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Original Research Article

A RETROSPECTIVE ANALYSISOF TSH RESULTSOF CHILDREN UNDER THE AGE OF FIVE YEARS ANALYSED AT THE NAMIBIA INSTITUTE OF PATHOLOGY, WINDHOEK, NAMIBIA

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Abstract: Thyroid hormones are essential for central nervous system development and growth of the babies. Thyroid disorders can negatively affect the normal metabolic processes within the body and cause permanent mental retardation in children. Neonatal screening, with thyroid stimulation hormone (TSH) as a screening tool, can give a better understanding of the foetal thyroid function. A retrospective cross sectional study was conducted over a six year period from 2009 to 2014 on TSH records collected on children under the age of five years who had a TSH test done while in the Windhoek Central and Katutura Hospitals, Windhoek, Namibia. A total number of 263 TSH records were included in this study. There were more males (58.2%) than females (38.4%). The prevalence of abnormal TSH was found to be 21.3%, with low TSH values being predominant within the population (20.2%). Males had more abnormal TSH values (40%) than the females (21%). The high prevalence of abnormal TSH is a cause for concern as this may be an indication of thyroid disorders in neonates and children. Early neonatal screening and detection of these thyroid disorders may increase the chance for the child to live a normal and healthy life.

Key words: Thyroid; Children; Abnormal; Windhoek; Namibia

Introduction: The thyroid hormones are responsible for maintaining the basal metabolic activity in the body and are controlled by the release of thyroid stimulating hormone (TSH), also known as thyrotropin, which is secreted by the anterior pituitary gland. The pituitary gland is part of the body's feedback system to maintain stable levels of thyroid hormones released into the circulatory system. Measurement of TSH is an overall sensitive and specific method to assess the thyroid function[1]. Disorders of the thyroid gland may result is either too much thyroid hormone production (hyperthyroidism) or too little hormone production (hypothyroidism). Children born

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with thyroid disorders may suffer severe mental and growth complications[2]. Thyroid disorders in neonates are difficult to diagnose clinically as symptoms may not appear till later in life. These neonatal thyroid disorders are more commonly found in continents with iodine deficiencies, such as Africa, as iodine is required for thyroid hormone production[3]. Statistics on the neonatal thyroid disorders are very rare in African countries, as concern lies more with the big three; Human Immunodeficiency Virus (HIV) and Acquired Immune Deficiency Syndrome (AIDS), tuberculosis (TB) and malaria[4]. Globally thyroid dysfunctions affect about 2–5% of the general population[5].

In order to achieve optimal neurological outcome for infants, treatment is recommended for children with thyroid disorders within the first two weeks of life[6]. Neonatal screening programs were thus introduced in most industrialized countries[7]. Neonatal thyroid screening is considered one of the most cost-effective tools in preventing mental retardation in a population. The ratio of the cost of care to the cost of implementation of the screening program in children is about 1 to 16 and the ratio of the benefit (cost saving) to the implementation cost is 1 to 15 [8]. When the current study was carried out there were no published statistics on neonatal thyroid disorders in Namibia

Materials and methods: This was a retrospective cross sectional study using data from a six year period (2009 to 2014).

Study population: The study population included all records of children under the age of five years who had a TSH tested while attending Windhoek Central hospital and Katutura Hospitalfrom 2009 to 2014. The records that were excluded were all repeat tests, haemolysed samples, tests not performed due to insufficient sample and patients older than the age of five years.

Sample Size: The sample size required for this study was calculated as 385 samples and a total of 484 records were collected from NIP but only 263 records met the inclusion criteria.

Sampling procedure: The sampling procedure was a non-probable purposive. All TSH tests performed from 2009 to 2014 were extracted from the Laboratory Information System (LIS) at NIP.

Data collection procedure: Permission was granted by the Ministry of Health and Social Services (MoHSS0, NIP and Namibia University of Science and Technology research committees. Data was retrieved from the LIS at NIP. The information retrieved was entered into spreadsheets created in Microsoft Excel.

Sample collection and processing: This was a retrospective study but the archived results used were obtained after blood specimens were collected from subjects in a paediatric tube and sent to the laboratory for analysis. Specimens received at the laboratory were entered into the LIS. Once entered, samples were tested using the Abbott Architect immunochemistry analyser (Illinois, USA).

Immunochemistry analyser sample procedure: The assay was a two-step immunoassay for quantitation of TSH in human serum and plasma using Chemiluminescent Microparticle Immunoassay (CMIA) technology with flexible assay protocols (also referred to as Chemiflex). In the first step the sample, anti-β TSH antibody coated paramagnetic micro particles and TSH assay diluents were combined. TSH present in the sample attached to the anti-TSH antibody coated microparticles. After washing, in the second step anti-α TSH acridinium labeled conjugate was added. Pre-Trigger (containing 1.32% hydrogen peroxide) and Trigger Solutions (containing 0.35N sodium hydroxide) were then added to the reaction mixture; resulting in a chemiluminescent reaction. This was measured as relative light units (RLUs). A direct relationship existed between the amount of TSH in the sample and the RLUs detected by the architect's optical system (Abbott Laboratories, 2010).

Results: The study population was 263 samples of children under the age of five years who had their TSH performed at NIP in Windhoek,

Namibia. There were more males (153) than females (101). From the population studied, 196 (74.5%) children were under the age 1 year. Subjects older than one year and younger than five years were 67 (25.5%).

The age groups were set according to the reference range used by NIP for interpretation of results. Children one year old and younger had a TSH reference range of 1.2-25.0 mIU/ml. Children older than one year and younger than five years had a TSH reference range of 1.5-25.0 mIU/ml.

Table 1: Population distribution by year (2009-2014)

	Population	
Years	**Frequency (n)**	**Percentage (%)**
2009	25	9.5
2010	37	14.1
2011	49	18.6
2012	56	21.3
2013	44	16.7
2014	52	19.8
Total	263	100.0

The year 2012 had the highest number of TSH tests performed (56 samples).On the other hand 2009 had the lowest number of samples with only 25 (9.5%) TSH tests performed.

Table 2: Frequency of TSH values

		Frequency	
		n	**%**
TSH results	Normal	204	77.6
	Low	56	21.3
	High	3	1.1
Total		263	100

Most subjects had normal TSH values. Of the abnormal values more subjects had low values (56) than high values (3).

Table 3: Distribution of TSH values within the age groups

	TSH values						
Age	**Normal**		**Low**		**High**		
	n	**%**	**n**	**%**	**n**	**%**	**Total**
≤1 year	156	76.5	37	66.1	3	100.0	196
>1 to ≤5 years	48	23.5	19	33.9	0	0.0	67
Total	204	100.0	56	100.0	3	100.0	263

Subjects under 1 year had more abnormal TSH values (40) than subjects between the 1 year and 5 years (19).

Table 4: Distribution of TSH values by gender

	TSH values					
	Normal		**Low**		**High**	
	n	**%**	**n**	**%**	**n**	**%**
Female	80	39.2	19	33.9	2	66.7
Male	115	56.4	37	66.1	1	33.3
Unknown	9	4.4	0	0	0	0
Total	204	100.0	56	100.0	3	100.0

Males had a higher frequency of abnormally low TSH values (37) and the lower frequency of high TSH results (1). The ratio of high TSH results for females to males is 2:1.

Table 5: Distribution of abnormal TSH values from 2009 to 2014

	Results						
	Normal		Low		High		
	n	%	n	%	n	%	Total
2009	21	84.0	3	12.0	1	4.0	25
2010	33	89.2	4	10.8	0	0.0	37
2011	37	75.5	12	24.5	0	0.0	49
2012	40	71.4	15	26.8	1	1.8	56
2013	31	70.5	13	29.5	0	0.0	44
2014	42	80.8	9	17.3	1	1.9	52
Total	204	77.6	56	21.3	3	1.1	263

There was an increase in abnormally low TSH values from 2010 to 2013 with 2013 recording the highest percentage (29.5%) of low TSH values.

Discussion: The current study found the prevalence of abnormal TSH values in children below 5 years to be 22.4%. A study in Nigeria found the prevalence of paediatrics thyroid disorders to be 29.3% (18 out of 62 subjects), which is slightly higher than the prevalence found in this study [9]. This higher percentage of neonatal thyroid disorders in Nigeria may be due to the differences in the study population. The Nigerian study population subjects were between 5 days to 13 years old. In contrast a study conducted in Cherthala town and Ernakulam city in India recorded thyroid disorders as high as 37% and 53% respectively [10]. The differences recorded could be contributed to the difference in location or due to the variation in food and life style of the people. The study in India also had more subjects participating in the research (500 subjects per location).

There was a higher number of subjects under the age of one who had a TSH test performed (196) compared to subjects between the age of one and five year old (67). The younger age group had 3 subjects with high TSH values but there were none found in the older age group. Studies have stated that children who had their thyroid disorders diagnosed and treated within the first two week have a better prognosis with respect to intelligence and growth development as the hormones are essential during the first weeks after birth [2],[7],[11],[12].

There were more males affected with abnormal TSH values than females. Similarly, a study done in Nigeria found thyroid disorders more prevalent in males [9]. In contrast other studies have found females tend to have a higher prevalence of thyroid disorders [13],[14],[15],[16]. Differences in prevalence may be due to the smaller sample size in this study and the uneven distribution of the genders (higher number of males present).

All the years included in this current study have a high number of normal TSH values with 2010 recording the highest percentage of 89.2%. An increase in low TSH values was observed from 2011 till 2013. High TSH values on the other hand were only observed in 2009, 2012 and 2014 with each year registering one subject. The year 2012 had the highest abnormal TSH values recorded. There were no known factors in the Namibian population which could have led to an increasing trend of low TSH values over the years. Similarly, there were no known or documented interventions which could have led to the change in the trend.

Conclusion: The increasing number of abnormal TSH values may be an indication of thyroid disorders within the population. The delayed diagnosis and treatment may lead to permanent retardation and health complications. The high frequency of low TSH may either indicate a hyperthyroidism or a defect in the normal function of the pituitary gland, such as in neonatal thyrotoxicosis. Both conditions are life threatening to infants as the body experiences symptoms such as tachycardia, weakness and diarrhoea. High TSH values may

be indicative of congenital hypothyroidism, resulting in defects of the infant's development.

Unfortunately the study was conducted in the public sector where there are no routine neonatal screenings performed. There is a high possibility that a number of undiagnosed thyroid disorders were missed due to the fact that symptoms are not obvious in the first few weeks of life.

The TSH test can act as an excellent screening tool for thyroid dysfunction due to its low cost. To positively diagnose the condition, further thyroid function testing should be ordered. If screening is to be implemented within the first 48 Hours from birth, diagnosis and treatment of possible thyroid disorders can be given earlier. Early treatment can lead to the child living a normal healthy life. Delayed treatment may not be as effective and the child may have permanent health complications and/or mental retardation.

Competing interests: The authors declare that they have no competing interests.

Author's contribution: SBB and MM conceptualized the study. SBB collected data and analysed. MM drafted the manuscript. SRMreviewed and revised the manuscript. All authors read and approved the final manuscript.

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