

# Allergens in the Environment

An allergen is any substance that can trigger an allergic response - Type-I hypersensitivity reaction in atopic (genetically predisposed) individuals.

## The Reaction

**Acute response** - the antigen is presented by an Antigen-Presenting Cell to TH<sub>2</sub> lymphocytes. These TH<sub>2</sub> lymphocytes interact with B lymphocytes and secrete Interleukin-4 (IL-4). The TH<sub>2</sub> interaction and IL-4 cause the B-lymphocytes to respond by producing IgE antibodies. Secreted IgE circulates in the blood and binds to IgE-specific receptors on the surface of mast cells and basophils and sensitises these cells to the allergen. On subsequent exposure, the allergen binds to the IgE on the surface of sensitised mast cells or basophils. The cells are activated and undergo degranulation - release of histamine and other inflammatory mediators (cytokines, interleukins, leukotrienes, and prostaglandins) into the extracellular space. The effects of this include:

- Vasodilation
- Mucous secretion
- Nerve stimulation
- Smooth muscle contraction

This manifests clinically as rhinorrhea, itchiness, dyspnea, and anaphylaxis. Depending on various factors, the effects can be systemic (anaphylaxis), or localized (asthma in the respiratory system and eczema in the dermis)

**Late-phase response** - 2 to 24 hours after acute reaction. It's mediated by other cells (neutrophils, lymphocytes, eosinophils and macrophages) that migrate to the inflamed site.

## Risk Factors

Risk factors can be divided into host and environmental factors.

**Host factors** Heredity (most important) Allergies are strongly familial: 70% concordance in identical twins and 40% in non-identical twins. Children with allergic parents are more likely to have the allergies and with increased severity compared to children of non-allergic parents. Others include: Gender Race Age

### Environmental factors

- Exposure to infectious diseases during early childhood - The hygiene hypothesis was developed when it was observed that hay fever and eczema were less common in children from larger families - where there are apparently more infectious agents present - than in children from one-child families. It states that insufficient stimulation of the TH<sub>1</sub> arm of the immune system leads to an overactive TH<sub>2</sub> arm, which in turn leads to allergic disease. It is supported by epidemiological data that shows immunological and autoimmune diseases are less common in developing countries than in industrialised countries.
- Environmental pollution
- Allergen levels in the environment
- Dietary changes

## Transmission of Allergens

Allergens are substances normally present in the environment and direct contact with allergen can be through:

- Surface contact with the allergen
- Ingestion
- Inhalation

They can also be contacted through

- Bite of allergen carrier
- Inoculation

## Common Allergens

**Foods** - Ingestion The 'officially' recognised list changes across countries due to different genetic profiles and eating habits, the United States Food and Drug Administration recognises eight foods as common allergens - **peanuts, tree nuts, eggs, milk, shellfish, fish, wheat** and their derivatives, and **soy** and their derivatives, as well as **sulphites** (at 10ppm and over, found in food flavouring and colouring). Canada recognises these eight as well as **sesame seeds** and **mustard**. The European Union recognises the ten in Canada as well as **celery**.

**Animal products** - Inhalation / surface contact

- Dust mite - among the most common cause of allergies and triggers of asthma worldwide. They excrete least 15 allergens in their faeces and these are divided into groups. Groups 1 and 2 are the culprits of allergies. Group 1 consists of catalytic proteins (e.g. proteases) and group 2 are mite proteins (not as common as Group 1).
- Fel d 1 (cats)
- Fur and Dander
- Cockroach calyx
- Wool

#### Drugs - By inoculation

- Penicillin
- Sulfonamides
- Salicylates

#### Fungal allergies - Inhalation

- Fungal allergies are considered to be a major source of airborne allergens and are associated with seasonal asthma. Basidiospores (<https://en.wikipedia.org/wiki/Basidiospore>) are the dominant airborne fungal allergens and this family Includes - **mushrooms, rusts, smuts, brackets, and puffballs.**

#### Insect stings/bites

- Bee sting venom
- Wasp sting venom
- Mosquito stings

#### Plant pollen (hay fever) - Fall under **seasonal** allergies - Inhalation

- Grass e.g. ryegrass
- Weeds e.g. nettle
- Trees e.g. birch, willow

## Testing

2 tests are widely used to detect the presence of allergen-specific IgE antibodies. A skin prick test and/or an allergy blood test. Both methods are recommended and have similar diagnostic value in terms of sensitivity and specificity.

**Skin-prick testing** Tiny punctures are made into the patient's skin, commonly on the forearm and back. Small amounts of suspected allergens and/or their extracts (e.g. pollen, peanut extract) are introduced to marked sites. A small plastic or metal device is used to puncture or prick the skin. Sometimes, the allergens are injected into the skin. If the reaction is positive, inflammation will occur within 30 minutes. This can range from slight reddening to hives.

**Allergy blood test** This measures the concentration of specific IgE antibodies in the blood. It's suitable for all regardless of age, skin condition, medication, symptom, illness or pregnancy. Multiple allergens can be detected with a single blood sample and it's safe since the patient isn't exposed to the allergen.

## Treatment

Traditional treatment is to simply avoid the allergen or reduce exposure.

**Pharmacological intervention** includes administering drugs that block the action of chemical allergy mediators or prevent activation of cells and degranulation. These include antihistamines, glucocorticoids, epinephrine (adrenaline), theophylline and cromolyn sodium.

**Anti-allergy immunotherapy** is a desensitisation treatment where the patient's production of IgG against the allergen is gradually stimulated. He/She is progressively larger doses of the allergen and this can either reduce the severity or eliminate hypersensitivity altogether.

## Links

### Related Articles

### Bibliography

Kay AB (2000). "Overview of 'allergy and allergic diseases: with a view to the future'". Br. Med. Bull. 56 (4): 843-64. doi:10.1258/0007142001903481

Food Allergy in children and young people. Costing report. Implementing NICE guidance, 2011. <http://guidance.nice.org.uk/CG116/CostingReport/pdf/English>

Kerkhof M, Dubois AE, Postma DS, Schouten JP, de Monchy JG (2003). "Role and interpretation of total serum IgE measurements in the diagnosis of allergic airway disease in adults". *Allergy* 58

Sicherer SH, Leung DY (2007). "Advances in allergic skin disease, anaphylaxis, and hypersensitivity reactions to foods, drugs, and insects". *J. Allergy Clin. Immunol.* 119

GREGORY, PH.; HIRST, JM. (Sep 1952). "Possible role of basidiospores as air-borne allergens". *Nature* 170 (4323): 414-414

Goldsby, Richard A., et al., *Immunology*. 5th ed. New York: W.H. Freeman