staining of the amniotic fluid and stillbirth^[8]. Despite ongoing research, variations in diagnostic criteria, treatment approaches, and outcome prediction models persist across populations.

This study aims to evaluate maternal and fetal outcomes in cases of intrahepatic cholestasis of pregnancy and analyze their correlation with serum bile acid levels. By systematically assessing maternal parameters and biochemical indicators, this research seeks to contribute to a deeper understanding of ICP's clinical impact and support evidence-based interventions for improving pregnancy prognosis.

Furthermore, the research seeks to emphasize the critical importance of early detection, individualized care, and appropriate timing of delivery in mitigating risks and thus improving perinatal outcomes.

Methodology

This observational study was conducted to evaluate maternal and fetal outcomes in cases of intrahepatic cholestasis of pregnancy (ICP) and study their correlation with serum bile acid levels. The study was carried out in the Department of Obstetrics and Gynecology at St Stephen's Hospital, Delhi from 1st February 2023 to 31st January 2025 among pregnant females attending antenatal OPD or admitted in labour ward.

Pregnant women diagnosed with ICP during the second or third trimester were included. Diagnosis was based on clinical presentation of pruritus (particularly on palms and soles) along with elevated serum bile acid levels ($> 10 \mu\text{mol/L}$) in the absence of other hepatic or dermatological conditions.

All singleton pregnant women beyond 28 weeks period of gestation (POG) who were diagnosed with ICP and consented to participate were enrolled in the study.

Women with preexisting liver or gall bladder disorders, multiple pregnancy, other obstetric complications such as pre-eclampsia, gestational diabetes, chronic hypertension, HELLP syndrome and acute fatty liver of pregnancy were all excluded.

Data Collection

Demographic details like age, parity, gestational age at diagnosis, relevant family history, drug history and past obstetric history was entered in a study proforma. Clinical findings of pruritus, its onset and other associated findings like jaundice was noted and any other dermatological cause of pruritus was ruled out by an expert opinion. Laboratory sample was collected under aseptic conditions and analyzed for SGOT (Serum Glutamic-Oxaloacetic Transaminase) levels, SGPT (Serum Glutamic-Pyruvic Transaminase) levels, ALP (Alkaline Phosphatase) levels and Serum Bile Acid (SBA) levels. Serum bile acid levels were measured using an enzymatic colorimetric assay, and values were categorized into mild ($10\text{--}39 \mu\text{mol/L}$), moderate ($40\text{--}99 \mu\text{mol/L}$), and severe ($\geq 100 \mu\text{mol/L}$) groups for comparative analysis.

All patients were subsequently treated with tablet ursodeoxycholic acid (UDCA) $10\text{--}15 \text{ mg/kg/day}$ in divided doses according to the level of serum bile acid. Liver enzymes were tested weekly/biweekly till delivery. All enrolled patients were clinically monitored and followed up in high-risk antenatal clinics weekly. The maternal outcomes studied were mode of delivery, gestational age at delivery for any preterm labour, post

postpartum hemorrhage, duration of hospital stay, and maternal mortality.

The fetal outcomes preterm birth, birth weight, APGAR score at 5 minutes < 7 , meconium-stained liquor, neonatal intensive care unit (NICU) admissions, IUD & neonatal mortality were recorded.

This study was started after approval of the Institutional Ethical Committee [SSHEC/R0255]. The objectives and associated benefits of the study were explained to all the participants. The confidentiality of the patient's details was maintained.

Statistical analysis

Data were entered into Microsoft Excel and analyzed using SPSS software version 28. Descriptive statistics were used to summarize demographic and clinical variables. Correlation between serum bile acid levels and maternal outcomes was assessed using Pearson's or Spearman's correlation coefficient, as appropriate. Chi-square and ANOVA tests were applied to examine group differences, with a p-value of < 0.05 considered statistically significant.

Results

Out of these 125-singleton pregnant female included in the study, 63 (50.4%) mild IHCP (BA $10\text{--}39 \mu\text{mol/L}$), 45 (36%) had moderate IHCP (BA $40\text{--}99 \mu\text{mol/L}$) and 17 (13.6%) had severe IHCP (BA $\geq 100 \mu\text{mol/L}$), (Table 1). The mean maternal age did not significantly differ across mild (29.06 ± 5.08 years), moderate (30.44 ± 4.48 years), and severe ICP (30.06 ± 3.85 years) groups ($P=0.311$). Gravidity distribution was similar across groups ($P=0.767$). Mean bile acid levels increased significantly with severity, from $28.67 \pm 5.74 \mu\text{mol/L}$ in mild to $143.12 \pm 28.76 \mu\text{mol/L}$ in severe ICP ($p<0.001$). Similarly, AST, ALT, and ALP levels were significantly elevated in moderate and severe ICP compared to mild ($p<0.001$). The period of gestation at the time of diagnosis of IHCP was significantly lower in mild and moderate IHCP ($P\text{-value } 0.028$). Nearly 16% of pregnant women with IHCP with a period of gestation less than 37 weeks underwent the termination of pregnancy, out of this 1.97% ($N=3$) had termination of pregnancy in less than 32 weeks of POG and this difference was also statistically significant ($P\text{-value } 0.0006$). Visual representation of baseline characteristics across categories of intrahepatic cholestasis of pregnancy (IHCP) is shown in Figure 1.

Table 2 presents the association between categories of intrahepatic cholestasis of pregnancy (ICP) and maternal outcomes. The mode of delivery did not significantly differ among mild, moderate, and severe ICP groups, with vaginal delivery rates of 57.1%, 64.4%, and 58.8%, respectively. Caesarean sections were performed in 42.9%, 35.6%, and 41.2% of mild, moderate, and severe ICP cases, respectively ($P=0.871$). The incidence of postpartum hemorrhage was highest in the moderate ICP group (11.1%) but was not statistically significant ($P=0.250$). Blood transfusion were required in 1 patient with moderate IHCP and two patients with severe IHCP due to post partum hemorrhage but it was not significant. The mean hospital stay was significantly longer in severe ICP cases (2.98 ± 0.94 days) compared to moderate (2.33 ± 0.82 days) and mild ICP (1.90 ± 0.94 days) ($P=0.009$). The visualization of all maternal outcomes (delivery type, hemorrhage, transfusion) with frequency values across all severity is shown in Figure 2 & 3.

Table 3 presents the association between categories of intrahepatic cholestasis of pregnancy (ICP) and fetal outcomes. Birth weight significantly decreased with increasing ICP severity, with mean values of $3257.59 \pm 373.61 \text{ g}$ in mild ICP,

3103.47±283.82 g in moderate ICP, and 2842.53±315.89 g in severe ICP ($p<0.001$). APGAR scores at 1 minute and 5 minutes were also significantly lower in severe ICP cases ($P=0.004$). Preterm births and meconium-stained liquor (MSL) suggesting fetal distress was significantly high in the severe IHCP group when compared to mild and moderate groups ($p<0.001$). Intrauterine fetal demise were significantly high with severe cases ($p<0.001$). NICU admission ($P=0.587$) did not show statistically significant differences among the groups. No case of neonatal death was reported. Figure 4 and 5 shows continuous and categorical foetal outcomes in the form of line chart and grouped bar chart.

The correlation analysis demonstrated a significant relationship between serum bile acid levels and key maternal and fetal outcomes. A moderate negative correlation was observed with birth weight ($r = -0.38$, $p<0.001$), indicating that higher bile acid concentrations were associated with lower neonatal birth weight. Similarly, bile acid levels showed a significant negative correlation with APGAR scores at 1 minute ($r = -0.27$,

$P=0.0027$) and 5 minutes ($r = -0.26$, $p = 0.0030$), reflecting an adverse impact on the immediate postnatal condition of neonates. In contrast, a significant positive correlation was noted between bile acid levels and hospital stay ($r = 0.33$, $p<0.001$), suggesting that increasing bile acid burden contributes to prolonged maternal hospitalization. These findings reinforce the role of serum bile acids as a clinically relevant marker in IHCP, with direct implications for predicting both maternal morbidity and adverse neonatal outcomes.

Figure 6 shows the Pearson correlation coefficients between serum bile acid levels, birth weight, APGAR scores (1 and 5 minutes), and hospital stay. Figure 7 shows Scatterplot matrix depicting the relationships between serum bile acid levels, birth weight, APGAR scores and hospital stay. The plots illustrate inverse associations between bile acids and both birth weight and APGAR scores, along with a positive association with hospital stay, reinforcing the adverse impact of elevated bile acids in IHCP.

Table 1: Association between categories of IHCP and baseline characteristics

Maternal Demography		Mild IHCP [N=63]	Moderate IHCP [N=45]	Severe IHCP [N=17]	P-Value
Age (Years)	18-25	18	14	3	0.311
	26-35	32	16	8	
	>35	13	15	6	
Gravida	Primigravida	22	19	6	0.767
	Multigravida	41	26	11	
Period of gestation at diagnosis of IHCP		32.2±2.42	33.6± 2.84	29.8± 3.32	0.656
POG at Termination of pregnancy	< 37 weeks	8	11	5	0.005
	37-40 weeks	52	33	10	
	>40 weeks	2	1	2	
Haemoglobin		10.5±2.2	10.1±1.8	9.8±1.9	0.18
Liver function	Total Bilirubin	0.6±0.22	0.85±0.28	1.1±0.36	< 0.001
	SGPT [IU/L]	45.63± 11.919	83.98±26.95	125.76±38.55	< 0.001
	SGOT [IU/L]	72.60±24.57	141.11± 49.41	162.0±42.49	< 0.001
	ALP [IU/L]	189.11±31.52	220.76±40.27	249.69±27.93	< 0.001
Bile acid	BA (μmol/L)	28.67± 5.74	71.07±18.68	143.12±28.76	< 0.001

-Chi-square; ANOVA; $P\leq 0.05$ is statistically significant

Table 2: Association between categories of IHCP and maternal outcomes

Baseline demographics	Mild IHCP [N=63]	Moderate IHCP [N=45]	Severe IHC [N=17]	P-Value
Type of delivery				
Vaginal	36	29	10	0.871
Cesarean	27	16	7	
Post-partum hemorrhage	2	5	3	
Blood transfusion	0	1	3	0.656
Hospital stay	1.90±0.94	2.33±0.82	2.98±0.94	0.009

Chi-square; ANOVA; $p\leq 0.05$ is statistically significant

Table 3: Association between categories of IHCP and fetal outcomes

Baseline demographics	Mild ICP (N=63), Mean±SD	Moderate ICP (N=45), Mean±SD	Severe ICP (N=17), Mean±SD	P-Value
Birth weight	3257.59±373.6	3103.47±283.82	2842.53±315.89	< 0.001
APGAR at 1 mins	9.0±0.0	8.96±0.21	8.82±0.39	0.004
APGAR at 5mins	10.00±0.0	9.96±0.2	9.82±0.39	0.004
Preterm birth	2 [3.2]	4[8.8]	6[35.3]	< 0.001
MSL	7[11.1]	10[22.2]	5[29.4]	< 0.009
NICU admission	1[1.6]	1[2.2]	2[11.8]	< 0.001
Intrauterine fetal death (IUD)	0[0]	0[0]	2[11.8]	< 0.001
Neonatal death	0	0	0	-

Chi-square; ANOVA; $p\leq 0.05$ is statistically significant

Table 4: Correlation of serum bile acid levels with fetal and maternal outcomes

Outcome	Correlation Coefficient (r)	P-Value	Interpretation
Birth weight	-0.38	< 0.001	Significant negative correlation; higher bile acid levels are associated with lower birth weight.
APGAR (1 min)	-0.27	0.0027	Significant negative correlation; higher bile acids predict lower immediate neonatal condition.
APGAR (5 min)	-0.26	0.0030	Significant negative correlation; effect persists at 5 minutes.
Hospital stay	+0.33	<0.001	Significant positive correlation; higher bile acids are associated with longer hospital stay.

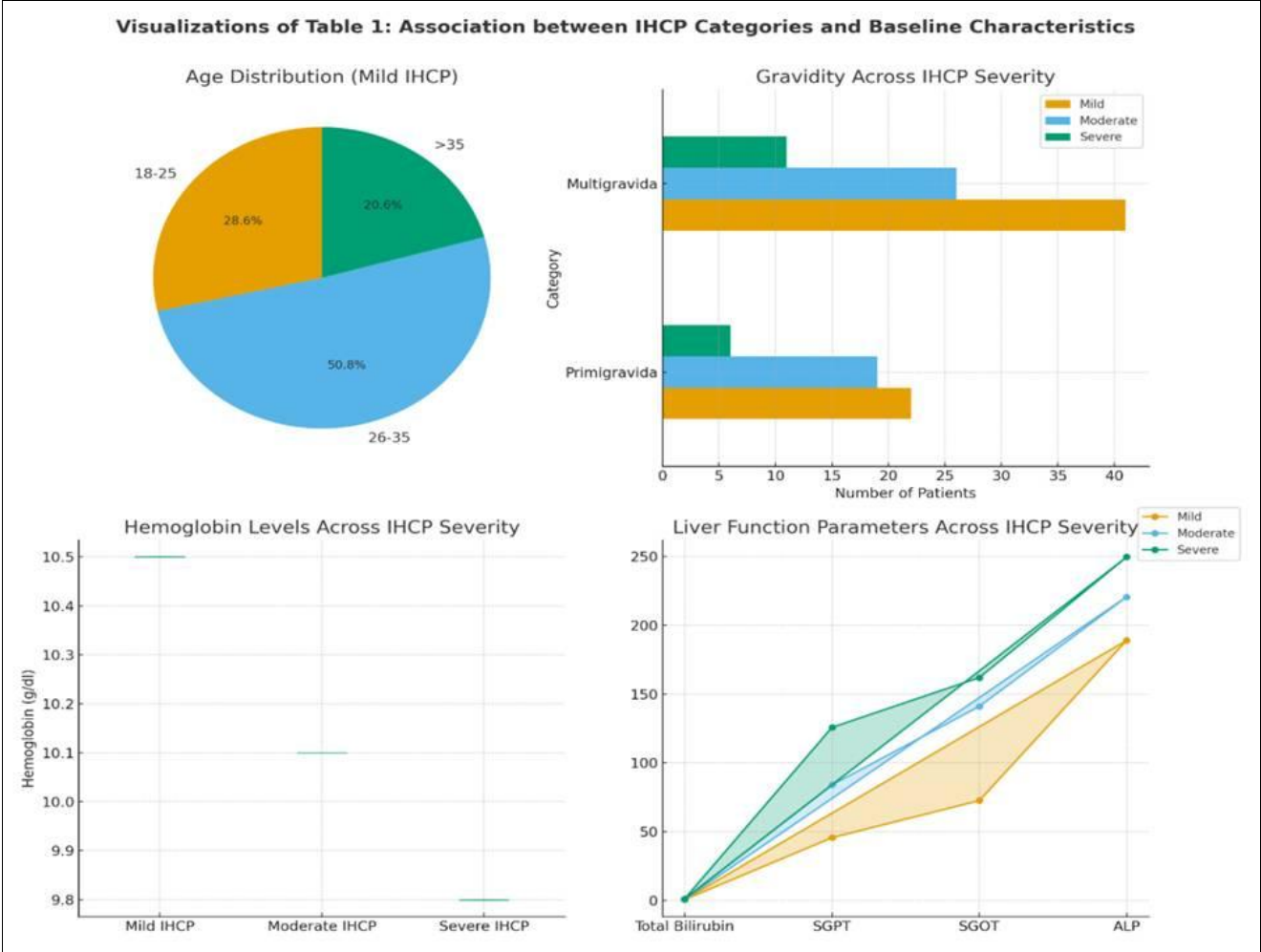
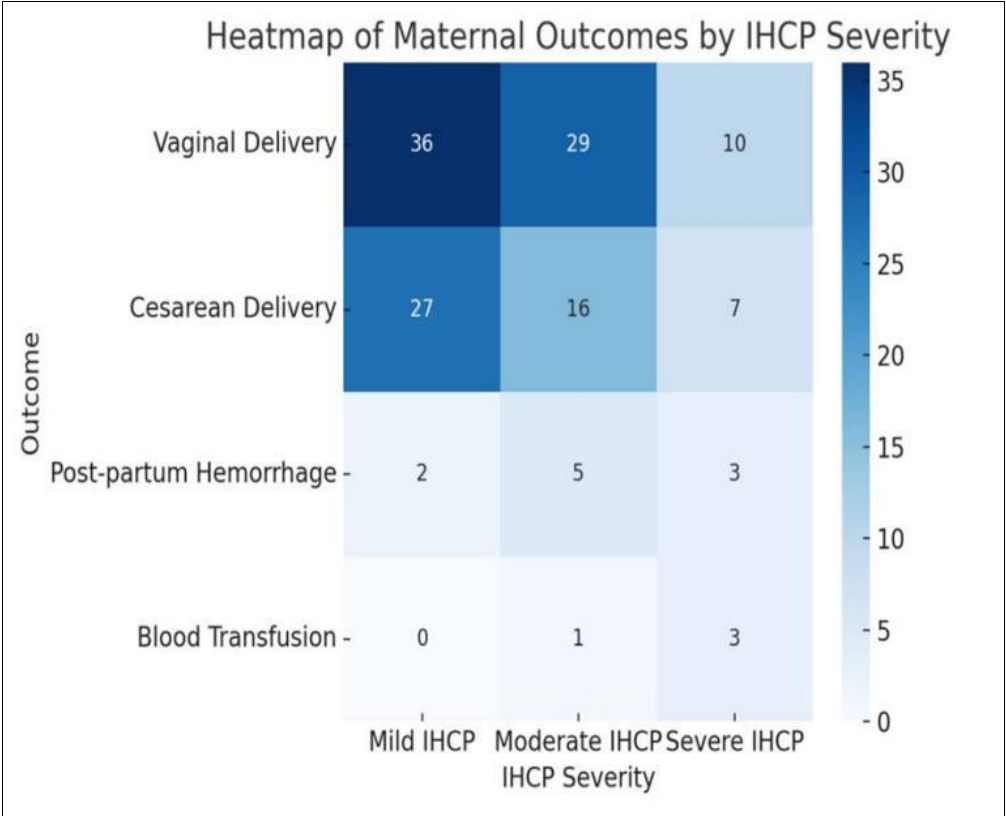
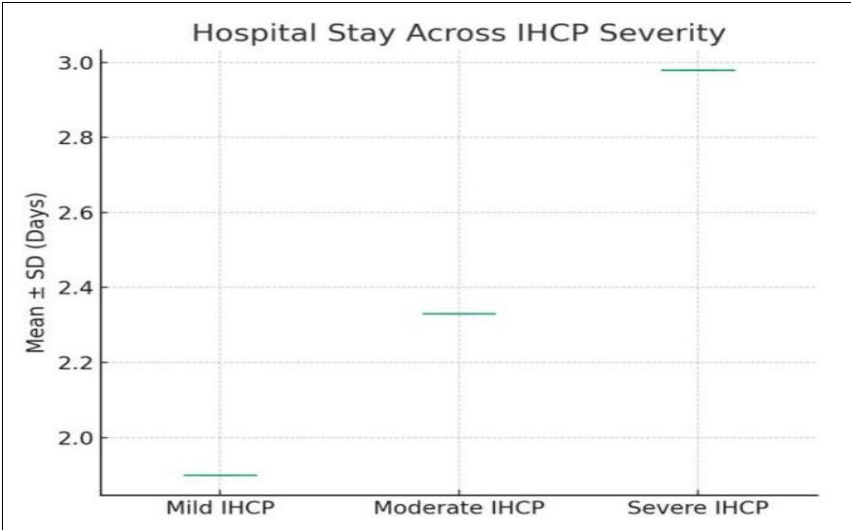


Fig 1: Visual representation of baseline characteristics across categories of intrahepatic cholestasis of pregnancy (IHCP)



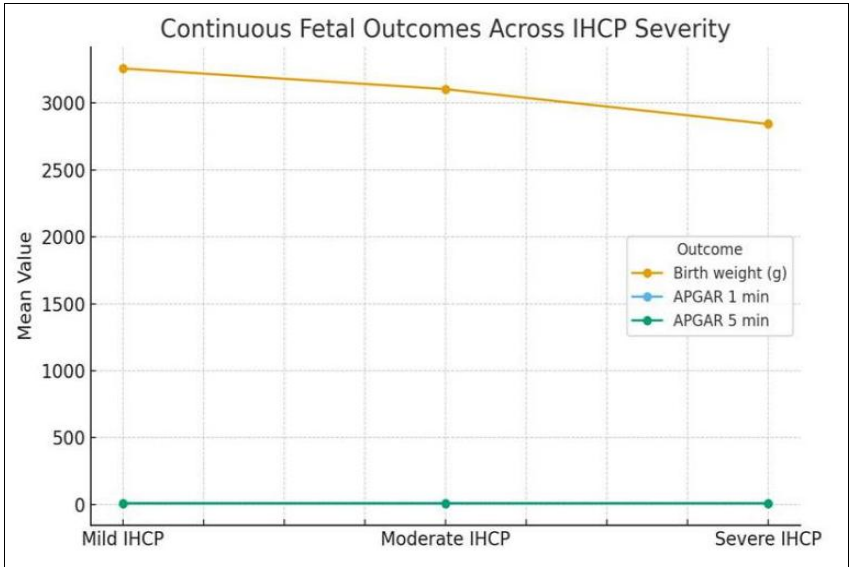
Heat map-Maternal Outcomes by Severity

Fig 2: A compact visualization of all maternal outcomes (delivery type, hemorrhage, transfusion) with frequency values across all severity



Box Plot-Hospital Stay

Fig 3: Illustrates mean ± SD of hospital stay duration across IHCP severity



Continuous fetal outcomes across IHCP severity.

Fig 4: Line chart showing the decline in mean birth weight, APGAR scores at 1 minute, and APGAR scores at 5 minutes from mild to severe intrahepatic cholestasis of pregnancy

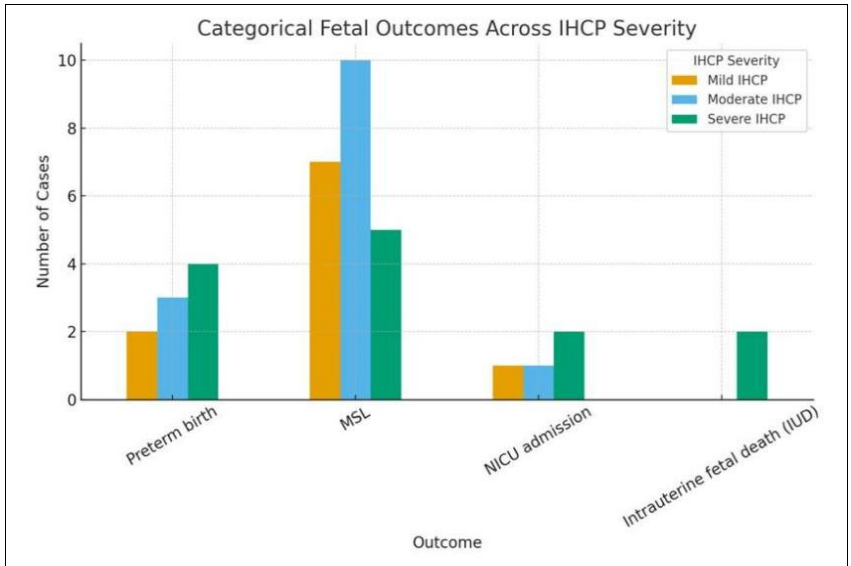


Fig 5: Grouped bar chart illustrating the number of preterm births, cases of meconium-stained liquor (MSL), NICU admissions, and intrauterine fetal deaths (IUD) across mild, moderate, and severe IHCP.

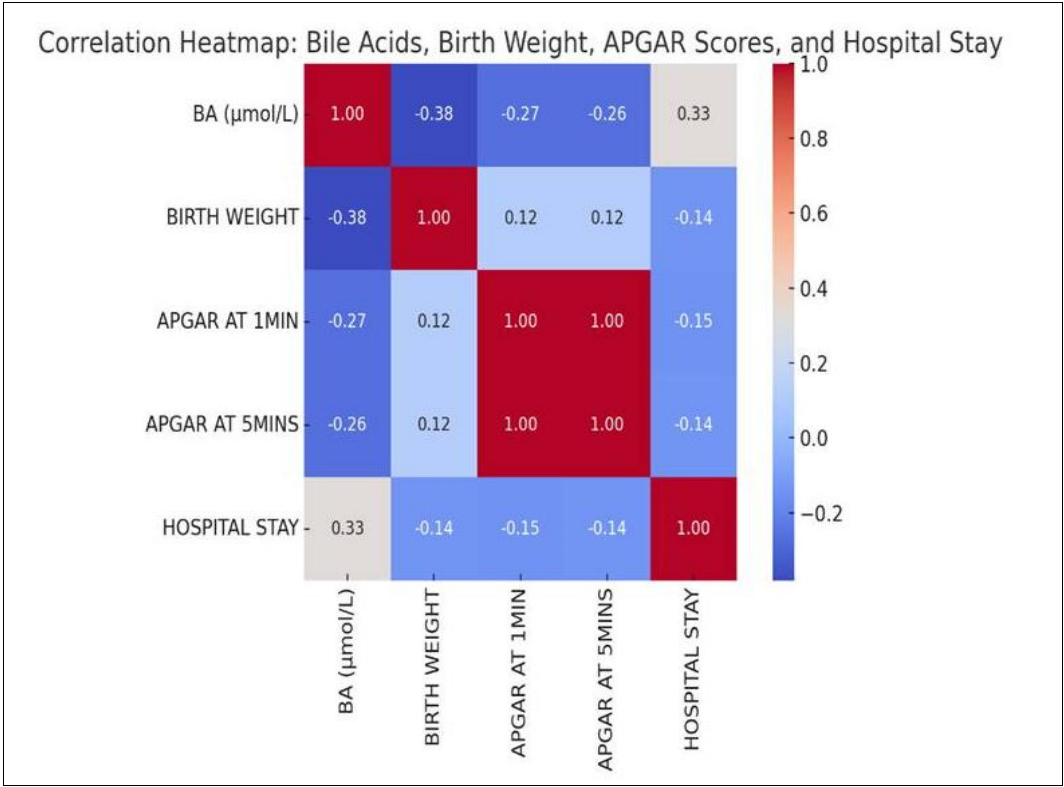


Fig 6: Heatmap showing the Pearson correlation coefficients between serum bile acid levels, birth weight, APGAR scores (1 and 5 minutes), and hospital stay.

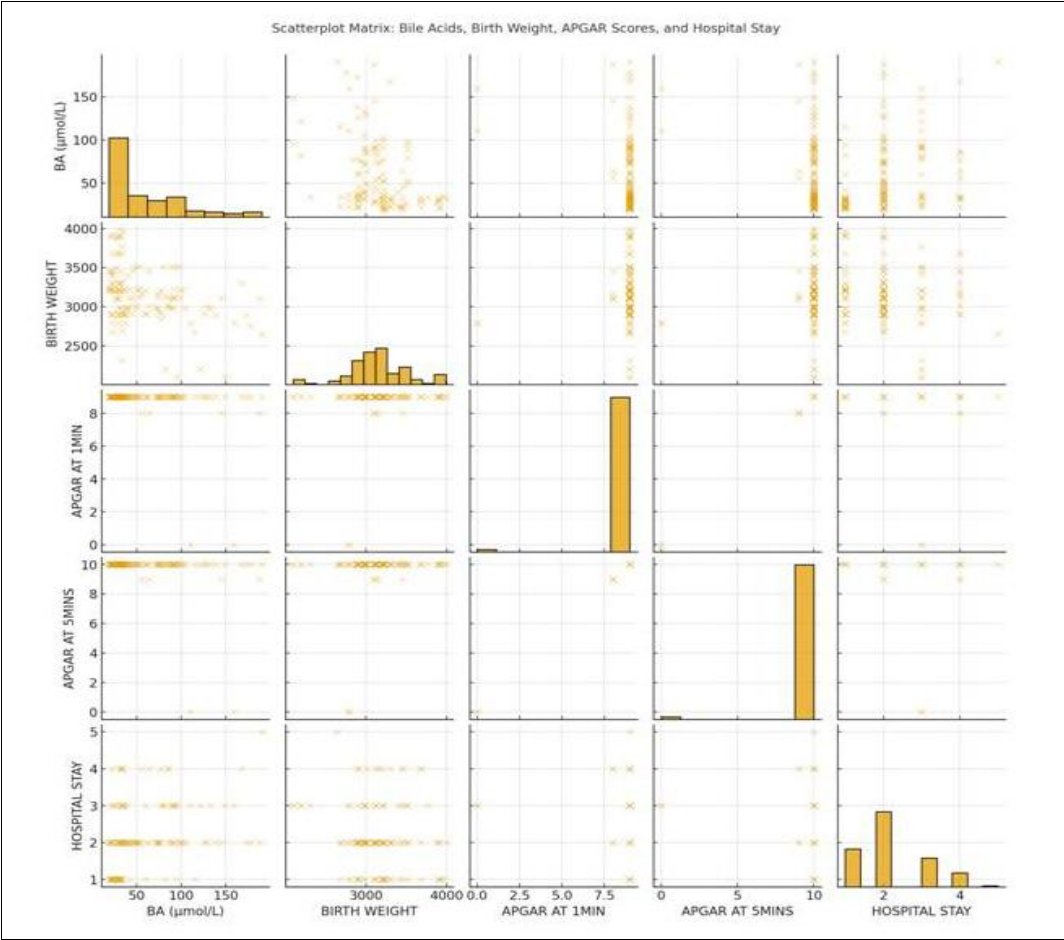


Fig 7: Scatterplot matrix depicting the relationships between serum bile acid levels, birth weight, APGAR scores and hospital stay. The plots illustrate inverse associations between bile acids and both birth weight and APGAR scores, along with a positive association with hospital stay, reinforcing the adverse impact of elevated bile acids in IHCP.

Discussions

The present study evaluated the correlation between maternal outcomes and serum bile acid levels in women diagnosed with Intrahepatic Cholestasis of Pregnancy (ICP). The findings demonstrated a significant association between the degree of bile acid elevation and adverse maternal outcomes, consistent with observations from previous studies^[9]. As serum bile acid levels increased, there was a corresponding rise in the incidence of preterm delivery, induction of labor, and cesarean section rates. These results highlight the prognostic importance of bile acid quantification in the management and monitoring of ICP.

Elevated bile acids are known to induce uterine contractility by stimulating myometrial activity and altering placental function, which may explain the higher rates of spontaneous or iatrogenic preterm labor observed among women with severe ICP. Several earlier studies have reported similar findings. Investigations by Glantz *et al.* and Ovadia *et al.* have shown that serum bile acid levels above 40 $\mu\text{mol/L}$ are associated with an increased risk of adverse perinatal and maternal outcomes. The current study supports these conclusions and suggests that even moderate bile acid elevations warrant careful monitoring and timely intervention^[9].

Association between severity of IHCP and baseline characteristics

The mean age in the present study (29.70 ± 4.728 years) and did not show a significant difference across mild (29.06 ± 5.08 years), moderate (30.44 ± 4.48 years), and severe ICP (30.06 ± 3.85 years) groups ($P=0.311$). The findings were almost consistent with the findings of Kant *et al.* (29.88 ± 4.35 years) and Cetinkaya Demir B *et al.* (28 years)^[10, 11].

Gravidity distribution was also comparable across the groups ($P=0.767$). In the present study, 51.2% of participants were primigravida, which was nearly identical to the 50.66% reported by Gupta V *et al.* and Aftab *et al.*^[12]. The mean serum bile acid level in the current study was 59.50 ± 41.680 $\mu\text{mol/L}$ that was comparable to the range of 39 (21-66) $\mu\text{mol/L}$ reported by Brouwers, L *et al.*, and higher than the 24 ± 41.3 $\mu\text{mol/L}$ recorded by Aftab *et al.*^[12].

However, bile acid levels increased significantly with severity, from 28.67 ± 5.74 $\mu\text{mol/L}$ in mild ICP to 143.12 ± 28.76 $\mu\text{mol/L}$ in severe ICP ($p < 0.001$). Additionally, AST, ALT, and ALP levels were significantly higher in moderate and severe ICP cases compared to mild ICP ($p < 0.001$). These findings align with Brouwers L *et al.* who reported that maternal age and parity had no impact on ICP severity, while AST, ALT, bilirubin, and ALP levels increased significantly with disease severity^[3]. In the current study, mild IHCP was observed in 50.4% of participants, moderate IHCP in 36.0%, and severe IHCP in 13.6%, based on bile acid levels categorized as 19-39 $\mu\text{mol/L}$ for mild, 40-99 $\mu\text{mol/L}$ for moderate, and ≥ 100 $\mu\text{mol/L}$ for severe cases. Compared to other studies, Das S and Roy A reported 5.2% of cases with normal bile acid levels (< 10 $\mu\text{mol/L}$), 2.6% with mild IHCP (19-40 $\mu\text{mol/L}$), 10.5% with moderate IHCP (40-100 $\mu\text{mol/L}$), and 2.6% with severe IHCP (> 100 $\mu\text{mol/L}$)⁸. In Gupta V *et al.*, 30.77% of cases had bile acid levels between 10-40 $\mu\text{mol/L}$, 65.38% between 41-100 $\mu\text{mol/L}$, and 3.85% above 100 $\mu\text{mol/L}$ ^[12]. Similarly, Brouwers, L *et al.* classified their cases into mild ($N=108$), moderate ($N=86$), and severe ($N=21$). Sharma B *et al.* categorized cases into mild (65.11%) and severe (34.89%) based on a bile acid threshold of ≥ 10 -39 $\mu\text{mol/L}$ for mild and ≥ 40 $\mu\text{mol/L}$ for severe cases. 24 The findings of the current study align closely with those of Brouwers, L *et al.* and Gupta V *et al.*^[3, 13].

Association between categories of ICP and maternal outcomes

In the present study, the mode of delivery did not significantly differ among mild, moderate, and severe ICP groups, with vaginal delivery rates of 57.1%, 64.4%, and 58.8%, respectively. Caesarean sections were performed in 42.9%, 35.6%, and 41.2% of mild, moderate, and severe ICP cases, respectively ($P=0.871$). Comparison with other studies reveals almost similar findings with some variations among studies in the mode of delivery. Gupta V, *et al.*, reported vaginal delivery in 56.7% of cases, including 4% instrumental deliveries, while cesarean section was performed in 43.3% with the highest rate (49.1%) among patients with serum bile acid levels of 41-100 $\mu\text{mol/L}$ ^[13]. Sharma *et al.* reported 50% normal deliveries, 8.33% instrumental deliveries, and 41.66% cesarean sections^[13]. Pegu B *et al.*²⁰ found 60.29% normal deliveries, 8.82% instrumental, and 30.8% cesarean sections^[14]. Arora *et al.* observed 63% vaginal deliveries, 3% forceps-assisted, 12% elective cesarean, and 22% emergency cesarean sections^[2]. Luo *et al.*^[16] reported a 35.09% cesarean rate. Gupta V *et al.* further categorized deliveries into 22% spontaneous normal vaginal, 1.33% spontaneous instrumental, 30.67% induced normal vaginal, 2.67% induced instrumental, 10.67% elective cesarean, and 32.67% emergency cesarean sections^[13]. In the current study, 6.4% of participants had a history of postpartum hemorrhage among which 3 patients needed blood transfusion^[2] in severe and 1 in moderate group] and the finding is consistent with Granese *et al.*, who reported a similar prevalence of 6.5%.⁹ Brouwers *et al.* reported a slightly higher incidence of 7.6%^[3]. Preterm birth was observed in 7.2% of cases in the current study, with highest incidence among patients with severe IHCP (23.5%) and the findings were consistent with Roy A (25.9%)^[8], Cetinkaya Demir B, *et al.*^[10] (24.5%), Kant A, *et al.*^[1] (25%), and higher than Sharma B, *et al.*^[14] (14%), Granese, *et al.*^[9] (15.5%)^[6, 8, 12, 13]. Brouwers L, *et al.* reported a significant reduction in gestational age at delivery in moderate and severe ICP cases ($P=0.001$), with preterm birth occurring in 13.0% of cases, 38.1% of which were in the severe ICP group ($P=0.003$)^[3].

Association between categories of ICP and fetal outcomes

In the present study, birth weight significantly decreased with increasing ICP severity, with mean values of 3257.59 ± 373.61 g in mild ICP, 3103.47 ± 283.82 g in moderate ICP, and 2842.53 ± 315.89 g in severe ICP ($p < 0.001$). APGAR scores at 1 and 5 minutes were also significantly lower in severe ICP cases ($P=0.004$). However, preterm birth rates ($P=0.336$), meconium-stained liquor (MSL) ($P=0.127$), and NICU admissions ($P=0.587$) did not show statistically significant differences among the groups. No neonatal death was recorded in any category. Intrauterine fetal demise occurred in 11.8% of severe ICP cases, while none were reported in mild or moderate cases, showing a statistically significant association ($p < 0.001$). These findings contrast with Sharma B *et al.*^[14], where birth weights, Apgar scores, and fetal distress incidence were comparable between mild and severe ICP cases, although severe cases had earlier gestational age at delivery and higher rates of iatrogenic preterm births. Similarly, Brouwers L, *et al.*^[3] reported significantly lower birth weights in severe ICP cases ($P=0.009$) but no significant difference in small for gestational age (SGA) incidence ($P=0.831$). In the present study, MSL was observed in 17.6% of neonates. In comparison, Granese, *et al.* 46.5% and Brouwers L *et al.* reported a higher incidence at 20.5%^[3, 9]. Unlike the current study, spontaneous preterm birth rates were

significantly higher with increasing ICP severity ($P=0.023$), and meconium-stained amniotic fluid was more frequent in severe cases ($P=0.003$)^[19]. Intrauterine fetal demise occurred in two severe ICP cases ($P=0.009$), which was similar to study by Arthuis C *et al.*^[21]. Overall, the findings of the present study highlight that ICP is associated with varying degrees of maternal and fetal complications, with increasing severity of ICP correlating with higher bile acid levels and adverse outcomes^[20].

Management strategies, including the use of ursodeoxycholic acid, timely induction of labor upon reaching fetal maturity, and correction of coagulopathies, remain central to improving maternal prognosis. The importance of multidisciplinary care involving obstetricians, hepatologists, and neonatologists cannot be overstated in optimizing outcomes.

Conclusions

This study demonstrates a clear correlation between elevated serum bile acid levels and adverse maternal outcomes in intrahepatic cholestasis of pregnancy (ICP). Higher bile acid concentrations were associated with increased rates of preterm delivery, labor induction, cesarean section, and postpartum complications, underscoring their prognostic significance in clinical practice. These findings highlight the importance of early identification of ICP, regular biochemical monitoring, and timely interventions to reduce maternal morbidity. Incorporating serum bile acid assessment into routine management protocols can aid in risk stratification and guide decision-making regarding delivery timing and treatment strategies. While further multi-center studies with larger sample sizes are needed to confirm and expand upon these results, this study reinforces that vigilant surveillance and multidisciplinary care are crucial for optimizing maternal outcomes in ICP.

Strength of the study

The study's prospective nature ensures accurate data collection and minimizes recall bias. The inclusion of both clinical symptoms and laboratory parameters (SGOT, SGPT, ALP, and serum bile acid levels) ensures a comprehensive diagnosis of ICP. The study compares findings with previous literature, strengthening its relevance in the existing body of research.

Limitations of the study

The study's limitations include a relatively small sample size and single-center design, which may limit generalization. Serum bile acid measurements were performed at discrete intervals rather than continuously, which may not fully reflect temporal fluctuations. Nevertheless, the study underscores the clinical relevance of serum bile acid assessment as a key tool in risk stratification and management of ICP.

Author Contributions

- **RK:** Writing the original article including data collection, methodology and results
- **BA:** Supervising the project, mentoring, analyzing data and editing.
- **SS:** Validating the results and helped in analyzing the data
- **NC:** Final preparation and presentation of the article
- **AS:** Supervision and leadership

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The study did not receive any funds

Conflict of Interest: None

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Not available

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