

# EDA-ID

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Anhidrotic ectodermal dysplasia with immune deficiency (EDA-ID) is a form of ectodermal dysplasia, which is a group of conditions characterized by abnormal development of ectodermal tissues including the skin, hair, teeth, and sweat glands. In addition, immune system function is reduced in people with EDA-ID. The signs and symptoms of EDA-ID are evident soon after birth, and due to the severity of the immune system problems, most people with this condition survive only into childhood.

genetic conditions

## 1. Introduction

Skin abnormalities in children with EDA-ID include areas that are dry, wrinkled, or darker in color than the surrounding skin. Affected individuals tend to have sparse scalp and body hair (hypotrichosis). EDA-ID is also characterized by missing teeth (hypodontia) or teeth that are small and pointed. Most children with EDA-ID have a reduced ability to sweat (hypohidrosis) because they have fewer sweat glands than normal or their sweat glands do not function properly. An inability to sweat (anhidrosis) can lead to a dangerously high body temperature (hyperthermia), particularly in hot weather and during exercise, because the body cannot cool itself by evaporating sweat.

The immune deficiency in EDA-ID varies among individuals with this condition. Children with EDA-ID often produce abnormally low levels of proteins called antibodies or immunoglobulins. Antibodies help protect the body against infection by attaching to specific foreign particles and germs, marking them for destruction. A reduction in antibodies makes it difficult for children with this disorder to fight off infections. In EDA-ID, immune system cells called T cells and B cells have a decreased ability to recognize and respond to foreign invaders (such as bacteria, viruses, and yeast) that have sugar molecules attached to their surface (glycan antigens). Other key aspects of the immune system may also be impaired, leading to recurrent infections.

Children with EDA-ID commonly get infections in the lungs (pneumonia), ears (otitis media), sinuses (sinusitis), lymph nodes (lymphadenitis), skin, bones, and gastrointestinal tract. Approximately one quarter of individuals with EDA-ID have disorders involving abnormal inflammation, such as inflammatory bowel disease or rheumatoid arthritis.

There are two forms of EDA-ID that have similar signs and symptoms and are distinguished by the modes of inheritance: X-linked recessive or autosomal dominant.

## 2. Frequency

The prevalence of the X-linked recessive type of EDA-ID is estimated to be 1 in 250,000 individuals. Only a few cases of the autosomal dominant form have been described in the scientific literature.

## 3. Causes

Mutations in the *IKBKG* gene cause X-linked recessive EDA-ID, and mutations in the *NFKBIA* gene cause autosomal dominant EDA-ID. The proteins produced from these two genes regulate nuclear factor-kappa-B. Nuclear factor-kappa-B is a group of related proteins (a protein complex) that binds to DNA and controls the activity of other genes, including genes that direct the body's immune responses and inflammatory reactions. It also protects cells from certain signals that would otherwise cause them to self-destruct (undergo apoptosis).

The *IKBKG* and *NFKBIA* gene mutations responsible for EDA-ID result in the production of proteins with impaired function, which reduces activation of nuclear factor-kappa-B. These changes disrupt certain signaling pathways within immune cells, resulting in immune deficiency. It is unclear how gene mutations alter the development of the skin, teeth, sweat glands, and other tissues, although it is likely caused by abnormal nuclear factor-kappa-B signaling in other types of cells.

### 3.1. The genes associated with Anhidrotic ectodermal dysplasia with immune deficiency

- *IKBKG*
- *NFKBIA*

## 4. Inheritance

When EDA-ID is caused by mutations in the *IKBKG* gene, it is inherited in an X-linked recessive pattern. The *IKBKG* gene is located on the X chromosome, which is one of the two sex chromosomes. In males (who have only one X chromosome), one altered copy of the gene in each cell is sufficient to cause the condition. In females (who have two X chromosomes), a mutation would have to occur in both copies of the gene to cause the disorder. Because it is unlikely that females will have two altered copies of the *IKBKG* gene, males are affected by X-linked recessive disorders much more frequently than females. A characteristic of X-linked inheritance is that fathers cannot pass X-linked traits to their sons.

When EDA-ID is caused by mutations in the *NFKBIA* gene, the condition is inherited in an autosomal dominant pattern, which means one copy of the altered gene in each cell is sufficient to cause the disorder. Most cases result from new mutations in the gene and occur in people with no history of the disorder in their family.

## 5. Other Names for This Condition

- ectodermal dysplasia, hypohidrotic, with immune deficiency
  - EDA-ID
  - HED-ID
  - hyper-IgM immunodeficiency with hypohidrotic ectodermal dysplasia
  - hypohidrotic ectodermal dysplasia with immune deficiency
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