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Why Men and Women Experience Differences in Immune Function

Analysis by Dr. Joseph Mercola | October 23, 2025

STORY AT-A-GLANCE

- Women face far higher rates of autoimmune conditions like lupus and multiple sclerosis because of their double set of X chromosome immune genes and the effects of hormones such as estrogen
- Men experience more severe viral infections, higher cancer risks, and age-related immune decline in part due to testosterone's suppressive effects and the gradual loss of Y chromosomes in immune cells
- Hormones shift immunity across life stages, meaning puberty, pregnancy, menopause, and andropause all create unique windows of higher or lower disease risk that you can plan around
- Environmental factors such as diet, toxin exposure, and gut health interact with your genetic and hormonal makeup, shaping how your immune system handles inflammation and infection
- Precision strategies based on sex-specific biology allow you to lower risks — women can focus on reducing autoimmune triggers, while men benefit from strengthening defenses against severe infections and cancer

Autoimmune conditions like lupus, characterized by fatigue, joint pain, and organ inflammation, or multiple sclerosis, which damages your brain and spinal cord leading to weakness and numbness, disproportionately strike women compared to men. The

numbers are staggering: women are 2.5 times more likely to develop multiple sclerosis and nine times more likely to develop lupus than men.[1]

Every cell in your body carries either XX chromosomes if you're female or XY chromosomes if you're male, and this genetic blueprint directly influences your immune system. Erica Ollmann Saphire, Ph.D., at La Jolla Institute, explains that the X chromosome carries many immune-related genes, and women effectively have a "double palette" of immune instructions.[2]

This double dosage strengthens defenses against viruses like SARS-CoV-2 but also raises the risk of the immune system turning against the body itself. Hormones are another key factor. Estrogen, testosterone, and progesterone do far more than regulate reproduction — they act directly on immune cells, dictating which genes turn on or off.

For example, estrogen amplifies antibody production, boosting your defense against pathogens, but at certain levels it also sparks inflammation that drives autoimmune conditions. Testosterone, by contrast, tends to dampen immune activity, reducing inflammation but leaving men more vulnerable to infections. Such differences explain why men are more likely to face severe outcomes from viral diseases like COVID-19, while women live with higher rates of chronic autoimmune disorders.

A scientific review published in Science underscores this point by showing how sex-based differences extend down to the tissue level, shaping responses in organs such as your lungs and brain.[3] These findings set the stage for understanding why the immune system works differently in men and women and why those differences matter when you think about disease risk.

Sex Differences Shape Tissue Immunity

In a review published in Science, researchers examined how genetics, hormones, and environmental exposures alter immune responses in tissues such as the lungs, brain, and skin.[4] The review highlighted that these differences are not abstract — they explain

why men and women experience organ-specific infections, autoimmune diseases, and cancers in distinct ways.

- **Women carry double the immune-related genetic material —** Because females have two X chromosomes, they inherit a broader set of immune-related genes compared to males with one X and one Y chromosome. This means a woman's immune system is equipped with a "double dosage" of immune defenses, giving her stronger protection against infections but also increasing the risk of autoimmune conditions like lupus and multiple sclerosis.

- **Female immune cells show a mosaic effect —** Unlike males, women's cells randomly switch which X chromosome is active, creating a patchwork of immune cells that respond in slightly different ways. This mosaic adds resilience because pathogens face a more diverse defense system, but it also raises the chances that some of those immune cells overreact, triggering autoimmune disease.

- **Sex hormones tell immune cells how to behave —** Hormones such as estrogen and testosterone act directly on immune cells, influencing which genes turn on or off. Estrogen boosts the strength of immune responses, improving defense against bacteria and viruses, while testosterone suppresses immune activity, lowering inflammation but leaving men more prone to severe viral infections.

- **Environmental factors further shape these immune differences —** Nutrition, chemical exposures, and differences in the skin and gut microbiomes between men and women all influence how immune systems function. The review emphasized that lifestyle and environmental choices interact with sex-linked biology, which means factors like diet quality or toxin exposure affect men and women differently.

- **The future of precision medicine —** By understanding these differences at the tissue level, scientists argue that treatments for cancer, autoimmune disorders, and infections should be tailored by sex. As Sonia Sharma, Ph.D., co-author of the

review, noted, "When it comes to medicine, one size doesn't fit everybody."[5] This points toward therapies designed not just for the disease itself but for how your sex shapes immune responses to that disease.

How Men's and Women's Immune Systems Differ

Disease risks look very different for men and women. Scientists at the La Jolla Institute for Immunology point out that while women make up the majority of autoimmune disease cases, men are more likely to develop heart disease and brain disorders like Parkinson's. This shows why your sex plays a big role in what health problems you're more likely to face over time.

- **Immune cells switch on different genes in men and women —** Using advanced cell-mapping tools, researchers studied thousands of immune cells and saw that "helper" T cells activate different sets of genes depending on whether the person is male or female. These differences influence how strongly your immune system reacts and how it handles disease risk.

- **Errors in X chromosome control raise autoimmune risk for women —** Women have two X chromosomes, but one is normally shut down in each cell to prevent overload. When this process fails, the cells that are supposed to keep the immune system calm — called regulatory T cells — stop working properly. This makes women more likely to develop autoimmune conditions such as rheumatoid arthritis and Sjögren's syndrome.

- **The brain is also affected by sex-based immune changes —** In Parkinson's disease, harmful immune cells attack clumps of abnormal proteins in the brain. La Jolla scientists discovered that these attacks differ in strength and number between men and women, showing that immune function helps drive sex-based differences in how Parkinson's develops.

- **Pregnancy creates unique immune challenges —** The placenta does an excellent job of shielding a baby from infection, but viruses like Zika sometimes get through, causing brain damage. Studies show that during pregnancy, women's killer T cells react differently to infections, which explains why certain viruses are especially dangerous at this time.

- **Inflammation chemicals vary by sex —** Researchers found that special fat-based signaling molecules that drive inflammation are present at very different levels in men and women. These differences help explain why conditions like heart disease, Alzheimer's, and certain autoimmune illnesses progress differently depending on sex.

  In addition, buried in your DNA are fragments of old viruses from human evolution. Scientists discovered that these genetic remnants interact with the immune system differently in men and women. In some cases, such as breast or ovarian cancer, this interaction could shape disease risk and guide new treatments.

Sex Hormones Change How Your Immune System Works

An editorial paper in Frontiers in Immunology explained that hormones like **estrogen**, progesterone, prolactin, and testosterone act directly on immune cells.[6] They decide whether your body turns up inflammation or turns it down, which affects your risk for autoimmune disease, infection severity, and allergies.

- **Each hormone influences disease differently —** Estrogen plays both sides: at low levels it sparks inflammation, but at higher levels — such as during pregnancy — it calms the immune system. Prolactin, known for helping with milk production, boosts antibodies and drives inflammation. Testosterone and progesterone, on the other hand, work more like brakes, slowing down immune activity.

- **Hormones help explain why some autoimmune diseases hit harder —** In lupus, estrogen pushes T cells and antibody production into overdrive, which worsens the disease. Researchers also found that certain drugs that raise dopamine block

prolactin's stimulating effects, offering new ways to treat conditions linked to high prolactin.

- **Infections and allergies shift with hormonal changes —** Testosterone makes neutrophils — cells that fight bacteria — less effective, which drags out infections in men. Female mice given influenza produced more antioxidants in their lungs and blood, giving them better protection than males. Fluctuations during puberty, menstruation, pregnancy, and menopause also change asthma and allergy risks, which is why women often notice symptom changes during these life stages.

- **Hormones interact in complex ways —** Steroid drugs called glucocorticoids were found to cross-talk with sex hormones, creating overlapping pathways that influence how autoimmune diseases progress. This means your overall hormone balance matters more than just one hormone acting alone.

Big-Picture Immune Science Makes Sex Differences Useful for You

A review published in Oxford Open Immunology explains that "systems immunology" pulls together huge amounts of data — genetics, cell mapping, protein profiles — to reveal how male and female biology shape immune responses. In simple terms, it gives you concrete signals for prevention, treatment, and recovery instead of leaving things to chance.

- **Transplant and post-viral recovery differ by sex —** Men who receive organs from female donors often have worse outcomes, and women given bone marrow from previously pregnant female donors have higher risks of graft rejection. Long COVID is more common in women, highlighting the need for closer monitoring if you're female after a viral infection.

- **Genes and aging add another layer —** About 54 immune-related genes live on the X chromosome, and women sometimes express both copies, boosting immune activity. In men, loss of the Y chromosome with age has been tied to severe COVID-

19, Alzheimer's, and prostate cancer. For older men, this makes infection control and anti-inflammatory habits especially important.

- **Hormones shift your immunity through life —** Estradiol, progesterone, and testosterone rise and fall at different ages — fetal life, puberty, pregnancy, menopause, and andropause — and each phase alters immunity. If you're going through puberty, perimenopause, or age-related testosterone decline, planning medical procedures during steadier hormone periods reduces complications.

How to Balance Your Immune System Based on Sex Differences

Your immune system does not work the same way if you are male or female. Hormones, genetics, and even environmental exposures change how your body fights infection, inflammation, and autoimmune disease. That means the way you care for yourself should take those differences into account. You have more control than you think, and simple daily steps lower your risks and help you work with your biology instead of against it.

1. **Pay attention to hormone balance in daily life —** If you're a woman, estrogen and prolactin push your immune system toward stronger activity, which is useful against infection but raises your risk of autoimmune flare-ups. If you're a man, testosterone suppresses your immune system, leaving you more vulnerable to severe infections.

   Keeping your hormones balanced through healthy routines — like consistent sleep, avoiding alcohol and endocrine-disrupting chemicals, and managing stress — keeps your immune system steady.

2. **Support your X chromosome advantage without triggering autoimmunity —** Women have two X chromosomes, giving them double the immune-related genes, but this double dosage raises the chance of autoimmunity.

To lower the risk, focus on reducing triggers of mitochondrial damage and chronic inflammation such as processed foods, vegetable oils, and chemical exposures. Improving your mitochondrial function to increase cellular energy is key to preventing and managing autoimmune diseases.

3. **Protect your brain and nerves with anti-inflammatory habits —** Men are more prone to Parkinson's, and women face higher Alzheimer's risk. These diseases involve misfiring immune cells in the brain. Supporting brain health through regular walking, sun exposure, and nutrient-dense food gives your nervous system the steady energy it needs to stay resilient.

4. **Strengthen your defenses during pregnancy or hormonal changes —** If you're pregnant or going through major hormonal shifts like puberty or menopause, your immune system will act differently. During these times, be extra intentional with what you eat, your toxin exposure, and your sleep. These lifestyle anchors help stabilize the swings in immunity caused by changing hormones.

5. **Use precision strategies that fit your sex-specific risks —** If you're a woman with autoimmune tendencies, improving mitochondrial function is a top priority. If you're a man, preventing severe infections is worthy of focus.

   Tailor your daily choices — what you eat, how you move, and how you recover — depending on whether your body benefits from dialing the immune system down or turning it up. Studies show that blanket recommendations fall short, which is why it's important to follow strategies that match your own biology.

FAQs About Sex-Based Differences in Immunity

Q: Why are women more likely to develop autoimmune diseases than men?

A: Women have two X chromosomes, which means they inherit a double set of immune-related genes. This makes their immune system stronger against infections but also increases the risk of it attacking the body, leading to conditions such as lupus and multiple sclerosis. Hormones like estrogen also play a role by amplifying immune activity, which fuels autoimmunity.

Q: Why do men face more severe infections and higher cancer risks?

A: Testosterone naturally suppresses the immune system, lowering inflammation but making men more vulnerable to severe viral infections and some cancers. In addition, aging men lose Y chromosomes in certain immune cells, a change linked to worse outcomes in conditions like COVID-19, Alzheimer's, and prostate cancer.

Q: How do hormones shape immune function at different life stages?

A: Hormone levels rise and fall across life — during puberty, pregnancy, menopause, and andropause — and each shift changes how the immune system behaves. For example, high estrogen in pregnancy calms inflammation, while low estrogen removes that protection, altering disease risks.

Q: What role does environment play in sex-based immune differences?

A: Diet, chemical exposures, and even gut and skin microbes interact with genetic and hormonal differences to change how men's and women's immune systems function. This means lifestyle choices like eating nutrient-dense foods, managing stress, and limiting toxin exposure directly affect disease risks differently by sex.

Q: How can I use this information to protect my health?

A: Tailor your habits to your biology. If you're female, focus on keeping inflammation in check to reduce autoimmune flare-ups. If you're male, strengthen defenses against infections and cancer with anti-inflammatory routines. Timing major health interventions around steadier hormone phases also improves outcomes.

Sources and References

- [1, 2, 5] Medical Xpress August 8, 2025
- [3, 4] Science August 7, 2025, Vol 389, Issue 6760, pp. 599-603
- [6] Frontiers in Immunology May 8, 2019