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RESEARCH ARTICLE

"AN OBSERVATIONAL STUDY TO ESTIMATE THE PREVALENCE OF CONGENITAL HYPOTHYROIDISM IN NEWBORNS AT A RURAL TERTIARY CARE HOSPITAL"

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Abstract

Background: Congenital hypothyroidism (CH) is one of the most common preventable causes of intellectual disability and growth failure in children. Most affected newborns are asymptomatic at birth due to transplacental transfer of maternal thyroxine, leading to delayed diagnosis in the absence of screening. Early detection through newborn thyroid-stimulating hormone (TSH) screening and prompt initiation of levothyroxine therapy can prevent irreversible neurodevelopmental impairment. Data from rural tertiary care settings in India remain limited.

Objectives: To estimate the prevalence of congenital hypothyroidism among newborns and to analyse the distribution of TSH levels in relation to selected demographic and perinatal factors.

Methods: This prospective observational cross-sectional study was conducted in a rural tertiary care hospital over 23 months. A total of 919 healthy newborns aged 72 hours to 7 days were enrolled after obtaining informed consent.Newborns with major congenital anomalies or born to mothers with overt hypothyroidism were excluded. Venous blood samples were collected, and serum TSH levels were estimated using a standardized immunoenzymometric assay. Newborns with elevated TSH underwent repeat testing and confirmatory evaluation. Data were analysed using SPSS version 26.0,and statistical significance was set at $p < 0.05$.

Results: Out of 919 newborns screened, one case of congenital hypothyroidism was confirmed, yielding a prevalence of 1.09 per 1000 live births (95% confidence interval: 0.03–6.07). The majority of newborns had TSH levels within the normal range. No statistically significant association was found between elevated TSH levels and gender, birth weight, gestational age, mode of delivery, or other perinatal factors ($p > 0.05$).

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Conclusion: The prevalence of congenital hypothyroidism in this rural tertiary care setting was comparable to other Indian studies. These findings support the need for routine newborn screening programs in rural healthcare settings for early detection and prevention of long-term neurodevelopmental morbidity.

Introduction:-

Congenital hypothyroidism (CH) is a neonatal endocrine disorder characterized by inadequate availability of thyroid hormones at the tissue level from birth due to abnormalities in thyroid gland development, thyroid hormone synthesis, secretion or transport, or defects involving the hypothalamic–pituitary–thyroid (HPT) axis. It is one of the most common endocrine disorders of the newborn and remains one of the leading preventable causes of irreversible intellectual disability and impaired physical growth in children worldwide.[1]

Thyroid hormones are indispensable for normal fetal and postnatal growth and development, particularly for maturation of the central nervous system. During fetal life and early infancy, thyroxine (T_4) and triiodothyronine (T_3) regulate neuronal proliferation, migration, differentiation, synaptogenesis, myelination, and cortical organization.[2–4] Deficiency of thyroid hormones during these critical periods results in permanent neurodevelopmental impairment manifested by intellectual disability, delayed motor and language development, poor scholastic performance, and growth failure. Fortunately, these complications are largely preventable if congenital hypothyroidism is diagnosed early and treatment with levothyroxine is initiated within the first two weeks of life.[1–4]

Most newborns with congenital hypothyroidism appear clinically normal at birth because maternally derived thyroxine crosses the placenta and provides partial protection during fetal life.[5–7] Consequently, reliance on clinical examination alone often delays diagnosis until irreversible neurological damage has already occurred. This limitation underscores the importance of universal newborn screening for early detection and timely treatment.
The thyroid gland is the first endocrine organ to develop during embryogenesis. It originates from the primitive pharyngeal floor during the third to fourth week of gestation and migrates to its normal pretracheal position by the seventh to tenth week.[8–10] Disruption of thyroid development results in thyroid dysgenesis, which accounts for the majority of permanent congenital hypothyroidism. A smaller proportion of cases results from inherited defects in thyroid hormone synthesis (dyshormonogenesis), while the fetus remains dependent on maternal thyroxine during early gestation for normal brain development.[5–10]

Immediately after birth, exposure to the extrauterine environment induces a physiological surge in thyroid-stimulating hormone (TSH), followed by an increase in circulating T_4 and T_3 concentrations. This normal adaptation is essential for thermogenesis, metabolic homeostasis, and continued maturation of the neonatal brain.[11] Failure of this physiological response due to thyroidal or central defects leads to congenital hypothyroidism, emphasizing the need for early diagnosis and treatment.

Congenital hypothyroidism is broadly classified into primary, central, and transient forms.[12] Primary congenital hypothyroidism, resulting from thyroid dysgenesis or dyshormonogenesis, accounts for nearly 85–90% of permanent cases.[12-14] Central congenital hypothyroidism occurs because of hypothalamic or pituitary dysfunction resulting in inadequate TSH secretion, whereas transient congenital hypothyroidism may occur secondary to iodine deficiency or excess, maternal antithyroid medications, prematurity, or transplacental passage of TSH receptor-blocking antibodies.[13-15]

Newborn screening has revolutionized the management of congenital hypothyroidism and is regarded as one of the most successful public health interventions in neonatal medicine. Measurement of TSH in dried blood spot samples collected between 48 and 72 hours of life permits detection of affected infants before the onset of clinical manifestations.[12–16] Early identification followed by prompt initiation of levothyroxine therapy results in normal physical growth, neurocognitive development, and quality of life, thereby transforming congenital hypothyroidism from a major cause of intellectual disability into a preventable disorder.[12-17]

Despite the proven effectiveness of newborn screening, implementation across India remains inconsistent, particularly in rural and resource-limited settings.[18] Most published Indian data are derived from urban tertiary care centres and may not accurately reflect the burden of congenital hypothyroidism in rural populations, where access to antenatal care, institutional deliveries, laboratory facilities, and follow-up services is often limited.[18-22] Generation of region-specific prevalence data is therefore essential to strengthen newborn screening programmes, improve

healthcare planning, optimize resource allocation, and facilitate early diagnosis and treatment. The present study was therefore undertaken to estimate the prevalence of congenital hypothyroidism among newborns delivered at a rural tertiary care hospital, thereby contributing to the evidence base required for strengthening neonatal screening services and improving long-term neurodevelopmental outcomes in this population.

Aims and Objectives:-

Aim:-

To study the prevalence of congenital hypothyroidism among newborns attending a rural tertiary care hospital.

Objectives:-

Primary Objective:-

- To estimate the prevalence of congenital hypothyroidism among newborns at a rural tertiary care hospital in preventing the neurodevelopmental morbidity.

Secondary Objectives:-

- To analyse the distribution of serum TSH levels among screened newborns.
- To assess the association between elevated TSH levels and selected demographic and perinatal factors.

Materials and Methods:-

Methodology:-

This prospective observational cross-sectional study was conducted in the Department of Paediatrics and Neonatal Unit at Akash Institute of Medical Sciences and Research Centre, Devanahalli, Bengaluru Rural, Karnataka. The institution functions as a rural tertiary care referral centre catering to surrounding rural and semi-urban populations, with facilities for institutional deliveries, neonatal monitoring, NICU support and laboratory support.

Study Design and Duration:-

The study was designed as a prospective observational cross-sectional study conducted over a period of twenty three months from March 2024 to February 2026.

Study Population:-

The study population comprised healthy live newborns delivered at the study hospital and those presenting to the neonatal outpatient services between 72 hours and 7 days of life. The screening window of 72 hours to 7 days was selected to avoid the immediate postnatal physiological surge in thyroid-stimulating hormone (TSH), which typically occurs within the first 24–48 hours of life, thereby reducing false-positive results. Healthy newborns were defined as neonates with stable cardiorespiratory parameters, absence of major congenital anomalies, and normal systemic examination at the time of screening.

Eligibility Criteria:-

Inclusion Criteria:-

- Live newborns delivered at the Rural Tertiary Care Hospital and those attending the neonatal outpatient services between 72 hours and 7 days of life during the study period were included in the study.
- Newborns were defined as neonates with stable vital parameters and no evidence of major congenital malformations on clinical examination.
- Parents or legal guardians who provided written informed consent were included.

Exclusion Criteria:-

- Newborns born to mothers with known overt hypothyroidism on treatment during pregnancy were excluded from the study.
- Newborns with major congenital anomalies detected clinically at birth were excluded.
- Neonates with syndromic features suggestive of chromosomal or genetic disorders were excluded.
- Newborns whose parents or legal guardians did not provide written informed consent were excluded.

Methodology:-

Enrolment and Consent:-

Institutional Ethics Committee approval was obtained prior to initiation of the study. Written informed consent was obtained from parents in their preferred language after explaining the purpose and procedure of the study. Eligibility was confirmed prior to enrolment.

Maternal Assessment:-

A detailed maternal history was obtained through structured interview and review of antenatal records. Maternal age was recorded in completed years. Obstetric status was categorized as primigravida or multigravida. History of maternal hypothyroidism or hyperthyroidism was documented. Details of thyroid medication during pregnancy, including Levothyroxine, Methimazole, or Propylthiouracil, were recorded from antenatal records. History of gestational diabetes mellitus and pregnancy-induced hypertension was documented. Iodine exposure was assessed indirectly through history of iodised salt consumption. History and degree of consanguinity were recorded. Antenatal screening including nuchal translucency scan and anomaly scan were documented when available.

Perinatal Assessment:-

Mode of delivery was recorded from delivery records as normal vaginal delivery, lower segment cesarean section, or instrumental delivery. Presence of meconium-stained liquor was documented. Immediate cry at birth and need for resuscitation were recorded from delivery room documentation. APGAR score at 1 minute was recorded as per standard neonatal resuscitation protocol. APGAR score at 5 minute was recorded as per standard neonatal resuscitation protocol. Initiation of breastfeeding within the first hour of life and exclusive breastfeeding status were documented from nursing records. Passage of meconium within 24 hours was confirmed through nursing documentation and maternal history.

Anthropometric Measurements:-

Birth weight was measured using a calibrated digital neonatal weighing scale Length was measured using a standard infantometer with the neonate positioned supine. Head circumference was measured using a non-stretchable measuring tape placed over the occiput and supraorbital ridges. Gestational age was determined based on first-trimester ultrasound records wherever available.

Clinical Examination:-

A detailed systemic examination was performed for each neonate by the investigator.

Special emphasis was placed on identifying clinical features suggestive of congenital hypothyroidism, including:-

- Large anterior or posterior fontanelle
- Macroglossia
- Coarse facial features
- Umbilical hernia
- Dry or mottled skin
- Generalized hypotonia
- Hoarse cry

Primitive Reflex Assessment:-

Primitive reflexes were assessed as indicators of neurological maturity:

Suckling reflex was evaluated during feeding. Rooting reflex was elicited by stroking the cheek. Moro reflex was assessed using the standard head-drop maneuver. Palmar and plantar grasp reflexes were elicited by tactile stimulation. Reflexes were documented as present or absent.

Blood Sample Collection and Laboratory Analysis:-

Venous blood sampling was performed between 72 hours and 7 days of life under strict aseptic precautions. Approximately 0.5 ml of venous blood was collected and transferred into a red-top vacutainer. Serum TSH estimation was performed using a two-site immunoenzymometric assay (ST AIA-PACK TSH kit) on the TOSOH AIA automated analyser, in accordance with manufacturer instructions. Internal quality control measures were maintained throughout the study period. Age at sampling in hours was recorded to account for variation related to the physiological neonatal TSH surge.

Interpretation of Thyroid Function:-

TSH values were interpreted based on neonatal reference standards:-

- TSH < 10 μIU/mL was considered normal.
- TSH > 20 μIU/mL was considered suggestive of Presumptive congenital hypothyroidism and repeat testing with free T4 estimation was performed.
- TSH > 40 μIU/mL was considered suggestive of severe congenital hypothyroidism and referred for appropriate management.

Data Management:-

Data were entered into Microsoft Excel and subsequently analyzed using SPSS version 26.

Sample size calculation:-

The sample size was calculated for estimation of prevalence using the standard formula for a single population proportion:

$n = (Z^2 \times p \times q) / d^2$

Where:-

- n = required sample size
- Z = standard normal deviate at 95% confidence level (1.96)
- p = expected prevalence
- q = 1 – p
- d = absolute precision

The expected prevalence (p) was derived from a hospital-based newborn screening study conducted at a tertiary care centre in Kochi, South India, which reported a prevalence of congenital hypothyroidism of 2.1 per 1000 live births.[23]

$p = 2.1/1000 = 0.0021$

$q = 1 - 0.0021 = 0.9979$

Considering 95% confidence interval (Z = 1.96) and absolute precision of 0.296% (d = 0.00296), the sample size was calculated as follows:

$n = ((1.96)^2 \times 0.0021 \times 0.9979) / (0.00296)^2$

$n = (3.8416 \times 0.002095) / 0.00000876$

$n \approx 918$

Statistical analysis :-

Data were entered into Microsoft Excel and analysed using Statistical Package for Social Sciences (SPSS) version 26.0 (IBM Corp., Armonk, NY, USA).

Descriptive Statistics:-

- Continuous variables such as birth weight, gestational age, and TSH levels were expressed as mean ± standard deviation (SD) when normally distributed and as median (interquartile range) when skewed.
- Categorical variables such as gender, mode of delivery, presence of consanguinity, breastfeeding initiation, and elevated TSH status were expressed as frequency and percentage.

Estimation of Prevalence:-

The prevalence of congenital hypothyroidism was calculated as:-

Prevalence=Number of confirmed CH cases/No of Confirmed CH cases×1000

It was expressed as per 1000 live births, along with 95% confidence interval (CI) using exact binomial method.

Inferential Statistics:-

- Association between categorical variables and elevated TSH levels was analysed using Chi-square test.
- Fisher exact test was applied when expected cell frequencies were less than 5.
- Continuous variables between groups were compared using Independent sample t-test or Mann–Whitney U test, depending on data distribution.

A p-value < 0.05 was considered statistically significant. All tests were two-tailed.

Observations and Results:-

Table 1. Maternal Characteristics of the Study Population (n = 919)

Variable	Value
Maternal age (Mean ± SD)	27.08 ± 2.19 years
Median (Range)	27 (20–38)
GDM	53 (5.77%)
PIH	20 (2.18%)
Consanguinity	41 (4.46%)
Hypothyroidism	0
Hyperthyroidism	0
Thyroid medication	0
Radiation exposure	0
Iodized salt use	919 (100%)

The mean maternal age was 27.08 ± 2.19 years, with a median age of 27 years (range: 20–38 years), indicating that most mothers belonged to the optimum reproductive age group. Among maternal risk factors, gestational diabetes mellitus (5.77%), consanguinity (4.46%), and pregnancy-induced hypertension (2.18%) were the most frequently observed. None of the mothers had documented hypothyroidism, hyperthyroidism, thyroid medication use, or radiation exposure during pregnancy. Universal use of iodized salt (100%) was reported among the study population, reflecting adequate iodine supplementation in the maternal cohort.

Table 2. Baseline Characteristics of the Neonates (n = 919)

Variable	Number (%)
Male	489 (53.21)
Female	430 (46.79)
Term	858 (93.36)
Preterm	61 (6.64)
≥2.5 kg	822 (89.45)
<2.5 kg	97 (10.55)
LSCS	544 (59.19)

Variable	Number (%)
NVD	375 (40.81)
APGAR 7 at 1 min	67 (7.29)
APGAR 8 at 1 min	852 (92.71)
APGAR 9 at 5 min	919 (100)

Among the 919 neonates included in the study, there was a slight male predominance (53.21%). The majority were term neonates (93.36%) with a birth weight of ≥2.5 kg (89.45%). Delivery by lower segment caesarean section (59.19%) was more common than normal vaginal delivery. Most neonates had satisfactory birth adaptation, with 92.71% achieving an APGAR score of 8 at one minute, while all neonates (100%) had an APGAR score of 9 at five minutes, indicating good postnatal adaptation and overall favourable neonatal status at birth.

Table 3: Clinical Examination and TSH Profile of the Study Population (n = 919)

Variable	Result
Clinical features suggestive of CH	None detected in any neonate (0%)
Primitive reflexes	Present in all neonates (100%)
Mean serum TSH (± SD)	2.85 ± 4.44 μIU/mL
Median serum TSH	1.56 μIU/mL
Range	0.10–100 μIU/mL
Normal TSH (<20 μIU/mL)	917 (99.78%)
Repeat TSH required (20–40 μIU/mL)	1 (0.11%)
Confirmed CH (>40 μIU/mL)	1 (0.11%)
Prevalence of CH	0.1088% (1.09 per 1000 live births)
95% Confidence Interval	0.003–0.60%

None of the neonates had clinical features suggestive of congenital hypothyroidism, and all primitive neonatal reflexes were intact. The mean serum TSH concentration was 2.85 ± 4.44 μIU/mL (median 1.56 μIU/mL; range 0.10–100 μIU/mL). Among 919 screened neonates, 917 (99.78%) had normal TSH values, one (0.11%) required repeat testing, and one (0.11%) was confirmed to have congenital hypothyroidism, yielding a prevalence of 0.1088% (1.09 per 1000 live births; 95% CI: 0.003–0.60%).

Table 4: TSH Category in Relation to Birth weight, Gestational age and Sex

Variable	Category	Normal	Repeat	Confirmed	Total
Birth Weight	< 2.5 kg	97	0	0	97
	≥ 2.5 kg	820	1	1	822
Gestational Age	Preterm	61	0	0	61
	Term	856	1	1	858
Sex	Male	489	0	0	489
	Female	428	1	1	430

Total		**917**	**1**	**1**	**919**

No statistically significant association was observed. However, the number of confirmed congenital hypothyroidism cases was very low, limiting the power of association testing The confirmed case of congenital hypothyroidism occurred in a neonate with birth weight ≥2.5 kg, born at term, and of female sex. No confirmed cases were observed among low birth weight or preterm neonates. The repeat case also occurred in a term female neonate with normal birth weight. Across all categories, the majority of neonates demonstrated normal TSH levels. Due to the extremely small number of elevated TSH cases, only descriptive comparison was performed.

Discussion:-

Congenital hypothyroidism (CH) is one of the most important preventable causes of intellectual disability and growth failure in children. The introduction of newborn screening has transformed the prognosis of affected infants by enabling early diagnosis and prompt initiation of levothyroxine therapy, thereby preventing irreversible neurodevelopmental impairment.[24] Consequently, neonatal screening for congenital hypothyroidism is now regarded as one of the most successful public health interventions in paediatric practice.

The present prospective hospital-based study was undertaken to estimate the prevalence of congenital hypothyroidism among apparently healthy newborns delivered at a rural tertiary care hospital. A total of 919 neonates were screened between 72 hours and 7 days of life, and one neonate was confirmed to have congenital hypothyroidism following repeat thyroid function testing. The observed prevalence was 0.1088%, corresponding to 1.09 per 1000 live births (approximately 1 in 919 live births). Although only one confirmed case was detected, the prevalence estimate provides valuable epidemiological data for this rural population and contributes to the limited literature available from similar healthcare settings. The calculated 95% confidence interval was wide, reflecting the rarity of the disease and the relatively small sample size, a finding expected in prevalence studies of uncommon disorders.[25]

The ICMR multicentric newborn screening study reported a prevalence of approximately 1 in 1130 live births after excluding transient hypothyroidism, while studies by Kaur et al. and Singh et al. have reported prevalence ranging from 1 in 700 to 1 in 1700 live births across different regions of India.[10,26,27] The findings of the present study therefore fall within the reported national range, supporting the observation that congenital hypothyroidism is relatively more common in Indian newborns than previously believed.

Historically, Western countries reported a prevalence of approximately 1 in 3000–4000 live births.[13] However, more recent reports from the United States and Europe indicate higher detection rates of approximately 1 in 2000–3000 live births, largely attributable to improvements in screening strategies, enhanced assay sensitivity, and lower TSH cut-off values.[28,29] Despite these methodological advances, the prevalence reported from India continues to be higher than that observed in many Western populations. This difference may reflect variations in genetic susceptibility, iodine nutrition, demographic characteristics, and screening methodologies, as well as regional differences in neonatal healthcare practices.[30,31]

An important observation in the present study was that none of the screened neonates exhibited classical clinical features of congenital hypothyroidism at the time of examination, including macroglossia, hypotonia, coarse facies, prolonged jaundice, or umbilical hernia. This finding is consistent with previous newborn screening studies demonstrating that the majority of affected infants are clinically asymptomatic during the neonatal period because maternally derived thyroxine provides partial protection before birth. [24, 32, 33] Consequently, reliance on clinical examination alone would delay diagnosis until irreversible neurological injury has already occurred. The present findings therefore reinforce the indispensable role of biochemical newborn screening for early identification of affected infants.

The present study employed a screening protocol in which blood samples were collected between 72 hours and 7 days of life, thereby avoiding the physiological neonatal TSH surge observed immediately after birth. This approach is consistent with international recommendations and improves screening specificity by reducing false-positive results while maintaining adequate sensitivity. [34,35] Confirmation of abnormal screening results by repeat TSH and free T4 estimation further enhanced diagnostic accuracy and ensured appropriate identification of permanent congenital hypothyroidism.

Overall, the findings of the present study demonstrate that the prevalence of congenital hypothyroidism in this rural tertiary care population is comparable with contemporary Indian data and emphasizes that congenital hypothyroidism remains an important neonatal health problem. Although the prevalence appears numerically low, the lifelong consequences of missed diagnosis are profound. Identification and treatment of even a single affected infant prevents irreversible intellectual disability, improves long-term neurodevelopmental outcomes, and substantially reduces future healthcare and societal burden. These findings support the continued expansion of universal newborn screening programmes, particularly in rural and resource-limited settings where epidemiological data remain limited.

Interpretation of Maternal and Neonatal Characteristics

The maternal and neonatal characteristics observed in the present study were broadly comparable with those reported in previous Indian newborn screening studies. The mean maternal age was 27.08 ± 2.19 years, with most mothers belonging to the optimum reproductive age group. Maternal age has not been established as an independent determinant of congenital hypothyroidism, and the age distribution in the present study was similar to that reported in other hospital-based Indian studies.[10, 36]

Among the maternal risk factors evaluated, gestational diabetes mellitus (5.77%), pregnancy-induced hypertension (2.18%), and consanguinity (4.46%) were the most frequently observed. These frequencies are comparable with those reported in Indian obstetric populations. [36,37,38] Although maternal metabolic and hypertensive disorders may influence fetal growth and transient neonatal endocrine adaptation, current evidence does not support a consistent association with permanent congenital hypothyroidism, which is predominantly caused by thyroid dysgenesis occurring during early embryogenesis.[39] Therefore, no meaningful relationship between these maternal factors and congenital hypothyroidism could be established in the present study.

Consanguinity remains clinically relevant because inherited defects in thyroid hormone synthesis (dyshormonogenesis) follow an autosomal recessive pattern and are more frequently reported in populations with higher rates of consanguineous marriages.[40, 41] However, thyroid dysgenesis continues to account for the majority of permanent congenital hypothyroidism worldwide. [39] In the present study, the relatively low prevalence of consanguinity and the identification of only one confirmed case precluded meaningful assessment of its association with congenital hypothyroidism.

An important observation was the universal use of iodized salt (100%) among participating mothers. Universal salt iodization has substantially reduced iodine deficiency disorders in India and remains one of the most effective public health interventions for preventing thyroid dysfunction.[42] The low frequency of abnormal neonatal TSH values observed in the present study further supports adequate iodine nutrition in the study population.

The neonatal characteristics of the present cohort reflected a predominantly healthy newborn population. Slight male predominance (53.21%) was observed, which is comparable with the normal neonatal sex distribution reported in hospital-based studies. Although some international studies have described a female predominance among confirmed congenital hypothyroidism cases, particularly those due to thyroid dysgenesis, no consistent association between neonatal sex and congenital hypothyroidism has been demonstrated in large newborn screening programmes.[10, 39] Therefore, the present findings support the recommendation for universal newborn screening irrespective of sex.

The majority of neonates were term infants (93.36%) and had a birth weight ≥2.5 kg (89.45%). These findings are important because preterm and low birth weight infants are more likely to exhibit transient abnormalities of thyroid function due to immaturity of the hypothalamic–pituitary–thyroid axis, often necessitating repeat screening. [34, 43 44] The predominance of term, normal birth weight neonates in the present study probably contributed to the low recall rate and reduced the likelihood of transient elevations in TSH.

More than half of the neonates (59.19%) were delivered by lower segment caesarean section, reflecting the obstetric profile of a tertiary care referral centre. Although operative delivery may produce transient alterations in neonatal endocrine responses because of perinatal stress, there is no convincing evidence to suggest an association with permanent congenital hypothyroidism.[45] Accordingly, mode of delivery in the present study should be interpreted as a demographic characteristic rather than a causal factor.

The neonatal condition at birth was satisfactory, as demonstrated by favourable APGAR scores. Nearly all neonates achieved an APGAR score of 8 at one minute and 9 at five minutes, indicating successful transition to extrauterine life. Severe perinatal stress or birth asphyxia has been reported to transiently influence thyroid hormone concentrations; however, the uniformly good APGAR scores in the present cohort minimized this potential source of confounding.[45]

No statistically significant association was observed between congenital hypothyroidism and maternal or neonatal characteristics in the present study. However, this finding should be interpreted cautiously because only one confirmed case of congenital hypothyroidism was detected. The primary objective of the study was to estimate prevalence rather than identify risk factors, and the study was not adequately powered to detect associations between individual maternal or neonatal variables and congenital hypothyroidism. Larger multicentric studies with greater numbers of confirmed cases would be required to evaluate these relationships more robustly.

Overall, the maternal and neonatal characteristics of the present cohort are representative of a rural tertiary care hospital population. The findings indicate that congenital hypothyroidism can occur even in apparently healthy term neonates without identifiable maternal or neonatal risk factors, thereby emphasizing the importance of universal newborn screening rather than selective screening based on perceived risk.

TSH Findings, Screening Methodology, and Public Health Implications:-

The principal objective of the present study was to determine the prevalence of congenital hypothyroidism through biochemical screening using serum thyroid-stimulating hormone (TSH) estimation. The mean serum TSH concentration among the screened neonates was 2.85 ± 4.44 µIU/mL, with a median of 1.56 µIU/mL and a range of 0.10–100 µIU/mL. The TSH distribution demonstrated a right-skewed pattern, with most neonates having values within the normal range and a single markedly elevated value corresponding to the confirmed case of congenital hypothyroidism. Such a distribution is characteristic of newborn screening populations and reflects the low prevalence of the disorder. [39,46]

Among the 919 neonates screened, 917 (99.78%) had normal TSH values, one neonate (0.11%) required repeat testing because of a borderline elevation, and one neonate (0.11%) was confirmed to have congenital hypothyroidism after repeat TSH and free T4 estimation. The markedly elevated TSH level (>100 µIU/mL) associated with low free T4 strongly supported the diagnosis of permanent primary congenital hypothyroidism. These findings are consistent with international paediatric endocrine guidelines, which recommend confirmation of abnormal screening results using repeat thyroid function tests before establishing the diagnosis. [34,39]

Appropriate timing of sample collection is a critical determinant of newborn screening accuracy. Neonatal thyroid physiology is characterized by a transient surge in TSH immediately after birth, which gradually declines over the first 48–72 hours of life. Screening during this physiological surge may result in false-positive results and unnecessary recalls.[34,35] To minimize this effect, blood samples in the present study were collected between 72 hours and 7 days of life, consistent with internationally accepted recommendations. This strategy reduced the influence of physiological TSH elevation while maintaining adequate sensitivity for detecting congenital hypothyroidism.

The low recall rate observed in the present study further supports the effectiveness of this screening protocol. Only one neonate required repeat testing, suggesting high specificity with minimal parental anxiety and reduced healthcare costs. Confirmation by repeat TSH and free T4 estimation ensured accurate differentiation between transient TSH elevation and permanent congenital hypothyroidism, thereby preventing both unnecessary treatment and missed diagnoses. The methodology adopted in the present study therefore reflects a practical and reliable approach for newborn screening in routine clinical practice.

An important observation was that none of the neonates exhibited classical clinical features of congenital hypothyroidism at the time of screening, despite one neonate having severe biochemical hypothyroidism. Previous studies have consistently demonstrated that most affected newborns are clinically asymptomatic because maternally derived thyroxine provides temporary hormonal support during fetal life, delaying the appearance of characteristic clinical manifestations. [24, 32, 33] The present findings reinforce the concept that congenital hypothyroidism is primarily a biochemical diagnosis in the neonatal period and that reliance on clinical examination alone would result in delayed diagnosis and irreversible neurodevelopmental impairment.

The prevalence observed in the present study (1.09 per 1000 live births) is consistent with contemporary Indian literature and demonstrates that congenital hypothyroidism is not an uncommon disorder in the neonatal population. Although only one confirmed case was identified, the clinical significance of this finding is considerable. Early detection followed by prompt initiation of levothyroxine therapy can prevent irreversible intellectual disability, ensure normal growth and neurodevelopment, and substantially improve long-term quality of life.[24] The diagnosis of even a single affected infant therefore represents an important clinical and public health achievement.

From a public health perspective, the findings of this study support the continued expansion of universal newborn screening programmes, particularly in rural and resource-limited settings where epidemiological data remain limited. The successful implementation of screening in a rural tertiary care hospital demonstrates that such programmes are feasible and can effectively identify clinically silent cases before irreversible neurological damage occurs. Early diagnosis not only improves individual patient outcomes but also reduces the long-term economic and societal burden associated with lifelong disability.

Overall, the present study demonstrates that screening performed between 72 hours and 7 days of life, followed by confirmatory thyroid function testing, is an effective strategy for the early detection of congenital hypothyroidism. The findings emphasize that biochemical screening is indispensable because clinical examination alone is insufficient during the neonatal period. Expansion of universal newborn screening programmes across rural healthcare facilities has the potential to substantially reduce the burden of preventable intellectual disability and improve neonatal health outcomes in India.

The present study identified one female neonate with confirmed congenital hypothyroidism among 919 screened newborns. The diagnosis was established following detection of markedly elevated serum TSH levels (>100 μIU/mL) with low free T4 on repeat testing, fulfilling the biochemical criteria for primary congenital hypothyroidism. Ultrasonography of the neck demonstrated non-visualization of the thyroid gland, suggestive of thyroid agenesis, while radiographic evaluation showed delayed appearance of the distal femoral epiphyseal ossification centre, supporting antenatal onset of thyroid hormone deficiency. These findings are consistent with previous reports indicating that thyroid dysgenesis, particularly thyroid agenesis, is the commonest cause of permanent congenital hypothyroidism.

Despite severe biochemical hypothyroidism, the neonate had no classical clinical manifestations such as macroglossia, hypotonia, coarse facies, umbilical hernia, or prolonged feeding difficulty at the time of screening. This observation is in agreement with previous newborn screening studies demonstrating that maternally transferred thyroxine temporarily masks clinical manifestations during the neonatal period, making early diagnosis based solely on physical examination unreliable. [24, 32, 33] The present case therefore highlights the indispensable role of biochemical newborn screening in identifying affected infants before irreversible neurological damage occurs.
The confirmed case fulfilled all inclusion criteria and none of the exclusion criteria adopted in the present study. There was no maternal history of thyroid disease, antithyroid drug exposure, gestational diabetes mellitus, pregnancy-induced hypertension, or consanguinity. The neonate was born at term with normal birth weight and satisfactory APGAR scores, emphasizing that congenital hypothyroidism may occur in apparently healthy newborns without identifiable maternal or neonatal risk factors. This finding further supports the recommendation that newborn thyroid screening should be universal rather than risk-based, as selective screening would fail to identify many affected infants.

The identification of a single confirmed case also validates the screening protocol adopted in the present study. Collection of blood samples between 72 hours and 7 days of life, followed by confirmatory estimation of serum TSH and free T4, enabled accurate differentiation of permanent congenital hypothyroidism from transient neonatal thyroid dysfunction. The markedly elevated TSH level together with low free T4 and imaging evidence of thyroid agenesis confirmed permanent primary congenital hypothyroidism and justified immediate initiation of levothyroxine therapy. Early treatment in such infants has been consistently shown to normalize growth and neurodevelopment and prevent irreversible intellectual disability. [24, 34, 39]

The findings of the present study have important public health implications. Although the prevalence of congenital hypothyroidism was low (1.09 per 1000 live births), the consequences of an undiagnosed case are lifelong and irreversible. Early identification through newborn screening provides an opportunity for timely intervention during the critical period of brain development, thereby preventing cognitive impairment and improving long-term quality of life. From a health systems perspective, newborn screening for congenital hypothyroidism is recognized as one of

the most cost-effective preventive interventions in paediatric practice because the cost of screening and treatment is substantially lower than the lifelong social and economic burden associated with untreated disease.[29]

The present study also demonstrates the feasibility of implementing newborn screening in a rural tertiary care hospital. Most published Indian studies have originated from urban tertiary centres, whereas data from rural populations remain limited. The successful identification of a clinically asymptomatic but biochemically confirmed case in the present study highlights the need for strengthening newborn screening services in rural healthcare settings. Expansion of such programmes, coupled with timely confirmatory testing, treatment, and long-term follow-up, would contribute significantly to reducing preventable neurodevelopmental disability in India.

In conclusion, the present study demonstrated a prevalence of 1.09 cases of congenital hypothyroidism per 1000 live births, comparable with contemporary Indian data. The confirmed case of thyroid agenesis emphasizes that congenital hypothyroidism is frequently clinically silent during the neonatal period and can only be reliably detected through biochemical screening. These findings strongly support the implementation of universal newborn screening programmes, particularly in rural and resource-limited settings, to ensure early diagnosis, prompt initiation of levothyroxine therapy, and prevention of irreversible neurodevelopmental impairment. The study adds valuable epidemiological data from a rural tertiary care hospital and reinforces the importance of integrating newborn screening into routine neonatal healthcare services.

Confirmed Case of Congenital Hypothyroidism

Among the 919 neonates screened between 72 hours and 7 days of life, one female neonate was diagnosed with congenital hypothyroidism, corresponding to a prevalence of 1.09 per 1000 live births. The diagnosis was established through detailed clinical, biochemical, and radiological evaluation and was consistent with permanent primary congenital hypothyroidism due to thyroid agenesis.

The infant was delivered at term by lower segment cesarean section on 4 October 2025 at 6:00 PM in view of a previous cesarean delivery. She cried immediately after birth, passed urine and meconium within 24 hours, and required neither resuscitation nor neonatal intensive care admission. Birth weight was 2.7 kg, length was 50 cm, and head circumference was 34.5 cm, with all anthropometric parameters being appropriate for gestational age. APGAR scores were satisfactory.

The mother was a 26-year-old G2P1L1 woman from a non-consanguineous marriage with an uneventful antenatal course. Routine antenatal investigations, including dating, nuchal translucency, and anomaly scans, were normal. She received standard antenatal supplementation with folic acid, iron, and calcium. There was no history of maternal thyroid disease, gestational diabetes mellitus, pregnancy-induced hypertension, autoimmune disorders, teratogenic drug exposure, or antepartum complications.

Clinical examination revealed a well-appearing neonate with no dysmorphic features or classical manifestations of congenital hypothyroidism, such as macroglossia, hypotonia, umbilical hernia, coarse facies, or goiter. Neonatal reflexes were appropriate for age. The absence of these characteristic signs in the neonatal period is attributable to transplacental transfer of maternal thyroid hormones, which often masks the early manifestations of congenital hypothyroidism.

On the fourth day of life, the neonate developed neonatal hyperbilirubinemia with a total serum bilirubin level of 16.4 mg/dL and direct bilirubin of 0.41 mg/dL. Double-surface phototherapy was administered for 24 hours, following which bilirubin levels declined and clinical improvement was observed.

Newborn thyroid screening revealed markedly elevated thyroid-stimulating hormone (TSH) levels exceeding 100 µIU/mL, associated with reduced thyroid hormone concentrations (free T4 <0.9 ng/dL and T3 0.20 ng/mL). Repeat testing confirmed persistent hypothyroidism, with TSH remaining elevated at 72.46 µIU/mL and free T4 measuring 0.511 ng/dL. Following initiation of levothyroxine therapy, TSH normalized to 3.91 µIU/mL.

Further metabolic evaluation, including amino acid profile, acylcarnitine profile, screening for congenital adrenal hyperplasia, galactosemia, and biotinidase deficiency, was normal. Serum electrolytes were within normal limits. Radiological assessment demonstrated delayed skeletal maturation, evidenced by the absence of distal femoral

epiphyseal ossification centers. Imaging also revealed complete non-visualization of thyroid tissue, confirming thyroid agenesis and indicating antenatal onset of hypothyroidism.

The diagnosis of permanent primary congenital hypothyroidism secondary to thyroid dysgenesis was established based on the combination of markedly elevated TSH, persistently low free T4, absent thyroid tissue, and delayed bone age. This case is particularly noteworthy because the neonate remained clinically asymptomatic despite profound biochemical abnormalities and complete thyroid agenesis. The diagnosis was made solely through universal newborn screening, underscoring the limitations of clinical examination alone in the neonatal period.

The uniqueness of this case lies in the presence of severe congenital hypothyroidism in an infant born to a mother without identifiable risk factors and the absence of classical clinical signs at presentation. Radiological evidence of delayed skeletal maturation suggested intrauterine onset of disease, while thyroid agenesis confirmed permanent hypothyroidism. As the only confirmed case identified among 919 screened neonates, this case validates the screening methodology employed in the present study and highlights the indispensable role of universal newborn screening programs in facilitating early diagnosis and timely intervention, thereby preventing irreversible neurodevelopmental sequelae.

Summary:-

Congenital hypothyroidism (CH) is a deficiency of thyroid hormone present at birth, often caused by an abnormally developed thyroid gland. Affected infants develop irreversible neurodevelopmental impairment, growth failure, and long-term socioeconomic disability. The introduction of newborn screening programs has dramatically transformed the prognosis of this disorder by enabling presymptomatic diagnosis and timely initiation of levothyroxine therapy. Given emerging evidence suggesting relatively higher prevalence rates of congenital hypothyroidism in India compared to earlier Western reports, regional epidemiological data are essential to guide implementation of universal newborn screening programs.

The present prospective observational study was conducted in a rural tertiary care hospital with the primary objective of estimating the prevalence of congenital hypothyroidism among apparently healthy neonates. Secondary objectives included analysis of maternal and neonatal demographic variables in relation to thyroid function and evaluation of the feasibility of hospital-based newborn screening in a rural setting.

A total of 919 neonates were enrolled consecutively over the study period. Only clinically stable neonates between 72 hours and 7 days of life were included to avoid confounding by the physiological neonatal TSH surge and by non-thyroidal illness. Neonates born to mothers with overt thyroid disease or receiving antithyroid medications were excluded to prevent misclassification of transient or secondary thyroid dysfunction as congenital primary hypothyroidism.

Serum thyroid stimulating hormone (TSH) levels were measured using a standardized immunoenzymometric assay. The screening algorithm categorized TSH values as follows: values below 20 µIU/mL were considered normal; values between 20 and 40 µIU/mL required repeat testing; values exceeding 40 µIU/mL were considered highly suggestive of congenital hypothyroidism and were confirmed with repeat TSH and free T4 estimation.
Among the 919 neonates screened, 917 (99.78%) had TSH values within normal limits. One neonate (0.11%) had a borderline elevation requiring repeat testing. One neonate (0.11%) demonstrated markedly elevated TSH (100 µIU/mL) with low free T4 on confirmation and was diagnosed with congenital hypothyroidism. The calculated prevalence of congenital hypothyroidism in this cohort was 0.1088%, corresponding to 1.09 per 1000 live births or approximately 1 in 919 live births. The 95% exact Clopper–Pearson confidence interval ranged from 0.003% to 0.60%.

The demographic profile of the screened population revealed a predominance of term neonates (93.36%) and normal birth weight infants (89.45% ≥2.5 kg). The male-to-female distribution was comparable to expected neonatal ratios. Lower segment cesarean section accounted for 59.19% of deliveries, reflecting institutional referral patterns rather than disease association. Maternal variables included gestational diabetes mellitus in 5.77% of mothers, pregnancy induced hypertension in 2.18%, and consanguinity in 4.46%. Universal iodised salt usage was reported, suggesting adequate iodine nutrition in the population.

The serum TSH distribution demonstrated a mean of 2.85 μIU/mL, median of 1.56 μIU/mL, standard deviation of 4.44, and a range of 0.10 to 100 μIU/mL. The distribution was right-skewed, reflecting the presence of a single markedly elevated outlier corresponding to the confirmed case. This pattern is characteristic of screening populations, where the majority of neonates cluster within normal ranges and rare high values represent clinically significant disease.

The observed prevalence aligns closely with contemporary Indian studies, including the ICMR multicentric screening report which documented prevalence approximating 1:1130 live births. International comparisons indicate lower prevalence in many Western countries, often between 1:2000 and 1:3000 live births, though methodological differences influence such comparisons. The relatively higher prevalence observed in Indian cohorts may reflect genetic heterogeneity, evolving iodine nutrition patterns, and variations in screening thresholds.

Importantly, none of the neonates, including the confirmed case, exhibited classical clinical features of congenital hypothyroidism at the time of screening. This finding reinforces the well-established principle that congenital hypothyroidism is frequently clinically silent in the neonatal period due to transplacental maternal thyroxine transfer. Biochemical screening is therefore essential for early detection.

The study demonstrated a very low recall rate (0.11%), indicating high specificity of the screening protocol. Sampling after 72 hours likely minimized false positive results related to the neonatal TSH surge. The number needed to screen to detect one confirmed case was 919, a figure that is acceptable given the severity and preventability of the condition.

From a public health perspective, extrapolation of the observed prevalence suggests that approximately 10 to 11 infants per 10,000 births in similar populations may be affected annually. Without systematic screening, these children would be at risk of delayed diagnosis and irreversible neurodevelopmental impairment. Early initiation of levothyroxine therapy within the first two weeks of life has been shown to normalize cognitive outcomes.In my study, CH is caused by Thyroid dysgenesis (Deficiency in Thyroid gland development) In summary, this study confirms that congenital hypothyroidism in this rural tertiary care population occurs at a prevalence comparable to national Indian data. The findings demonstrate the feasibility of hospital-based newborn screening in rural settings, highlight the silent clinical presentation of affected neonates, and support expansion of universal newborn screening programs.

Conclusion:-

Congenital hypothyroidism is a treatable cause of preventable intellectual disability, resulting from a thyroid hormone deficiency present at birth. Early detection via newborn screening and prompt lifelong treatment are critical, allowing most children to develop normally. The present prospective observational study conducted in a rural tertiary care hospital identified congenital hypothyroidism at a prevalence of 1.09 per 1000 live births (approximately 1 in 919 live births). This prevalence is consistent with contemporary Indian epidemiological data and underscores the public health relevance of the disorder in rural populations.

The study demonstrated that congenital hypothyroidism is frequently clinically silent in the neonatal period, reinforcing the necessity of biochemical screening rather than reliance on clinical examination alone. The screening protocol adopted, including appropriate sampling timing and evidence-based TSH cut-off values, resulted in high specificity and minimal recall burden while successfully detecting a confirmed case.

These findings strongly support the implementation and strengthening of universal newborn screening programs for congenital hypothyroidism in rural and semi-urban healthcare settings. Early identification and prompt initiation of levothyroxine therapy can prevent irreversible intellectual disability and significantly reduce long-term societal burden.

The present study demonstrated a prevalence of 1.09 per 1000 live births in a rural tertiary care setting. Although the number of confirmed cases was low and the confidence interval wide, early detection of even a single case highlights the clinical and public health importance of neonatal thyroid screening. The findings support the feasibility of implementing routine newborn screening programs in rural healthcare institutions. Larger multi-centric studies are required for more precise prevalence estimates and risk factor evaluation.

Expansion of structured newborn screening services, establishment of reliable recall systems, and integration with existing maternal and child health programs are recommended to ensure timely diagnosis and follow-up. Congenital hypothyroidism screening should be regarded as an essential component of neonatal healthcare delivery.

The key conclusions of the present study regarding congenital hypothyroidism include:-

- Preventable disability
- Newborn screening is crucial
- Effective treatment
- outcome – while untreated cases can lead to permanent severe intellectual disability and stunted growth, timely treatment provides an excellent prognosis.

Limitations of the Study:-

Single-centre study:-
The study was conducted in one rural tertiary care hospital, so the results may not represent the entire community population.

Small number of confirmed cases:-
Only one case of congenital hypothyroidism was identified. Because of this low number, statistical comparison between groups was limited.

Not powered for association analysis:-
The study was mainly designed to estimate prevalence, not to find risk factors. Therefore, absence of statistical significance does not mean absence of association.

Wide confidence interval:-
The confidence interval for prevalence was wide due to the low event rate. Larger studies are needed for more precise estimates.

TSH-only screening:-
Screening was done using TSH levels only. Rare cases of central hypothyroidism might not have been detected.

Iodine status not assessed:-
Maternal and neonatal iodine levels were not measured.

No long-term follow-up:-
The study focused on early detection and did not assess long-term neurodevelopmental outcomes.

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