Influence of Age and Body Mass Index on Spirometry Parameters in Women with Hypothyroidism

Dalal Ayad Al-Alaf* , Afraa Mohammed Alameen* , Janan Abdalrazzak Alrefaee*
***Collage of Medicine, University of Mosul, Mosul, Iraq**
Correspondence: dalal.23hmp22@student.uomosul.edu.iq

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ABSTRACT

Background: Thyroid hormones are essential for the function of the respiratory system. Hypothyroidism affects respiration by a decrease in lung compliance, muscle weakness, and a reduction in ventilatory drive. Lung function is influenced by age and body mass index, but the correlation of spirometry with BMI and age in hypothyroid women remains poorly understood.

Aims: To investigate the effect of age and BMI on spirometry parameters in hypothyroid women in Nineveh Governorate.

Materials and Methods: A case-control study of 50 newly diagnosed hypothyroidism and 50 euthyroid individuals. Measurement of spirometry parameters such as FVC, FEV1, and FEV1/FVC with a spirometer. Weight and height were measured to calculate BMI.

Results: A significant negative correlation between age and FVC% was predicted in the hypothyroid group ($r = -0.364$, $p = 0.009$). Nevertheless, FEV1/FVC exhibited a significant negative correlation with BMI in the hypothyroid group ($r = -0.296$, $p = 0.037$).

Conclusion: Lung function declines with age in women with hypothyroidism, especially FVC% predicted. BMI appears to increase the airflow limitation as pronounced by a decrease in FEV1/FVC in hypothyroid women.

Keywords: Hypothyroidism, Body mass Index (BMI), Spirometry

تأثير العمر ومؤشر كتلة الجسم على مقياس التنفس (السبايروميتري) في النساء المصابات بقصور الغدة الدرقية

دلال اياد العلاف* ، د.عفراء محمد الامين* ، د.جنان عبد الرزاق الرفاعي*
*كلية الطب ، جامعة الموصل ، الموصل ، العراق

الخلاصة

الخلفية: هرمونات الغدة الدرقية ضرورية للجهاز التنفسي. يؤثر قصور الغدة الدرقية على التنفس من خلال انخفاض مرونة الرئة وضعف العضلات وانخفاض الدافع التنفسي. تتأثر وظيفة الرئة بالعمر ومؤشر كتلة الجسم، لكن ارتباط قياس التنفس بمؤشر كتلة الجسم والعمر لدى النساء المصابات بقصور الغدة الدرقية لا يزال غير مفهوم بشكل جيد.

الأهداف: دراسة تأثير العمر ومؤشر كتلة الجسم على معايير قياس التنفس لدى النساء المصابات بقصور الغدة الدرقية في محافظة نينوى.

الطرق: دراسة حالة وشاهد لـ ٥٠ فردًا تم تشخيصهم حديثًا بقصور الغدة الدرقية و٥٠ فردًا سليمًا. قياس معايير قياس التنفس مثل (FVCو FEV1و FEV1 / FVC)باستخدام مقياس التنفس. تم قياس الوزن والطول لحساب مؤشر كتلة الجسم.

النتائج: تم التنبؤ بارتباط سلبي كبير بين العمر ونسبة FVC في مجموعة قصور الغدة الدرقية ($r=-0.0364$، $p=0.009$)ومع ذلك، أظهر FEV1/FVC ارتباطًا سلبيًا كبيرًا بمؤشر كتلة الجسم في مجموعة قصور الغدة الدرقية ($r=-0.296$, $p=0.037$).

الاستنتاج: تتراجع وظيفة الرئة مع تقدم العمر لدى النساء المصابات بقصور الغدة الدرقية، وخاصة نسبة FVC المتوقعة. ويبدو أن مؤشر كتلة الجسم يزيد من تقييد تدفق الهواء كما يتضح من انخفاض FEV1/FVC لدى النساء المصابات بقصور الغدة الدرقية.

الكلمات المفتاحية : قصور الغدة الدرقية، مؤشر كتلة الجسم، مقياس التنفس(سبايروميتري).

INTRODUCTION

Thyroid hormones are essential for lung development, surfactant production, and enhancing respiration by promoting oxygen consumption and carbon dioxide production, Increase the respiratory rate and minute ventilation[1,2].

Hypothyroidism is a common endocrine disorder, particularly in women, characterized by insufficient production of thyroid hormones, which is associated with multiple effects on the respiratory system. Respiratory symptoms in hypothyroidism patients range from minor breathing difficulties to respiratory failure in severe cases [3,4]. Additionally, hypothyroidism is associated with respiratory muscle weakness, including the diaphragm [5]. Hypothyroidism also alters the central ventilatory response, decreasing respiratory drive and reducing sensitivity to oxygen and carbon dioxide in the blood [6].

Spirometry is the most common test used to assess the health of the respiratory system by measuring certain lung function parameters such as forced vital capacity (FVC), forced expiratory volume in the first second (FEV1), and peak expiratory flow rate (PEFR) [7]. These parameters are influenced by factors such as age and body mass index (BMI) [8,9].

The respiratory system exhibits significant changes with age. These alterations include weakening of alveolar structures and a decrease in respiratory muscle mass [10,11]. Research suggests that pulmonary capacity is generally highest during adulthood and then reduced, which is attributed to physiological reduction in lung tissue elasticity and respiratory mechanics [12]. In hypothyroid women, the hormonal imbalance of thyroid disorders can accelerate sexual dysfunction and quality of life with aging [13,14], suggesting age-related physiological changes affecting overall health, including respiration.

Body mass index (BMI) has a major impact on lung function.

The effect of obesity on lung volumes primarily results from a reduction in compliance of the thoracic chest wall, leading to restricted movement of the chest wall and diaphragm [15]. Furthermore, a study found overweight individuals had significantly lower FVC compared to normal-weight individuals [16].

Moreover, A study showed that increasing thyroid-stimulating hormone levels in hypothyroidism positively correlates with higher BMI [17].

Table (1): The effect of obesity on spirometry parameters [18]

Parameters	**Effect**
Expiratory reserve volume	Reduction
Functional residual capacity	Reduction
Total lung capacity	Reduction (only in the morbidly obese)
Vital capacity/forced vital capacity	Mild reduction
Forced expiratory volume in 1 second	Mild reduction

These studies indicate that age, BMI, and spirometry parameters are related .Additional research is needed to understand this correlation, particularly in hypothyroid women, for better therapeutic strategies and improved respiratory outcomes.

The study aims to investigate the effect of age and BMI on spirometry parameters in hypothyroid women in Mosul city.

MATERIALS AND METHOD

This case-control study was conducted in the Alawram and Nuclear Medicine Hospital from November 2023 to May 2024. One hundred women were divided into 50 newly diagnosed hypothyroid women and 50 euthyroid women compatible by age and BMI in the hypothyroid group. Participants with a history of smoking, pregnancy, chronic obstructive pulmonary disease, heart disease, diabetes mellitus, or chronic renal failure were excluded from the study.

The purpose and procedure of the study were explained, and informed written consent was obtained from each participant. A detailed questionnaire containing the personal, medical, family, occupational, and drug history was taken, and a thorough physical examination was performed.

The height and weight of the subjects were measured using a stadiometer and electronic weighing scale, respectively. Body mass index was calculated by dividing body weight by kilograms per square meter. Spirometry examination was conducted according to the American Thoracic Society and the European Respiratory Society (ATS/ERS) guidelines using a Minispir light spirometer with Win Spiro software, Rome, Italy. A thyroid function test was measured using a mini VIDAS system to confirm the diagnosis of hypothyroidism.

Data were analyzed using an independent sample t-rest and Pearson's correlation coefficient test. The statistical analysis was conducted using IBM-SPSS version 26. A p value less than or equal to 0.05 is considered statistically significant.

RESULTS

Figure (1) illustrates the distribution of the studied groups according to age. Among each group, 15 individuals were aged 18–29, while 35 individuals fell within the 30–50 age range.

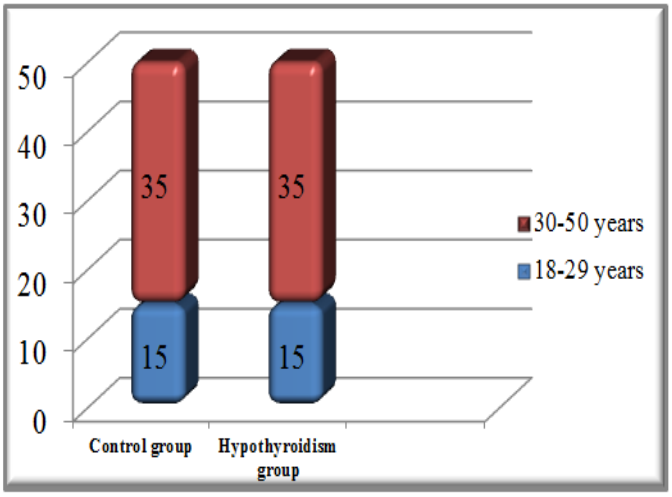

Figure (1): Distribution of the study group according to age

Regarding BMI, the distribution in the control group was 43 individuals with a BMI ranging from 25 to 29.9, and 43 in the hypothyroid group also fell within the same BMI range. The remaining individuals in each group, specifically 7 in the control group and 7 in the hypothyroid group were classified as having a normal BMI, as shown in Figure (2).

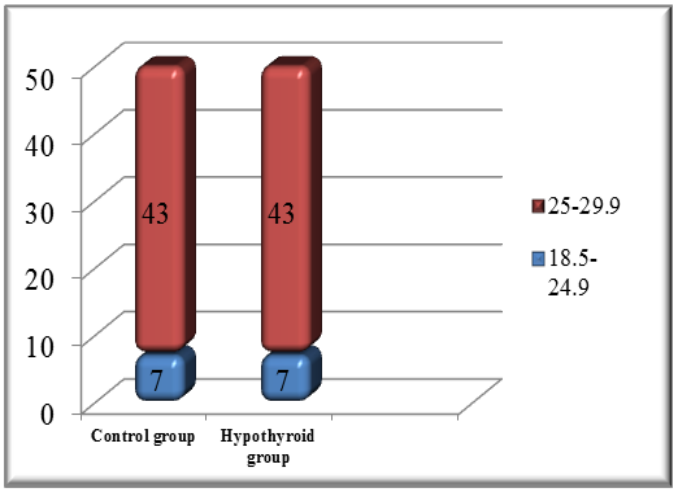

Figure (2): Distribution of the study groups according to BMI

Table (2) demonstrates the correlation of age with lung function parameters across the study groups. The hypothyroid group had a significant inverse correlation with FVC% Predicted (r= - 0.364, p=0.009). For the control group, the age was inversely correlated with the FEV1/FVC ratio (r= -0.294, p=0.038), as shown in Figure (3).

Table (2): Correlation of age with spirometry parameters between the study groups

Correlation of Age with	Groups	r-value	p-value
FVC% predicted	Control	-0.193	0.179
	Hypothyroidism	-0.364	**0.009**
FEV1% predicted	Control	0.022	0.879
	Hypothyroidism	-0.269	0.059
FEV1/FVC ratio	Control	-0.294	**0.038**
	Hypothyroidism	-0.253	0.076

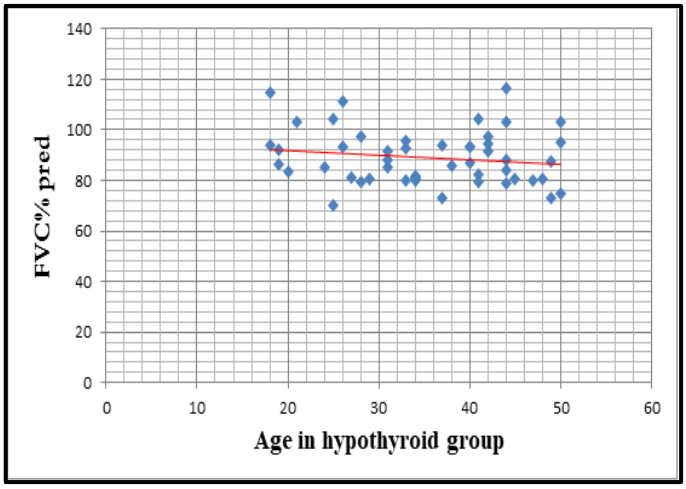

Figure (3): Correlation of age with FVC% predicted in hypothyroid groups

In Table (3), within the hypothyroid group, BMI was inversely correlated with the FEV1/FVC ratio (r= -0.296, p=0.037). In the control group, BMI demonstrated a significant inverse correlation with the FEV1/FVC ratio (r= -0.300, p=0.034), as shown in Figure (4).

Table (3): Correlation of BMI with spirometry parameters between the study groups

Correlation of BMI with	Groups	r-value	p-value
FVC% predicted	Control	0.151	0.294
	Hypothyroidism	-0.017	0.904
FEV1% predicted	Control	0.224	0.117
	Hypothyroidism	-0.095	0.514
FEV1/FVC ratio	Control	-0.300	**0.034**
	Hypothyroidism	-0.296	**0.037**

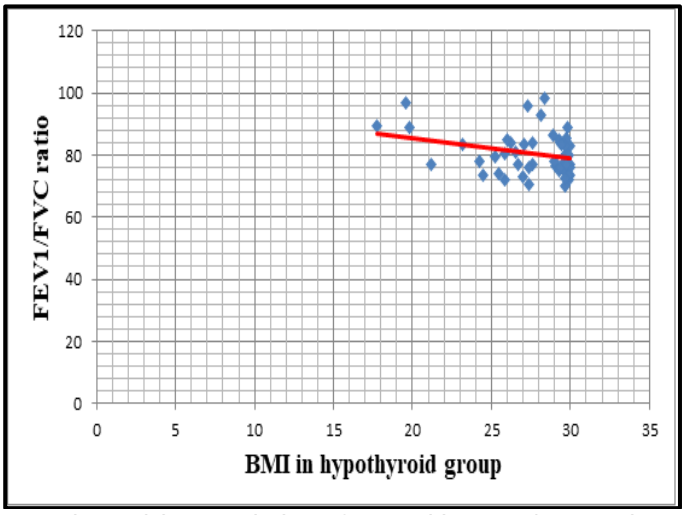

Figure (4): Correlation of BMI with FEV1/FVC ratio in the hypothyroid group

DISCUSSION

The most important factor in the incidence of hypothyroidism is age. Zhang et al. conducted a study demonstrating an increase in the incidence of thyroid disease in older United States adults [19]. This finding results from increased susceptibility to autoimmune thyroid disorders in older women [20].

This study matched the age of participants in each group, as shown in Figure (1).

The decline in lung function with increasing age was identified previously. A systematic review of prospective cohort studies found that spirometry parameters such as FEV1 and FVC decreased with age in individuals without lung disease [21].

Our study detected a negative association between age and the percent predicted FVC in hypothyroid patients, as illustrated in Table (2) and Figure (3). This result is consistent with findings by Iyer et al. and Maiti et al., who found as age increased, all spirometry showed a significant reduction in newly diagnosed hypothyroid patients [22,23].

Hypothyroidism can exacerbate age-related physiological changes such as respiratory muscle weakness and lung capacity reduction [6]

Hypothyroid patients tend to gain weight due to a decreased metabolic rate. This is evidenced by a study showing significant weight loss in hypothyroid patients after normalization of thyroid function [24]. There is a high prevalence of hypothyroidism in the overweight category, as shown in Figure (2). This finding is supported by research showing that individuals with higher BMI levels tend to have elevated TSH levels [25]. Furthermore, research showed obese adults have a higher prevalence of autoimmune hypothyroidism, with a prevalence rate of around 62.2% [26]. This could be credited to low-grade inflammation and immune dysregulation in hypothyroidism [27].

In the present study, BMI did not impact FVC FEV1 in the hyperthyroid group (see Table 3). This finding contradicts other studies by Tatavarthi et al. that demonstrated that hypothyroidism compromises lung function, and the degree of impairment depends on other factors, such as thyroid stimulating hormone levels, duration of disease, and BMI [28].

Other studies showed that the prevalence of hypothyroidism in patients with diabetes, which is linked to obesity, is 25.3 [29]. In contrast, another study by Al-Ameen and Al-Habbo showed that lung function is decreased in patients with diabetes mellitus [30], suggesting a possible relationship between obesity in hypothyroidism and reduced lung function.

In Table (3) Figure (4), the FEV1/FVC ratio showed a significant reduction with increased BMI in the hypothyroid group. A similar result was detected in a study by Yaqub et al. [31].

The possible explanation for these results is an accumulation of adipose tissue in airways leading to thickening of the chest wall in individuals with high BMI [32].

CONCLUSION

This study shows that lung function declines with age in hypothyroid patients, particularly a reduction in FVC% predicted, highlighting that age is a significant factor influencing respiratory function in hypothyroidism. However, BMI significantly negatively affected the FVC/FEV1 ratio. These findings are so important in the follow-up of hypothyroid patients. We aim to focus on the FVC% predicted in aging people while focusing on the FVC/FEV1 ratio in overweight people. This finding is so important to catch hypothyroid patients with early respiratory problems and quick treatment and prevent health deterioration in order to improve community outcomes.

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