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Atopic Allergy Type 1 and Association with *Chlamydia Pneumonia* in Allergic Patients in Mosul City/Iraq

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Abstract

The present study aimed to investigate the role of age, gender, and family history in the incidence of atopic allergy and its relationship with Chlamydia pneumoniae infection by measuring immunoglobulin E (IgE) levels in humans. Blood samples were collected from 100 individuals (aged 6-60 years, both genders), with 50 patients diagnosed with atopic allergy and 50 healthy individuals considered as the control group. IgE levels were measured in all study participants across different ages and genders by Enzyme-linked Immunosorbent Assay (ELISA). Additionally, the diagnosis of Chlamydia pneumoniae infection was determined by ELISA via measuring IgM levels in all participants. The results were statistically analysed to compare allergic patients with the control group. The findings showed that IgE, in blood samples was notably greater in patients than in individuals without health issues The age range of 18 to 30 years exhibited a high level of IgE among people with allergies. Males have slightly higher IgE levels than females and this difference was noticeable when compared to the control group. Those with a family background of allergies displayed significantly elevated IgE levels suggesting a genetic inclination, towards higher levels of IgE 85 per cent of people, with allergies tested positive for IgM levels indicating Chlamydia pneumonia infection compared to 15 per cent in those, without the infection. The research findings indicated a link, between allergies and Chlamydia pneumonia infection. Mentioned that atopic allergies are influenced by age differences as well, as gender and family medical background.

Keywords: *Allergy, Chlamydia pneumoniae, IgE, IgM, Immunity.*

Introduction

Type 1 hypersensitivity is also referred to as hypersensitivity or atopic allergic reaction, described as an exaggerated reaction that occurs when the body comes into contact with substances that are usually harmless to most people [1]. These substances are called allergens, including pollen and pet dander as well as household dust. For some individuals affected by the allergens, there is a response resulting in symptoms like itching or sneezing and in some cases more severe reactions such, as asthma or anaphylaxis [2]. This overreaction is triggered by cells, like mast cells and basophils that release chemicals, like histamine when they are activated [3].

Type 1 hypersensitivity has the potential to cause a range of term issues such as asthma and allergies, like hay fever and eczema [4] .For instance, encountering allergens like dust mites or pollen may lead to bouts of breathing problems and coughing [5]. Typically, in normal responses, the immune system tackles only harmful elements such as bacteria or viruses [6].

In cases of type 1 hypersensitivity reactions though; the immune system mistakenly identifies substances as invaders. This

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misunderstanding triggers the symptoms described earlier [7]. In instances necessitating diagnosis and specialized care measures from experts. Common treatments may involve medications, like antihistamines or corticosteroids and in severe cases, immunotherapy can be considered to alleviate symptoms or decrease the body's reactivity to allergens [8].

People, with type 1 hypersensitivity often produce levels of immunoglobulin E (IgE antibodies when exposed to allergens [9]. When these antibodies attach to mast cells and basophils, the body's immune system response mechanism triggers the release of substances like histamine that can lead to reactions such as itching, sneezing, nasal congestion and skin rashes. In some situations, it may result in anaphylaxis [10;11].

Chlamydia pneumonia is a type of bacteria that can lead to respiratory illnesses such as throat infections (pharyngitis) bronchial infections (bronchitis) and pneumonia [12]. It is part of the Chlamydiaceae family along with species like *Chlamydia trachomatis* and *Chlamydia psittaci* [13]. Although *Chlamydia pneumonia* infections are not as common as those caused by other respiratory bacteria pathogens, among people of all ages [14].

Chlamydia pneumonia is mainly transmitted through droplets released into the air by a person when they sneeze or cough or through close physical contact, with them in places, like schools and elderly care facilities where outbreaks are more likely to happen [15]. Because it spreads through the air and can affect anyone regardless of age group individuals are, at risk; however, young children and elderly adults are more prone to infections due to factors such, as systems and living in close quarters with others [16]. Infections stemming from *Chlamydia pneumonia* can range from issues to more severe health conditions. The usual time for symptoms to show up can vary, between 1 to 3 weeks following exposure [17]. *Chlamydia pneumonia* is a type of bacteria that can affect the body's system and result in conditions, like throat infections and pneumonia [18].

It does not happen often as bacteria that lead to infections do. It is common, among both younger and older people [19]. *Chlamydia pneumonia* infections can be tricky to identify and treat due, to their symptoms that can mimic those of respiratory issues [20]. The bacteria can be transmitted through the air when people cough or sneeze and can cause infections to spread quickly in places, with many people like schools and offices. The infection can result in issues, like long-term lung infections or bronchitis if not identified and managed promptly [21].

Recent research indicates that *Chlamydia pneumonia* may not only affect health but also potentially contribute to the onset of other long-term conditions, like atherosclerosis and heart disease [22]. Certain research indicates that respiratory infections such as *Chlamydia pneumonia* may heighten sensitivity in people with a tendency for conditions like asthma. The ongoing inflammation triggered by the infection could worsen reactions. Lead, to increased production of IgEs [23]. *Chlamydia pneumonia* infection could worsen asthma symptoms, in people, with asthma because asthma is linked to IgE levels which could lead to an immune reaction involving more IgE production [24]. We believe that there could be a connection, between Type 1 reactions and *Chlamydia pneumonia* infection, in how they relate to IgE antibodies. The study seeks to determine IgE levels through measurement. Make sure to verify if the patient group has Type 1 atopic allergy using evidence. By checking the IgA levels, in both the non-allergic groups to see if there's a difference and if it supports the idea that people, with Type 1 hypersensitivity will have higher IgE levels.

Deepen the comprehension of IgE, as a marker for Type 1 allergies to enhance precision and explore treatments, for managing allergic disorders. The consistent methods used

for preparing samples and measuring IgEs enhance the trustworthiness of the study. Guarantee that the results accurately represent the participant's immunological conditions.

Materials and Methods

Sample Collection from Patients

In this research project, blood samples were gathered from a group of 100 people to explore indicators linked to Type 1 atopic allergy. These individuals were split into two categories. A total of 50 patients were part of the patient group, in this study who had been identified with Type 1 allergies at the Allergy Department of the Republican Teaching Hospital in Mosul (Iraq) by a specialist using clinical indicators for atopic hypersensitivity reactions such, as asthma or food allergies. Patients, in this group, showed signs aligned with Type 1 hypersensitivity syndrome—an immune reaction, to everyday environmental allergens like dust mites, pollen, pet fur or certain foods.

The control group comprised 50 individuals who had no allergies or respiratory issues and were chosen meticulously to match the patient group in terms of age and gender for precise and fair comparison sake. A Matched, by age and gender, aims to reduce any influencing factors allowing for accurate attributions of differences in biomarker levels between the two groups to be linked with Type 1 atopic allergy presence rather, than age and gender effects.

Age and Gender of Participants

The study involved individuals aged, between 6 and 60 years old. Included both children and grown-ups to thoroughly analyze biomarkers at stages of life where age can impact immune response and atopic condition prevalence. The participants comprised both males and females to consider any gender-related variations in biomarker expression or immune response levels, for applicable results.

Serum Sample Collection and Handling

Blood samples were taken from all participants following protocols to guarantee the safety and well-being of each person involved in the study process. The blood samples were treated to extract serum, which was subsequently stored in controlled environments to maintain the quality of biomarkers until they could be analyzed. Serum samples are frequently utilized in studies related to immunology because they contain antibodies cytokines and other proteins that indicate system function and remain stable for assessing biomarkers associated with immunity.

Purpose of Sample Collection

The serum samples gathered from both sets of participants will enable an examination of markers linked to Type 1 atopic allergies. Through comparing data, from the patient and control groups, the research seeks to pinpoint markers or immune elements that are heightened in those with Type 1 hypersensitivity. This study aims to deepen our comprehension of how atopic allergies work and potentially aid, in creating tools for diagnosing or treating ailments.

Ethical Approval

The study received approvals, from the Ethics Committees at both the University of Mosul and the Al Jumhuri Educational Hospital in Mosul before commencing research activities involving participants in areas such as health data collection and patient diagnosis to ensure adherence, to ethical standards.

Informed Consent

In line with standards and rules of conduct, we made sure to get the approval of all individuals involved in the study or their legal guardians (for those below 18 years old) before they were included in the research project. The process of obtaining consent included an explanation of the purposes of the study the

procedures involved, and potential risks and benefits in understandable language. Participants were aware that their involvement was voluntary and that they had the freedom to opt out of the study at any time, without it affecting their care.

Confidentiality and Data Protection

To protect the privacy of participants involved in the study we took steps to ensure that all data collected was kept confidential with measures in place. We made sure to anonymize any identifying information and securely store it to prevent access. Each participant was given a study code for labeling their samples and related data ensuring that the analyzed results were not linked to identifiers. Only authorized research staff had access to the anonymized data and all handling of data followed legal guidelines for the protection of data.

Compliance with Ethical Standards

The study was carried out by the Declaration of Helsinki and the applicable guidelines, on research ethics. The team conducting the research was dedicated to safeguarding the rights and welfare of the participants by ensuring their safety, respect and dignity were maintained throughout the study. Furthermore, the participants were briefed on how their data would be used for research purposes. No data would be disclosed beyond the scope of the study without obtaining prior consent.

Sample Preparation for the Study

Following the collection of blood, from all participants in the study, we adhered to steps to prepare the samples, for trustworthy laboratory analysis. Below is a guide outlining the preparation procedures. During this stage of the process. Collection and Initial Handling. Every blood sample was carefully obtained in an environment to prevent contamination and maintain the sample's purity. Blood was specifically taken into sterile tubes without anticoagulants to aid in separating the serum. After the blood samples were gathered and put into containers, they were left to rest for 20 minutes, at room temperature. During this time the clotting process occurred naturally which is necessary, for separating the serum. Clotting helps to separate the blood cells and fibrin from the liquid portion resulting in a layer of clear serum forming on top of the container. Allowing the blood samples to settle for some time on their own accord and then spinning them in a centrifuge, at 2500 revolutions per minute for 15 minutes is an essential procedure that speeds up the separation of the different components of blood; the heavier components such as red blood cells sink to the bottom while the serum creates a distinct layer, on top. After spinning the blood in the centrifuge to separate its components we gently extracted the serum – the hued part – to prevent any mixing, with cells. With pipettes in hand, we carefully transferred the serum into labelled Eppendorf tubes, each marked with a participant's study code, for tracking and privacy protection. The serum samples, in Eppendorf tubes, were stored in a manner that maintains the markers accurate for testing purposes like ELISA by preserving them under suitable conditions or, at low temperatures if immediate testing is not possible to avoid protein degradation.

Measurement of Total IgE

To examine whether the participants had allergies or not we checked the IgEs in both the patient group and the control group. IgEs are a type of antibodies linked to responses. Are higher, in people, with Type 1 hypersensitivity. The process of measuring IgE levels involved. ELISA was utilized to measure the IgEs in the blood serum employing Enzyme-linked Immunosorbent Assay (ELISA) a precise technique known for its sensitivity, in identifying antibodies, in the blood serum sample accurately. The study employed a BioCheck assay kit specifically created to detect IgEs in the samples tested. The kit comprises reagents referenced standards and

instructions aimed at the quantification of IgEs to guarantee adherence, to standardized procedures, for dependable outcomes.

The ELISA Test Requires the following Steps

Serum samples, from each participant, were placed into the wells of the plate that were already coated with IgE-binding substances before testing began. Incubation Step 1 involved allowing the serum samples to incubate enabling any IgEs, in the serum to attach to the plate surface. Enzyme-linked antibodies designed for IgEs were placed into the wells first and then a substrate that interacts with the enzyme was added to give rise to a colour change that corresponds to the IgE level detected in the sample. The spectrophotometer was used to measure the absorbance or optical density, in each well of the sample to determine the IgE concentration based on the color intensity observed in each well.

Interpretation of Results

If the total IgE concentration exceeds 100 IU/cm² it suggests a hypersensitivity or atopic allergy without an infection being present, per clinical benchmarks that differentiate between typical and heightened IgE levels linked to allergic disorders.

In the control group (allergic individuals) it was anticipated that IgEs would stay under this limit value. This implies that elevated IgEs in the patient group could confirm the presence of an allergy and align, with the diagnoses given by specialists earlier on.

Diagnosis of *Chlamydia pneumoniae* infection: To check for *Chlamydia pneumonia* infection, in people belonging to the allergy patient group and the control group a diagnostic method was employed. This method involves measuring the levels of IgM antibodies that are targeted towards *Chlamydia pneumonia* using an enzyme-linked immunosorbent assay (ELISA). ELISA is a trusted and commonly used technique, for identifying acute infections.

Serological Diagnosis using ELISA

Sample Collection and Preparation

Blood samples were gathered from individuals, with allergies well as from those who are in good health. The serum part that has antibodies was. Stored correctly before testing.

ELISA Test for IgM Detection

The level of IgM antibodies was determined through ELISA (enzyme-linked immunosorbent assay) a technique, for detecting and measuring antibodies targeting C.pneumonia bacteria. The lab utilized a specialized BioCheck test kit tailored for detecting *Chlamydia pneumonia* antibodies of the IgM type, with components and instructions for reliable results, across all specimens tested.

The procedure of the ELISA Test

Before starting the test; The ELISA plates have already been treated with antigens that target *Chlamydia pneumonia*. During the test; when patient serum samples are put into these plates any IgMs specific, to *Chlamydia pneumonia* present in the sample will attach to the antigens, in the plate. The participant's serum samples were diluted as, per the kit instructions. Then placed into the designated wells, on the ELISA plate. During the incubation process, the plates were left to enable the IgMs to attach to the antigens, on the plate. After the samples were left to sit for a while in the plates to allow for interaction, with antibodies and other substances, in the assay setup. A specific detection reagent, for IgM was included in the mix. An enzyme-linked one. In addition, it was introduced into the solution mixture being tested for the presence of IgM that targets *Chlamydia pneumonia* antibodies. Substrate Interaction Details; To trigger a reaction a solution containing the substrate was mixed with the enzyme connected to the detection agent resulting in a colour transformation, in the wells that corresponded to the quantity of IgM detected. The spectrophotometer was used to measure the

colour intensity, in each well to determine the concentration of IgMs based on the higher absorbance values detected. By adhering to these standardized protocols, the study ensures reliable and valid detection of *Chlamydia pneumoniae* infection, allowing for meaningful comparisons between respiratory allergy patients and healthy individuals in the context of respiratory pathogen exposure and immune response.

Statistical Analysis

Used t-test to compare sample means between different groups, such as comparing IgE levels between allergy patients and the control group within each age group. Applied transformative analysis to improve the statistical distribution of data before performing other statistical tests. Used Linear Regression Analysis to understand the relationship between variables such as age and IgE levels or factors like family history of allergies and IgE levels. Analysis of Variance (ANOVA) was used to verify multiple mean differences between different groups, such as comparing IgE levels among different age groups. The significance level was set at ≤ 0.05.

Results

The IgE concentration in serum samples of patients with atopic allergy was significantly higher than that of the control group. Age and IgE Levels: In all age groups, allergic patients have significantly higher IgE levels compared to the control group. The highest IgE levels were observed in the 18-30 years age group among allergic patients (Table 1).

Table 1. Relationship of Total IgE Concentration Level (IU/cm³) with Age Groups (Years)

Age (years)	**Control**	**Patients**
6-17	42.60±34.06	385.83±349.06*
18-30	55.31±33.7	564.81±318.29*^
≥30	54.56±32.65	505.71±348.74*
Total	53.42±11.01	519.39±32.71*
Data expressed as mean±SD, *indicates a significant difference at p<0.05 using two-sample t-tests, *as compared to the control group. ^ as compared to ≥30years group.		

Stratification of results according to demographic parameters indicated that males have slightly higher IgE levels compared to females. Individuals with a family history of allergies have significantly higher IgE levels compared to those without such a history, indicating a genetic predisposition to elevated IgE levels (Table 2).

Table 2. IgE Levels Based on Demographic Parameters

IgE (IU/cm³)	Male	Female
Sex	501.24±90.82*	452.04±82.49
	Positive	Negative
Family History	583.51±35*	339.30±55
Chlamydia pneumonia	456.44±75	519.42±91*
Data expressed as mean±SD, *indicates a significant difference at p<0.05 using two-sample t-tests.		

According to the BioCheck assay kit, an IgM concentration above 10.3 units is indicative of an active or recent *Chlamydia pneumoniae* infection. This cut-off value is based on the manufacturer's recommendations and is designed to distinguish between positive and negative cases with a high degree of accuracy.

Patients exceeding the 10.3 units threshold were therefore considered to have an active or recent *Chlamydia pneumonia* infection. In contrast, individuals with IgM levels below this threshold were classified as negative for *Chlamydia pneumoniae* infection.

Infection in Respiratory Allergy Patients: Measuring *Chlamydia pneumoniae* IgM levels in patients with respiratory allergies helps determine if an underlying infection may be exacerbating allergic symptoms or contributing to respiratory distress. Since *Chlamydia pneumonia* is a known respiratory pathogen, co-infection with allergies could worsen symptoms and complicate treatment.

Control Group Comparison: Testing in the healthy control group provides a baseline for IgM levels, helping to identify whether elevated *Chlamydia pneumoniae* IgM is specific to patients with respiratory allergies or if it is equally prevalent in non-allergic individuals.

The infection rate of *Chlamydia pneumoniae* was significantly higher in the allergic group (85%) compared to the control group (10%), suggesting that allergic individuals are more susceptible to this infection (Table 3).

Table 3. Percentage of Chlamydia pneumoniae Infection in Allergic and Control Groups

Group	***Chlamydia pneumoniae* Positive**	***Chlamydia pneumoniae* Negative**	**Total Number**
Allergic	85%	15%	50
Control	10%	90%	50

Discussion

Some studies indicated that chronic infections, including Chlamydia, may lead to immune disorders and affect the body's immune balance. This may enhance certain types of immune reactions, including allergies [25,26]. When we employ the ELISA technique to quantify IgM antibodies against, for Sensitive Detection purposes it becomes feasible to identify minimal levels of IgM. This capability facilitates the prompt identification of ongoing infections [27]. Measuring IgM levels helps determine the seriousness or progression of an infection [28].

When IgEs are elevated it means there has been exposure or an ongoing infection is present [29]. The research has shown that there could be an indirect link, between Type 1 reactions and *Chlamydia pneumonia* infection concerning their connection, with IgE antibodies [30]. In Type 1 atopic hypersensitivity reactions are driven by IgEs as a factor where individuals, with allergies experience increased IgEs in response to allergens like dust or pollen triggering the system to release excess IgEs that attach to mast cells and basophils leading to the release of substances like histamine that cause allergy symptoms such as itching and nasal congestion [31]. In contrast, bacterial infections such as *Chlamydia pneumoniae* trigger the system by activating cellular immunity using T cells and other antibodies like IgG and IgM which are commonly effective, against bacterial infections. In instances of chronic or recurring bacterial infections including *Chlamydia pneumonia* increased levels of IgE might be detected [32].

In situations where *Chlamydia pneumonia* infection persists or recurs over time in a person's body, it can trigger a response that

boosts the production of antibodies, like IgEs. This may lead to a reaction of allergic responses [33]. Moreover, a standing *Chlamydia pneumonia* infection could result in prolonged inflammation, in the system leading to an increased risk of developing allergic respiratory conditions such, as asthma which is classified as a type of atopic allergy and is associated with higher levels of IgEs [34]. Certain research indicates that respiratory infections, such as *Chlamydia pneumonia* could potentially heighten sensitivity in people who tend to conditions, like asthma. The persistent inflammation caused by the infection may exacerbate the immune response, including IgE production [35,36]. *Chlamydia pneumoniae* infection may exacerbate asthma symptoms in individuals with atopic asthma. Given that asthma is associated with elevated IgE levels, the infection might contribute to an immune response that includes increased IgE production [37].

Tailoring treatment approaches based on a patient's age and IgE levels can enhance their effectiveness by allowing for adjustments in dosages and therapies [38]. Analysis of the results presented in Table 2 indicates that total IgE levels are notably higher in individuals across all age groups compared to allergic individuals. Notably, the 18-30 age group exhibits IgE levels suggesting heightened activity during this period. These findings offer insights into the distribution of IgE levels among age groups shedding light on their importance in diagnosing and treating allergies clinically.

There are differences, in IgE levels between males and females with males having levels due to genetic variations. Men have markers, on chromosome 20 that can affect the production of IgE, a key player in allergic reactions. Other factors like smoking, and exposure to allergens and pollutants can also affect IgE levels in men [39]. Studies show that individuals with a family history of allergies tend to have IgE levels indicating an influence on immune responses and allergy susceptibility [40]. While both infected and uninfected individuals usually have IgE in their systems, there are variations within these groups suggesting that factors such as infections or different immune responses may affect IgE levels [41]. The research emphasizes the role of family history in determining IgE levels though the influence of gender and *Chlamydia pneumoniae* infection remains somewhat uncertain [42]. These findings underscore the importance of considering family history when evaluating IgE levels in individuals as this information can help in diagnosing conditions associated with IgE levels [43]. Moreover, there is a correlation between allergies and an increased incidence of *Chlamydia pneumoniae* infection [44,45]. This link may be attributed to individuals having an immune system making them more susceptible to infections [46, 47]. *Chlamydia pneumoniae* infection may exacerbate symptoms. Even potentially trigger them by causing an immune response that heightens allergic reactions. These results underscore the significance of screening individuals, for *Chlamydia pneumoniae* infection as part of therapeutic protocols [48, 49].

Knowing how allergies and *Chlamydia pneumoniae* infection are connected could help improve treatment methods. Treating the infection properly plays a role in handling allergies. Studies show that people with allergies are more likely to have *Chlamydia pneumonia* infection than those in the control group. This link can have an impact on diagnosing and treating allergies.

Conclusion

There is a relationship between *Chlamydia pneumoniae* infection and atopic allergy. In addition, age and family history of the disease play a role in influencing the severity of atopic dermatitis. Moreover, males are more susceptible to infection than females.

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Ethical approval

The study was approved and registered in the College of Basic Education, University of Mosul (Ref. No. 1498 on 17.04.2024).

Conflict of Interest

The authors declare no conflict of interest.

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