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Frequencies of Thyroid Problems in Different Age, Sex and Seasons

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Frequencies of thyroid problems in different age, sex and seasons were determined from the relative concentration of thyroid hormones (T_3 and T_4) and thyroid stimulating hormone (TSH) in 9054 patients. These patients visited the radioimmunoassay (RIA) laboratory of the Institute of Radiotherapy and Nuclear Medicine (IRNUM) Peshawar during the years 1984-1990 (except 1987) and 1995 and 1996. The patients were classified into infants, children, adults and old age groups according to their age, into malesand females according to their sex and into winter, spring, summer and autumn according to their visit to the laboratory. T_3 and T_4 in the blood serum of these patients were determined by radioimmunoassay (RIA) and their TSH in the blood serum were determined by immuno-radiometric assay (IRMA). The data revealed that 54% thyroid patients were having normal levels of T_3, T_4 and TSH. Considering all age groups together, the frequencies of hyperthyroidism/Thyrotoxicosis and hypothyroidism were 5.1 and 4.0% respectively. Similarly, the frequencies of subclinical hyperthyroidism and subclinical hypothyroidism were 5.8 and 5.4% respectively. The frequencies of other thyroid problems were 25.8%. The frequency of hyperthyroidism/ thyrotoxicosis was higher in adults group (2.9%) followed by old age group (2.0%), children group (0.2%) and infants group (0.01%). Similarly the frequency of hypothyroidism was higher in adults group followed by old age group, children group and infants group were 1.8, 1.3, 0.7, 0.1% respectively. Similar pattern of frequencies of subclinical hyperthyroidism, subclinical hypothyroidism and other thyroid problems was observed. Iodized salted should be used only in iodine deficient areas and with caution.

Key words: Thyroid problems, hyperthyroidism, hypothyroidism, age, sex.

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Introduction

Thyroid disorders are due to abnormality in thyroid functions and enlargement of the thyroid gland. The major disorders of thyroid gland are over secretion (hyperthyroidism) and under secretion (hypothyroidism) of thyroid hormones namely T_3 and T_4 (Gadde and Krishnan, 1994; Guyton and Hall, 1996; Chandrasoma and Taylor, 1997; Mann and Dunn, 1997). Both situations lead to abnormal health conditions and have different manifestations and symptoms. Several pathological conditions like hyperthyroidism, subclinical hyperthyroidism, hypothyroidism and subclinical hypothyroidism exist. The identification of these conditions is based on the relative concentration of T_3, T_4 and TSH (Guyton and Hall, 1996).

Iodine is an integral part of thyroid hormones and plays an important role in the incidence of hyperthyroidism and hypothyroidism (Haggerty and Prange, 1995; Gadde and Krishnan, 1994). Excessive iodine intake produces hyperthyroidism or thyrotoxicosis while low intake of iodine causes cretinism and other iodine deficiency disorders like goiter and myxedema (ICCIDD, 1995; Stanbury and Hetzel, 1980; Chandrasoma and Taylor, 1997). Rapid introduction of even ordinary amount of iodine to a severely deficient population has induced hyperthyroidism in older population with nodular goiter (WHO, 1996). Use of iodine rich compounds in the milk processing plants and in water storage tanks as disinfectant and in the livestock feed as ingredients may enhance the iodine consumption. Use of iodized salt also increases the intake of iodine.

Human being can tolerate high levels of iodine, however, some sensitive individuals may develop untoward reactions to higher levels of iodine. Therefore, iodine supplementation is contraindicated in individuals who are sensitive to higher intakes of iodine and in those who are suffering from thyrotoxicosis (Welt and Blythe, 1970). This study reports the frequencies of different thyroid problems which are evaluated on the basis of relative concentration of T_3, T_4 and TSH.

Materials and Methods

Size and Location of Sample: Nine thousands and fifty four suspected thyroid patients were referred to the RIA laboratory of the Institute of Radiotherapy and Nuclear Medicine (IRNUM) Peshawar by various Physicians and medical practitioners of Peshawar City during the years 1984-1990 (except 1987), 1995 and 1996 for T_3, T_4 and TSH tests. These patients were advised to test all the three hormones.

Classification of the Data: Out of 9054 thyroid patients, age and sex were known for 8693 and 8979 patients respectively. The patients were classified into infants (0-1 year), children (>1-13 years), adult (>13-40 years) and old age (>40 years) groups according to their age; males and females according to their sex and into winter (Nov.- Jan.), spring (Feb.-April), summer (May-Jul.) and autumn (Aug-Oct.) according to their visit to the laboratory. The data were organize to know the frequencies of thyroid problems in different age, sex and seasons.

Collection of Blood Sample: Blood samples were collected from the patients through a disposable syringes of suitable volume. The samples were transferred into properly labeled sterilized test tubes and were left for 30-60 min. at room temperature for coagulation. The Coagulated blood samples were centrifuged at 1500-2000 rpm for approximately five min. Serum were separated and transferred into sterile plastic tubes that were appropriately labeled for the required test, and the date of sample collection. The samples were analyzed either on the same working day or stored at -20 °C until analyzed.

Determination of T_3, T_4 and TSH: T_3 and T_4 were determined by RIA and TSH was determined by IRMA (Edwards, 1985). Concentrations of T_3, T_4 and TSH in the serum were measured by using AMERSHAM, RIA and IRMA kits for each hormone (Ortho-clinical Diagnostics Amersham, UK, 1998). All the kits were provided with standards, tracer antibody in case of T_3 and T_4, and antibody coated tubes in case of TSH. The samples were taken out of the freezer, arranged in order and were left for complete thawing. Assay tubes were labeled as a standards, non-specific binding (NSB), total count, patient samples and quality control in duplicate. Procedures recommended by the manufacturer for sample dispensing, incubation and decanting were adopted . Gamma Counter (Oakfield instrument LTD, UK, 1995) was used for counting the assay tubes. Hormones concentration were measured by using a computer program (RIASTAT software package). The normal ranges of T_3, T_4 and TSH used in the RIA laboratory of IRNUM and reported by Ortho-Clinical Diagnostics Amersham, UK (1998) were 0.8 - 2.7 for T_3, 62.0 - 165.0nmol L^{-1} for T_4 respectively and 0.5 - 5.0 miu L^{-1} for TSH.

Table 1: The Possible Combinations of T_3, T_4 and TSH in an Individual

Group[1]	Hormones Level[2]		
	T_3	T_4	TSH
1	L	H	H
2	L	L	N
3	L	L	H
4	L	N	N
5	N	N	N
6	N	L	N
7	N	L	H
8	N	H	N
9	N	N	H
10	N	H	H
11	N	N	L
12	N	H	L
13	H	H	L
14	H	H	N
15	H	N	N
16	H	L	N
17	H	L	H
18	H	N	H
19	H	L	L
20	H	N	L
21	N	L	L
22	L	L	L
23	L	N	L
24	L	H	N
25	L	N	H
26	L	H	L
27	H	H	H

1. There are 27 possible combination's of T_3, T_4 and TSH. Out of these 27 combination's only one is for normal condition which is given in the Table at Sr. No. 5. Combination of T_3, T_4 and TSH at Sr. No. 3 stands for hypothyroidism; at 9 for subclinical hypothyroidism; at 11 for subclinical hyperthyroidism and at 13 for hyperthyroidism. All the other combinations of T_3, T_4 and TSH are combined together and called as others.
2. The letters L, N and H in a column of the particular hormone indicate Low, Normal and High concentration level of that particular hormone respectively.

Pathological Conditions: The various pathological conditions (thyroid problems), namely hypothyroidism, subclinical hypothyroidism, subclinical hyperthyroidism and hyperthyroidism were identified by the relative concentrations of T_3, T_4 and TSH. Twenty seven possible combinations (Table 1) of T_3, T_4 and TSH levels are possible.

Statistical Analysis: The data was statistically analyzed with correlation analysis and general linear model procedures by using available SAS statistics package (SAS, 1990).

Results

The frequencies of different thyroid problems based on the relative concentration of T_3, T_4 and TSH in different age groups are presented in Table 2. The data revealed that 54% thyroid patients were having normal T_3, T_4 and TSH. Considering all age groups together, the frequencies of hyperthyroidism and hypothyroidism were 5.1 and 4.0% respectively. Similarly, the frequencies of subclinical hyperthyroidism and subclinical hypothyroidism were 5.8 and 5.4% respectively. The frequencies of other thyroid problems were 25.8%. The frequency of hyperthyroidism and hypothyroidism was higher in adults group followed by old age group, children group and infants group. Similar pattern of frequencies of subclinical hyperthyroidism, subclinical hypothyroidism and other thyroid problems was observed. Except for hypothyroidism whose frequency was not different statistically in adults and old age groups, the frequencies of all other conditions were significantly different ($P < 0.05$) in all age groups.

The frequencies of thyroid problems in different sex based on relative concentration of T_3, T_4 and TSH are presented in Table 3. Out of 8979 suspected thyroid patients, 54% were normal as they were having normal values of T_3, T_4, and TSH. Considering both sexes together, the frequency of hyperthyroidism was higher (5.0%) than hypothyroidism (4.0%). There was not much difference in the frequency of subclinical hyperthyroidism (5.8%) than subclinical hypothyroidism (5.4%). The frequencies of hyperthyroidism, subclinical hyperthyroidism, hypothyroidism and subclinical hypothyroidism were almost the same in males. While in female the frequency of subclinical hyperthyroidism was higher followed by subclinical hypothyroidism, hyperthyroidism and hypothyroidism. The differences were not statistically different at $p < 0.05$. Frequencies of all the four disease conditions studied were higher in females as compare to males.

The frequencies of thyroid problems in different seasons are given in Table 4. The frequency of hyperthyroidism in summer, winter, spring, and autumn were 2.0, 1.4. 1.1 and 0.4% respectively. The frequency of hypothyroidism in spring, autumn, winter, and summer was 1.2, 1.0, 1.0 and 0.9% respectively.

Table 2: Frequencies of Thyroid Problems in Different Age Groups Based on Concentration of Thyroid Hormones and TSH

Thyroid Problems	Thyroid Patients	% of total	Infants	% of total	Children	% of total	Adults	% of total	Old age	% of total
All Cases	8693	100.0	86	1.0	856	10.0	5208	59.9	2543	29.1
Normal	4692	54.0	40	0.5	420	5.0	2960	34.1	1272	14.6
Hyperthyroidism	440	5.1	1a	0.01	15b	0.2	257d	2.9	167c	2.0
Subclinical Hyperthyroidism	508	5.8	3a	0.03	17b	0.2	309d	3.6	179c	2.1
Hypothyroidism	345	4.0	10a	0.1	62b	0.7	156c	1.8	117c	1.3
Subclinical Hypothyroidism	467	5.4	6a	0.1	72b	0.8	263d	3.0	126c	1.4
Others	2241	25.8	26	0.3	270	3.1	1263	14.5	682	7.8

Means followed by different letters in a row is significantly different at $p < 0.05$ as determined by Chi-square test.

Table 3: Frequencies of Thyroid Problems in Different Sex Based on Concentration of Thyroid Hormones and TSH

Thyroid Problems	Total Thyroid Patients (Both sex)	% of Total	Males	% of Total	Females	% of Total
All Cases	8979	100.0	2604	29.0	6375	71.0
Normal	4849	54.0	1450	16.2	3399	37.9
Hyperthyroidism	451	5.0	106a	1.2	345b	3.8
Subclinical Hyperthyroidism	520	5.8	130a	1.5	390b	4.3
Hypothyroidism	356	4.0	113a	1.3	243b	2.7
Subclinical Hypothyroidism	483	5.4	131a	1.5	352b	3.9
Others	2320	25.8	674	7.5	1646	18.3

Means followed by different letters in a row is significantly different at $p < 0.05$.

Table 4: Frequencies of Thyroid Problems in Different Seasons Based on Concentration of Thyroid Hormones and TSH

Thyroid Problems	Thyroid Patients	% of Total	Winter	% of Total	Spring	% of Total	Summer	% of Total	Autumn	% of Total
All Cases	9054	100.0	2661	29.4	2129	23.5	2607	28.8	1657	18.3
Normal	4891	54.0	1468	16.2	1151	12.7	1364	15.1	908	10.02
Hyperthyroidism	452	5.0	131c	1.4	104b	1.1	178d	2.0	39a	0.4
Subclinical Hyperthyroidism	524	5.8	208d	2.3	105b	1.2	140c	1.5	71a	0.8
Hypothyroidism	363	4.0	86b	1.0	107d	1.2	80a	0.9	90c	1.0
Subclinical Hypothyroidism	487	5.4	125c	1.4	112b	1.2	158d	1.7	92a	1.02
Others	2337	25.8	643	7.1	550	6.1	876	7.6	457	5.04

Means followed by different letters in a row is significantly different at $p < 0.05$.

Discussion

Thyroid problems were determined by the relative concentration of T_3, T_4 and TSH. The concentration of each T_3, T_4 and TSH in human body is either low, normal or high. So these hormones make 27 possible combinations in human body (Table 1). Only one combination of T_3, T_4 and TSH given at serial no. 5 in Table 1, is for normal condition. The remaining 26 combinations are for different pathological conditions. Out of these 26 pathological conditions, 4 pathological conditions are well established and are usually called thyroid problems.

In hyperthyroidism, the T_3 and T_4 concentration are higher than normal and TSH concentration level is lower than normal values. In hypothyroidism, the T_3 and T_4 concentration are lower than normal and TSH concentration is higher than normal values. The concentration of T_3 and T_4 in subclinical hyperthyroidism is normal, while concentration of TSH is low. Similarly, the concentration of T_3 and T_4 in subclinical hypothyroidism is normal, and TSH is high. In other thyroid problems, the concentration of T_3, T_4 and TSH are in other different concentration as shown in Table 1.

The data in Table 2 revealed that 54% thyroid patients were normal. The doctors/physicians had referred them to the RIA Laboratory for thyroid problems, but their thyroid hormones and TSH concentration were in the normal ranges indicated that they were not thyroid patients. The doctors/physicians should be a little more conscious about referral of patients to the RIA laboratory. This will save the resources of RIA laboratory and will make the treatment cheaper for the patients.

Well planned nutritional studies about the requirement of iodine and other factors that affect the secretion and functions of T_3, T_4 and TSH are needed. The health department should initiate such projects. In infants and children, hypothyroidism and subclinical hypothyroidism were more frequent than hyperthyroidism and subclinical hyperthyroidism. Similar results have been reported in a survey conducted in Peshawar (Zafar, 1994). The prevalence of initial stage goiter in children of under 10 was 59%. This is due to the fact that these groups have greater demand of iodine for their growth and even mild iodine deficiency can lead to the development of clinical signs of hypothyroidism and subclinical hypothyroidism. Hyperthyroidism and subclinical hyperthyroidism were observed more frequently among adults and old age groups. Connolly (1971, 1973), Stewart *et al.* (1971) and Vidor *et al.* (1973) noted higher prevalence of hyperthyroidism in middle age and older individuals with nodular goiter lived in iodine deficient region of Tasmania.

The frequencies of thyroid problems in different sex based on relative concentration of T_3, T_4 and TSH are presented in Table 3. Out of 8979 suspected thyroid patients, 54% were normal as they were having normal values of T_3, T_4 and TSH. Such referral are really a burden on the time and resources of the RIA Laboratory as well as on the pocket of the patient. Doctors/physicians may be trained/educated about the prescription of T_3, T_4 and TSH. Considering both sex together, the frequency of hyperthyroidism was higher (5.0%) than hypothyroidism (4.0%). Frequencies of all the four diseased conditions were higher in females as compare to males, indicated higher susceptibility of females towards thyroid problems. Females are more sensitive to nutritional deficiency diseases and are more affected than males. Galofre (1994) also reported greater frequency of hyperthyroidism in females. The thyroid problems reported in this study is a question of concern for the health policy makers. Both situations are in general linked with iodine intake. More iodine intake in the form of iodized salt may produce hyperthyroidism problem and less iodine intake may produce the problem of hypothyroidism. Hence iodized salt should be recommended only for those areas where iodine is deficient in foods and water and not for all areas.

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