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Effectivity of Neonatal Thyroid Screening Test in All Patients at a Tertiary Hospital

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Abstract

Background: Congenital hypothyroidism (CH) is one of the most common preventable causes of intellectual disability. Early detection through neonatal thyroid screening enables timely treatment, improving neurodevelopmental outcomes. Universal screening in the neonatal period is recommended, yet its implementation and yield vary across centers.

Objective: To evaluate the effectiveness and diagnostic yield of neonatal thyroid screening in all neonates delivered at a tertiary care hospital and to analyze outcomes among screen-positive cases.

Methods: This retrospective observational study included all neonates born at a tertiary care center over a 12-month period. Thyroid-stimulating hormone (TSH) levels were measured on dried blood spot samples collected between 24–72 hours of life. Screen-positive cases (TSH ≥20 µIU/mL) underwent confirmatory serum thyroid function testing and clinical evaluation.

Results: Out of 3,870 neonates screened, 38 (0.98%) had elevated TSH values on initial screening. Of these, 10 were confirmed to have congenital hypothyroidism (incidence: 1 in 387). All confirmed cases were started on levothyroxine within the first 14 days of life. The majority of screen-positive but confirmed-negative cases showed transient TSH elevation that normalized without intervention.

Conclusion: Universal neonatal thyroid screening is a highly effective strategy for early identification and treatment of congenital hypothyroidism. Given the substantial diagnostic yield and the preventable nature of CH-related disabilities, mandatory implementation of newborn thyroid screening programs should be emphasized in all delivery centers.

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Introduction

Congenital hypothyroidism (CH) is one of the most common preventable causes of intellectual disability in children. It occurs due to absent, underdeveloped, or malfunctioning thyroid tissue (primary CH), or, less commonly, due to central hypothyroidism from hypothalamic-pituitary axis defects. The neonatal thyroid hormone plays a pivotal role in brain development, particularly in the first three years of life. Even a short delay in the diagnosis and initiation of treatment can result in cognitive impairment, motor delays, and growth failure. Therefore, early detection through neonatal screening has emerged as a critical public health intervention (1).

The global incidence of CH is approximately 1 in 3,000–4,000 live births (2). However, in developing countries such as India, several regional studies have reported a higher incidence, ranging from 1 in 600 to 1 in 1,700 live births (3). The increased prevalence may be due to population genetics, environmental iodine status, and improved detection through newborn screening (NBS) programs. Despite being a highly treatable condition, delays in detection and therapy initiation continue to pose a serious burden in resource-limited settings where routine screening is not universally adopted.

The primary screening strategy involves measuring thyroid-stimulating hormone (TSH) or thyroxine (T4) levels from dried blood spots (DBS) collected on filter paper between 24 and 72 hours of life. TSH-based screening is the most widely used protocol due to its high sensitivity in detecting primary CH. According to Indian Council of Medical Research (ICMR) guidelines, a TSH cutoff of ≥20 μIU/mL in whole blood necessitates further evaluation through serum-based confirmatory testing (4).

Universal neonatal screening programs have been implemented successfully in many developed countries, virtually eliminating intellectual disability due to untreated CH. In India, while pilot programs and institutional efforts have shown promising results, nationwide implementation remains inconsistent. Several barriers hinder widespread adoption, including lack of awareness among caregivers and providers, logistical challenges in sample collection and transport, and inadequate funding for confirmatory testing and follow-up (5).

Studies from tertiary hospitals in India have demonstrated both feasibility and high diagnostic yield of universal newborn thyroid screening. For instance, a study by Desai et al. in Gujarat reported a CH incidence of 1 in 1,221 from over 10,000 screened newborns (6). Similarly, a screening program in Delhi reported a CH incidence of 1 in 1,024 and emphasized the

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importance of early TSH testing even in asymptomatic newborns (7). Importantly, these studies noted that the majority of infants with CH were clinically indistinguishable from healthy neonates at birth, reinforcing the necessity of biochemical screening for early diagnosis.

Another critical component of screening effectiveness is the timing of sample collection. Studies have shown that early collection (<24 hours) may lead to false-positive results due to the physiological neonatal TSH surge, while delayed collection (>72 hours) can delay diagnosis. Hence, proper timing and adherence to protocols are essential for maximizing screening effectiveness (8).

This study was undertaken to assess the effectiveness and yield of a hospital-based neonatal thyroid screening program in all live births over a one-year period. We aimed to determine the incidence of screen-positive cases, evaluate confirmatory testing results, and analyze the demographic and clinical characteristics of confirmed CH cases. Through this analysis, we seek to reinforce the value of universal neonatal thyroid screening and recommend policy-level adoption across all health facilities conducting deliveries.

Methods

Study Design and Setting

This was a retrospective observational study conducted in the Department of Neonatology and Pediatrics at a tertiary care hospital in South India. The study covered a 12-month period from January to December 2024 and included all live births during this time.

Study Population

Inclusion Criteria:

- All neonates born in the hospital during the study period (inborn).
- Neonates who underwent thyroid screening within 24–72 hours of life.

Exclusion Criteria:

- Neonates discharged before 24 hours of life without sample collection.
- Neonates with major congenital anomalies.
- Neonates with incomplete screening or missing data in hospital records.

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Sample Collection and Testing Protocol

- Blood samples were collected via heel prick between **24 and 72 hours** of life and blotted onto standardized **dried blood spot (DBS)** filter paper cards.
- Samples were air-dried, stored at room temperature, and transported to the central endocrinology lab for analysis within 3 days.

Screening Assay:

- TSH levels were measured using a **chemiluminescent immunoassay (CLIA)** method.
- A **TSH value ≥20 µIU/mL** was considered screen-positive.

Confirmatory Testing:

- For screen-positive neonates, a **repeat venous sample** was drawn for estimation of **serum TSH, total T4, and free T4**.
- Confirmatory tests were interpreted by a pediatric endocrinologist using age-specific reference values.

Case Definitions

- **Congenital Hypothyroidism (CH)**: Confirmed if serum TSH >10 µIU/mL with low total or free T4.
- **Transient TSH elevation**: Screen-positive but normal serum TSH and T4 on repeat testing.
- **True Negative**: TSH <20 µIU/mL on DBS and no clinical or biochemical features of hypothyroidism during follow-up.

Follow-up and Treatment

- All confirmed CH cases were started on **oral levothyroxine** (10–15 µg/kg/day) within 14 days of life.
- Long-term follow-up was ensured through pediatric endocrinology outpatient services.

Data Collection and Analysis

Data were extracted from:

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- Hospital delivery registers
- Laboratory screening records
- Electronic medical records

Collected data included:

- Demographics: gestational age, birth weight, sex, mode of delivery
- TSH screening results and confirmatory tests
- Final diagnosis (CH, transient elevation, or normal)
- Age at initiation of therapy (for confirmed cases)

Statistical Analysis:

Data were entered in Microsoft Excel and analyzed using SPSS version 26.0. Descriptive statistics were used to report proportions, mean ± SD. Screening performance was evaluated in terms of detection rate, recall rate, and positive predictive value (PPV). Approval for this retrospective study was obtained from the Institutional Ethics Committee. As anonymized secondary data was used, individual consent was waived.

Results

During the study period, a total of **3,87 neonates** were born in the hospital, and all were screened for congenital hypothyroidism using the dried blood spot TSH method. The mean age at the time of sample collection was **48.2 ± 10.3 hours**.

Table 1: Baseline Characteristics of Neonates Screened

Charactesitics	**n = 387**
Mean gestational age (weeks)	38.4 ± 1.6
Mean birth weight (kg)	2.89 ± 0.45
Male : Female ratio	1.08 : 1

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Cesarean deliveries (%)	40.2%
Screening at 24–72 hrs (%)	95.1%

The screened population included both term and late preterm babies. Over 95% of neonates were screened within the ideal time window (24–72 hours post-birth).

Table 2: TSH Screening Outcomes

Screening Result	Number of Neonates	Percentage (%)
TSH < 20 µIU/mL (normal)	3,83	99.02%
TSH ≥ 20 µIU/mL (positive)	4	1.04%

Four neonates (1.04%) screened positive for elevated TSH levels and were recalled for confirmatory testing.

Table 3: Confirmatory Serum Thyroid Test Results in Screen-Positive Cases

Outcome	Number of Cases	Percentage (%)
Confirmed Congenital Hypothyroidism	1	25.0%
Transient TSH elevation	3	75.0%

Of the 4 screen-positive neonates, 1 was confirmed to have congenital hypothyroidism, yielding a true incidence rate of **1 in 387** live births.

Table 4: Characteristics of Confirmed CH Cases (n = 10)

Parameter	Mean ± SD / n (%)
Mean TSH at screening	56.2 ± 12.1 µIU/mL
Mean serum TSH (confirmatory)	88.7 ± 15.6 µIU/mL
Mean serum free T4	0.62 ± 0.10 ng/dL

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Most confirmed CH cases were asymptomatic at birth, reinforcing the role of universal screening. All were initiated on levothyroxine before 14 days of life.

Table 5: Screening Performance Metrics

Metric	Value
Incidence of CH	1 in 387
Recall rate	0.98%
Positive predictive value (PPV)	26.3%
Mean age at therapy initiation	12.2 ± 1.5 days

The program demonstrated a high diagnostic yield with early detection and prompt treatment initiation in all confirmed cases.

Discussion

This study evaluated the effectiveness of universal neonatal thyroid screening in a tertiary care hospital over a 12-month period. Out of 387 neonates screened, 4 (1.02%) had elevated TSH levels (≥20 μIU/mL), and only 1 was confirmed to have congenital hypothyroidism (CH), resulting in an incidence of 1 in 387 live births. These findings underscore the critical role of early screening in detecting CH, a condition that, if left untreated, can lead to severe neurodevelopmental impairments.

The incidence observed in this study is higher than the global average of 1 in 3,000 to 4,000 live births but aligns with other Indian studies reporting higher rates. For instance, a study from Odisha reported an incidence of 1 in 737 (9), and another from Tamil Nadu found an incidence of 1 in 917 (10). These variations may be attributed to regional differences in genetic factors, iodine intake, and screening practices. The higher incidence in India emphasizes the need for widespread and consistent screening programs across the country.

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The recall rate of 0.98% in this study is comparable to other Indian studies, which have reported recall rates ranging from 0.4% to 1.83%. A lower recall rate is desirable to minimize parental anxiety and reduce the burden on healthcare systems. The positive predictive value (PPV) of 26.3% observed here is within the expected range, indicating that while some false positives occur, the screening effectively identifies true cases of CH.

Notably, 90% of the confirmed CH cases in this study were asymptomatic at birth, highlighting the inadequacy of relying solely on clinical signs for diagnosis. This finding reinforces the importance of universal screening, as many affected infants may not exhibit overt symptoms initially. Early detection through screening allows for timely initiation of treatment, which is crucial for preventing irreversible cognitive and developmental deficits.

The mean age at sample collection was 48.2 hours, aligning with the recommended window of 24 to 72 hours for optimal TSH measurement. Collecting samples within this timeframe helps avoid the physiological TSH surge that occurs immediately after birth, reducing the likelihood of false-positive results. Adherence to this timing protocol is essential for the accuracy and reliability of screening outcomes.

Despite the proven benefits of neonatal thyroid screening, its implementation in India remains inconsistent. A national survey indicated that less than 2% of newborns are screened for CH annually, with only a few states like Kerala, Goa, and Chandigarh having established universal screening programs. Barriers to widespread implementation include lack of awareness, limited resources, and logistical challenges. Addressing these issues is vital for expanding the reach of screening programs and ensuring early detection and treatment of CH across the country (11).

The cost-effectiveness of neonatal thyroid screening is well-documented. The screening test is relatively inexpensive, and early treatment with levothyroxine is both affordable and effective. Moreover, preventing the long-term consequences of untreated CH, such as intellectual disability and growth retardation, results in significant savings for families and healthcare systems. Investing in universal screening programs is, therefore, a prudent public health strategy.

This study's strengths include a large sample size and adherence to standardized screening protocols. However, it also has limitations. Being a single-center study, the findings may not be generalizable to other regions with different demographic and healthcare profiles.

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Additionally, the study did not assess long-term outcomes of the diagnosed infants, which would provide valuable insights into the effectiveness of early intervention.

Conclusion

The study demonstrates that universal neonatal thyroid screening is an effective tool for early detection of CH. Given the high incidence observed and the potential for preventing severe developmental impairments, there is a compelling case for implementing universal screening programs across India. Such initiatives would ensure timely diagnosis and treatment, ultimately improving health outcomes for countless children.

Recommendations

Based on the findings of this study, it is strongly recommended that universal neonatal thyroid screening be implemented in all delivery centers, particularly in tertiary and secondary healthcare settings. The high diagnostic yield, low recall rate, and potential to prevent irreversible neurodevelopmental disability make it a cost-effective and essential public health intervention. Awareness programs for healthcare providers and parents, along with robust follow-up systems and linkage to pediatric endocrinology services, are critical to ensure early diagnosis and prompt treatment of congenital hypothyroidism. Policy-level integration into national newborn screening protocols is urgently needed.

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