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Retrospective Analysis: Infant Health Outcomes Born to Mother with Systemic Lupus Erythematosus

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ABSTRACT

Introduction: Systemic lupus erythematosus (SLE) is an autoimmune disease that affects young women and presents risks during pregnancy, potentially impacting infant health. This study analyzes infant health outcomes such as birth weight, APGAR score (AS), preterm birth, NICU admission, and mortality in infants born to mothers with SLE.

Material and Methods: A retrospective analysis was performed on data from infants born to mothers with SLE between 2023–2025. Data were analyzed using descriptive, bivariate, and multivariate tests with $p < 0.05$ considered significant. The study was conducted at General Hospital Dr. Saiful Anwar.

Results: Of the subjects, 78.57% had mild SLE, 14.28% had moderate SLE, and 7.15% had severe SLE. Significant associations were found between pregnancy status and SLE severity ($p = 0.000$), delivery method ($p = 0.005$), blood loss ($p = 0.035$), birth weight ($p = 0.022$), and APGAR score ($p = 0.005$). Cesarean sections were more common in mild to moderate SLE cases. NICU admission was significantly associated with SLE severity ($p = 0.002$), and fetal mortality was higher in severe SLE cases ($p = 0.001$). The R-square values for the variables showed that 61.9% of the variation in Apgar score, 73.3% in blood loss, and 73.6% in mortality were explained by factors such as blood loss, grade of SLE, gravida, MEX SLEDAI, maternal age, and mode of delivery.

Conclusion: SLE severity significantly influences maternal and neonatal outcomes, including delivery method, blood loss, birth weight, and APGAR score.

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INTRODUCTION

Systemic lupus erythematosus (SLE) is a prevalent autoimmune disease that can affect young women and involves a range of immune that can impact multiple organs [1]. While may pregnancies in women with lupus are successful, all patients with SLE should be considered "high risk" due to the potential impacts on the health of the infants born to these mothers [2].

Despite the growing body of research on maternal outcomes of SLE in pregnancy, there remains a significant gap in understanding the specific health challenges faced by infants born to mothers with this autoimmune condition [3]. While studies have reported associations between SLE and various neonatal complications, such as low birth weight and early admission to the neonatal intensive care unit (NICU) [4]. There is a lack of comprehensive data evaluating the full spectrum of health outcomes for these infants.

This study aims to conduct a retrospective analysis of health outcomes in infants born to mothers with SLE. It seeks to provide a deeper understanding of outcomes such as birth weight, APGAR score (AS), incidence of preterm birth, neonatal intensive care unit (NICU) admission rates, and mortality rates. This research is expected to offer significant insights for healthcare practitioners, researchers, and relevant stakeholders in efforts to improve prenatal and postnatal care and to support better decision-making in addressing this health issue.

MATERIAL AND METHODS

This study employs a retrospective analysis design to evaluate the health outcomes of infants born to mothers with systemic lupus erythematosus (SLE). The retrospective approach involves collecting primary data from documented medical records (birth weight, APGAR Score, incidence of preterm birth, NICU admission, and mortality) with a purposive sampling and analyzing the relationship between maternal condition and infant health outcomes.

To ensure clarity and reproducibility, the research design and procedures have been structured into distinct steps, covering data collection, sample collection, sample selection, and statistical analysis. The study population includes all infants born to mothers with SLE between 2023 – 2025. The inclusion criteria involve infants born to mothers with a clinically confirmed diagnosis of SLE, with severity assessed using the MEX-SLEDAI grading (mild 0-4; moderate 5-6; severe ≥7). The exclusion criteria include mothers with SLE who have additional diseases and infants with genetic disorders or other medical conditions that could significantly affect health outcomes.

Data will be analyzed using descriptive, bivariate, and multivariate analysis. Using normality test, chi-square test, Kruskal-Wallis test, Pearson and Spearman test, also running a path model for multivariate analysis will be conducted to evaluate the relationship between the variables. A p-value < 0.05 will be considered statistically significant. This study will be conducted in accordance with ethical approval no.400.194/K.3/102.7/2024 from the Health Research Ethics Commission, General Hospital Dr. Saiful Anwar.

RESULTS

Table 1 presents the demographic and clinical characteristics of the 28 pregnant women with systemic lupus erythematosus (SLE), categorized according to disease severity (mild, moderate, severe). Among the total subjects, 78.57% (n=22) were pregnant women with mild SLE, 14.28% (n=4) with moderate SLE, and 7.15% (n=2) with severe SLE. The mean maternal age was relatively similar across all groups: 29.41 ± 5.11 years in the mild group, 27.75 ± 4.99 years in the

Table 1. Frequency Distribution of Demographic Characteristics

Demographic Characteristics	Mild (n=22)		Moderate (n=4)		Severe (n=2)	
	n	%	n	%	n	%
Age (mean±SD)	29.41 ± 5.11		27.75 ± 4.99		29.37 ± 5.06	
Gravida						
1	8	36.36	1	25	0	0
2	7	31.82	1	25	2	100
3	5	22.73	2	50	0	0
4	2	9.09	0	0	0	0
Pregnancy Status						
Preterm	2	9.09	4	100	0	0
Aterm	20	90.91	0	0	0	0
Abortus	0	0	0	0	2	100
Delivery Method						
Caesarean Section (C-Section)	18	81.82	2	50	0	0
Spontaneous Vaginal Delivery	1	4.54	0	0	2	100
Breech Extraction	3	13.64	2	50	0	0
Blood Loss (cc) (mean ± SD)	153.18 ± 66.07		87.50 ± 25.00		20.00 ± 0.05	
Birth Weight (gr) (mean ± SD)	1423.41 ± 749.29		1425.00 ± 703.16		175 ± 25.0	
Birth Length (cm) (mean ± SD)	45.09 ± 6.28		39.00 ± 5.71		16.5 ± 4.50	
APGAR Score						
<5	2	9.09	2	50	0	0
5-6	3	13.64	1	25	0	0
>6	17	77.27	1	25	0	0
Can't be observed	0	0	0	0	2	100
Neonatal Care						
Neonatal Care Unit	20	90.91	2	50	0	0
NICU	2	9.09	2	50	0	0
Can't be observed	0	0	0	0	2	100
Mortality						
Alive	22	100	4	100	0	0
Decrease	0	0	0	0	2	100

n = number of participants; % = percentage of participants in each category; term = full-term pregnancies; preterm = pregnancies delivering before 37 weeks; abortus = miscarriages; gravida = number of pregnancies a woman has had. can't be observed because it occurs in cases of abortion.

Table 2. Bivariate Test Based on SLE Severity in Pregnancy Women

Demographic Characteristics	Comparison test	Correlation test
Pregnancy Status Preterm Aterm Abortus	0.000*	0.000*
Delivery Method Caesarean Section (C-Section) Spontaneous Vaginal Delivery Breech Extraction	0.005*	0.123*
Blood Loss (cc) (mean ± SD)	0.035**	0.010**
Birth Weight (gr) (mean ± SD)	0.022**	0.000**
Birth Length (cm) (mean ± SD)	0.018**	0.001**
APGAR Score <5 5-6 >6 Can't be observed	0.005*	0.014*
Neonatal Care Neonatal Care Unit NICU Can't be observed	0.002*	0.624*
Mortality Alive Decrease	0.001*	0.154*

Comparison test using *) Chi-Square Test and **) Kruskal-Wallis Test.
Correlation test using *) Spearman Test and **) Pearson Test.
term = full-term pregnancies; preterm = pregnancies delivering before 37 weeks; abortus = miscarriages; gravida = number of pregnancies a woman has had. can't be observed because it occurs in cases of abortion.

moderate group, and 29.37 ± 5.06 years in the severe group. Most women in the mild SLE group were multigravida, with 31.82% having two pregnancies and 22.73% having three. All subjects with severe SLE were primigravida (100%).

In terms of pregnancy status, all subjects with moderate SLE experienced preterm delivery, whereas 90.91% of mild cases and none of the severe cases delivered at term. Notably, both severe cases ended in abortion (100%). Regarding delivery methods, the majority of subjects in the mild group underwent cesarean section (81.82%), while breech extraction was recorded in 13.64% and spontaneous vaginal delivery in 4.54%. In contrast, 50% of subjects with moderate SLE underwent cesarean section, and 50% breech extraction. None of the severe SLE cases progressed to delivery due to abortion.

The average estimated blood loss was highest in the mild SLE group (153.18 ± 66.07 cc), followed by the moderate group (87.50 ± 25.00 cc), and lowest in the severe group (20.00 ± 0.05 cc). Similarly, the mean birth weight in the mild and moderate groups was comparable (1423.41 ± 749.29 g and 1425.00 ± 703.16 g, respectively), whereas the severe group showed significantly lower mean birth weight (175.00 ± 25.00 g). Birth length followed the same trend, with the mild group averaging 45.09 ± 6.28 cm, moderate 39.00 ± 5.71 cm, and severe only 16.50 ± 4.50 cm.

In the assessment of neonatal condition using APGAR scores, 77.27% of neonates in the mild group scored >6, 13.64% scored between 5–6, and 9.09% scored <5. In contrast, 50% of neonates in the moderate group had scores of 5–6, and 50% <5. APGAR scores could not be assessed in the severe group due to abortion-related outcomes. With regard to neonatal care, 90.91% of neonates in the mild SLE group required admission to a standard neonatal care unit, while 9.09% were admitted to NICU. In the moderate group, half required standard care and half required NICU admission. Neonatal care data could not be observed in the severe SLE group. All infants born to mothers in the mild and moderate groups survived. However, the two cases in the severe group resulted in fetal death (100%).

Table 2 presents the results of the bivariate analysis assessing the association between maternal and neonatal characteristics with the severity of Systemic Lupus Erythematosus (SLE) in pregnant women. Both comparison and correlation tests were performed to evaluate these relationships. Pregnancy status showed a statistically significant association with SLE severity ($p = 0.000$) in both the comparison and correlation analyses. A higher incidence of preterm deliveries and abortions was observed in women with more severe forms of SLE.

Regarding delivery method, the comparison test indicated a significant association ($p = 0.005$), although the correlation was weaker ($p = 0.123$). Cesarean section

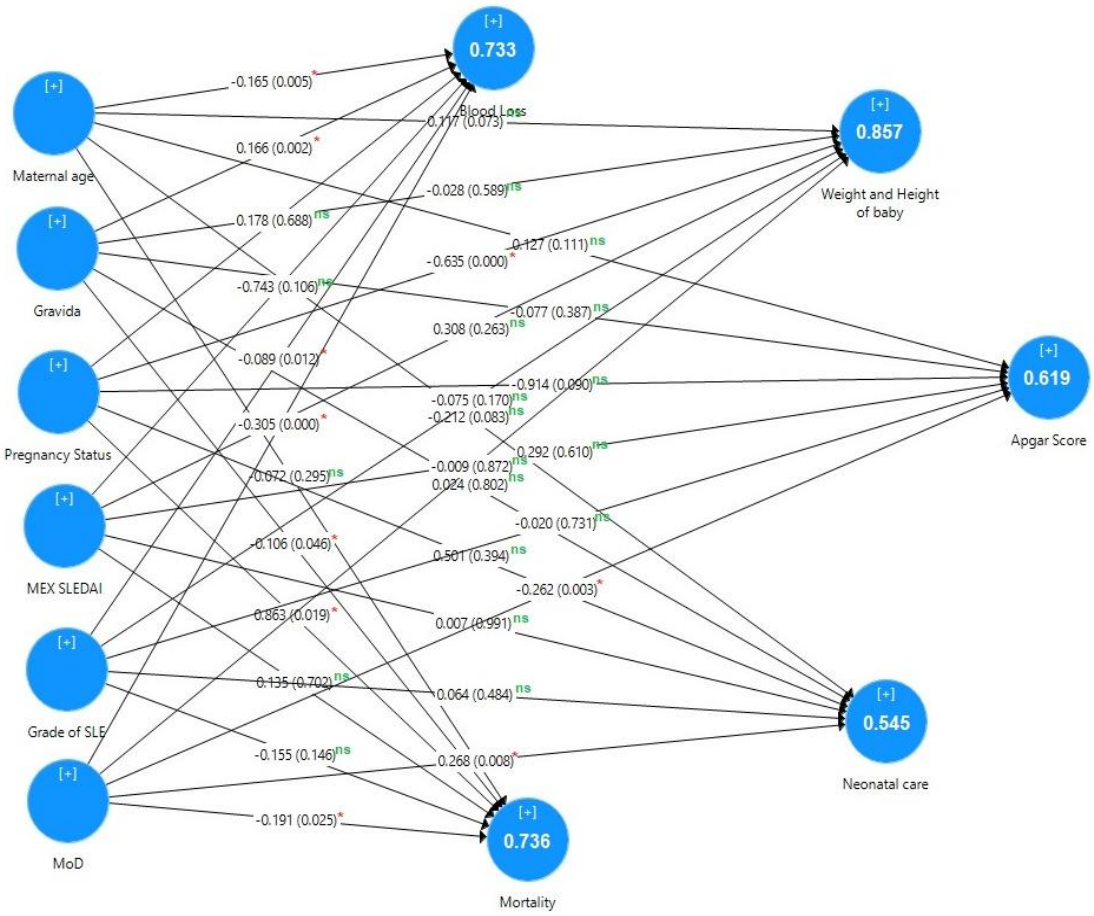


Fig. 1. Structural Equation Diagram

Model from the results of running PLS using the Partial Least Square Approach with SmartPLS Software (Model t-Statistic). *) significant effect; ns = no significant effect. Blue color indicates construct variable. Number outside the parentheses is loading factor coefficient. Number inside the parentheses is p-value. Number inside the blue circle is R-square.

was more commonly performed in patients with mild to moderate SLE, while spontaneous or breech deliveries were infrequent. For quantitative variables, significant differences across SLE severity groups were found for blood loss ($p = 0.035$), birth weight ($p = 0.022$), and birth length ($p = 0.018$) based on the Kruskal-Wallis test. These variables also demonstrated strong and statistically significant correlations with SLE severity (blood loss: $r = 0.010$; birth weight: $r = 0.000$; birth length: $r = 0.001$). These results indicate that increasing SLE severity is associated with reduced birth weight and length, as well as decreased maternal blood loss, possibly due to earlier gestational termination or abortion.

APGAR score was significantly associated with SLE severity in both comparison ($p = 0.005$) and correlation analyses ($p = 0.014$). Lower APGAR scores were more common in neonates born to mothers with moderate SLE. For neonatal care, the need for NICU admission or general neonatal care unit placement differed significantly across groups ($p = 0.002$); however, the correlation with SLE severity was not statistically significant ($p = 0.624$), suggesting variability in clinical decisions or individual neonatal conditions.

Finally, fetal mortality was significantly associated with SLE severity ($p = 0.001$), with all cases of mortality occurring in the severe SLE group. However, the correlation test showed no significant relationship ($p = 0.154$), possibly due to the small sample size in the severe category.

The R-square values for the variables indicate the proportion of variation explained by the model. The Apgar score is explained by 61.9% of the factors, including blood loss, grade of SLE, gravida, MEX SLEDAI, maternal age, and mode of delivery (MoD), with the remaining 38.1% influenced by other factors. Blood loss is explained by 73.3% of these factors, with 26.7% attributed to other influences. Mortality is

explained by 73.6% of the same factors, with 26.4% due to other variables. Neonatal care is explained by 54.5%, with 45.5% influenced by other factors, while the weight and height of the baby are explained by 85.7%, leaving 14.3% to other factors. The overall Q-square value for the model is 0.9983, indicating excellent predictive relevance and strong suitability for making predictions (Fig.1).

The direct effects of maternal factors on infant outcomes were assessed using the inner model of the path analysis. The grade of SLE showed no significant direct effect on Apgar score (path coefficient = -0.020, p = 0.731), blood loss (path coefficient = -0.089, p = 0.012), mortality (path coefficient = -0.155, p = 0.146), neonatal care (path coefficient = 0.064, p = 0.484), or weight and height of the baby (path coefficient = -0.075, p = 0.170). In contrast, gravida significantly impacted blood loss (path coefficient = 0.166, p = 0.002) and mortality (path coefficient = -0.106, p = 0.046), with higher gravida associated with more blood loss and a greater chance of survival for the infant. However, gravida did not significantly influence Apgar score (path coefficient = -0.077, p = 0.387), neonatal care (path coefficient = 0.024, p = 0.802), or weight and height (path coefficient = -0.028, p = 0.589).

MEX SLEDAI did not significantly affect Apgar score (path coefficient = 0.292, p = 0.610), blood loss (path coefficient = -0.743, p = 0.106), mortality (path coefficient = 0.135, p = 0.702), neonatal care (path coefficient = 0.007, p = 0.991), or weight and height of the baby (path coefficient = 0.308, p = 0.263). Maternal age had a significant effect on blood loss (path coefficient = -0.165, p = 0.005), with older maternal age associated with less blood loss. However, maternal age did not significantly influence Apgar score (path coefficient = 0.127, p = 0.111), mortality (path coefficient = -0.072, p = 0.295), neonatal care (path coefficient = -0.212, p = 0.083), or weight and height (path coefficient = 0.117, p = 0.073).

The mode of delivery (MoD) showed significant direct effects on Apgar score (path coefficient = -0.262, p = 0.003), blood loss (path coefficient = -0.305, p = 0.000), mortality (path coefficient = -0.191, p = 0.025), and neonatal care (path coefficient = 0.268, p = 0.008). C-section deliveries were associated with higher Apgar scores, less blood loss, better chances of survival, and more frequent neonatal care compared to other modes of delivery. However, MoD had no significant effect on weight and height of the baby (path coefficient = -0.009, p = 0.872). Pregnancy status significantly affected mortality (path coefficient = 0.863, p = 0.019) and weight and height (path coefficient = 0.635, p = 0.000), with infants born to mothers with aterm or preterm pregnancies showing better outcomes. However, pregnancy status did not significantly affect Apgar score (path coefficient = -0.914, p = 0.090), blood loss (path coefficient = 0.178, p = 0.688), or neonatal care (path coefficient = 0.501, p = 0.394).

DISCUSSION

Systemic Lupus Erythematosus (SLE) is a chronic autoimmune disease that can affect various organs, including the skin, kidneys, and heart, and can also influence pregnancy outcomes. Mothers with SLE are at an increased risk for complications during pregnancy, which can in turn affect the health of their newborns [5]. This retrospective analysis aims to explore the infant health outcomes born to mothers with SLE, focusing on infant health outcomes, including birth weight, APGAR score (AS), preterm birth, NICU admission, and mortality rates, and to provide insights into how maternal health in SLE pregnancies can impact neonatal health.

Based on the research findings, mothers with SLE (Systemic Lupus Erythematosus) experience a range of outcomes concerning both maternal and fetal health [6, 7]. In terms of maternal health, instances of premature birth, abortion, and bleeding are observed in every delivery involving a mother with SLE [8]. This aligns with several studies conducted in China, India, and the United States, which have investigated outcomes significantly correlated with SLE [9,10].

This retrospective analysis aims to explore the influence of SLE severity on maternal and neonatal health outcomes, based on data of pregnant women with varying degrees of SLE severity. The results of this study provide significant insights into the associations between SLE severity, pregnancy outcomes, and neonatal health. The study revealed that the majority of women with SLE in this study (78.57%) had mild disease, while a smaller proportion had moderate (14.28%) and severe (7.15%) SLE. The mean maternal age was similar across the severity groups, with minor differences in age between the mild and moderate groups (29.41±5.11 vs. 27.75±4.99 years, respectively), while the severe group had a mean age of 29.37 ± 5.06 years. These findings suggest that SLE severity does not significantly impact maternal age, which is a known factor influencing pregnancy outcomes.

One of the most notable findings of this study is the association between SLE severity and the delivery method. Cesarean section (C-section) was more common among women with mild to moderate SLE (p = 0.005), indicating that the severity of SLE can influence the decision to perform a C-section. This is consistent with previous studies, which have found that women with autoimmune diseases, including SLE, are more likely to have C-sections due to concerns about fetal well-being, maternal health, and the potential for complications during vaginal delivery [11]. These results

highlight the need for careful planning and consideration of delivery methods in pregnancies complicated by SLE, particularly in the context of maternal and fetal health risks [12].

Significant differences were observed in blood loss ($p = 0.035$), birth weight ($p = 0.022$), and birth length ($p = 0.018$) across the different SLE severity groups. Women with more severe forms of SLE experienced greater blood loss during delivery, which could be attributed to factors such as impaired coagulation and vascular involvement, both of which are common in SLE [11, 13]. Excessive blood loss during delivery poses risks for maternal health, including postpartum hemorrhage, which can further complicate neonatal outcomes [4]. Regarding birth weight, infants born to mothers with severe SLE had lower birth weights compared to those born to mothers with mild or moderate SLE. This is an important finding, as low birth weight is associated with an increased risk of neonatal morbidity, including respiratory and developmental complications. The observed difference in birth length ($p = 0.018$) may also reflect intrauterine growth restriction, which is often seen in pregnancies complicated by maternal autoimmune diseases. In mothers with SLE, several factors can explain why their infants tend to have lower birth weights [14]. One key factor is the adverse impact of active SLE disease. High disease activity can trigger systemic inflammation and disrupt immunological balance, ultimately affecting fetal growth [15,16]. Additionally, disorders in placental blood supply and nutrient delivery to the fetus may be influenced by the autoimmune condition and inflammation in mothers with SLE, potentially leading to impaired fetal growth and low birth weight at delivery [14,17].

The study found that the severity of SLE is significantly associated with APGAR scores ($p = 0.005$), suggesting that infants born to mothers with severe SLE may have poorer immediate health outcomes as indicated by lower APGAR scores. This is consistent with the known risks associated with maternal autoimmune diseases, which can impact fetal oxygenation and development [18]. These findings emphasize the importance of postnatal monitoring for infants born to mothers with severe SLE, as they may require additional care to address potential complications. Similar research has explained that Apgar scores are closely related to neurological development [19,20]. However, infants born to mothers with SLE generally do not exhibit significant neurological developmental disorders. Nevertheless, long-term neurological conditions may arise in these children, such as learning disabilities, speech delays, and attention deficit/hyperactivity disorder [21].

In terms of pregnancy status, all subjects with moderate SLE experienced preterm delivery, whereas 90.91% of mild cases and none of the severe cases delivered at term. Notably, both severe cases ended in abortion (100%). Regarding delivery methods, the majority of subjects in the mild group underwent cesarean section (81.82%), while breech extraction was recorded in 13.64% and spontaneous vaginal delivery in 4.54%. In contrast, 50% of subjects with moderate SLE underwent cesarean section and 50% breech extraction. None of the severe SLE cases progressed to delivery due to abortion. Several key factors may contribute to the higher incidence of preterm birth in SLE patients. First, increased levels of placental corticotropin-releasing hormone (CRH) occur when the maternal or fetal hypothalamic-pituitary axis is activated. This activation triggers labor by enhancing the synthesis of prostaglandins and cortisol. Second, local and systemic inflammation due to infections can induce labor through cytokines, prostaglandins, increased anti-dsDNA antibodies, and hypocomplementemia. Third, estrogen levels, which correlate with gestational age at birth and have been used for decades as an indicator of placental health, are often lower in pregnant women with SLE compared to the general population. Thus, low estradiol levels may indicate a higher likelihood of preterm birth in women with mild to moderate disease activity. Fourth, the use of oral prednisone may be associated with preterm birth, regardless of the inflammation being treated [22]. Overall, preterm birth is caused by factors such as clinical or subclinical inflammation, autoimmune antibodies, hormonal imbalances, immunological abnormalities related to lupus, and the use of medications to manage disease activity [23]. Preterm birth is more likely to occur when there is disease activity during conception due to increased clinical inflammation, autoimmune antibodies, lupus-related immunological changes, and medication use [10, 24].

The need for neonatal intensive care unit (NICU) admission was significantly higher among infants born to mothers with severe SLE ($p = 0.002$). This is not surprising, as the infants of women with severe SLE are at greater risk for complications such as prematurity, respiratory distress, and infection, which may necessitate NICU care. Additionally, fetal mortality was significantly associated with SLE severity ($p = 0.001$), with higher mortality rates observed among infants born to mothers with severe SLE. Although the correlation between SLE severity and fetal mortality was not significant, the trend highlights the potential risks associated with severe maternal disease and the need for careful prenatal care [25,26]. If mortality occurs in infants born to mothers with SLE, it reflects the complex interplay between this autoimmune disease and pregnancy outcomes. High disease activity during pregnancy is a key factor contributing to poor outcomes. Additionally, complications such as preeclampsia, fetal growth restriction, and preterm birth—frequently

associated with SLE—can increase the risk of mortality in infants [27].

This retrospective analysis explores the impact of Systemic Lupus Erythematosus (SLE) on both maternal and neonatal health outcomes. The study highlights significant associations between SLE severity and various pregnancy complications. The findings demonstrate that women with severe SLE are more likely to experience increased blood loss during delivery, lower birth weight, and poorer neonatal health outcomes, such as lower APGAR scores and a higher likelihood of NICU admissions. Preterm birth was notably more frequent in women with moderate SLE, while severe cases were associated with abortion. Furthermore, the study underlines the importance of monitoring neonates born to mothers with severe SLE for potential complications, including respiratory distress and infections, which may require specialized neonatal care.

The study also indicates that SLE severity plays a critical role in delivery decisions, with a higher incidence of cesarean sections in mild and moderate cases. The results emphasize the need for careful prenatal management, particularly for women with active disease, to mitigate risks such as preterm birth, fetal growth restriction, and neonatal complications. These findings contribute valuable insights into the complex relationship between maternal autoimmune disease activity and pregnancy outcomes, stressing the need for individualized care in managing pregnancies complicated by SLE. While this study provides insights into immediate neonatal health outcomes, it does not assess long-term outcomes such as developmental milestones, cognitive impairments, or future health issues in children born to mothers with SLE. Long-term follow-up would provide a more comprehensive understanding of the implications of SLE on both maternal and neonatal health.

CONCLUSION

In summary, our findings indicate that the maternal and fetal outcomes in pregnant women with Systemic Lupus Erythematosus (SLE) are consistent with previously published reports in other populations. These outcomes reveal several adverse effects, including low birth weight, a higher incidence of preterm births, and an increased need for cesarean deliveries. These results highlight the challenges associated with managing pregnancies affected by SLE and underscore the importance of understanding the specific risks involved.

This research reflects clinical practices and provides insight into the practical implications of SLE on pregnancy outcomes. It emphasizes the necessity of a multidisciplinary approach in managing such pregnancies, which is essential for optimizing maternal and fetal health. The findings support the development of targeted strategies to address the complex issues faced by women with SLE during pregnancy, aiming to improve overall pregnancy outcomes.

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CONFLICT OF INTEREST

There is no conflict of interest for this research.

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