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Prevalence of elevated alanine aminotransferase (ALT) in pregnancy

A cross-sectional labor and delivery-based assessment

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Abstract

Since liver tests are not routinely checked in pregnancy, the prevalence of abnormal liver tests and liver-related abnormalities in pregnancy in a US-based population is not known. We sought to determine the prevalence of abnormal alanine aminotransferase (ALT) among pregnant Individuals who present to labor and delivery for evaluation and to evaluate prevalence of underlying diagnosed liver conditions. Prospective study evaluating liver tests in consecutive samples obtained on the labor and delivery unit. Patient characteristics were compared between those with and without abnormal ALT and those with and without abnormal ALT without a liver-related diagnosis made in clinical practice, using *t* tests for continuous measures and $\chi 2$ or Fisher's exact tests as appropriate for categorical measures. Logistic regression was utilized to identify factors associated with abnormal ALT in this subcohort to determine predictors of abnormal ALT in those without a known liver-related diagnosis. We collected 1024 laboratory specimens from 996 patients. Of these patients, 131 of 996 (13.2%) had elevated ALT ≥25 IU/L; 20 (2%) had ALT ≥50, 6 (0.6%) had ALT ≥125 and 3 (0.3%) had ALT ≥250. 61/131 (46.6%) of patients with ALT ≥25 IU/L had not had LTs checked during routine pregnancy care. 20 (15%) of individuals with abnormal LT had preeclampsia; 5 (4%) had cholestasis of pregnancy; 1 (0.8%) had hepatitis C; there were no other chronic liver diseases diagnosed. There were no significant demographic or clinical differences between those with and without ALT ≥25, whether liver disease diagnosis was made or not. We identified an over 10% prevalence of abnormal LTs in consecutive pregnant individuals who presented to L&D, most of whom did not have a liver-related condition diagnosed in clinical practice. Among those with liver-related diagnoses, PE and ICP were the most common among individuals with ALT≥25 IU/mL, with chronic liver disease rarely diagnosed. Further evaluation of the role of ALT testing as part of routine prenatal care is needed, particularly in establishing a baseline prevalence of liver test abnormalities in pregnancy and independent association with pregnancy outcomes.

Abbreviations: ALT = alanine aminotransferase, AST = aspartate aminotransferase, BMI = body mass index, EMR = electronic medical records, GDM = gestational diabetes, HELLP = hemolysis elevated liver enzymes; low platelets count syndrome, ICP = intrahepatic cholestasis of pregnancy, L&D = labor and delivery, LT = Liver Test, NAFLD = nonalcoholic fatty liver disease, NYC = New York City, OC = obstetric cholestasis, PE = preeclampsia.

Keywords: abnormal liver enzymes, labor and delivery, nonalcoholic fatty liver disease, preeclampsia spectrum

1. Introduction

Liver disease is thought to occur in 3%–5% of individuals of childbearing age[1] but prior international studies have indicated a higher-than-expected prevalence of liver disease in the context of pregnancy,[2,3] with US-based data suggesting that liver disease in pregnancy is on the rise and associated with increased cost of care.[4] Liver disease in pregnancy is generally categorized as chronic liver disease, liver disease unique to pregnancy, or liver disease coincidental to pregnancy.[5] In severe cases,

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The authors have no competing interests or relevant disclosures to declare.

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

This study was approved by the Mount Sinai School of Medicine Institutional Review Board (IRB) in November 2017 by expedited review procedure category 5 and granted a waiver of signed informed consent. The study was judged to be low risk and could not have practically been conducted without this waiver.

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pregnancy-related liver disease is independently associated with significant maternal and fetal morbidity and mortality.[6] Despite the recognition of associated adverse pregnancy outcomes, and increased healthcare cost related to maternal liver disease, liver tests (LTs) are not routinely recommended during pregnancy care and prenatal testing.

Currently, there are limited data on the true prevalence of abnormal alanine aminotransferase (ALT) or aspartate aminotransferase (AST) during pregnancy.[7] While changes in some liver-related tests (i.e. rise in alkaline phosphatase, lower albumin levels due to hemodilution) are considered normal during pregnancy, elevated serum ALT and AST levels are considered abnormal in pregnancy and may be a sign of hepatocellular liver injury and/or underlying liver disease. Patients with elevated ALT, which is more liver-specific than AST (which is more commonly elevated from other etiologies such as muscle turnover), defined as ALT ≥ 25 IU/L, should undergo further evaluation.[8,9]

In this study, we sought to establish the prevalence of abnormal ALT in individuals during pregnancy by performing analysis on consecutive individuals who presented to labor and delivery (L&D) for evaluation. Over two months, we measured ALT in discarded blood samples of consecutive labor and delivery admissions, including individuals admitted for antepartum complications and individuals admitted for delivery, at a high-volume inner-city obstetrical service. The study aimed to establish the prevalence of liver test abnormalities among individuals evaluated during pregnancy and to identify underlying etiologies associated with liver test abnormalities during pregnancy to determine whether there is a need for further evaluation of ALT testing as part of routine prenatal care.

2. Methods

We performed a prospective cross-sectional study evaluating ALT levels among consecutive L&D admissions at Mount Sinai West hospital located in New York City over 2 months in 2019 as part of a larger hepatitis C seroprevalence study.[10] Labor and delivery screening was chosen rather than prenatal clinic screening or newborn screening to avoid underestimating the true abnormal ALT prevalence in our population. Prenatal screening could result in underestimating abnormal ALT prevalence because the highest risk individuals might receive little or no prenatal care. Measurement of other liver tests was not performed given funding limitations, but ALT was chosen as the most representative and specific for hepatocellular liver injury. This study had ethics approval from the Mount Sinai School of Medicine Institutional Review Board (IRB).

2.1. Study variables

The primary variable of interest was the prevalence of abnormal ALT as defined by ALT ≥25IU/L. Other measures of interest included patient demographics, medical history, and diagnoses of chronic liver disease and liver disease unique to pregnancy.

2.2. Data sources

Mount Sinai West, located in Midtown West of Manhattan, has around 6000 pregnancy deliveries per year. Data were abstracted from maternal electronic medical records (EMRs) and infant birth certificates. Birth certificate records served as the primary data source for sociodemographic factors including race, country of origin, ethnicity, marital status, occupation, and employment status. EMRs served as the data source for maternal age, admission indication, parity, medical insurance status, history of substance use (including alcohol, tobacco, intravenous drug, cannabis, and cocaine), blood transfusion, and domicile in a shelter or residential treatment program. For those subjects for whom a birth certificate was unavailable, data were abstracted exclusively from the EMR.

2.3. Sample collection and processing

Specimens were collected from March 2019 through May 2019. As part of standard L&D practice, all admissions have serologic screening for syphilis (rapid plasma reagin) drawn regardless of gestational age or fetal viability. After testing, these specimens are routinely stored by the clinical laboratories for ~1 week in the event that additional testing is required. Based on information from daily L&D visit logs, the research coordinators created a list of eligible patients (all antepartum and delivery admissions) and assigned each patient a unique alphanumeric study number. During the study period, after RPR testing, the clinical laboratory stored all L&D specimens in designated refrigerators to preserve sample integrity and facilitate specimen location. Three times a week, research coordinators went to the laboratory to pull saved samples for eligible patients and relabel them with the study number. All samples were tested at Mount Sinai Hospital laboratories within 5 days of collection. Samples transported by research coordinators from L&D were maintained in a temperature-controlled environment. If patients had multiple specimens collected within 48 h, only a single specimen was tested. A separate deidentified database was created to link ALT test results with sociodemographic and relevant medical histories abstracted from EMRs and NYC birth certificates. This deidentified database was used for all statistical analyses.

2.4. Statistical analysis

Before data collection, based on annual delivery rates, we expected total sample size of ~1000 over 2 months. Patient characteristics were compared between those with and without abnormal ALT using *t* tests for continuous measures and χ^2 or Fisher's exact tests as appropriate for categorical measures. We then compared patient characteristics among all patients excluding those with a known liver-related diagnosis in clinical practice to determine if characteristics were different among those with and without ALT≥25 IU/mL. Logistic regression was utilized to identify factors associated with abnormal ALT in this sub-cohort to determine predictors of abnormal ALT in those without a known liver-related diagnosis. We also evaluated the correlation between elevated ALT and baseline BMI as well as pregnancy weight gain by plotting scatterplots with correlation coefficients. All analyses were conducted using SAS version 9.4 (SAS Institute Inc., Cary, NC).

3. Results

During the study period, there were 1024 ALT values recorded from 996 patients entered into the database.

3.1. Prevalence of abnormal ALT

Overall, 131 of 996 (13.2%) samples collected had elevated ALT ≥25 IU/L (Table 1). There were 20 patients (2%) with ALT ≥50, 6 (0.6%) ≥125 and 3 (0.3%) ≥250 (Table 2). Excluding patients with known liver disease (chronic HCV, pre-eclampsia, or ICP during their current pregnancy), 107/910 (11.8%) had ALT ≥25, 11 (1.2%) ≥50, 1 (0.1%) ≥125, and 1 (0.1%) ≥250 (see patient characteristics for this sub-cohort in Tables 3 and 4). Table 2 includes data on timing of abnormal ALT (i.e. antepartum or at time of delivery) to diagnoses made in clinical care.

Table 1

Demographics and clinical characteristics by ALT group.

	ALT ≥25 (N=131)	ALT <25 (N=865)	
	No. Mean ± sd	No. Mean ± sd	*P* value
Maternal age	131	865	.47
	32.4 ± 5.1	32.8 ± 5.1	
Pre-pregnancy BMI	93	650	.32
	25.2 ± 4.9	24.7 ± 4.9	
Race	No. (%)	No. (%)	
American Indian or Alaska Native	1 (0.8%)	0	.45*
Asian	7 (5.3%)	131 (15.1%)	
Black or African American	14 (10.7%)	111 (12.8%)	
Hispanic or Latino	7 (5.3%)	24 (2.8%)	
More than one race	7 (5.3%)	25 (2.9%)	
Native Hawaiian or other Pacific Islander	1 (0.8%)	3 (0.3%)	
Other	7 (5.3%)	15 (1.7%)	
Unknown	3 (2.3%)	31 (3.6%)	
White	84 (64.1%)	525 (60.7%)	
Ethnicity	No. (%)	No. (%)	
Hispanic or Latino	33 (25.2%)	176 (20.3%)	.14
Not Hispanic or Latino	96 (73.3%)	685 (79.2%)	
Unknown	2 (1.5%)	4 (0.5%)	
Country of origin	No. (%)	No. (%)	
US	84 (64.1%)	482 (55.7%)	.15
Outside of US	44 (33.6%)	344 (39.8%)	
Unknown	3 (2.3%)	39 (4.5%)	
Marital status	No. (%)	No. (%)	
Married	102 (77.9%)	657 (76.0%)	.66
Significant other/life Partner	20 (15.3%)	153 (17.7%)	
Single	8 (6.1%)	52 (6.0%)	
Unknown	1 (0.8%)	3 (0.3%)	
Occupation	No. (%)	No. (%)	
Healthcare worker	12 (9.2%)	82 (9.5%)	.94
Not employed	7 (5.3%)	58 (6.7%)	
Other	98 (74.8%)	638 (73.8%)	
Unknown	14 (10.7%)	87 (10.1%)	
Insurance	No. (%)	No. (%)	
Government (Medicare/Medicaid)	24 (18.3%)	156 (18.0%)	.86†
Other (self-pay, charity)	0	2 (0.2%)	
Private (commercial carriers, HMOs, PPOs)	107 (81.7%)	701 (81.0%)	
Uninsured	0	4 (0.5%)	
Unknown	0	2 (0.2%)	
Prior pregnancy history‡	No. (%)	No. (%)	
Intrahepatic cholestasis of pregnancy	1 (0.8%)	2 (0.2%)	–
Preeclampsia	1 (0.8%)	9 (1.0%)	–
Gestational diabetes	0	12 (1.4%)	–
Current pregnancy history	No. Mean ± sd	No. Mean ± sd	
Pregnancy weight gain	90	637	.84
	12.4 ± 5.5	12.3 ± 5.6	
	No. (%)	No. (%)	
Abnormal liver tests obtained in clinical practice	45/70 (64.3)	103/408 (25.2)	<.0001
Intrahepatic cholestasis of pregnancy	5/129 (3.9)	7/853 (0.8)	.01
Preeclampsia during current pregnancy	20/128 (15.6)	48/856 (5.6)	<.0001
Gestational diabetes during current pregnancy	9/127 (7.1)	76/850 (8.9)	.32
HCV test result	1/131 (0.8)	5/863 (0.6)	.57

* *P* value computed comparing percentage white between groups.

† *P* value computed comparing percentage with private insurance between groups.

‡ Prior pregnancy history was not applicable for 50 (38.2%) patients in the ALT ≥25 group and 270 (31.2%) in the ALT <25 group. History of intrahepatic cholestasis, preeclampsia, and gestational diabetes were unknown for >60% of patients in each group. Due to the high rate of not applicable and unknown, no formal tests to compare groups were conducted.

3.2. Characteristics of patients with elevated ALT versus those with normal ALT

Demographics including maternal age, race, Hispanic ethnicity, country of origin outside the U.S., and insurance were similar between those with ALT ≥25 and those with ALT <25 (Table 1). There was no significant difference in pre-pregnancy BMI between the two groups (Table 1) and mean pregnancy weight gain did not differ significantly between the two groups (12.4 ± 5.5 kg vs. 12.3 ± 5.6 kg; $P = .84$). Among those without diagnosed liver disease, a pregnancy weight gain *was* associated with higher odds of ALT ≥25 IU/L in a model adjusted for pre-pregnancy BMI (adjusted OR: 1.23, 95% CI 0.97–1.55); however, this association did not reach statistical significance ($P = .08$).

Table 2

ALT cutoffs based on timing of labor and delivery admission and clinical diagnosis.

	ALT <25	ALT 25-49	ALT 50-124	ALT 125-249	ALT 250+	All
Term delivery (> 37 weeks) – No. (row %)						
Preeclampsia	35 (76.1)	8 (17.4)	0	2 (4.3)	1 (2.2)	46 (100)
Intrahepatic Cholestasis	5 (62.5)	1 (12.5)	0	1 (12.5)	1 (12.5)	8 (100)
Positive HCV test result	3 (100)	0	0	0	0	3 (100)
No recognized co-morbid condition*	608 (88.5)	72 (10.5)	6 (0.9)	0	1 (0.1)	687 (100)
Pre-term delivery (< 37 weeks) – No. (row %)						
Preeclampsia	3 (33.3)	5 (55.6)	1 (11.1)	0	0	9 (100)
Intrahepatic Cholestasis	0	0	1 (100)	0	0	1 (100)
Positive HCV Test Result	1 (100)	0	0	0	0	1 (100)
No recognized co-morbid condition*	38 (86.4)	4 (9.1)	2 (4.5)	0	0	44 (100)
Antepartum Admission – No. (Row %)						
Preeclampsia	10 (76.9)	0	2 (15.4)	1 (7.7)	0	13 (100)
Intrahepatic Cholestasis	2 (66.7)	1 (33.3)	0	0	0	3 (100)
Positive HCV Test Result	1 (50)	1 (50)	0	0	0	2 (100)
No recognized co-morbid condition*	160 (87.9)	20 (11)	2 (1.1)	0	0	182 (100)

* No record of pre-eclampsia, intrahepatic cholestasis or positive HCV test result during the current pregnancy; 3 patients had more than one co-morbid condition and are included in 2 rows – one patient with ALT <25 admitted for term delivery had preeclampsia and intrahepatic cholestasis, one patient with ALT 25-49 admitted antepartum had intrahepatic cholestasis and a positive HCV test result, and one patient with ALT 125-249 admitted for term delivery had preeclampsia and intrahepatic cholestasis.

Table 3

Demographics by ALT Group excluding patients with known chronic hepatitis C, preeclampsia, or cholestasis during their current pregnancy.

	ALT ≥25 (N=107)	ALT <25 (N=803)	
	No. mean ± sd	No. mean ± sd	*P* value
Maternal age	107 32.4 ± 4.9	803 32.8 ± 5.1	.47
Race	No. (%)	No. (%)	
American Indian or Alaska Native	1 (0.9%)	0	.67*
Asian	7 (6.5%)	119 (14.8%)	
Black or African American	10 (9.3%)	98 (12.2%)	
Hispanic or Latino	4 (3.7%)	23 (2.9%)	
More than one race	6 (5.6%)	22 (2.7%)	
Native Hawaiian or other Pacific Islander	1 (0.9%)	3 (0.4%)	
Other	7 (6.5%)	15 (1.9%)	
Unknown	3 (2.8%)	30 (3.7%)	
White	68 (63.6%)	493 (61.4%)	
Ethnicity	No. (%)	No. (%)	
Hispanic or Latino	22 (20.6%)	162 (20.2%)	.25
Not Hispanic or Latino	83 (77.6%)	637 (79.3%)	
Unknown	2 (1.9%)	4 (0.5%)	
Country of Origin	No. (%)	No. (%)	
US	67 (62.6%)	446 (55.5%)	.32
Outside of US	37 (34.6%)	319 (39.7%)	
Unknown	3 (2.8%)	38 (4.7%)	
Marital status	No. (%)	No. (%)	
Married	86 (80.4%)	615 (76.6%)	.49
Significant other/life Partner	14 (13.1%)	134 (16.7%)	
Single	6 (5.6%)	51 (6.4%)	
Unknown	1 (0.9%)	3 (0.4%)	
Occupation	No. (%)	No. (%)	
Healthcare worker	9 (8.4%)	76 (9.5%)	.82
Not Employed	5 (4.7%)	54 (6.7%)	
Other	81 (75.7%)	593 (73.8%)	
Unknown	12 (11.2%)	80 (10.0%)	
Insurance	No. (%)	No. (%)	
Government (Medicare/Medicaid)	13 (12.1%)	140 (17.4%)	.11†
Other (self-pay, charity)	0	2 (0.2%)	
Private (commercial carriers, HMOs, PPOs)	94 (87.9%)	655 (81.6%)	
Uninsured	0	4 (0.5%)	
Unknown	0	2 (0.2%)	

* *P* value computed comparing percentage white between groups.

‡ *P* value computed comparing percentage with private insurance between groups.

Table 4

Medical History – pre-pregnancy by ALT Group – excluding patients with known chronic hepatitis C, preeclampsia, or cholestasis during their current pregnancy.

	ALT ≥25 (N=107)	ALT <25 (N=803)	
	No. mean ± sd	No. mean ± sd	*P* value
Prepregnancy BMI	75	606	.94
	24.5 ± 4.4	24.6 ± 4.8	
Intrahepatic cholestasis of pregnancy during past pregnancy	No. (%)	No. (%)	
Positive	1 (0.9%)	1 (0.1%)	n/a
Negative	0	2 (0.2%)	
N/A	43 (40.2%)	249 (31.0%)	
Unknown	63 (58.9%)	551 (68.6%)	
Preeclampsia during past pregnancy	No. (%)	No. (%)	
Positive	0	6 (0.7%)	n/a
Negative	0	2 (0.2%)	
N/A	43 (40.2%)	249 (31.0%)	
Unknown	64 (59.8%)	546 (68.0%)	
Gestational diabetes during past pregnancy	No. (%)	No. (%)	
Positive	0	11 (1.4%)	n/a
Negative	1 (0.9%)	13 (1.6%)	
N/A	42 (39.3%)	248 (30.9%)	
Unknown	64 (59.8%)	531 (66.1%)	
HIV	No. (%)	No. (%)	
Positive	0	2 (0.2%)	n/a
Negative	84 (78.5%)	611 (76.1%)	
Missing	23 (21.5%)	190 (23.7%)	
Transplant	No. (%)	No. (%)	
No	107 (100.0%)	803 (100.0%)	n/a
Other infection or immunosuppressed condition	No. (%)	No. (%)	
Yes	34 (31.8%)	211 (26.3%)	.23
No	73 (68.2%)	592 (73.7%)	

3.3. Liver-related diagnosis and abnormal LFTs in clinical practice during the current pregnancy

Of the 131 patients with ALT ≥25, 61 (46.6%) did not have LTs checked at any time during routine care of the index pregnancy. Among those with available LTs, 45/70 (64.3%) in the ALT ≥25 group had abnormal LTs (elevated AST or ALT) compared to 103/408 (25.2%) in the ALT <25 group ($P < .0001$).

Those with ALT ≥25 were significantly more likely than those with ALT <25 to be diagnosed with ICP (5/129 [3.9%] vs. 7/853 [0.8%]; $P = .01$) and preeclampsia (20/128 [15.6%] vs. 48/856 [5.6%]; $P < .0001$) (Table 1) There was no significant difference in rates of GDM in the current pregnancy, likelihood of having a positive HBV/ HCV test result, or reported alcohol use history. There were no patients with a reported diagnosis of other liver diseases such as nonalcoholic fatty liver disease (NAFLD). We evaluated the association of ALT values with baseline maternal BMI and pregnancy weight gain to determine if these factors (which are known to contribute to NAFLD) were associated, but did not identify a trend of degree of ALT evaluation and BMI or pregnancy weight gain.

When evaluating liver tests checked at the time of delivery, there were 13/105 (12.4%) with ALT ≥25 compared to 42/692 (6.1%) with ALT < 25 with preterm deliveries ($P = .02$), suggesting an association of high ALT with preterm delivery, although given small cohort size logistic regression adjusting for other predictors of preterm delivery (such as PE) was not performed.

4. Discussion

In this cross-sectional study, we identified a high rate of abnormal liver tests with over one in ten individuals who were admitted through our L&D unit, either for antepartum indications or for delivery-related admissions, having abnormal liver tests. Our unique study design evaluated consecutive patients many of whom had not had liver tests performed as part of routine clinical care. The highest prevalence of diagnosed liver-related diagnoses were conditions unique to pregnancy including PE and ICP, although almost half of the patients (47 %) with elevated liver tests did not have a clinical diagnosis of liver disease or have liver tests ever checked as part of routine pregnancy care, suggesting potential underdiagnosis of underlying liver injury. There were no significant demographic or clinical differences between patients with and without abnormal ALT, suggesting that abnormal LTs may be missed if not part of routine testing.

The prevalence of abnormal liver tests in pregnancy in our study (13.2% of patients with ALT≥25 IU/L) was higher than rates published in previous studies.[2,3,11] In an earlier prospective study of pregnant individuals in Southwest Wales, nearly 3% of all pregnancies were complicated by liver dysfunction,[2] with the most common contributory diagnoses among patients with abnormal liver tests being PE, "incomplete HELLP" syndrome, and obstetric cholestasis (OC). A more recent study conducted at a tertiary referral hospital in Mexico City reported the incidence of liver disease in pregnancy was 11.24%, based on hospitalizations related to liver disease in pregnant individuals recorded over three years.[3] Again, the most common associated conditions were PE, occurring in approximately 9.94% of all pregnancies, ICP and HELLP syndrome (0.37% and 0.32% of pregnancies respectively), which may be diagnosed more frequently due to associated adverse pregnancy outcomes such as in ICP.[11] In our study, ~20% of individuals with elevated ALT had PE or ICP and ~1% had evidence of previously diagnosed chronic liver disease. The higher prevalence of elevated ALT in pregnant individuals identified in our study may be attributed to a few factors, including differences in sample population demographics – the Wales study was conducted using "a very stable and ethnically uniform population" while the Mexico

City study reflected data from a primarily Latin American population, in contrast to our diverse inner-city patient population. Furthermore, in both studies, LTs were only assessed on clinical grounds in contrast to our study in which ALT levels were evaluated in all consecutive L&D admissions including those with and without recognized clinical problems. Finally, metrics for establishing liver disease in pregnancy differed among studies, with the Wales study identifying abnormal LTs based on bilirubin >25μmol/L, aspartate transaminase (AST) >40 U/L, or γglutamyl transpeptidase >35 U/L, and the Mexico City study using hospitalizations due to liver disease to determine the incidence of liver disease in pregnant individuals. The disparate findings highlight the need for further evaluation of rates of abnormal LFTs in pregnancy.

Although we found a higher than previously reported prevalence of abnormal ALT in pregnancy, we did not identify distinct differences between those with and without abnormal ALT. Although among individuals without a diagnosed liver disease, pregnancy weight gain was associated with higher odds of having ALT≥25, it did not achieve statistical significance. Furthermore, there was not a clear correlation between baseline BMI, and/or pregnancy weight gain with occurrence of elevated ALT. Although NAFLD is a growing problem among pregnant individuals in the United States, with rates nearly tripling in the last 10 years,[12] we were not able to establish it as the underlying cause of elevated liver tests in our cohort, although further prospective studies would be helpful, as there is a growing body of evidence that NAFLD is associated with adverse pregnancy outcomes, including hypertensive disorders of pregnancy, pre-term delivery, and hemorrhage.[12,13] However, challenges remain in determining the ideal method to diagnose NAFLD in the context of pregnancy, given that many tools utilized in non-pregnant individuals have not been validated in pregnancy.[14–16]

Our study has several unique strengths. First, data were obtained from screening consecutive L&D admissions. As a result, we were able to evaluate data from two important populations: patients admitted for delivery and those admitted for antepartum complications. We believe that this provided us with an accurate assessment of the rates of elevated ALT in all pregnancies, given that the population of individuals included individuals who may not have received optimal prenatal care, individuals who experienced loss of pregnancy, and patients with comorbid medical conditions, as well as those with uncomplicated pregnancies. In addition, in prospectively evaluating ALT levels in a large number of serum specimens, we were able to minimize sampling bias in our data and obtain sufficient information for analysis.

There were some notable limitations to our study as well. Specifically, our analysis was limited to ALT levels in serum specimens and therefore we did not obtain a comprehensive liver test assessment. Additionally, this study was performed at a single center in New York City and the results may not be generalizable to other patient populations in the United States or globally. However, we believe that the high-volume obstetrical service where this study was conducted, as well as the large number of subjects, allowed us to capture a diverse patient population and obtain information that reflects rates of elevated ALT in pregnant individuals among the general U.S. based population. Because this was not a longitudinal study, we were unable to determine outcomes among those with abnormal LTs during pregnancy (i.e. did ALT continue to be elevated postpartum and were they diagnosed with liver disease), nor did we have data on pre-pregnancy liver tests in the majority of patients and thus were not able to determine differences in ALT values before and during pregnancy.

5. Conclusions

In summary, we found a higher than expected prevalence of abnormal liver tests in a diverse U.S.-based population of pregnant individuals presenting for admission from our L&D unit. The majority of patients did not have a liver-associated diagnosis OR have liver tests checked during pregnancy. Future work should continue to evaluate whether integrating routine liver assessment as part of pregnancy care will improve the earlier identification of liver disease in pregnancy.

Author contributions

Guarantor of article: RS;
Concept and Design: RS, TK;
Acquisition of Data: CP, DM, ER, CR;
Statistical Analysis and Interpretation of Data: JO, HD;
Drafting and Revision of Manuscript: TK, CP, DM, ER, CC, RS, BW;
All authors approved the final version of the article.

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