Prevalence of Thyroid Dysfunction and Its Effect on Serum Lipid Profiles in a Murzok, Libya Population

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Abstract. The objective of this study was to assess the prevalence of thyroid dysfunction and its correlation with serum hyperlipidemia among the adult population of Murzok City, Libya. Blood samples were collected randomly from 356 subjects (179 male and 177 female) in the age range of 20-to-65 years. The blood was analyzed for the levels of TT_3, TT_4, FT_4, and TSH by electrochemiluminescence immunoassay (ECLIA). Lipid levels of total cholesterol, triacylglycerol (TAG), LDL, and HDL were measured using the enzymatic colorimetric method.

The prevalence of thyroid dysfunction types was the following: overt hyperthyroidism (0.84%), subclinical hyperthyroidism (0.84%), overt hypothyroidism (1.12%), and subclinical hypothyroidism (6.18%). Also, thyroid dysfunction was more common in females (0.56%, 0.84%, 0.84%, and 4.21%) than in males (0.28%, 0.00%, 0.28%, and 1.97%).We found a higher prevalence of subclinical hypothyroidism (27%) among the subjects with hypercholesterolemia. We also found a significant negative correlation between subjects with normal T_3 and hypercholesterolemia ($P<0.05$), and a significant positive correlation between subjects with high T_4 and HDL ($P<0.05$).

Keywords. Hypercholesterolemia • Libya • T_3 • T_4 • Thyroid dysfunction prevalence • Triacylglycerol • TSH

Introduction

Historically, methods for classifying patients with milder degrees of thyroid dysfunction have undergone dramatic changes. Classification has involved clinical, biochemical, and immunologic criteria.[1][2] The serum TSH assay is an accurate test for detecting out-of-range circulating levels of thyroid hormone. Subclinical hypothyroidism is defined as an elevated TSH level with reference range thyroid hormone levels. This disorder is found in 6%-to-8% of adult women and 3% of adult men.[6] It can be associated with reversible hypercholesterolemia.[6][7][8]

Women have a higher incidence of overt hyperthyroidism (a TSH level less than 0.1 mU/L with high levels of thyroid hormones[9]), and the incidence increases with advancing age.[6][10][11][12][13][14] Subclinical hyperthyroidism (a TSH level less than 0.1 mU/L with normal thyroid hormone levels[15]) has been associated with a higher incidence of atrial fibrillation in older persons.[11]

The prevalence of thyroid dysfunction is defined by testing patients in geographic areas, primary care clinics, and in populations that have not been screened previously.[16][17] Thyroid function tests are recommended in populations with high health risks, including lipid disorders, goiter, autoimmune disorders, infertility, women after menopause, and women who are pregnant or postpartum.[18]

Materials and Methods

Blood samples were obtained from 356 subjects, 179 male and 177 female. Age of the subjects ranged from 20-to-65 years. Our sample of 356 subjects was 10% of the population of Murzok City in this age range. Venous blood samples were drawn after 8-to-12 hours of overnight fasting. Blood samples were left to clot and serum samples were separated and kept in two plain tubes. The tubes were labeled as Total T_3 (TT_3), Total T_4 (TT_4), Free T_4 (FT_4), and TSH. The tubes were stored and later assayed using a Roche Elecsys 2010 analyzer and reagents.

The lipid profile included the total cholesterol, triacylglycerol (TAG), LDL, and HDL. These were measured by the COBAS INTEGRA autoanalyser system using the corresponding Roche diagnostic kits. The Minitab Graph Statistical Analysis program

Table 1. Thyroid dysfunction in all subjects and sex.

Diagnosis	Total	Male		Female		Total
	%	Number	%	Number	%	Number
Normal		170		154		324
Overt hyperthyroidism	0.84	1	0.28	2	0.56	3
Subclinical hyperthyroidism	0.84	0	0.00	3	0.84	3
Overt hypothyroidism	1.12	1	0.28	3	0.84	4
Subclinical hypothyroidism	6.18	7	1.97	15	4.21	22
Total		179		177		356

Table 2. Mean values of T_3, T_4, f T_4 and TSH in thyroid dysfunction subjects.

Dysfunction	No.	T_3	T_4	Free T_4	TSH
		Mean(SD) nmol/L	Mean(SD) nmol/L	Mean(SD) pmol/L	Mean(SD) µU/L
Overt hyperthyroidism	3	4.4±1.5	199±32	30.2±8.8	0.01±0.00
Subclinical hyperthyroidism	3	2.1±0.5	119±19	17.1±4	0.01±0.00
Overt hypothyroidism	4	1.6±0.2	82±11	10.6±1.3	20.6±12
Subclinical hypothyroidism	22	2.1±0.5	109±25	13.6±2.4	3.3±1.3
Total	32				

Table 3. Mean values of T_3, T_4, FT_4 and TSH in normal and abnormal subjects.

Variables	Number Mean (SD)	
	Normal	**Abnormal**
T_3 (nmol/L)	346 [a]2.1±0.41	10↑ [b]3.7±0.41
T_4 (nmol/L)	351 [a]111±22	5↑ [b]217±26
FT_4 (pmol/L)	324 [a]15±1.7	3↑ [b]30±9
FT_4 (pmol/L)	324 [a]15±1.7	29↓ [b]11±0.95
TSH (µU/L)	337 [a]1.7±0.98	13↑ [b]5.5±2.1
TSH (µU/L)	337 [a]1.7±0.98	6↓ [b]0.006±0.001

[a, b] *Mean values with different superscripts are significantly different (P<0.01).*

was used for statistical analyses of our results.

Results

We diagnosed thyroid dysfunction by the use of thyroid function tests.[6][3][15][18] These included TT_3, TT_4, FT_4, and the TSH. The reference range for the TT_3 was 1.3-to-3.1 nmol/L, for the TT_4 was 66-to-181 nmol/L, for the FT_4 was 12-to-22 pmol/L, and for the TSH was 0.3-to-4.2 μU/L). The manufacturers of the assay kits recommended these ranges.

Tables 1 and 2 show the results of the diagnoses. We found that three subjects (0.84%), one male (0.28%) and two females (0.56%), had a low mean TSH value (0.01±0.0 μU/L). They also had high mean thyroid hormone levels, T_3, T_4 , FT_4 (4.4±1.5 nmol/L, 199±32 nmol/L, 30.2±8.8 pmol/L, respectively). We diagnosed these subjects as having overt hyperthyroidism. The 0.84% prevalence of overt hyperthyroidism in our study is lower than the 1.9% prevalence among Brazilians.[21] However, it is higher than the 0.3% among Japanese subjects,[19] 0.5% in Koreans,[20] 0.5% among Englanders,[22] and 0.5% among Americans.[26]

We diagnosed three female subjects (0.84%) as having subclinical hyperthyroidism. They had a low mean TSH value (0.01±0.0 μU/L) and reference range mean values for T_3, T_4 , FT_4 (2.1±0.5 nmol/L, 119±19 nmol/L, and 17.1±4 pmol/L, respectively). This prevalence among our subjects of 0.84% is in agreement with previous studies.[24][25] Those studies showed a lower incidence of subclinical hyperthyroidism among middle-age subjects and a higher incidence among subjects more than 60 years old.

Four subjects (1.12%), one male (0.28%) and three females (0.84%), were diagnosed as having overt hypothyroidism.[4][5] They had a high mean TSH value (20.6±12 μIU/L) and a low mean reference range value for T_3 and T_4 (1.6±0.2 nmol/L, 82±11 nmol/L, respectively). Their mean FT_4 level was low (10.6±1.3 pmol/L). The 1.12% prevalence of overt hypothyroidism among our subjects does not differ from that reported among the Japanese (1.1%)[19] and Brazilians (1.4%).[21]

Twenty-two subjects (6.18%), seven males (1.97%) and fifteen females (4.21%), were diagnosed as having subclinical hypothyroidism. They had a high mean reference range TSH value (3.3±1.3 μU/L) and mean reference range values for the T_3, T_4, and FT_4 (2.1±0.5 nmol/L, 109±25 nmol/L, 13.6±2.4 pmol/L, respectively). The 6.18% prevalence of subclinical hypothyroidism among our subjects is higher than that reported among Americans (4.3%)[26] and Brazilians (5%).[27] However, our prevalence is lower than that reported among Japanese (8.7%)[19] and Englanders (8%).[22]

For thyroid variables, our study shows a highly significant difference ($P<0.01$) between subjects' TSH and abnormal thyroid hormone levels. This is true for levels that are above or below the reference ranges (see Table 3).

In this study, the prevalence of thyroid dysfunction was more common among women than men (Table 1). The percentage of thyroid dysfunction among women was 13% and among men was 5%. The difference in the prevalence may result from immunological changes that increase or decrease thyroid hormone levels during pregnancy and the postpartum period. These prevalence differences between subjects in this study and others may be due to differences in age, gender, family history, and pathophysiologic conditions. Results of this study, however, are within the prevalence limits established by other studies.

Table 3 shows the results of mean values of T_3, T_4, FT_4, and TSH among subjects with different thyroid diagnoses. The difference between the mean values for thyroid hormone parameters that are within and outside the reference ranges is significant ($P<0.01$).

These results show that 346 subjects were found to have normal levels of T_3 (2.1±0.41 nmol/L) and 10 subjects had high levels of T_3 (3.7±0.41 nmol/L); whereas 351 subjects had normal levels of T_4 (111± 22 nmol/L) and five subjects had high T_4 levels (217 ±26 nmol/L). In this study, 324 subjects had normal FT_4 levels (15±1.7 pmol/L), 3 subjects had high FT_4 levels (30±9 pmol/L), and 29 subjects had low FT_4 levels (11±0.95 pmol/L).

With regard to TSH measures, 337 subjects had normal TSH levels (1.7±0.98 μU/L). Thirteen subjects had high TSH levels (5.5±2.1 μU/L), and 6 subjects had low TSH levels (0.006±0.001 μU/L).

Mean values of the various parameters of lipid profile in all subjects are shown in Table 4. The difference between means of normal (N) and abnormal (Ab) subjects is significant ($P<0.05$). The mean value of normal total cholesterol (TC) for 278 subjects was 155±27 mg/dl. The mean value of TC for 78 subjects was abnormal at 229±26 mg/dl. The mean value of TAG was normal for 261 subjects (117±42

Table 4. Mean values of TC, TAG, and LDL in normal and abnormal subjects.

Variables	Number Mean (SD)	
	Normal (N)	**Abnormal (Ab)**
TC (mg/dL)	278 [a]155±27	78 [b]229±26
TAG (mg/dL)	261 [a]117±42	95 [b]285±70
LDL (mg/dL)	256 [a]93±22	100 [b]153±21

[a,b]Mean values with different superscripts are significantly different (P<0.05).

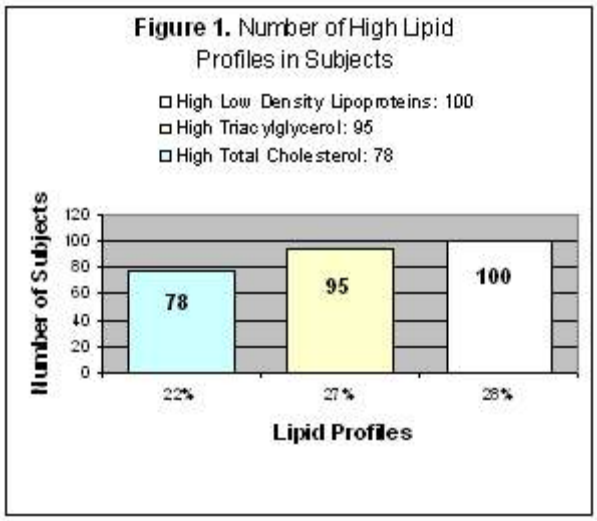
Table 5. Correlation of thyroid parameters and lipid profiles in all subjects.

Variables		TC	TAG	HDL	LDL
		r^2	r^2	r^2	r^2
T_3	N	-0.114*	-0.020	-0.021	-0.106*
	H	-0.046	-0.097	-0.434	0.021
T_4	N	-0.029	-0.066	0.095	-0.012
	H	0.807	-0.019	0.951*	-0.541
FT_4	L	-0.470*	-0.478**	0.269	-0.438*
	N	-0.073	-0.196*	0.215**	-0.063
	H	-1.000*	0.570	-0.031	-0.944
TSH	L	0.403	-0.449	0.162	0.066
	N	0.104	0.073	-0.117*	0.122*
	H	0.652*	0.213	0.050	0.609

***Correlation is significant at <0.01 level (2-tailed).*
**Correlation is significant at ≤0.05 level (2-tailed).*
N=Normal, H=High, L=Low.
r^2=coefficients of correlation.

mg/dl) and abnormal for 95 subjects (285±70 mg/dl). In addition, 256 subjects had normal LDL (mean value was 93±22 mg/dl), and 100 subjects had abnormal LDL (mean value was 153±21 mg/dl).

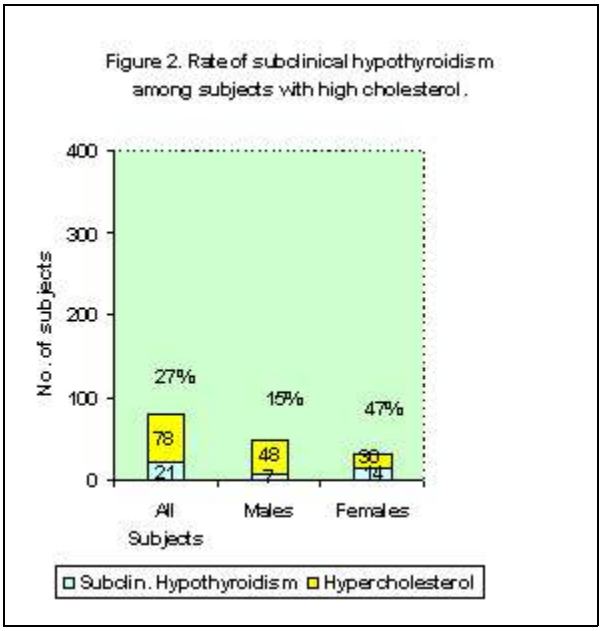
As shown in Figure 1, 78 subjects had high cholesterol levels (22%), 95 subjects had high triacylglycerol (27%), and 100 subjects had low density lipoproteins (28%). In addition, Figure 2 shows that 21 subjects (7 males and 14 females) had subclinical hypothyroidism among all subjects with high cholesterol levels. These 21 subjects are 27% of the total number of subjects (78) with high cholesterol. This percentage is higher than that in a study reported in Italy (10%),[28] and we also show an increase in numbers of females over males.



The coefficients of correlation between the thyroid values and the lipid values are shown in Table 5. There was a significant negative correlation between T_3 (normal) and each of TC and LDL parameter values ($P<0.05$). A positive correlation was significant between T_4 (high) and HDL ($P<0.05$).

Negative correlations were also found between FT_4 (low) and each of TC ($P<0.05$), TAG ($P<0.01$), and LDL ($P<0.05$). FT_4 (normal) had a significant negative correlation with TAG ($P<0.05$), and a positive correlation with HDL ($P<0.01$). There was a significant negative correlation between FT_4 (high) and TC ($P<0.05$).

Normal TSH negatively correlated with HDL and positively correlated with LDL significantly ($P< 0.05$). A significant positive correlation was found between TSH (high) and TC ($P<0.05$).



Conclusion

In the Murzok City, Libya population we studied, thyroid dysfunction was more common among females than males. Our results showing an association between thyroid dysfunction and hyperlipidemia agree with the results of previous studies.[23][26][29][30] In addition, among subjects with hypercholesterolemia, subclinical hypothyroidism was more common.

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