

Human Allergies: Types, Effects, and Treatments

Abstract:

In this review I will be talking about allergies in humans. The review will first introduce what allergies are, and then it will go through specific types of allergens. Symptoms that are common and rare in allergies are then discussed, followed by how allergies affect day to day lives. The effects are described in four categories: sleep, work/ activity levels, and emotional impact. Additionally, the various kinds of treatments available for allergies are described. Treatments include vaccines, oral immunotherapy/ nasal decongestants, and then serum shots. The effectiveness of treatments to alleviate symptoms. What people can do to alleviate symptoms are lastly discussed.

Introduction: What Are Allergies?

Allergies are a bodily reaction to a foreign subject in the human body. Allergens elicit a response in the immune system to fight the foreign substance. This response can come in varying forms, such as: sneezing, rashes, watering eyes, itching, and occasionally a cough. The response is normally called an allergic reaction. An allergic reaction causes the immune system to produce IgE antibodies (1). These antibodies search out the invading allergens and send them to the mast cells, which are a type of white blood cell (1). Mast cells destroy allergens and as the destruction occurs a chemical called histamine is released into the body (1). The histamine is the chemical that causes the allergic response. Different allergens can elicit different responses throughout the body.

I. What types of allergies are there?

There are various allergens that trigger allergies. Some of the most common ones include an allergy to pollen (also known as hay fever), dust mites, molds, and certain foods. In 2018 5.2 million children suffered from hay fever, but skin allergies seem to be the most common among children. Skin allergies can arise from various allergens like pollens, chemicals, dusts and molds (Figure 1).

a. Pollen

An allergy to pollen is called seasonal allergic rhinitis, or hay fever (1). Pollen elicits responses in the nasal cavities, eyes, throat and lungs (3). Seasonal allergic rhinitis can occur anytime during the spring, summer, or fall seasons (3). During these seasons, plants are releasing pollen to fertilize other plants. A majority of plants that cause pollen allergies come from trees, weeds, and grasses. These plants make fine and light pollen that is easily carried by the wind. Scientists and researchers have found that

grasses are the common cause of allergies and among weeds, ragweed by far tops the charts as the common allergen (4).

b. Dust Mites

Dust mites are small organisms that inhabit dust and in various fibers around households. They inhabit places such as carpets, pillows, mattresses, and any upholstery item (1). Dust mites cause similar symptoms as pollen. They can thrive in humid temperatures, roughly between 70 to 80 percent (5). These organisms survive off the dead skin that humans shed daily (5). Dust mites can make problems for people who have allergies and asthma. Dust mites can trigger a flare up in people who have asthma making it hard for them to breathe by aggravating their airway and lungs. These creatures can also cause people to experience tightness in their chests and cause issues with sleeping. Dust mites are a common problem for people who have year-round allergies (5). Dust mites die in low humidity and extreme temperature.

c. Molds

Molds are tiny fungi that have spores that can be dispersed and float throughout the air. Mold can be found in damp areas indoors like a basement and can be found outdoors in grass, mulch, and leaf piles (1). Molds can be commonly found throughout the month of July to October (6). Depending on the time of year and climate molds found outdoors can cause symptoms year around. Mold spores can cause symptoms such as sneezing, itching, running nose, and scaling skin (6). Molds can also cause issues with asthma that can be immediate or delayed.

d. Certain Foods

Food allergies are acquired when the human body develops an antibody to a specific food. Common food allergens in adults are peanuts/tree nuts, and shellfish. Children are more sensitive to food and are more likely to develop an allergy. In 2018 4.8 million children were afflicted with food allergies (Figure 1). Allergens that are commonly found in children are milk, egg, soy, wheat, shellfish, peanuts, and treenuts (1). Symptoms of food allergies are itching, hives, nausea, vomiting, diarrhea, breathing difficulties, and swelling around the mouth. There is only one treatment for people who have a severe allergic reaction to a food and that is injectable epinephrine. Food allergies are not to be mistaken with food intolerances, which do not involve the immune system.

Allergies Morbidity of Children in 2018

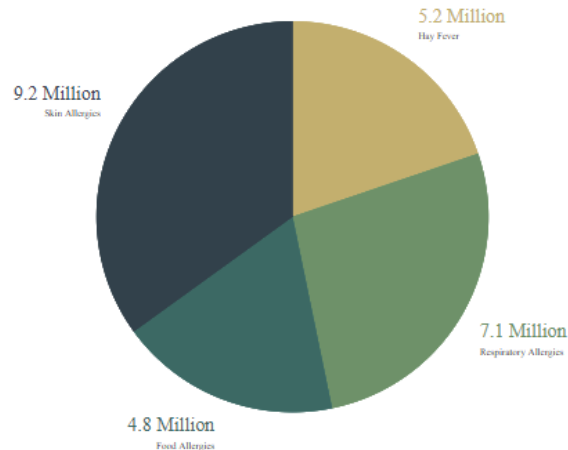


Figure 1. Allergy Morbidity of Children in 2018. This figure is showing how many children (in millions) were afflicted by varying allergies. (2)

II. What kinds of symptoms are associated with allergens?

Allergies can produce an array of symptoms that affect various areas of the body. Major areas of the body that are affected are the nasal cavity, eyes, skin, throat, and lungs. Most of the areas are only mildly affected. In the nasal cavity, symptoms include itchy/runny nose, sneezing, and congestion. In the eyes, symptoms include itchy/ watering eyes, and redness. In the throat and lungs, a more serious reaction called anaphylaxis can occur.

a. Anaphylaxis

Anaphylaxis is a severe life-threatening medical condition caused by one or more allergens. It requires immediate medical attention. When an allergen enters the body, the immune system sees it as something that will harm the body. The immune system reacts and tries to remove or isolate it. This condition occurs suddenly and affects the entire body. Leading causes of anaphylaxis in adults are medicines such as penicillin and other antibiotics. In children the leading cause are foods such as tree nuts, peanuts and shellfish (7). The other causes include insect stings, latex, and physical activity. Organ systems that can be affected are the skin, mouth, lungs, heart and the gut (7). Symptoms skin rashes or

hives, swelling of the lips, tongue, or throat, trouble breathing, stomach pain, vomiting, diarrhea, and dizziness or fainting.

b. Sinusitis

Sinusitis is an infection of the sinuses. There are two different kinds of sinusitis acute and chronic. Acute sinusitis is a temporary inflammation of the sinuses. The sinuses become swollen and block the drainage of mucus. Chronic sinusitis is when the symptoms of sinusitis happen more frequently or are worse. People who have mild or severe asthma are more likely to have chronic sinusitis (8). There are various reasons why sinusitis may be exacerbated in patients with asthma. A paper looking at asthma and sinusitis suggests that there are three proposed mechanisms that may be the causes. One is that eosinophils play a role, the other is that inflammatory mediators are the cause, and lastly it may be caused by a nasal-sinus-bronchial reflex (9). The eosinophils were the strongest out of the three presented because there were extensive amounts of them found in patients' sinus tissues (9). With this said there is still research that needs to be done to find out why people with asthma normally have chronic sinusitis.

c. Rhinitis

Rhinitis is an inflammation of the nose. When the nose becomes irritated mucus in the nose becomes thick. Rhinitis can be chronic, which can last for longer periods or it can last for a few days. There are four types of rhinitis: seasonal allergic rhinitis, perennial allergic rhinitis, non-allergic rhinitis, and infectious rhinitis. Seasonal rhinitis takes place during certain seasons normally fall or spring, and it is usually caused by pollen producing plants. Perennial rhinitis is seen all year long and is normally caused by dust mites, molds, and animal dander. Non-allergic rhinitis is not caused by allergens but by substances like chemicals and smokes, and occasionally can be caused by physical defects of the nose (10). Lastly, infectious rhinitis is the most common of the four. It is caused by the common cold or an upper respiratory infection. Allergy sufferers usually are affected by seasonal allergic rhinitis, and perennial allergic rhinitis (10).

III. How do allergies affect day to day lives?

Allergies affect every aspect of daily life. Symptoms cause people to miss work, school, and activities that they want to participate in. Common issues that allergy sufferers have are problems with sleep, activities and productivity. People find it difficult in allergy season to produce their best work while they are suffering. Coincidentally, sleep influences productivity and activities. Allergies that affect

sleep could be the major cause of how allergies affect daily lives. Allergies can also have an emotional effect on people.

a. Sleep

In a study on the impact of perennial allergic rhinitis with/without allergic asthma on sleep, work and activity level found that 66% of all subjects reported sleep problems (11). People also reported about how much these issues impacted their activity level and work time. A majority of patients who had allergic rhinitis and allergic rhinitis plus allergic asthma were found to be unsatisfied with their sleep, had daytime functioning very or extremely affected, and were concerned with their sleep (Figure 2a). People who suffer from perennial allergies seem to have symptoms that affect them while they are sleeping. These symptoms can include nasal congestion, and sneezing. When people are having issues breathing, it can also have a big impact on how people sleep. These sleeping issues lead into the performance issues in life.

b. Work/ Activity Level

A study found that work performance and activity performance were impacted by perennial allergic rhinitis. The study found that 12% of work time was missed due to sleep problems (11). They also found that almost 50% of productivity at work was impaired. As seen in figure one, work missed due to health was much less than impairment while working due to health, overall work impairment due to health, and activity impairment due to health. It can be believed then that sleep issues need to be addressed for allergy sufferers to produce the best work that they can.

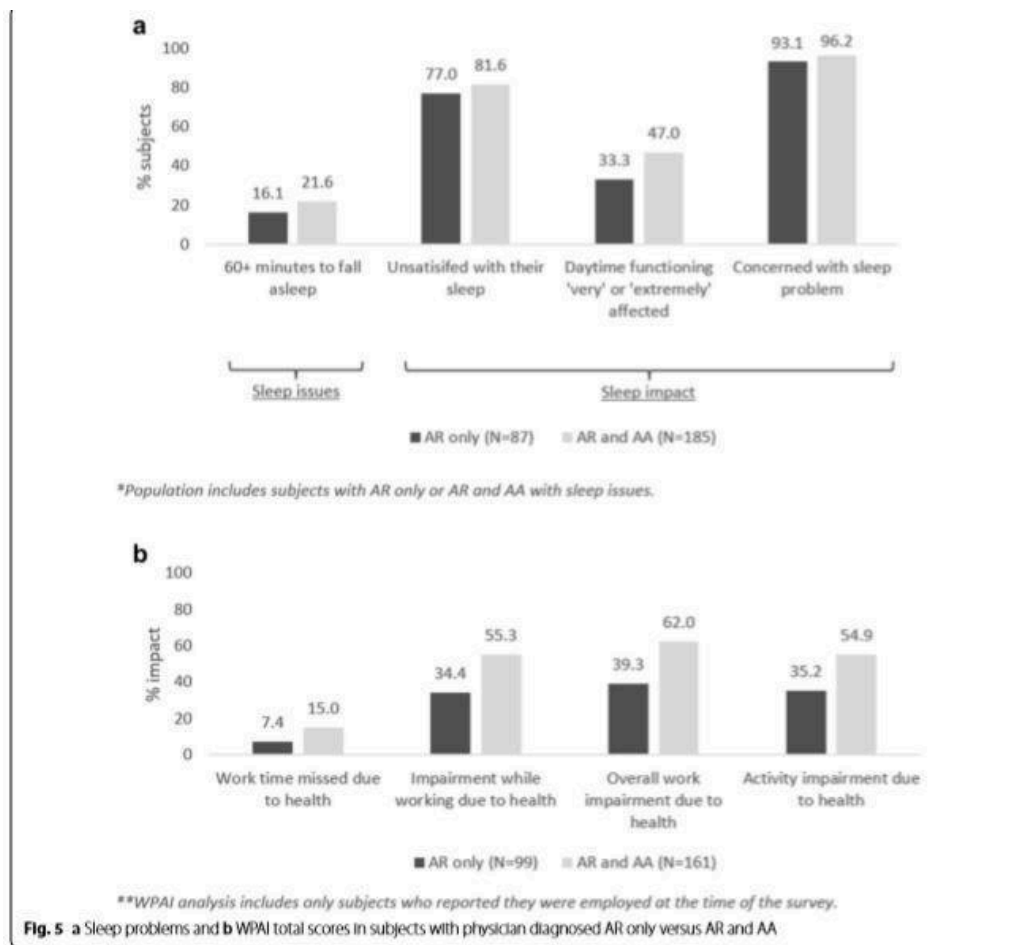


Figure 2. Taken from the study looking at the impact of perennial allergic rhinitis with/without allergic asthma on sleep, work and activity level. Majority of patients who had allergic rhinitis and allergic rhinitis plus allergic asthma were unsatisfied with their sleep.

c. Emotional Impact

A study looking at the quality of life in children and adolescents who had a grass pollen allergy found a strong relationship between symptoms, the quality of life and grass pollen exposure (12). People who have allergies suffer in their daily lives with not being able to live the life that they want. This can cause a lot of emotional problems for people, including stress, depression, anxiety, and a feeling of burden. In a study looking at the burden of allergic rhinitis (AR) they found that it was more of a nuisance to patients. They also found that children who had allergies had lower positive feelings (13). Compared to kids that did not have allergies, kids who had allergies seem to be less happy, less calm and peaceful, less energy, and overall not full of life (Figure 3).

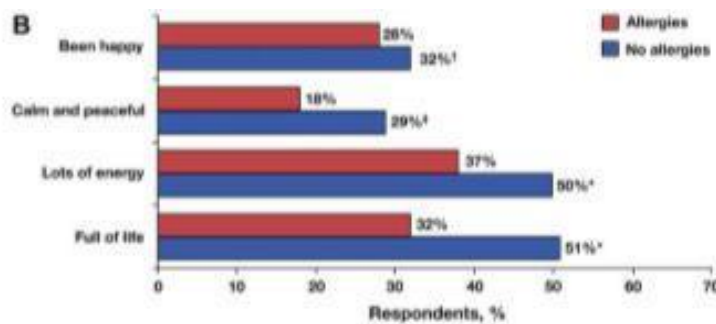


Figure 3. Parent’s perceptions of the children's overall wellbeing. Percentage of children who have allergies are compared to the children who don’t have allergies. It also shows how their allergies affect them emotionally.

d. Anxiety and Stress

Allergy patients normally experience various emotional problems. Some of these emotional disturbances include anxiety and stress. Patients who have atopic dermatitis, which can be a symptom of allergies, are more prone to stigmatization, social isolation, and discrimination because of the skin disease that their allergies cause (14). This can be understandable because allergies can make people seem different and in today’s society people can draw assumptions about people based on how they look and not who the person actually is. People who have atopic dermatitis seem to have large amounts of stress that also exacerbate their symptoms. It is a vicious cycle that these people fall into. Atopic dermatitis patients also exhibit high amounts of anxiety. Serum IgE levels are elevated in patients who exhibit high amounts of anxiety (14).

IV. What kind of treatments are there?

There are various treatments for allergy sufferers. The most common treatments are vaccines, oral/ nasal immunotherapy, and serum shots. Allergists have the belief that serum shots are the best treatment, but for people who don’t want to or can’t pay for serum shots normally rely on oral/ nasal immunotherapy.

A. Vaccines

A.1 Pollinex Quattro Ragweed

There are a variety of vaccines that researchers have developed to fight allergies. A majority of them deal with grass allergies and pollen allergies. Pollinex Quattro Ragweed was developed to prevent the symptoms that are caused by ragweed. The vaccine has a modified ragweed pollen

extract, which can be absorbed by using an L-tyrosine and an MPL adjuvant (15). A study compared single dose toxicity and multiple dose toxicity. It was found that there was no evidence of toxicity in the single or multiple dosages. There was support for clinical usage of the vaccine and there only symptoms that patients reported were that of a dose site irritation. With the support of the clinical usage it seems to have support as a treatment for ragweed allergy.

A.2 BM32

BM32 is a grass pollen allergy vaccine. It contains four fusion proteins that are recombinant and that consist of hepatitis B-derived PreS and timothy grass hypoallergenic peptides (16). BM32 is unique because it did not induce boosts of IgE production. Patients who have had BM32 had blood samples taken and they were compared to a placebo or Aluminum Hydroxide. Overall, it seems that BM32 worked well as a vaccine for grass pollen allergies.

A.3 Five Grass Pollen Vaccine

A five-grass pollen vaccine is pertinent because many people suffer from more than one grass allergy. There is debate over what grasses to use in the vaccine. Arguments are normally in favor for a mixture of grass pollen. There are studies based on a pollen mixture of *Anthoxanthum odoratum*, *Dactylis glomerata*, *Lolium perenne*, *Poa pratensis* and *Phleum pratense* (17). Trials with this vaccine have deemed it safe and efficient in patients who suffer from rhinoconjunctivitis (17).

B. Oral Antihistamines/ Nasal Sprays

Antihistamines like loratadine, cetirizine, and fexofenadine are some of the antihistamine of choice for many allergy sufferers (18). These antihistamines come in tablet form and can be non-drowsy or drowsy. These antihistamines have been known to relieve allergy symptoms, but only for a short amount of time (18). Antihistamines are the choice for many patients because it doesn't require seeing a doctor or having to deal with needles. It is a simple and easy way to control allergies, but with this treatment patients will continually have to take the medication and people will have to do it for the rest of their lives.

Nasal sprays work like oral antihistamines, but they're administered through the nose. Nasal sprays seem to give relief to nasal allergy symptoms. Nasal sprays are normally considered under decongestants and they can provide temporary relief like the oral antihistamines. Nasal sprays do not have serious side effects, so they are the top choice for parents who have children with allergies.

C. Serum Shots

Serum shots, or allergy shots, are shots that are made specifically to cater to a person's allergies. The serum is made specifically based on the person's allergies and is injected into the backs of the arms. Injections are given every 1 to 2 weeks and doses of the allergens gradually increase (19). There is a buildup phase and a maintenance phase. The maintenance phase is reached four to six months after the start of the shots and the maintenance dose is given once a week every two weeks. After months of shots the amount of times that a shot is needed is decreased (19). Serum shots are useful because they can actually eradicate symptoms and make people who suffer from allergies better. There are risks with the shots, sometimes there may be swelling, redness, and itching at the injection site. On rare occasions there may be a more severe reaction.

V. Can treatments improve symptoms?

There are varying treatments for allergies. The issue is deciding what treatment is the most effective. What people want in a treatment is something that is going to alleviate their symptoms. Azelastine is a nasal spray. In a study looking at the nasal spray Azelastine and examining if it can be used as a long term or short-term treatment for seasonal rhinitis, it was found continuous usage was more effective than on demand usage (20). Azelastine reduced symptoms and neutrophils and eosinophils. It was determined on demand usage also did not control nasal symptoms as well as expected. Overall azelastine was an effective treatment.

In another study, researchers were looking at a short course of allergen peptide immunotherapy. Allergen peptide immunotherapy is another type of vaccine. In this study they used *Lolium perenne* (LPP) and looked at its usage before the grass pollen season. They reported clinical efficacy and that it was safe. The 3-week treatment was administered subcutaneously over 4 visits prior to the grass pollen season. LPP was more useful in preventing symptoms than rescue medications. Over the short period of time that this study was happening they found that LPP offered the possibility of a shorter treatment course (21). A shorter treatment course could allow for people to have less symptoms and not have to continuously take a pill or do shots. This treatment could change how people choose to handle their allergies. The only issue with this study was there were various screening failures.

. CD83 is another vaccine that was looked at to alleviate allergic rhinitis. Allergic rhinitis is a major issue for many allergy sufferers. They found that AR patients had lower levels of sCD83 levels.

They found that administering sCD83 inhibited AR responses (22). If AR responses are inhibited, then the symptoms are also inhibited. If symptoms were inhibited, then the symptoms are improved or eradicated. If symptoms are improved, then maybe CD83 is a good treatment for allergies.

Another study examined the varying outlooks of the different treatments. Allergic Immunotherapy (AIT) was the strongest of all the products that had the best outlook and that prevented and alleviated allergic symptoms. The scientist determined that the future is in next generation AIT that rely on recombinant or synthetic proteins or DNA instead of biological allergen extracts (23). This is better because it can target the allergens better than other treatments (23). There is belief that new therapies for allergies and new formulation may be the optimal way to improve symptoms for patients. There is a need for more research, but currently most patients will successfully respond to AITs. Overall AITs seem to improve symptoms and potentially have the potential to be the best treatment for allergies.

Another treatment that has been effective is SCIT or subcutaneous specific immunotherapy. This can be either a vaccine or a serum shot. In a study using grass pollen vaccine with an adjuvant of aluminum. It was determined that the adjuvant of the aluminum allowed for the optimization of the pollen vaccine (24). If the vaccine is optimal then it has the best chance to beat the symptoms among grass pollen sufferers.

Overall, it seems that symptoms have the potential to be improved by the uses of varying treatments. Studies are focusing on different vaccines that can help symptoms because if there is a vaccine then there wouldn't be the need to continuously take medications or nasal sprays. The best treatment right now has been serum shots and allergy medications.

VI. What can people do to improve their symptoms?

Seasonal allergies and allergies in general can be a nuisance in life. There are various steps that people can go through to prevent their allergy symptoms. Some of those include reducing exposure, taking precautionary steps when pollen counts are high (this is if you have a pollen allergy), keeping indoor air clean, and over the counter remedies.

A. Reducing Exposure

There are various ways people can reduce their exposure to their allergens. People can stay indoors when it is dry outside, or it is windy (25). Also try to stay away from yard work like mowing, weed pulling, or gardening because these can stir up allergen. Doctors and researchers also recommend

that people remove clothes that have been worn outside and to shower to rinse off pollen that may be on your skin and hair. If you do outdoor chores it is recommended that you wear a mask to prevent exposure and to prevent symptoms later on.

Doctors have seen the symptoms flare up when pollen counts are high. It is recommended that check the local forecast for the pollen counts for the day. If there are going to be high pollen counts take allergy medications before symptoms start. You should avoid outdoor activity in the early morning when pollen counts are the highest (25).

B. Keep Indoor Air Clean

You won't be able to eradicate all allergens in the air but there are ways that you can keep the counts low. It is recommended that you use the air conditioning in your home and car, if there is forced air heating or conditioning in your house you should use filters that regulate allergens and you should keep up with the maintenance of the filters. You should try to combat humid areas with a dehumidifier, and you should keep the floors and upholstery cleaned constantly (25). HEPA (High Efficiency Particulate Air) filters are a great way to combat allergens. This filter can remove roughly 99% of dust, pollen, mold, and bacteria (26)

C. Over the Counter Remedies

There are various over-the-counter remedies that can eliminate allergy symptoms. Some include oral antihistamines, decongestants, nasal sprays, and combination medications. The top OTCs are Zyrtec, Allegra, Benadryl, Flonase, and Sudafed. Each of these medications have an array of symptoms they can treat like sneezing, itching, runny nose, and nasal congestion. These only provide temporary relief for sufferers and need to be used constantly if you want symptoms to be improved (25).

Conclusion:

In conclusion this review looked at various factors, which included: some common allergens, symptoms caused by those allergens, the effects of allergens in day to day lives, the various kinds of treatments there are, can those treatments improve symptoms, and lastly what can people do to improve their symptoms. There are multiple allergens that cause allergies in humans. Some of the top ones being pollen, dust mites, mold and certain foods. Overall the worst ones being pollen and dust mites because they're the ones that cause skin allergies. Skin allergies being the top allergy that children had in 2018 (Figure 1). Allergens can cause an array of symptoms including anaphylaxis, rhinitis, and sinusitis.

Anaphylaxis being the worst out the three because it is the one that is life threatening. Allergies affect day to day lives by affecting sleep, emotions, and activity/ work level. The one that was highlighted the most was sleep because sleep affects every other system in the body. The next thing talked about was the types of treatments. All the treatments had strong evidence that they worked well. It can be inferred that most these treatments would be helpful in preventing allergies. This goes with can allergy treatments improve symptoms. There were nasal sprays, vaccines, AIT, and SLIT presented in this review. Relief was seen in each kind of treatment. The strongest of them all being AIT because it has the ability to target allergens better. Lastly, what can people do to improve their symptoms? Reducing exposure, keeping indoor air clean, and over the counter remedies are all great ways to prevent allergies from flaring up.

Overall, this review was meant to provide detail about allergies in humans and provide effective ways to help combat them.

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