Dust Mite Allergy and The Significance of Different Immunotherapies to Treat It.

By

Faiyaz Ahasan

ID: 21376005

A project submitted to the Department of Mathematics and Natural Science in partial fulfillment of the requirements for the degree of Master of Science in Biotechnology.

Department of Mathematics and Natural Science,

Brac University,

March 2022

Declaration

It is hereby declared that

1. The project submitted is my original work while completing Master of Science in Biotechnology at Brac University.

2. The project does not contain material previously published or written by a third party, except where this is appropriately cited through full and accurate referencing.

3. The project does not contain material that has been accepted or submitted for any other degree or diploma at a university or other institution.

4. I have acknowledged all primary sources of help.

Student's Full Name & Signature:

Faiyaz Ahasan

21376005

Student Full Name
Student ID

Approval

The project titled “Sea Snail venom: A Potential Alternative to Opioid Analgesics.” submitted by-
Faiyaz Ahasan, ID: 21376005
of Summer, 2021 has been accepted as satisfactory in partial fulfillment of the requirement for the degree of Master of Science in Biotechnology.

Examining Committee:
Thesis Supervisor:

_____

Dr. Fahim Kabir Monjurul Haque
Assistant Professor, Department of Mathematics and Natural Sciences,
Brac University

Program Coordinator:

_____

Dr. Iftekhar Bin Naser
Assistant Professor, Department of Mathematics and Natural Sciences,
Brac University

Departmental Head:
(Chair)

_____

Prof. Dr. A F M Yusuf Haider
Professor and Chairperson
Department of Mathematics and Natural Sciences
Brac University

Ethics Statement

Hereby, I, Faiyaz Ahasan, actively assure that for the project that this review work entitled " Effect of House Dust Mite in Human Body and Importance of Sublingual Immunotherapy to Overcome it.” is submitted for the fulfillment of the requirements for the degree of Master of Science in Biotechnology from the Department of Mathematics and Natural Sciences, Brac University, signifies my work under the supervision of Dr. Fahim Kabir Monjurul Haque, Assistant Professor, Department of Mathematics and Natural Sciences, Brac University, and I have been given adequate credit where I have included others' words, insights, or writings. No animals were used or harmed in this project.

Abstract

Dust mite allergy is an inflammatory reaction to microscopic insects that reside in household dust. Dust mite allergy symptoms include those associated with hay fever, such as sneezing and a runny nose. Many persons who are allergic to dust mites also exhibit symptoms of asthma, such as wheezing and trouble breathing. Immunotherapy is an important treatment option for dust allergies. Numerous patients are being alleviated by the use of sublingual or subcutaneous immunotherapy, which provides more alleviation for a longer length of time and is devoid of adverse effects, in contrast to synthetic medications. Sublingual immunotherapy (SLIT) allergy pills are a new type of allergy immunotherapy that was recently licensed in the United States. Instead of injections, allergy tablets entail sublingual administration of allergens with in form of a liquid or tablet on a regular basis. Subcutaneous immunotherapy (SCIT) is a very well kind of this treatment. Additional allergens, including such venoms or food allergies, are examined independently in SCIT. Oral and sublingual immunotherapy, rush immunotherapy, mechanisms of action, and allergen extract production are all covered separately.

Keywords: Dust; Allergy; Immunotherapy; Sublingual; Subcutaneous

Dedication

Dedicated to

My Parents, Md. Humayun Kabir and Farhana Kabir,

My younger brother, Md. Yeasir Ahasan.

Acknowledgment

First and foremost, I would like to praise and thank Allah (SWT), the Almighty, who has granted countless blessings, knowledge, and opportunity to me so that I have been finally able to accomplish the thesis. Apart from my efforts, the success of this thesis depends largely on the encouragement and guidelines of many others. I take this opportunity to express my gratitude to the people who have been instrumental in completing this thesis.

I am grateful to my respected supervisor, Dr. Fahim Kabir Monjurul Haque, Assistant Professor, Department of Mathematics and Natural Sciences, Brac University, for supporting me continuously and giving me the motivation to complete the project paper. Without his support, it was not possible to finish my project work.

I am also grateful to Professor A.F.M Yusuf Haider, Honorable Chairperson, Department of Mathematics and Natural Sciences, and Brac University, for giving me the support and opportunity to complete my project work and M.Sc program.

Table of Content

List of Table

List of Figures

List of Acronyms

House Dust Mite	HDM
Allergic Rhinitis	AR
Sublingual Immunotherapy	SLIT
Subcutaneous Immunotherapy	SCIT
Allergen-Specific Immunotherapy	AIT
Histamine Receptors	HRs
Polyvinyl Chloride	PVC

Chapter 01

Background

A chemical that induces an allergic response is referred to as an allergen. Many people are allergic to dust mites' body parts and excrement. Low humidity or extreme heat kills the majority of dust mites. They do, however, leave their rotting carcasses and garbage behind. Several environmental exposures may persist. Dust mites may often live the whole year in a warm, damp environment (Resch et al., 2011).

A dust mite is about a third of a millimeter long. They are more than enough to detect with our eyes alone. Under a microscope, they imitate white beetles. Due to the fact that these creatures have pairs of legs, they are classified as arthropods, including spiders, instead of insects. Dust mites like temperatures between 68- and 77-degrees Fahrenheit (20 to 25 degrees Celsius). Humidity levels between 70% and 80% are indeed optimal for them. At least 13 distinct species of mites exist. They're all very well with our home's circumstances. They feed mostly on the minute human skin particles that humans shed on a regular basis. These bits are capable of penetrating the internal layers of furniture, carpets, beds, and sometimes even stuffed animals. Mites thrive under these conditions. Each day, an average adult may lose up to 1.5 grams of skin (Shahhosseini et al., 2019).

Dust mite allergy is an allergic reaction to dust mite allergens present in household dust. Another term for it is house dust allergies. Sensitization is caused by an allergic reaction to dust mite excrement. When breathed, the droppings act as an internal aeroallergen, eliciting an allergic reaction. Atopic illnesses including allergic rhinitis and asthma have been increasing in prevalence, with household dust mites serving as the primary allergen. Around 1920, it was recognized that

home dust was an allergy. Dermatophagoides pteronyssinus was identified as the allergen responsible for household dust allergies in 1967. (Courtioux & Boudot, 2021).

The most prevalent indoor allergen is the house dust mite (HDM or DM). Allergy-induced rhinoconjunctivitis, allergic asthma, and atopic eczema are only a few of the allergic diseases associated with the HDM. Allergic rhinitis is best treated by avoiding allergens, backed by medicine and allergy immunotherapy (AIT). All of these medications are effective: antihistamines, leukotriene receptor blockers, and inhaled or intranasal corticosteroids (ICS). Each of these therapies is effective and beneficial, but it has not been shown that they alter the course of allergic infections characterized by HDM (Banerjee et al., 2015).

Chapter 02

Schematical Representation of Project Methodology

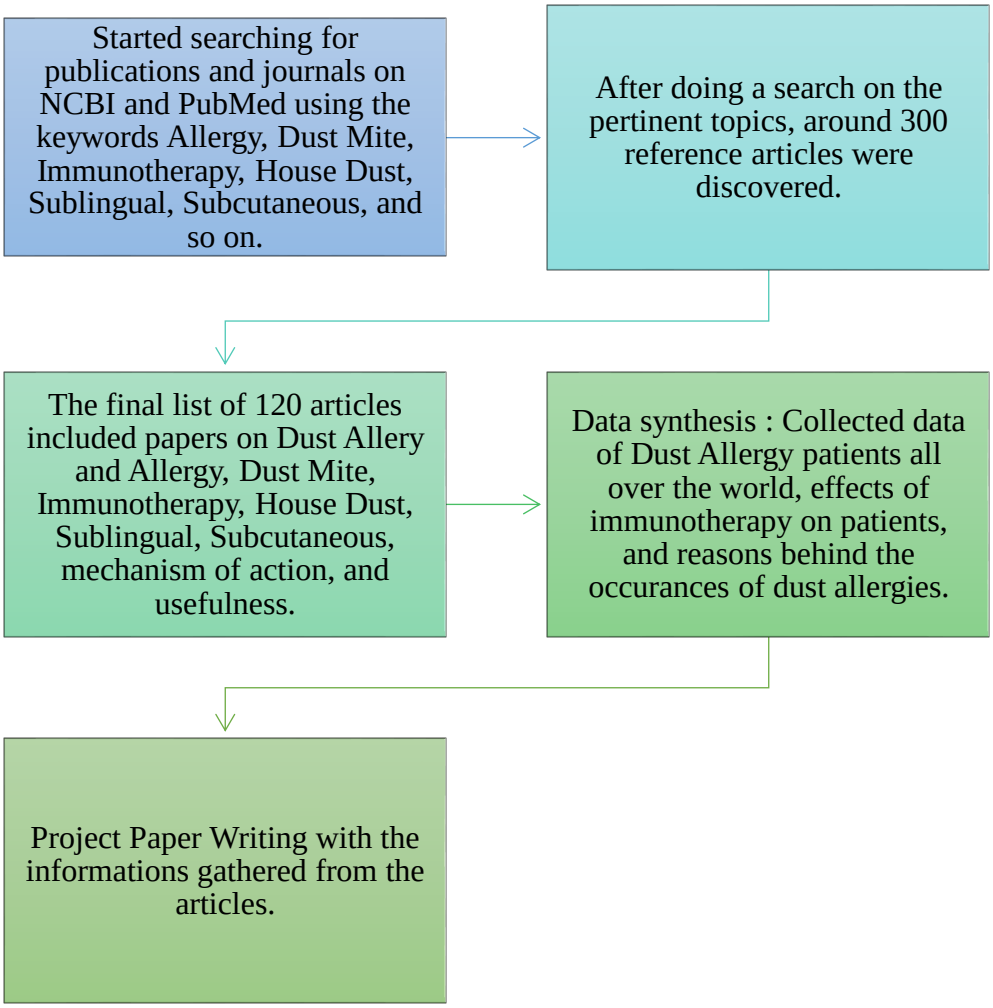

Figure 1- Schematical Representation of Project Methodology

Chapter 03

Different Houses Has Different Types of House Dust Mites

House dust mites are often detected in traces of household dust taken from everywhere in the globe. Despite the fact that house dust mites are found worldwide, the number of mites in different places and time periods varies significantly. The wide variation in the proportion of mites identified in residences demonstrates that critical components of the dwellings have an effect on the mites' growth conditions and, as a consequence, the proportion of mites that might also emerge in a habitation (Carnés et al., 2017).

Dust mites in the home live on human dander, and a single gram of dander may nourish millions of parasites for months. Given that each person creates between 0.5 and 1.0 grams of dander per day, food seems to be sufficient. Due to the lack of an increase in the prevalence of mites in psoriasis patients' houses, it has been demonstrated informally that the quantity of human dander is not really a major bottleneck for mite proliferation. According to scientific culture tests, mites cannot thrive at relative humidity levels beneath 55% (H. Ormstad et al., 1998). When compared to the average level of humidity in Danish houses, it seems as if indoor air humidity is the determining factor in mite growth. It is relevant during most of the dry winter season when the average humidity level is 40%, but it is continuously over 55% throughout the warmer months. Numerous epidemiological studies have shown that when the humidity level in dwellings increases, the populations of house dust mites increases. The amount of humidity generated by people and their activities, including the degree of humidity in the surrounding air, all have an effect on the humidity level in buildings (Heidi Ormstad, 2000). The latter component's magnitude is proportional to the residence's airflow. External relative humidity fluctuates from 4 g water

vapor/kg dry air in the winter to 10 g/kg in the summer, and this is the single most important factor impacting inside humidity levels. Through the movement of air, the change in external humidity is conveyed to the houses. In the winter, the frigid exterior air is warmed to roughly 20°C, resulting in low relative humidity in the inside air. There are distinct concerns during the summer, as the hot damp air is only slightly heated as it enters the dwellings, resulting in a high relative humidity level in the inside air. Due to the significant variations in outside humidity caused by seasonal change and geographic location, this results in extreme variations in internal humidity (Nielsen et al., 2007).

Epidemiological study has shown a relationship between outside humidity and the spread of house dust mites, and it has been established that external humidity, which varies according to climatic zone and elevation, is associated with house dust mite dispersal. The most humid areas are home to a far greater number of mites (Heidi Ormstad, 2000).

The mite population is proportional to the internal humidity level, which is influenced by seasonal changes in external humidity. The highest concentration of mites is recorded during the seasons when the interior humidity level is highest. The changes in humidity levels amongst dwellings may be linked to the substantial differences in mite counts between households in the same region at the same time of year. Apart from the correlation involving relative humidity and the quantity of house dust mites, some study indicates that there is a minimum level of moisture content, comparable to 45 percent at 20-25°C, below which house dust mites would not proliferate (Schroer & Aalberse, 2018). House dust mites will sometimes emerge in dwellings with fewer than 7 g water vapor/kg dry air or less than 10 mites/0.1 g dust. Thus, according to long-term studies conducted on a large number of houses well over the period of a year, the degree of humidity in winter was a critical factor in the year-round manifestation of house dust mites. One possible

reason for this effect would be that, even if house dust mites are removed during the dry winter period, the moist summertime is just too brief for house dust mites to establish a home base (Singh & Hays, 2016). Even during the humid summertime, if the humidity level is maintained below 7 g/kg during the winter, the residence will maintain a low mite population throughout the year. There appears to be a complete consensus that the most critical factor affecting mite occurrence is the humidity level in a residence. Additionally, the minimum humidity limit of 7 g/kg, under which house dust mites cannot reproduce, is generally recognized. Additionally, if the moisture and internal water vapor production are known, the minimum airflow required to keep the interior humidity below 7 g/kg may be calculated. For Denmark's climate conditions, the minimum ventilation need is one air movement for every hour throughout the day (Yang, 2001).

Chapter 04

House Dust Mites and Allergy

Exposure to indoor dust mites is a prevalent chronic condition with a significant social and economic burden. One percent of the population in Denmark is impacted. Moreover, there seems to be considerable heterogeneity in the incidence of sensitivity to dwelling dust mites, particularly corresponding to a considerable difference in the dispersal of house dust mites. Observational studies indicate a dose-effect relationship exists connecting exposure to household dust mites and the proportionate risk of acquiring a household dust mite sensitivity in a single person (Akkoc et al., 2011). According to many studies, the degree of sickness in persons who are allergic to house dust mites is based on their overall exposure to house dust mites in their household. The prevalence of household dust mite allergies in children was evaluated in many geographically distinct regions. One area was classed as humid, with comparable internal humidity over 50% for at minimum four months each year, while the another was categorized as dry, with roughly similar indoor humidity above 50% for no more than two months each year. A tuberculin skin prick test for Dermatophagoides pteronyssinus was detected in 40% of children with respiratory symptoms in a moist region, but just 2% in a dry climate. Comparable research conducted in Australia examined the prevalence of a positive skin prick test for house dust mites among children in two geographic areas (M. Akdis & Akdis, 2009).

Dust mites are microscopic insect-like parasites that create some of the most common indoor allergens, which may trigger allergic reactions and asthma in a large number of people. Households may host hundreds of millions of dust mites in their mattresses, pillows, upholstered furniture, mats, and draperies. They feed on decomposing human skin cells found in the dust. Dust mites are

parasitic insects that are incapable of biting, stinging, or penetrating human skin. Their fecal pellets and corpse fragments are the basis of the allergy. Dust mites may be found almost everywhere; in the United States, a maximum of one mattress in about four in five homes has dust mite allergen. Mites are one of the most prevalent household allergens for people with allergic rhinitis. Apart from the case of pet allergies, house dust allergens are hardly ever airborne. They cling to molecules that are too large to remain suspended in the air for a longer duration. Dust mite allergens easily settle into dust or nesting materials such as cushions, mattresses, or soft furnishings. Dust mite allergens are most frequently exposed during sleep and whenever dust is stirred up throughout bedmaking or other activities (C. A. Akdis, 2012).

Individuals with asthma and those who are allergic or especially susceptible to mites may have significant health effects if they are regularly exposed to dust mites at home. Furthermore, allergic rhinitis is really the immune system's response to specific allergens. Dust mite allergies may vary from mild to severe. A mild case may cause difficulty breathing, watery eyes, and occasional sneezing. In severe situations, the condition is persistent, resulting in frequent sneezing, coughing, congestion, facial pressure, or a frequent asthma attack. Individuals with asthma who are allergic to mites are more prone to have asthma flare-ups or attacks. Dust mite allergies and asthma caused by them demand a dust mite decrease in the house. Dust mites are particularly prevalent in older houses, residences located in humid locations, low-income housing, and residences with a moldy or mildewy stench (M. Akdis & Akdis, 2009).

Chapter 05

Global Impact of HDM

House dust mite allergens (HDMs) are perhaps the most prevalent source of allergens in respiratory allergies (asthma and allergic rhinitis (AR)). Persistent diseases affect considerably above 400 million people worldwide, despite substantial regional and periodic diversity in exposures. While HDM-induced bronchial sensitivities are uncommon, their severity fluctuates over time as indoor HDM colonies and allergen contents decrease or rise in response to changes in climatic factors or the family environment (Demoly et al., 2020). Patients with HDM allergy who have had an allergist frequently present with a modest disease profile, which is characterized by a high degree of polysensitization and (perhaps) polyallergy. Including a retrospective study, almost 60% of HDM-allergic patients receiving allergen immunotherapy in France were polysensitized, and nearly half developed asthma. Furthermore, 56% of 1212 HDM-allergic patients shown in a proactive, prospective, multicenter, cross-sectional research in France between 2013 and 2014 were polysensitized, with nearly half having asthma. In France, a survey of 1212 patients allergic to HDM (mean lifespan: 20 years; 50% females) screened for allergen AIT discovered that 42% developed asthma. In a similar vein, an Italian study of HDM-allergic, AIT-eligible individuals revealed a 41% incidence of asthma (Calderón et al., 2015).

The fact that individuals allergic to grass pollen visit a physician but not those allergic to HDM demonstrates the complexity and severity of HDM allergy. Only a few comprehensive research have attempted to unravel the complexities of the illness profile associated with HDM bronchial allergies. Changes in the strength of HDM-induced sensations were observed over a one-year timeframe in a continuous, solitary investigation done in Sydney (Australia). The experiment was

completed by 37 participants. During 65 percent of the 12-month trial period, the scientists noticed pathologically high basal levels of perceived. The intensity assessments of the nasal passages were utilized to predict the usage of nasal medicines (Bousquet et al., 2007).

Chapter 06

Physiological Conditions Associated with HDM

Allergic rhinitis is caused by house dust allergens, which means that dust mite allergy symptoms persist year-round. Due to the fact that dust mites live in cushions, bedspreads, couches, and comforters, ailments are also much more likely to manifest throughout sleep and shortly after waking. Symptoms of dust mite allergies include sneezing, rhinorrhea, allergic conjunctivitis, nasal stuffiness, and irritated nose, throat, and face. Tiredness, sickness, and sleep difficulties are induced, among many other things, by shortness of breath, coughing, or wheezing (Thomas et al., 2010).

Additionally, the accompanying symptoms develop if a dust mite allergy triggers asthma: dyspnea, breathlessness or soreness, gasping for air all through exhalation; people are more probable to cultivate dust mite allergies when they have comorbidities, such as a family background of the young person or childhood allergy; excessive house dust exposed; cross-reactivity could also outcome in the progress of allergies to specific foods, including such shellfish or mollusks (Fern).

Sleeping patterns may suffer after an extended period of being hypersensitive to dust mites. Exhaustion, daytime lack of energy, challenges focusing at work, decreased vocational or academic achievement, truancy, interpersonal difficulties, mental illnesses, unappealing physical features (dark circles under the eyes, redness, swelling), fear of participating in sports, and other physically and mentally obstacles are all prevalent between all of people with allergies (Sharma et al., 2011).

Thus according to a study, production loss due to seasonal allergies (about 20%) has a substantial impact on health and society, especially as allergy prevalence grows; up to 30% of the aged suffer from allergic rhinitis. The consequences of seasonal allergies such as rhinitis as well as rhinoconjunctivitis on adolescents may be different than on grownups, and they'll have a significant influence on academic performance and everyday activities. Without treatment for dust-mite allergies, individuals do not grow desensitized; on the contrary, they become more sensitive. Our allergy can increase and become more pervasive in your everyday life, making it more difficult to eliminate. Moreover, if the allergy is just not effectively controlled, this could progress to asthma. As a result, it is critical to detect and treat allergic rhinitis early (Lou et al., 2020).

Nevertheless, prolonged symptoms of asthma may well have a negative impact on the lungs in the long run. Whether we have asthmatic as a consequence of an allergic reaction to dust mites, our airways may be inflamed even when we are not having an episode. It is inadequate to cure asthma attacks as they occur; a successful asthma treatment strategy maintains control of sensations and avoids irreversible respiratory damages (Nelson et al., 2012).

Chapter 07

Different Ways of Diagnosing HDM

The physician is prompted to do additional testing for the identification of dust mite allergy by current signs, previous medical background of allergic reactions, living environment, and situations.

7.1 In Vivo Tests

Due to the great sensitivity of the skin prick test, it is used as the first diagnostic test for dust-mite allergy sensitivities. Nevertheless, it is a quick and inexpensive test that produces findings in less than 20 minutes. Cross-reactivity, but on the other side, may result in a high percentage of falsified outcomes. It is not recommended for individuals with eczema or those who take antihistamines. Patch tester for atopic dermatitis It quantifies the allergic reaction mediated by T cells. The basophil activation test (BAT) is a quantifiable technique for detecting stimulating indications here on the basophil periphery in all of the blood. This test may be administered to individuals who already have taken antihistamines. Furthermore, it illustrates the response's efficacy. Unfortunately, the findings may be contradictory due to the wide diversity of professional testing equipment and methodologies employed. Examining the nose as a stimulus. It analyzes and assesses house dust allergen's clinical significance. To assess physical illness, the dust mite allergen is injected into the respiratory mucosa. As a consequence, utilizing frontal rhinomanometry and auditory rhinometry, and even an IgE blood test, the variations in nasal airflow and frequency are clearly shown (Yang, 2001).

7.2 In Vitro Tests

ELISA is an abbreviation for enzyme-linked immunosorbent assay. It is a kind of immunoassay wherein the enzymes are utilized (ELISA). It is proficient in detecting simultaneously total and selective IgE content. When considering IgE cross-reactivity, a competitive ELISA may be utilized. The primary disadvantage is that ELISA can always be utilized to quantify a variety of food allergies thoroughly. A radio allergen high sorption test is a technique for detecting allergies in the air (RAST). This has an in vitro test for determining IgE concentrations. The allergen-specific IgE through a person's blood is fixed on a solid substrate and afterward detected using radiolabeled anti-IgE antibodies. Their usage has indeed been curtailed owing to the accessibility of other procedures such as ELISA (Kazemi-Shirazi et al., 2002).

Microarrays. It is feasible to recognize multiple antigens on a single slide. ImmunoCAP ISAC tests can be performed in both single-plex (ImmunoCAP) and multiplex (ImmunoCAP ISAC) formats. ImmunoCAP immunosorbent allergen chip (ISAC) is a regularly utilized microarray for evaluating an individual's overall susceptibility profile to allergens. A MeDALL chip, which is capable of detecting IgE and IgG reactivity profiles to over 170 allergens, is a less expensive alternative to a microarray, although this is still being explored. Owing to the high cost and availability of such tests in only major hospitals, techniques can be used to assess dust mite allergy sensitivity at the point of treatment. Moreover, fluoroenzyme-based immunoassays are used (Li et al., 2018).

7.3 Diagnosis of asthma

The PEFR is more than or equal to 200 L per minute in persistent asthma; between 80 and 200 L per minute in intermediate asthma; and much less than 80 L per minute in severe asthma.

Spirometry and the methacholine challenge test are employed in the lack of acute asthma. A decrease in FEV1 of less than 20% after methacholine administration is indicative of asthma. Acute asthma is controlled using beta-agonists breathed into the lungs, including notable salbutamol. Whenever the FEV1 rises by far more than 12%, asthma is diagnosed. Asthmatics who were exposed to home dust mites had a lower FEV1/FVC proportion than asthmatics who were not medicated (Bousquet et al., 2007).

To quantify dust mite allergens in the home, immunochemical procedures including RAST inhibition, sandwich radio or enzyme immunoassays, or MAb tests could be used. Nevertheless, their usefulness is limited by the need for skilled laboratory personnel and complex equipment (Jaén et al., 2002).

Chapter 08

Factors That Trigger Dust Allergy in Human

Dust mites, more commonly described as mattress mites, are by far the most prevalent cause of allergic reactions to home dust. Dust mites flourish in humid, damp environments and reproduce quickly. They prefer conditions between 70 and 80 degrees Fahrenheit as well as relative humidity of 75 to 80 percent. Since they perish whenever the relative humidity goes under 50%. They are rarely seen in arid environments. Dust mites are frequently found in cushions, beds, carpets, and soft furnishings especially. They fly into the air and settle soon after when someone vacuums, walks on a carpet or disturbs bedding. Dust mites are commonly the reason for a child's respiratory problems (Singh & Hays, 2016).

Even though the house does not seem to be filthy, a dust mite allergic reaction may occur. Nanoparticles are undetectable and often difficult to remove using standard cleaning methods. Furthermore, professional cleaning may aggravate the complaints of a sensitive person (Carnés et al., 2017).

Cockroaches are found in a broad variety of structures and environments. Certain persons are allergic to cockroaches. Cockroach nanoparticles are a typical component of home dirt and they may actually be the cause of a dust allergy. Mold is a fungus that produces spores that spread through the air. If those who are susceptible to mold breathe the spores, they will experience allergic responses. Mold manifests itself in a variety of ways, some apparent and some not. Mold grows on decaying leaves and logs, including in wet areas such as bathrooms and kitchens. Mold spores and tiny mold granules are commonly involved in home dust and they may play a role in the development of a dust allergy (Nagata, 2019). Trees, grasses, flowers, and weeds all generate

pollen. Pollens exist in a variety of forms and may elicit allergic reactions in people. For instance, some people are hypersensitive to pollen from beech trees, while others are exclusively sensitive to an allergen from specific grass species. Pollen is a frequent component of home dust and could be the source of the sensitivity to dust (Pittner et al., 2004).

Dogs may damage people with allergies in a variety of ways. Their dander (skin flakes), spit, and urine all have the potential to cause allergic reactions, particularly when mixed with home dust. In houses with birds, hairs and bird droppings may become lodged inside the dust, causing health dangers to people who are allergic to them (Jovanovic et al., 2003).

Chapter 09

Different Medicines Applied to Treat Dust Allergies in Human

The very first line of defense towards dust mite sensitivities is complete avoidance. We may experience fewer or lesser allergy responses if we limit our exposure to dust mites. Unfortunately, completely eliminating dust mites from our surroundings is challenging. Medicines may be required to alleviate our symptoms (Huss et al., 2001).

Antihistamines inhibit the immune system's production of a substance involved in allergic reactions. Different medications exist to alleviate itching, sneezing, and a runny nose. Antihistamine pills including fexofenadine (Allegra Allergy), loratadine, and cetirizine, as well as antihistamine syrups for kids, are obtainable without a prescription. Azelastine and olopatadine are two nasal spray antihistamines. Nasal corticosteroids can assist in decreasing irritation and controlling seasonal allergies. Fluticasone propionate, mometasone furoate, triamcinolone, and ciclesonide are among such medications. Compared to oral corticosteroids, nasal corticosteroids provide the drug in a considerably lower dosage with a significantly decreased risk of adverse effects. Decongestants work by restricting the bloated nasal channel tissues, enabling us to breathe more freely via our noses. Some OTC allergy treatments include a combination of antihistamines and decongestants. Oral decongestants may increase the blood level to increase if you have severe hypertension, glaucoma, or a cardiovascular illness. Men using the drug may experience increased symptoms of an expanded prostate (Zhltikova et al., 1987).

Decongestants, especially nasal sprays, are available over the counter and may give brief alleviation from allergies. Using a decongestant spray for more than three consecutive days, on the

other hand, may worsen a runny nose. Stabilizers of leukotrienes decrease the action of several immune system components. Montelukast, a tablet-based leukotriene modulator, may be prescribed by doctors. Montelukast has been associated with upper respiratory infections, headaches, and fever. As a consequence of the drug, behavioral or depressive disorders like anxiety or sadness are much less probable to arise (Zhltikova et al., 1985).

Chapter 10

Immunotherapy in Allergy Treatment

Immunotherapy is a type of medication that helps people prevent hypersensitivity to allergens such as pollen, house dust mites, and insect stings. Immunotherapy is a technique wherein the dosage of the chemical, or allergen, to which the patient is allergic is progressively increased. The immune system becomes less susceptible to the allergen as the dose increases, quite probably through stimulating the creation of an "impending" antibody that assuages allergy symptoms if the chemical is met repeatedly. By lowering inflammation, immunotherapy may also be effective in the treatments of rhinitis and asthma. The allergist as well as the patient collaborate to identify allergy trigger factors prior to commencing therapy. Skin or blood tests are used to verify specific allergens the person has developed antibodies towards. Immunotherapy is often prescribed only when an individual is sensitive to a high number of allergens in fast succession (Fernández-Caldas et al., 2014).

Allergen immunotherapy is a kind of medication that is utilized to treat allergic reactions. This treatment involves exposing the individual to an allergen in escalating doses. This aids in the development of allergy tolerance. Allergen immunotherapy reduces or eliminates seasonal allergies by progressively increasing the quantity of allergen administered to a patient's immune system. It is continued until the patient achieves a stable level. Generally, resistance to the allergen persists the following therapy. On the other hand, the rate at which lengthy reactions occur differs according to the individual (Cai et al., 2019).

Immunotherapy for environmental allergens has been shown to be beneficial in the following circumstances: pollen allergies, most noticeably grass allergies, but also ragweed allergies, mold

allergies, animal dander allergies, most notable immunotherapy for cat and dog allergies, and house dust mite allergies. Allergies to bug stings and cockroaches Immunotherapy may help prevent future allergies in conjunction with treating seasonal allergies. This may help prevent or stop the progression of allergy illnesses such as hay fever, eczema, and asthma. It may help control asthma attacks by reducing the inflammatory response that results in them (Liu et al., 2021).

The types of immunotherapy choices available to us are determined by the allergen. Actually, environmental allergen immunotherapy is available in two forms: allergy injections and under-the-tongue pills. Subcutaneous immunotherapy, or SCIT for short, is another word for allergy injections. They are the most well-known kind of immunotherapy for allergic reactions to outdoor stimuli. Numerous allergens are often mixed in a single injection. This adds to the development of sensitivity to many allergens concurrently. Injections are administered once or twice a week in the office of a board-certified allergist. This strategy usually lasts between six and twelve months (Demoly et al., 2020).

10.1 Sublingual Immunotherapy in Dust Allergies

Sublingual immunotherapy (SLIT) has been used in the United States since the mid-1800s. Throughout the last 3 decades, thorough studies have established indisputably that this meditation technique is an effective, efficient, and safe method of immunotherapy delivery. The reliability of SLIT is one of its most noticeable properties. SCIT is very well for eliciting local arm responses as well as moderate to severe systemic effects (Wilson et al., 2005). Allergy shot treatment is comprised of two components. Typically, increasing volumes of allergen extract are given during the early phase. After that, injections are administered about once a month throughout the recovery process. While allergy injections are quite efficient in treating allergic rhinitis, adhering to a

regimen may be challenging. Symptoms of a local allergic response, including such swelling and pain at the injection site, are also prevalent (Jaén et al., 2002). Sublingual immunotherapy (SLIT) allergy pills are a unique kind of allergy immunotherapy that was recently licensed in the United States. Rather than injections, allergy tablets frequently deliver allergens sublingually in the shape of a liquid or tablet. SLIT (allergy tablets) is comparable to SCIT in regards to symptomatic alleviation, and both have been found to offer long-term relief even after therapy is done. Meanwhile, the medication is only active against the allergen included in SCIT or allergy pills. Ragweed tablets/shots might be effective for treating ragweed symptoms only if the individual is both ragweed and tree sensitive. Due to the superior tolerability of allergy pills compared to SCIT, the first dosage would not need to be provided in a medical environment. The FDA-approved content information for the four SLIT pills, nevertheless, includes an alert about the possibility of severe allergic reactions to SLIT, and even a recommendation that patients taking allergy medications to be provided with an epinephrine autoinjector in the event of a severe allergic reaction (Radulovic et al., 2011).

SLIT is not without flaws. Adverse Outcomes are responses to SLIT that occur during its administration (AEs). These responses are often described in the literature as moderate and self-resolving. In the bulk of datasets, these adverse occurrences are infrequent. There really are no reported fatalities associated with SLIT. Only a few serious responses to SLIT administration have been observed, including individuals who had difficulty breathing episodes and required hospitalization. Sneezing, itchy/watery eyes, itchy/runny nose, and congestion are all signs of rhinitis or seasonal allergies. For millions of patients, antihistamines and nasal corticosteroid medications provide temporary relief. For the remainder of the population, allergy injections (a.k.a. SCIT or subcutaneous immunotherapy) is a long-term standard treatment (Wilson et al., 2005).

10.2 Subcutaneous Immunotherapy in Dust Allergies

Immunotherapy for allergic disease comprises the administration of an allergen to which the patient is allergic in order to alleviate allergy symptoms by modulating the antigen's adverse autoimmune response. Immunotherapy is the only medication that tackles the aberrant autoimmune response that underlying allergic disease. SCIT (subcutaneous immunotherapy) is a very effective form of this therapy. SCIT also examines other allergens, such as venoms or food allergies. Separate sections are devoted to oral and sublingual immunotherapy, rush immunotherapy, mechanism of action, and allergen extract synthesis (Liu et al., 2021).

SCIT may be administered in the traditional, cluster, or rush format. Traditionally, SCIT involves weekly injections of the allergen at increasing concentrations until a maintenance dose is attained, at which point injections are administered every four weeks. In a cluster schedule, many injections, often 2–3, are given on nonconsecutive days, but in a rush protocol, multiple injections are given on consecutive days, enabling the patient to achieve stability in 1–3 days. In contrast to SCIT, SLIT's safety profile enables it to be given with a brief or no build-up period. After 3–4 years of treatment, studies utilizing SCIT have shown lasting remission; hence, a typical immunotherapy process lasts 3–5 years. Three years of SCIT may be sufficient for asthmatic children, since a prospective study found no significant therapeutic advantage from adding two years of SCIT, including changes in asthma symptoms, ICS dose, quality of life, or bronchial hyperreactivity. SLIT, on the other hand, had a comparable effect, with sustained remission lasting 7–8 years following 3–5 years of treatment for allergic rhinitis caused by house dust mites. The severity of the illness, the benefits of treatment, and the ease of treatment all play a role in the decision to terminate or extend immunotherapy (Calderon et al., 2007).

Chapter 11

Mechanism of Action of Immunotherapy Against Allergic Reactions

The immune system interacts within tissues as well as takes decisions in response to signals involving local tissue cells, infectious pathogens, symbiotic microorganisms, and then almost as any outside input. The contemporary study has concentrated on a variety of topics in order to provide fresh insights on how the immune system unwillingly accepts allergens and also on how allergic illnesses must be adequately handled. Immunological tolerance formation has proven to be a prominent technique for avoiding and curing a variety of disorders associated with immune system dysfunction. AIT is now utilized subcutaneously or sublingually in kids and adults to manage pollen, pet dander, house dust mite, and venom allergies. It has been said to be useful in the treatment of rhinoconjunctivitis and both acute and chronic asthma. AIT's disease-modifying properties result in lower pathogenicity, reduced medicine use, prevention of subsequent allergen sensitizations, and a long-term curative benefit. The fundamental objective of studies into the development of innovative vaccines and AIT treatment schemes is to optimize safety while maintaining or even improving effectiveness (C. A. Akdis & Akdis, 2011). Immune adaptation to allergens is defined as the formation of long-term clinical resistance to allergens, that immunologically entails changes in memory T and B cell responses, as well as mast cell and basophil activation thresholds, because then allergens no more elicit allergy symptoms. Immune tolerance also has therapeutic implications in terms of stopping recurrent allergen sensitizations and escalation to more severe illness, such as the formation of asthma as a consequence of allergic rhinitis or anaphylaxis (Yang, 2001). Many more therapies are currently being investigated in try to enhance effectiveness, reduce adverse effects, shorten treatment durations, and enhance patient

participation. Innovative strategies such as externally given AIT and the combination of grass pollen allergen peptides with the hepatitis B virus Pre-S protein, peptide immunotherapy using short and intermediate T cell epitope peptides, and intratympanic immunotherapy are currently being studied. Further research is being conducted to ascertain prophylactic use. Numerous efforts have been made to enhance and standardize traditional subcutaneous and sublingual AITs, as well as oral immunotherapy for food intolerances, spanning the spectrum from individual screening via vaccine administration and medication regimens (Matsui & Eggleston, 2016).

The immunologic foundation of allergic diseases may be divided into two stages: sensitization and formation of memory T and B cells, as well as IgE synthesis (early phase), and downstream activities involved in tissue inflammation and damage (late phase) (C. A. Akdis, 2006). Sensitization requires the development and clonal expansion of allergen-specific CD4+ Th2 cells that release IL-4 and IL-13 in order to induce B cells to switch to the immunoglobulin heavy chain and manufacture allergen-specific IgE antibodies. Sensitization occurs when allergen-specific IgE binds to the enhanced FcRI on the surface of mast cells and basophils. When sensitized basophils and mast cells' IgE-FcRI complexes are cross-linked, they get triggered and release anaphylactogenic mediators, leading to the characteristic acute phase symptoms (type 1 hypersensitivity) (Yang, 2001).

Although years of AIT are necessary to decrease IgE antibody levels and IgE-mediated skin sensitivity, the majority of patients are protected from bee stings or withstand skin later phase response difficulties during the early phases of their specific venom or grass pollen SITs (M. Akdis & Akdis, 2014). A quick reduction in mast cell and basophil activity associated with degranulation and systemic anaphylaxis is a vital finding that should begin with the first injection. There is indeed a shortage of evidence on the mechanisms through which AIT modulates and/or inhibits basophil

and mast cell immune responses, particularly when escalating allergen dosages are frequently delivered during the initial hours. Although AIT seems to have a desensitizing effect comparable to the quick reduction in drug allergy reactions, the mechanism by which AIT sensitizes remains unexplained. Autoimmune desensitization to antigens was shown to be a major fundamental mechanism of acute oral desensitization in mice. AIT and sting challenges induce the release of anaphylaxis mediators (histamine and leukotrienes) without triggering a widespread anaphylactic reaction (C. A. Akdis et al., 2006). While diminished mediator discharge from mast cells and basophils is a well-documented feature early after the beginning of AIT, their piecemeal release below the threshold of systemic anaphylaxis may lower mediator granule content and also alter these cells' activation thresholds. Histamine is a significant soluble component that responder cells release in response to allergen stimulation, and it acts through histamine receptors (HRs). H1-4 signifies the four distinct human HR subtypes found so far (Akkoc et al., 2011). Both the pattern of HR expression and differences in the degree of expression of a single HR type impact the nature of the immunological response. H1R has been linked to the adenylate cyclase and phosphoinositide second messenger systems and is believed to be involved in tolerogenic immune responses, whereas H2R has been linked to the adenylate cyclase and phosphoinositide second messenger systems and is believed to be involved in tolerogenic immune responses. While there are individual variances and dangers of developing systemic anaphylaxis during AIT, other immunological factors such as the formation of allergen-specific Treg cells and lower specific IgE continue to have an effect on mast cell and basophil suppression. Researchers identified considerably increased tryptophan breakdown and increased human Ig receptor inhibitory transcript (ILT4) expression in monocytes after a few hours of the initial injection on day 1 (Fig 2), indicating rather early alterations. Additionally, improvement in basophil sensitivity early in the course of grass

pollen immunotherapy is predictive of illness alleviation. Additionally, basophil diamine oxidase expression is significantly elevated during AIT (Fig 2), suggesting that it might be used as a biomarker for allergen immunotherapy efficacy (Yang, 2001).

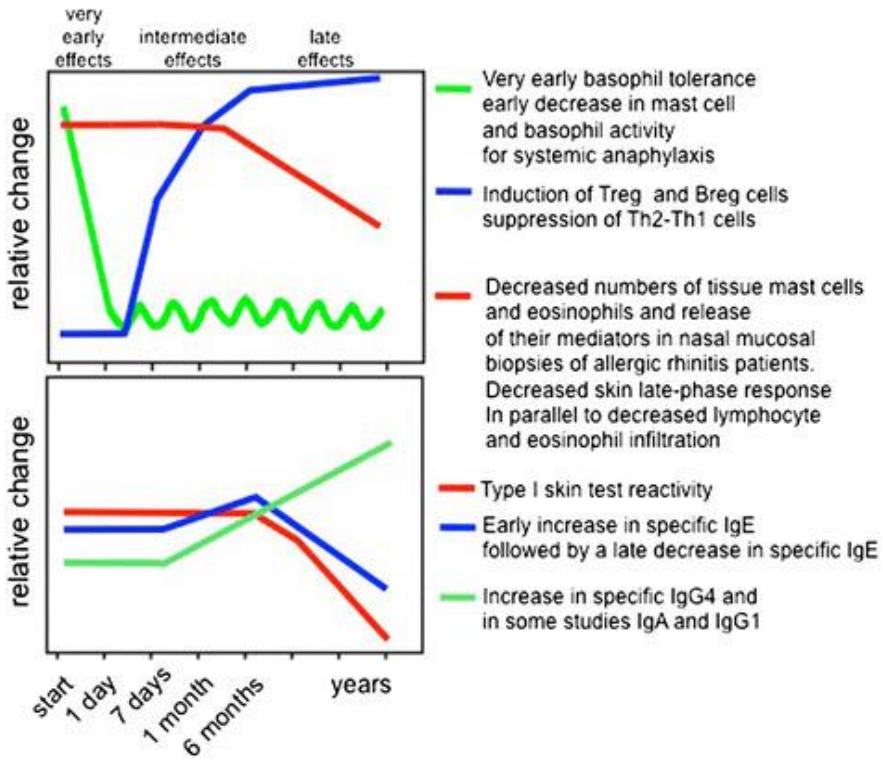

Figure 2- Immunologic changes during the course of AIT (C. A. Akdis & Akdis, 2015)

Chapter 12

Statistical Data of Dust Allergy Patients and House Dust Mites

The study focused exclusively on soft cell mites found in home dust samples. Approximately 150 Assam-based atopic individuals were surveyed about their age, gender, symptoms, living circumstances, as well as other factors. The study involved patients from a variety of social backgrounds, ages, and sexes. 47% of people lived in RCC buildings (concrete walls, floors, and roofs), 39% in Assam structures (semi-RCC constructions with tin metallic element roof tiles), 13% in bamboo huts, and 7% in wood dwellings. Men made up 73% of the individuals chosen, while women made up 27%. This research included only individuals with a background of allergy disorders (i.e., respiratory and skin allergic diseases). After validating their medical data, participants were identified and classified. Due to concerns about some allergy verification reports, all of the chosen individuals were classified as probable allergic patients (Huss et al., 2001).

500 milligrams (500 mg) of interior home dust was gathered from the chosen patient's ground and beds. Owing to the reduced frequency with which hoovers are utilized in a significant variety of neighborhood houses, dust samples were collected. People suffering were told to refrain from cleaning their floors or relaxing mattresses for two days during the dust sample collection. The samples were gathered in a Tupperware box that had been autoclaved. To remove debris and fibers debris from the dust, a 300-mess brass filter with a 6 mm diameter was used. Mites were physically scraped from a dust sample using a brass paintbrush. After 24 hours of immersion in 50% lactic acid, isolated mites became transparent (Courtioux & Boudot, 2021). After that, they were put in the center of a glass slide along with a drop of melted glycerin jelly. The existence of house dust mites was discovered by microscopic inspection. Mites were classified according to their genus,

species, and gender. Dust mites were found in the house using reference slides and published research. Around 48.6 percent of respondents report having the worst pollen allergies in the winter, whereas 21.4 percent report having the worst effects in the summer. Despite this, 25.7 percent of patients reported having an adverse reaction at any time of year (Sharma et al., 2011).

In general, 50% of those surveyed on interior mites were between the ages of 30 and 50, 31% were between the ages of 30 and 30, and 20% were above the age of 50. 73% of responders were masculine, while 27% were feminine. Around 60% of individuals were stated to already have respiratory allergy diseases, whereas 40% had allergy symptoms (including dermal, ocular, etc.) Mite populations greater than 50 per 500 mg dust were detected in dust samples taken from 57% of Assam houses. Approximately one-seventh of them included dust with a population of more than 100/500 mg. Patients 118 (204.0/500 mg), 31 (187.0/500 mg), 13 (152.0/500 mg), and 39 (122.0/500 mg) exhibited the highest mite colony counts in their respective dust samples, trailed by patients 31 (187.0/500 mg), 13 (152.0/500 mg), and 39 (122.0/500 mg) (Sharma et al., 2011). Nevertheless, the bulk of residences analyzed emit an average of 4–5 g of dust each day. When the samples were grouped by housing type, it was observed that samples taken from RCC structures had the highest mite population (46%), followed by those taken from Assam semi-RCC constructions (36 percent). The dust sample taken from a wooden home had the fewest organisms. Acarus, Blomia, Cheyletus, and Dermatophagoides were the most often identified genera in RCC-style structures, while Acarus and Dermatophagoides were the most frequently detected genera in Assam-style structures. Acarus, Blomia, and Cheyletus were discovered in the bamboo dwelling, whereas Acarus and Dermatophagoides were discovered in the wooden dwelling. When samples from bamboo and wooden dwellings were compared to those from other types of housing, huge clusters of hard cell dust mites were seen.

Table 1- Statistical Data of Dust Allergy Patients and House Dust Mites (Adapted from (Sharma et al., 2011))

Age group (Years)	**No. of Patients (%)**		**Allergic symptoms (%)**	**Dust mites recorded**		
	Male	Female		Male	Female	Unidentified sex
1–30	36	7	27	936	810	834
>30–50	55	22	45	1116	751	795
>50	18	11	18	875	547	887

Table 2- Percentage of Patient, Mite Population and Dominant Genus of The House Mites (Adapted from Sharma et al., 2011)

House type	**No. of patients (%)**	**Mites' population**	**Dominant genus**
RCC	69	3574	*Acarus, Blomia, Cheyletus, Dermatophagoides*
Assam Type	55	2848	*Acarus, Dermatophagoides*
Bamboo house	17	786	*Acarus, Blomia, Cheyletus*
Wooden house	9	343	*Acarus, Dermatophagoides*

Chapter 12

Discussion

Contact with household dust allergens, mostly from household mites, is a primary source of allergic reactions in sensitive people with asthma. Across the globe, in every 50 households, at least 10 had a person with bronchial asthma, most notably a kid (aged 4–17 years). The most often encountered species included Dermatophagoides pteronyssinus (60 percent of the total count) and Dermatophagoides farinae (32 percent). Pyroglyphids were found in 68% of mite samples, whereas nonpyroglyphids such as glycyphagids, cheyletids, and gamasids were found in 35% of the data. The statistics indicate a link between frequency of various mite species (per gram of dust) as well as the relevant interior/exterior conditions: pets, population, coal stoves for heat, frequent washing, elevated moisture levels, flowers, and even PVC windows (Akinfenwa et al., 2021). D. farinae counts, total household mite counts, and live mites per gram of dust seem to be linked with symptom severity. In developed countries, the prevalence of atopic allergies has grown. There seems to be emerging proof that home dust is one of the most prevalent allergens inhaled by people, causing allergy illness. Allergens in household dust are a common source of allergy responses in hypersensitive asthmatic patients. Domestic mites are by far the most allergenic component of home dust, and their concentration is influenced by a variety of biotic and abiotic elements in the indoor environment. House dust mites of the Pyroglyphidae family are believed to become the most common allergen in indoor environments. The principal allergen origins in home dust have indeed been recognized as Dermatophagoides pteronyssinus, Dermatophagoides farinae, and Euroglyphus maynei (Dahl et al., 2006).

Respiratory system illnesses, particularly asthma, are mostly caused by allergens existing in a restricted area. D. farinae is the most widespread mite species found in Polish homes, where it flourishes at relative humidity levels of 70–75 percent and temperatures of 23–30 degrees Celsius. Between 40% and 45%, relative humidity is the essential threshold for mite survival (RH). As a result, installing devices that reduce indoor humidity has been recommended as a strategy to reduce the quantity of dust mites in the house. Furthermore, it has been proposed that internal atmospheric factors have a role in the formation of allergy disorders characterized by respiratory symptoms, including atopic asthma. For instance, wet housing encourages the invasion of domestic dust mites, which increases the risk of sensitization and the onset of allergy illnesses (Köberlein & Mösges, 2013).

House dust mite sensitization is indeed a significant independent danger factor for asthma and other allergy illnesses such as chronic rhinitis, atopic dermatitis, urticaria, and/or oculorhinitis. Conversely, the role of exposure (housing types) in the pathway leading from sensitization to asthma formation is less clear. Up to this time, around 15–20 published research from all across the globe have explored the association between household variables and mite allergen concentrations. Certain studies enrolled insufficient people to permit multivariate analysis, whereas others enrolled just asthma patients (Nelson et al., 2012). Despite the fact that household variable data differed greatly throughout the research and building materials and processes ranged significantly between countries, many similar themes emerged. It is critical to understand the circumstances in the home that lead to higher mite allergen levels in a public health environment (Durham & Riis, 2007). Numerous abiotic indoor atmospheric factors have been investigated in order to ascertain their influence on pyroglyphid dust-mite communities with the purpose of establishing managerial restricting criteria. Numerous recent studies have shown that a

considerable proportion of allergy patients newly diagnosed with asthma were exposed to severe indoor allergens. Furthermore, microscopic examination of mites recovered from dust gathered from patients' homes (flats, dwellings) revealed geographical diversity in mite recuperation and species identification (Lou et al., 2020).

In Poland, the first research studied the incidence of house dust mites in connection to different types of homes and interior environmental factors that may impact the progression of asthma in children and adolescents allergic to house dust mites. Pyroglyphid mites account for 60–90% of the residential dust acarofauna worldwide, including Poland. They are frequently encountered in mattresses, recliners, couches, and some other upholstered furniture, including in apparel, flooring, and carpeting. The two most widespread and numerous mite species detected in home dust globally are D. pteronyssinus and D. farinae4. Dust mites cannot survive relative humidity levels under 60% (or 55% for D. farinae) in experimental culture studies (Czerwiska et al., 2021). Various studies on household dust, on the other hand, advocate a lower relative humidity limit for dwellings of 45 percent at 20–25 °C. Mites dehydrate and die if the temperature falls below certain limits. But on the other side, other research shows that a 45 percent relative humidity inside the inside corresponds to a mite density of 100 or more mites per gram of dust (the danger of exposure to home dust mites). Dust mites are more resilient to absorption at lower temperatures since their Critical Equilibrium Activity (CEA) (or Critical Equilibrium Humidity—CEH) is largely reliant on and decreases increasing ambient air temperature. Dust mite colonies have also been detected in homes whenever the indoor humidity level goes below 65 percent for lengthy periods of time throughout each 24-hour period. D. farinae mites are less vulnerable to moisture loss at relative humidity values of 30–50% than D. pteronyssinus, which was almost missing first from analyzed samples. Several pyroglyphid dust mite species, most notably D. pteronys-sinus and D. farinae,

have a wide range of communities worldwide. Solarz and Pajk (2019) discovered that both the relative humidity and temperature of outside and interior air are major determinants of individual presence and frequency. The ideal temperature (25–30 °C) and relative humidity (50–75 percent RH) for D. farinae are stated to be greater (25–30 °C) and lesser (50–75 percent RH), respectively, than for D. pteronyssinus. The earlier is more adapted to dry conditions than otherwise. In combined laboratory cultures, lower temperatures (15–20 °C) and greater humidity (75–80% RH) promote D. pteronyssinus survival. D. pteronyssinus domination in dwellings seems to be widespread in several Polish areas. This tendency may also imply that some regions of the nation have a more humid environment. Internal environment ambient humidity, but on the other hand, changes according to the degree of ventilation in dwellings and is dependent on the construction of the structure. As a result, enclosing energy-efficient structures tends to raise relative humidity, perhaps raising dust mite populations (especially D. pteronyssinus). Glycyphagidae and Acaridae mites are considered to be substantially more desiccation-resistant than pyroglyphids. Furthermore, several house mites have been shown to flourish in extremely moist environments. Acarids, glycyphagids, and cheyletids are included in this group. As a result, the presence and quantity of these mites may be used to infer the existence of moist environments (Solarz et al., 2021).

By and large, these mites are less numerous and plentiful in Europe than those in the tropics. After evaluating the influence of various housing factors on dust mite counts (both biotic and abiotic), quite a few of them were found to have an effect on dust mite populations. These variables included the type of heating, the type of duvet, the age of the home furnishings, the type of bedding, carpets, soft furnishings, soft toys, the age of the house, the number of participants, the presence of pets, and floor warming. Subsequent research, however, has revealed a fragile or non-existent link

between these environmental factors and mite density. Contextual variables were found to be associated with a decline in allergy reactions in the kids whose residences were studied. A negative link between the severity of symptoms and the square footage of a flat, and therefore a positive correlation with the number of family members, may be explained by an increase in allergens (not only mites) under certain situations (James & Bernstein, 2017).

When inhalation allergens are present, allergen immunotherapy is one strategy for modulating TH2-directed immune responses and relieving allergy nasal and ocular symptoms (AIT). Actually, subcutaneous allergen immunotherapy (SCIT) and sublingual allergen immunotherapy (SLAI) seem to be the two principal AIT methods employed in clinical practice (SLIT). While both treatments have been demonstrated to be effective in alleviating symptoms and necessitating the use of emergency drugs, the potential of unexpected systemic responses upon injection is a serious patient safety issue (Makatsori & Calderon, 2014). Today's SCIT provides escalating doses of allergen extraction until an optimal maintenance dose' is identified inside the range of doses previously shown to be clinically efficacious for a specific treatment allergen. For years, this medication has been successfully utilized in clinical practice to treat patients with allergic rhinitis, allergic asthma, and hypersensitivity to stinging insects (Reich et al., 2011). 3 years of SCIT or SLIT with grass pollen has been proven to provide ongoing clinical improvement in allergic rhinitis for up to 2 years after treatment is discontinued. SCIT's advantages must always be evaluated against the genuine hazards of deadly anaphylaxis and uncommon but potentially catastrophic systemic allergic responses. From 1990 and 2001, a national study of allergists in North America revealed that such death reaction happened for each and every 2.5 million injection visits or an incidence of 3.4 fatal reactions each year. Unregulated asthma at the time of injection administration, dosing errors, insufficient or delayed epinephrine administration during

anaphylaxis, a prior history of injection-related systemic reactions, and injection administration during peak allergy seasons are all known risk factors for potentially fatal responses (Sánchez-Borges et al., 2020).

One other kind of immunotherapy utilized throughout Europe is SLIT, which is used by 50% of patients undergoing allergen immunotherapy. Whereas the FDA authorized SLIT tablet formulations lately, they are not as widely used in the United States as SCIT. In well-designed, double-blind, placebo-controlled studies, SLIT tablets significantly decreased both clinical signs scores and medication needs in individuals with seasonal allergic rhinitis caused by grass and ragweed pollen and nasal/ocular symptoms caused by home dust mites (HDM). In the United States, grass SLIT pills have been shown to be efficacious and useful in children, and investigation on the efficacy and safety of ragweed tablets in this group is now continuing (Moingeon & Mascarell, 2012).

SLIT has a safer profile than SCIT. Individuals who get SLIT seem to have a much-reduced probability of developing severe systemic responses than those who undergo SCIT. As per the WAO guidelines, 11 occurrences of nonfatal anaphylaxis have been reported out of 1 billion SLIT doses administered since 2000. On the basis of a comprehensive inspection. Seven unpleasant events occur for every 1000 SLIT doses, with only 0.056% of these responses being classed as serious (i.e., stomach discomfort, vomiting, urticaria, and uvular edema) (Thien, 2006). The most frequently observed SLIT adverse effects are those affecting the Oro mucosa or gastrointestinal system. These really are typically modest in character and manifest themselves more typically throughout the therapy build-up period. While lower gastrointestinal symptoms such as diarrhea, nausea, and stomach pain may signal modest critical approaches, the WAO advised that these symptoms be classed as local responses until more systemic indications are observed.

Notwithstanding the decreased incidence of systemic adverse events, 3% of patients cease medication due to regulatory responses, despite a 6% dropout rate in one placebo-controlled research (Nichani & De Carpentier, 2009).

SLIT was recently confirmed to be safe in individuals with seasonal and perennial allergic rhinitis in a series of major placebo-controlled trials. In a major study of children and adults given SLIT grass tablets for seasonal allergic rhinitis, local symptoms including throat irritation, oral pruritus or paresthesia, mouth edema, and ear pruritus were seen in 79 percent of the treated group. These were mostly temporary in character and self-resolving. Whereas severe anaphylaxis was not reported as a side consequence of medication in this study, 6% of patients quit owing to treatment-related local adverse effects (Adamic et al., 2009). In well-controlled asthmatics who participated in the documented clinical study, SLIT did not seem to increase the risk of ill effects. The frequency of adverse events was assessed in adult and pediatric patients just without reported asthma in a posthoc analysis of eight studies that included SLIT-tablet therapy for Timothy grass allergic rhinitis with or without conjunctivitis. In comparison to the general population, 24% of adult patients and 31% of pediatric patients had well-controlled, moderate asthma, with no higher risk of treatment-related side events. In a major double-blind placebo-controlled (DBPC) study, individuals with untreated HDM allergy-related asthma were randomly assigned to receive placebo or HDM SLIT-tablet treatment at two dose levels (six SQ-HDM or 12 SQ-HDM) in addition to inhaled corticosteroid (ICS) with salbutamol. ICS was progressively lowered and eventually withdrawn altogether throughout the last six months of the experiment (Corrigan, 2007). Between mild to severe asthma aggravation, patients who received active HDM SLIT-tablet therapy had a longer lifetime than those who received placebo during ICS decrease. The much more frequently reported side effects were mild to severe oral pruritus (13 percent in six SQ-HDM groups and 20%

in 12 SQ-HDM groups), mouth puffiness, and throat discomfort. No anaphylactic responses, systemic adverse reactions requiring epinephrine, or localized airway compromise occurred. Several patients who had major adverse effects all through the study were determined to have been caused by the treatment — arthralgia and moderate laryngeal edema in the six SQ-HDM groups, and mild asthma in the twelve SQ-HDM groups (Wang et al., 2021).

Regardless of the fact that it was not an aeroallergen, most patients with a history of stinging insect sensitivity tolerate subcutaneous immunotherapy with Hymenoptera venoms effectively. Patients with systemic macrocytosis who really are hypersensitive to venom have been found to have a significantly increased risk of severe systemic responses to both field stings and subcutaneous venom immunotherapy (VIT) injections, presenting significant concerns. It was observed that nine patients with epidermal macrocytosis and/or systemic macrocytosis could effectively execute a rapid VIT build-up program utilizing wasp venom (Panzner et al., 2008). One patient with cutaneous and indolent systemic macrocytosis demonstrated a widespread response to therapy during the up-dosing period. After a dosage modification, this patient was able to maintain an acceptable level of medication. As a result, the authors believe that while this kind of AIT may indeed be useful in individuals with cutaneous macrocytosis, caution should be used in individuals with general macrocytosis (Latysheva et al., 2021).

In comparison to wasp VIT injections, honeybee VIT injections are linked with a greater risk of systemic responses; nevertheless, the mechanisms behind this association remain unknown. To evaluate the constructed phase of ultra-rush honeybee VIT, one study examined the systemic response of 93 persons to immunological, patient-specific, and sting-specific parameters. Five of the thirteen individuals who had significant systemic symptoms terminated therapy. Severe systemic responses were predicted by the basophil authentication (CD63) test in patients with VIT;

a brief time gap between sting and onset of symptoms (less than 5 minutes) and low specific IgE to rApi m1 were also related with chronic inflammatory reactions. The authors recommended that basophil CD63 stimulation sensitivity be tested on a regular basis prior to honeybee VIT therapy in order to identify individuals at increased risk of systemic inflammatory responses (Gateman et al., 2021).

The ongoing advancement of both established and novel allergen immunotherapy techniques for the treatment of allergic disorders necessitates a thorough assessment of efficacy during clinical trials and post-marketing monitoring. Modern research has focused on the local and systemic consequences of SCIT and SLIT. In Europe and North America, self-administration of SLIT-tablet compositions with acceptable safety profiles is permitted. Preventing and treating severe AIT responses is important because it permits the introduction of quality-improvement initiatives in clinical care with the goal of lowering the future risk (Aue et al., 2021).

Chapter 13

Conclusion

Dust allergy is one of the most prevalent daily annoyances for a large number of individuals, particularly those who live in metropolitan areas. Due to housing forms and constructions, as well as a lack of dust management, there has been a noticeable rise in dust allergy sufferers. Each year, patients experience significant problems as a result of sinusitis, asthma, runny nose, headaches, and skin rashes caused by incorrect management of surroundings and a rise in the number of dust mites. Immunotherapy is a significant treatment option for dust allergies that, when combined with other synthetic medications such as antihistamines, may provide relief to individuals who suffer each year throughout seasonal changes.

Chapter 14

Future Work

House dust mite allergy is a widespread chronic disease with significant socioeconomic consequences. There is a considerable difference in the prevalence of allergy to house dust mites, which is comparable to the great diversity in house dust mite dispersion. Immunotherapy is a type of drug that helps patients prevent becoming hypersensitive to things like pollen, dust mites, and insect bites. Immunotherapy comprises gradually increasing dosages of the substance to which the patient is allergic. The development of immunotherapies in the future may be more beneficial to persons who are allergic to dust. It is critical to make immunotherapy more accessible to patients all across the world, as it is still a rarity in most third-world nations. It's critical to improve the efficacy of sublingual and subcutaneous immunotherapy since there are still certain side effects that raise doubts about its reliability.

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