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Review Article

IMPROVING IMMUNITY THROUGH HEARTFULNESS MEDITATION – A LITERATURE REVIEW

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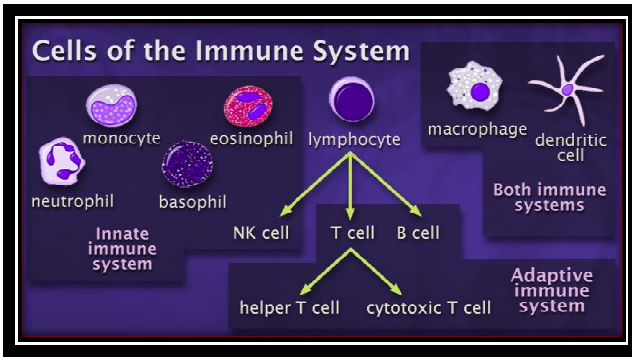
ABSTRACT

The human immune system consists of many interdependent cell types that together defend the body from infections and prevents the growth of tumor cells. Its effective functioning depends on a balanced interplay between immune cells, their chemical mediators, and the regulatory neuro endocrine pathways. Stress tilts this balance through several mechanisms and results in impaired immunity. The purpose of this article is to explore the beneficial effects of meditation on the immune system. Based on the contemporary research, it is evident that regular practice of meditation improves the functioning of the immune system through its moderating effect on emotional, psychological and neuro endocrinal pathways. Meditation improves immunity against infections and cancer and it is an effective adjunct in the treatment of several auto immune disorders. Almost all the methods of meditation explored so far have been effective in this regard, however, strict adherence to the practice appears to be crucial. In today's busy world, people generally require user-friendly systems. Customized adaptations of Raja Yoga system like Heartfulness meditation are simple, easy to practice and foster better adherence to derive maximum benefits.

INTRODUCTION

The immune system consists of many interdependent cell types that together defend the body from bacterial, parasitic, fungal, viral infections and from the growth of tumor cells. They have specialized functions like engulfing bacteria or killing parasites, tumor cells, viral-infected cells etc. Immune function is essentially a complex interaction between cells and cellular products. The white blood cells (leukocytes) are the primary fighter cells of the immune system. They are made of 3 classes; lymphocytes, monocytes, and granulocytes. Each class has its very own functions. Lymphocytes are subdivided into B cells, T-helper cells, T-suppressor cells, and natural killer cells. T-cells are accountable for making close and direct contact with the antigen and produce cytokines, lymphokines, and interleukins which in turn activate B cells to produce antibodies that neutralize the antigens of microbes.



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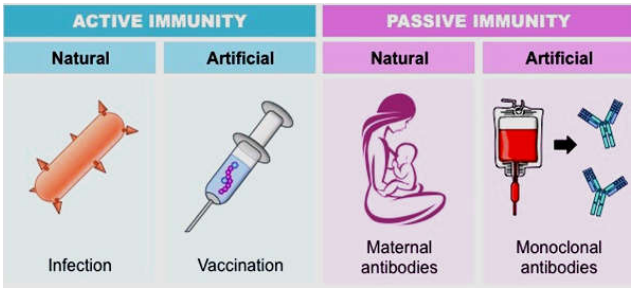
T-helper cells enhance while T-suppressor cells lower this response. Monocytes mature to develop into dendritic cells or macrophages. Dendritic cells function as antigen presenting cells and macrophages are phagocytic cells. Granulocytes mainly function as phagocytes. They digest the engulfed antigens like bacteria, virus and other parasites (Binder CJ *et al*., 2005).

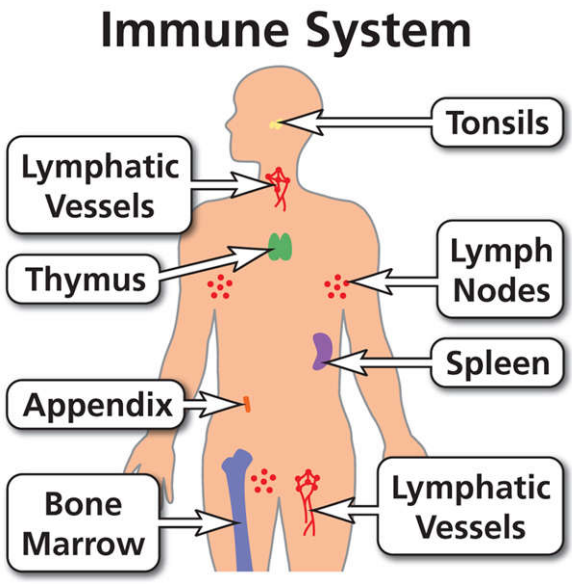


Humans have two forms of immunity – Innate (Natural) and Adaptive (Acquired) immunity.

Innate immunity represents the primary line of defense to an intruding pathogen. It is an antigen-independent (non-specific) defense mechanism that is utilized by the host within hours of encountering an antigen. The innate immune reaction has no immunologic reminiscence and, consequently, it is not able to apprehend or "memorize" the same pathogen should the body be exposed to it in the future. The primary feature of innate immunity is the recruitment of immune cells to sites of infection and inflammation without delay through the production of cytokines (Kawai T *et al*., 2010).

Acquired immunity may be active or passive in nature.

Active (Adaptive) immunity refers to the production of antibodies towards a specific agent after exposure to an antigen. It may be acquired after a natural infection or after administration of a vaccine with inactivated organisms. Adaptive immunity is antigen-dependent and antigen-specific, consequently, includes a lag time between exposure to the antigen and the maximal reaction. The hallmark of adaptive immunity is its memory, which allows the host to mount a more rapid and efficient immune reaction upon subsequent exposure to the same antigen. Adaptive immunity develops when innate immunity is ineffective in getting rid of an infectious agent and the infection is mounting up.



Passive immunization refers to the transfer of active humoral immunity, in the form of "ready-made" antibodies, from one person to another. It could occur naturally via transplacental transfer of maternal antibodies to the growing fetus, or it could be transferred artificially via injecting a recipient with exogenous antibodies directed against a specific pathogen or toxin (Trinchieri G *et al*., 2003; Medzhitov R *et al*., 2007). Cells of the immune system are positioned all through the body in different organs. Inside these organs, the lymphocytes grow, mature and are deployed.

All the cells of the immune system are initially derived from the bone marrow via hematopoiesis. Bone marrow produces B lymphocytes, natural killer cells, granulocytes and immature thymocytes, in addition to red blood cells and platelets. Immature thymocytes, also called prothymocytes, depart from the bone marrow and migrate into the thymus, where they mature to form T lymphocytes.

The spleen is an immunologic filter of the blood. It is largely made of B cells, T cells, macrophages, dendritic cells, natural killer cells and red blood cells. These cells capture foreign antigens from the blood that passes through the spleen.

Lymph nodes are observed all through the body and act as immunologic filters for lymph. Composed mainly of T lymphocytes, B lymphocytes, dendritic cells, and macrophages, these nodes drain fluid from most of our tissues. Antigens are filtered out of the lymph within the lymph node before the lymph returns to the circulation.

In addition, migratory macrophages and dendritic cells bring antigens from different organs to the spleen and lymph nodes, present those foreign substances to the T and B lymphocytes, consequently starting up an immune response (Straub RH *et al*., 1998; Saladin KS and Miller L, 1998; Cyster JG, 1999; Ader R *et al*., 1995).

Cortisol and Immunity

Almost all the cells that are part of immune and/or inflammatory reactions are powered by cortisol. Cortisol and corticoids regulate the functions of lymphocytes, natural killer (NK) cells, monocytes, macrophages, eosinophils, neutrophils, mast cells, and basophils. These white blood cells act as defense system of the body at places of injury or in the course of the microbial invasion. They combat the invaders with potent chemicals (Collip JB and Anderson EM, 1935; Duncan WC, 1996).

Chemical mediators released by the white blood cells at the site of inflammation or infection may cause damage to the surrounding tissues that commonly manifests as the classic signs of inflammation- Calor (heat), Rubor (redness), Dolor (pain) and Tumor (swelling). Cortisol functions to minimize this collateral damage. It prevents the local white blood cells from binding to the site of inflammation and letting out their chemicals. In addition, it maintains lower levels of available white blood cells by presiding over the number of circulating lymphocytes and other white blood cells. By doing so, any exaggerated reaction of the immune system, irritation and

tissue destruction that takes place at the site of congregating white blood cells may be kept under control (Hartman FA and Brownell KA, 1930; Jameson P *et al*., 1997).

Persistent infection, lifestyle factors like unhealthy dietary habits and stress impair cortisol's functions and wreck the immune system. All physiological responses that occur due to the activation of the sympathetic nervous system are enhanced by cortisol. Cortisol, if present in the blood for a longer period, results in the production of cytokines which in turn develops resistance to cortisol. Persistent and excessive cortisol resulting from stress causes excessive weight gain, hirsutism, and diabetes. Over the time, immune cells get desensitized to cortisol and lead to chronic inflammation and autoimmune conditions like fibromyalgia, rheumatoid arthritis, and systemic lupus erythematosus (Elenkov IJ and Chrousos GP, 1999).

Chronic stress results in dysfunction of immune cells and their chemical mediators which reduce body's defense to an acute illness. Thus, the body is prone to infection and healing process gets delayed (McEwen BS, 1998).

Stress and immune system

With the contemporary lifestyles, stress has become a common companion in daily life. Stress can be either beneficial or detrimental. Eustress generates a well-regulated fight or flight response which helps to overcome the problems and challenges of daily life. This is essential for us to cope up with our emotional and physical environment and succeed in life. Distress produces an unregulated and persistent fight or flight response which goes on self-perpetuating resulting in a wide variety of harmful effects on the mind and body (Burke RJ, 1994).

When stress becomes chronic, many organ systems in the body are affected. Persistent stress results in excessive levels of cortisol and other corticosteroids circulating in the blood for a longer period of time that produces irregularities in the immune responses. This result in increased susceptibility to infections, increased risk of cancer, tendency to develop an allergy, increased gastrointestinal problems and an increased risk of autoimmune disorders (Brady JV, 1958; Kiecolt-Glaser JK *et al*., 1984). Chronic stress also leads to anxiety, depression, sleep deprivation, hypertension, cardio vascular diseases, diabetes and metabolic syndrome (Miller AL, 2006; Adam FB, 2017). Stress also leads to unhealthy behaviors such as smoking, overeating, or drug abuse which can further deteriorate health (Khansari DN *et al*., 1990; Tsigos C and Chrousos, 2002; GP Miller DB and O'Callaghan JP, 2002).

Chronic psychological stress reduces immune system's reaction to hormonal stimuli (Miller GE *et al*., 2002). Studies on the students during exam times revealed that the level of T-lymphocytes and their response to mitogens was lower and there was a higher self-reported occurrence of health problems, such as upper respiratory-tract infections (O'leary A, 1990). Stress being the cause of depression and vice versa is debatable and needs further research. Persistent stress leads to the development of depression. Stress may result from anxiety, depression or other unpleasant life events.

Recent studies found a clear connection between the inflammation and depression. There is a dynamic communication between the brain and immune systems using specialized pathways. Cytokines released as part of the inflammatory response alter the function of neurotransmitters like serotonin, dopamine, and glutamate, all of which play a role in the development of depression (Wheatley D, 1997; Cavaillon JM, 1994; Beaton DB, 2003). Cytokines, which are the markers of inflammation, have been found to peak in people with depression, confirming the fact that immune system is definitely at risk in them. Often, patients with depression complain physical pain such as abdominal pain, musculoskeletal pain, headaches and even chest pain. This psychosomatic effect is commonly seen due to an increase in the inflammatory markers. Current consensus is that depression should be viewed and evaluated as a whole-body phenomenon, taking into account the multiple systems it can affect in the body (Haapakoski R *et al*., 2015; Raison CL *et al*., 2013; Felger JC and Miller AH, 2014)

There is clear evidence that schizophrenic patients need longer healing times after major surgeries. Research findings showed that these patients had a reduced efficiency of cytokine function to fight inflammation which could be explained by their weakened hypothalamus-pituitary-adrenal pathways (McKim DB *et al*., 2016; Hodes GE *et al*., 2014). Everyday occurrences that drastically affect emotions can also create stress, thus weakening the immune system. Spoiled relationships with friends, partners, co-workers and/or family members can take a toll on the mind and the body.

Managing stress through relaxation techniques, Meditation, Yoga, Positive thinking and molding a healthy lifestyle can dramatically improve mood and strengthen the immune system.

Effects of meditation on Immune system

Research has shown that meditation produces remarkable effects on the brain and immune functions. During the recent times, the beneficial effects of meditation on health are being acknowledged by the scientific community as well as by the laymen (Rivest S, 2009; Davidson RJ *et al*., 2003; Davidson RJ *et al*., 2004)

Studies revealed that the relaxation produced after meditation reduces the levels of IL-6, a proinflammatory cytokine produced by T cells, that plays a major role in the pathophysiology of several auto immune diseases, different types of cancers and Alzheimer's diseases (Ishihara K and Hirano T, 2002). Meditation increases telomerase activity and lengthens telomeres and thus promotes immune cell longevity. Beneficial effects of meditation also include reducing the activity of nuclear factor-$_k$B (NF-$_k$B) which is a mediator in the pathogenesis of certain cancers, arthritis, chronic inflammatory conditions, asthma and neurodegenerative diseases and lowering C - reactive protein levels that is high in lymphoma, systemic lupus erythematous, arteritis, rheumatoid arthritis and inflammatory bowel disease (Black DS *et al*., 2013; Jacobs TL *et al*., 2011; Creswell JD *et al*., 2012).

Meditation has also been shown to increase the levels of salivary immunoglobulin A, which is an important immune mediator at mucosal surfaces such as gastrointestinal tract, respiratory tract and genitourinary tract (Davidson RJ *et al*., 2003; Bower JE *et al*., 2015; Creswell JD *et al*., 2012; Jedel S *et al*., 2014; Malarkey WB *et al*., 2013; Oken BS *et al*., 2010).

Meditation increased the levels of hemagglutination-inhibition antibody titer against influenza virus thus increasing immunity against some of the common viral infections (Benson H *et al*., 1974; Jacobs TL *et al*., 2011; Olivo EL, 2009; Pace TW *et al*., 2009). Regular meditation practice increased absolute lymphocyte count which is an important predictor of the risk of opportunistic infections (Hall JM *et al*., 2012). In patients with HIV and advanced breast cancer, meditation increased CD4 T cell count and favorably altered CD4+/CD8+ ratio (Chun TW *et al*., 2002).

Meditation weakens the connection between medial pre frontal cortex and amygdala which in turn increases attention and concentration. It also strengthens the lateral pre frontal cortex which moderates emotions, behaviors, and habits. Meditation increases grey matter content and the differentiation between sulci and gyri. Meditation also increases cortical thickness in anterior cingulate cortex, pre frontal cortex, and hippocampus which govern the self-regulatory process, executive functions, learning, and memory. In addition, meditation decreases the size of the amygdala, the center of fight or flight response. These changes favorably regulate emotions, attention, awareness, perception, memory, learning and self-orientation and decrease anxiety. Similarly, decrease in skin resistance found in individuals with stress, anxiety, and psychosomatic problems are also reverted with meditation (Learning E, 2000; Saatcioglu F, 2013; Nelson DE *et al*., 2004; Epel ES *et al*., 2016; Strauss C *et al*., 2014).

Meditation stimulates the release of healing hormones such as melatonin, serotonin, endorphins, DHEA etc. which promote feelings of happiness and well-being that in turn influences immune system favorably. Meditation also suppresses gene expressions related to stress and inflammation and promotes wound healing. Furthermore, meditation down regulates amyloid-beta protein production in patients with Alzheimer's disease and thus, positively affects dementia and depression (Khoury B *et al*., 2015; Jain FA *et al*., 2015; Hilton L *et al*., 2017).

The calming effects of Heartfulness Meditation on cardio respiratory systems and stress have been discovered. Regular practice of Heartfulness Meditation can aid in stress reduction and general well being. Shifting the autonomic balance towards parasympathetic from sympathetic and reducing the secretion of stress hormones are the key reasons. Relaxation response produced from meditation reduces metabolic rate, moderates fight or flight response, reduces breathing and heart rate (HR), lowers blood pressure, brings cortisol and lactate levels down, and elevates blood flow to the key internal organs. Heartfulness Meditation alleviates physical and psychological stress and restores mental harmony, and if practiced on a regular basis- it is a remarkable medium for maintaining and promoting physical, mental and spiritual health (Solberg EE *et al*., 2004; Wallace RK *et al*., 1971; Banquet JP, 1973; Jevning R *et al*., 1978).

CONCLUSION

Modern medicine's understanding of the human immune system, as a complex multidimensional interaction among different organ systems, is slowly expanding, throwing its light on new facets like neuro endocrine and psycho emotional aspects governing its effective functioning. Chronic stress, although mental in origin, has many detrimental effects on the body as well as on the immunity by creating an imbalance in the neuro endocrine pathways. Meditation establishes moderation in the person's psychological and emotional spheres and corrects the imbalance at neuroendocrine pathways. Studies exploring this aspect have revealed that meditation moderates the levels and functions of several immune cells and mediators like CD4+ T cells, Inter Leukins-6 (IL-6), lymphocytes, cytokines, amyloid proteins, Immunoglobulin A (Ig A), nuclear factor-κB(NF-$_k$B), *C-reactive protein* (*CRP*), hemagglutination-inhibition antibody etc. Regular practice of meditation enhances immunity against infections and has been an effective adjunct in the management of Alzheimer's disease, multiple sclerosis, systemic lupus erythematosus, arteritis, rheumatoid arthritis, inflammatory bowel disease and several other auto immune diseases.

Different meditation techniques adapted from Raja Yoga system have been studied, investigating their beneficial effects on the immunity. Evidence generated till date substantiates favorable effects of meditation on immunity - if practiced on a regular basis. More regular, sincere and longer the practice had been, better were the results. Limitations in most of these studies are -shorter durations, small numbers of participants, high attrition rates and most are uncontrolled and observational studies. We need more studies on large groups exploring this angle further deep. It is the common man's perspective that most of the traditional methods of meditation are not very easy to follow with all the required diligence. Choosing a simple and effective method suiting the current day's busy lifestyles appears to be the key to enable better adherence. Modified Raja Yoga systems like 'Heartfulness meditation', which are simple and practiced by the majority of spiritual seekers around the world over the last several decades, needs to be explored much deeper through large controlled trials in this regard.

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