Article

FVC, FEV_1 and FEV_1 / FVC % in Hypothyroid Female and their Relationships with Thyroid Hormones

Pervin Akter[1], Shelina Begum[2], Taskina Ali[3], Noorzahan Begum[4]

Abstract

Background: Hypothyroidism is a common hormonal disorder affecting various organs including lungs. It may be associated with respiratory symptoms and can decrease lung function. **Objective**: To observe FVC, FEV_1 and FEV_1 / FVC % in hypothyroid female patients. **Methods:** This cross-sectional study was carried out in the Department of Physiology, BSMMU, Dhaka, from 1st July 2008 to 30th June 2009 on 60 hypothyroid female patients of 30-50 years age (Group B). For comparison, 30 age and BMI matched apparently healthy subjects (Group A) were also studied. Based on receiving treatment, hypothyroid patients were divided into B_1 (untreated patients on their 1st day of diagnosis) and B_2 (patients treated for at least 12-18 months). They were selected from the Out Patient Department of Endocrinology wing of department of Medicine, BSMMU, Dhaka. Serum TSH and FT_4 levels were measured by Microparticle Enzyme Immunoassay (MEIA) principle in AxSYM system. The FVC, FEV_1, FEV_1/FVC%, of all the subjects were measured by a digital MicroDL spirometer. Data were analyzed by One way ANOVA test, Independent sample t- test and Pearson's correlation coefficient test. **Results:** The mean percentage of predicted values of all the lung function variables in healthy female subjects and treated hypothyroids were within normal ranges. However, all of them were lower in untreated hypothyroids in comparison to those of control and treated hypothyroids.FVC and FEV_1 showed statistically significant ($p<0.001$) difference and FEV_1/FVC% showed non significant difference . In addition, all the ventilatory variables had negative correlation with serum TSH level and positive correlation with serum FT_4 level and these relationships were statistically significant in control ($p<0.001$) and treated hypothyroids ($p<0.01$). **Conclusion:** This study reveals that lung function may be lower in untreated hypothyrod patients and correlated with thyroid hormones. Treatment of hypothyroids may reverse this changes..

Key words : FVC, FEV_1, FEV_1/FVC%, Hypothyroidism

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Introduction

Hypothyroidism is a common endocrine disorder resulting from deficiency of thyroid hormones. The Third National Health and Nutrition Examination Survey (NHANES III) reported that hypothyroidism affect about 4.6% of the USA population (0.3% overt and 4.3% sub clinical). It is commonly manifested by slowing in physical and mental activities which may be asymptomatic. Symptoms may not appear until the thyroid gland has stopped functioning. Majority of systemic effects are present due to reduction in metabolic activity and deposition of glycosaminoglycans in interstitial tissues[1].

Hypothyroidism can have numerous effects on the respiratory system including respiratory muscle weakness, dyspnea, upper airway obstruction, central and obstructive sleep apnea, alveolar hypoventilation, reduced maximal inspiratory and expiratory pressure, nasal congestion, hoarseness of voice, impaired ventilatory response to both hypoxia and hypercapnia, pleural effusion and even respiratory failure.[2-4]

Like other target organs, the lungs are also affected in hypothyroidism. There is increasing evidence of an association between autoimmune thyroid disease and respiratory morbidity.[2] Several researchers reported that pulmonary functions may decrease in hypothyroid female and after thyroid hormone replacement these values may increase significantly in these group of patients [3-7]. Incidence[8] is greater in females than males with a ratio 5:1.

Bangladesh is an iodine deficient area and thyroid related diseases are common in our country. The latest national survey showed that about 17% of our population is suffering from thyroid disorder and the number of hypothyroid patients in our country are increasing day by day[9]. It is surprising that there is no age limitation for presentation of hypothyroidism. Along with this it is also remarkable that, many of the patients are diagnosed after development of one or more complications.

Many studies on pulmonary functions in hypothyroidism have been done in other countries[4-7,10]. With the best of our knowledge no data is available in Bangladesh on this issue. Therefore, the present study was conducted to observe some aspects of lung functions in hypothyroid female patients to evaluate their lung function status and also correlate them with thyroid hormones.

Methods

This cross - sectional study was carried out in the Department of Physiology, BSMMU, Dhaka, from 1st July 2008 to 30th June 2009 on 60(sixty) hypothyroid female patients of 30-50 years of age (Group B). For comparison, 30 (thirty) age, BMI and socioeconomic status matched apparently healthy female subjects (Group A) were also studied. The protocol of this study was approved by Departmental Ethical Committee. Patients with serum TSH >5.01mIU/L and serum FT_4 <9.14 pmol/L were selected as hypothyroid. Based on receiving treatment, hypothyroid patients were divided into B_1 i.e 30 untreated patients on their 1st day of diagnosis and B_2 i.e.30 patients treated for at least 12-18 months. The patients were selected from the Out Patient Department (OPD) of Endocrinology (an unit of Internal Medicine) of BSMMU, Dhaka. Subjects with history of any type of smoking, COPD, heart disease, diabetes mellitus, hypertension, Chronic renal failure were excluded from the study. After selection of the subjects the purpose and procedure of the study were explained to each subject with a cordial attitude giving emphasis on the benefits they would obtain from this study. They were encouraged for their voluntary participation and were also allowed to withdraw themselves as soon as they are reluctant. All the subjects were requested to attend at Department of Physiology, BSMMU within 9 am (after taking breakfast at 7 am) on the day of examination. Before examination an informed written consent was taken from each subject. A detail personal, medical, family, socio economic, occupational and drug history were taken and a thorough physical examination was done which were documented in a prefixed questionnaire. Height and weight of the subject were measured for calculation of BMI . Then after taking all the aseptic precaution, 5 ml of venous blood was

collected at 9 am from the subject for estimation of serum glucose, serum creatinine, TSH and FT_4 level . Then the subject was taken to the Respiratory Laboratory of Department of physiology for pulmonary function tests. The detailed procedure of spirometric examination was explained to the subject and FVC, FEV_1 and FEV_1/FVC% were measured by a digital MicroDL Spiro meter manufactured by Clement Clarke International Ltd., Edinburgh Way, Harlow, Essex CM202TT England. Data were analyzed by One way ANOVA test, Independent sample t-test and Pearson's correlation coefficient test, as applicable.

Results

The demographic variables of the study subjects are presented in Table I. All the groups were matched for age and BMI.

Table I: Age and BMI in different groups (n=90)

Groups	Age (Years)	BMI (Kg/m^2)
A (n=30)	37.27± 6.20	24.50 ± 4.31
B_1(n=30)	38.00±6.64	24.68 ± 4.77
B_2 (n=30)	37.83±5.93	25.91 ± 4.57

Statistical analysis:

Groups	p value	
A vs B_1 vs B_2 [a]	0 .902[ns]	0.437 [ns]
A vs B_1 [b]	0 .660 [ns]	0.893[ns]
A vs B_2 [b]	0.724 [ns]	0.231[ns]
B_1 vs B_2 [b]	0.807[ns]	0.312 [ns]

Data were expressed as mean ± SD. a = one way ANOVA, b = independent sample t - test.

BMI = Body Mass Index.Group A: Apparently healthy Euthyroids (control group)

Group B: Hypothyroid (study group) B_1: Untreated B_2: Treated ns= p > 0.05

Serum TSH level was significantly (p<0.001) higher and serum FT_4 level was significantly (p<0.001) lower in group B_1 than those of group B_2 and A. But statistically no significant difference of these values were observed between group B_2 and A.(Table II).

Table II : Serum TSH and FT_4 level in different groups (n=90)

Groups	TSH level (mIU/L)	FT_4 level (pmol/L)
A (n=30)	2.19 ±1.04	15.09± 4.14
B_1(n=30)	38.16±30.51	5.12±1.89
B_2(n=30)	2.05±1.02	15.01±3.82

Statistical analysis:

Groups	p value	
A vs B_1 vs B_2 [a]	0.000***	0.000***
A vs B_1 [b]	0.000***	0.000***
A vs B_2 [b]	0.608[ns]	0.964[ns]
B_1 vs B_2 [b]	0.000***	0.000***

Data were expressed as Mean ± SD. a = one way ANOVA, b = independent sample -t test .

Group A: Apparently healthy Euthyroids (control group) Group B: Hypothyroid (study group)

B_1: Untreated B_2: Treated *** = p<0.001 ns = p > 0.05.TSH = Thyroid stimulating hormone, FT_4= Thyroxine (free form).

The mean percentage of predicted values of both FVC and FEV_1 were significantly (p<0.001) lower in group B_1 than those of A and B_2. But statistically no significant differences of these values were observed between group A and B_2.However, similar changes were observed in FEV_1/FVC ratio in different groups and the difference was statistically non significant. (Table III).

Table III: Mean percentage of predicted values of FVC, FEV_1 and FEV_1/FVC% in different groups (n=90)

Groups	FVC	FEV_1	FEV_1/FVC ratio
A (n=30)	91.03±12.52	89.80 ± 10.60	104.30 ± 11.89
B_1(n=30)	76.67±11.21	75.80 ± 10.37	101.70 ± 17.69
B_2(n=30)	89.73±9.92	88.10± 9.0	102.60± 11.72

Statistical analysis:

Groups	P value		
A vs B_1 vs B_2 [a]	0.000***	0.000***	0.762[ns]
A vs B_1 [b]	0.000***	0.000***	0.501[ns]
A vs B_2 [b]	0.657[ns]	0.507[ns]	0.572[ns]
B_1 vs B_2 [b]	0.000***	0.000***	0.817[ns]

Data were expressed as Mean ± SD. a = one way ANOVA, b = independent sample -t test .
Group A: Apparently healthy Euthyroids (control group)Group B: Hypothyroid (study group)
B_1: Untreated B_2: Treated *** = p<0.001 ns = p > 0.05

Again, all the parameters were negatively correlated with serum TSH level (Figure 1,2 and 3) and positively correlated with serum FT_4 level and these relationships were statistically significant only in group A and B_2. (Figure 4,5 and 6)

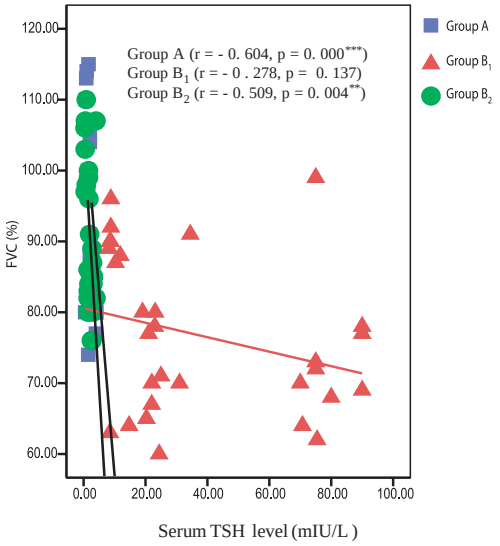

Figure 1: Correlation of percentage of predicted values of FVC with serum TSH level in different groups (n=30)

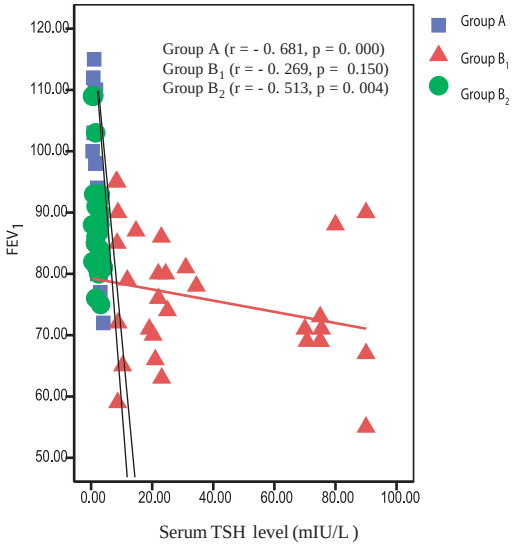

Figure 2: Correlation of percentage of predicted values of FEV_1 with serum TSH level in different groups (n=30)

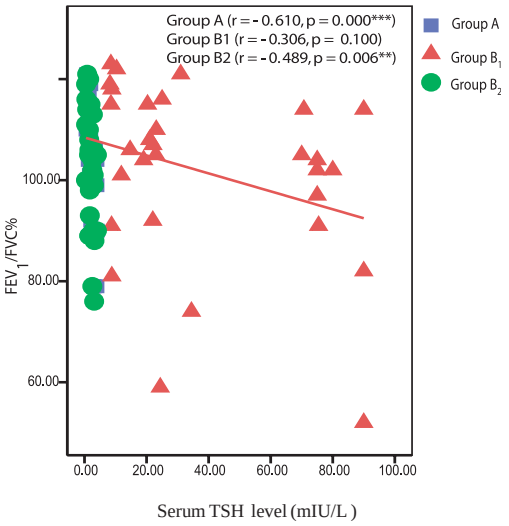

Figure 3: Correlation of percentage of predicted values of FEV_1 / FVC % with serum TSH level in different groups (n=30)

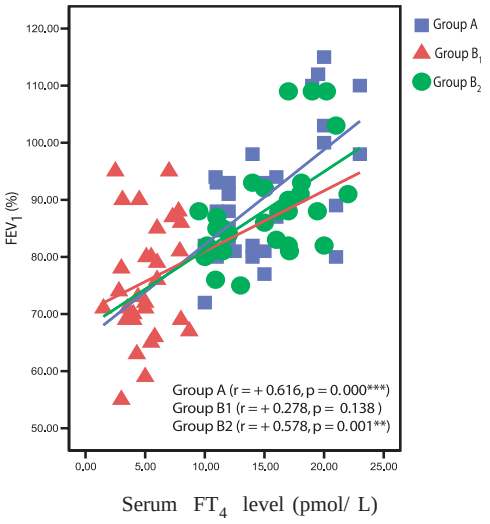

Figure 5: Correlation of percentage of predicted value of FEV_1 with serum FT_4 level in different groups (n=90)

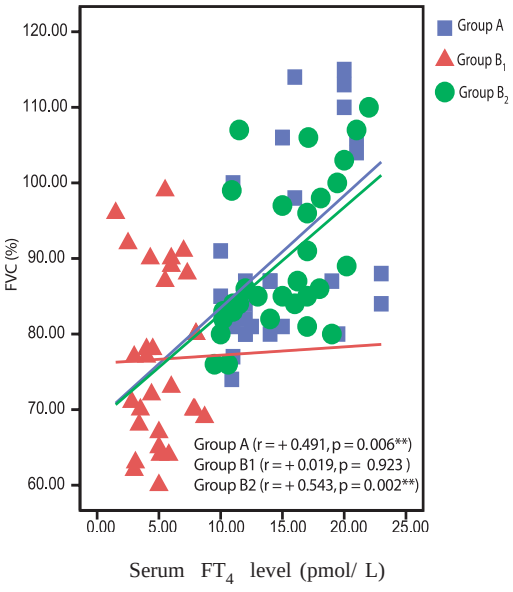

Figure 4 : Correlation of percentage of predicted value of FVC with serum FT_4 level in different groups (n=90)

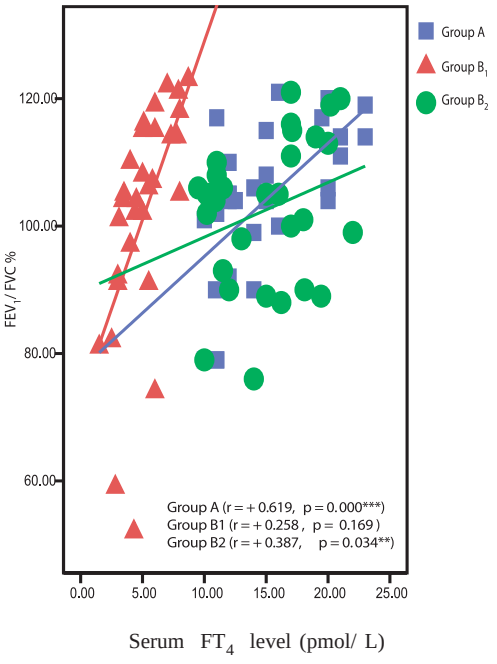

Figure 6: Correlation of percentage of predicted value of FEV_1/ FVC % with serum FT_4 level in different groups (n=90)

Discussion

In the present study, the lung function parameters in healthy subjects were almost similar to the findings reported by the various investigators from different countries [5,6,10] as well as in our country[11,12]. No abnormal pulmonary tests were detected in them.

Serum TSH level was significantly higher and serum FT_4 level was significantly lower in untreated hypothyroids than those of control and treated hypothyroids. However, statistically no significant difference in TSH level was observed between control and treated hypothyroid patients.

The mean percentage of predicted values of FVC and FEV_1 were significantly lower in untreated hypothyroids compared to treated patients and healthy control and the observation was similar to other findings [3, 5,6]. But no significant difference of these values were observed between treated hypothyroids and control and this findings were in agreement with several investigators from different countries[4,10,13].

However, statistically no significant difference of FEV_1/FVC ratio was observed among untreated hypothyroids, treated hypothyroids and healthy control. Almost similar type of finding was reported by some researchers in different countries[4-6,10] .

All the observed spirometric variables were negatively correlated with serum TSH level and positively correlated with serum FT_4 level. These relationships were statistically significant in treated hypothyroids and control but nonsignificant in untreated hypothyroids. These observations were in partial agreement with those of Cakmak at. Al[6]

Various mechanisms have been proposed for these observed changes in spirometric lung functions in hypothyroidism. Some investigators suggested that respiratory center depression, interference of neural conduction or neuromuscular transmission to the respiratory muscles and respiratory muscles diseases in hypothyroidism may cause alveolar hypoventilation which may affect central ventilatory control and can impair ventilation[14]. In addition, in hypothyroidism, reduced surfactant phospholipid, phosphatidylglycerol and phosphatidic acid along with increase in surface active lipids phosphatidylserine and phosphatidylinositol in alveolar epithelium may decrease alveolar septation and reduce lung compliance and surfactant adsorption [15-18]. Moreover, mucopolysaccharide deposition in the lungs may cause fibrosis and thickening of the alveolar wall with loss of elastic tissue and may increase the work of breathing. All these changes may reduce ventilatory lung functions[19].

In this study, decreased percentage of predicted values of FVC and FEV_1 in untreated hypothyroid patients in comparison to the control subjects and treated hypothyroids are most likely due to decreased thyroid hormone level which may cause respiratory muscle weakness and reduction in contractile strength. This low thyroid hormone level may also decrease lung elastic tissue and increase the work of breathing. However, the normal ratio of FEV_1/ FVC % in hypothyroid patients may be due to proportionate reduction of FVC and FEV_1. This is further supported by negative correlation of FVC, FEV_1 and FEV_1/FVC % with serum TSH level and positive correlation of these ventilatory variables with serum FT_4 level .

Conclusion

This study reveals that, hypothyroidism may cause decrement in ventilatory lung functions and the deterioration may be positively correlated with serum FT_4 level and negatively correlated with serum TSH level.

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