

Original Research Article

Normal T4, T3, TSH Levels in Adult Sudanese in Khartoum State, Sudan

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ABSTRACT

Introduction: Thyroid dysfunctions (hypo- and hyperthyroidism) are common clinical disorders in Sudan. The diagnosis of these conditions depends on measurement of TSH, T4, and T3. Sudanese hospitals and clinics normal reference values are obtained from non-Sudanese subjects. The aim of this study to establish the normal T4, T3, and TSH levels in adult Sudanese. The normal range of T4, T3, and TSH for Americans in United States (T4= 4.5 -11.5 ug/dl, T3= 0.8 - 2.0 ng/ml, TSH= 0.5 – 5.0 IU/L)

Methods: A cross sectional study was done in Khartoum state from September 2016 to November 2018. 311 healthy adult Sudanese aged 20 to 60 years (males= 59 females= 252) were selected from staff, students and employers of two randomly selected governmental universities (Khartoum & Bahri). Personal data and clinical history were taken by a questionnaire. 5ml of Blood sample was obtained from anti-cubital vein from each subject between 8:00 AM to 11:00 AM. The separated blood sera were immediately stored at - 20 °C for later measurements of TSH, T4, and T3. The samples were analyzed for TSH, T4 and T3 by AIA-360 Fluorometric Enzymatic Immunoassay by using TOSOH manufactures.

Results: The Mean \pm SD for TSH was 1.7 ± 1.1 uIU/ ml, for T3 was 1.2 ± 0.3 ng/ml and for T4 was found to be 7.5 ± 1.5 ug/dl with a range TSH= 0.6 to 2.8 uIU/ ml, T3= 0.7 to 1.5 ng/ml and T4 = 6 to 9 ug/dl. The mean value of T4 was slightly higher in males (males= 7.7 ± 1.5 , females= 7.5 ± 1.6 ug/dl) while TSH was higher in females (females= 1.8 ± 1.1 , males= 1.6 ± 0.9 uIU/ ml)

Conclusion: The range value of T4, T3, and TSH were found to be lower when it is compared with international reference values. The mean of T3 in underweight participants was found to be significantly lower than acceptable BMI (P= 0.003).

Key words: Normal values, Thyroid hormones, Thyrotropin

INTRODUCTION

The reference normal ranges are important especially for thyroid hormones assays because these tests are widely used in

the screening, diagnosis, treatment and monitoring of thyroid disease. Population-specific reference intervals are of particular importance for thyroid hormones because

recent literature highlights the fact that thyroid hormone reference intervals can differ considerably from country to country. (1) TSH and thyroid hormones level are affected by ethnic variation. The normal TSH upper limit was lower in African Americans than in Mexican Americans or Caucasians. The mean TSH and T4 are greater in whites and Mexican Americans than blacks. (2) It is generally accepted that nutritional status may interfere with endocrine functions, particularly thyroid function. The prevalence of thyroid dysfunction is increasing. (3)

Thyroid dysfunctions (hypo- and hyperthyroidism) are common clinical disorders in Sudan. The diagnosis of these conditions depends on measurement of TSH, T4, and T3. Sudanese hospitals and clinics normal reference values are obtained from non-Sudanese subjects depending on the International, American and British Guidelines. In Sudan pilot studies have shown a lower level of thyroid hormones. (4, 5)

Geographic variations affect the hormonal levels; this is most probably due to differences in life style, environmental and nutritional factors. In spite of these differences still we have no Sudanese database for normal values. So this study was conducted in Khartoum state and will cover the whole states of Sudan to establish the normal TSH and thyroid hormones levels in Sudanese.

METHODS

A cross sectional study was done in Khartoum state from September 2016 to

November 2018. 311 healthy adult Sudanese aged 20 to 60 years (males= 59 females= 252) were selected from staff, students and employees of two randomly selected governmental universities (Khartoum & Bahri). Subjects with any illness or any systemic diseases that directly or indirectly affect thyroid profiles were excluded. Ethical approval was issued by the ethical committee of the National Ribat University and from the Federal Ministry of Health. Written consent was obtained from the participants. Personal data and clinical history were taken by a questionnaire.

5ml of blood were obtained from anti-cubital vein from each subject between 8:00 Am to 11:00 Am. Serum was separated by centrifugation at 5000 rpm for 5 minutes. The separated blood sera were immediately stored at - 20 °C for later measurements of TSH, T4, and T3.

The samples were analyzed for TSH, T4 and T3 by AIA-360 Fluorometric Enzymatic Immunoassay by using ST AIA pack T3, ST AIA pack T4 and ST AIA pack TSH supplied by TOSOH manufactures.

Statistical analysis was performed by using the Statistical Package for the Social Sciences (SPSS) version 22.

RESULTS

The Mean±SD for TSH was 1.7 ± 1.1 uIU/ ml, for T3 was 1.2 ± 0.3 ng/ml and for T4 was found to be 7.5 ± 1.5 ug/dl.

The normal hormonal levels are slightly different for different genders. The mean value of T4 was slightly higher in males and TSH was higher in females than males while T3 was the same in both (Table 1).

Gender		T ₃ (ng/ml)	TSH(uIU/ ml)	T ₄ (ug/dl)
Males (T ₃ ,n=58;TSH &T ₄ , n=59)	Mean ±SD	1.2±0.2	1.6 ± 0.9	7.7±1.5
Females (T ₃ and TSH n= 252, & T ₄ n= 255)	Mean ±SD	1.2 ± 0.3	1.8 ± 1.1	7.5 ±1.6

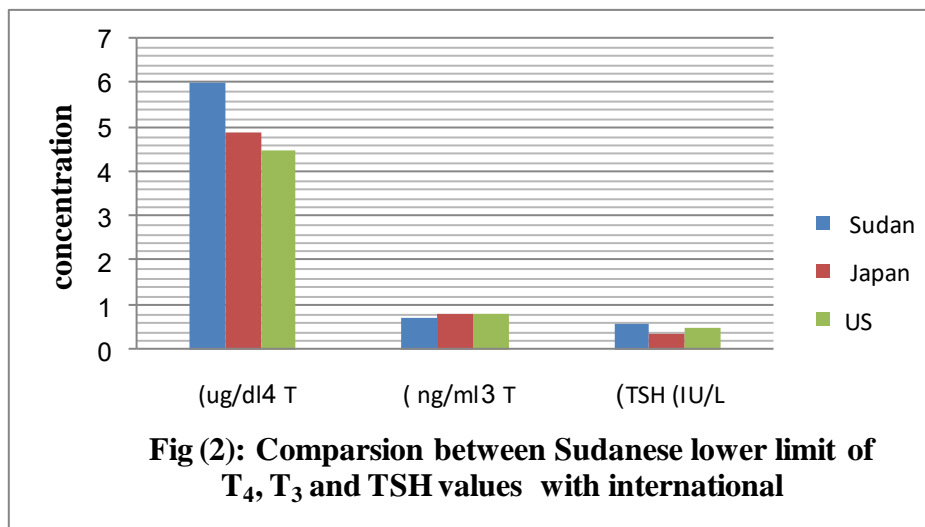
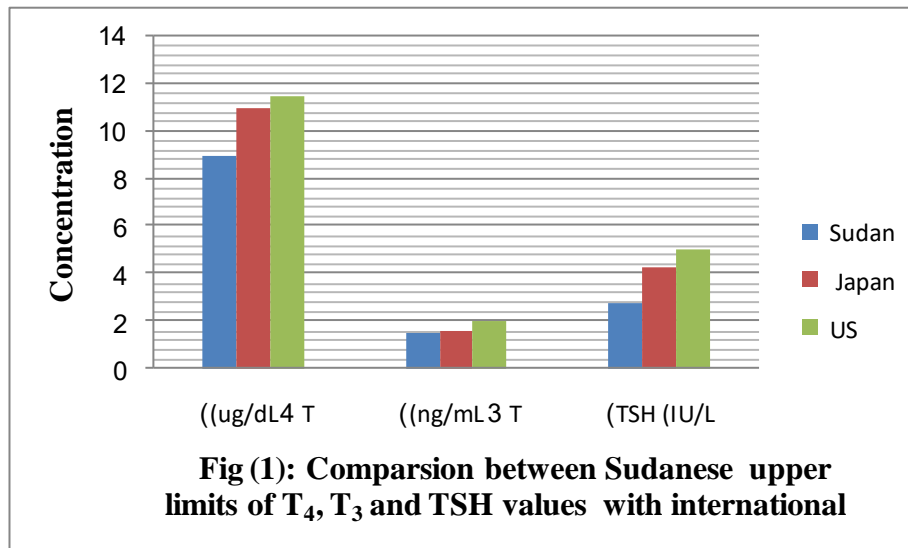
The effect of BMI on the concentration of T4, T3 and TSH is shown in table 2. The mean ±SD for T4 increases with increasing of BMI while TSH and T3 decrease with increasing of BMI with a slight change in T3.

Table (2): Mean of T₃, TSH, and T₄ levels according to BMI:

Body Mass index		T ₃ (ng/ml)	TSH (uIU/ ml)	T ₄ (ug/dl)
Under weight (less than 19)	Mean ±SD	1.1 ± 0.2	1.7 ± 1.01	7.3 ± 1.8
		n= 70	n=72	n=72
Acceptable (19 -25)	Mean ±SD	1.2 ± 0.4	1.7 ± 1.3	7.5 ± 1.5
		n= 157	n= 157	n=158
Over weight (25 -30)	Mean ±SD	1.2 ± 0.2	1.5 ±0.8	7.5 ±1.4
		n= 54	n= 53	n=55
Obese (Over30)	Mean ±SD	1.2 ± 0.2	1.5 ± 0.6	7.7 ±1.3
		n= 29	n= 29	n= 29

Table (3): T₄, T₃ and TSH levels in adult Sudanese and international values

	SUDAN	JAPAN	US
T ₄ (ug/dL)	6 – 9	4.9 – 11.0	4.5 -11.5
T ₃ (ng/mL)	0.7 – 1.5	0.79 – 1.58	0.8 - 2.0
TSH (IU/L)	0.6 -2.8	0.38 – 4.31	0.5 – 5.0



DISCUSSION

In our study the upper limit of normal range of T₄, T₃ and TSH were found

to be lower when compared with Japanese and Americans while the lower limit of T₄ and TSH is higher than international but the

lower limit of T₃ is lower than international values that means the normal range for Sudanese is very narrow when is compared with international values (Table-3). This is may be due to ethnicity, iodine intake, nutritional intake and climate that need further investigations. The normal TSH upper limit was lower in African Americans (3.6 IU/L) than in Mexican Americans or Caucasians (4.2 IU/L).⁽²⁾

The variations in the normal values of the thyroid hormones and TSH in males and females is small and insignificant (Table 1). The level of T₄ is slightly higher in males than females. Some authors have attributed the increased level of T₄ in males to the sex hormones which increase the circulating level of thyroxin binding globulin (TBG), which directly leads to an increase in the circulating level of T₄.^(6,7) Ahmed et al⁽⁷⁾ noticed increased levels of only T₄ in males compared to females. Some other studies reported no effect of gender on thyroid hormones.⁽⁸⁻¹⁰⁾ TSH was slightly lower in males than females while T₃ level in both genders was almost similar. This observation is in accordance with previous studies.^(6,11) However, some other results reported that the level of T₄ was higher in females than males while T₃ and TSH were not influenced by gender.^(12,13)

A variation in the mean of T₄ and TSH within the normal range have been associated with BMI; T₄ was positively correlated with BMI, over weight and obese participants showed a higher level of T₄ while TSH was lower in obese. This could be due to the negative feedback of T₄ on TSH secretion. However, some contradictory results reported that the level of TSH positively correlates with BMI.⁽¹⁴⁾ T₃ was significantly lower in underweight participants when compared with acceptable BMI (p= 0.003). No significant difference for T₄ in obese with acceptable BMI because the number of participants was relatively small.

CONCLUSION

In conclusion the range values of T₄, T₃ and TSH were found to be lower than international values. The mean of T₃ in underweight participants was significantly lower than acceptable BMI.

REFERENCES

1. Baadenhuijsen H, Smit JC. Indirect estimation of clinical chemical reference intervals from total hospital patient data: Application of a modified Bhattacharya procedure. *J ClinChemClinBiochem* 1985; 23:829-39.
2. Hollowell JG, Staehling NW, Flanders WD, Hannon WH, Gunter EW, Spencer CA & Braverman LE (2002) Serum TSH, T(4), and thyroid antibodies in the United States population (1988 to 1994): National Health and Nutrition Examination Survey (NHANES III). *J ClinEndocrinolMetab* 87(2): 489-99.
3. Thilly CH, Swennen B, Bourdoux P, et al. The epidemiology of iodine-deficiency disorders in relation to goitrogenic factors and thyroid-stimulating-hormone regulation. *Am J ClinNutr* 1993;57:267-70.
4. Ali I.N. A pilot study to determine of the normal range of thyroid hormones in Sudanese by locally produced reagents. Higher diploma in Nuclear Medicine. University of Sudan. May 1999
5. Rabab. AB, Omer. AM, Abdarhman. I. A pilot study for normal thyroid hormones in Sudanese in Khartoum state. M.Sc degree. The National Ribat University. Dec. 2008.
6. Razzak, MA Effect of Age and Sex on Thyroid Function Tests Established of norms for the Egyptian Population in Development in Radioimmunoassay and Related Procedures International Atomic Energy Agency, 1992. P.353-8.
7. Ahmed Z, Khan MA, UIHaq A, Attaullah S, Ur Rehman J. Effect of race, gender and age on thyroid and thyroid stimulating hormone levels in North West Frontier Province, Pakistan. *J Ayub Med Coll Abbottabad*. 2009;21(3):21-4.
8. González-Sagrado M, Martín-Gil FJ Population-specific reference values for thyroid hormones on the Abbott Architect i2000 analyzer. *ClinChem Lab Med*. 2004;42:540-2

9. Kratzsch J, Fiedler GM, Leichtle A, Brügel M, Buchbinder S, Otto L et al. New reference intervals for thyrotropin and thyroid hormones based on National Academy of Clinical Criteria and regular ultrasonography of the thyroid. *Clin Chem.* 2005;51:1480-6.
10. D'Herbomez M, Jarrige V, Dartre C. Reference intervals for serum thyrotropin (TSH) and free thyroxine (FT4) in adults using the Access immunoassay system. *ClinChem Lab Med.* 2005;43:102-5
11. Muslim S, Khalil Z. Effect of Age, Sex, Salt, Water and Climate on T3, T4 and TSH in Healthy Individuals, Department of Zoology Peshawar University; 2000.
12. Tannu K, Anupa P, K. K. Sinha, Meetu GB, Kumar S. Age and sex specific thyroid hormone profile in euthyroid subjects. *J Biochem Tech* 2015, 6(3): 1008-1012
13. Franklyn JA, Ramsden BD, Sheppard MC. The influence of age and sex on tests of thyroid function. *Am ClinBiochem* 1985; 22:502-5.
14. Biondi B. Thyroid and obesity: an intriguing relationship. *J ClinEndocrinolMetab.* 2010; 95:3614-3617.

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