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Original Research Article

PERINATAL OUTCOME IN PREGNANT WOMEN WITH BETA-THALASSEMIA MINOR: A RETROSPECTIVE STUDY

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ABSTRACT

Background: Beta-thalassemia minor (β-TM) is a common hemoglobinopathy in South Asia, typically considered benign. However, its potential impact on maternal and perinatal outcomes during pregnancy remains inadequately studied. Understanding these risks is essential for optimizing care in affected pregnancies. This study evaluated and compared the perinatal outcomes—including cesarean delivery, neonatal jaundice, excessive neonatal weight loss, and immediate postnatal indicators—in pregnant women with β-TM and matched healthy controls. **Materials and Methods:** This retrospective observational study was conducted at a tertiary care hospital in Gujarat, India, over 12 months. A total of 230 pregnant women were included: 115 diagnosed with β-TM and 115 age- and BMI-matched controls without hemoglobinopathies. Clinical and laboratory data were extracted from medical records. Hematological profiles and perinatal outcomes were analyzed. Relative risk (RR) and attributable risk (AR) were calculated for each outcome to estimate the effect of β-TM. **Results:** Women with β-TM had consistently lower hemoglobin levels throughout pregnancy. The risk of cesarean delivery was higher in the β-TM group (38.3% vs. 26.9%; RR 1.42; AR 11%). Neonatal jaundice was more frequent in the β-TM group (12.2% vs. 4.3%; RR 2.80; AR 8%), as was excessive neonatal weight loss (10.4% vs. 3.5%; RR 3.00; AR 7%). No significant differences were observed in NICU admissions or Apgar scores. **Conclusion:** Although β-TM does not appear to increase the risk of immediate neonatal distress, it is associated with a higher incidence of cesarean delivery and early neonatal complications such as jaundice and weight loss. These findings highlight the need for enhanced antenatal and postnatal surveillance and multidisciplinary care for pregnancies complicated by β-TM.

INTRODUCTION

Beta-thalassemia minor (β-TM), also known as the beta-thalassemia trait, is a heterozygous condition characterized by reduced synthesis of the beta-globin chain of hemoglobin due to mutations in the HBB gene.[1] Although individuals with β-TM are typically asymptomatic or present with mild microcytic anemia, the implications of this condition during pregnancy remain an area of growing clinical interest.[2]

Pregnancy induces profound hematological and metabolic changes, which may unmask or exacerbate underlying disorders such as β-TM.[3,4] While β-TM is traditionally viewed as benign in the antenatal context, emerging literature suggests that it may be associated with adverse maternal and perinatal outcomes, potentially through mechanisms related to chronic maternal anemia, oxidative stress, placental insufficiency, and altered fetal oxygen delivery.[5,6]

Several studies have explored the association between hemoglobinopathies and pregnancy complications. Among these, β-TM has been linked with increased risk of intrauterine growth restriction (IUGR), preterm labor, low birth weight, and neonatal jaundice.[5,7] However, the results are inconsistent, particularly in the Indian subcontinent, where both the carrier rate of thalassemia and the burden of adverse perinatal outcomes are substantial. Regional differences in nutritional status, antenatal care practices, and iron supplementation policies further contribute to variability in reported outcomes.[8]

India, and specifically the state of Gujarat, carries a high prevalence of β-TM.[9] Despite this, there is limited data from large-scale, hospital-based studies examining perinatal outcomes in β-TM pregnancies

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compared to unaffected pregnancies. Understanding these outcomes is critical for formulating targeted antenatal surveillance strategies and guiding clinical decision-making.

This study was conducted to evaluate and compare perinatal outcomes—particularly cesarean delivery, neonatal jaundice, excessive neonatal weight loss, and immediate postpartum health indicators—among pregnant women with and without beta-thalassemia minor. By quantifying the relative and attributable risks associated with β-TM, this study aims to provide clinically actionable evidence to improve maternal and neonatal care pathways in affected populations.

MATERIALS AND METHODS

This study was designed as a retrospective observational analysis and conducted in the Department of Obstetrics and Gynaecology at GMERS Medical College and General Hospital, Junagadh, Gujarat, India. The study was carried out over 12 months, from June 2024 to May 2025.

Study Population

The study included 230 pregnant women, divided into two equal groups: 115 women diagnosed with β-TM (study group) and 115 age- and body mass index (BMI)-matched women without β-TM (control group). Participants were retrospectively selected from hospital records and matched for key baseline characteristics to minimize confounding variables.

Inclusion and Exclusion Criteria

Participants were eligible for inclusion if they were between 18 and 40 years of age, had a confirmed singleton pregnancy, and were between 12 and 28 weeks of gestation at the time of registration. Only those with accessible antenatal and perinatal records were considered. Although the study was retrospective, the requirement for informed consent was waived or obtained by institutional ethical guidelines.

Women were excluded from the study if they had pre-existing diabetes mellitus (either type 1 or type 2), co-existing hemoglobinopathies other than beta-thalassemia minor, or any chronic systemic illnesses such as renal, cardiac, or autoimmune disorders. Pregnancies involving multiple gestations or women who had received a blood transfusion within the past three months were also excluded. Additionally, any case lacking complete clinical documentation of maternal and neonatal outcomes was not considered for final analysis.

Diagnosis of Beta-Thalassemia Minor

The diagnosis of β-TM was established through a combination of hematological and biochemical tests. Initial suspicion was based on a complete blood count (CBC) revealing microcytic hypochromic anemia. Further confirmation was obtained using either hemoglobin electrophoresis or high-performance liquid chromatography (HPLC). A hemoglobin A2 (HbA2) level >3.5% was considered diagnostic of β-TM.

Data Collection and Sources

Clinical and laboratory data were collected from patient files, labor room registers, and electronic hospital databases using a structured proforma. Data included demographic parameters (age, parity, BMI), antenatal hemoglobin levels by trimester, mode of delivery, and neonatal parameters such as birth weight, Apgar scores, need for NICU admission, neonatal jaundice, and significant weight loss within 48 hours postpartum.

Definition of Outcomes

- Cesarean Section: Any operative delivery conducted for maternal or fetal indications
- Neonatal Jaundice: Defined as clinical or laboratory-confirmed jaundice requiring phototherapy within the first 48 hours of life
- Excessive Neonatal Weight Loss: Defined as >7% weight reduction from birth weight within 48 hours
- Low Apgar Score: Apgar score <7 at 1 or 5 minutes
- NICU Admission: Requirement of neonatal intensive care due to clinical deterioration or risk factors

Data Analysis

All data were entered and organized using Microsoft Excel and analyzed with IBM SPSS Statistics for Windows, Version 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables were summarized as means ± standard deviations and compared between groups. Categorical data were presented as frequencies and percentages. Rather than relying on statistical significance testing alone, relative risk (RR) and attributable risk (AR) were calculated for key perinatal outcomes using standard epidemiological formulas:

- Relative Risk (RR) = [a/(a+b)] ÷ [c/(c+d)]
- Attributable Risk (AR) = [a/(a+b)] − [c/(c+d)]

Where “a” is the number of cases with outcome in the exposed group (β-TM), and “c” is the number in the non-exposed (control) group.

Ethical Considerations

The study protocol was reviewed and approved by the Institutional Ethics Committee of GMERS Medical College and General Hospital, Junagadh (IEC/27/2025 dated 25 July 2025). As this was a retrospective record-based study, the requirement for informed consent was waived by institutional policy. Confidentiality of patient information was maintained throughout data collection and analysis.

RESULTS

Baseline Characteristics

A total of 230 pregnant women were included in the study, with 115 in the β-TM group and 115 in the control group. The two groups were matched for maternal age and body mass index (BMI). The mean

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maternal age in the β-TM group was 27.8 ± 4.2 years, while that in the control group was 28.1 ± 4.5 years. The average BMI was 24.5 ± 2.8 kg/m² in the β-TM group and 24.7 ± 2.6 kg/m² in the control group. The proportion of primigravida women was comparable across the groups (45.2% in β-TM vs. 43.5% in controls). These findings confirmed the adequacy of matching and ensured comparability at baseline.

Table 1: Baseline Characteristics of Study Participants

Parameter	β-TM Group (n=115)	Control Group (n=115)
Maternal Age (years)	27.8 ± 4.2	28.1 ± 4.5
BMI (kg/m²)	24.5 ± 2.8	24.7 ± 2.6
Primigravida (%)	52 (45.2%)	50 (43.5%)

Hematological Parameters

Hemoglobin levels were consistently lower in women with β-TM across all trimesters of pregnancy. In the first trimester, the mean hemoglobin level in the β-TM group was 10.2 ± 0.8 g/dL compared to 11.5 ± 0.7 g/dL in the control group. This trend persisted throughout the second (9.8 ± 0.9 g/dL vs. 11.3 ± 0.6 g/dL) and third trimesters (9.5 ± 0.7 g/dL vs. 11.1 ± 0.5 g/dL), indicating the expected impact of β-TM on maternal anemia.

Table 2: Hemoglobin Levels During Pregnancy

Trimester	Hb (g/dL) – β-TM	Hb (g/dL) – Control
First Trimester	10.2 ± 0.8	11.5 ± 0.7
Second Trimester	9.8 ± 0.9	11.3 ± 0.6
Third Trimester	9.5 ± 0.7	11.1 ± 0.5

Perinatal Outcomes

The β-TM group showed a higher frequency of cesarean delivery, neonatal jaundice, and excessive neonatal weight loss compared to the control group. The rates of NICU admission and low Apgar scores were similar between the groups. Cesarean delivery occurred in 38.3% of β-TM pregnancies versus 26.9% of controls. The relative risk (RR) of cesarean section in the β-TM group was 1.42, with an attributable risk (AR) of 0.11. Neonatal jaundice was reported in 12.2% of newborns in the β-TM group compared to 4.3% in controls, yielding an RR of 2.80 and AR of 0.08. Excessive neonatal weight loss occurred in 10.4% of neonates born to β-TM mothers versus 3.5% in controls, corresponding to an RR of 3.00 and AR of 0.07. No meaningful differences were observed in NICU admissions (5.2% vs. 4.3%) or Apgar scores <7 at 1 or 5 minutes.

Table 3: Relative and Attributable Risk for Perinatal Outcomes

Outcome	β-TM Group (n=115)	Control Group (n=115)	Relative Risk (RR)	Attributable Risk (AR)
Cesarean Delivery	44 (38.3%)	31 (26.9%)	1.42	0.11
Neonatal Jaundice	14 (12.2%)	5 (4.3%)	2.80	0.08
Excessive Neonatal Weight Loss	12 (10.4%)	4 (3.5%)	3.00	0.07
NICU Admission	6 (5.2%)	5 (4.3%)	1.20	0.01
Apgar Score < 7 at 1 Minute	4 (3.5%)	3 (2.6%)	1.17	0.01
Apgar Score < 7 at 5 Minutes	2 (1.7%)	2 (1.7%)	1.00	0.00

DISCUSSION

This retrospective study aimed to assess perinatal outcomes among pregnant women with beta-thalassemia minor (β-TM) compared to a matched cohort of healthy controls. The findings revealed that although β-TM was not associated with an increased risk of gestational diabetes mellitus, it was linked to a higher frequency of cesarean deliveries, neonatal jaundice, and excessive neonatal weight loss. These observations underline the importance of tailored antenatal and perinatal care in women carrying this common hemoglobinopathy.

The incidence of cesarean section was notably higher in the β-TM group, with a relative risk of 1.42 and an attributable risk of 11%. This aligns with previous findings by Falcone et al., who reported increased cesarean rates in women with β-TM in a matched case-control study.[10] Although the thalassemia trait itself may not directly necessitate operative delivery, it may be associated with maternal anemia, fetal compromise, or heightened obstetric vigilance, all of which could contribute to the increased cesarean rate. In some instances, clinicians may opt for cesarean delivery due to concern for fetal well-being in the setting of chronic maternal anemia or subclinical placental insufficiency.[10]

Neonatal jaundice was observed in 12.2% of newborns in the β-TM group compared to only 4.3% in controls, with a relative risk of 2.80. This corroborates findings from Zhang et al., who noted increased rates of jaundice and neonatal asphyxia in pregnancies affected by thalassemia trait.[5] The likely mechanism is chronic hypoxia and oxidative stress in utero due to reduced maternal oxygen-carrying capacity, which can predispose neonates to hemolysis and hyperbilirubinemia. In settings where facilities for early neonatal screening and phototherapy are limited, this risk may translate into more severe complications.

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The study also identified a threefold increase in the risk of excessive neonatal weight loss among infants born to β-TM mothers (RR 3.00). This may reflect poor fetal nutrition secondary to maternal anemia and placental insufficiency, as well as early postnatal feeding challenges. Koumoutsea et al., in their meta-analysis, noted similar trends, with β-TM pregnancies showing increased incidence of low birth weight and delayed neonatal weight recovery.[6] This reinforces the importance of close postpartum monitoring of feeding patterns and weight changes in neonates born to β-TM mothers.

Interestingly, there were no significant differences between the groups in terms of Apgar scores or NICU admissions. This suggests that while β-TM affects intermediate neonatal outcomes like jaundice and weight loss, it does not appear to significantly compromise immediate post-delivery adaptation when standard obstetric and neonatal care is available. Sheiner et al. previously reported similar findings, suggesting that β-TM by itself may not lead to overt neonatal distress in well-managed pregnancies.[7]

Moreover, the long-term health of neonates born to β-TM mothers warrants attention. A population-based cohort study by Adler et al. demonstrated a modest but significant increase in long-term hematologic morbidity among such children, emphasizing the potential for subtle effects that may not be apparent in the early neonatal period.[11] These data highlight the need for longitudinal pediatric follow-up, particularly in resource-constrained settings.

Taken together, the findings of this study are consistent with prior international literature and offer valuable data from the Indian context, where the prevalence of β-TM is particularly high. They suggest that while β-TM may not drastically alter major delivery outcomes or require intensive neonatal care, it is associated with measurable increases in adverse perinatal events that are clinically relevant and potentially preventable.

Clinical Implications

Antenatal care in women with β-TM should include routine hematologic monitoring and nutritional support to mitigate anemia-related complications. Delivery planning should account for higher cesarean rates, and obstetric teams should remain alert to the possibility of fetal compromise in the presence of severe anemia. Postnatal surveillance for neonatal jaundice and early feeding patterns should be prioritized, particularly within the first 48 hours of life.

Limitations

This study has several limitations that warrant consideration. First, being retrospective, the study depended on the accuracy and completeness of hospital records, which introduces the risk of information bias and missing data. Second, the study was conducted at a single tertiary care center in Gujarat, which may limit the generalizability of the findings to other populations with different genetic backgrounds, healthcare access, or prenatal care practices. Third, iron status and serum ferritin levels were not uniformly available for all participants, limiting the ability to assess the role of iron overload or deficiency as a modifying factor in pregnancy outcomes. Finally, neonatal outcomes were recorded only during the immediate postpartum period (up to 48 hours), and long-term follow-up data on infant growth and development were not included. These factors suggest the need for prospective, multicentric studies with longitudinal follow-up to validate and expand upon the current findings.

CONCLUSION

Beta-thalassemia minor, though typically regarded as a benign carrier state, was associated in this study with increased risks of cesarean delivery, neonatal jaundice, and excessive neonatal weight loss. While immediate neonatal adaptation—as assessed by Apgar scores and NICU admission—remained largely unaffected, the elevated relative and attributable risks for specific complications emphasize the need for enhanced antenatal surveillance and postnatal care in pregnancies complicated by β-TM. Multidisciplinary management involving obstetricians, hematologists, and pediatricians can help mitigate these risks and improve both maternal and neonatal outcomes. Given the high prevalence of β-TM in regions like India, these findings support the development of tailored guidelines and follow-up protocols for this unique population.

REFERENCES

1. Langer AL. Beta-Thalassemia. 2000 Sep 28 [Updated 2024 Feb 8]. In: Adam MP, Feldman J, Mirzaa GM, et al., editors. GeneReviews® [Internet]. Seattle (WA): University of Washington, Seattle; 1993-2025. Available from: https://www.ncbi.nlm.nih.gov/books/NBK1426/
2. Needs T, Gonzalez-Mosquera LF, Lynch DT. Beta Thalassemia. [Updated 2023 May 1]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan–. Available from: https://www.ncbi.nlm.nih.gov/books/NBK531481/
3. Townsley DM. Hematologic complications of pregnancy. Semin Hematol. 2013 Jul;50(3):222-31. doi: 10.1053/j.seminhematol.2013.06.004.
4. Paradkar MN, Mejia I, Abraheem R, Marroquín León E, Firdous A, Barroso MJ, et al. Assessing the Impact of Hematological Changes in Pregnancy on Maternal and Fetal Death: A Narrative Review. Cureus. 2024 Aug 16;16(8):e66982. doi: 10.7759/cureus.66982.
5. Zhang L, Fan E, Chen X, Zhuo Y, Lee Y, Yan R. Effects of thalassemia minor on umbilical artery blood flow and perinatal outcomes in pregnancy: A retrospective cohort study. Int J Gynaecol Obstet. 2024 Jul 27. doi:10.1002/ijgo.15822
6. Koumoutsea EV, Mogharbel H, Kuo KHM, Ryu M, Shehata N, Malinowski AK. Pregnancy outcomes and iron status in the context of beta thalassemia major and intermedia: A systematic review and meta-analysis. Blood. 2022;140(Suppl 1):2580–1. doi:10.1182/blood-2022-162956
7. Sheiner E, Levy A, Yerushalmi R, Katz M. Beta-thalassemia minor during pregnancy. Obstet Gynecol. 2004;103(6):1273–7. doi:10.1097/01.AOG.0000126575.34482.fb

ISSN (O): 2687-5365; ISSN (P): 2753-6556

8. Sumedha D, Anita K. Prevalence of beta thalassemia carriers in India: a systematic review and meta-analysis. J Community Genet. 2023 Dec;14(6):527-541. doi: 10.1007/s12687-023-00683-7.
9. Ministry of Health and Family Welfare. Government of India. 2016. Prevention and Control of Hemoglobinopathies. https://sickle.nhm.gov.in/uploads/guidelines/NHM_Guidelines_on_Hemoglobinopathies_in_India.pdf. Accessed on 3 Aug 2025.
10. Falcone V, Heinzl F, Itariu BK, Reischer T, Springer S, Muin DA, et al. Gestational diabetes mellitus in pregnant women with beta-thalassemia minor: A matched case-control study. J Clin Med. 2022;11(7):2050. doi:10.3390/jcm11072050.
11. Adler A, Wainstock T, Sheiner E. Prenatal exposure to maternal β-thalassemia minor and the risk for long-term hematologic morbidity in the offspring: A population-based cohort study. Early Hum Dev. 2021;158:105397. doi:10.1016/j.earlhumdev.2021.105397.

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