Center of Medicine

RESEARCH ARTICLE

The Role of Transthyretin and Other Dominant Biomarkers in Patients with Asthma

Talib Dabshee Al-Tmimeea[1], Dr. Fatin Fadhel Al-Kazazz [2]

[1] Protein Research Center, Shahid Beheshti University, Velenjak, Tehran, Iran.

[2] Al-Mustansiriyah University, Baghdad, Iraq.

*Corresponding author E-mail: alwalytalib@gmail.com

ARTICLE INFO.

ARTICLE HISTORY:

RECEIVED: 10/10/2025

ACCEPTED: 06/01/2026

PUBLISHED: 25/01/2026

ABSTRACT

Asthma is one of the most common chronic diseases affecting both children and adults. Mortality rates vary based on factors such as stage of diagnosis, treatment options, and patient health. However, treatments in advanced stages often yield limited results, underscoring the importance of early detection to improve outcomes. In this study, we evaluated transthyretin levels as a potential biomarker for Asthma, along with general markers such as albumin, cholesterol, total protein, high-density lipoprotein (HDL), triglycerides, thyroid-stimulating hormone (TSH), triiodothyronine (T3), and tetraiodothyronine (T4) in both asthma patients and a control group. We included 60 asthma patients and 60 controls. Data on age and body mass index (BMI) were collected from all participants. Comparisons of biomarkers were made across genders and age groups. Significant changes in T3, T4 and TSH levels were observed in asthma patients compared to the control group. Thyroid-Stimulating Hormone (TSH) levels were higher in asthma patients, while triiodothyronine and tetraiodothyronine levels were lower and showed a positive correlation with triiodothyronine and thyroid-stimulating hormone (TSH) levels. ROC analysis revealed that TSH, cholesterol, high-density lipoprotein (HDL), and triglycerides were strong predictors of asthma diagnosis. Our results suggest that TSH, T3, and T4 can serve as reliable biomarkers for asthma. Early detection using these biomarkers can improve treatment outcomes and reduce mortality rates. Further research is needed to validate these findings and explore their potential in clinical settings. Incorporating TSH, T3, and T4 into routine screenings could enhance diagnostic accuracy and patient prognosis. While the study results indicated an association between cholesterol levels and the risk of developing or worsening asthma, as well as between triglycerides (TG), a positive relationship was also observed between triglycerides (TG), total cholesterol (TC), and asthma. Our study also represents a positive interaction between high-density lipoprotein (HDL) cholesterol levels and the prevalence of asthma, which could be biomarkers for disease diagnosis.

KEYWORDS: Asthma, Transthyretin, Thyroid Hormones, Body Mass Index, Albumin, Cholesterol

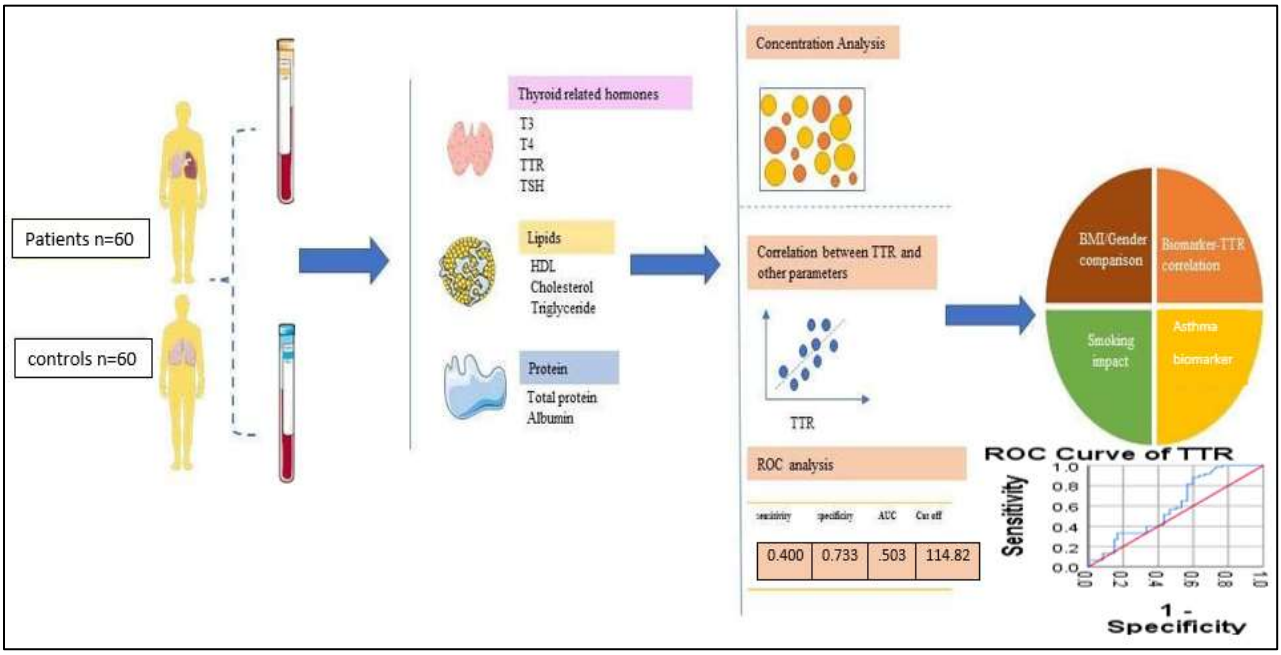

Fig. 1 The graphical abstract presents a study on the role of Transthyretin (TTR) in Asthma progression. The research involves 60 Asthma patients and 60 healthy controls, with blood samples analyzed for thyroid-related hormones, lipids, and proteins. The study examines correlations between TTR levels and various parameters, including BMI, gender, smoking impact, and specific Asthma biomarkers. Analytical methods such as concentration analysis, correlation assessment, and ROC analysis are used to evaluate TTR's potential as a biomarker for Asthma.

1. Introduction:

Asthma is one of the most common chronic diseases affecting both children and adults characterized by airway inflammation and constriction during attacks. Its typical symptoms include wheezing, chest tightness, and coughing [1] far, the incidence of asthma has been attributed to a combination of environmental and genetic factors. However, the specific mechanism of asthma attacks has not yet been fully clarified [2]

The symptoms of asthma can vary in severity from mild to severe, and some individuals may experience life-threatening symptoms [3] A significant body of research has demonstrated that persistent wheezing is associated with slower lung function improvement during adolescence [4] Moreover, individuals with persistent asthma are more likely to experience an increased incidence of other respiratory diseases, such as bacterial pneumonia, which can be induced by an increased nasopharyngeal carriage of Streptococcus pneumoniae [5]Asthma and its related complications have posed a significant public health challenge, leading to high morbidity and, in severe cases, a high fatality rate [6]Unfortunately, asthma cannot currently be cured, but it can be effectively managed with current medical care [7] While asthma cannot be cured, it can be effectively managed with appropriate therapy, allowing individuals to maintain a healthy condition [8].

Although there is increasing technological advancement in drug research, drug repurposing has garnered more attention [9]- [10] Drug repurposing, also known as drug repositioning, involves using existing drugs for new therapeutic purposes [11]- [12] Compared to developing new drugs, drug repurposing offers reduced development time, higher approval rates, and existing safety data [13] This approach has been employed in many diseases, such as psoriasis [14], COVID-19 [15]- [16] HPV-associated cervical cancer [17] endometrial cancer [18]and tubulointerstitial fibrosis [19] among others.

Lipid-lowering drugs comprise a range of medications used to reduce blood cholesterol levels, thereby lowering the risk of heart disease and stroke [20] Another study found that among patients with severe asthma, those who took statins achieved better asthma control [21] Although the benefits of statins for asthma have been widely reported, less evidence has been shown regarding the role of other lipid-lowering drugs in asthma. Hence, we aimed to explore the association between different lipid-lowering drugs and asthma.

2. Materials and Methods

2.1 Patients and sample collection

This study was conducted at Imam Hussein Teaching Hospital in Karbala city from June 28, 2023, to September 24, 2023. The research involved 120 Iraqi individuals divided into two groups: a control group comprising 60 individuals and Asthma group comprising another 60 individuals. Among the 60 patients in the Asthma group, (Fig 2). Samples were collected along with pertinent information obtained through oral questioning, including medical history, smoking habits, and other potential factors. Information was also sourced from pathology records, as all Asthma patients have a pathology report. Department. Each group was stratified based on clinical and demographic characteristics such as age, BMI, gender.

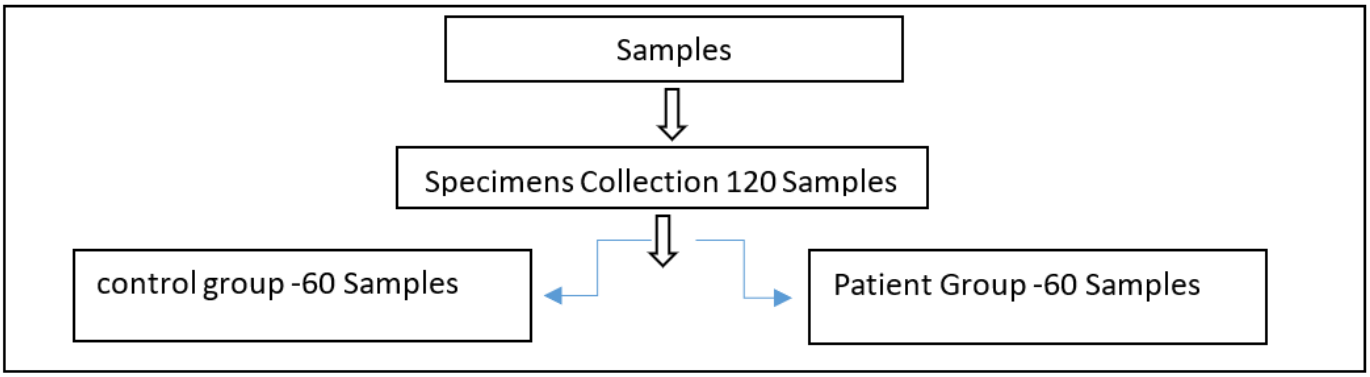

Fig. 2 After dividing the samples into four groups and placing the serums of these samples in Eppendorf tubes for the purpose of conducting tests on it for each of these parameters (TTR, TSH, T3, T4, TP, Alb, HDL-C, Chol and TG)

2.2 Ethical Approval

All human samples used in this research were obtained with informed consent from each subject or the subject's guardian. Additionally, the experimental protocols were approved by the Mustansiriyah University-College of Science ethical committee.

2.3 Sample collection

Two milliliters of venous blood were collected from controls and patients. The blood was left to clot and subsequently centrifuged for 5 minutes at 8000 x g. The separated serum was then preserved at -80 °C.

2.4 Methodology

Results of TTR, TSH, T3, T4, TP, ALB, Chol, and TG were initially compared among all groups, including healthy controls, to explore their relationships with various clinical characteristics and identify potential indicators of disease or its progression. All samples from the healthy control group were selected based on the absence of any Asthma diseases, adhering to the exclusion criteria outlined in the study protocol. Due to the prolonged hospitalization and extended infection periods exceeding ten years among some Asthma patients, their results were not compared with those of other patients. This was due to decomposition of most blood components and the lack of access to effective serum in the respiratory system or other organs, as well as the absence of recent surgical operations.

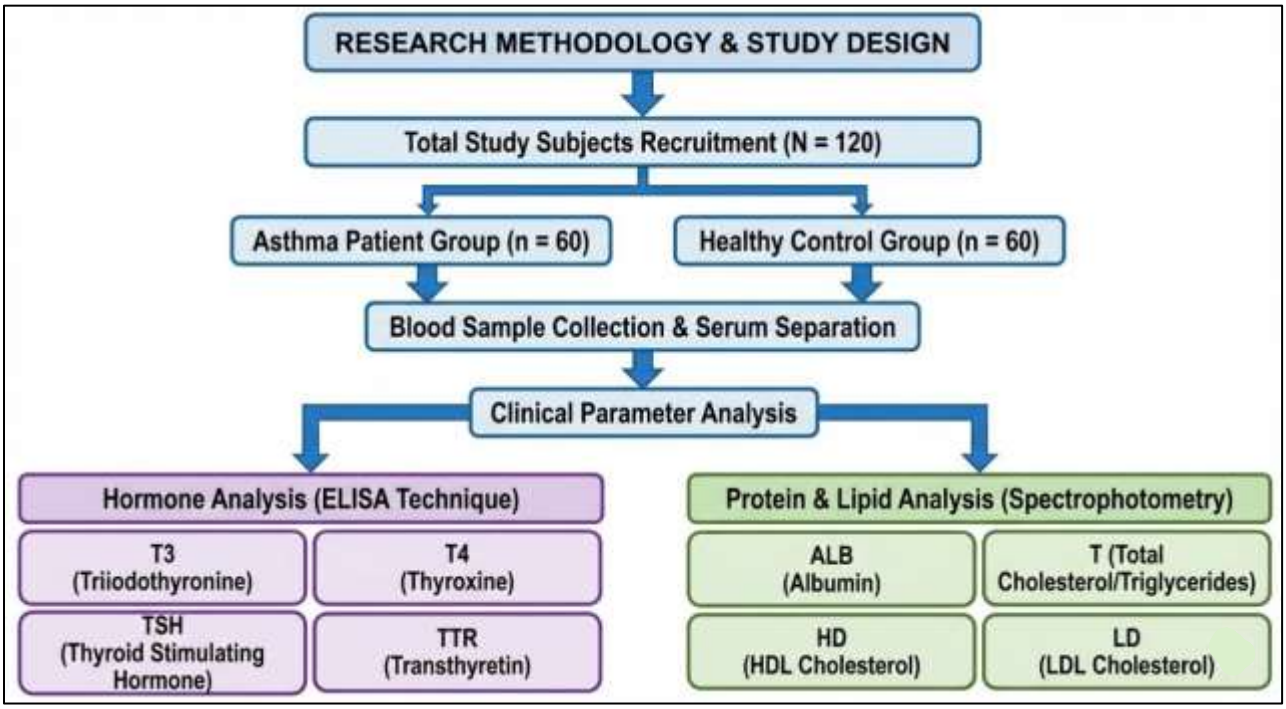

Fig 3: Methodology.

2.5 Materials

The TTR kit (Biotech Company, China), T3, T4, TSH kits (Pishtaz Teb Diagnostic company, Iran), HDL, Chol, TG, and TP kits (Biorexfars company, Iran) and Alb kit (Darman Kave company, Iran) was utilized for detecting biomarkers concentration in blood samples.

2.6 Biomarkers Detection

For the comprehensive detection of T3, T4, TTR, Alb, Chol, HDL, Total Protein, and TSH in a single blood sample, blood was collected from the patient using a sterile syringe and placed into a vacutainer tube. The sample was centrifuged to separate serum or plasma from blood cells. Specific test kits for each analyte were prepared, and a defined volume of serum/plasma was dispensed into wells of microplates pre-coated with antibodies specific to each analyte.

Biomarker detection methods, such as enzyme-linked immunosorbent assay (ELISA), utilize specific antibodies to capture target molecules like proteins or hormones in biological samples.These assays often involve enzyme reactions that produce measurable signals, correlating the signal intensity with the biomarker concentration, crucial for diagnostic and research purposes. The assay for detecting Human TTR utilized Biotin double antibody sandwich technology. Wells were pre-coated with monoclonal antibodies specific to TTR. TTR samples were added and allowed to bind, followed by incubation with biotin-labeled anti-TTR antibodies. Streptavidin-Horseradish Peroxidase (HRP) was then introduced to form an immune complex. After washing to remove unbound enzymes, chromogens were added, causing a color change from blue to yellow due to acidification. Absorbance at 450 nm was measured within 10 minutes of adding the stop solution, correlating with the TTR concentration. For T3 detection, the competitive ELISA technique was employed. Wells were coated with anti-T3 monoclonal antibodies. Patient serum and standards were added, followed by the T3-HRP conjugate. After incubation and washing to remove unbound substances, a chromogen-substrate solution was added, resulting in a blue color change. Absorbance was measured at 450 nm within 30 minutes. For T4 detection, wells were coated with anti-T4 monoclonal antibodies. Patient serum, standards, and T4-HRP conjugate were added and incubated. After washing, a chromogen-substrate solution induced a blue color change, stopped by the addition of a stop solution. Absorbance was measured at 450 nm. For TSH detection, the method followed the same immunoassay procedure, utilizing specific anti-TSH antibodies for accurate measurement. TP was detected using the Biuret reagent protein assay. Proteins reacted with copper salts in an alkaline medium, producing a violet-blue color. Absorbance at 540 nm was measured using an ELISA reader after

incubation. Alb was detected using the Bromcresol Green method. Alb reacted with bromcresol green reagent in a moderately acidic environment, producing a complex with a color change. Absorbance at 628 nm indicated Alb concentration.

Chol detection involved hydrolysis of cholesteryl esters by cholesterol esterase. Chol reacted with phenol and 4-aminophenazone to form a red quinone, resulting in a pink-red solution after incubation. Absorbance at 200 nm was measured. HDL measurement was carried out using similar biochemical reactions appropriate for lipoproteins. TG detection utilized lipoprotein lipase to release glycerol, which reacted with peroxidase to form a quinonimine compound. Absorbance at 450 nm was measured after incubation. Each assay followed the specific instructions provided with the biochemical kits concerning sample addition, incubation, and measurement. The obtained signals were compared to standard curves to determine the concentrations of T3, T4, TTR, Albumin, Cholesterol, HDL, Total Protein, and TSH. Quality control samples were included to ensure the accuracy and reliability of test results. Manufacturer instructions for each test kit were followed meticulously, and all instruments were properly calibrated.

2.7 Statistical analysis

Data are presented as frequencies or percentages for categorical variables and as mean ± standard deviation for continuous variables, unless otherwise specified. Differences in categorical clinical variables between two groups were evaluated using the chi-square test or Fisher's exact test. Mean value differences between groups were analyzed using the Mann-Whitney U test. One-way analysis of variance (ANOVA) was employed to compare variables among more than two groups, with Tukey's post hoc test used for multiple comparisons. Associations between variables were quantified using Spearman's rank correlation coefficient. This study assessed the diagnostic performance of a predictive model using values related to biomarker concentration and BMI in patients diagnosed with Asthma. The primary outcome was a binary variable indicating the presence or absence of Asthma., coded as 0 for negative and 1 for positive outcomes. The ROC curve analysis was conducted in SPSS to evaluate the model's ability to discriminate between positive and negative cases.

The ROC analysis in SPSS provided a table detailing sensitivity (true positive rate) and specificity (true negative rate) at various cutoff points. The Area Under the Curve (AUC) was calculated to quantify the model's overall performance. A higher AUC suggests better performance, indicating the model's effectiveness in distinguishing between the outcome classes. To determine the optimal cutoff point, sensitivity and specificity values were reviewed across different thresholds. The cutoff point that maximized Youden's Index (Sensitivity + Specificity - 1) was selected to balance sensitivity and specificity. This chosen cutoff point demonstrated a practical balance for clinical decision-making, highlighting the model's capability to effectively classify positive and negative outcomes. These findings have significant implications for its application in clinical settings.

3. Results

Table 1 shows the number, percentage and value of categorical variables for the asthma group compared to the control group. Effect of Demographic characteristics of the participants in this study, including gender, age, BMI, smoking, and family history on asthma patients and control group. Since our study had a minimum age of 18 years and above, we found a higher prevalence of asthma in female participants (60.0%) than in male participants (40.0%) (P value for interaction = .271) (Fig 4-d). We also found a higher prevalence of asthma in female participants than in control group participants (50.0%), while it was lower in male participants than in control group male participants (50.0%), respectively (Figure 4c). Body mass index (BMI) was calculated as weight (kg) divided by height squared (m2). Participants were classified into two categories (normal weight and overweight) based on BMI score. Percentages for each category were determined (75.0%, 55.0%) normal weight (25.0%, 45.0%) overweight for patients and healthy controls respectively, where the value ($p<.05$) is statistically significant as shown in (Figure 1-a) there are age differences in asthma. We found a higher prevalence of asthma in the age group above (40) years (70.0%) compared to the age group below (40) years (30.0%) (interaction value p=.000) (Fig 4-c). Table 1). Since the significance level is less than 0.01, we reject the null hypothesis and accept the alternative hypothesis that there is a significant age difference for both ages in asthma patients.

The world population of smokers is about 1 billion.1 The prevalence of cigarette smoking was significantly higher in men than in women. Smoking has a negative impact on life years. The descriptive statistics in Table 1 and (Fig 4-e) showed that smoking is a risk factor for asthma in adults. Smoking causes accelerated deterioration of lung function from the beginning of adulthood among current smokers with asthma compared to non-smokers with asthma, while cigarette smoking increased the risk in asthma patients. Regarding other diseases, the percentage of individuals with diseases (56.6%) is higher than those without diseases (43.4%), which has an effect but is not statistically significant (Figure 4-i). The same applies to disease history (g-h). By surveying the family history with patients, we found that it contains a number of types, as follows, if one of the parents suffers from asthma, the risk of the child developing asthma is average. For example, if asthma patients on the mother's side developed asthma at an early age compared to asthma patients on the father's side, the differences and effects are very large. But when both parents have

asthma: In this group, the risk of developing asthma is increased more than in the first case. Siblings also showed a strong independent risk of developing asthma. This risk was higher when more of the person's siblings had asthma. The person's risk of developing asthma was higher when both siblings and parents had asthma. Family history of asthma is an important predisposing factor for people with asthma. In our study, 23.3% (14 out of 60) of the group had a family history of asthma, this difference was highly statistically significant (p= .000 , p< 0.0001) .Since the significance level is less than 0.01, we reject the null hypothesis and accept the alternative hypothesis.

Table 1: *shows the number, percentage and p-value of categorical variables for the asthma group compared to the control group*.

Gender	male	24	40.0%	30	50.0%	54	45.0%	.271
	female	36	60.0%	30	50.0%	66	55.0%	
Age Group	More 40	42	70.0%	12	20.0%	54	45.0%	.000
	Less 40	18	30.0%	48	80.0%	66	55.0%	
BMI Groups	overweight	45	75.0%	33	55.0%	78	65.0%	.035
	normal weight	15	25.0%	27	45.0%	42	35.0%	
Smoking	smoking	29	48.3%	17	28.3%	46	38.3%	.024
	No smoking	31	51.7%	43	71.7%	74	61.7%	
Other Diseases	asthma	3	5%			34	56.6 %	.435
	DM	10	16.6 %					
	DM,MI	1	1.6 %					
	Ht	2	3.4 %					
	HT	10	16.6 %					
	HT MI	1	1.6 %					
	HT+ DM	2	3.4 %					
	MI	2	3.4 %					
	Thyroid	3	5 %					
No Other Diseases	no	3	5 %			26	43.4 %	
	No	23	38.4 %					
History illess	1-5 years	9	7.5 %	0	0.0%	9	7.5 %	.907
	5- 10 years	34	28.3 %	0	0.0%	34	28.3 %	
	More 10 years	17	14.2 %	0	0.0%	17	14.2 %	
Family history	Have history	14	23.3%	0	0.0%	14	11.7%	.000
	NO Have history	46	76.7	0	0.0%	46	38.3%	
-The chi-square test has been utilized to analyze the categorical variables. -*. Association is significant at the 0.05 level.								

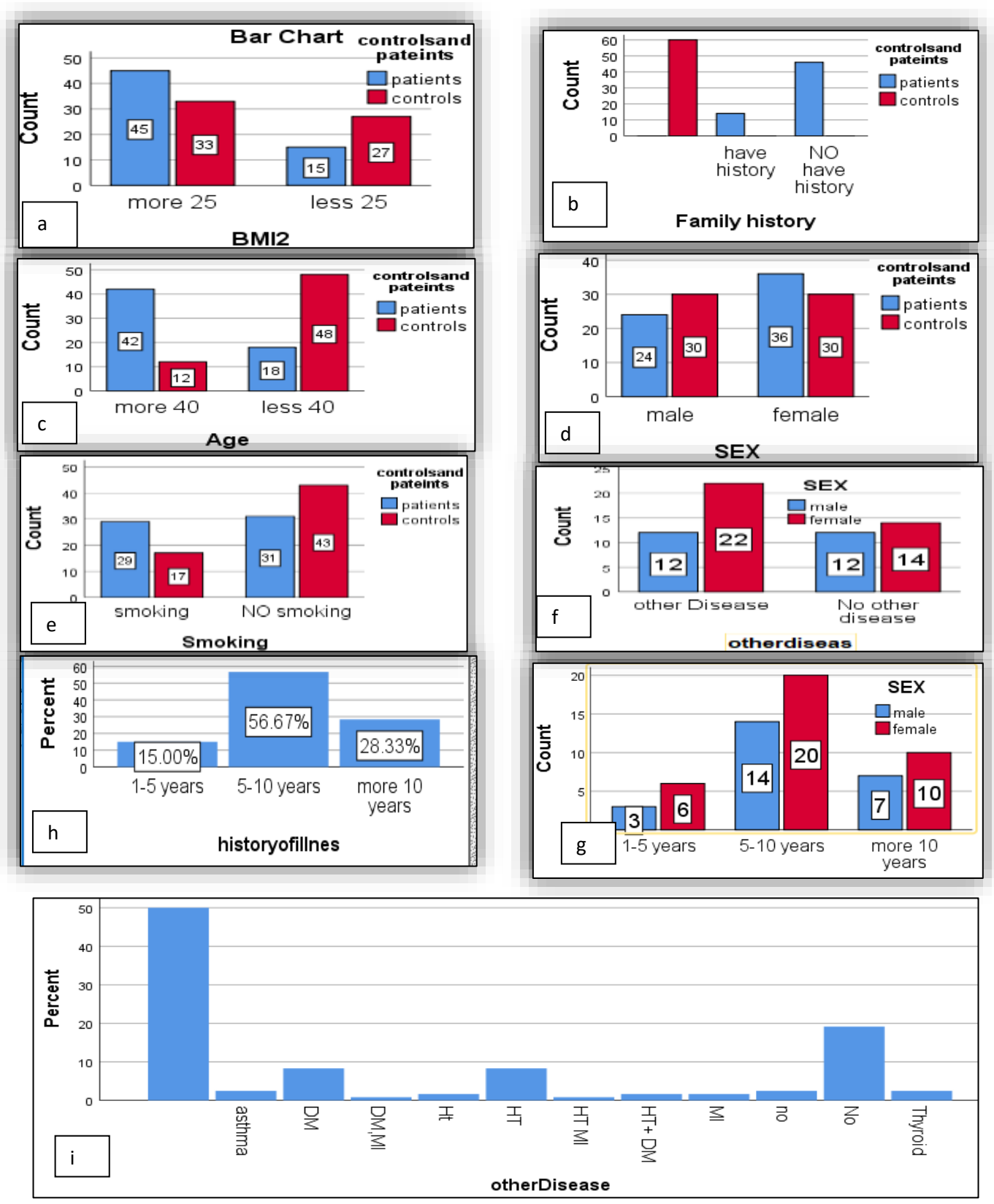

Fig 4: Statistical analysis

3.2 Comparison of TTR level between patients Asthma groups and controls groups.

According to Table 2, and figure 5, TTR was found to be lower in asthma patients compared to controls ($p = 0.05$)., it was not statistically significant ($p = 0.057$). The results of the study also showed that in asthma patients, with the worsening of asthma severity, there was a significant increase in TSH secretion ($p < 0.05$) as in the asthma and control groups (9.26, 4.70) respectively, against the background of a sharp decrease in triiodothyronine and thyroxine ($p < 0.001$). Compared to the control group, therefore, the determination of this hormone is important for determining the course of asthmatic diseases. (low thyroid hormone levels) is a major indicator of the disease. Higher annual decreases in T3 were observed in patients with asthma. While the results of the study indicated that the levels of proteins and fats (TG, ALB,HDL, TP, Chol) in asthma patients were higher than the control group, and the differences between them were highly significant ($p<0.05$) and their value was ($p=.006$, $p=0.000$, $p=0.000$, $p=0.003$, $p=0.000$), respectively, and since the significance level is ($p<0.05$), we will reject the null hypothesis and accept the alternative hypothesis, which states that there are significant differences between (patients and healthy people), which indicates that increasing the levels of proteins and fats above leads to an increase in the incidence of asthma. studies that included human asthma patients over the age of 18 years were selected. Although significant difference in BMI, Age values was observed for patients with different levels of asthma ($p < 0.05$), ($p = 0.000$), ($p = 0.012$), the trend of increasing BMI with age was more severe for patients with asthma.

Table 2: *Comparison of the research parameters of patients-based Asthma disease compared with control group.*

Type	Parameters	Disease Status	Number	Mean	Std. Deviation	Std. Error	P-Value
Hormone	TTR	Asthma	60	135.7807	116.48	16.74	.057
		Control	60	105.9609	85.97	11.09	
	T3	Asthma	60	4.8973	3.63	.46	.000
		Control	60	8.9010	1.41	.18	
	T4	Asthma	60	.7239	.43	.05	.000
		Control	60	1.0973	.55	.07	
	TSH	Asthma	60	9.26	13.31	1.71	.002
		Control	60	4.70	2.67	.34	
Proteins and lipid	TG	Asthma	60	208.27	119.33	15.40	.006
		Control	60	163.22	67.69	8.73	
	HDL	Asthma	60	56.5017	33.94983	4.38	.000
		Control	60	29.9960	6.70932	.86	
	ALb	Asthma	60	58.47	14.056	1.81	.000
		Control	60	48.25	5.562	.71	
	TP	Asthma	60	74.50	8.220	1.06	.003
		Control	60	70.27	6.002	.77	
	Chol	Asthma	60	240.45	61.146	7.89	.000
		Control	60	191.13	26.901	3.47	
Age		Asthma	60	1.30	.462	.060	.012
		Control	60	1.80	.403	.052	
Body Mass Index	BMI	Asthma	60	1.27	.446	.058	.000
		Control	60	1.45	.502	.065	
-Independent T-Test and Mann-Whitney U test have been utilized to conduct a comparative analysis. -*. The mean difference is significant at the 0.05 level.							

Comparison between level of biomarkers in Male and Female group

Table 3 shows the relationship between gender (males and females) separately between asthma patients and the control group, where it was found that the percentage of infected females was higher than males, and it was found that the level of transthyretin for both genders was not significant ($p > 0.05$), and equaled (.946, .697) respectively for both genders, while we noticed in the table that the rest of the hormones (T3, T4, TSH) were statistically significant, meaning that the value ($p < 0.05$) equaled (0.000- 0.003, 0.004 - 0.045, 0.039) respectively for both genders, but it showed that the level of T3, T4 in the asthma group was lower than the control group, which means that a decrease in the level of T3, T4 leads to an exacerbation of asthma in both genders. That is, there is a negative relationship between (T3, T4) and asthma, and that the effect of T4 in men is greater than in women. While it was found that the level of TSH in patients is higher than in healthy people, this indicates a positive relationship between TSH and asthma, and also the level of TSH in men is higher than in women when compared to each other (11.99, 7.52). As for the three

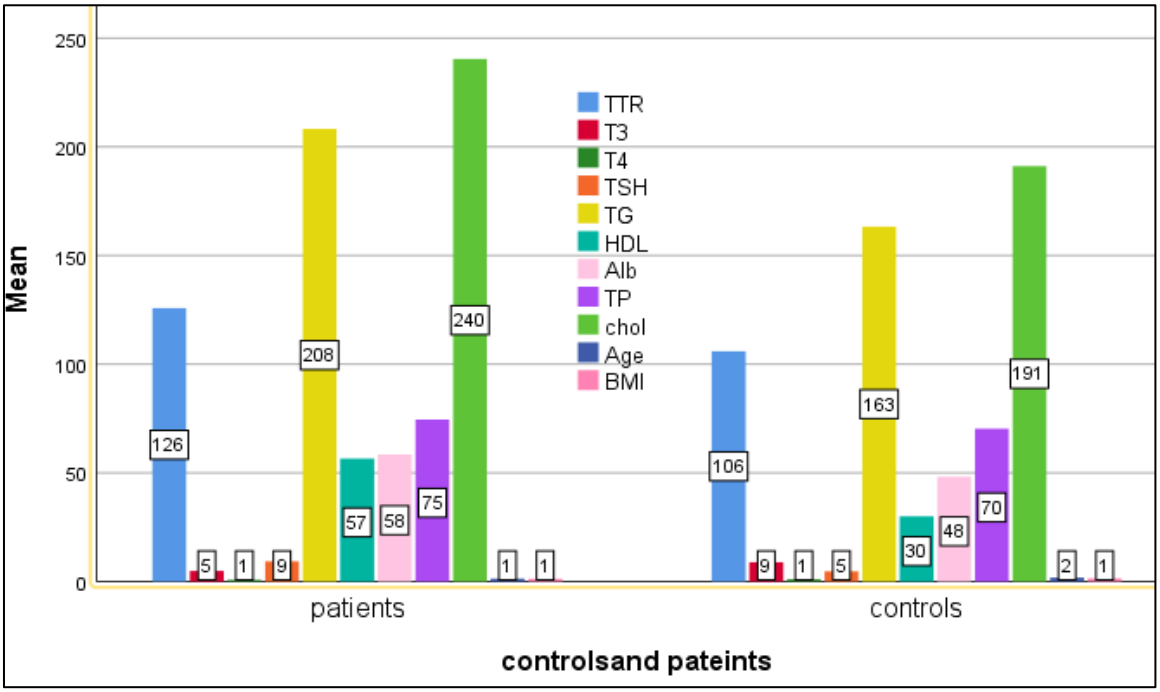

Fig. 5: Comparison of the research parameters of patients-based Asthma disease compared with control group (TTR, T4, Chol, HDL, T3, TSH, TP, TG, Alb, BMI,years, and Age) of Asthma patients.

hormones above, we find that the level of significance is ($p<0.05$), so we will reject the null hypothesis and accept the alternative hypothesis, which indicates that there are significant differences between the levels of ((T3, T4, TSH)) with an increase in one of them leading to an increase or decrease in the other.

Table 2 also indicated that the level of TG, TP in males has no significant significance ($p>0.05$) when comparing the asthma group to the control group, as it was found that the value ($p>0.05$) is equal to (0.79, 0.081), so we will reject the alternative hypothesis and accept the null hypothesis, which indicates that there are no significant differences between the levels of (TG, TP), as an increase in one of them does not affect the other. On the contrary, it was found in Table 2 that the level of TG, Tp in females with asthma is higher than that of non-asthmatics and has a significant value when comparing the asthma group with the control group. The value was found to be ($p<0.05$) and equals (0.050, 0.01), which indicates the presence of significant differences in the levels of (TG, Tp), as an increase in one of them leads to a decrease in the other. As for the rest of the proteins and fats (HDL, ALb, Chol), their levels are high in the group of patients compared to the control group for both sexes and the value ($p<0.05$) and equals (0.002, 0.000- 0.000, 0.001- 0.004, 0.000), which indicates the presence of significant significance in the levels of (HDL, ALb, Chol). Also, the level of ALb in men is higher than in women when compared to each other, while (HDL, Chol) is the opposite. As for age, its level is low in the infected group compared to the control group for both sexes, and its value reached ($p<0.05$) and equals (0.000), which indicates the presence of statistical significance in the levels of (age), and this indicates that increasing age leads to a decrease in the incidence of asthma. As for the body mass index, its level has no significant value when comparing the infected group with the healthy group, as well as when comparing the two sexes with each other.

***Table 3**: Comparison according to the male and female of all patients -based Asthma disease compared with control group.*

Para	*Disease Status*	*Number*		*Mean*		*Std. Deviation*		*Std. Error*		*P-Value*	
		male	*female*	*male*	*female*	*male*	*female*	*male*	*female*	*male*	*female*
TTR	*Asthma*	*24*	*36*	*111.83*	*106.65*	*65.03*	*79.64*	*13.27*	*13.27*	*.094*	*.069*
	Control	*30*	*30*	*113.05*	*114.69*	*64.95*	*86.01*	*11.85*	*15.70*		
T3	*Asthma*	*24*	*36*	*5.10*	*4.45*	*3.38*	*3.56*	*.69*	*.59*	*.000*	*.000*
	Control	*30*	*30*	*8.71*	*9.09*	*1.17*	*1.61*	*.21*	*.29*		
T4	*Asthma*	*24*	*36*	*.69*	*.71*	*.44*	*.41*	*.09*	*.06*	*.003*	*.004*
	Control	*30*	*30*	*1.18*	*1.00*	*.67*	*.38*	*.12*	*.07*		
TSH	*Asthma*	*24*	*36*	*11.99*	*7.52*	*18.92*	*7.35*	*3.86*	*1.22*	*.045*	*.039*
	Control	*30*	*30*	*4.81*	*4.58*	*2.98*	*2.37*	*.54*	*.43*		
TG	*Asthma*	*24*	*36*	*219.21*	*200.97*	*155.96*	*88.78*	*31.83*	*14.79*	*.079*	*.050*
	Control	*30*	*30*	*159.43*	*167.00*	*85.18*	*45.13*	*15.55*	*8.24*		
HDL	*Asthma*	*24*	*36*	*61.62*	*57.00*	*45.75*	*18.78*	*9.33*	*3.13*	*.002*	*.000*
	Control	*30*	*30*	*29.69*	*30.29*	*5.62*	*7.73*	*1.02*	*1.41*		
ALb	*Asthma*	*24*	*36*	*57.54*	*59.08*	*11.22*	*15.78*	*2.29*	*2.63*	*.000*	*.001*
	Control	*30*	*30*	*48.03*	*48.47*	*5.80*	*5.39*	*1.06*	*.98*		
TP	*Asthma*	*24*	*36*	*73.83*	*74.94*	*9.26*	*7.54*	*1.89*	*1.25*	*.081*	*.01*
	Control	*30*	*30*	*70.17*	*70.37*	*5.78*	*6.31*	*1.05*	*1.15*		
Chol	*Asthma*	*24*	*36*	*247.00*	*236.08*	*78.87*	*46.53*	*16.10*	*7.75*	*.004*	*.000*
	Control	*30*	*30*	*193.80*	*188.47*	*28.92*	*24.91*	*5.28*	*4.55*		
Age	*Asthma*	*24*	*36*	*1.21*	*1.36*	*.41*	*.48*	*.08*	*.08*	*.000*	*.000*
	Control	*30*	*30*	*1.73*	*1.87*	*.45*	*.34*	*.08*	*.06*		
BMI	*Asthma*	*24*	*36*	*1.20*	*1.27*	*.41*	*.45*	*.08*	*.07*	*.129*	*.631*
	Control	*30*	*30*	*1.40*	*1.33*	*.49*	*.47*	*.09*	*.08*		

Independent T-Test and Mann-Whitney U test have been utilized to conduct a comparative analysis.
-. The mean difference is significant at the 0.05 level.*

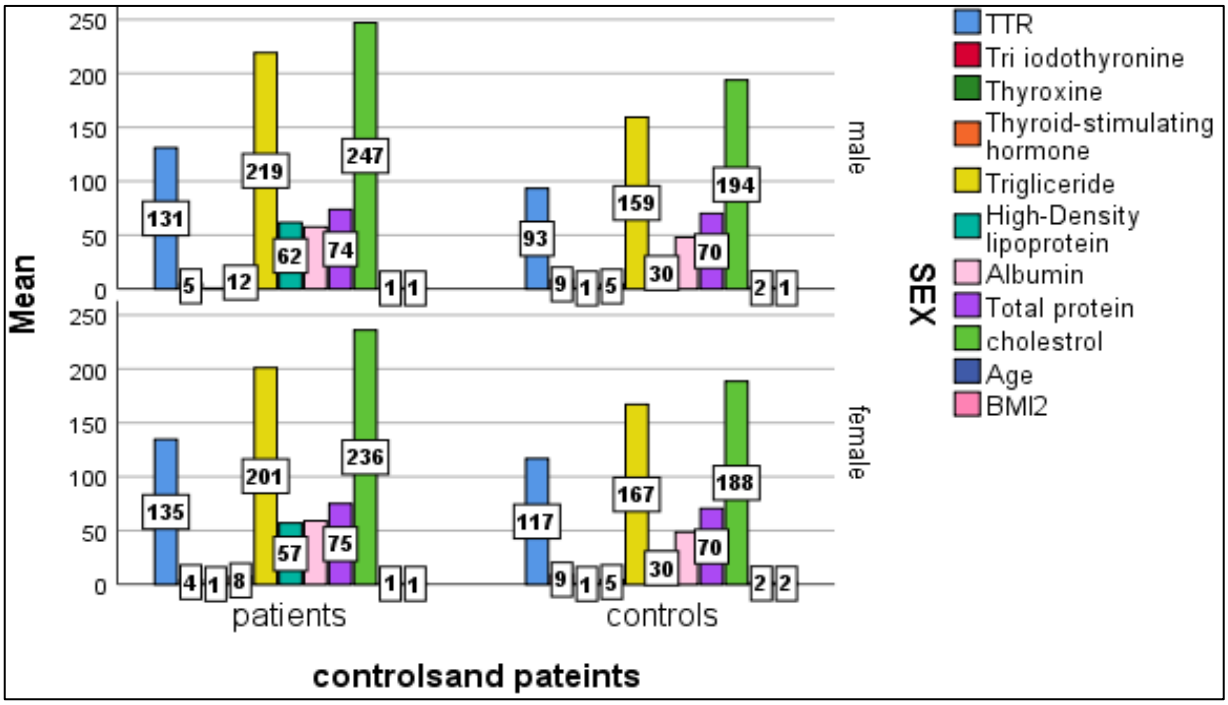

Fig. 6: Comparison of the research parameters of patients-based Asthma disease compared with control group (TTR, T4, Chol, HDL, T3, TSH, TP, TG, Alb, BMI, and Age) of Asthma patients

3.4 Comparison between level of biomarkers in Greater than or equal to 40 or less than 40 group

Table 4 and figure 7 shows that the TTR level decreases with age over forty in asthma patients compared to the control group and is statistically significant as the value of (p=0.05) for TTR. This indicates that there are statistically significant differences in TTR levels as an increase in one of them leads to a decrease in the other, meaning that an increase in age leads to a decrease in TTR level in asthma patients. However, for ages under forty ($p>0.05$), the TTR level = 0.957 is not statistically significant. On the contrary, for the TSR hormone, the hormone level increases in ages under forty in asthma patients and is statistically significant as the value of P = (0.009). While in ages above forty it has no statistical significance. While the hormones (T3, T4) had a significant effect for all ages ($p<0.05$) and the P-value for the hormone (T3, T4) =(0.000,0.000- 0.45,0.007) and causes a decrease in the level of (T3, T4) in the infected group compared to the control group, so we reject the null hypothesis and accept the alternative hypothesis that indicates a significant difference between the hormones (T3, T4) and age. The table showed that the level of (HDL, ALb, Chol) was higher in the infected group compared to the control group and had a significant value and P-value = (0.009, 0.000- 0.039, 0.000- 0.005, 0.000) for the older and younger ages respectively and it was found that ($p<0.05$). As indicated in Table (3), the level of (TP) did not have a significant value when comparing the asthma group with the control group in the ages (age > 40) and (age < 40). Where it was found that ($p>0.05$) equals (0.142, 0.087) respectively, therefore we reject the alternative hypothesis and accept the null hypothesis which indicates that there are no significant differences between the levels of (TP) as increasing one of them does not affect the other. While it was noted that age and body mass index are not statistically significant between the two groups of infection and control as the values of (p) = (0.197, 0.176 - 0.295, 0.614) respectively ($p>0.05$), we will reject the alternative hypothesis and accept the null hypothesis which indicates that there are no significant differences between the levels and that increasing one of them does not affect the other.

Table 4: *Comparison according to the Greater than or equal to 40 or less than 40of all patients -based Asthma disease compared with control group*

Para	Disease Status	Number		Mean		Std. Deviation		Std. Error		P-Value	
		More 40 years	Less 40 years	More 40 years	Less 40 years	More 40 years	Less 40 years	More 40 years	Less 40 years	More 40 years	Less 40 years
TTR	Asthma	42	18	109.83	106.14	79.79	58.62	12.31	13.81	.050	.095
	Control	12	48	148.86	105.12	80.60	72.51	23.26	10.46		
T3	Asthma	42	18	4.80	4.49	3.59	3.28	.55	.77	.000	.000
	Control	12	48	9.11	8.84	2.07	1.22	.59	.17		
T4	Asthma	42	18	.70	.70	.43	.41	.06	.09	.045	.007
	Control	12	48	.98	1.12	.35	.59	.10	.08		
TSH	Asthma	42	18	8.49	11.22	12.00	16.10	1.85	3.79	.221	.009
	Control	12	48	4.15	4.83	2.36	2.75	.68	.39		
TG	Asthma	42	18	212.55	198.28	125.97	104.87	19.43	24.72	.113	.161
	Control	12	48	152.75	165.83	40.10	73.08	11.57	10.54		
HDL	Asthma	42	18	59.06	58.34	36.99	16.61	5.70	3.91	.009	.000
	Control	12	48	29.96	30.00	6.90	6.73	1.99	.97		
ALb	Asthma	42	18	58.24	59.00	14.05	14.44	2.16	3.40	.039	.000
	Control	12	48	49.42	47.96	5.14	5.67	1.48	.81		
TP	Asthma	42	18	74.60	74.28	8.78	6.94	1.35	1.63	.142	.087
	Control	12	48	70.58	70.19	5.68	6.13	1.64	.88		
Chol	Asthma	42	18	245.74	228.11	65.69	48.33	10.13	11.39	.005	.000
	Control	12	48	189.50	191.54	15.40	29.19	4.44	4.21		
Age	Asthma	42	18	1.55	1.72	.50	.46	.07	.10	.197	.176
	Control	12	48	1.33	1.54	.49	.50	.14	.07		
BMI	Asthma	42	18	1.16	1.44	.37	.51	.05	.12	.295	.614
	Control	12	48	1.33	1.37	.49	.48	.14	.07		

Independent T-Test and Mann-Whitney U test have been utilized to conduct a comparative analysis.
-*. The mean difference is significant at the 0.05 level.

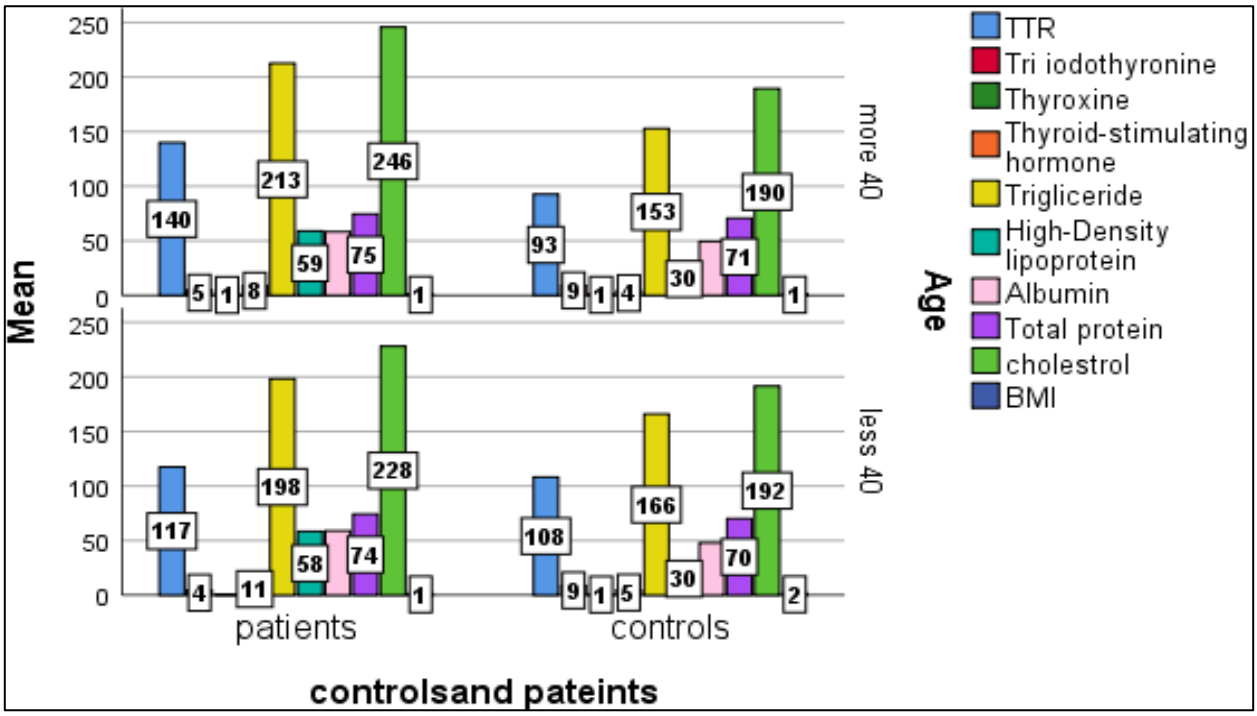

***Fig. 7*:** Comparison according to the Greater than or equal to 40 or less than 40of all patients -based Asthma disease compared with control group (TTR, T4, Chol, HDL, T3, TSH, TP, TG, Alb, BMI,years, and Age) of Asthma patients

3.5 Patients Correlation Coefficient Among TTR and other parameters

Pearson's correlation test was applied to the statistical data to assess the association and probability values between TTR and other factors and biomarkers (TSH, T3, T4, TP, ALB, HDL, cholesterol, triglycerides, BMI, and age) in asthma. Figure 8 shows the correlation coefficients between these parameters. T3 levels showed weak positive correlations with T4 (r = 0.201, p = 0.028) (Figure 8a). While T3 levels showed weak inverse correlations with TG (r = -0.198, p = 0.030) (Figure 8a), T3 levels showed moderate inverse correlations with ALB and cholesterol (r = -0.198, p = 0.030) and moderate inverse correlations with HDL (r = -0.494, p = 0.000) (Figure 8b), respectively. Serum T4 levels showed a weak inverse correlation with ALb (r = -0.185, p = 0.043) and (Figure 8g), respectively. TSH levels showed weak positive correlations with Chol (r = 0.180, p = 0.050) and (r = 0.230, p = 0.012) (Figure 8c). TG levels showed weak positive correlations with HDL (r = 0.211, p = 0.021) and (r = 0.282, p = 0.002) (Figure 8c). However, it showed moderate positive correlations with (ALb) (r = 0.537, p = 0.000) (Figure 3d). However, it showed weak negative correlations with BMI (r = -0.193, p = 0.032). While serum HDL levels showed a weak inverse correlation with TP (r = -0.168, p = 0.056), serum high-density lipoprotein levels showed a moderate inverse correlation with age (r = -0.168, p = 0.056), but a moderate positive correlation with Chol (r = 0.530, p = 0.000) (Figure 8e). ALb levels showed a strong positive correlation with TP (r = 0.614, p = 0.000), but a weak positive correlation with Chol (r = 0.381, p = 0.000), and a weak inverse correlation with age (r = -0.224, p = 0.014) (Figure 8f). Serum TP levels showed a positive correlation with BMI (r = -0.161, p = 0.051) (Figure 8h). Cholesterol levels showed weak positive correlations with BMI (r = 0.200, p = 0.028) and weak inverse correlations with age (r = -0.298, p = 0.001).

Table 5: *Pearson's correlation*.

Par	Value	TTR	T3	T4	TSH	TG	HDL	ALB	TP	Chol	BMI	Age	other	history
TTR	R-Value	1	.049	.015	-.034-	-.023-	.070	-.095-	.066	.022	-.141-	-.088	-.180	.162
	P-Value		.050	.872	.716	.803	.446	.303	.473	.809	.125	.337	.169	.217
T3	R-Value		1	.201*	-.008-	-.198*-	-.494**	-.248**-	-.076-	-.332**-	.097	.280	-.055	-.150
	P-Value			.028	.935	.030	.000	.006	.408	.000	.291	.002	.674	.254
T4	R-Value			1	-.064-	-.054-	-.185-	-.223*-	-.127-	-.151-	-.108-	.230*	-.081	-.155
	P-Value				.486	.560	.093	.014	.166	.102	.241	.011	.540	.236
TSH	R-Value				1	-.040-	.180	.067	-.065-	.230*	-.047-	-.049	-.014	-.052
	P-Value					.667	.050	.465	.484	.012	.612	.598	.917	.692
TG	R-Value					1	.180*	.337**	.129	.282**	-.196*	-.124	.019	-.133-
	P-Value						.049	.000	.161	.002	.032	.178	.887	.312
HDL	R-Value						1	.129	-.219*	.386**	-.036-	-.251**	.084	-.027
	P-Value							.159	.016	.000	.698	.006	.522	.839
ALB	R-Value							1	.614***	.381**	.038	-.224*	-.044	-.012-
	P-Value								.000	.000	.678	.014	.740	.925
TP	R-Value								1	.131	.161*	-.160-	-.210	-.086-
	P-Value									.156	.051	.080	.107	.515
Chol	R-Value									1	.200*	-.298**	-.202	.183
	P-Value										.028	.001	.122	.161
BMI	R-Value										1	.348**	.015	-.192-
	P-Value											.000	.911	.142

Age	R-Value												.233	-.008-
	P-Value												.073	.953
other diseas	R-Value												1	-.129-
	P-Value													.327
history	R-Value													1
	P-Value													

-Pearson and Spearman's correlations were performed to assess the association strength and direction between the two continuous variables.
-**. Correlation is significant at the 0.01 level.
-*. Correlation is significant at the 0.05 level.

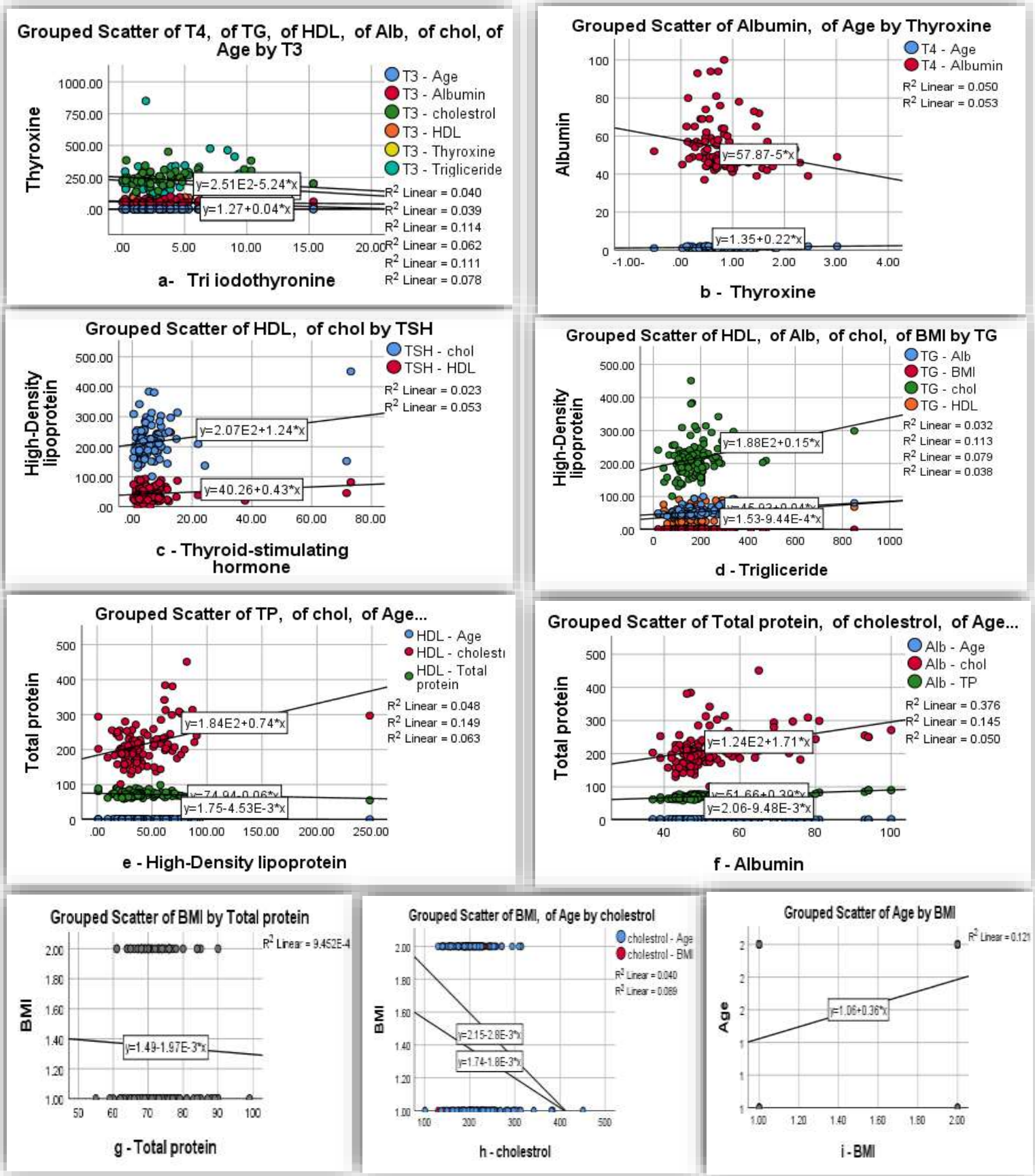

Fig. 8: Patients Correlation Coefficient Among Parameters According to Asthma (T3, T4, TSH, TG, HDL, ALB, TP, Chol and BMI) of Asthma patients

3.6 ROC analysis

In this study, we performed ROC and AUC analysis to evaluate the diagnostic accuracy and effectiveness of several parameters (TTR, T4, Chol, HDL, T3, TSH, TP, TG, Alb, BMI, and age) in diagnosing asthma (Table 6). The ROC curve in this study for TTR and BMI showed failure, with AUC = 0.503 and 0.529, respectively, and unreliability.

While TSH and TG levels showed poor accuracy in predicting the presence of asthma, with poor sensitivity and specificity, with AUC = 0.632 and 0.647, respectively.

However, HDL level in ROC curve analysis indicated high accuracy in predicting the presence of asthma, with high sensitivity and specificity (0.800, 0.983), area under the curve (.877) making it a reliable and good predictor of asthma and statistically significant ($P < 0.05$). This means that the model has an 87% probability of accurately distinguishing between patients. (Figure 9B).

ALB and Chol levels showed acceptable accuracy with moderate sensitivity and high specificity (0.707, 0.833- 0.600, 0.793), and the area under the curve was (.796, .764) indicating their potential as a fairly reliable marker for diagnosis, and a significant value ($P < 0.05$) was observed equal to (.000). The ROC curve also showed acceptable accuracy for years with high sensitivity and specificity (0.864, 0.700), and the area under the curve (AUC) was (.784) indicating their potential as a fairly reliable marker for diagnosis. While TG and TP performed poorly, with poor sensitivity and specificity, with AUC = 0.647, 0.662, respectively (Figure 8B).

Table 6 : *Sensitivity, specificity, cut off and AUC values for biomarkers*.

parameters	Sensitivity	Specificity	Area	Std. Error	SIg	Cut OFF
TTR	0.400	0.733	.503	.053	.952	114.82
TSH	0.667	0.600	.632	.051	.013	4.26
TG	0.400	0.917	.647	.051	.006	210.00
HDL	0.800	0.983	.877	.038	.000	40.30
ALb	0.600	0.793	.764	.043	.000	51.50
TP	0.881	0.350	.662	.050	.002	67.50
Chol	0.707	0.833	.796	.043	.000	214.50
Ages	0.864	0.700	.784	.045	.000	31.50
BMI	0.508	0.583	.529	.053	.584	28.28
T3	0.203	0.493	.182	.044	.000	8.68
T4	0.377	0.390	.293	.047	.000	0.82

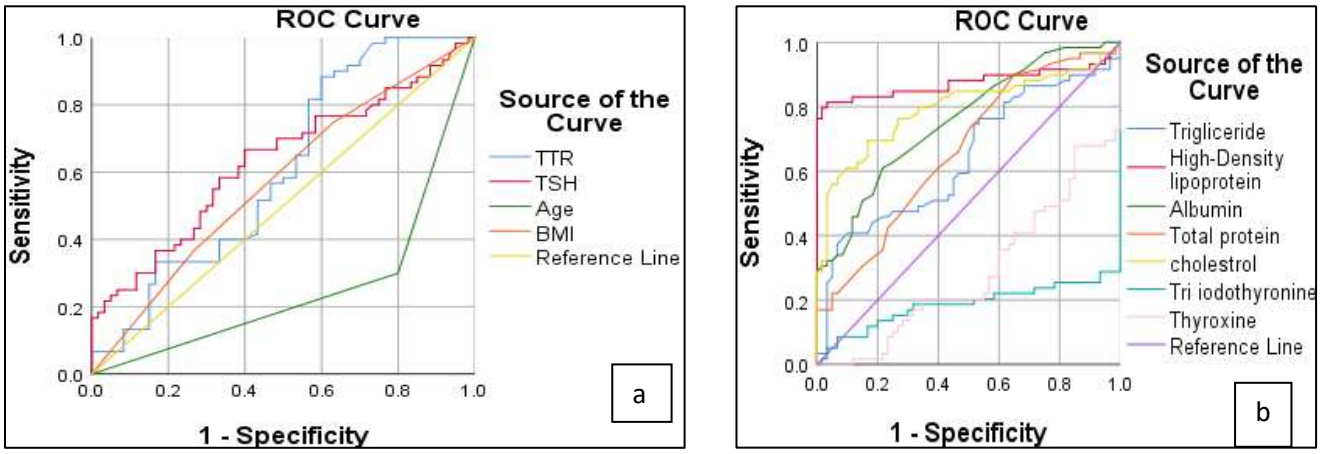

Fig. 9 : ROC analysis illustrating the sensitivity and 1−specificity values for (TTR, T4, Chol, HDL, T3, TSH, TP, TG, Alb, BMI, and Age) of Asthma patients.

4. Conclusions:

In our study, we found when comparing participants with asthma with control , and since our study included a minimum age of 18 years and older, we found a higher prevalence of asthma among female participants (60.0%) compared to male participants (40.0%). We also found a higher prevalence of asthma among female participants compared to control participants, and vice versa for males, without any statistical significance ($P < 0.05$). Our results also mirror a study by ***[22]***- ***[23]*** of 499 asthma patients in Italy, which showed that adult females with asthma had a higher prevalence than males. While the current data in our study indicate age differences in asthma, we found a higher prevalence of asthma in the age group over 40 years (70.0%) compared to the age group under 40 years (30.0%) ($P = 0.000$). Given that the significance level is less than 0.01, our results are also consistent with previous studies that reported that the incidence of asthma in adults did not decline with age and that the incidence of asthma has increased in the United States and globally ***[24]***, ***[25]***, ***[26]***, ***[27]*** . In 2021 (the latest available data). The cumulative incidence rate of asthma at age 25 was 4.5 per 1000, and by age 30 it was 7.2 per 1000. This means that as a patients age, disease symptoms worsen and patients are more likely to experience exacerbations. It is the body mass index (BMI), calculated as body weight in kilograms divided by the square of height in meters ***[28]***. Overweight and obesity are defined as abnormal or excessive fat accumulation that poses a health risk ***[29]*** For adults, the World Health Organization defines overweight as a BMI greater than or equal to 25 kg/m2 and obesity as greater than or equal to 30 kg/m2, respectively ***[30]*** Participants in our study were classified into two categories (normal weight and overweight) based on their BMI score. Percentages for each category (75.0%, 55.0%), normal weight (25.0%, 45.0%), and overweight were determined for patients and healthy controls, respectively, with a $p < .05$ value being statistically significant (interaction $p = .000$). The relationship between obesity and asthma has long been considered unidirectional; people with severe asthma become less active and less fit, and gain weight, exacerbating the cycle of weight gain. However, increasing evidence supports a causal relationship between high BMI, asthma, and poor asthma control. Furthermore, a positive relationship between BMI and poor asthma control has been demonstrated ***[31]***. In a study conducted by ***[32]***, results showed that obesity increases the incidence of asthma, with a 4- to 6-fold increase in the likelihood of developing severe asthma. Studies indicate that asthma primarily affects women ***[33]***- ***[34]***- ***[35]***. Smoking is the second most important risk factor (9.9%) for shortening life expectancy in asthma patients, among many other factors ***[36]***- ***[37]*** . There are approximately 1 billion smokers worldwide. 1 The prevalence of cigarette smoking is significantly higher among men than among women. Smoking has a negative impact on life expectancy. Descriptive statistics in our study indicate that smoking is a risk factor for asthma in adults. Smoking causes an accelerated decline in lung function from the onset of adulthood in smokers with asthma compared to non-smokers with asthma, which is consistent with previous studies ***[38]***- ***[39]***- ***[40]***

On the other hand, cigarette smoking increases the risk of asthma in asthma patients. Although the proportion of smokers is lower, the effect is statistically significant ($p < .05$). Smoking in asthma patients can exacerbate deterioration in lung function parameters, and this deterioration is related to the amount of smoking ***[41]- [42]- [43]***.

Through a family history questionnaire with patients, we found that it includes several types, as follows: If one parent has asthma, the child's risk of developing asthma is average. For example, if asthmatics on the mother's side develop asthma at an earlier age than asthmatics on the father's side, the differences and effects are very significant. However, when both parents have asthma, the risk of developing asthma is significantly higher in this group than in the first case. Siblings also showed a strong independent risk of developing asthma. This risk was higher when more siblings had asthma. The risk was higher when both siblings and parents had asthma.

A family history of asthma is an important predisposing factor for individuals with asthma. In our study, 23.3% (14 out of 60) of the group had a family history of asthma, and this difference was highly statistically significant ($p = 0.000$, $p < 0.0001$). Previous studies have confirmed this ***[44]*** Therefore, a family history of asthma is a strong predictor of risk, and this has also been confirmed ***[45]- [46]***

Comparison of TTR levels between asthmatic and control groups:

TTR levels were found to be higher in asthmatic patients compared to the control group ($p = 0.05$). this value was statistically significant ($p = 0.140$). TTR levels increase after exposure to dust in asthmatic individuals compared to non-responders, as confirmed by previous proteomic studies [47]- [48]Our study results also showed that as asthma worsened, TSH secretion increased significantly ($p < 0.05$), as was the case when comparing the asthma and control groups (9.26, 4.70), respectively. This was exacerbated by a sharp decrease in triiodothyronine and thyroxine ($p < 0.001$). Compared to the asthmatic with control groups, T3,T4 levels decreased by 4.71, 8.90, -0.70, and 1.09, respectively, in line with previous research [49]. In severe asthma, there was a significant increase in TSH secretion ($p < 0.001$) . Since TSH is significantly elevated during the acute phase of severe asthma, serum free thyroxine concentrations are of particular importance. Thus, serum free thyroxine concentrations were found to be significantly lower in patients with mild asthma, and in severe asthma patients, they were found to be lower compared to those with mild and moderate asthma ($p < 0.001$). Therefore, determining this hormone is important for determining the subclinical course of thyroid disease. A consistent decline with age has also been observed in asthma patients [50]- [51]- [52].

While the study results indicated an association between cholesterol levels and the risk of developing or worsening asthma, there was also a positive relationship between triglycerides (TG), albumin (ALb), total protein (TP), and cholesterol (Chol), as shown [53]- [54]The levels of asthma patients were higher than those of the control group, and the differences between them were highly statistically significant ($p < 0.05$) and highly significant ($p = 0.013$, $p = 0.000$, $p = 0.002$, $p = 0.000$), respectively. This is consistent with the results of our study [55]. Our study also showed a positive association between high-density lipoprotein cholesterol (HDL-C) levels and the prevalence of asthma, and HDL-C was highly statistically significant, as confirmed by previous studies [56]- [57]
This suggests that increased levels of the aforementioned proteins and lipids lead to an increased incidence of asthma.

Comparison of Biomarker Levels in Males and Females

The majority of patients in our study were female, which may have influenced the results. However, this is consistent with previous studies showing that adult asthma is more common in women. 13 The relationship between gender (males and females) can be explained separately between asthma patients and controls. The proportion of females affected was higher (60.0%) than males (40.0%), which is consistent with previous research on the gender distribution of adult asthma patients ***[58]- [59]*** Transthyretin levels were found to be statistically insignificant in both sexes ($p > 0.05$), at 0.094 and 0.069, respectively.

We also observed that goiter levels were positively associated with elevated TSH levels in both sexes. TSH values were higher in men than women (11.99 and 7.52, respectively) in asthma patients, and this was highly statistically significant ($p < 0.05$), which is consistent with previous studies ***[60]- [61]***Some previous studies have also indicated that serum TSH levels can be strongly influenced by age, gender, and other diseases ***[62]- [63]***The remaining hormones (T3 and T4) were also statistically significant, with $p < 0.05$ values ranging from 0.004 to 0.045, respectively, for both sexes. However, T3 and T4 levels were found to be lower in the asthma group than in the control group, suggesting that low T3 and T4 levels lead to worsening asthma in both sexes. This suggests an inverse relationship between T3 and T4 and asthma. We also found that T4 levels were significantly lower, while T3 was higher in males than in females. While TSH levels were found to be higher in patients than in healthy individuals, this suggests a direct

relationship between TSH and asthma.

TG and TP levels in men were found to be statistically insignificant ($p>0.05$) when comparing the asthma group with the control group. The p-value <0.05 was found to be (0.79, 0.081). Conversely, TG and TP levels in women with asthma were found to be higher than those in women without asthma, and were statistically significant when comparing the asthma group with the control group. The p-value ($p<0.05$) was found to be (0.050, 0.01), indicating statistically significant differences in TG and TP levels, as an increase in one leads to a decrease in the other. As for the remaining proteins and lipids (HDL, ALB, and Chol), their levels were higher in the patient group compared to the control group for both sexes. The probability value ($p<0.05$) was found to be (0.002, 0.000-0.000, 0.001-0.004, 0.000), indicating statistical significance for HDL, ALB, and cholesterol levels. Furthermore, ALB levels were higher in men than in women when compared to each other, while the opposite was true for HDL and cholesterol. Hypercholesterolemia has been found to increase the risk of asthma in both adolescents and adults ***[64]***Additionally, a Taiwanese study reported a positive association between TC levels and the development of asthma in boys only ***[65]***High LDL-c levels were associated with concurrent asthma, while high HDL-c levels were associated with improved airway specific resistance, as demonstrated by ***[66]***-Studies in asthma patients have shown elevated levels of high-density lipoprotein cholesterol (HDL-c) and total cholesterol (TC) ***[67]***.

High serum albumin levels have also been shown in asthma patients to have antioxidant and anti-inflammatory properties, which reduce chronic inflammation ***[68]- [69]***. Epidemiological research further supports these findings. Each 1 g/L increase in albumin levels is associated with a 13% reduction in all-cause mortality among asthma patients, suggesting that albumin may influence disease progression ***[70]- [71]***.

Comparison between level of biomarkers in Greater than or equal to 40 or less than 40 group:

TTR levels decreased with age over 40 in asthma patients compared to the control group, and this was statistically significant, with a p-value of 0.05 for TTR. This indicates a statistically significant difference in TTR levels, as an increase in one leads to a decrease in the other. That is, increasing age leads to a decrease in TTR levels in asthma patients. However, for ages under 40 ($p>0.05$), TTR levels (0.957) were not statistically significant. Conversely, for TSH, the hormone levels increased in asthma patients under 40, and this was statistically significant, with a p-value of 0.009. However, it was not statistically significant in ages over 40. While the two hormones (T3, T4) had a significant effect for all ages ($p<0.05$), the P value for (T3, T4) = (0.000, 0.000-0.45, 0.007), and caused a decrease in (T3, T4) levels in the infected group compared to the control group, indicating a significant difference between (T3, T4) and age. The data in our study showed that (HDL, ALb, and Chol) levels were higher in the infected group compared to the control group, and had a significant P value ($p=0.009$, 0.000-0.039, 0.000-0.005, 0.000) for the oldest and youngest ages, respectively, and were found to be ($p<0.05$). The level of (TP) was not significant when comparing the asthma group with the control group at ages (age > 40) and (age < 40). It was found that ($p>0.05$) equals (0.142, 0.087) respectively, which indicates that the levels of triglycerides (TG), total cholesterol (TC) and bad cholesterol (LDL-c) were positively associated with age during the acute phase, and body mass index (BMI). These data indicate that increasing age and high BMI may be factors influencing the acute phase of asthma. This was confirmed by previous studies, [72]- [73]

While it was noted that BMI was not statistically significant between the infected and control groups, with p-values of (0.197, 0.176) respectively ($p>0.05$), indicating no significant differences between the levels and that an increase in one does not affect the other.The current study found that levels of triglycerides (TG), total cholesterol (TC), and low-density lipoprotein (LDL-c) were positively associated with age during the acute phase, while high-density lipoprotein (HDL-c) was inversely associated with age and body mass index (BMI). These data suggest that increasing age and higher BMI may be factors influencing dyslipidemia during the acute phase of asthma, [72]- [73].

Pearson's correlation test was applied to the statistical data to assess the association and probability values between TTR and other factors and biomarkers (TSH, T3, T4, TP, ALB, HDL, cholesterol, triglycerides, BMI, and age) in asthma. Significant positive correlations were recorded between TTR and T3 ($r = 0.049$, $p = 0.050$). Significant positive correlations were recorded between T3 and T4 ($r = 0.201$, $p = 0.028$), as confirmed by studies [74]While T3 levels showed weak inverse correlations with triglycerides ($r = -0.198$, $p = 0.030$), T3 levels showed moderate inverse correlations with ALB and cholesterol ($r = -0.198$, $p = 0.030$) and moderate inverse correlations with HDL ($r = -0.494$, $p = 0.000$), respectively. [75].

Serum T4 levels showed a weak inverse correlation with ALB ($r = -0.185$, $p = 0.043$), respectively. TSH values were weakly positively correlated with total cholesterol ($r = 0.180$, $p = 0.050$) and ($r = 0.230$, $p = 0.012$), which is consistent with studies conducted by , [72] Triglyceride levels showed a weak positive correlation with high-density lipoprotein (HDL) cholesterol ($r = 0.211$, $p = 0.021$). A study conducted in England, Scotland, and Wales between 2006 and 2010 also showed a positive relationship between triglycerides (TG), total cholesterol (TC), low-density lipoprotein (LDL)

cholesterol, and asthma [76]This is consistent with our findings as well [77]and (r = 0.282, p = 0.002) (Figure 3c). However, it showed a moderate positive correlation with (ALb) (r = 0.537, p = 0.000) and a weak negative correlation with BMI (r = -0.193, p = 0.032) [78] . While serum HDL levels showed a weak inverse correlation with TP (r = -0.168, p = 0.056), serum HDL levels showed a moderate inverse correlation with age (r = -0.168, p = 0.056) but a moderate positive correlation with cholesterol (r = 0.530, p = 0.000). ALb levels showed a strong positive correlation with TP (r = 0.614, p = 0.000), but a weak positive correlation with Chol (r = 0.381, p = 0.000), and a weak inverse correlation with age (r = -0.224, p = 0.014). Serum TP levels showed a positive correlation with BMI (r = -0.161, p = 0.051).
Cholesterol levels showed a weak positive correlation with BMI (r = 0.200, p = 0.028) and a weak inverse correlation with age (r = -0.298, p = 0.001). Moreover, Pearson correlation analysis indicated that there were statistically significant positive correlations between age and BMI in males and females (r = .348**, p = .000) and this was confirmed in the study [74] and was proven [78].

In this study, we conducted ROC and AUC analysis to evaluate the diagnostic accuracy and effectiveness of several parameters (TTR, T4, Chol, HDL, T3, TSH, TP, TG, ALB, BMI, and age) in diagnosing asthma.
In our study, the ROC curve for both TTR and BMI showed failure, with AUC values of 0.503 and 0.529, respectively, as well as unreliability. Although BMI was higher in asthma patients compared to the control group, there was no significant association. This is consistent with previous studies, in which researchers reported no association between obesity and asthma pattern [79]Similarly, Lavoie et al. (2006) found no association between BMI and asthma severity. This reinforces our findings, which showed non-significant positive associations between BMI and serum asthma severity in obese patients compared to non-obese patients While TSH and TG levels showed poor accuracy in predicting asthma, with poor sensitivity and specificity, with an area under the curve (AUC) of 0.632 and 0.647, respectively.

However, HDL levels showed high accuracy in predicting asthma in ROC analysis, with high sensitivity and specificity (0.800, 0.983), and an AUC of 0.877, making it a reliable and good predictor of asthma, and statistically significant ($P < 0.05$). This means that the model has an 87% probability of accurately distinguishing between patients. The UK Biobank also found a positive association between high-density lipoprotein cholesterol (HDL-C) levels and asthma prevalence [80]ALB and Chol levels showed acceptable accuracy with moderate sensitivity and high specificity (0.707, 0.833, 0.600, and 0.793), with area under the curve (AUC) of 0.796 and 0.764, indicating their potential as a reasonably reliable diagnostic marker. A statistically significant value ($P < 0.05$) was observed at 0.000.
The ROC curve for age also showed acceptable accuracy with high sensitivity and specificity (0.864 and 0.700), with an AUC of 0.784, indicating their potential as a reasonably reliable diagnostic marker [81].
While TG and TP performed poorly, with poor sensitivity and specificity, with AUCs of 0.647 and 0.662, respectively. Our study also showed that T3 and T4 levels in the ROC analysis were low and statistically insignificant, with sensitivity and specificity of 0.203, 0.493, 0.377, and 0.390, and area under the curve (AUC) of 8.68 and 0.82, respectively [82]. This was also the case with [83].

A study conducted in England, Scotland, and Wales between 2006 and 2010 showed a positive association between triglycerides (TG), total cholesterol (TC), and low-density lipoprotein (LDL) cholesterol, and asthma. [84] studied the relationship between lipid levels and asthma prevalence. LDL and total cholesterol levels were significantly higher in asthma patients. The result was that triglyceride levels were not statistically significantly elevated in asthma patients (p = 0.61) [85] .

References

[1] Sockrider M, “What is asthma? Am J Respir Crit Care Med.,” p. P25–6, 2020;202(9).

[2] M. JW., “Asthma: definitions and pathophysiology. Int Forum Allergy Rhinol.,” 2015;5(Suppl 1):S2–6.

[3] Lemanske RF Jr., “Asthma Jama.,” 1997;278(22):1855–73.

[4] Lodge, “Childhood wheeze phenotypes show less thanexpected growth in FEV1 across adolescence. Am J Respir Crit Care Med,” pp. 1351-1358, 2014.

[5] Baidi SR, “Why are people with asthma susceptible to pneumonia?review of factors related to upper airway bacteria. Respirology.,” p. 423–30., 2019;24(5).

[6] Yeatts K, "A brief targeted review of susceptibility factors, environmental exposures, asthma incidence, and recommendations for future asthma," 2006;114(4):634–40..

[7] Castillo JR, “Asthma exacerbations: Pathogenesis, Prevention,and treatment. J Allergy Clin Immunol Pract.,” p. 918–27,

2017;5(4).

[8] Gans MD, “Understanding the immunology of asthma: pathophysiology,biomarkers, and treatments for asthma endotypes. Paediatr,” p. 118–27, 2020;36.

[9] Samantasinghar, “A comprehensive review of key factors affecting the efficacy of antibody drug conjugate. Biomed Pharmacother,” 2023;161:114408..

[10] Asif, “Microphysiological system with continuous analysis of albumin for hepatotoxicity modeling and drug screening. J Ind Eng Chem.,” p. 318–26, 2021;98.

[11] Ahmed F, “A systematic review of computational approaches to understand cancer biology for informed drug repurposing. J Biomed Inform,” 2023;142:104373..

[12] Ahmed F, “Drug repurposing for viral cancers: a paradigm of machinelearning, deep learning, and virtual screening-based approaches. J Med Virol.,” 2023;95(4):.

[13] Kort E, “Drug Repurposing: claiming the full benefit from Drug Development. Curr Cardiol Rep.,” 2021;23(6):62..

[14] Ahmed F, “Drug repurposing in psoriasis, performed by reversal of disease-associated gene expression profiles. Comput Struct Biotechnol J.,” 2022;20:6097–107..

[15] Ahmed F, “A comprehensive review of artificial intelligence and network based approaches to drug repurposing in Covid-19. Biomed Pharmacother,” 2022;153:1.

[16] Ahmed F, “SperoPredictor: an Integrated Machine Learning and Molecular Docking-based drug Repurposing Framework with Use Case of COVID-19.Front Public Health,” 2022;10:902123..

[17] Ahmed F, “Network-based drug repurposing for HPV-associated cervical cancer. Comput Struct Biotechnol J,” 2023;21:5186–200..

[18] Network-based drug repurposing identifies small molecule drugs as immune checkpoint inhibitors for endometrial cancer. Mol Divers, 2024.

[19] Samantasinghar A, “Artificial intelligence-assisted repurposing of lubiprostone alleviates tubulointerstitial fibrosis. Transl Res.,” 2023.

[20] Okopień B, “A. Current and future trends in the lipid lowering therapy. Pharmacol Rep,” 2016;68(4):737–47.

[21] Statin use and asthma control in patients with severe asthma. BMJ Open, 2013. 3(8).

[22] Ricciardolo, “Asthma in the real-world: the relevance of gender." International archives of allergy and immunology,” pp. 462-466, (2020).

[23] Chedraoui, “Sex differences in lung function in asthma across the ages." CHEST pulmonary 2.2,” (2024).

[24] P´erez A, “Use of electronic nicotine delivery systems and age of asthma onset among US adults and youths. JAMA Netw Open,” 2024;7(5).

[25] Eagan TM, “The incidence of adult asthma: a review. Int J Tuberc Lung Dis,” pp. 603-612., 2005;9(6).

[26] Grabenhenrich LB, “Early-life determinants of asthma from birth to age 20 years: a German birth cohort study. J Allergy Clin Immunol.,” pp. 133(4):979-988., 2014.

[27] Pérez, “Use of Hookah and Age of Asthma Onset Among US Adults." Tobacco Use Insights 18,” (2025):.

[28] Y. Wang, “Epidemiology of Childhood Obesity—Methodological Aspects and Guidelines: What Is New? Int. J. Obes,” 2004.

[29] World Health Organization, “Available online: https://www. Who. Int/en/news-room/fact- sheets/detail/influenza-(seasonal)(accessed,” on 22 September 2022).

[30] World Health Organization, “Available online: https://www. Who. Int/en/news-room/fact-sheets/detail/influenza-(seasonal) (accessed,” on 22 September 2022).

[31] C. Koebnick, H. Fischer, M. Daley, A. Ferrara, M. Horberg, B. Waitzfelder, D. Young and M. Gould, “Interacting Effects of Obesity, Race, Ethnicity and Sex on the Incidence and Control of Adult-Onset Asthma. Allergy Asthma Clin. Immunol,” 2016, 12, 50..

[32] Holguin, “Obesity and asthma: an association modified by age of asthma onset." Journal of Allergy and Clinical Immunology,” pp. 1486-1493., 2011.

[33] C. Salome, P. Munoz, N. Berend, C. Thorpe, L. Schachter and G. King, “Effect of Obesity on Breathlessness and Airway Responsiveness to Methacholine in Non-Asthmatic Subjects. Int. J. Obes,” p. 502–509, 2008.

[34] A. Meiliana, N. Dewi and Wijaya, “A. Adipose Tissue, Inflammation (Meta-Inflammation) and Obesity Management. Indones.Biomed. J.,” 2015.

[35] Olejnik, “Association of obesity and severe asthma in adults." Journal of Clinical Medicine 13.12,” (2024).

[36] Silverman RA, “Camargo CA Jr. Multicenter study of cigarette smoking among adults with asthma exacerbations in the emergency department,” pp. 2017;125:89-91., 2011e2012..

[37] Cerveri, “The impact of cigarette smoking on asthma: a population-based international cohort study." International archives of allergy and immunology,” pp. 175-183, 2012.

[38] Strzelak A, “Tobacco smoke induces and alters immune responses in the lung triggering inflammation, allergy,asthma and other lung diseases: A Mechanistic Review. Int J Environ Res,” 2018;.

[39] Sun YB, “Effects of cigarette smoke on the aggravation of ovalbumin-induced asthma and the expressions of TRPA1 and tight junctions in mice. Mol Immunol,” p. 62–72., 2021.

[40] Ma, “Risk factor analysis and nomogram for predicting poor symptom control in smoking asthmatics. BMC Pulmonary Medicine,,” (2024): 264.

[41] Jaakkola JJK, “Smoking and lung function among adults with newly onset asthma. BMJ Open Respir Res,” 2019.

[42] Álvarez-Gutiérrez FJ, "Consensus document on asthma and smokingof the Regional asthma forum of SEPAR. Adicciones," 2021.

[43] Tiotiu A, “Theimpact of tobacco smoking on adult asthma outcomes. Int J Environ ResPublic Health,” 2021.

[44] Burke W, “Family history as a predictor of asthma risk. Am J Prev Med,” p. 24:160–169., 2003.

[45] Patino CM, “Interactions between genes and environment in the development of asthma. Allergy,” p. 56:279–286., 2001.

[46] Sheikh, "Environmental exposures and family history of asthma. Journal of Asthma," pp. 53(5), 465-470., 2016.

[47] Singh, “Plasma proteomics can discriminate isolated early from dual responses in asthmatic individuals undergoing an allergen inhalation challenge. PROTEOMICS–Clinical Applications,” pp. 6(9-10), 476-485, 2012.

[48] Rhim, “Plasma protein profiles in early asthmatic responses to inhalation allergen challenge. Allergy,” pp. 64, 47–54., 2009.

[49] Gulamovich, “Classification of the most common infectious diseases today." International Multidisciplinary Journal for Research & Development,” 2023.

[50] Bingyan, “Impact of thyroid hormones on asthma in older adults. Journal of International Medical Research,,” pp. 4114-4125, 2019.

[51] Fra̧czek MM, “The relation between thelow T3 syndrome in the clinical course ofmyocardial infarction and heart failure.Polski Merkuriusz Lekarski Jourl,” p. 40: 380–383., 2016.

[52] Miranda C, “Distinguishing severe asthma phenotypes:role of age at onset and eosinophilic inflammation.J Allergy Clin Immunol,” p. 113: 101–108., 2004.

[53] Costache, “Association between serum lipids and asthma in adults—A systematic review. Nutrients,,” 2024.

[54] K. Allan and G. Devereux, “Diet and Asthma: Nutrition Implications from Prevention to Treatment,” p. 258–268., 2011.

[55] Z. Tang, M. Shen, Y. Xiao, H. Liu and X. Chen, “Association Between Atopic Dermatitis, Asthma, and Serum Lipids: A UK Biobank Based Observational Study and Mendelian Randomization Analysis. Front. Med.,” [PubMed], 2022,.

[56] Zhang, “Association between monocyte-high-density lipoprotein cholesterol ratio and mortality in a population with asthma: a cohort study. Lipids in Health and Disease,” 2025.

[57] Tang Z, “Association between atopic dermatitis,Asthma, and serum lipids: a UK Biobank Based Observational Study andmendelian randomization analysis. Front Med (Lausanne).,” 2022.

[58] Jenkins, "Personalized treatment of asthma: the importance of sex and gender differences. The Journal of Allergy and Clinical Immunology: In Practice," pp. 963-971., 2022.

[59] Ying, "Gender-specific association between a lipid composite index and asthma among US adults: insights from a population-based study. Lipids in Health and Disease,," 2024.

[60] Porsbjerg, “Lung function impairment increases with age of diagnosis in adult onset asthma. Respiratory medicine,,” pp. 821-827, 2015.

[61] Park, "Classification and implementation of asthma phenotypes in elderly patients. Annals of Allergy, Asthma & Immunology,," pp. 18-22, 2015.

[62] Sarinc Ulasli S, “Effect of thyroid function on COPD exacerbation frequency: a preliminary study. Multidiscip Respir Med.,” 2013.

[63] Chaudhary, “Prevalence of thyroid dysfunction in chronic obstructive pulmonary disease patients in a tertiary care center in North India. Journal of Family Medicine and Primary Care,” pp. 584-588, 2018.

[64] Bingyan, “Impact of thyroid hormones on asthma in older adults. Journal of International Medical Research,,” pp. 4114-4125, 2019.

[65] X. Su, Y. Ren, M. Li, X. Zhao, L. Kong and J. Kang, “Association between lipid profile and the prevalence of asthma: A meta-analysisand systemic review. Curr. Med. Res. Opin,” p. 423–433., 2018.

[66] Vinding RK, “Blood lipid levels associate with childhood asthma, airway obstruction, bronchial hyperresponsiveness, and aeroallergen sensitization. J Allergy Clin Immunol,” p. 68–74., 2016.

[67] Fenger, “The relationship of serum triglycerides, serum HDL, and obesity to the risk of wheezing in 85,555 adults.

Respiratory medicine," pp. 816-824., 2013.

[68] Zinellu, "Serum albumin concentrations in stable chronic obstructive pulmonary disease: a systematic review and meta-analysis. Journal of clinical medicine," 2021.

[69] Tian, "Association between advanced lung cancer inflammation index and all-cause and cause-specific mortality among asthma patients: a cohort study. Frontiers in Nutrition,," 2025.

[70] Zhuang, "Relationship between dietary protein, serum albumin, and mortality in asthmatic populations: a cohort study. Frontiers in Immunology,," 2024.

[71] Hu, "Supplementation of serum albumin is associated with improved pulmonary function: NHANES 2013–2014. Frontiers in Physiology,," 2022).

[72] Elkordi, "Study the relationship between serum lipid profile and bronchial asthma exacerbation. Al-Azhar Assiut Medical Journal,," pp. 82-89., 2024.

[73] Yiallouros, "Asthma: the role of low high-density-lipoprotein cholesterol in childhood and adolescence. International archives of allergy and immunology," pp. 91-99, 2014.

[74] Lokaj-Berisha, " Increased thyroxine levels of patients with allergic rhinitis. Scientific Reports,," 2025.

[75] Cui, "Relationship between thyroid-stimulating hormone and blood lipids in patients with first-episode depression. BMC psychiatry,," 2024.

[76] Maștaleru, "Association between serum lipids and asthma in adults—A systematic review. Nutrients," 2024.

[77] Maștaleru, "Association between serum lipids and asthma in adults—A systematic review. Nutrients," 2024.

[78] Pan, "The association between body mass index and subclinical thyroid dysfunction in different sexes of Chinese. Endocrine Practice," pp. 1166-1175, 2019.

[79] Pelegrino, "Relationship between body mass index and asthma severity in adults. Jornal Brasileiro de Pneumologia,," pp. 641-646, 2007.

[80] Hua, "Association between high-density lipoprotein cholesterol-related inflammation indices and chronic obstructive pulmonary disease: a cross-sectional study employing machine learning analysis. Lipids in Health and Disease," 2025.

[81] Shu, "The relationship between high-density lipoprotein cholesterol and overall sleep quality in the adult population with asthma. Sleep and Biological Rhythms," pp. 481-488, 2022.

[82] Frączek, "The relation between the low T3 syndrome in the clinical course of myocardial infarction and heart failure. Polski merkuriusz lekarski: organ Polskiego Towarzystwa Lekarskiego," pp. 380-383, 2016.

[83] Bingyan, " Impact of thyroid hormones on asthma in older adults. Journal of International Medical Research,," pp. 4114-4125., 2019.

[84] Su, " Association between lipid profile and the prevalence of asthma: a meta-analysis and systemic review. Current medical research and opinion,," pp. 423-433, 2018.

[85] Fang, "The lipid profile in obese asthmatic children compared to non-obese asthmatic children. Allergologia et Immunopathologia," pp. 346-350., 2016