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Burden of sickle cell disease in pregnancy: A tertiary hospital experience

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Abstract

Background: Pregnancy in women with sickle cell disease (SCD) is associated with increased maternal and perinatal morbidity due to chronic hemolysis, vaso-occlusive events, and pregnancy-related physiological stress. Despite advances in multidisciplinary care, adverse outcomes remain common, particularly in low- and middle-income settings.

Objective: To assess maternal and neonatal outcomes among women with sickle cell disease managed in Enugu State University Teaching Hospital and compare them with outcomes in women with normal hemoglobin genotype (HbAA).

Methods: This retrospective descriptive and analytical study was conducted at Enugu State University Teaching Hospital. Medical records of 324 pregnancies were reviewed, comprising 66 HbSC, 98 HbSS, and 160 HbAA women. Sociodemographic, clinical, maternal, and neonatal outcome data were extracted and analyzed using SPSS. Comparative analyses were performed and statistical significance was set at $p < 0.05$.

Results: Women with SCD delivered at significantly lower gestational ages than HbAA controls, with preterm delivery occurring more frequently in HbSS (27.1%) and HbSC (35.5%) compared with HbAA (12.7%). Extreme preterm birth (<32 weeks) occurred only in SCD groups. Mean birth weight was significantly lower in HbSS (2.27 ± 0.45 kg) and HbSC (2.86 ± 0.76 kg) compared with HbAA (3.33 ± 0.91 kg) ($p < 0.001$). Low birth weight was more prevalent among HbSC (43.5%) and HbSS (21.4%) than HbAA (5.1%). Stillbirth rate was highest in HbSS (22.5%) compared with HbSC (6.1%) and HbAA (1.9%) ($p < 0.05$). Caesarean section rates were significantly higher among SCD women. Pre-eclampsia was significantly increased in HbSS and HbSC groups, while gestational hypertension was more common in HbSC. Mean hemoglobin levels were significantly lower in SCD women both pre-labor and postpartum, with greater postpartum decline observed in these groups. No maternal deaths were recorded.

Conclusion: Pregnancy in women with sickle cell disease, particularly HbSS genotype, is associated with significantly increased risks of preterm delivery, low birth weight, hypertensive disorders, operative delivery, and perinatal mortality compared with HbAA controls. Although maternal survival was favorable in this tertiary center, substantial maternal and neonatal morbidity persists. Enhanced multidisciplinary management, early antenatal booking, and close surveillance are essential to improving pregnancy outcomes in women with SCD.

Keywords: Sickle cell disease; Pregnancy outcomes; HbSS; HbSC; Preterm delivery

1. Introduction

Sickle cell disease (SCD) is a hereditary haemoglobinopathy characterized by chronic haemolytic anaemia, recurrent vaso-occlusive crises and progressive multi-organ damage [1]. Improved survival of affected individuals has resulted in an increasing number of women with SCD reaching reproductive age, thereby increasing the frequency of pregnancies complicated by the disease [2]. Pregnancy in women with SCD is considered high risk due to the physiological stresses

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of gestation, which may exacerbate sickling and worsen maternal and fetal outcomes [3]. Tertiary health institutions are central to the management of these pregnancies because of the need for multidisciplinary care involving obstetricians, haematologists, anaesthetists and neonatologists [4].

Anaemia is the most frequently reported complication among pregnant women with SCD. Studies conducted in tertiary hospitals consistently report high rates of moderate to severe anaemia requiring blood transfusion [5–7]. In a 10-year review at a tertiary hospital in Ibadan, Nigeria, over 75% of pregnant women with SCD developed anaemia during pregnancy, while more than half experienced vaso-occlusive pain crises requiring hospital admission [5]. Similar findings have been reported in other Nigerian tertiary centres, highlighting the persistent haematological burden of SCD despite specialist care [6, 8].

Vaso-occlusive crises are precipitated by dehydration, infection and hypoxia, all of which may be exacerbated during pregnancy [9]. Frequent pain episodes contribute significantly to maternal morbidity, prolonged hospital stay and increased healthcare costs [10].

Pregnant women with SCD have an increased risk of hypertensive disorders, particularly pre-eclampsia [11]. A large systematic review and meta-analysis demonstrated significantly higher odds of pregnancy induced hypertension and pre-eclampsia among women with SCD compared with women without the disease [12]. Acute chest syndrome, infections such as urinary tract infection and sepsis, and thromboembolic events are also more prevalent in SCD pregnancies managed in tertiary institutions [13–15].

Higher caesarean section rates have been reported among women with SCD, often due to fetal distress, pre-eclampsia and poor progress of labour [6, 16]. While maternal mortality has declined in well-resourced tertiary centres, it remains higher than in the general obstetric population, particularly in low- and middle-income countries [17].

Adverse fetal outcomes are common in pregnancies complicated by SCD. Preterm delivery and low birth weight have been consistently reported across tertiary health institutions [5, 18, 19]. Chronic maternal anaemia and placental insufficiency contribute to impaired fetal growth and premature delivery [20].

Intrauterine growth restriction (IUGR) is frequently observed in SCD pregnancies and is associated with increased perinatal morbidity [21]. Fetal distress during labour is also common and contributes to increased operative deliveries and neonatal intensive care unit (NICU) admissions [16, 22].

Despite advances in care, perinatal mortality remains significantly higher among SCD pregnancies than in non-SCD pregnancies [12, 23]. Tertiary centre studies report increased rates of stillbirth, early neonatal death and NICU admission due to complications such as respiratory distress, sepsis and birth asphyxia [5, 24].

Early booking and regular antenatal care are strongly associated with improved maternal and fetal outcomes [6,25]. Multidisciplinary management involving obstetricians, haematologists and neonatologists has been shown to reduce the frequency of complications and improve survival rates [4, 26].

Maternal education has been identified as an important determinant of pregnancy outcome in women with SCD. Higher educational status is associated with better health-seeking behaviour, early antenatal booking and improved adherence to medical advice [5, 27].

Large cohort studies and meta-analyses from both high- and low-income countries confirm that SCD pregnancies are associated with increased risks of maternal morbidity, operative delivery, preterm birth, low birth weight and perinatal mortality [12, 18, and 28]. These findings are consistent across tertiary health institutions worldwide, emphasizing the need for standardized care protocols [29, 30].

In conclusion, Pregnancy among women with sickle cell disease remains a significant public health and clinical challenge, even within tertiary health institutions equipped with specialist services. The available literature demonstrates persistently high rates of maternal complications such as anaemia, vaso-occlusive crises, hypertensive disorders, and increased operative deliveries, alongside adverse fetal outcomes including preterm birth, low birth weight, intrauterine growth restriction, and elevated perinatal mortality. While improvements in multidisciplinary care have contributed to better survival, wide variations in outcomes persist across settings, reflecting differences in resource availability, clinical protocols, antenatal care utilization, and patient-related factors.

Despite the growing body of evidence, there remains a paucity of context-specific data from many tertiary health institutions, particularly in low and middle income countries where the burden of sickle cell disease is highest. Existing studies are largely retrospective, heterogeneous in outcome reporting, and limited in their ability to identify modifiable predictors of adverse outcomes. This underscores the need for institution-specific research to generate locally relevant evidence that can inform clinical practice, guide policy formulation, and support the development of standardized care protocols tailored to the realities of tertiary healthcare settings.

Therefore, this research on pregnancy outcomes among women with sickle cell disease in a tertiary health institution is essential to accurately quantify maternal and fetal outcomes, identify key determinants of morbidity and mortality, and evaluate the effectiveness of current management strategies. The findings are expected to contribute to improved risk stratification, enhanced antenatal and intrapartum care, and ultimately better maternal and neonatal outcomes for women living with sickle cell disease

2. Methodology

2.1. Study Design

This study was a retrospective descriptive and analytical study conducted to assess pregnancy outcomes among women with sickle cell disease managed in Enugu State University Teaching Hospital.

2.2. Study Setting

The study was carried out at the Enugu State University Teaching Hospital, a referral centre that provides specialized obstetric, haematological, and neonatal care. The institution manages high-risk pregnancies, including those complicated by sickle cell disease, and serves as a referral centre for surrounding primary and secondary health facilities.

2.3. Study Population

The study population consisted of all pregnant women with sickle cell disease who received antenatal, intrapartum, and delivery care at the Enugu State University Teaching Hospital.

2.4. Study Period

The study covered a ten-year period, from to January 2015 to January, 2025.

2.5. Inclusion Criteria

- Pregnant women with a confirmed diagnosis of sickle cell disease (HbSS, HbSC, or other variants)
- Women who booked for antenatal care and delivered at Enugu State University Teaching Hospital
- Availability of complete medical records containing antenatal, delivery, and neonatal outcome data

2.6. Exclusion Criteria

- Pregnant women with sickle cell trait (HbAS)
- Women with incomplete or missing medical records
- Women with coexisting chronic medical conditions unrelated to sickle cell disease that could independently affect pregnancy outcome (e.g., chronic renal failure, cardiac disease)

2.7. Sample Size and Sampling Technique

All eligible cases that met the inclusion criteria within the study period were included in the study using a total population (census) sampling technique.

2.8. Data Collection

Data were collected using a structured data extraction proforma designed specifically for the study. Information was obtained from patients' antenatal clinic records, labour ward registers, delivery records, and neonatal unit records.

The variables collected included:

- **Sociodemographic characteristics**: age, marital status, educational level, parity

- **Clinical characteristics**: sickle cell genotype, gestational age at booking, antenatal complications, frequency of vaso-occlusive crises, blood transfusion history
- **Maternal outcomes**: anaemia, hypertensive disorders, infections, mode of delivery, length of hospital stay, maternal mortality
- **Fetal and neonatal outcomes**: gestational age at delivery, birth weight, Apgar scores, preterm delivery, intrauterine fetal death, neonatal intensive care unit admission, neonatal mortality

2.9. Outcome Measures

The primary outcome measures were:

- Maternal morbidity and mortality, fetal and neonatal outcomes including preterm delivery, low birth weight, stillbirth, and neonatal death
- Secondary outcome measures included:
- Mode of delivery, frequency of antenatal and intrapartum complications

2.10. Data Analysis

Data were entered and analysed using Statistical Package for Social Sciences (SPSS) version (23).

Descriptive statistics were used to summarize variables, with results presented as means and standard deviations for continuous variables, and frequencies and percentages for categorical variables.

Inferential statistical analysis was performed to determine associations between maternal characteristics and pregnancy outcomes using:

- Chi-square test or Fisher's exact test for categorical variables
- Student's t-test or Mann–Whitney U test for continuous variables
- A p-value of < 0.05 was considered statistically significant.

3. Results

Table 1 Characteristics of pregnant woman with sickle cell disease (HbSC and HbSS) and control (HbAA)

Age (years)			
18-24	26 (26.53)	14 (21.21)	47 (29.38)
25-34	50 (51.02)	35 (53.03)	72 (45)
≥35	22 (22.45)	17 (25.76)	41 (25.63)
Parity			
Nulliparous	45 (45.92)	26 (39.39)	48 (30)
Primiparous	34 (34.69)	26 (39.39)	51 (31.88)
Multiparous	19 (19.39)	15 (22.72)	61 (38.13)
Gestational age			
<27	2 (2.04)	0 (0)	0 (0)
28-30	4 (4.08)	2 (3.03)	1 (0.63)
31-32	6 (6.12)	3 (4.55)	4 (2.5)
33-34	9 (9.18)	6 (9.09)	11 (6.88)
35-37	11 (11.22)	13 (19.70)	22 (13.75)
38-39	50 (51.02)	35 (53.03)	90 (56.25)

40-42	16 (16.33)	7 (10.61)	32 (20)
Mean HB (g/dl)			
Before labor	8.12 ± 0.91	8.99 ± 1.35	10.69 ± 2.34
48 hour post delivery	6.73 ± 1.43	8.02 ± 1.75	8.86 ± 2.57

A total of 324 pregnancies were analyzed, comprising 66 HbSC, 98 HbSS, and 160 HbAA pregnancies. The majority of pregnant women across all groups were aged 25–34 years, accounting for 51.0% of HbSC, 53.0% of HbSS, and 45.0% of HbAA participants. Women older than 35 years represented about one-quarter of each group. Nulliparity and primiparity were more common among women with sickle cell disease, whereas multiparity was highest among HbAA controls (38.1%).

Most pregnancies reached term (38–39 weeks), particularly among HbAA women (56.3%), while earlier gestational ages were more frequent in the sickle cell groups, especially HbSC. Preterm delivery before 32 weeks occurred only among women with sickle cell disease.

Mean hemoglobin levels were lowest among HbSC women both before labor (8.12 ± 0.91 g/dl) and 48 hours postpartum (6.73 ± 1.43 g/dl), followed by HbSS, while HbAA controls had the highest hemoglobin levels at both time points. A marked decline in hemoglobin concentration after delivery was observed in all groups, with the greatest reduction seen among women with sickle cell disease.

Table 2 Comparison of pregnancy outcome in sickle cell disease and control (HbAA)

Variables	**HBSC**	**HbSS**	**HbAA**	**SS versus SC**	**SS versus AA**	**SC versus AA**
				***X*² (p value)**	***X*² (p value)**	***X*² (p value)**
Total pregnancies (n)	66	98	160			
Pregnancy outcome, n (%)						
Miscarriage	0(0)	6(6.12)	0(0)			
Stillbirth	4(6.06)	22(22.45)	3(1.88)	6.79(0.009)	27.09(0.001)*	1.51(0.219)
Live birth	62(93.94)	70(71.43)	157(98.13)	11.33(0.008)*	1.51(0.219)	38.49(0.001)*
Early neonatal death	3	4	6			
Mode of delivery (live birth)						
Vaginal	45(72.58)	52(74.29)	147(93.63)	3.13(0.076)	49.79(0.001)*	18.71(0.001)*
Caesarean section	17(27.42)	18(25.71)	10(6.37)			
Outcome of live birth (n)	62	70	157			
Birth weight						
Mean + SD	2.86+0.76	2.27+0.45	3.33+0/91	<0.001*	<0.002*	<0.001*
Weight <2.5 kg, n (%)	27(43.54)	15(21.42)	8(5.09)	6.43(0.011)*	12.45(0.001)*	46.12(0.001)*
Apgar score <7 at 5 minutes	1016.12)	6(8.57)	15(9.55)	1.12(0.289)	0.01(0.99)	1.31(0.254)
Preterm (<37 weeks)	22(35.48)	19(27.14)	20(12.73)	0.07(0.791)	6.08(0.013)*	9.31(0.002)*
Mean + SD	36.77+1.51	36.67+1.34	39.11+2.09	<0.03*	<0.001*	<0.008*

Pregnancy outcomes differed significantly across the groups. Miscarriage occurred only among women with HbSS (6.1%). The stillbirth rate was highest in the HbSS group (22.5%), compared with HbSC (6.1%) and HbAA (1.9%). This difference was statistically significant for HbSS versus HbSC ($\chi^2 = 6.79$, p = 0.009) and HbSS versus HbAA ($\chi^2 = 27.09$, p = 0.001), but not for HbSC versus HbAA (p = 0.219). Consequently, the live birth rate was significantly lower in HbSS (71.4%) compared with HbSC (93.9%) and HbAA (98.1%).

Among women who had live births, vaginal delivery was the predominant mode of delivery in all groups; however, it occurred significantly less frequently in HbSS and HbSC compared with HbAA ($\chi^2 = 49.79$ and 18.71 respectively, p = 0.001). Caesarean section rates were correspondingly higher in the sickle cell disease groups.

Neonatal outcomes showed marked differences. The mean birth weight was significantly lower in HbSS (2.27 ± 0.45 kg) and HbSC (2.86 ± 0.76 kg) compared with HbAA (3.33 ± 0.91 kg) (p < 0.001 for all comparisons). The proportion of infants with low birth weight (<2.5 kg) was highest among HbSC (43.5%) and HbSS (21.4%), and significantly greater than in the HbAA group (5.1%).

There was no statistically significant difference in the proportion of neonates with Apgar score <7 at 5 minutes among the three groups (p > 0.05). However, preterm delivery (<37 weeks) was significantly more common in HbSS (27.1%) and HbSC (35.5%) compared with HbAA (12.7%). Mean gestational age at delivery was also significantly lower in HbSS (36.67 ± 1.34 weeks) and HbSC (36.77 ± 1.51 weeks) than in HbAA (39.11 ± 2.09 weeks**).**

Table 3 Comparison of pregnancy-associated complications in sickle cell disease and control

Variables	**HBSC**	**HbSS**	**HbAA**	**SS versus SC**	**SS versus AA**	**SC versus AA**
				X^2 (p value)	X^2 (p value)	X^2 (p value)
Total pregnancies (n)	66	98	160			
Gestational hypertension						
Pregnancy-induced hypertension	11	10	6	0.95(0.329)	3.31(0.068)	9.68(0.001)*
Pre-eclampsia	16	19	12	0.30(0.583)	7.04(0.008)*	10.57(0.001)*
Eclampsia	0	3	0			
Hemorrhage						
Antepartum	4	5	2	0.01(0.92)	2.53(0.111)	2.11(0.146)
Postpartum	7	7	7	0.24(0.624)	0.45(0.502)	2.14(0.143)
Gestational diabetes	1	3	3	0.01(0.92)	0.04(0.841)	0.28(0.596)
Retained placenta	0	1	0			
Uneventful pregnancies	43	33	152	14.48(0.001)*	109.66(0.001)*	32.70(0.001)*
Sickle cell related complications						
Painful crises	12	28	0	1.78(0.182)		
Acute chest syndrome	8	14	0	0.04(0.862)		
Urinary tract infection	13	12	0	1.17(0.279)		
Maternal death	0	0	0			

Pregnancy-associated complications were more frequent among women with sickle cell disease (HbSS and HbSC) compared with controls (HbAA). Gestational hypertension occurred significantly more often in HbSC women than in HbAA controls (p = 0.001), while differences between HbSS and HbSC or HbSS and HbAA were not statistically significant. Pre-eclampsia was significantly higher in both HbSS and HbSC groups compared with HbAA (p = 0.008 and p = 0.001 respectively), with no significant difference between HbSS and HbSC. Eclampsia was observed only in the HbSS group.

Rates of antepartum and postpartum hemorrhage, gestational diabetes, and retained placenta did not differ significantly across groups. Uneventful pregnancies were significantly less common in HbSS and HbSC women compared with HbAA controls ($p = 0.001$ for all comparisons).

Sickle cell related complications occurred exclusively in women with sickle cell disease. Painful crises, acute chest syndrome, and urinary tract infections were more frequent in the HbSS group than in HbSC, although these differences were not statistically significant. No maternal deaths were recorded in any group.

4. Discussion

This study demonstrates that pregnancy outcomes among women with sickle cell disease (SCD), particularly those with HbSS and HbSC genotypes, are significantly poorer than those of HbAA controls. These findings are consistent with existing literature showing that SCD is associated with increased maternal and perinatal morbidity and adverse neonatal outcomes [31–33].

The majority of women across all groups were aged 25–34 years, reflecting the peak reproductive age and aligning with prior reports from sub-Saharan Africa and other low-resource settings [34, 35]. The higher proportion of nulliparous and primiparous women among those with SCD compared with HbAA controls may reflect reduced fertility, pregnancy loss, or clinician-advised limitation of family size due to disease severity and perceived pregnancy risks [36, 37]. Multiparity was most frequent among HbAA women, consistent with their lower obstetric risk profile.

Women with SCD delivered at significantly lower gestational ages than HbAA controls, with preterm delivery occurring more frequently in both HbSS and HbSC groups. Notably, extreme preterm birth (<32 weeks) was observed only among women with SCD. These findings are well documented in previous studies, which attribute preterm birth in SCD to placental insufficiency, chronic anemia, vaso-occlusive placental infarction, and increased rates of hypertensive disorders [32,38–40]. The higher preterm rate observed in HbSC compared with HbSS in this study contrasts with some earlier reports but supports emerging evidence that HbSC disease is not always a benign phenotype in pregnancy [41].

Mean hemoglobin concentrations were significantly lower among women with SCD, particularly those with HbSC, both before labor and postpartum. The pronounced postpartum hemoglobin decline across all groups, with the greatest reduction in SCD women, underscores their vulnerability to peripartum blood loss and hemolysis. Chronic hemolytic anemia, compounded by increased plasma volume and obstetric blood loss, likely explains these findings [31, 42]. Similar peripartum hemoglobin declines have been reported in previous cohorts of pregnant women with SCD [43].

Pregnancy loss was substantially higher in women with HbSS, with miscarriages occurring exclusively in this group and stillbirth rates significantly exceeding those in HbSC and HbAA women. The markedly reduced live birth rate among HbSS women is consistent with multiple studies reporting increased fetal demise associated with severe SCD phenotypes [33, 39, 44]. Chronic uteroplacental hypoxia, placental infarction, and maternal complications such as pre-eclampsia are thought to contribute to these adverse outcomes [38,45].

Although vaginal delivery remained the predominant mode of birth, caesarean section rates were significantly higher among women with HbSS and HbSC. This finding mirrors previous studies and likely reflects higher rates of fetal distress, failed induction, hypertensive disorders, and clinician preference for operative delivery in high-risk pregnancies [35,46]. The lower vaginal delivery rate among SCD women highlights the increased obstetric intervention burden associated with the disease.

Neonatal outcomes were significantly poorer among infants born to women with SCD. Mean birth weight was lowest in HbSS, intermediate in HbSC, and highest in HbAA controls, with low birth weight occurring most frequently among SCD infants. These findings align with established evidence linking SCD pregnancies to fetal growth restriction due to placental insufficiency and chronic hypoxia [32,40,47]. Despite these adverse outcomes, Apgar scores at 5 minutes did not differ significantly among groups, suggesting that immediate neonatal adaptation may not be universally compromised, particularly in facilities with skilled neonatal care.

Hypertensive disorders of pregnancy were significantly more common among women with SCD. Pre-eclampsia was increased in both HbSS and HbSC groups, while gestational hypertension was particularly frequent in HbSC women. These results are consistent with prior studies reporting a two- to three-fold increased risk of hypertensive disorders in SCD pregnancies [45,48]. Eclampsia occurred exclusively in HbSS women, underscoring the severity of disease in this group.

Uneventful pregnancies were significantly less common among women with SCD, reflecting the cumulative burden of obstetric and medical complications. Importantly, no maternal deaths were recorded, which likely reflects improved antenatal surveillance, multidisciplinary care, and timely intervention, an encouraging finding consistent with trends reported in specialized care settings [36,49].

SCD-specific complications occurred exclusively among women with HbSS and HbSC. Painful crises, acute chest syndrome, and urinary tract infections were more frequent in HbSS women, although differences were not statistically significant. This pattern aligns with the known higher disease severity in HbSS and has been widely reported in the literature [31,37,50]. The absence of maternal mortality despite these complications further supports the value of structured obstetric and hematologic care.

Overall, these findings reinforce that pregnancy in women with SCD particularly HbSS is high risk and requires specialized, multidisciplinary management. The significant burden of adverse maternal and neonatal outcomes highlights the need for early antenatal booking, close surveillance for hypertensive disorders, optimization of hemoglobin levels, and careful timing and mode of delivery. Additionally, the substantial morbidity observed in HbSC women supports growing calls to abandon the perception of HbSC as a mild disease in pregnancy [41, 48].

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare no conflict of interests.

Statement of ethical approval

Approval of the ethics committee was obtained.

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