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Immunotherapy in Patients with Allergic Asthma and Chronic Allergic Rhinitis: A Retrospective Cohort

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Abstract: Asthma and allergies both cause similar signs and symptoms and often occur together. Evidence for the effectiveness of immunotherapy has rapidly increased in recent years. Several well-designed studies have demonstrated that allergen immunotherapy may prevent the development of asthma in people with allergic rhinitis. The present study aimed to assess the effect of subcutaneous immunotherapy with specific allergens on clinical symptoms, immunological factors, and cytokines in patients with allergic rhinitis and allergic asthma from the Kyrgyz Republic. This retrospective cohort study was conducted on patients with a slight to moderate level of persistent asthma and moderate to severe allergic rhinitis who had been referred to Osh State Clinic in Osh city, Kyrgyz Republic, from March 2000 to February 2025. About 160 atopic patients with allergic rhinitis and asthma were included in the study; confirmed by history, physical examination, and SPT, irrespective of gender. In patients with allergic asthma, 23 (58.97%) patients showed complete symptom improvement, 11 (28.2%) patients showed complete improvement, and 5 (12.82%) patients showed no response to treatment. Compared to previous treatment in the allergic rhinitis group, the cytokine TGFβ was significantly increased ($p < 0.001$), while the levels of IFN-γ ($p = 0.047$) and FOXP3 ($p = 0.013$) were also insignificantly decreased after immunotherapy. This study examined the impact of standard subcutaneous immunotherapy on patients with allergic respiratory diseases. The study also shows that immunotherapy stands as the most effective treatment for asthma and nasal allergies in patients who meet selection criteria, especially when medications do not work.

Keywords: Asthma; Allergies; Immunotherapy; Immune Response

1. Introduction

Asthma and allergies have comparable signs and symptoms and frequently co-occur. Similar contaminants that develop hay fever symptoms, such as dust mites, pollen, and pet dander, may also induce asthma symptoms. In allergic asthma or allergy-induced asthma, skin or food allergies may provoke asthma symptoms [1]. These triggers

include cold air, smoke from smoking, burning wood or charcoal, allergenic chemicals such as insecticides, dust mites, and respiratory illnesses such as colds and flu [2]. Many cells, including mast cells, eosinophils, T lymphocytes, and neutrophils, are involved in the development of asthma [3]. In 2023, 580.09 per 100,000 people had asthma, according to the World Health Organization (WHO) and the global burden of disease (GBD) [4]. Epidemiological research indicates that 12.8% of individuals in middle-income countries experience common asthma symptoms like wheeziness, shortness of breath, tightness in the chest, and cough. These symptoms can greatly affect routine work efficiency. Overall well-being, especially in places with limited healthcare resources, where specialized treatment for asthma may be lacking. The incidence of asthma symptoms among children in LMICs is roughly 5.3%, indicating that while asthma is less prevalent in pediatric populations than in adults, it remains a significant health concern. Childhood asthma may result in frequent school absences, decreased physical activity, sleep disruptions, and an elevated risk of severe exacerbations necessitating emergency medical care. Moreover, in countries with lower and middle incomes, children frequently face exposure to factors that could increase the risk of asthma symptoms starting early and lasting longer, like indoor and outdoor air pollution allergens and respiratory infections [1]. The variation in asthma rates among different age groups underscores the significance of focusing on specific public health initiatives. Improved availability of diagnostic and treatment services to address the rising impact of asthma in low- and middle-income nations. Implementing measures and increasing access to medications such as inhalers are crucial steps in reducing the negative effects of asthma and improving health results in these regions [5]. Previous research has reported this figure as 10%, which indicates an increase in the prevalence of asthma in this age group [6]. According to studies, the number of people who have asthma symptoms is increasing, and this number is alarming; special measures should be taken to prevent this disease [7]. Many studies suggest that the rising global incidence of asthma could be linked to changes in habits over time. Over the decades, food choices have undergone significant transformations, especially in countries with lower and moderate incomes. There is a shift from traditional diets abundant in fresh produce, whole grains, and lean meats towards processed foods, fatty diets, sweetened beverages, and fast food options. This dietary change has been associated with heightened inflammation, modified immunological responses, and an elevated vulnerability to allergy conditions, such as asthma. A potential mechanism connecting diet to asthma is the Westernization of dietary habits, marked by elevated consumption of saturated fats, refined carbohydrates, and food additives, coupled with diminished intake of fiber, antioxidants, and vital micronutrients such as vitamin D, omega-3 fatty acids, and zinc. Several such dietary changes may lead to the development of chronic low-grade inflammation of the gut, alteration in the microbiota of the gut, and increased oxidative stress, all of which are now recognized to be important in the pathogenesis of asthma. Furthermore, new studies demonstrate that diet determines the composition of the gut microbiota, which, in turn, controls immune system functions. Thus, low-fiber and low-prebiotic diets may lack beneficial gut flora, resulting in immune regulatory imbalances and increased propensity to allergic diseases, including asthma. An increased usage of preservatives, artificial flavoring agents, and food colorants in processed foods has raised concerns about their potential to induce immune system hyperreactivity, which may result in airway inflammation and bronchial hyperresponsiveness. In addition, deficiencies in essential minerals, such as vitamin D, have been found to impair lung growth, immune function, and airway inflammation, all of which are critical risk factors for asthma. Modern lifestyles, especially in metropolitan populations, have diminished outdoor solar exposure, leading to an increased incidence of vitamin D deficiency, which exacerbates respiratory problems. While dietary modifications alone cannot fully explain the rising incidence of asthma, they are regarded as a substantial contributing factor, especially when combined with other environmental influences such as air pollution, reduced physical activity, increased obesity rates, and allergen exposure. As a result, there is growing interest in nutritional therapies and dietary modifications as effective strategies for asthma prevention and management, underscoring the need for balanced, nutrient-rich diets that enhance immune health and respiratory function [8,9]. Another hypothesis is the increase in the level of hygiene following the urbanization of societies and the reduction in contact with various infectious agents, followed by a decrease in the body's beneficial microbes [9,10]. The gene responsible for this disease has been traced to various chromosomes, including 5 and 11; however, recently, a new gene called Adams 33 has been identified on chromosome 20 [11]. Asthma medications fall into two general categories: controller therapy using steroids, leukotriene modifiers, and cromolyn (a mast cell stabilizer), and short-acting therapy using fast-acting beta-agonists, inhaled anticholinergics, immunotherapy, and aminophylline [12]. One of the most common treatments for asthma and allergies is the leukotriene modifiers such as montelukast, which can reduce symptoms of these diseases [13]. Montelukast has sometimes been linked to psychiatric side effects, such as

suicide ideation [14]. Immunotherapy involves a gradual escalation of the immune response, and when delivered correctly, can provide long-lasting relief from allergic conditions, reducing inflammation of the airways, hyperreactivity of the bronchi, and the severity of asthma attacks. It is particularly helpful for patients with severe allergic rhinitis or asthma who are not well controlled with standard medications [15]. Immunotherapy stands out as a significant therapeutic approach, particularly in the management of allergic diseases. This treatment involves the gradual exposure of the patient to an allergen extract, which is administered in increasing doses. The methods of administration can vary, including subcutaneous, sublingual, or oral routes, each offering unique benefits and considerations for patient care [16]. Regular injections of trace quantities of the allergens causing symptoms are part of immunotherapy. Allergy symptoms diminish when the immune system develops a tolerance to the allergens. As a result, asthma symptoms also lessen. Typically, this therapy calls for three to five years of consistent injections. As an example, anti-immunoglobulin E (IgE) therapy when a person has asthma or an allergy, leads to mistakenly identifying a certain substance as harmful by the immune system, and it releases antibodies, i.e., IgE, against it [17]. In recent years, several double-blind, controlled studies working with common allergens have validated the efficacy of immunotherapy in treating hypersensitivity responses and allergic asthma [18–20]. Furthermore, immunotherapy has been shown in numerous studies to be useful in preventing allergic asthma. Immunotherapy is often recommended for mild to moderate allergic asthma and moderate to severe allergic conditions. Immunotherapy has no proven efficacy in food allergy and atopic dermatitis [21]. In patients with severe and poorly controlled asthma, immunotherapy should be used with extreme caution due to the increased risk of systemic reactions [22]. Skin prick testing (SPT) is the gold standard for diagnosing allergic diseases and the ideal technique for assessing exclusive IgE [23]. When a positive test for a particular IgE is linked to probable triggering events in the patient's environment, immunotherapy should be taken into consideration [24]. Research has shown that immunotherapy with an effect on regulatory T-cells causes an increase in Th1 lymphocytes and a decrease in Th2 lymphocytes, along with an increase in IgG, a decrease in inflammatory cells, and the creation of inhibitory antibodies against IgE in the body [25].

Evidence for the effectiveness of immunotherapy has rapidly increased in recent years. Several well-designed studies have demonstrated that allergen immunotherapy may prevent the development of asthma in people with allergic rhinitis [26]. Thus, the present study aimed to assess the effect of subcutaneous immunotherapy with specific allergens on clinical symptoms, immunological factors, and cytokines in patients with allergic rhinitis and allergic asthma from the Kyrgyz Republic.

2. Methods

2.1. Study Design and Population

This retrospective cohort study was conducted on patients with mild to moderate persistent asthma and moderate to severe allergic rhinitis who had been referred to Osh State Clinic in Osh city, Kyrgyz Republic, from March 2000 to February 2025. In this study, 160 patients with allergic rhinitis and asthma, regardless of gender, who were confirmed by history and physical examination, as well as SPT, atopic and allergic, were included. Every patient who participated in the study was mandated to fill out the standardized questionnaire provided by the American Academy of Allergy. This comprehensive assessment evaluated their history of allergies, the severity of their symptoms, and identified any potential triggers that could be influencing their condition. Before the treatment period commenced, informed consent was meticulously secured from every participant. This process ensured that each individual had a comprehensive understanding of the study's objectives, the procedures involved, as well as the potential risks and benefits associated with their participation. Patients received comprehensive information about the treatment regimen, which encompassed the specific type of therapy being administered, the anticipated outcomes, potential side effects, and the critical importance of adhering to the prescribed protocol. The study underwent a thorough review process and received formal approval from the local Ethics Committee of Osh State University. This rigorous evaluation confirmed that the research adhered to ethical standards about human subjects, encompassing critical aspects such as patient confidentiality, safety measures, and alignment with international research guidelines.

2.2. Inclusion and Exclusion Criteria

Patients with allergic asthma and chronic allergic rhinitis, based on the diagnostic criteria used for allergic rhinitis, were those defined by the Joint Group on Practice Parameters in Allergy, Asthma, and Immunology. They

included sneezing, nasal obstruction, excessive tearing, or conjunctival redness in the presence of mixed reactions to positive skin allergens [27] were selected. The presence of firmness (induration) and erythema (redness) more than 3mm in diameter at the test site constituted a positive skin prick test (SPT) in this research, suggesting a clinically relevant allergic response. Participants were selected to provide a homogeneous research population depending on certain eligibility criteria. The age range was defined as 5 to 65 years, therefore enabling a wide yet clinically relevant population. Advanced or severe asthma patients were sent away to avoid possible problems. To guarantee safety, female participants had to have a negative pregnancy test before enrolling. Those with cancer, immunodeficiency disorders, or autoimmune diseases were also excluded, as these conditions might compromise immune response assessments. Underlying inflammatory diseases must be checked out with a normal peripheral blood ESR. Finally, individuals who had prior usage of beta-blockers were omitted as they can alter allergic responses and affect the therapy of severe reactions. These well-selected criteria serve to eliminate any confusing aspects and ensure the accuracy of the study results.

2.3. Procedure

In this study, information about patients who underwent clinical examination before and after immunotherapy and completed the American Academy of Allergy, Asthma and Immunology questionnaire, which included demographic data and clinical signs. The treatment includes that after completing the 30-month immunotherapy period, the above clinical symptoms, which these data were collected and statistically analyzed. The data collection method in this study was based on observation, a data recording form, and examination. According to the study conditions, patients underwent SPT with common aeroallergens, and patients who had positive SPT who underwent immunotherapy with three vials of 1:10,000 picogram dilutions every week for 10 sessions that were subcutaneously injected. Patients completed a questionnaire with personal data and clinical signs after the immunotherapy treatment period, and they also had another physical examination.

2.4. Statistical Analysis

A comprehensive meta-analysis of the available study data was conducted using both descriptive and inferential statistical methods. The data was effectively presented using descriptive statistics, including frequency distributions and measures of central tendency. A dependent t-test was used to compare mean differences on dependent variables, which enabled the investigation of changes within the same group over time. Chi-square test was used to analyze categorical data and determine if there is any relationship between the variables. Confidence intervals for key findings were calculated using an online statistical tool to enhance the precision and reliability of the results. The study employed SPSS software version 20 (SPSS Inc., Chicago, IL, USA) for data collection and statistical analysis. The T-test and chi-square test were applied to determine the correlation and difference between the research variables. The statistical significance was set at $p < 0.05$, which means that any result with a p value less than 0.05 was considered statistically significant and unlikely to occur by chance.

3. Results

There were 160 patients in total recruited for this study: 108 women (67.5%) with a mean age of 38 ± 5.1 years and 52 men (32.5%) with a mean age of 35 ± 4.8 years. Of these subjects, 9 (5.62%) had both allergic rhinitis and allergic asthma; 112 (70%) were diagnosed with allergic rhinitis, and 39 (24.38%) with allergic asthma. Significantly, before the immunotherapy was started, clinical and physical exams showed that 42 patients (26.25%) were experiencing wheezing. Immunotherapy significantly reduced the cases of wheeze; only 12 (7.5%) of the population were afflicted ($p < 0.05$). The potential effectiveness of immunotherapy in reducing respiratory problems in people with allergic disorders is shown by this noteworthy development. Also, 50 (31.25%) patients had cough at the beginning of treatment, which decreased significantly to 11 (6.87%) patients after immunotherapy ($p < 0.05$). Overall, 160 (100%) of patients had rhinitis, and 120 (75%) had nasal congestion and stuffiness, which decreased significantly to 49 (30.62%) patients after immunotherapy ($p < 0.05$). Overall, immunotherapy in allergic rhinitis patients resulted in complete symptom improvement in 62 (54.46%) patients, moderate improvement in 26 (23.21%) cases, and no effect in 24 (15%) patients (**Table 1**). Of the 39 patients, 23 (58.97%) with an allergic asthma diagnosis had complete regression of clinical signs; that is, their symptoms disappeared completely after the therapy. Eleven

patients (28.2%) also had some improvement; however, this meant that they had a partial reduction in the severity of their symptoms rather than total clearance. However, 5 patients (12.82%) did not improve with the therapy and remained symptomatic even with the intervention. These results are summarized in **Table 1** and emphasize the importance of individualized treatment plans to enhance clinical benefits since allergic asthma patients had varying degrees of therapeutic response. A total of 7 (77.78%) patients of 9 patients with both asthma and allergic rhinitis completely responded to immunotherapy, and the rest had no response (**Table 1**). A complete response to therapy was defined in patients diagnosed with allergic rhinitis as the accomplishment of a normal clinical examination with full remission of all allergic rhinitis symptoms, including nasal congestion, rhinorrhea, sneezing, and nasal itching. This suggested that the patient no longer had any clinically suggestive allergic rhinitis. A lack of response was characterized by the persistence of rhinitis symptoms occurring more than four days each week for more than four consecutive weeks, despite ongoing treatment efforts. The individuals within this group continued to experience notable allergy and nasal symptoms, suggesting either an inadequate response to the treatment provided or persistent exposure to allergens in their environment. There was a ground, between reacting and not responding at all, known as a mild response level. While some individuals exhibited improvement in their symptoms and clinical data, many did not achieve relief from symptoms. Their allergic rhinitis symptoms were still present. They were either less intense or occurred frequently compared to the group that had no response.

Compared to before treatment in the allergic rhinitis group, the cytokine TGFβ was considerably amplified ($p < 0.001$), while the levels of IFN-γ ($p = 0.047$) and FOXP3 ($p = 0.013$) were also insignificantly decreased after immunotherapy (**Figure 1**). Also, the same pattern was observed in the allergic asthma group (**Figure 1**). The change in the group having both diseases showed no significant increase in TGFβ (**Figure 1**).

Table 1. Frequency of response to treatment in patients with allergic rhinitis, allergic asthma, and a combination of both in the studied patients.

Patient Groups	Response to Immunotherapy (Symptoms Improvement)			
	Complete	Moderate	No Response	All
Allergic rhinitis	62 (54.46%)	26 (23.21%)	24 (21.43%)	112 (70%)
Allergic asthma	23 (58.97%)	11 (28.2%)	5 (12.82%)	39 (24.38%)
Both	7 (77.78%)	-	2 (22.22%)	9 (5.62%)
All	92 (57.5%)	37 (23.13%)	31 (19.37%)	160 (100%)

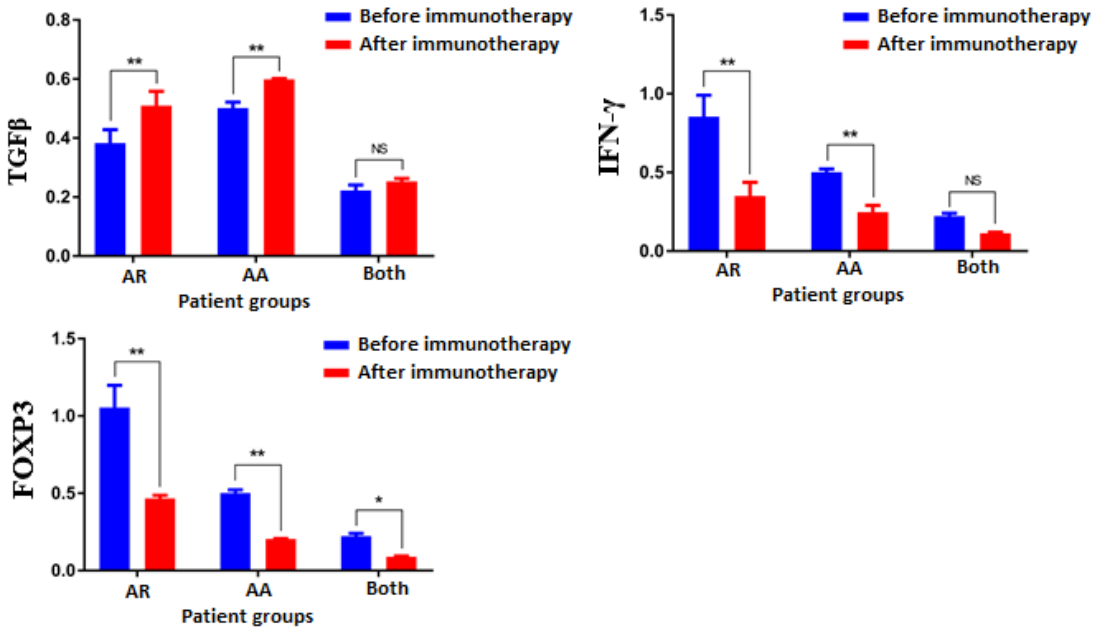

Figure 1. Comparing immunologic factors before and after immunotherapy in different groups of patients with patients amid allergic asthma (AS), allergic rhinitis (AR), and both.

4. Discussion

Each year, 2 to 3 million of the 55 million allergic patients in the United States undergo immunotherapy [28]. Today, immunotherapy for allergic asthma and allergic rhinitis is approved by the US FDA [15]. Although this procedure requires frequent visits and only a few standardized allergens have been prepared, systemic and anaphylactic reactions have been reported as complications of this procedure [29]. A study in Spain showed that of around six thousand injections given weekly to patients during the first month of immunotherapy, only 14 local reactions and 27 systemic reactions occurred, while in this study, only 5 patients experienced complications [30]. The worst complication of this procedure is anaphylactic shock, which occurred only 131 times in a study of 453 patients who received twenty-one thousand injections during thousand visits [31]. The recent investigation indicated that subcutaneous immunotherapy (SCIT) is safe, with no instances of allergic reactions like anaphylactic shock reported among the participants involved in the study group. However, a few individuals mentioned experiencing a high level of responses after undergoing the treatment. During the month of receiving immunotherapy injections, two patients encountered itching in their limbs, while three patients showed symptoms of generalized urticaria. A condition marked by extensive rashes and itchiness. Fortunately, these reactions subsided on their own without requiring assistance as they were self-resolving. For individuals who do not respond well to medications, subcutaneous immunotherapy is widely recognized as a safe and effective solution, for allergic rhinitis and asthma. It functions by desensitizing the system to allergens, thus reducing symptoms and improving overall disease control. While SCIT has proven its long-term efficacy and safety in numerous studies, its potential for systemic allergic reactions emphasizes the need for careful administration under medical guidance. SCIT is not advised, nevertheless, for children under the age of five with allergic rhinitis and asthma, despite its advantages. Younger children could have an undeveloped immune system, which might affect their immunotherapy response, and they might also have trouble expressing early symptoms of side effects. Furthermore, younger children are more likely to have severe systemic responses, which emphasizes even more the necessity of prudence when contemplating immunotherapy in this age range. Therefore, maintaining the safety and efficacy of subcutaneous immunotherapy depends critically on meticulous patient selection and monitoring [32]. Subcutaneous immunotherapy is more effective than sublingual immunotherapy in the treatment of asthma and allergic rhinitis [33]. However, several studies have recently shown that moderate persistent asthma and moderate to mild allergic rhinitis may be successfully treated by combining sublingual and subcutaneous immunotherapy [34]; there is still little experience in using the latter method in children [35]. Some researchers in the past believed that, even though immunotherapy was effective in treating patients with allergic rhinitis and asthma, the impact of immunotherapy on the day-to-day functioning of individuals was limited due to factors such as the lack of patient compliance, local or systemic reactions following repeated subcutaneous injections, and the late onset of therapeutic response [36–39]. Since allergic rhinitis, as the most common chronic allergic disease, plays a significant role in the transformation of this disease into asthma, appropriate and timely treatment seems essential. The correlation between allergic rhinitis and asthma is greater in children than in adults, and there is a higher percentage of possibility of it transforming into asthma compared to adults [40]. Of course, in children under 14 years of age who have rhinitis with or without asthma, in addition to the effectiveness of immunotherapy, no difference in response to treatment has been observed [41]. While immunotherapy has shown effectiveness, in treating rhinitis, the primary method of addressing this condition remains treatment in most cases. Many different medications are readily accessible and commonly used to enhance the quality of life for patients by alleviating symptoms. These medications encompass topical and inhaled corticosteroids that play a vital role in reducing inflammation and managing symptoms, antihistamines that work by blocking histamine receptors to prevent allergic reactions, and anticholinergics, which help decrease nasal secretions. Additionally, decongestants offer short-term relief by reducing swelling in the passages and improving airflow, while mast cell stabilizers work to lower the production of substances. Although these treatments remain components of managing rhinitis, research is ongoing to explore alternative therapeutic options. The development of prostaglandin antagonists is one fascinating path under research that could eventually provide an innovative approach for therapy. These newly created medications seek to target inflammatory pathways linked to allergic responses, therefore helping people with allergic rhinitis control their symptoms and get long-term relief [42]. In case of resistance to drug therapy, immunotherapy is recommended as a successful therapeutic approach [43]. Immunotherapy has been established as a successful treatment for respiratory allergies, and it demonstrates many advantages in the management of allergic rhinitis and

asthma. In addition to its efficacy in alleviating symptoms, proper and timely management of allergic rhinitis is crucial in the control of asthma and the prevention of disease progression from rhinitis to asthma. This underscores the importance of early intervention in the prevention of worse respiratory diseases. In addition, several research with high treatment response rates of more than 80% for allergic rhinitis and more than 90% for asthma have supported the effectiveness of immunotherapy and its necessity as a primary treatment for allergic respiratory diseases [44].

Subcutaneous immunotherapy (SCIT) remains the primary treatment for allergic respiratory diseases, yet its value against sublingual immunotherapy (SLIT) and intralymphatic immunotherapy (ILIT) must be recognized. Meta-analyses demonstrate that symptom reduction rates reach 60–70% with SCIT for pollen-driven allergies compared to 40–50% with SLIT for dust mite sensitivity. Yet, SCIT demonstrates better long-term results in allergic rhinitis and asthma [45]. The way SLIT is given can cause mouth pain for 20–40% of patients, but serious side effects are uncommon, while SCIT has a higher chance of serious reactions, like anaphylaxis, occurring in about 0.1–0.3% of injections [18]. Patient adherence also varies: The home-based administration of SLIT enhances patient compliance rates, but SCIT requires patients to visit clinics frequently for injections, leading to higher dropout rates ranging from 15% to 30%. The experimental treatment ILIT demonstrates potential benefits through its use of 3–4 treatment sessions at reduced dosages while showing comparable results to SCIT in initial research. However, long-term safety information is limited [46]. ILIT could revolutionize therapy if its safety and convenience are validated, yet SCIT remains the preferred choice for patients who are polysensitized or have difficulties following daily SLIT protocols. Research should focus on directly comparing these treatment approaches to achieve personalized therapeutic plans.

The current study's results show that those diagnosed with allergic rhinitis and asthma after immunotherapy had a mean concentration of Transforming Growth Factor Beta (TGFβ) much greater than others. This rise in TGFβ points to a possible immunomodulating action of the medication, therefore helping to reduce symptoms and enhance therapeutic results. These results indicate even further the effectiveness of immunotherapy in changing immune systems and enhancing illness control in allergy sufferers [47, 48]. TGFβ reactivation and consequently activation of the TGF-β/Smad signaling pathway participate in the process of immune evasion [49]. Therefore, it is expected to be higher in people with allergic rhinitis and asthma than in healthy groups. In this study, 88% of patients with rhinitis/asthma and 4% with allergies responded to treatment. A European study showed that over 80% of patients' symptoms were reduced over 3 years of immunotherapy, and more than 70% of patients reported a reduction in medication use [50]. Since 70% of allergic rhinitis patients and 75% of asthma patients in this study had a complete response to treatment, this reduction in cost and medication use for patients can be considered at least [51]. When it comes to immunotherapy, some experts feel that children between the ages of 5 and 17 who suffer from moderate to severe allergic rhinitis should first follow a strategy of waiting and seeing before beginning treatment. If the symptoms become more severe or the condition develops into asthma, immunotherapy should be included in the therapeutic approach [52].

The research contains a few limitations as well because of its retrospective, single-center design. First, the study selection bias stems from its reliance on clinic referrals because participants might not accurately represent the general population of allergic rhinitis and asthma patients, particularly in terms of socioeconomic factors, adherence, and unmeasured confounders such as environmental exposures. Second, the research conducted at a single centre in Kyrgyzstan fails to apply to other regions because their allergen profiles and genetic characteristics, as well as their healthcare systems, differ from each other. Finally, the study lacks follow-up data beyond a short period, which prevents researchers from evaluating how immunotherapy maintains its clinical and immunological benefits and whether any adverse events emerge over time. It would have been better if the study had been conducted in a double-blind manner, which was not possible given the study conditions. Future research needs prospective multicenter studies with diverse participant groups and extended follow-up evaluations to validate these findings and establish the long-term advantages of immunotherapy.

5. Recommendations and Future Direction

Particularly in situations unresponsive to traditional pharmacological treatments, immunotherapy has shown great promise as a final treatment for allergic asthma and persistent allergic rhinitis. Still, various suggestions and future study paths should be taken into account if one wants to optimize patient outcomes and improve their clinical relevance.

5.1. Clinical Recommendations

5.1.1. Optimizing Patient Selection

Although immunotherapy helps mild to moderate allergic rhinitis and allergic asthma, appropriate patient selection is vital. Personalized biomarkers, including particular IgE levels and cytokine profiles should be included in future clinical recommendations to forecast therapy response and reduce side effects.

5.1.2. Combination Therapies

Investigation should be conducted on the combination of immunotherapy with various therapeutic methods, including biologic medicines, targeting IL-5, IL-4, and IL-13. Combining monoclonal antibodies with immunotherapy might improve the effectiveness and control of diseases.

5.1.3. Enhanced Safety Monitoring

Because of the potential of systemic reactions, it is important to build up real-time monitoring strategies using digital health technologies like wearable devices and mobile applications to track patient responses and to detect adverse reactions early.

5.1.4. Patient Adherence Strategies

Long-term compliance is a difficulty in immunotherapy. Emphasizing educational programs, streamlined treatment plans, and patient support programs will help to raise treatment results and adherence.

5.2. Future Research Directions

5.2.1. Precision Medicine Approaches

With the development of genomic and proteomic technologies, it is possible to individualize immunotherapy treatment based on a patient's characteristics. Future trials should also aim to determine the genetic determinants of the response to the different allergens.

5.2.2. Development of Novel Immunotherapies

Alternative and safer options to subcutaneous and sublingual immunotherapy are on the horizon, such as new immunomodulatory treatments, like DNA-based therapies and peptide-based vaccines. One should concentrate research on improving these methods.

5.2.3. Long-Term Outcome Studies

Although immunotherapy has proven effective in reducing symptoms of conditions such as asthma, prevention studies are essential to understand its lasting effects over time and how it may influence the progression of allergic rhinitis to asthma in the long term.

5.2.4. Exploration of Alternative Delivery Methods

Investigated as less intrusive and more effective substitutes are innovations, including intralymphatic immunotherapy and epicutaneous immunotherapy via skin patches. Establishing their safety and effectiveness calls for further investigation.

5.2.5. Public Health Integration

Lawmakers should consider looking into integrating immunotherapy into asthma and allergy management initiatives to enhance access, for cost-effective measures in research efforts, across low and middle-income nations.

6. Conclusion

Chronic allergic respiratory diseases like asthma and allergic rhinitis affect patients' quality of life. Symptom-focused pharmacological management of these diseases involves antihistamines, corticosteroids, and bronchodilators, although without targeting the underlying immune mechanisms responsible for these diseases. However,

drug treatments fail to control symptoms sufficiently for some patients, so other therapeutic options are required. Immunotherapy has been known to be the only disease-modifying treatment that can change the natural history of allergic diseases. By administering gradually increasing doses of allergens to the immune system, it works to desensitize the hyper-reactivity, resulting in long-term improvement or even remission of symptoms. This study, which investigated the effect of standard subcutaneous immunotherapy in patients with allergic respiratory diseases, showed that, based on the indicators of the two standard criteria, immunotherapy is still considered the only definitive treatment for these diseases if patients are properly selected. Therefore, it is recommended that this treatment method be used in cases of non-response to drug treatments in asthma and nasal allergies. The results of the current study show that immunotherapy significantly improved clinical signs and symptoms in patients with asthma and allergic rhinitis who did not respond adequately to medical treatment and is therefore recommended as an effective treatment modality in these patients. Furthermore, investigations with larger sample sizes and longer follow-up times are needed to explore the long-term benefits of SCIT and its potential to impact disease progression.

Author Contributions

Conceptualization, S.A., M.F.S., A.M.J., S.A.M., S.S.M., and W.N.; validation, A.M.J. and S.A.M.; formal analysis, S.A., M.F.S., S.S.M., and W.N.; data curation, S.A., M.F.S., S.S.M., and W.N.; writing—original draft preparation, S.A. and M.F.S.; writing—review and editing, A.M.J. and S.A.M. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement

The article is comprehensive in its consideration of ethical concepts. The ethics committee gave the study the all-clear.

Informed Consent Statement

Not applicable.

Data Availability Statement

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Conflicts of Interest

The authors declared no conflict of interest.

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