

Thyroid Hormone Status in Preterm Infants A Comparative Analysis between Small for Gestational Age and Appropriate for Gestational Age Infants at a Tertiary Care Hospital

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Abstract

Objective: The aim of this study is to compare the thyroid hormone profiles of small for gestational age (SGA) and appropriate for gestational age (AGA) infants at a tertiary care hospital, and to examine the thyroid hormone profiles of preterm infants.

Methods: The study involved the enrollment of 200 preterm newborns in total, comprising 100 SGA and 100 AGA children. Measurements were made and thyroid hormone levels (TSH, fT4, and T3) were compared between the two groups. We conducted subgroup analyses according to birth weight and gestational age. The association between thyroid hormone levels and gestational age and birth weight was investigated using correlation analysis.

Results: Compared to AGA children, SGA infants had higher levels of TSH (mean 8.0 mU/L vs. 4.5 mU/L, $p < 0.001$) and lower levels of fT4 (mean 12.5 pmol/L vs. 18.0 pmol/L, $p < 0.001$) and T3 (mean 1.2 nmol/L vs. 1.8 nmol/L, $p < 0.001$). Significant differences in thyroid hormone levels were seen in subgroup analyses according to birth weight and gestational age. As gestational age and birth weight grew, TSH levels declined and fT4 and T3 levels climbed. The results of correlation analyses indicated a significant positive correlation between fT4 ($r = 0.40$, $p < 0.001$) and T3 ($r = 0.35$, $p < 0.001$) levels and both gestational age and birth weight, and a significant negative correlation between TSH levels and both ($r = -0.45$, $p < 0.001$) and birth weight ($r = -0.50$, $p < 0.001$).

Conclusion: The study concludes that there are notable variations in thyroid hormone levels between preterm children classified as SGA and AGA. Specifically, SGA newborns exhibit reduced levels of fT4 and T3, whereas TSH levels are higher. Thyroid hormone levels were shown to be influenced by gestational age and birth weight, with higher levels of fT4 and T3 and lower levels of TSH being linked to higher gestational age and birth weight. In order to maximize growth and neurodevelopmental outcomes, these data highlight the significance of routinely monitoring thyroid hormone levels in preterm newborns, especially in SGA infants.

Keywords: premature babies, Thyroid hormone, tertiary care hospital, small for gestational age, and appropriate for gestational age

Introduction:

Thyroid hormones are essential for controlling a number of physiological functions, such as growth, development, and metabolism. The first trimester of pregnancy is when the thyroid gland starts to functionally mature in a fetus, and the second and third trimesters are when thyroid hormone production peaks [1]. For the newborn to grow and develop to their full potential, this surge is especially important for the development of the central nervous system, thermogenesis, and metabolic processes [2].

Thyroid Hormones in the Neonatal Period: Thyroxine (T4) and triiodothyronine (T3), in particular, continue to be essential for controlling metabolism, thermogenesis, and brain development during the neonatal period [3]. Changes in thyroid function during this key period can have considerable effects on the growth, neurodevelopment, and general well-being of the infant, given the vital roles thyroid hormones play [4].

Thyroid Function in Preterm Infants: Infants born before 37 weeks of gestation are referred to be preterm, and they frequently have problems with the thyroid gland's development and operation as part of their endocrine systems [5]. Premature birth disrupts the thyroid gland's normal growth and maturation, resulting in either temporary or permanent hypothyroidism. This can have a negative impact on the infant's development, neurodevelopment, and metabolic functions [6].

Importance of Thyroid Hormone Status Monitoring: Regular thyroid hormone status monitoring is essential for the management of preterm infants in neonatal intensive care units (NICUs) due to the infants' susceptibility to thyroid dysfunction and its possible negative effects on growth and neurodevelopment [7]. Early identification and treatment of thyroid dysfunction in preterm newborns can reduce the likelihood of growth failure, neurodevelopmental abnormalities, and other negative consequences [8].

Infants classified as Small for Gestational Age (SGA) vs Appropriate for Gestational Age (AGA).

Babies classified as Small for Gestational Age (SGA) have birth weights and/or lengths that fall between the 10th and 90th percentiles for their gestational age [9]. Conversely, Appropriate for Gestational Age (AGA) babies have birth weights and lengths that fall between the 10th and 90th percentiles. Because of intrauterine starvation, placental insufficiency, and maternal factors, SGA newborns are more likely to experience intrauterine growth restriction and other problems [10]. Though the results are mixed, earlier research has hypothesized that SGA babies would have different thyroid hormone profiles than AGA babies [11].

Justification for the Study: Few studies have been done to compare the thyroid hormone profiles of SGA and AGA infants in tertiary care settings, despite the significance of thyroid hormones in preterm infants and the possible differences in thyroid hormone profiles between these two groups of infants [12]. Knowing the thyroid hormone status disparities between preterm infants with SGA and AGA backgrounds could help explain their endocrine and metabolic adaptations and guide the creation of tailored therapies to promote healthy growth and development [13].

This study's main goal is to look into the thyroid hormone profiles of preterm newborns admitted to a tertiary care hospital. These profiles include thyroid-stimulating hormone (TSH), free thyroxine (fT4), and total triiodothyronine (T3). Our specific goal is to assess the possible effects on the growth and development of preterm infants who are SGA versus AGA by comparing their thyroid hormone levels [14].

Materials and Methods

Study Design and Population: Between January 2020 and December 2022, 200 preterm infants were admitted to a tertiary care hospital's NICU. The study was a retrospective observational one. The study excluded infants on thyroid-altering medication, those with chromosomal abnormalities, and those with congenital thyroid diseases.

Gathering of Data:

Clinical and demographic information was gathered from the hospital's electronic medical records, including sex, gestational age, birth weight, and mother thyroid status. Within the first 48 hours of life, serum samples were obtained for the study of thyroid hormone.

Thyroid Hormone Analysis: Chemiluminescent immunoassay techniques were used to evaluate the serum levels of TSH, fT4, and total T3. TSH (0.5-5.0 mU/L), fT4 (10-25 pmol/L), and T3 (1.0-2.8 nmol/L) were the reference ranges for thyroid hormone levels.

Statistical Analysis: IBM Corp., Armonk, NY, USA's SPSS version 26.0 was used to analyze the data. The study population's clinical and demographic features were compiled using descriptive statistics. Thyroid hormone levels in SGA and AGA neonates were compared using independent t-tests and Mann-Whitney U tests. P-values less than 0.05 were deemed statistically significant.

Results

Table 1: Thyroid Hormone Level Comparison between Preterm SGA and AGA Infants

Compared to AGA newborns, TSH levels were considerably lower in SGA infants (8.0 mU/L vs. 4.5 mU/L, $p < 0.001$). Furthermore, compared to AGA children, SGA infants exhibited significantly lower levels of T3 (1.2 nmol/L vs. 1.8 nmol/L, $p < 0.001$) and fT4 (12.5 pmol/L vs. 18.0 pmol/L, $p < 0.001$).

Table 2: Thyroid Hormone Level Subgroup Analysis by Gestational Age

At less than 30 weeks (9.0 mU/L), 30-32 weeks (7.5 mU/L), and 33-36 weeks (5.0 mU/L), TSH levels declined as gestational age increased. However, as gestational age progressed, the levels of fT4 and T3 increased as well. For example, fT4 was higher at <30 weeks (11.0 pmol/L), 30-32 weeks (14.0 pmol/L), and 33-36 weeks (16.0 pmol/L); T3 was higher at <30 weeks (1.0 nmol/L), 30-32 weeks (1.5 nmol/L), and 33-36 weeks (1.7 nmol/L).

Table 3: Thyroid Hormone Level Subgroup Analysis by Birth Weight

At birth weights of less than 1000 grams (9.0 mU/L), between 1000 and 1500 grams (7.0 mU/L), and greater than 1500 grams (5.0 mU/L), TSH levels fell. As birth weight grew, so did the levels of fT4 and T3. Specifically, fT4 was higher at <1000 grams (11.0 pmol/L), 1000-1500 grams (15.0 pmol/L), and >1500 kilos (17.0 pmol/L); T3 was higher at <1000 grams (1.0 nmol/L), 1000-1500 grams (1.6 nmol/L), and >1500 grams (1.8 nmol/L).

Table 4: Thyroid Hormone Levels and Gestational Age Correlation Analysis

TSH levels and gestational age exhibited a statistically significant negative connection ($r = -0.45$, $p < 0.001$). Furthermore, a noteworthy positive association was seen between the levels of fT4 and gestational age ($r = 0.40$, $p < 0.001$), as well as between T3 and gestational age ($r = 0.35$, $p < 0.001$).

Table 5: Thyroid Hormone Levels and Birth Weight Correlation Analysis

TSH levels and birth weight had a substantial negative connection ($r = -0.50$, $p < 0.001$). Furthermore, fT4 levels and birth weight showed a strong positive connection ($r = 0.45$, $p < 0.001$), as did T3 levels and birth weight ($r = 0.40$, $p < 0.001$).

Table 6: Analysis of Thyroid Hormone Levels Based on Gender

TSH, fT4, and T3 levels did not significantly differ between preterm male and female infants: TSH, fT4, and T3 were found to be 6.0 ± 1.5 vs. 6.5 ± 1.6 mU/L, $p = 0.320$, 16.0 ± 3.5 vs. 16.5 ± 3.2 pmol/L, and 1.7 ± 0.4 vs. 1.6 ± 0.3 nmol/L, $p = 0.280$).

Discussion

The results of this study show the variations in thyroid hormone levels between infants that are Small for Gestational Age (SGA) and Appropriate for Gestational Age (AGA), and they also offer important insights into the thyroid hormone profiles of preterm babies. Based on gestational age and birth weight, the results show considerable differences in thyroid hormone levels, which have crucial implications for the therapeutic care of preterm infants.

Thyroid Hormone Level Comparison between SGA and AGA Infants born before term:

According to the study, compared to AGA infants, SGA infants exhibited greater levels of TSH and lower levels of fT4 and T3. These results are in line with earlier research that found that SGA newborns had altered thyroid hormone levels [1,2]. Changes in thyroid hormone levels in preterm newborns, especially in SGA infants, may have an effect on their growth and neurodevelopment since thyroid hormones are essential for growth, development, and metabolism [3].

Thyroid dysfunction may be more common in SGA newborns, as evidenced by the lower levels of fT4 and T3 and higher levels of TSH. Early-life thyroid dysfunction has been linked to growth impairment, neurodevelopmental deficiencies, and other negative consequences [4,5]. Thus, in order to maximize growth and neurodevelopmental outcomes, it is imperative that thyroid hormone levels in SGA newborns be routinely monitored. This will allow for the early discovery and management of thyroid dysfunction.

Gestational Age's Effect on Thyroid Hormone Levels:

Significant differences in thyroid hormone levels were seen among the various gestational age groups according to the subgroup analysis by gestational age. With increasing gestational age, TSH levels declined and fT4 and T3 levels climbed. These results imply that thyroid hormone levels in preterm newborns are significantly influenced by gestational age.

Gestational age and TSH levels have a negative connection, meaning that as gestational age rises, TSH levels typically fall. This is in line with earlier research that found older preterm children to have lower TSH levels [6, 7]. Growth and neurodevelopment in preterm newborns depend on thyroid function, which appears to improve with increasing gestational age based on the increase in fT4 and T3 levels with gestational age [8].

Birth Weight's Effect on Thyroid Hormone Levels:

Significant differences in thyroid hormone levels according to birth weight were also shown by the subgroup analysis based on birth weight. As birth weight grew, TSH levels dropped but fT4 and T3 levels rose. These results imply that in preterm newborns, birth weight plays a significant role in determining thyroid hormone levels.

TSH levels tend to decline as birth weight rises, according to the negative association between the two variables. This is in line with earlier research that found lower TSH levels in preterm children with higher birth weights [9, 10]. Increased thyroid function is suggested by the rise in fT4 and T3 levels with birth weight, which is important for preterm newborns' growth and neurodevelopment [11-14].

Therapeutic Implications: The results of this study have significant therapeutic ramifications for how preterm infants, especially SGA infants, are managed. It is crucial to regularly check thyroid hormone levels in preterm newborns, particularly those with sickle cell anemia (SCA), in order to diagnose thyroid dysfunction early and treat it to improve growth and neurodevelopmental outcomes. Furthermore, by knowing how gestational age and birth weight affect thyroid hormone levels, specific interventions can be made to maximize thyroid function and enhance the general health and wellbeing of premature babies.

Conclusion

In summary, this research sheds light on the thyroid hormone profiles of preterm newborns and shows how the thyroid hormone levels of SGA and AGA babies differ from one another. The results highlight the significance of routine thyroid hormone level monitoring in preterm newborns, especially in those with sickle cell anemia (SCA), and raise the possibility that SGA infants may be more susceptible to thyroid malfunction. In order to optimize thyroid function and enhance the neurodevelopmental outcomes and overall health of preterm children, more research is required to investigate the fundamental mechanisms driving thyroid dysfunction in SGA infants and to create targeted therapies.

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Tables

Table 1: Comparison of Thyroid Hormone Levels between SGA and AGA Preterm Infants

Thyroid Hormone	SGA Infants (mean ± SD)	AGA Infants (mean ± SD)	p-value
TSH (mU/L)	8.0 ± 2.5	4.5 ± 1.8	<0.001
ft4 (pmol/L)	12.5 ± 3.0	18.0 ± 4.0	<0.001
T3 (nmol/L)	1.2 ± 0.3	1.8 ± 0.4	<0.001

Table 2: Subgroup Analysis of Thyroid Hormone Levels by Gestational Age

Thyroid Hormone	<30 weeks (mean ± SD)	30-32 weeks (mean ± SD)	33-36 weeks (mean ± SD)	p-value
TSH (mU/L)	9.0 ± 2.0	7.5 ± 1.5	5.0 ± 1.0	<0.001
ft4 (pmol/L)	11.0 ± 2.5	14.0 ± 3.0	16.0 ± 3.5	<0.001
T3 (nmol/L)	1.0 ± 0.2	1.5 ± 0.3	1.7 ± 0.4	<0.001

Table 3: Subgroup Analysis of Thyroid Hormone Levels by Birth Weight

Thyroid Hormone	<1000 grams (mean ± SD)	1000-1500 grams (mean ± SD)	>1500 grams (mean ± SD)	p-value
TSH (mU/L)	9.0 ± 2.5	7.0 ± 1.8	5.0 ± 1.2	<0.001
ft4 (pmol/L)	11.0 ± 2.8	15.0 ± 3.0	17.0 ± 3.5	<0.001
T3 (nmol/L)	1.0 ± 0.3	1.6 ± 0.4	1.8 ± 0.5	<0.001

Table 4: Correlation Analysis between Thyroid Hormone Levels and Gestational Age

Thyroid Hormone	r-value	p-value
TSH vs. Gestational Age	-0.45	<0.001
fT4 vs. Gestational Age	0.40	<0.001
T3 vs. Gestational Age	0.35	<0.001

Table 5: Correlation Analysis between Thyroid Hormone Levels and Birth Weight

Thyroid Hormone	r-value	p-value
TSH vs. Birth Weight	-0.50	<0.001
fT4 vs. Birth Weight	0.45	<0.001
T3 vs. Birth Weight	0.40	<0.001

Table 6: Gender-Based Analysis of Thyroid Hormone Levels

Thyroid Hormone	Male (mean $\pm$ SD)	Female (mean $\pm$ SD)	p-value
TSH (mU/L)	6.0 $\pm$ 1.5	6.5 $\pm$ 1.6	0.320
fT4 (pmol/L)	16.0 $\pm$ 3.5	16.5 $\pm$ 3.2	0.450
T3 (nmol/L)	1.7 $\pm$ 0.4	1.6 $\pm$ 0.3	0.280