Assessment of thyroid hormone levels and thyroid disorders: A case study from Gujranwala, Pakistan

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Abstract: This case study is conducted to investigate the thyroid hormone levels and relevant disorders including evaluation of dietary conditions in the rural area of Gujranwala and its surrounding districts. Thyroid disorders are clinically prevalent and their manifestation differs considerably with geographical variations. A randomized study of 177 subjects was carried out, with a questionnaire about their dietary habits/life style and acquisition of blood samples for thyroid hormone level assessment using radioimmunoassay technique. This study was permitted by the local ethics committee and an informed consent was obtained from the patients. Study of normally distributed population with p value less than <0.005 and mean age 32.67±13 years demonstrated that 37% female and 43% males were hyperthyroid with elevated levels of FT3and FT4. Amongst the diagnosed cases of hyperthyroidism 47% females and 33% of males were using Iodized salt with 50ug/ppm increased concentration of KIO_3 in their diet without any prescription. Furthermore, 60% of diagnosed hypothyroid cases were having no iodine supplementation in their diet. Thyroid function problems are more common in females (N=137) than males (N=40) but the severity of this disease was found to be more pronounced in males as the TSH level (33.13±22.73) was twice that as compared to females (17.63±18.15). Despite a high prevalence of recognized thyroid disease in the population a considerable number of inhabitants have undiagnosed thyroid dysfunction. These findings necessities wider scale studies for the mapping of thyroid behavior and the contributing factors for this region with a population of more than 20 million.

Keywords: Thyroid, hyperthyroidism, radioimmunoassay, thyroid function test, iodine.

INTRODUCTION

Thyroid gland is one of the vital endocrine gland that controls metabolic functions and also affects many other systems in the body throughout all phases of life (Zimmermann *et al.,* 2008; Bjoro *et al.,* 2000; Hamilton *et al.,* 2008). Disturbed thyroid hormone action has adverse effects on the normal reproduction, cardiovascular, physiological and central nervous systems (Mohanty *et al.,* 2008; Nyrnes *et al.,* 2006; Resta *et al.,* 2004; Roos *et al.,* 2007; Soldin *et al.,* 2003). Iodine is an essential micro nutrient for human growth and its deficiency causes thyroid disorders (Obregon *et al.,* 2005; Li *et al.,* 2001; Rasmussen *et al.,* 2002; Laurberg *et al.,* 2000; Ursu *et al.,* 2014).

After Diabetes, disorders of thyroid linked with Iodine deficiency are recognized as major global public health problem. However, the manifestation of these disorders is highly depends on the iodine intake of the region. According to the latest estimates, about 2.5 billion people worldwide (i.e 38% of the world's population) have insufficient iodine intake, out of which 313 million reside in the South-east Asian region including Pakistan (Yusuf *et al.,* 2008; Jamil *et al.,* 2008).

Thyroid function disruption due to iodine deficiency is of particular concern, affecting the intellectual development of large segments of the population in the underdeveloped countries. This is especially more worrying as all adverse effects of iodine deficiency is preventable. Even though certain limitations of the epidemiological studies of thyroid dysfunction has shown that prevalence and incidence of thyroid disorders is influenced primarily by gender and age. These disorders are more common in women than men, and in old age group compared with the younger population (Cappola and Ladenson, 2003; Hollowell *et al.,* 2002). The minimum daily recommended iodine intake by the World Health Organization (WHO) varies with age, ranging from 50 to 120 µg from infancy to adolescence, 150 µg for adults and 200 µg for pregnant and lactating women (WHO 1994; Canaris *et al.,* 2000; Vanderpump, 2011).

Gujranwala is an industrial unit in the north east of province Punjab. It is the 2nd largest division of province with a population of more than 20 million. However, health care facilities and public awareness about healthy life style is neglected in the region. Gujranwala Institute of Nuclear Medicine & Radiotherapy (GINUM) is the only establishment in this division providing comprehensive cancer health care facilities. No previous methodical thyroid disorder evaluation has been conducted in this area.

This study plans to estimate thyroid behavior and nutritional conditions in Gujranwala. It is aimed to

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ascertain if there is any evidence to support the idea of prevalence of undiagnosed thyroid disorders. Furthermore, to find out the level of thyroid mal-treatment resulting from lack of awareness, mal nutrition, socio economic conditions and unchecked implementation of the nutritional campaigns (e.g. administration of iodized salt).

MATERIALS AND METHODS

The study was designed as a preface/pilot to seek out association in the thyroid hormone level and dietary conditions in population. In this study 177 patient visiting Gujranwala Institute of Nuclear Medicine & Radiotherapy (GINUM) were included as subjects. These patients came to the institute for some problem irrespective of whether they were referred for thyroid problem or not. No age boundary was fixed. All male and female were invited to participate in the study.

A questionnaire was designed to collect the patient data from each subject regarding the weight, height, salt used, family disease and previous history of thyroxin or neomercazole. For clinical measurements blood samples were collected at the phlebotomy room of the institute. For the purpose of this study serum from the collected samples was separated by using the rotofix centrifuge machine at RIA Lab. The serum was preserved in the lab at -20^{o}C.

Values of TSH were measured by Immuno Radiometric Assay (IRMA) and FT3 and FT4 with Radioimmunology Assay (RIA) techniques using Kits of Immunotec™. Radioimmunoassay is the most sensitive and specific for *in vitro* analysis of hormones. Sensitivity limits are known up to ppm/L with high accuracy. Sensitivity of the method was upto micro levels and the results quoted were within 10% Coefficient of variances per IP. Calibrated Genesis twenty well Gamma Counter of LTI was used for gamma counting of the analytes. Reliability of the results was confirmed by performing quality control of the immunoassay kits and all analytes in duplicate. The results are presented as average values with Standard Deviation (SD) by employing Minitab 15 for statistical analysis of the data.

The participating population was classified as euthyroid, hypothyroid, hyperthyroid and equivocal according to the clinical history and thyroid function test values. Reference ranges used in laboratory for analysis areas are FT4: 11.5-23.0 pmol/L, FT3: 2.5-5.8pmol/L, TSH: 0.2-4.0mIU/L

RESULTS

The blood samples of 177 persons who visited the institute to participate in the study composed of 137 (77%) females and 40 (23%) males. The whole sample BMI value of 23±1.3 was skewed towards obesity.

The population participated was normally distributed having mean value of 33.67 years and with SD of 13.03 [fig. 1]. The youngest and oldest age groups have the lowest attendance rate 17±3 years 18% (32) and 63±11years 4% (8) only while in the age group 35±8 years, the attendance rate was 73% (129).

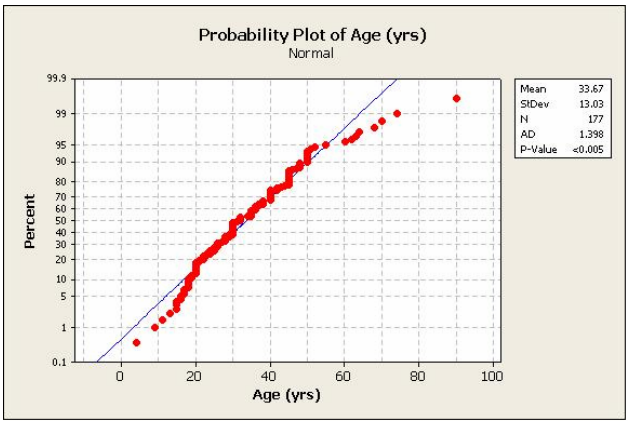

Fig. 1: Normality graph of participants.

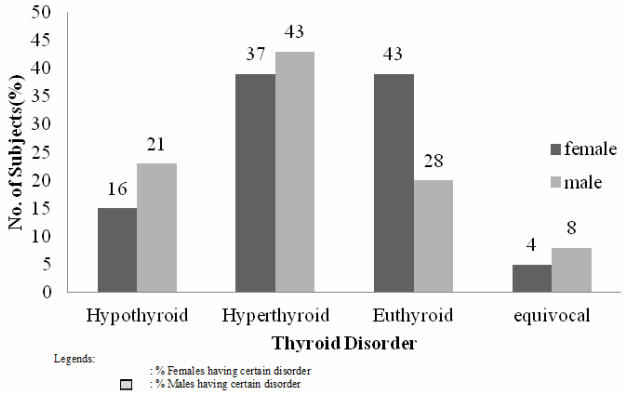

Fig. 2: Ratio of thyroid disorders in female/male.

Investigations revealed the overall dietary pattern in the region among which consumption of solid fat, chicken and tap water were prominent. Very few patients were aware of the hygienic diet style with filtered water and unsaturated fats in their intake.

Common diseases in the studied sample were Diabetes and Hepatitis. 46% population was using the iodized salt with 50µg/ppm added concentration of KIO_3 in plain salt [table 1]. Diagnosis established on the basis of the hormonal level and clinical history indicated the high ratio of the hyperthyroidism in the sample [fig. 2].

37% of female were recognized as hyperthyroid with elevated levels of FT4 and FT3 (35.22±15.43pmol/L, 16.59±13.88pmol/L) and reduced levels of TSH 0.139±0.01mIU/L levels. FT4, FT3 and TSH levels in 43% diagnosed hyperthyroid males were 33.13±15.60 pmol/L, 18.08±16.37 pmol/L and 0.13±0.24 mIU/L, respectively.

Table 1: Diet analysis of the population

	Plain salt	Iodized salt	Filtered water	Simple water	Edible oil	Solid Fat Ghee	Chicken	Red Meat
Male (N)	24	16	10	30	8	32	26	14
Female (N)	72	65	29	108	46	91	103	34
Overall (N)	96	81	39	138	54	123	129	48
% population	54	46	22	78	30	69	73	27

N = Total number of samples

Table 2: Thyroid hormone levels in males/females

	Diagnosis	Hyperthyroid	Hypothyroid	Equivocal	Euthyroid
Female	Number (n, %)	51(37%)	22(16%)	5(4%)	59(43%)
	FT4*	35.22±15.43	11.99±7.57	16.44±5.40	17.36±2.78
	FT3*	16.59±13.88	3.67±1.49	4.27±1.44	4.78±0.76
	TSH**	0.139±0.01	17.63±18.15	2.14±2.12	1.45±0.95
Male	Number (n, %)	17(43%)	09 (21%)	4(8%)	11(28%)
	FT4*	33.13±15.60	7.88±7.81	14.6±0.28	17.10±2.62
	FT3*	18.08±16.37	3.15±2.42	4.35±0.91	5.44±0.50
	TSH**	0.13±0.24	36.83±22.73	0.80±1.11	1.92±0.93

Second observable thyroid dysfunction was in the form of Hypothyroidism having 16% females and 23% males. TSH levels were markedly elevated in males having average value of 36.83±22.73mIU/L and 17.63±18.15 mIU/L in females. FT4 and FT3 levels were observed to be 7.88±7.81pmol/L, 3.15±2.42pmol/L and 11.99±7.57 pmol/L, 3.67±1.49pmol/L in male and female, respectively. Only 8% female and 4% males were already diagnosed with distressed thyroid level and receiving thyroxin or Neomercazole treatment.

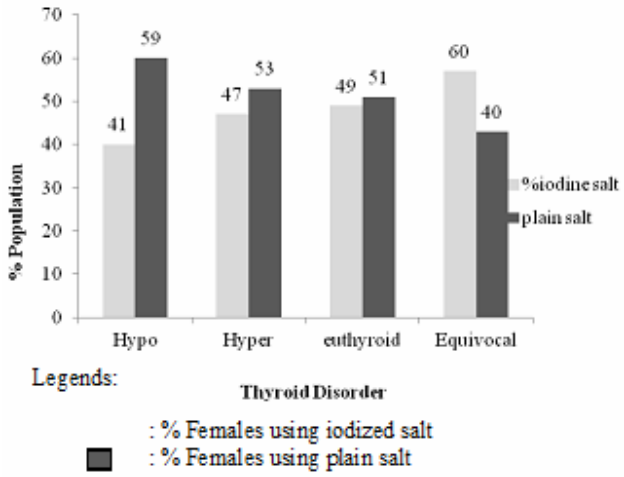

Fig. 3: Use of iodized salt by females.

Normal thyroid hormone value was observed in 34% participants though they were reported to have some thyroid problem like goiter and cold nodules as indicated by Thyroid Scans with Tc-99m. Only 5% of the participants were already diagnosed cases of thyroid disorder and referred for further treatment. Thyroid Hormone levels in euthyroid were FT4 17.36±2.78 pmol/L, FT3 4.78±0.76pmol/L, TSH 1.45±0.95 in females and 17.10±2.62pmol/L, 5.44±0.50pmol/L, 1.92±0.93mIU/L for FT4, FT3 and TSH in males, respectively table 2.

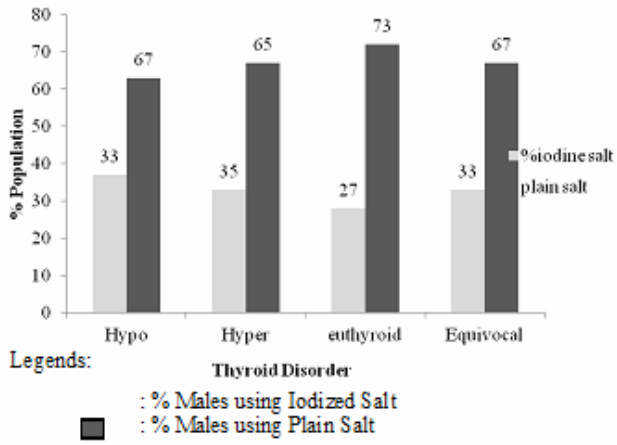

Fig. 4: Use of iodized salt by males.

Questionnaire established the opinion about the unnoticed use of commercially available iodized salt in market. Almost half of identified hyperthyroid cases in females and one third males were using iodized salt in their food (figs. 3, 4).

DISCUSSION

A lot of studies have been conducted on the thyroid disorders in different areas of world. This study has confirmed the prevalence of thyroid gland dilemma in selected region and supported the postulate of undiagnosed thyroid problem. It indicates the fact that thyroid disorders are ethnic and geographical in origin (Bjoro *et al.*, 2000).

Attendance rate in above 60 and below 20 years was lower which might explain the lower prevalence of thyroid disorders in this age group, or possibly due to unawareness about the problem in the region. Increased incidence rate of population in adult age demonstrated the gradual development in thyroid disorders. Obesity in the population might attribute to the use of solid fats diet and increased level of TSH in euthyroid (table 2) (Nyrnes *et al.,* 2006)

Established levels of hormone for euthyroid cases are skewed towards the upper limits pointing towards the hyperactivity of the gland. The results depicted the hyperactive behavior of the gland which showed hyperthyroidism in the population (fig. 2). This increased hyperthyroidism in the population is also correlated with use of Iodized salt. Amongst the surveyed individuals 46% were consuming iodized salt with additional concentration of the KIO_3 without any physician advice. Increased rate of hypothyroidism suggests that the area under observation is thyroid hyperactive than Iodine deficient. The generalized supplementation in the form of Iodized salt should not be administered in this region.

Use of iodine supplementation in the form of iodized salt is aggravating the disease making population unhealthy which subsequently increased thyroid related disorders in different age groups (Laurberg *et al.,* 2000; Hollowell *et al.,* 2002). Furthermore, high levels of TSH (36.83 mIU/L) in male demonstrated hypothyroid cases as compared to the female hypothyroid cases (17.63 mIU/L). Although the prevalence of thyroid disorders is higher in females as compared to males but disease is more aggressive in males. Thyroid problems are pronounced in the population with age of 33 years.

Since no database is available which may provide a comparison for establishing the increased thyroid disorders in this area therefore, it is suggested that a comprehensive screening of all the age groups should be executed promptly on the basis of this preface data. Furthermore, an environmental study is recommended to map the complete epidemiology of this highly populated region (Canaris *et al.,* 2000).

ACKNOWLEDGEMENTS

The study was conducted at Gujranwala Institute of Nuclear Medicine & Radiotherapy. The authors are grateful to The Director of the Institute (GINUM) for his valuable support for management of resources for this case study.

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