

# Autoimmune Diseases: Causes and Mechanisms

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# **1 Introduction**

Autoimmune disease occurs when the immune system mistakenly attacks the body's own tissues. There is no single cause; it results from multiple interacting factors.

## **2 Overview of Autoimmune Diseases**

There are over 80–100 autoimmune diseases that can affect almost any organ system. Common examples include type 1 diabetes, rheumatoid arthritis, lupus, multiple sclerosis, and Hashimoto's thyroiditis.

## **3 Major Categories of Causes**

### **3.1 Genetic Factors**

Polygenic susceptibility: many small-effect gene variants increase risk. Some diseases run in families; twin studies show high concordance for certain conditions like Hashimoto's thyroiditis.

### **3.2 Environmental Triggers**

Chemicals (solvents, pesticides, industrial toxins, hair dyes), ultraviolet light, and pollution can disrupt immune tolerance. Vitamin D deficiency can reduce immune regulation.

### **3.3 Infectious Agents & Molecular Mimicry**

Viruses and bacteria can activate T cells, confusing the immune system into attacking self. Molecular mimicry occurs when pathogens share peptide sequences with self-antigens, leading to cross-reactivity.

### **3.4 Immune Regulation Failure & Dysregulation**

Loss of self-tolerance, T-reg dysfunction, and mutations in immune checkpoint genes like CTLA-4 lead to autoimmunity. Chronic stress can increase inflammatory cytokines and dysregulate immune balance.

### **3.5 Gut Microbiome Imbalance (Dysbiosis)**

Leaky gut, reduced tolerance to oral antigens, and unhealthy gut bacteria can contribute to autoimmunity.

### **3.6 Hormonal & Gender Influences**

About 75–80% of autoimmune patients are women. Hormonal modulation, especially by estrogen, plays a role in disease risk.

### **3.7 Lifestyle, Stress & Exposome**

Accumulated exposures across life such as poor diet, smoking, and chronic stress increase cumulative risk.

### **3.8 Rare Genetic Disorders: Inborn Errors of Immunity**

Mutations in immune-regulating genes can cause both immunodeficiency and autoimmunity in rare cases.

## **4 Selected Examples: In-Depth**

### **4.1 Type 1 Diabetes**

Genetic risk plus environmental triggers such as viral infection or gut influences lead to T-cell destruction of insulin-producing beta cells.

### **4.2 Rheumatoid Arthritis**

Genes, smoking, Epstein-Barr virus exposure, and gut bacteria similarity contribute to autoantibody production against joint tissues.

### **4.3 Lupus (Systemic Lupus Erythematosus)**

Strong female predominance, genetic risk, and environmental triggers such as sunlight and infections lead to autoantibodies attacking multiple organs.

### **4.4 Hashimoto's Thyroiditis**

Familial clustering, high twin concordance, and chromosomal disorder associations lead to immune-mediated destruction of thyroid cells.

## **5 Cross-disease Themes & Why Having One Raises Risk of Others**

Shared gene networks, overlapping environmental triggers, and immune overactivity explain why many people with one autoimmune disease may develop others.

## 6 How These Causes Intersect: Summary Table

Cause Category	Mechanism	Example Contribution
Genetic	Polygenic variants	Hashimoto's family history
Environment	Toxins / UV / diet	Pesticides increasing rheumatoid arthritis risk
Infection	/ Cross-reactivity	EBV triggering lupus or MS-like autoimmunity
Mimicry		
Immune Dysregulation	Treg defects / stress	CTLA-4 mutations, chronic IL-6 elevation
Microbiome	Gut permeability, dysbiosis	Leaky gut driving immune activation
Hormonal	Estrogen modulation	Explains high female prevalence
Exposome (lifestyle)	Cumulative risk exposures	Smoking plus poor diet and poor sleep increase risk
Inborn Immune Errors	Rare gene defects	IEI causing autoimmune features

## 7 Conclusion & Practical Takeaways

Autoimmune diseases result from a combination of genetics, environment, infections, and immune mis-regulation. Lifestyle factors such as vitamin D, healthy diet, sleep, stress management, and avoiding smoking may reduce risk or disease flares.