Evaluation of the Level of Variables Related to Allergic Rhinitis

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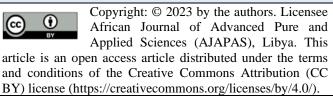*Corresponding author: walaafa84@gmail.com

Abstract:

The study aimed to measure some biochemical variables in the blood serum of patients with allergic rhinitis. The study was conducted on (60) healthy and allergic rhinitis patients, their ages ranged between (10–60) years, and the study indicated that there was a significant increase at the probability level ($p \leq 0.05$) for the activity of the Lipoxygenase (LOX) enzyme in the blood serum of patients with allergic rhinitis of both genders. It also aimed to study the impact of oxidative stress on patients with allergic rhinitis and comparing it with the healthy ones, by measuring (14) variables of oxidation and antioxidants, also, measuring the enzyme activity. the results showed that there was a significant increase at the probability level ($p \leq 0.05*$) in the activity of (LOX) enzyme, malondialdehyde, glucose and uric acid in comparison with healthy people. Also, the results showed a significant decrease in the patients with allergic rhinitis in all antioxidants (vitamin C - vitamin D - vitamin E - bilirubin - albumin - globulin - glutathione - iron - total protein) compared to healthy people as a result of the increased oxidative stress. The effect of age, gender and blood type was also studied.

Keywords: allergic rhinitis, blood serum, lipoxygenase, enzyme

Introduction

Allergic rhinitis (AR) is a type of chronic nasal mucosa mediated by Immunoglobulin E (IgE), the etiology of AR is determined by a combination of genetic, environmental factors and familial predisposition. Symptoms are caused by seasonal and perennial allergens that cause persistent or intermittent complaints of sneezing, runny nose, itchy throat, nasal congestion, and eyelid edema[1]. AR is classified as acute, recurrent, or chronic and the predominant symptom is a stuffy nose, and seasonal allergic rhinitis (SAR) is triggered periodically by exogenous allergens, especially pollen, grass, trees or noxious weeds. The symptoms of perennial allergic rhinitis (PAR) continue throughout the year in response to persistent indoor allergens such as house dust mite (HDM), animal dander, insects, and mold [2], Therefore, people with AR should avoid contact with allergens. Allergic rhinitis is classified as perennial and seasonal compared to ARIA guidelines (Allergic Rhinitis and its Impact on Asthma). Seasonal Pollen Disease, allergic rhinitis caused by pollen antigens, often complicated by allergic conjunctivitis [3] Allergic rhinitis is part of a systemic inflammatory process and is associated with other inflammatory disorders of the mucous membranes including asthma, sinusitis, and allergic conjunctivitis [4] Symptoms of allergic rhinitis (AR) include runny nose, stuffy nose, itchy nose and frequent sneezing. Allergic conjunctivitis may be associated with symptoms that may include itching, redness, watery and/or swollen eyes, sometimes uninfected people may see these symptoms as trivial[5], and allergic rhinitis is one of the most common allergic diseases affecting nearly 400 million people worldwide, and is associated with decreased quality of life, decreased productivity in the workplace, and poor school performance [6].

Lipoxygenases LOXs (EC 1.13.11.12) are the most important class of non-heme iron enzymes that are expressed in different cell types including endothelial, epithelial and immune cells [7][8]. It stimulates the stereo-specific peroxidation of poly unsaturated fatty acids (PUFAs) that contain dinuclear hydrogen of the Cis-Cis type by adding two oxygen atoms to it to form hydroxy derivatives. The results showed that the enzyme plays an important role through the production of many fatty intermediate compounds called leukotrienes (LTs) [9] LOX enzymes stimulate the generation of lipid mediators derived from arachidonic acid such as leukotrienes and 5-hydroperoxyeicosatetraenoic acid (HETEs-5), which are rapidly converted to leukotriene A4 (LTA4) and subsequently converted to leukotriene C4 (LTC4). These oxidative products support inflammatory processes by acting as chemotropic and kinetic agents in addition to bronchoconstriction. LOX-5 has an active role in bronchial asthma and allergic rhinitis as well as heart disease, arthritis, and other infections[10].

2. The aim of this study is:
The aims of this research were a biochemical study of allergic rhinitis patients and its effect on age, gender and blood type.

3. Materials and methods:
3.1. The Subjects:
60 blood samples were collected for people with allergic rhinitis who were diagnosed by specialized doctors in cooperation with Al-Salam Hospital (Allergy and Asthma Unit), whose ages ranged from (10-60) years. The study included 35 females and 25 males, which were divided into three age groups, (less than 20 years), (21-40years) and (more than 40 years).

3.2. Preparation of blood serum:
Blood samples were collected from patients with allergic rhinitis (10ml), then the serum samples were separated and divided into four parts in small dry plastic tubes and kept in covered tubes at a temperature of (-20ºc) until it is used in measuring the specified variables in the research.

3.3. Measurement of some biochemical variables in blood serum:
1.3.3. Determination of the activity of lipoxygenase enzyme:
The effectiveness of the enzyme lipooxygenase (LOX) was determined based on the method followed by the researchers.

3.3.2. Determination of interleukin-6:
Interleukin-6 was determined using a ready-made assay kit from the German company Roche [11].

3.3.3 Determination of Vitamin E Concentration:
The concentration of vitamin E was determined using a method based on the oxidation-reduction reaction called (Emmeric Engle Reaction) by the researchers [12].

3.3.4. Determination of Vitamin D:
Vitamin D concentration has been determined by the researchers [13].

3.3.5. Determination of the level of vitamin C concentration in the blood serum:
Vitamin C concentration has been determined by the researchers [14].

3.3.6. Determination of malondialdehyde level:
Vitamin C concentration has been determined by the researchers [15].

3.3.7. Determination of the level of glutathione (GSH) in the blood serum:
Serum glutathione was determined using a modified method used by the researchers [16] (Sedlak & Lindsay, 1968)

3.3.8. Determination of total protein
The protein concentration was determined using the ready-made analysis kit from the French company BIOLABO group [17].

3.3.9. Determination of the level of albumin concentration
The albumin was determined using Bromocresol Green Method, according to the method used by [18], as a ready-made analysis kit from the French company (BIOLABO) was used.

3.3.10. Determination of globulin level:

According to the amount of globulin after finding the concentration of total protein and albumin according to the following equation:

$$\text{Total Protein} = \text{Albumin} + \text{Globulin}$$
$$\text{Globulin} = \text{Total Protein} - \text{Albumin}$$

As the concentration of globulin, total protein, albumin in (g/l) [19]

3.3.11. Determination of uric acid concentration level:

The concentration of uric acid was determined using the Uricase Enzyme method, using a ready-made analysis kit from the French company (BIOLABO) [20].

3.3.12. Determination of glucose in the blood serum:

The level of glucose concentration in the blood serum was determined based on the enzymatic Tinder method using the ready-made analysis kit [21].

3.3.13. Determination of the level of total bilirubin concentration:

Bilirubin concentration was determined using ready-made Kit solutions from the French company BIOLABO[22].

3.3.14. Determination of the level of iron concentration in the blood serum:

The concentration of iron in the blood serum was determined by following the colorimetric method, in which a ready-made analysis kit was used from the French company BIOLABO [23].

4. Statistical analysis

The results were statistically analyzed using the statistical program 18SPSS [24], and the data were statistically analyzed using the Analysis of Variance (ANOVA) test and Duncan test to compare more than two variables and find the difference at the level of probability $p \leq 0.05$.

5. Results and discussion:

5.1. The results of the biochemical study

The study included, as in Table (1), the impact of oxidative stress on the patients with allergic rhinitis and comparing it with the healthy ones by measuring (14) variables of oxidation and antioxidants, also, measuring enzyme activity, which was conducted on (60) samples of patients and healthy people, their ages ranged from (10–60) years, the results showed a significant increase at the level of probability ($p \leq 0.05^*$) in the activity of LOX enzyme, glucose, malondialdehyde and uric acid, compared to healthy people. Also, the results showed a significant decrease in patients with allergic rhinitis in all antioxidants (vitamin C - vitamin D - vitamin E - bilirubin - albumin - globulin - glutathione - iron - total protein) compared to healthy people as a result of the increased oxidative stress. The effect of gender, age and blood type on the measured biochemical parameters was also studied, and the results showed a significant increase in the concentration of the activity of LOX enzyme and interleukin-6 and malondialdehyde, in female patients and controls compared to male patients and healthy ones. Also, the decrease of all antioxidants in male and female patients compared to healthy people. The results also showed there was no significant difference in female patients compared to male patients in (albumin, total protein, vitamin D, globulin, bilirubin), while vitamin C, vitamin E and glutathione are slightly higher in female patients than they are in male patients at a probability level of ($p > 0.05$). As for iron, glucose, and malondialdehyde, they appeared less in female patients compared to male patients at a probability level of ($p > 0.05$). As for the study of the effect of age, the results showed that there was an inverse relationship between the age and antioxidants, where antioxidants decreased with increasing age, the difference was significant at a probability level of ($p \leq 0.05^*$), and the activity of LOX, malondialdehyde, glucose sugar and uric acid increased for patients compared to the healthy people, also, for patients with older age groups compared to the younger ones.

Table 1. Levels of some biochemical variables in the blood serum of people with allergic rhinitis disease compared to the control group.

Biochemical variables	patient group (n = 60)		control group (n = 60)		P-value
	Average	Standard error	Average	Standard error	
Lipoxygenase activity (U/L)	152.01	0.055	41.027	0.061	0.05*
Interleukin-6 (pg/ml)	21.90	0.039	3.32	0.011	0.05*
Vitamin E (µmol/L)	8.30	0.040	18.14	0.029	0.05*

Biochemical variables	patient group (n = 60)		control group (n = 60)		P-value
	Average	Standard error	Average	Standard error	
Vitamin D (μmol/L)	24.67	0.012	17.31	0.020	0.05*
Vitamin C (μmol/L)	11.044	0.031	28.36	0.046	0.05*
Malondialdehyde (μmol/L)	4.11	0.027	0.51	0.021	0.05*
Glutathione (μmol/L)	1.28	0.010	16.10	0.017	0.05*
Total protein (g/dl)	53.016	0.789	71.86	0.083	0.05*
Albumin (g/dl)	24.56	0.099	43.13	0.058	0.05*
Globulin (g/dl)	28.41	0.010	28.83	0.079	0.05*
Uric acid (μmol/L)	6.79	0.028	2.90	0.069	0.05*
Glucose (mmol/L)	3.50	0.015	4.58	0.010	0.05*
Total bilirubin (μmol/L)	11.67	0.026	10.10	0.061	0.05*
Iron (μmol/L)	3.76	0.068	21.05	0.058	0.05*

Indicates that there is a significant difference at the probability level p ≤0.05

6. Study of some factors affecting the biochemical variables measured in the blood serum of people with allergic rhinitis and healthy people

6.1. Effect of Gender:

The effect of gender factor on all biochemical variables that was measured in the group of patients and the control group was studied, as well as the study of the effect of the gender factor on the group of allergic rhinitis patients and the control group. Whereas the results shown in Table (3) (2) indicate that there is a significant increase in the activity of the enzyme lipoxygenase (LOX) in the male patients group compared to the males of the control group, as well as the activity of the enzyme lipoxygenase (LOX) in female patients with allergic rhinitis was also higher than the activity of LOX in healthy females, this means that the activity of the enzyme lipoxygenase (LOX) increases significantly in the group of patients (males and females) with allergic rhinitis compared to the control group. The results also showed that the gender factor plays a major role in allergic rhinitis disease, if the enzyme activity increases in female patients and control compared to male patients and control, and this result is consistent with the experimental study that female patients with local allergic rhinitis show higher levels of sensitivity towards irritants and air hyperresponsiveness compared to allergic rhinitis in males, showing a strong female predominance. Studies have shown that sex hormones, primarily estrogen, affect the activation of mast cells, which may increase the activity of the enzyme (5-LOX) [25] Where estrogen receptors are expressed in macrophages, lymphocytes and myeloid cells, neutrophil recruitment in acute inflammation was higher in females with macrophage activity and higher levels associated with inflammatory markers [26].

The results also indicate that the antioxidants (vitamin C, vitamin D, vitamin E, bilirubin, glutathione, total protein, albumin, globulin and iron) give a significant decrease in the group of patients (males and females) compared to the control group (males and females), and the reason for the decrease in these antioxidants is to increase their use in fighting and scavenging free radicals caused by inflammation, as well as increasing leukotrienes generated by LOX enzyme. As for uric acid, the results indicate a significant increase in the group of patients (males and females) compared to the control group (males and females) as shown in Table (3) and (4), where an increase in uric acid secretion was observed in patients with allergic rhinitis. As pro-inflammatory cytokines can affect the secretion of uric acid or the level of uric acid in the blood, as uric acid strongly enhances the immune responses of T cells to viruses [27]. As for vitamin D, a significant decrease in the rate of its concentration was observed in the group of patients with allergic rhinitis, as the level of vitamin D3 affects the activity of immune cells and has a direct effect on the activity of various cytokines and immunoglobulins, which have a major role in allergic diseases [28], As for the effect of gender factor in the group of allergic rhinitis patients, the results shown in Table (4) indicated a significant increase in the level of activity of LOX enzyme in the group of female patients compared to male patients, as the pro-inflammatory biosynthesis is gender biased, where the formation of eicosanoids is under the control of the male hormone testosterone regulating localization suppressed the synthesis of the LOX-5 product and the pro-inflammatory Th2 cytokines where this is consistent with the female and male hormones affecting the activity of LOX enzyme and increase the production of IL-6, therefore, neutrophils and white blood cells produce lower amounts of leukotrienes by LOX enzyme compared to females [29].

The results indicated that (total protein, albumin and globulin) were somewhat similar between (patient males and females), as well as bilirubin, so there was no significant difference. As for vitamin C, vitamin E, glutathione and interleukin-6, the results indicate that there is an insignificant increase in females compared to male patients by male patients, which causes a decrease in antioxidants and the generation of many free radicals. As for the

concentration of malondialdehyde (MDA), the results indicate a significant increase in its average concentration in the male patients group compared to the males in the control group, and also its concentration increased in female patients compared to healthy females, the reason is due to excessive oxidative stress that causes the generation of reactive oxygen (ROS), it is known that oxidative stress is involved in various pathological and physiological states, which is a major factor in the causes of acute pulmonary embolism in the elderly [30,31], as well as glucose and iron, their ratios decreased slightly in female patients compared to male patients.

Table 2. Oxidative and antioxidant levels in the blood serum of people with allergic rhinitis compared to the control group

Biochemical variables	Patient group (male) (n=26)		Control group (male) (n=30)		P –value
	Average	Standard error	Average	Standard error	
Lipoxygenase activity (U/L)	153.68	0.039	41.29	0.080	0.05*
Interleukin-6 (pg/ml)	21.02	0.048	3.49	0.013	0.05*
Vitamin E (µmol/L)	3.26	0.014	18.01	0.042	0.05*
Vitamin D (µmol/L)	22.86	0.051	30.65	0.077	0.05*
Vitamin C (µmol/L)	10.34	0.037	27.59	0.071	0.05*
Malondialdehyde (µmol/L)	4.40	0.059	0.53	0.022	0.05*
Glutathione (µmol/L)	1.16	0.013	4.56	0.015	0.05*
Total protein (g/dl)	54.69	0.017	69.86	0.090	0.05*
Albumin (g/dl)	26.38	0.048	43.70	0.083	0.05*
Globulin (g/dl)	28.65	0.011	26.16	0.092	0.05*
Uric acid (µmol/L)	6.7	0.013	3.11	0.083	0.05*
Glucose (mmol/L)	3.40	0.058	10.70	0.018	0.05*
Total bilirubin (µmol/L)	11.34	0.036	10.70	0.090	0.05*
Iron (µmol/L)	3.56	0.051	22.28	0.084	0.05*

* Indicates that there is a significant difference at the probability level p ≤ 0.05

Table 3. Oxidative and antioxidant levels in the blood serum of people with allergic rhinitis compared to the control group

Biochemical variables	Patient group (female) (n=33)		Control group (female) (n=30)		P –value
	Average	Standard error	Average	Standard error	
Lipoxygenase activity (U/L)	150.75	0.054	40.77	0.091	0.05*
Interleukin-6 (pg/ml)	22.57	0.055	3.14	0.017	0.05*
Vitamin E (µmol/L)	12.41	0.081	18.27	0.039	0.05*
Vitamin D (µmol/L)	25.96	0.054	3.97	0.014	0.05*
Vitamin C (µmol/L)	11.67	0.045	29.12	0.052	0.05*
Malondialdehyde (µmol/L)	3.90	0.029	0.48	0.003	0.05*
Glutathione (µmol/L)	1.34	0.033	27.65	0.079	0.05*
Total protein (g/dl)	51.42	0.097	73.86	0.314	0.05*
Albumin (g/dl)	23.09	0.031	42.56	0.086	0.05*
Globulin (g/dl)	27.99	0.079	31.50	0.093	0.05*
Uric acid (µmol/L)	6.87	0.041	2.68	0.023	0.05*
Glucose (mmol/L)	3.52	0.022	4.51	0.059	0.05*
Total bilirubin (µmol/L)	11.93	0.013	9.50	0.028	0.05*
Iron (µmol/L)	3.90	0.041	19.81	0.076	0.05*

* Indicates that there is a significant difference at the level of probability p ≤ 0.05

Table 4. oxidants and antioxidants levels in the blood serum of females with allergic rhinitis compared with males with allergic rhinitis.

Biochemical variables	Patient group (female) (n=33)		Patient group (male) (n=26)		P –value
	Average	Standard error	Average	Standard error	
Lipoxygenase activity (U/L)	152.01	0.035	41.027	0.061	P≤0.05
Interleukin-6 (pg/ml)	21.90	0.039	3.32	0.011	P>0.05
Vitamin E (µmol/L)	12.41	0.068	3.26	0.001	P>0.05
Vitamin D (µmol/L)	25.96	0.053	22.86	0.017	P>0.05
Vitamin C (µmol/L)	11.67	0.045	10.34	0.032	P>0.05
Malondialdehyde (µmol/L)	3.90	0.026	4.40	0.054	P>0.05
Glutathione (µmol/L)	1.34	0.012	1.16	0.008	P>0.05
Total protein (g/dl)	51.42	0.074	54.69	0.077	P>0.05
Albumin (g/dl)	23.09	0.033	26.38	0.048	P>0.05
Globulin (g/dl)	27.99	0.075	28.65	011.0	P>0.05
Uric acid (µmol/L)	6.87	0.043	6.75	0.004	P>0.05
Glucose (mmol/L)	3.52	0.028	3.40	0.001	P>0.05
Total bilirubin (µmol/L)	11.93	0.031	11.34	0.043	P>0.05
Iron (µmol/L)	3.90	0.015	3.56	0.006	P>0.05

8. Effect of age:

The effect of age on all the biochemical variables measured in the group of patients and the control group was studied, and the effect of age on the group of patients was also studied. Each group was divided into three different age groups: (less than 20 years), (21-40 years), and (more than 40 years).

By comparing the biochemical variables for different age groups in the patient group and the control group, which are shown in tables (5), (6), (7), the results show that the male and female groups included in the study were divided into three age groups for each of the healthy males, male patients, healthy females and female patients for the age groups (less than 20 years, 21-40 years, and more than 40 years) Accordingly, the statistical analysis of the age groups (healthy males for the category of twenty years and less, 21-40 years and more than 40 years, and healthy females for the category 20 years and less, 21-40 years and more than 40 years) showed that the statistical analysis did not show significant differences between each of the two groups when comparing them statistically for each of the two groups separately, while the statistical analysis showed that the above-mentioned six age groups showed a significant increase of p≤0.05 when comparing each of them with the age groups of male and female patients, and the age groups of male patients and female patients for age groups (less than 20 years old, 21-40 years old and more than 40 years old) did not show any significant difference between the two age groups among the six age groups. As for the concentration of interleukin-6 for the age groups included in the study (less than 20 years, 21-40 years and more than 40 years) for healthy males and female patients, they did not show significant differences when comparing the statistics between each of the two groups separately (Table (5), (6), (7)) While the interleukin-6 concentration for the six age groups mentioned above showed a significant decrease p≤0.05 when comparing each age group with the age groups of male patients and female patients, each of the two groups separately, and the last six age groups of male and female patients, the statistical analysis did not show significant differences in them when comparing each age group with the other separately, in the concentration of interleukin-6 in the blood serum of patients with allergic rhinitis where it is noted that there is a significant increase in the level of the activity of the lipoxygenase enzyme with increasing age for the group of patients compared to the control group and for all age groups, as the prevalence of allergic rhinitis shows a clear male predominance in childhood and appears to turn into a female predominance in adolescents [32].

The results also indicate that the antioxidants (bilirubin, glutathione, vitamin D, vitamin C, vitamin E and iron) decreased significantly within the same age group of the group of patients compared to the control group, this is due to the acute inflammation in the lungs for patients with allergic rhinitis, with the increase in oxidation in the respiratory cells, many free radicals will be generated, and these in turn need large amounts of antioxidants to eliminate them. Therefore, all antioxidants will be used to eliminate or reduce inflammation, which will lead to an imbalance in the defense systems of allergic rhinitis, which leads to low levels of antioxidants that lead to airway obstruction [33]. In addition, the results indicate through the shown tables (5), (6), (7) that there is a strong

positive correlation between lipid peroxidation (MDA concentration and aging) for patients with allergic rhinitis compared to the control group, where the results showed that the (MDA) concentration in patients of the age group (less than 20 years) was less, in groups of patients and healthy people, compared to other age groups (21-40 years) and (more than 40 years), and this indicates that the process of lipid peroxidation increases with age, this is due to the oxidative damage that will affect the membranes of the respiratory cells due to the lack of effectiveness of the cells as a result of the destruction of their components, due to oxidative processes, which leads to an increase in (MDA) [31]. Also, (MDA) level increases in females with age, due to a decrease in the female hormone estrogen in women associated with G-1 protein in women, which is secreted during inflammation and which distorts the immune response towards allergies, as the high or low level of this hormone causes inflammation in the airways and cytokine levels in the nasal mucosa by sneezing, nasal scratching, and eosinophilic infiltration[34]. In addition, we notice a significant increase in the level of glucose concentration, in the group of patients, compared to the control group, within the same age group, as well as a noticeable increase in the rate of its concentration, in the group of patients, compared to the control group, with age, and the reason is due to the lack of movement and exercise in the elderly, which in turn will lead to obesity, which makes the concentration of glucose high, the metabolic syndrome increases, and insulin resistance increases[35]. As for uric acid, the results showed that it will increase significantly, in the group of patients, compared to the control, within the same age group, its concentration rate increases significantly with age compared to the control group. As for the effect of age on oxidation and antioxidants in the group of patients, the results shown in Table (8) indicate that antioxidants (total protein, albumin, bilirubin, glutathione and vitamin E) also decrease in the group of patients with age due to the increase in the severity of the disease. Thus, large amounts of antioxidants are depleted to reduce damage to the respiratory membranes. Table (8) also shows that there is a significant increase in glucose concentration for patients with age, it is also noted that the concentration of malondialdehyde increased significantly and thus oxidative stress and an increase in free radicals in patients with allergic rhinitis of the elderly at the probability level (p>0.03) with age after the age of forty compared with patients at a younger age, and this indicates an increase in oxidative stress. As for vitamin D, the level of the group of allergic rhinitis patients decreased slightly with age. Whereas, vitamin C results indicate a significant and very notable decrease at the probability level p<0.05.

Table 5. Oxidation and antioxidant levels in the blood serum of people with allergic rhinitis compared to the control group (healthy) for the age group (20 years and under)

Biochemical variables	Patient group (n=13)		Control group (n=33)		P - value
	Average	Standard error	Average	Standard error	
Lipoxygenase activity (U/L)	161.63	0.062	38.85	0.038	0.05*
Interleukin-6 (pg/ml)	21.80	0.020	3.36	0.055	0.05*
Vitamin E (µmol/L)	3.72	0.039	18.89	0.015	0.05*
Vitamin D (µmol/L)	21.30	0.022	13.51	0.011	0.05*
Vitamin C (µmol/L)	10.33	0.016	28.74	0.052	0.05*
Malondialdehyde (µmol/L)	4.94	0.085	0.04	0.001	0.05*
Glutathione (µmol/L)	1.35	0.001	19.85	0.021	0.05*
Total protein (g/dl)	51.23	0.025	72.54	0.016	0.05*
Albumin (g/dl)	19.96	0.020	43.45	0.081	0.05*
Globulin (g/dl)	31.53	0.077	29.27	0.066	0.05*
Uric acid (µmol/L)	6.41	0.054	2.82	0.001	0.05*
Glucose (mmol/L)	3.27	0.002	4.41	0.001	0.05*
Total bilirubin (µmol/L)	11.88	0.051	10.10	0.063	0.05*
Iron (µmol/L)	3.68	0.093	22.42	0.077	0.05*

* Indicates that there is a significant difference at the probability level p ≤ 0.05

Table 6. Oxidation and antioxidant levels in the blood serum of people with allergic rhinitis disease compared to the control group (healthy) for the age group (21-40 years)

Biochemical variables	Patient group (n=21)		Control group (n=20)		P - value
	Average	Standard error	Average	Standard error	
Lipoxygenase activity (U/L)	147.49	0.098	39.57	0.071	0.05*
Interleukin-6 (pg/ml)	25.40	0.065	3.23	0.001	0.05*
Vitamin E (µmol/L)	3.98	0.001	17.97	0.028	0.05*

Vitamin D (μmol/L)	26.22	0.0315	17.87	0.023	0.05*
Vitamin C (μmol/L)	11.17	0.022	29.93	0.071	0.05*
Malondialdehyde (μmol/L)	3.73	0.018	0.54	0.001	0.05*
Glutathione (μmol/L)	1.37	0.021	18.16	0.035	0.05*
Total protein (g/dl)	54.76	0.041	71.70	0.031	0.05*
Albumin (g/dl)	26.70	0.079	43.20	0.087	0.05*
Globulin (g/dl)	28.48	0.056	28.50	0.018	0.05*
Uric acid (μmol/L)	6.84	0.021	2.88	0.042	0.05*
Glucose (mmol/L)	3.71	0.003	4.49	0.064	0.05*
Total bilirubin (μmol/L)	11.85	0.039	9.83	0.035	0.05*
Iron (μmol/L)	3.70	0.056	20.84	0.099	0.05*

* Indicates that there is a significant difference at the probability level $p \leq 0.05$

Table 7. Oxidation and antioxidant levels in the blood serum of people with allergic rhinitis compared to the control group (healthy) for the age group (more than 40 years).

Biochemical variables	Patient group (n=25)		Control group (n=19)		P - value
	Average	Standard error	Average	Standard error	
Lipoxygenase activity (U/L)	149.68	0.08	43.59	0.050	0.05*
Interleukin-6 (pg/ml)	22.67	0.081	3.23	0.029	0.05*
Vitamin E (μmol/L)	14.44	0.093	16.59	0.011	0.05*
Vitamin D (μmol/L)	25.43	0.091	16.73	0.051	0.05*
Vitamin C (μmol/L)	11.35	0.098	26.70	0.065	0.05*
Malondialdehyde (μmol/L)	3.94	0.041	0.57	0.003	0.05*
Glutathione (μmol/L)	1.22	0.015	13.63	0.068	0.05*
Total protein (g/dl)	52.12	0.095	70.31	0.047	0.05*
Albumin (g/dl)	25.19	0.013	41.36	0.058	0.05*
Globulin (g/dl)	26.48	0.054	28.94	0.056	0.05*
Uric acid (μmol/L)	6.85	0.045	3.04	0.021	0.05*
Glucose (mmol/L)	3.53	0.015	4.85	0.08	0.05*
Total bilirubin (μmol/L)	11.56	0.047	9.52	0.016	0.05*
Iron (μmol/L)	3.89	0.039	18.07	0.061	0.05*

* Indicates that there is a significant difference at the probability level $p \leq 0.05$

Table 8. Comparison in the levels of oxidants and antioxidants in the blood serum of patients for age groups (20 years and younger), (21-40 years), (more than 40 years)

Biochemical variables	20 years and younger (n=12)		21-40 years (n=21)		More than 40 years (n=25)		P-value
	Average	Standard error	Average	Standard error	Average	Standard error	
Lipoxygenase activity (U/L)	161.63	0.062	147.49	0.098	149.68	0.08	0.05*
Interleukin-6 (pg/ml)	21.80	0.020	25.40	0.065	22.67	0.081	0.05*
Vitamin E (μmol/L)	3.72	0.039	3.98	0.001	14.44	0.093	0.53
Vitamin D (μmol/L)	21.30	0.022	26.22	0.0315	25.43	0.091	0.32*
Vitamin C (μmol/L)	10.33	0.016	11.17	0.022	11.35	0.098	0.000*
Malondialdehyde (μmol/L)	4.94	0.085	3.73	0.018	3.94	0.041	0.000*
Glutathione (μmol/L)	1.35	0.001	1.37	0.021	1.22	0.015	0.82
Total protein (g/dl)	51.23	0.025	54.76	0.041	52.12	0.095	0.18*
Albumin (g/dl)	19.96	0.020	26.70	0.079	25.19	0.013	0.001*
Globulin (g/dl)	31.53	0.077	28.48	0.056	26.48	0.054	0.5
Uric acid (μmol/L)	6.41	0.054	6.84	0.021	6.85	0.045	0.83
Glucose (mmol/L)	3.27	0.002	3.71	0.003	3.53	0.015	0.001*
Total bilirubin (μmol/L)	11.88	0.051	11.85	0.039	11.56	0.047	0.88*
Iron (μmol/L)	3.68	0.093	3.70	0.056	3.89	0.039	0.02

9. The effect of blood type:

The effect of blood type on patients with allergic rhinitis (AR) has been studied compared to the control group. The results shown in Table (9) indicate that 33% of AR patients are of blood type O, and then blood type AB comes after that, and this result agrees with the researcher [36] . As for the type of blood, the results showed that most people with allergic rhinitis have the blood type O+, then AB+, A+, B-, B+, and lastly O-.

Table 9. The effect of blood type on the group of patients with allergic rhinitis compared with the control group

blood type	Patients 60		Healthy 60	
	No.	%	No.	%
O+	33	47.1%	29	58%
O-	2	%2.9	0	0
AB+	18	25.7%	15	30%
B+	4	5.7%	6	12%
B-	5	7.2	0	0
A+	8	11.4%	0	0

Conclusion

There is a significant increase in each of the enzyme (LOX), interleukin-6, glucose, malondialhyde, and uric acid in the serum of allergic rhinitis patients compared to the control group, while antioxidants (vitamin 3D, E, C, glutathione, bilirubin, total protein, albumin, globulin, and iron) showed a decrease in their levels in allergic rhinitis patients compared to healthy subjects. The results showed that the gender factor showed a clear and significant effect on the levels of each of the variables that were studied. Increased activity of the lipooxygenase enzyme (LOX, glucose, malondialdehyde, and uric acid in the serum of allergic rhinitis patients compared to the control group, where a significant decrease was found in all levels of antioxidants (vitamin D, E, C, bilirubin, total protein, and albumin). , globulin, glutathione, iron) that were studied compared with healthy subjects, which indicates that obesity has a clear effect on allergic rhinitis patients, as well as the presence of such variables in obese patients compared with non-obese patients.

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