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ETIOLOGICAL SPECTRUM OF PREGNANCY-ASSOCIATED LIVER DISORDERS AND FETOMATERNAL OUTCOMES AT A TERTIARY CARE HOSPITAL IN PAKISTAN

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ABSTRACT

Objective: To determine the etiological spectrum of pregnancy-associated liver disorders and evaluate their associated fetomaternal outcomes at a tertiary care hospital in Pakistan.

Methods: This descriptive cross-sectional study was conducted in the Department of Obstetrics and Gynecology, Unit 9B, Jinnah Postgraduate Medical Centre, Karachi. A total of 103 pregnant women aged 18–45 years diagnosed with liver disorders during pregnancy were enrolled using a non-probability consecutive sampling technique. Demographic, obstetric, clinical, laboratory, and outcome data were collected using a structured proforma. Pregnancy-associated liver disorders included HELLP syndrome, obstetric cholestasis, acute fatty liver of pregnancy (AFLP), and viral hepatitis. Maternal outcomes included intensive care unit (ICU) admission, blood transfusion requirement, postpartum hemorrhage, disseminated intravascular coagulation, renal failure, hepatic encephalopathy, and maternal mortality. Fetal outcomes included preterm birth, low birth weight, fetal distress, neonatal intensive care unit (NICU) admission, and perinatal mortality. Data were analyzed using SPSS version 26.0.

Results: Obstetric cholestasis (48.5%) and HELLP syndrome (47.6%) were the predominant etiologies. Women with HELLP syndrome had significantly higher rates of ICU admission (28.6%), preterm birth (53.1%), low birth weight (44.9%), fetal distress (26.5%), and NICU admission (30.6%). Multivariable analysis identified HELLP syndrome, unbooked pregnancy, and gestational age below 34 weeks as independent predictors of adverse maternal outcomes, while HELLP syndrome and maternal ICU admission independently predicted adverse neonatal outcomes.

Conclusion: Pregnancy-associated liver disorders were associated with substantial fetomaternal morbidity, particularly among women with HELLP syndrome, highlighting the importance of early recognition and multidisciplinary management.

KEYWORDS: Pregnancy-associated liver disorders, HELLP syndrome, obstetric cholestasis, maternal outcomes, neonatal outcomes.

INTRODUCTION

Pregnancy-associated liver disorders are a heterogeneous spectrum of conditions that occur in association with pregnancy and comprise a significant cause of global maternal and perinatal morbidity and mortality. They may also be either specifically diagnosed as associated with pregnancy, such as intrahepatic cholestasis of pregnancy (IPC), acute fatty liver of pregnancy (AFLP), and HELLP syndrome (hemolysis, elevated liver enzymes, and low platelet counts), or occur coincidentally with the development of viral hepatitis, gallstone disease, and other hepatobiliary diseases during the course of the same gestation (1). Early clinical manifestations of the disease are frequently obscured by the physiological changes of pregnancy, resulting in a diagnosis delayed until life-threatening complications such as hepatic failure, disseminated intravascular coagulation, postpartum haemorrhage, renal dysfunction, and maternal death (2).

Liver diseases complicate 3% to 10% of pregnancies worldwide, but their distribution varies widely by geographic region, ethnicity, and underlying disease burden. Worldwide, intrahepatic cholestasis of pregnancy is reported in 0.1–15.6% of pregnancies, with data concentrated largely in South American and Scandinavian populations. Acute fatty

liver of pregnancy (AFLP) is still rare, affecting around 1 in 7000 to 15000 pregnancies; however, it has maternal mortality rates as high as 18% and perinatal mortality over 20%, respectively (3). Likewise, HELLP syndrome occurs in 0.5–0.9% of all pregnancies and up to 20% of women with severe preeclampsia. It represents one of the most common causes of severe pregnancy-related liver dysfunction in developed countries (4).

Viral hepatitis is one of the leading causes of pregnancy-associated liver disease in low- and middle-income countries, especially South Asia and sub-Saharan Africa. Both hepatitis B (HBV) and hepatitis C (HCV) infections are abundant in Pakistan, where national prevalences have been reported to be 2.5% for HBV and about 4.8% for HCV (5). Various local studies performed in tertiary care hospitals have established viral hepatitis and HELLP syndrome as the main causes of hepatic dysfunction during pregnancy and demonstrated high rates of adverse maternal outcomes (including required admission to an intensive care unit, hepatic encephalopathy, renal failure, and PPH) and fetal complications including small for gestational age, preterm birth, stillbirth, and perinatal mortality (6).

Although pregnancy-associated liver disorders are not uncommon in Pakistan and impose a huge burden, the evidence for their etiological distribution and fetomaternal outcomes is limited and heterogeneous. The majority of published studies have been derived from single centres with limited sample sizes and describe isolated conditions rather than the full etiological spectrum of hepatic disorders associated with pregnancy. Moreover, location disparities in infectious disease prevalence, health care availability, referral chains, and social phenomena could heavily impact disease manifestation and prognosis. Therefore, the present study was conducted to comprehensively evaluate the etiological spectrum of pregnancy-associated liver disorders and their associated fetomaternal outcomes at a tertiary care hospital in Pakistan, to generate locally relevant evidence to facilitate early diagnosis, risk stratification, and optimization of maternal and neonatal care.

MATERIALS AND METHODS

Study Design and Setting

This descriptive cross-sectional study was conducted in the Department of Obstetrics and Gynecology, Unit 9B, at Jinnah Postgraduate Medical Centre, Karachi, Pakistan. The study was carried out over a period of six months from January 2024 to June 2025. The study aimed to determine the etiological spectrum of pregnancy-associated liver disorders and evaluate their associated fetomaternal outcomes among pregnant women presenting to a tertiary care referral hospital in Pakistan.

Sample Size Estimation

The sample size was calculated using the WHO sample size calculator for estimation of a single population proportion. Taking an anticipated prevalence of pregnancy-associated liver disorders of 3% (7), with a confidence level of 95% and an absolute precision of 5%, the minimum required sample size was estimated to be 103 participants. To improve the precision of estimates and account for incomplete records, all eligible patients presenting during the study period were included in the final analysis.

Study Population

This study included pregnant females in the age group of 18–45 years diagnosed with liver disease due to pregnancy by clinical findings, laboratory investigations (including wherever necessary and indicated) and radiological investigations. Any admission of women at any stage of gestation during the study period was eligible for inclusion. Pregnancy-associated liver disorders were considered pregnancy-specific conditions (e.g., HELLP syndrome, intrahepatic cholestasis of pregnancy, acute fatty liver of pregnancy, and hyperemesis gravidarum-related liver impairment) as well as incidental hepatic conditions including viral hepatitis and gallstone disease.

Patients were excluded if they had pre-existing chronic liver disease diagnosed before pregnancy, liver tumors or malignancy at enrollment, autoimmune liver disorders not requiring immunosuppression, or patients with incomplete or non-reliable clinical data. After getting the written informed consent, participants were consecutively selected using a non-probability sampling technique.

Data Collection Procedure

Following enrollment, demographic, obstetric, clinical, and laboratory information was recorded using a structured study proforma by the principal investigator and trained research staff. Baseline demographic variables included maternal age, residence, educational status, socioeconomic status, gravidity, parity, gestational age at presentation, and booking status.

Clinical variables: Presenting symptoms and signs (jaundice, pruritus, nausea and vomiting, abdominal pain), hypotension, edema, altered consciousness, and bleeding manifestations. Information was also recorded on obstetric history, such as complications in previous pregnancies and antenatal care visits.

Pregnancy-associated liver disorders and their etiological spectrum were as follows: HELLP syndrome, intrahepatic cholestasis of pregnancy (ICP), acute fatty liver of pregnancy (AFLP), viral hepatitis, hyperemesis gravidarum-related liver dysfunction, gallstone disease, and other recognized hepatic disorders. For the convenience of investigation, diagnoses were made through predefined operational criteria which relied on clinical presentation as well as laboratory findings and re-examination, if necessary.

Laboratory workup included complete blood count, platelet count, total and direct serum bilirubin, along with serum alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase, serum creatinine,

coagulation profile, and viral hepatitis serology. Data on admission to the intensive care unit, need for blood transfusion, and length of hospital stay were also recorded.

We collected data on maternal outcomes during hospitalization (postpartum hemorrhage, disseminated intravascular coagulation, hepatic encephalopathy, renal failure, intensive care unit admission; blood transfusion and Maternal mortality), Variables abstracted for fetuses and neonates included gestational age at delivery, mode of delivery, birth weight, preterm birth, low birth weight (LBW), fetal distress, stillbirth or intrauterine fetal demise (IUFD), admission to the neonatal intensive care unit (NICU), and perinatal mortality.

Outcome Measures

The primary outcome of the study was to determine the etiological spectrum of pregnancy-associated liver disorders among pregnant women presenting to a tertiary care hospital. Secondary outcomes included maternal complications such as postpartum hemorrhage, disseminated intravascular coagulation, hepatic encephalopathy, renal failure, intensive care unit admission, blood transfusion requirement, and maternal mortality, as well as fetal outcomes including preterm birth, low birth weight, fetal distress, intrauterine fetal demise, stillbirth, neonatal intensive care unit admission, and perinatal mortality.

Ethical Considerations

The study was conducted after obtaining approval from the Institutional Ethical Review Committee of the participating institution. Written informed consent was obtained from all participants before enrollment in the study. Participation was voluntary, and confidentiality was maintained by assigning unique identification numbers to study participants and restricting access to study records to members of the research team only. All procedures were performed in accordance with the ethical principles outlined in the Declaration of Helsinki for biomedical research involving human participants.

Statistical Analysis

The Statistical Package for the Social Sciences (SPSS) version 26.0 (IBM Corp., Armonk, NY, USA) was used for entry and analysis. Shapiro-Wilk test was used to assess the normality of continuous variables. Continuous variables (maternal age, gestational age at presentation, and birth weight) were reported as mean ± standard deviation (SD) or median with interquartile range (IQR), depending on the distribution of the data. The categorical variables, such as parity, booking status, and etiological categories of liver disorders, maternal complications, including mode of delivery, and fetal outcomes, were expressed in terms of frequency and percentage.

The Chi-square test was used for comparisons of categorical variables between the different etiological categories of liver disorders and fetomaternal outcomes, while an independent samples t-test or Mann–Whitney U test was used to compare continuous variables where appropriate. We adjusted for potential confounders, including maternal age, parity, gestational age, and booking status by stratifying and performing multivariable analysis. Multivariable logistic regression models were employed to identify independent predictors of adverse maternal/neonatal outcomes, and results are reported as adjusted odds ratios (aORs) with 95% confidence intervals (95% CIs). A two-tailed p-value <0.05 was deemed statistically significant throughout the analysis.

RESULTS

During the study period, a cohort of 103 pregnant women presenting with pregnancy-associated liver disorders was included in the analysis. The maternal age average was 28.4 ± 5.3 years (range: 18–42 years), and the gestational age at presentation average was 34.7 ± 3.2 weeks. The 25–29 years age group (35.9%) was the majority, followed by the 30–34 years age group (29.1%). There were 61.2% of all women living in the urban areas, and 56.3% had been regularly booked (i.e., antenatal care). Most of the participants were multigravida (71.8%), but 28.2% were primigravida. Intergroup analysis indicated significant heterogeneity in booking status and gestational age at presentation (p=0.018 and p=0.026, respectively) based on the etiological category of liver disorders, while maternal age and parity did not differ significantly. Table 1.

Table 1. Baseline demographic and obstetric characteristics according to the etiological category of liver disease (n = 103)

Baseline & demographic parameters	Overall (n=103)	HELLP (n=49)	Cholestasis (n=50)	AFLP/Viral Hepatitis (n=4)	p-value
Age (years), Mean ± SD	28.4 ± 5.3	29.0 ± 5.5	27.8 ± 5.0	30.3 ± 5.7	0.394
Age Group (years)					0.527
≤24	21 (20.4)	9 (18.4)	11 (22.0)	1 (25.0)	
25–29	37 (35.9)	16 (32.7)	20 (40.0)	1 (25.0)	
30–34	30 (29.1)	16 (32.7)	13 (26.0)	1 (25.0)	

≥35	15 (14.6)	8 (16.3)	6 (12.0)	1 (25.0)	
Gestational Age (weeks), Mean ± SD	34.7 ± 3.2	33.8 ± 2.8	35.8 ± 2.6	34.2 ± 4.9	0.026
Residence					0.311
Urban	63 (61.2)	32 (65.3)	29 (58.0)	2 (50.0)	
Rural	40 (38.8)	17 (34.7)	21 (42.0)	2 (50.0)	
Booking Status					0.018
Booked	58 (56.3)	22 (44.9)	33 (66.0)	3 (75.0)	
Unbooked	45 (43.7)	27 (55.1)	17 (34.0)	1 (25.0)	
Parity					0.621
Primigravida	29 (28.2)	15 (30.6)	13 (26.0)	1 (25.0)	
Multigravida	74 (71.8)	34 (69.4)	37 (74.0)	3 (75.0)	

Data are presented as mean ± standard deviation (SD) for continuous variables and frequency (percentage) for categorical variables. Continuous variables were compared using one-way analysis of variance (ANOVA), while categorical variables were compared using the Chi-square test or Fisher's exact test, as appropriate. A p-value <0.05 was considered statistically significant.

Obstetric cholestasis (48.5%) and HELLP syndrome (47.6%) were associated with the majority of diagnoses. The most common presenting manifestations were jaundice (58.3%), hypertension (51.5%), and pruritus (48.5%). Maternal complications occurred in 36.9% of women, with ICU admission (17.5%) and blood transfusion requirement (10.7%) as the most prevalent adverse outcomes. In our study, HELLP syndrome was significantly associated with hypertension and edema compared to obstetric cholestasis, which had a high incidence of pruritus (p < 0·001). Figure 1.

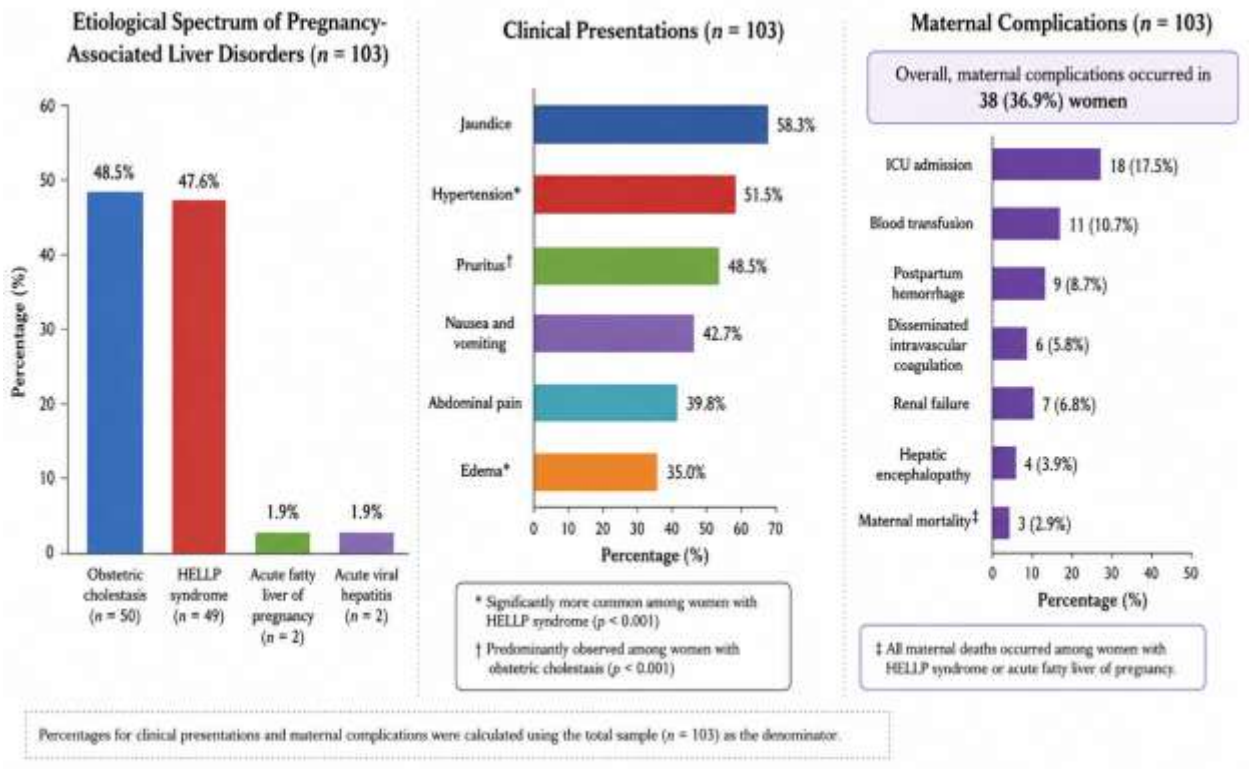

Figure 1. Etiological spectrum, major clinical presentations, and maternal complications among women with pregnancy-associated liver disorders (*n* = 103).

Women with HELLP syndrome experienced significantly higher rates of adverse maternal outcomes compared with other etiological groups. ICU admission (28.6%), blood transfusion requirement (18.4%), postpartum hemorrhage (14.3%), disseminated intravascular coagulation (10.2%), and renal failure (10.2%) were most frequently observed among women with HELLP syndrome. In contrast, hepatic encephalopathy (50.0%) and maternal mortality (25.0%) were predominantly observed among women with AFLP or viral hepatitis. All associations between liver disease etiology and maternal outcomes were statistically significant ($p < 0.05$). Table 2.

Table 2. Maternal outcomes according to the etiological category of liver disease (n = 103)

Maternal Outcome	Overall n (%)	HELLP n (%)	Cholestasis n (%)	AFLP/Viral Hepatitis n (%)	p-value
ICU admission	18 (17.5)	14 (28.6)	3 (6.0)	1 (25.0)	0.003
Blood transfusion	11 (10.7)	9 (18.4)	1 (2.0)	1 (25.0)	0.005
Postpartum hemorrhage	9 (8.7)	7 (14.3)	1 (2.0)	1 (25.0)	0.021
DIC	6 (5.8)	5 (10.2)	0 (0.0)	1 (25.0)	0.008
Renal failure	7 (6.8)	5 (10.2)	1 (2.0)	1 (25.0)	0.041
Hepatic encephalopathy	4 (3.9)	2 (4.1)	0 (0.0)	2 (50.0)	<0.001
Maternal mortality	3 (2.9)	2 (4.1)	0 (0.0)	1 (25.0)	0.017

Data are presented as frequency (percentage); bold *p*-values indicate statistical significance ($p < 0.05$).
Abbreviations: ICU, intensive care unit; AFLP, acute fatty liver of pregnancy; DIC, disseminated intravascular coagulation.

Women with HELLP syndrome experienced significantly poorer neonatal outcomes, including higher rates of preterm birth (53.1%), low birth weight (44.9%), fetal distress (26.5%), and NICU admission (30.6%) compared with other etiological groups. In contrast, AFLP/viral hepatitis was associated with the highest perinatal mortality (25.0%). Overall, the etiology of liver disease was significantly associated with all fetal and neonatal outcomes ($p < 0.05$). Table 3.

Table 3. Fetal and neonatal outcomes according to the etiological category of liver disease (n = 103)

Fetal Outcome	Overall n (%)	HELLP n (%)	Cholestasis n (%)	AFLP/Viral Hepatitis n (%)	p-value
Cesarean delivery	64 (62.1)	36 (73.5)	25 (50.0)	3 (75.0)	0.032
Preterm birth	39 (37.9)	26 (53.1)	11 (22.0)	2 (50.0)	0.004
Low birth weight	34 (33.0)	22 (44.9)	10 (20.0)	2 (50.0)	0.011
Fetal distress	18 (17.5)	13 (26.5)	4 (8.0)	1 (25.0)	0.023

NICU admission	22 (21.4)	15 (30.6)	6 (12.0)	1 (25.0)	0.037
Perinatal mortality	6 (5.8)	4 (8.2)	1 (2.0)	1 (25.0)	0.048

Data are presented as frequency (percentage); bold *p*-values indicate statistical significance ($p < 0.05$).
Abbreviations: NICU, neonatal intensive care unit; AFLP, acute fatty liver of pregnancy.

Women with HELLP syndrome demonstrated significantly higher rates of adverse neonatal outcomes compared with those with cholestatic liver disease, including preterm birth (53.1% vs. 22.0%), low birth weight (44.9% vs. 20.0%), fetal distress (26.5% vs. 8.0%), and NICU admission (30.6% vs. 12.0%), highlighting the greater fetal morbidity associated with hypertensive liver disorders during pregnancy (Figure 2).

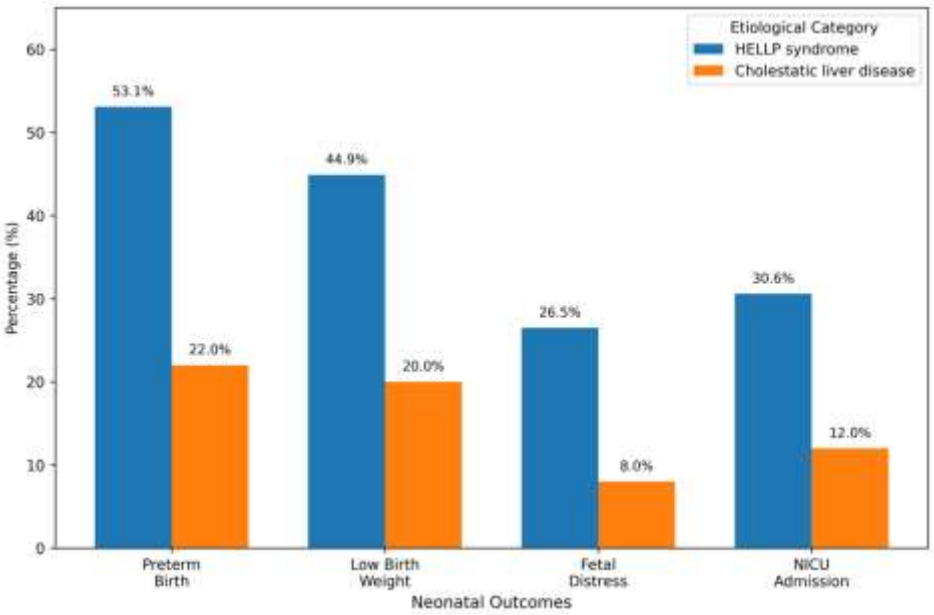

Figure 2. Distribution of adverse neonatal outcomes according to liver disease etiology

We used multivariable logistic regression analysis to identify independent predictors for adverse maternal outcomes defined as the composite of ICU admission, blood transfusion use, DIC, renal failure, hepatic encephalopathy, or maternal death. Persisting independent predictors of adverse maternal outcome (adjusted odds ratio [aOR]) included HELLP syndrome (3.61, 95% CI 1.54–8.47, p=0.003), unbooked pregnancy (2.43, 95% CI 1.08–5.45, p=0.031) and gestational age <34 weeks (2.97; 95% CI 1.29–6.86; P = 0.010) after adjustment for maternal age, parity status, booking history status and gestational age at presentation (Table 4).

Table 4. Multivariable logistic regression analysis identifying independent predictors of adverse maternal outcomes among women with pregnancy-associated liver disorders (n = 103)

Parameters	**n (%)**	**Adjusted Odds Ratio (aOR)**	**95% Confidence Interval**	**p-value**
HELLP syndrome	49 (47.6)	3.61	1.54–8.47	**0.003**
AFLP/viral hepatitis	4 (3.9)	4.88	0.92–25.93	0.062
Unbooked pregnancy	45 (43.7)	2.43	1.08–5.45	**0.031**
Gestational age <34 weeks	38 (36.9)	2.97	1.29–6.86	**0.010**
Maternal age ≥35 years	15 (14.6)	1.39	0.61–3.20	0.431
Multigravidity	74 (71.8)	1.16	0.53–2.57	0.708

Multivariable logistic regression analysis was performed with adverse maternal outcome as the dependent variable, defined as the composite occurrence of ICU admission, blood transfusion requirement, DIC, renal failure, hepatic encephalopathy, or maternal mortality. Bold *p*-values indicate statistical significance ($p < 0.05$).
Abbreviations: aOR, adjusted odds ratio; CI, confidence interval; ICU, intensive care unit; DIC, disseminated intravascular coagulation; AFLP, acute fatty liver of pregnancy.

A second multivariable logistic regression model identified determinants of adverse neonatal outcomes, defined as the composite occurrence of preterm birth, low birth weight, NICU admission, or perinatal mortality. HELLP syndrome(aOR 2.89, 95% CI 1.28–6.53, p=0.011), maternal ICU admission (aOR 3.42, 95% CI 1.37–8.57, p=0.008), and gestational age at presentation below 34 weeks (aOR 4.76, 95% CI 2.02–11.24, p<0.001) were independently associated with adverse neonatal outcomes (Table 5).

Table 5. Multivariable logistic regression analysis identifying independent predictors of adverse neonatal outcomes among women with pregnancy-associated liver disorders (n = 103)

Parameters	Frequency n (%)	Adjusted Odds Ratio (aOR)	95% Confidence Interval	p-value
HELLP syndrome	49 (47.6)	2.89	1.28–6.53	**0.011**
Maternal ICU admission	18 (17.5)	3.42	1.37–8.57	**0.008**
Gestational age <34 weeks	38 (36.9)	4.76	2.02–11.24	**<0.001**
Unbooked pregnancy	45 (43.7)	2.06	0.94–4.54	0.072
Maternal age ≥35 years	15 (14.6)	1.27	0.54–3.01	0.584

Multivariable logistic regression analysis was performed with adverse neonatal outcome as the dependent variable, defined as the composite occurrence of preterm birth, low birth weight, NICU admission, or perinatal mortality. Bold *p*-values indicate statistical significance ($p < 0.05$).
Abbreviations: aOR, adjusted odds ratio; CI, confidence interval; ICU, intensive care unit; NICU, neonatal intensive care unit.

DISCUSSION

The aim of the present study is to analyze the etiological spectrum of hepatic disorders in pregnancy and pregnancy outcomes associated with them at a tertiary care hospital in Pakistan. Our main objective was that obstetric cholestasis (48.5%) and HELLP syndrome (47.6%) represented the majority of pregnancy liver disorders, while acute fatty liver of pregnancy and viral hepatitis were comparatively rare, each forming only 1.9% of cases. This was much different than other earlier studies from Pakistan, where viral hepatitis, especially Hepatitis E virus infection, was the primary etiology of liver disease during pregnancy (8, 9). Butt et al. One study from Karachi described acute hepatitis E infection in 37.2% of cases, followed by preeclampsia/eclampsia and HELLP syndrome, indicating a considerable burden of infectious liver disease (7). Similarly, GM Hammoud et al. reported that one of the main diagnoses in 582 pregnant women with liver dysfunction was preeclampsia-related liver dysfunction (48.1%), HELLP syndrome (19.2%), obstetric cholestasis (7.0%), and viral hepatitis (7.0%) (10). The increased prevalence of cholestatic and hypertensive liver disease seen in our cohort may reflect differences in antenatal viral hepatitis screening programs, changing referral patterns, and the obstetrics-oriented nature of our study population, which preferentially captures pregnancy-specific liver disorders rather than infectious hepatology referrals.

In our study, we examined both acute and chronic causes of liver disease and specifically found that pregnancy-related liver disorders were much better reflected in the data; thus, our findings are closer to those from developed countries where pregnancy-specific liver disorders dominate, and viral hepatitis is a relatively less prevalent part of the overall disease burden (11-13). International studies have repeatedly recognised HELLP syndrome and intrahepatic cholestasis of pregnancy as the most common causes of liver dysfunction in pregnancy, especially when studied at tertiary obstetric centres (14, 15). These regional differences in etiological patterns can probably be explained by geographic differences in hepatitis prevalence, socioeconomic conditions, vaccination coverage, sanitation, and access to prenatal care.

Another important finding was that women with HELLP syndrome experienced adverse maternal outcomes more frequently. Significantly higher rates of ICU admission (28.6%), blood transfusion requirement (18.4%), postpartum hemorrhage (14.3%), disseminated intravascular coagulation (10.2%), and renal failure (10.2%) were observed in women with HELLP syndrome compared to other etiological groups. These results are in accordance with the already known literature, both nationally and internationally, describing HELLP syndrome as one of the most serious

obstetrically related causes of liver impairment due to generalized endothial injury/microangiopathy/ coagulopathy with multiorgan involvement (16, 17). A previously conducted study documented higher rates of oppressive mismatch in maternal mortality (25.0%) and hepatic encephalopathy (50.0%) among women with AFLP or viral hepatitis (18), which indicates the rapidly advancing course of acute hepatic failure governed by both pathological processes. Similar findings have been found in Pakistan and India, where fulminant hepatitis E infection or AFLP was associated with some of the highest maternal mortality rates.

The study further demonstrated a substantial burden of adverse neonatal outcomes, particularly among women with HELLP syndrome. Rates of preterm birth (53.1%), low birth weight (44.9%), fetal distress (26.5%), and NICU admission (30.6%) were significantly higher among women with HELLP syndrome than among those with cholestatic liver disease. These findings are in agreement with previous reports demonstrating that placental insufficiency, uteroplacental ischemia, and the need for early delivery contribute substantially to neonatal morbidity in hypertensive liver disorders of pregnancy (19, 20). Conversely, although obstetric cholestasis was associated with comparatively favorable maternal outcomes, it remained associated with important fetal risks, particularly prematurity and fetal distress, as described in previous European and South American studies (21).

An important strength of the present study was the use of multivariable logistic regression analysis to identify independent predictors of adverse outcomes. After adjustment for potential confounders, HELLP syndrome (aOR 3.61, 95% CI 1.54–8.47), unbooked pregnancy (aOR 2.43, 95% CI 1.08–5.45), and gestational age below 34 weeks (aOR 2.97, 95% CI 1.29–6.86) remained independently associated with adverse maternal outcomes. Similarly, HELLP syndrome (aOR 2.89, 95% CI 1.28–6.53), maternal ICU admission (aOR 3.42, 95% CI 1.37–8.57), and gestational age below 34 weeks (aOR 4.76, 95% CI 2.02–11.24) independently predicted adverse neonatal outcomes (22-24). These findings emphasize the importance of early identification of high-risk pregnancies and timely referral to tertiary care facilities for multidisciplinary management.

The present study had several limitations. First, it was conducted at a single tertiary care referral center, which may limit the generalizability of the findings to the wider population. Second, the observational design precluded causal inference between liver disease etiology and adverse outcomes. Third, referral bias may have resulted in overrepresentation of severe cases, particularly HELLP syndrome and AFLP. Finally, some etiological subgroups, including AFLP and viral hepatitis, had relatively small sample sizes, limiting the precision of subgroup analyses.

CONCLUSION

Pregnancy-associated liver disorders were related to significant maternal and neonatal morbidity. The majority of the etiologies were obstetric cholestasis and HELLP syndrome, and HELLP syndrome was found to be a significant predictor for adverse fetomaternal outcomes. Improvement in the outcome of women with liver disease during pregnancy relies on early diagnosis, close antenatal surveillance, and timely multidisciplinary management.

Conflict of Interest: The authors declare no conflict of interest.

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

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