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Stop Accelerated Aging!

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The Importance of Rebuilding the Immune System

A major factor underlying ***accelerated aging*** is a phenomenon known as **immune senescence**.

This marked decline in **immune function** strikes as we age past **60 years** and leaves us vulnerable to a host of opportunistic diseases.

Not only do we lose the ability to defend against cancers and infections, but our failing immune cells create a state of **hyperinflammation** that destroys neurons, endothelium, and joints.[1,2]

Life Extension® is funding research projects aimed at reversing the immune imbalance that causes chronic inflammatory disorders while failing to protect us from common pathogens. Once this research becomes clinically available, it may be possible to restore immune function back to youthful functionality.

The encouraging news is that maturing individuals can initiate steps today to improve immune surveillance while suppressing the degenerative fires of chronic inflammation.

Immune senescence makes us vulnerable to all the diseases of aging.

Recognition of this universal disorder has motivated scientists to identify solutions to compromised immune function through innovative pharmaceuticals and gene therapies. The dilemma is that translating these advances into clinical practice is still a few years away.

Fortunately, researchers have identified ***three*** specific natural compounds that have each been shown to ***reverse*** a broad spectrum of harmful changes that occur in the immune system with advancing age.

These three compounds are extracts of **Pu-erh tea**, ***Cistanche***, and **Reishi mushrooms**.

Each of these natural compounds has a millenniums-old history in traditional Asian medical systems, and is prized for their properties of improving quality of life and health, while promoting longevity. Each one also has its own unique profile of immune system-modulating effects that directly oppose the pathologic components of immune senescence.

Together, these nutrients help put the aging immune system back on a more youthful track, which in turn should help lower the risks for infections, malignancies, autoimmune disorders, and chronic inflammation.

How Aging Affects the Entire Immune System

Young people have a vigorous and well-regulated immune system that constantly patrols the body in search of potential threats to the healthy functioning of the body.[3]

But as people age, the immune system begins to lose its potency and effectiveness[1,2] in a process called ***immune senescence***. This aging in the immune system results in potentially devastating loss of the three main weapon systems against foreign invaders and cancer cells:

1. Reduction of ***bone marrow*** production of immune system cells,
2. Reduction of the supply and potency of ***circulating immune cells***, and
3. Loss of control over the production of the inflammatory and anti-inflammatory ***cytokines*** that maintain a safe and natural balance between sufficient and excessive inflammation.

As a result of these three changes, older adults become much more vulnerable to genuine threats, such as bacteria, viruses, and cancers, and at the same time are more likely to succumb to autoimmune disorders.[1]

Immune senescence can lead to a constant inflammatory state, in which the immune system is always "on" and often ends up attacking the body. This vicious cycle raises the risk for chronic conditions associated with aging, including arthritis, atherosclerosis, osteoporosis, and cancers.[1]

The good news is that extracts of **Pu-erh tea**, **Reishi mushrooms**, and ***Cistanche*** can help us fight back against the various factors of immune senescence. As beneficial as each individual component is, they have overlapping immunomodulatory activities that make the sum greater than the parts.

This article examines the immune benefits of each ingredient.

WHAT YOU NEED TO KNOW

Rebuilding Immune Defense

- Immune senescence is the gradual fading of all branches of the immune system with aging.
- Age-related changes occur in the bone marrow, which stops making as many and as potent immune system cells, in the size and composition of the circulating immune cell population, and in the balance of cytokines that maintain ample, but not excessive, inflammatory potential.
- As a result, older adults face a devastating array of infections, malignancies, and inflammation-aggravated disorders, all of which are life-shortening and reduce quality of life.
- A group of three natural extracts long used in traditional Asian medical systems, has been identified that provide overlapping coverage to oppose the destructive effects of immune senescence.
- Pu-erh tea extracts stimulate bone marrow activity, enhance the constituents of the circulating immune cells, and lower inflammatory cytokine levels while raising those of anti-inflammatory molecules.
- Reishi mushroom extracts enhance the circulating white blood cell pool and modulate cytokines, while also enhancing antibody-producing cells and stimulating activity of cells that devour bacteria and guide other immune cells to their targets.
- Cistanche deserticola extracts stimulate bone marrow and circulating white blood cells, lower inflammatory cytokine levels, and prolong life span in animal models of aging and immune senescence.
- The combination of all three ingredients provides broad-spectrum coverage to support the immune system and help protect against the triple threat of infection, inflammation, and cancer.

Pu-erh Tea Extract

Pu-erh tea (fermented, ripened leaves of *Camellia sinensis*) was historically prescribed to the emperors of China to provide them with longevity. It is native to the Upper Mekong River region of China's Yunnan province, a land of rain forests, rushing mountain rivers, and some of
the world's most spectacular scenery.

A major new study shows that **Pu-erh tea extract** contributes to ***reversing*** multiple components of immune senescence.

The study involved a widely used animal model of human aging, the ***senescence-accelerated mouse strain P8***, or SAMP8 mouse.[4] These SAMP8 mice are ideal for this kind of study because they have a shorter life span than normal mice and they demonstrate all of the immunological dysfunction seen in human immune senescence.

For the study, male SAMP8 mice and control mice that had normal aging and life spans were given either oral supplements of Pu-erh tea extract at various doses or a placebo for 28 days.[4] The animals' blood was then tested for various markers of immune dysfunction.

At the beginning of the study, the age-accelerated mice showed all of the features of immune senescence that occur in humans. For example, they had significantly lower bone marrow production of the vital **stem cell antigen-1** (Sca-1), a cell marker that indicates a robust, active production of healthy white blood cells. They also had lower proportions of versatile naïve T cells, natural killer cells, and activated cytotoxic T cells, while memory T cells were higher, as would be expected. In addition, levels of the powerful pro-inflammatory cytokine IL-6 were markedly elevated in the senescence-accelerated mice, compared with controls.

After supplementing with **Pu-erh tea** extract for four weeks using a dose equivalent in humans to **650 mg** per day, all of these features were reversed:

- In ***bone marrow***, the proportion of Sca-1 stem cells rose approximately **42%**, suggesting a much broader and faster immune response to challenges.
- In ***circulating white blood cells***, the proportion of natural killer (NK) cells rose by an approximate **7%**, while the percentage of versatile naïve T cells had an increase of about **10%**, and the proportion of activated T cells rose close to **9%**. This increase indicates enhanced protection against viral infections and cancers.

WHAT YOU NEED TO KNOW

Skyrocketing Death Risks with High Levels of IL-6 and CRP

Elevated IL-6 **and/or** C-reactive protein **is associated with a host of life-threatening conditions as shown in the table below:**	**Biomarkers**	
	IL-6	**CRP**
Increased risk of dying from any cause in people with a mean age of 61[65]	25%	
Increased risk of dying from any cause in people older than 80[66]	118%	158%
Increased risk of death following acute heart attack[67]	30%	30%
Increased risk of sudden cardiac death[68]	63%	

Increased risk of dying from any cause in patients with obstructive airway disease[69]	37%	
Increased risk of congestive heart failure following acute heart attack[67]	40%	40%
Increased risk of poor functional outcome after stroke[70]	210%	90%
Increased risk of knee osteoarthritis[71]	174%	
Increased risk of developing the blindness-inducing eye disease age-related macular degeneration (AMD)[72]	78%	118%

- ***IL-6 levels***, a pro-inflammatory cytokine, fell by a significant **43%**, reducing the risks associated with high IL-6 and chronic inflammation.

Powerful Anti-Inflammatory Effects in Humans

A **human** study of Pu-erh tea extract further emphasizes its role in reversing **inflammatory cytokine levels**. The study was performed among a group of patients with **metabolic syndrome**, a common condition defined by central obesity, borderline or high fasting glucose, and elevated triglycerides and cholesterol.[5] Those with metabolic syndrome have higher levels of inflammation and are at an increased risk of having low naïve and high memory T cell populations.[6]

Subjects were given either Pu-erh tea extract twice daily or a placebo. They were instructed to exercise and observe a healthy diet during the study period, but were permitted no medicines that might otherwise affect the results.

After three months, patients provided blood samples for analysis of **inflammatory cytokines** and other markers of inflammation.

As expected, placebo recipients showed no significant changes in blood levels of TNF-a or IL-6 (pro-inflammatory cytokine), IL-10 (an anti-inflammatory cytokine), or C-reactive protein (CRP, a marker of total body inflammation).

Subjects supplemented with **Pu-erh tea extract** showed robust improvements in immune status, including a marked reduction in inflammatory markers such as:

- **21%** reduction in **IL-6**,
- **23%** reduction in **TNF**-a,
- **26%** reduction in **CRP**, indicating significant decreases in their overall inflammatory status, and
- **34%** increase of *inflammation-quelling* **IL-10**, further demonstrating the overall reduction in inflammation.

Clearly, Pu-erh tea extract offers multiple benefits to prevent the progress of immune senescence. But, just as a good roof provides multiple, overlapping structures to prevent leaks, good immune system coverage should offer multiple, overlapping
mechanisms to ensure that no possible holes are left to allow untimely infections, inflammation, or cancers to progress.

As we will now see, **Reishi** mushrooms provide an ideal complement to **Pu-erh** (pronounced “Poo-air”) tea extract.

Reishi Mushrooms Teach Cells about Antigens, Antibodies

Reishi mushrooms (*Ganoderma lucidum*) have long been used in traditional Asian medical systems for the prevention and treatment of numerous human diseases.[7] These myriad benefits stem from Reishi's multiple classes of *bioactive molecules*, including polysaccharides, triterpenoids, sterols, and alkaloids. Each of these different components has a slightly different mechanism of action, resulting in very broad-spectrum immune system coverage.[7]

Like Pu-erh tea extract, Reishi extracts resurrect youthful patterns of ***circulating white blood cells***, including NK and T cells.[8-10] Reishi also helps raise protective ***IL-10*** levels and lower pro-inflammatory ***IL-6*** levels in animal studies.[11,12]

However, while Reishi lacks the ***bone marrow-stimulatory*** effects of Pu-erh tea extract, it has other benefits that Pu-erh tea does not, such as stimulating activities of immune circulating cells and stimulating energy production and transfer required by

the frenetic metabolic activity of active immune cells.[13]

In addition, Reishi enhances numbers and activities of the ***B cells.*** These B cells make antibodies and the ***macrophage/monocyte*** line of cells that engulf and destroy bacterial invaders. B cells also process foreign molecules (antigens), "presenting" them to T and B cells as examples of enemies in need of destruction.[7,9,14-18]

In this way, Reishi exerts subtle but powerful effects that reverse many of the impacts of immune senescence.[1]

Reishi Protects against Deadly Microorganisms

Based on laboratory and animal studies, there's now evidence that Reishi's cellular and molecular mechanisms directly protect against a deadly array of microorganisms that threaten the health of aging individuals. More human studies need to be

done, but based on a number of published studies the potential benefits of Reishi are extremely promising.

- Components in Reishi have been found to block infection with **Herpes simplex** (the virus that causes cold sores and genital herpes) and **Herpes zoster** (the virus responsible for painful **shingles** infections).[19] They accomplish this by activating natural killer cells and stimulating their proliferation, triggering them to label and destroy cells infected with

  the virus,[19] and by directly binding to the viruses, preventing them from attaching to and penetrating healthy body cells prior to setting up an infection.[20]
- Reishi extracts have been shown to reduce the painful effects of the viral outbreak in patients with ***postherpetic neuralgia***, an excruciating condition often resistant to standard pain management.[21] As with so many natural therapies, Reishi is most effective against herpes viruses when it is administered ***prior*** to the outbreak infection.[20,22]
- **Influenza viruses** are also targets of Reishi mushroom extracts, which are rich in trace elements essential for preventing influenza infections and mitigating their severity.[23]
- Reishi extracts potently inhibit the **Epstein-Barr virus**,[24,25] which causes both the relatively mild mononucleosis in young people and also several kinds of aggressive lymphomas in older ones.[26]
- Reishi mushroom extracts are effective against the dangerous **hepatitis B virus** (HBV), a major cause of liver disease worldwide. Studies show that the extracts can inhibit viral replication, reducing the organism's ability to express itself in liver cells.[27,28]
- Finally, Reishi extracts have an important role in combating one of the major scourges of the modern world, the **human immunodeficiency virus** (HIV), which causes the **acquired immune deficiency syndrome** (AIDS). Reishi

extracts produce a dramatic drop in the viral "load" (number of active virus particles) in monkeys infected with simian acquired immune deficiency syndrome (SAIDS), a model of human HIV/AIDS disease.[29] Laboratory studies now demonstrate that active compounds from Reishi mushrooms act by inhibiting HIV enzymes called *proteases*, an action identical to that of some of the most successful anti-HIV drugs on the market, but with vastly lower toxicity.[30] In this context, Reishi mushrooms have been said to have "*huge potential for HIV drug discovery*."[30]

All of these actions ultimately reflect the importance of Reishi mushroom extracts in reversing immune senescence by strengthening the aging immune system, while at the same time exerting direct destructive effects against some of humanity's
most relentless microbial foes.

But the beneficial effects of these remarkable mushrooms go still further, into the complex world of cancers and their interactions with the immune system.

Reishi Combats Cancer

Reishi mushroom extracts help prevent cancer before it starts by activating and modulating patrolling T cells and natural killer cells. These are the cells that identify abnormal cancerous tissue and attack it before it has a chance to develop into a full-blown tumor.[31,32] This is primarily the result of interactions of **Reishi polysaccharide molecules** with immune system cells, especially those in the spleen and the thymus, both of which are sources of aggressive cancer-killing cells.[33-35]

In mice bred to carry human cancers, Reishi has been found to inhibit tumor growth and prolong life span by stimulating normal immune function. Importantly, this effect was seen even when the [36] animals were treated *after* tumors had developed.

A similar extract of Reishi polysaccharides was found to markedly increase the ability of immune system cells to proliferate, engulf, and destroy tumor cells in mice bearing a variety of human cancers.[34] In addition, Reishi polysaccharides have been found to inhibit the adhesion of the "coating" protein, *fibrinogen*, to cancer cells, thereby stripping malignant cells of the protection naturally afforded by fibrinogen, and making the cells directly accessible to NK cells that destroy them.[37]

With all of this evidence in hand, it is easy to see why Reishi mushroom extract makes an ideal companion to **Pu-erh tea extract** in providing broad-spectrum protection aimed at preventing and reversing immune senescence and its infectious and malignant consequences.

But there's one additional compound called *Cistanche* that adds still another layer of immune system-potentiating proprieties.

Pu-erh tea extract fights against immune senescence by stimulating bone marrow activity, enhancing the constituents of circulating immune cells, and lowering inflammatory cytokine levels while raising those of anti-inflammatory molecules.

How does it do it?

Its unique quality and benefits can be distinguished from other types of tea by the degree of fermentation that each undergoes:[46-48]

- Green and white teas are made from dried but ***unfermented*** leaves of *Camillia sinensis*, the tea plant.
- Oolong tea is ***partially fermented***.
- Black tea is ***fully fermented***, but then used without further post-fermentation activity.
- Pu-erh tea is different from these other teas because it is a *"**post-fermented**,"* or *"**ripened**"* tea. It is allowed to undergo a natural microbial fermentation process under controlled conditions, which enhances the availability of beneficial bioactive molecules.[47,49]

Extracts from Pu-erh tea are rich in polyphenols and other bioactive molecules that develop during the unique post-fermentation process, including a unique group of phenolic compounds known as ***theabrownins***.[46,48,50-52] In comparison with green and black teas, Pu-erh tea is also especially rich in the polyphenol ***gallic acid***, a product of the fermentation process by which epigallocatechin gallate (EGCG), an active component in green tea, is broken down.[53]

These unique features make Pu-erh tea especially beneficial in supporting a strong, healthy immune system.

Cistanche Enhances Immune Responses

Cistanche deserticola is a resilient desert plant commonly used in traditional Chinese medicine to enhance longevity and treat many different health problems.[38] *Cistanche* extracts have been found to combat immune senescence by enhancing healthy immune responses while suppressing deleterious inflammatory ones.

Its extracts reduce ***inflammatory changes*** in animal models of intestinal inflammation, while also boosting the numbers of ***circulating white blood cells*** such as macrophages ("eating cells") and NK cells, particularly in the spleen, in ways that Pu-erh tea extracts do not, though this activity [38,39] does overlap constructively with that of Reishi.

Cistanche supplementation in animals also increases numbers of versatile **naïve T cells**, and reduces numbers of inflexible, committed memory T cells, while lowering ***pro-inflammatory IL-6*** levels in blood.[39] *Cistanche* stimulates ***bone marrow production*** of white blood cells, an effect found in Pu-erh tea extract, but lacking in Reishi.[39]

Cistanche's anti-inflammatory effects deserve some additional notice, given the importance of inflammation in most age-related diseases. Increased inflammation itself is a clear-cut consequence of immune senescence, as the body's immune regulatory systems begin to fail, releasing pro-inflammatory processes from their normal, youthful levels of control.

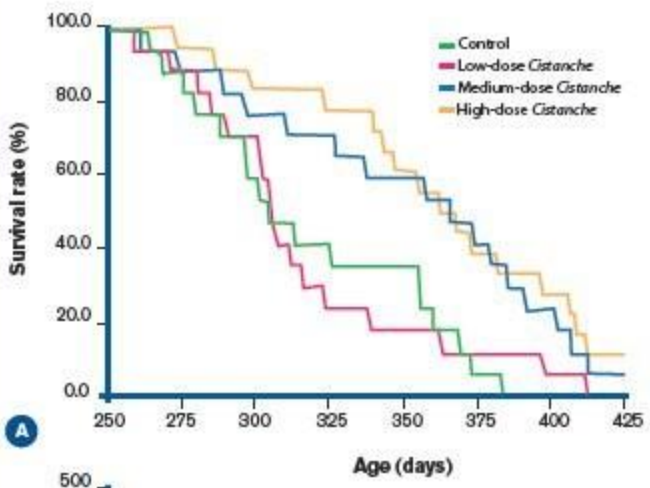
In animal studies, supplementation with *Cistanche* extracts reduces the inflammatory overgrowth in the intestines of cancer-prone mice (these animals, like humans, develop increased intestinal inflammation prior to development of cancers).[38,40] And *Cistanche* components known as ***phenylethanoid glycosides*** have been credited with multiple anti-inflammatory actions through their impact on a host of inflammatory molecular processes.[41,42] These unusual molecules have been shown to have the following anti-inflammatory actions:

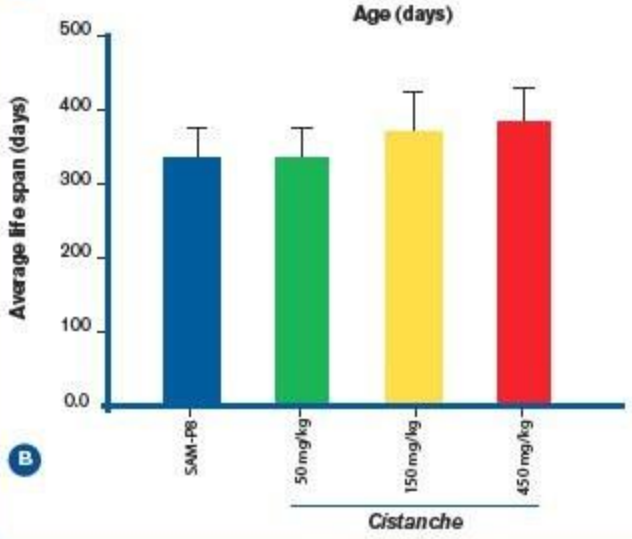
- Inhibition of pro-inflammatory signaling.[42]
- Reduced production of inflammatory cytokines including TNF-a and IL-4.[43]
- Reduced allergic responses related to decreased production of histamine and other contributors to allergy, which is in essence an inflammatory overreaction of the immune system.[43,44]

The combination of *Cistanche's* ability to enhance healthy immune responses while suppressing deleterious inflammatory ones has been credited with extending life span in mouse models of aging.[39] Here are the intriguing details.

A group of Chinese researchers used a special strain of laboratory mice bred to age faster than normal mice (the same SAMP8 mice mentioned earlier), to study the effects of *Cistanche* supplementation on life span.[39] The accelerated aging of these animals produces accelerated immune senescence as well.[39]

FIGURE 1: Life Span Extension in Mice Supplemented with *Cistanche*.[39]





A) *Cistanche* increased survival of age-accelerated mice. Control mice (green line) were all dead by about 382 days, and low-dose (pink) *Cistanche* mice had all died by about 413 days. About **5%** of mice supplemented with medium (blue) and about **10%** of mice supplemented with high (gold) doses of *Cistanche* were still alive by the end of the study, at 425 days.

B) *Cistanche* increased average life span of mice. Control age-accelerated mice (blue) lived on average about 325 days, as did mice supplemented with low-dose *Cistanche* (green). Mice supplemented with medium (yellow) and high (red) doses of *Cistanche*, however, had longer life spans compared with control mice, at about 350 and 375 days, respectively.[39]

Cistanche Increases Life Span

The first finding in this study was significant reductions in the supplemented animals' "memory T cells," which are immune system cells that can only respond to one kind of threat that they have experienced in the past.[39] An increased proportion of senile memory T cells is a classic feature of immune senescence because these cells have lost their flexibility to respond to new threats.

At the same time, *Cistanche*-supplemented mice had increased numbers of so-called "**naïve T** cells," which are immune cells that have *not* yet encountered any threat, and are therefore capable of rapid responses to any ***new*** abnormal cell, such as an
infecting organism or a potentially cancerous cell.

Cistanche -supplemented mice also had increased numbers of natural killer (NK) cells, which respond to T cell signals and apply the death blow to the new invader.

One of the most exciting feature of this study is the impact of *Cistanche* supplementation, and the reversal of immune senescence, on the animals' life spans.

In this study, while control mice lived on average about 325 days, mice supplemented with *Cistanche* lived to an average of about 375 days.[39] That's a **15.4%** increase in life span![39] (See Figure 1) If this increase were applied to the human life span,
the average American female's life expectancy would jump from 81 to more than 93 years, while that of the average American male would jump from 76 to 88 years.[39,45]

Read the preceding paragraphs again carefully, and you'll discern the emergence of a new paradigm for fighting aging. In addition to focusing on preventing or repairing heart disease, Alzheimer's disease, stroke, cancer, and other disease processes

that shorten life span, an overall improvement in the **immune function** seems capable of promoting longevity all by itself!

OVERLAPPING IMMUNOMODULATORY ACTIVITIES OF THREE NATURAL EXTRACTS

Extract	Stimulates Bone Marrow	Stimulates Circulating White Blood Cells	Lowers IL-6 Levels	Boosts IL-10 Levels	Enhances Antibody Production	Stimulates Macrophage-Monocyte Cells
Pu-erh Tea	X	X	X	X		
Reishi Mushrooms		X	X	X	X	X
Cistanche	X	X	X			

Summary

Immune senescence is a consequence of normal aging. It is a major cause of the ill effects associated with growing older.

Immune senescence is accompanied by the devastating loss of three main weapons systems against foreign invaders and cancer cells including:

1. ***Bone marrow*** production of immune system cells.
2. Potency of ***circulating immune cells***.
3. Control over ***signals*** that maintain a youthful balance between sufficient and excessive inflammation.

The cumulative impact of **immune senescence** is seen in the high rates of infections and cancers, the poor response to vaccines, and the chronic inflammatory state that predominates among older adults who might otherwise be in excellent health.

It's now possible to fight back against immune senescence with help from three natural ingredients. Extracts of **Pu-erh** tea, **Reishi** mushrooms, and ***Cistanche*** have demonstrated their own suite of immune senescence-fighting properties that help restore more youthful immune function.

Maturing individuals face health threats posed by immune senescence. Major breakthroughs may be around the corner, but taking steps now to rebuild aging immune systems is a critical component of a science-based longevity program.

If you have any questions on the scientific content of this article, please call a **Life Extension**® Health Advisor at 1-866-864-3027.

THREE IMMUNE SYSTEM WEAPONS

The following is a more detailed look at the three aspects of the immune system that are positively impacted by Pu-erh tea, Reishi, and *Cistanche* extracts. Scientists have now identified many of the specific problems that occur during immune senescence. These problems arise in all three of the immune weapons systems.[1,2]

Bone Marrow

Bone marrow is where circulating white blood cells are made, along with red cells that carry oxygen and platelets that stop bleeding.[54] All bone marrow-derived cells originate from a common predecessor, the blood-forming ***stem cells*** that differentiate into a wide variety of circulating white blood cells, with a bewildering array of names and functions.

Immune senescence causes a reduction in bone marrow stem cell activity, leaving us with reduced numbers of all the circulating cell lines. Scientists use a cell marker called **Sca-1** to measure bone marrow activity in animals: The higher the Sca-1 levels, the more vigorously new white blood cells are being produced. In aging bone marrow, levels of Sca-1 cells fall off significantly, resulting in a sharp, age-related reduction in bone marrow-derived white blood cells and their chemical weaponry, and the subsequent age-associated increase in infections and cancers.[55,56] Current animal research has demonstrated valuable stem cell concepts that are relevant to human health and disease.[56]

Circulating White Blood Cells

Circulating white blood cells are the mature, bone marrow-derived cells that recognize and destroy invading or abnormal cells. Among those most directly affected by immune senescence are ***natural killer*** (NK) cells, which directly attack and destroy infecting organisms and tumor cells,[1,2,57,58] and a variety of ***T cells***, which are involved in recognizing new threats, remembering old threats, stimulating direct action against invaders or malignancies, and suppressing the immune response appropriately when the invader has been neutralized.[59] These cells prevent serious infections, keep a constant patrol out for emerging cancers, and boost immunity after a vaccine.

Immune senescence specifically reduces the numbers and function of fresh young NK cells.[1,2,57,58] This is now thought to explain the high rate in older people of many cancers and leukemias, as the malignant cells fly under the impaired NK cells' radar. [1,2,58] In fact, rejuvenation of NK function is being explored as a promising means of preventing the spread of breast cancer.[60]

Similarly, age-related loss of NK function is implicated in the development of viral infections such as influenza, an annual killer of thousands of older adults.[61] Studies show the importance of energetic NK cell function in producing vigorous responses to influenza and other vaccines. [62]

Immune senescence also reduces the numbers and changes the function of circulating T cells, shifting their population from a youthful one predominated by ***naïve T cells*** capable of recognizing and responding to new threats, towards an aging one predominated by ***memory T cells*** that have committed themselves to fighting just one specific type of insurgent.

Such a shift in T cell patterns makes us unnecessarily vulnerable, for example, to each season's new influenza virus or emerging threats like West Nile virus, and at the same time less capable of responding to a host of vaccines.[2,63]

Inflammatory Cytokines

Inflammatory cytokines are signaling molecules that immune systems use to notify their various components of a need for attack, cleaning up an infection, and repair after tissue damage.[64] Among the most prominent and potent inflammatory cytokines is **interleukin-6 (IL-6)**.[59]

In youth, exquisite control systems regulate production of IL-6 and other cytokines to limit their actions only to active trouble sites, shutting down their production once a threat has been neutralized, and boosting production of other cytokines that contribute to resolution of inflammation (e.g., IL-10).[59,64]

But during immune senescence, these systems fail to operate properly, resulting in chronic elevations of IL-6, along with chronic suppression of anti-inflammatory cytokines.[59,64] This state of immune senescence has been aptly referred to as "inflamm-aging."[59,64]

Studies show that people who seem to be undergoing "healthy aging," not succumbing to the inflammatory state, have lower levels of IL-6, and higher levels of anti-inflammatory cytokines, such as IL-10.[59]

Those with higher levels of IL-6 are much more likely to demonstrate ***frailty***, which renders some older individuals especially vulnerable to falls, fractures, and infections.[64]

Immune senescence poses a major threat to longevity and quality of life by degrading three major defenses against outside attack or inside malignancies. Loss of bone marrow function, deleterious changes in circulating natural killer and T cells, and sharp increases in IL-6 and other inflammatory cytokines set one up for disability and death from infections, inflammation, and cancer.

Fortunately, breakthroughs in nutritional science now offer means of **reversing immune senescence** by providing a restructuring of the aging immune system's three primary bulwarks: restoring bone marrow function, shifting circulating cell populations back towards a more youthful pattern, and reducing deadly elevations of IL-6.

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