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ORIGINAL ARTICLE

Correlation Between Cord Blood TSH (CBTSH) and Maternal and Neonatal Factors: A Cross-sectional Study

Shiva Goel,[1] Shekhar Sharma[2,*] and Renu Yadav[2]

[1]*Junior Resident, Department of Pediatrics, Muzaffarnagar Medical College, Uttar Pradesh, India.*
[2]*Associate Professor, Department of Pediatrics, SJP Medical College, Bharatpur, Rajasthan, India.*

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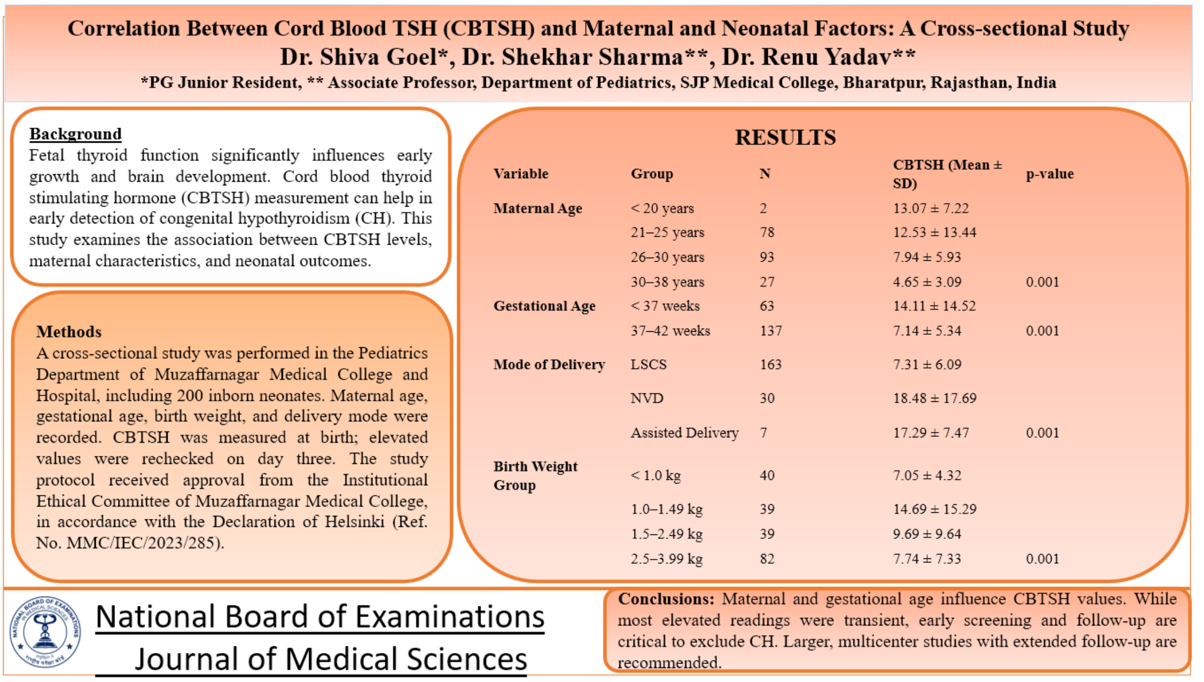
Abstract

Background: Fetal thyroid function significantly influences early growth and brain development. Cord blood thyroid stimulating hormone (CBTSH) measurement can help in early detection of congenital hypothyroidism (CH). This study examines the association between CBTSH levels, maternal characteristics, and neonatal outcomes. **Methods:** A cross-sectional study was performed in the Pediatrics Department of Muzaffarnagar Medical College and Hospital, including 200 inborn neonates. Maternal age, gestational age, birth weight, and delivery mode were recorded. CBTSH was measured at birth; elevated values were rechecked on day three. **Results:** Most mothers (91.5%) were aged 21–30 years. CBTSH was ≤20 mIU/L in 89.5% of neonates, while 5.5% showed ≥40 mIU/L; all normalized on repeat testing. Maternal age and gestational age were negatively correlated with CBTSH ($r = -0.315$, $p = 0.001$; $r = -0.284$, $p = 0.001$). Low birth weight and certain delivery modes were linked to transient TSH elevation. **Conclusion:** Maternal and gestational age influence CBTSH values. While most elevated readings were transient, early screening and follow-up are critical to exclude CH. Larger, multicenter studies with extended follow-up are recommended.

Keywords: Cord blood TSH, maternal age, birth weight, gestational age, congenital hypothyroidism, neonatal screening

*Corresponding Author: Shekhar Sharma
Email: shekharpeds@yahoo.com

Graphical Abstract



Variable	Group	N	CBTSH (Mean ± SD)	p-value
Maternal Age	< 20 years	2	13.07 ± 7.22	
	21–25 years	78	12.53 ± 13.44	
	26–30 years	93	7.94 ± 5.93	
	30–38 years	27	4.65 ± 3.09	0.001
Gestational Age	< 37 weeks	63	14.11 ± 14.52	
	37–42 weeks	137	7.14 ± 5.34	0.001
Mode of Delivery	LSCS	163	7.31 ± 6.09	
	NVD	30	18.48 ± 17.69	
	Assisted Delivery	7	17.29 ± 7.47	0.001
Birth Weight Group	< 1.0 kg	40	7.05 ± 4.32	
	1.0–1.49 kg	39	14.69 ± 15.29	
	1.5–2.49 kg	39	9.69 ± 9.64	
	2.5–3.99 kg	82	7.74 ± 7.33	0.001

Introduction

Thyroid hormones are vital for fetal neurodevelopment and overall growth. The pituitary gland produces thyroid-stimulating hormone (TSH), which stimulates the thyroid to release triiodothyronine (T3) and thyroxine (T4), while thyrotropin-releasing hormone (TRH) from the hypothalamus regulates TSH secretion. Cord blood TSH (CBTSH) reflects the newborn's thyroid status at birth [1].

Congenital hypothyroidism (CH) occurs when the neonatal thyroid cannot produce sufficient hormones. [2] It remains one of the most important preventable causes of intellectual disability in children. The condition occurs in approximately 1 in 2,500–2,800 live births in India and 1 in 3,000–4,000 worldwide. [3] Without systematic screening, CH often goes unnoticed, as most affected neonates appear asymptomatic at birth.

Screening for CH was first implemented widely in the 1970s, with Quebec among the pioneers, it is now standard in many high-income countries. The Indian Academy of Pediatrics recommends cord blood sampling as one viable method for neonatal CH screening. Although CBTSH testing is highly sensitive, its specificity is limited, resulting in more false positives.

Cord blood testing offers practical benefits: it is non-invasive, simple to perform immediately after birth, and minimizes the need for follow-up visits—particularly useful in early discharge settings. Studies have shown a strong correlation between cord blood and heel-prick TSH results obtained after 48 hours, reinforcing its clinical value despite the higher false-positive rate [4-6].

Measuring thyroid levels in cord blood, including TSH, T3, and T4, at birth may also help identify newborns at risk for adverse outcomes such as low birth weight, respiratory distress, or NICU admission. If strong associations are established between thyroid status and perinatal factors like gestational age, delivery method, and maternal health, such testing could be integrated into routine neonatal screening to enable timely interventions and improve long-term outcomes.

Materials and Methods

This cross-sectional, descriptive, and analytical study was conducted in the Department of Pediatrics at Muzaffarnagar Medical College and Hospital, Uttar Pradesh, India. All neonates born in the institution during the study period were eligible for inclusion. The study was carried out over 18 months, comprising 12 months of data collection and 6 months for data processing and analysis.

Sample Size

The target sample size of 200 neonates was determined using the average institutional delivery rate from the preceding year. All eligible neonates born during the study period were enrolled consecutively.

Data Collection

After obtaining written informed consent from mothers, relevant maternal and neonatal information was recorded using a structured proforma. Maternal variables included age, parity, gravida, history of gestational diabetes mellitus (GDM), pregnancy-induced hypertension (PIH), pre-eclampsia, premature rupture of membranes (PROM), and socioeconomic status. Neonatal parameters included birth weight, gestational age, sex, Apgar score, resuscitation status at birth, anthropometric measurements, mode of delivery, and any neonatal morbidity or mortality.

Inclusion Criteria

- All inborn neonates delivered at MMC, Muzaffarnagar
- Mothers who provided informed written consent

Exclusion Criteria

- Outborn neonates
- Mothers declining participation
- Neonates with major congenital anomalies

Sample Collection and Testing

Immediately after delivery, 2 mL of cord blood was drawn from the maternal end of the umbilical cord following clamping and cutting. Samples were stored at approximately 25°C and transported to the laboratory within four hours. CBTSH concentrations were measured using an electrochemiluminescence immunoassay. For neonates with CBTSH values above the established cut-off, a repeat venous blood sample was taken on the third day of life to confirm results.

Ethical Approval

The study protocol received approval from the Institutional Ethical Committee of Muzaffarnagar Medical College, in accordance with the Declaration of Helsinki (Ref. No. MMC/IEC/2023/285).

Statistical Analysis:

Data entry was performed in Microsoft Excel and analysis was conducted using SPSS version 18. Depending on data distribution, appropriate statistical tests were applied, including the t-test, ANOVA, chi-square test, and regression analysis. Spearman's rank correlation coefficient was used to assess relationships between CBTSH and other variables. A p-value below 0.05 was considered statistically significant.

Results

A total of 200 neonates were included in the study. The largest proportion of mothers (48.5%, n=97) were aged 26–30 years, followed by 43.0% (n=86) in the 21–25-year age group. Only two mothers (1.0%) were younger than 20 years, and 15 (7.5%) were aged between 31 and 35 years. (Table 1)

List of Table

Table 1. Demographic and Clinical Characteristics of the Study Population (N = 200)

Variable	Category	No. of Cases	Percentage (%)
Maternal Age (years)	< 20	2	1.0%
	21–25	86	43.0%
	26–30	97	48.5%
	31–35	15	7.5%
	> 35	0	0.0%
Gender	Female	65	32.5%
	Male	135	67.5%
Birth weight	<1 kg	40	20%
	1-1.49 kg	39	19.5%
	1.5-2.49 kg	39	19.5%
	2.5-3.99 kg	82	41%
Gestational Age	Pre-term (≤ 37 weeks)	63	31.5%
	Term (37–41 weeks)	137	68.5%
	Post-term (≥ 42 weeks)	0	0.0%
Mode of Delivery	LSCS	163	81.5%
	NVD	30	15.0%

	Assisted Deliveries	7	3.5%
Parity	Primigravida	84	42.0%
	Multigravida	116	58.0%
TSH Levels	20-40m IU/L	10	5%
	>40 m IU/L	11	5.5%

Among the newborns, 67.5% (n=135) were male, while 32.5% (n=65) were female. Birth weight distribution showed that 20% (n=40) weighed less than 1.0 kg, 19.5% (n=39) were between 1.0 and 1.49 kg, another 19.5% (n=39) were between 1.5 and 2.49 kg, and the largest group (41%, n=82) weighed between 2.5 and 3.99 kg. No neonates weighed 4.0 kg or more.

Gestational age analysis indicated that 68.5% (n=137) were born at term (37–41 weeks), while 31.5% (n=63) were preterm (≤37 weeks). There were no post-term deliveries in the cohort.

Regarding delivery mode, the majority of births occurred via lower segment cesarean section (LSCS) (81.5%, n=163), followed by normal vaginal delivery (15.0%, n=30) and assisted deliveries (3.5%, n=7). Parity analysis showed that 42% (n=84) of mothers were primigravida and 58% (n=116) were multigravida.

When CBTSH levels were evaluated, most neonates (89.5%, n=179) had levels ≤20 mIU/L. Ten neonates (5.0%) had levels between 20 and 40 mIU/L, and 11 (5.5%) had levels above 40 mIU/L. On repeat testing on day three, none of the neonates showed persistent elevation of CBTSH.

Associations with Maternal and Neonatal Factors:

- Neonates born to mothers under 25 years of age had higher mean CBTSH levels compared to those born to older mothers.
- Preterm infants (<37 weeks) exhibited higher CBTSH concentrations than term infants.
- Babies delivered vaginally or by assisted methods had higher CBTSH levels than those born via cesarean section.
- Low birth weight infants, especially those weighing 1.0–1.49 kg, recorded the highest mean CBTSH values (Table 2).

Table 2. Association of Maternal and Neonatal Variables with Cord Blood TSH Levels

Variable	Group	N	Mean TSH (mIU/L)	SD	SE	Min	Max	Test	p-value
Maternal Age	< 20	2	13.07	7.22	7.96	18.17	15.85	F = 5.973	0.001
	21–25	78	12.53	13.44	0.70	48.90	47.59		
	26–30	93	7.94	5.93	0.25	27.28	48.90		
	30–38	27	4.65	3.09	2.51	17.59	17.59		
Gestational Age	< 37 weeks	63	14.11	14.52	1.83	3.85	48.90	F = 24.476	0.001
	37–42 weeks	137	7.14	5.34	0.46	0.25	27.09		
Mode of Delivery	LSCS	163	7.31	6.09	0.48	0.25	47.59	F = 23.098	0.001

	NVD	30	18.48	17.69	3.23	2.51	48.90		
	Assisted Deliveries	7	17.29	7.47	2.82	7.36	24.44		
Birth Weight Group	< 1 kg	40	7.05	4.32	0.68	0.25	18.17	F = 5.762	0.001
	1.0–1.49 kg	39	14.69	15.29	2.45	2.51	47.59		
	1.5–2.49 kg	39	9.69	9.64	1.54	1.09	48.90		
	2.5–3.99 kg	82	7.74	7.33	0.81	2.51	48.17		

Correlation Analysis

Spearman's rank correlation revealed a significant negative relationship between CBTSH and maternal age (r = −0.315, p = 0.001), as well as between CBTSH and gestational age (r = −0.284, p = 0.001). Birth weight showed a negative but non-significant correlation with CBTSH (r = −0.127, p = 0.072) (Table 3).

Table 3. Relationship between CBTSH level and various factors

Variable	Correlation Coefficient (r)	p-value	Statistical Significance
Maternal Age	–0.315	0.001	Significant
Gestational Age	–0.284	0.001	Significant
Birth Weight	–0.127	0.072	Not Significant

Discussion

This study assessed the relationship between cord blood TSH (CBTSH) levels and various maternal and neonatal factors, with a particular focus on perinatal outcomes. The majority of mothers in our cohort were in their 20s, which aligns with patterns observed in other Indian hospital-based studies.

Our birth weight distribution revealed that most neonates (41%) weighed between 2.5 and 3.99 kg, while 39% were between 1.0 and 2.49 kg, and 20% weighed below 1 kg. No neonates exceeded 4.0 kg. In contrast, Raj S. et al. [7] reported a larger proportion of infants within the healthy weight range (2.5–3.5 kg) and fewer low birth weight cases.Most neonates (89.5%) had CBTSH levels ≤20 mIU/L. A small proportion had transiently elevated CBTSH, all of which normalized by day three. This finding suggests that birth-related stress or physiological adaptation may explain initial high values.

Significant negative correlations were found between CBTSH and maternal age and between CBTSH and gestational age. Although birth weight showed a negative correlation, it was not statistically significant. These trends align with prior studies linking higher CBTSH levels to preterm birth, vaginal delivery, and lower birth weight.

Limitations

This was a single-center study with a short follow-up period and no routine T3/T4 testing. Maternal iodine status, medications, and intrapartum stressors were not accounted for.

Implications

CBTSH remains a valuable screening tool when interpreted alongside gestational age and maternal age. Repeat testing is essential to distinguish transient from persistent elevation.

Conclusion

Maternal age and gestational age significantly influence CBTSH levels in neonates. Transient elevations are relatively common in preterm, low birth weight, and vaginally delivered infants, but no persistent cases of congenital hypothyroidism were identified. Routine CBTSH measurement, with follow-up testing for elevated results, can aid in early detection and intervention.

Statements and Declarations

Ethical Approval

Approved by Institutional Ethical Committee, Muzaffarnagar Medical College (Ref. No. MMC/IEC/2023/285)

Conflicts of interest

The authors declare that they do not have conflict of interest.

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