



## The Immune System May be Strengthened by Exercising

### Description

Researchers have been intrigued by the relationship between physical activity and inflammation since a study in the early 1900s found that Boston marathoners had an increase in white blood cells following the event. A recently released Harvard Medical School research paper, printed in *Science Immunology* on November 3rd, may have identified a molecular basis for the century-old observation. Research conducted on mice has indicated that physical activity may be beneficial, in part, due to the involvement of the immune system. The study found that exercise-induced muscle inflammation stimulates T cells, or Tregs, which aid in more efficiently using energy and increasing overall exercise stamina.

The research team has uncovered a new role for Tregs which is to help the body's immune responses during exercise. Longstanding knowledge has already established Tregs as being responsible for combating inflammation associated with autoimmune diseases. The T cell arm of the immune system is known to be influential in tissue health, according to a study conducted by Diane Mathis, Morton Grove-Rasmussen Professor of Immunology at the Blavatnik Institute at HMS. The research indicates that the immune system has an important role to play in muscle function during physical exercise.

Citing the need for further research to replicate the findings, the researchers emphasized that these results should not be generalized to humans. Nonetheless, the work is an important step in elucidating the cellular and molecular modifications that accompany physical activity and engender its health advantages. Gaining insight into the molecular factors that are associated with physical activity is essential.

For years, researchers have been captivated by the inquiry of how physical activity makes us healthier. This is due to its demonstrated benefits like safeguarding against dementia, diminishing the possibility of diabetes, and protecting from cardiovascular disease. Research into the molecular basis of physical activity is being intensified. A key element of this work is to decipher the role of the immune system in all of this.

It has long been established that exercise can lead to inflammation, Kent Langston, a postdoctoral researcher in the Mathis lab, observed; however, the precise immune mechanisms that are triggered

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by this have yet to be fully elucidated. Through their research, they were able to take a closer look at how T cells respond to physical activity in the muscle. Previous studies in exercise physiology have largely concentrated on the hormones discharged during physical activity and how they influence the organs such as the heart and the lungs. However, the new study has explored the immunological cascade that takes place within the muscle, which is the actual point of exercise.

### **Heroes of T cells and villains responsible for inflammation**

Engaging in physical activity can produce some temporary harm to the muscles, initiating a series of inflammatory reactions. It increases the expression of genes responsible for muscle form, metabolism, and the performance of mitochondria, which are the small engines that energize cellular activity. Mitochondria are an essential part of adapting to exercise as they enable cells to satisfy the amplified energy requirement of exercise.

The researchers of the new study examined the cells from the hind-leg muscles of mice that were made to run on a treadmill once, as well as those from mice that were given regular exercise, and contrasted them with cells taken from inactive mice. The mice that were running on the treadmills, regardless of the frequency, had muscle cells that had the standard indicators of inflammation – a stronger reaction of genes responsible for different metabolic activities and higher concentrations of inflammation-causing compounds, such as interferon.

The muscles of both groups displayed increased Treg cells, and these cells seemed to reduce exercise-induced inflammation in those same groups. However, the muscles of inactive mice had no such changes.

The benefits of exercise on metabolism and performance were seen only in the mice that exercised regularly. Researchers observed that Tregs reduced inflammation and muscle damage, as well as changed muscle metabolism and muscle performance. These findings correlate with established knowledge that a single session of exercise does not result in considerable improvements in performance, and that regular workout over time is necessary to gain advantages.

Subsequent investigations corroborated that Tregs were, in fact, responsible for the wide-ranging advantages experienced by frequent exercisers. Animals that lacked Tregs had uncontrolled muscular inflammation, characterized by the quick accumulation of inflammation-inducing cells in the hindleg muscles. Furthermore, the mitochondria of their muscle cells were distinctly bloated, indicating an anomaly in metabolism.

Significantly, mice without Tregs did not exhibit the same adaptive improvement in response to increased exercise as those with intact Tregs. Consequently, their overall fitness and aerobic capacity were significantly reduced. The investigators found that these creatures had an abundance of interferon, a chemical that can trigger inflammation. Further investigation showed that interferon had a direct effect on muscle fibers to disrupt mitochondrial activity and restrict energy production. Blocking interferon reversed the metabolic issues and aerobic aptitude was improved in mice without Tregs.

According to Langston, interferon is the offender in this situation. Without the protective Tregs to stop it, interferon caused an abundance of destruction. Interferon has been identified as a potential source of chronic inflammation, a phenomenon related to many long-term disorders and age-related conditions. Consequently, treatments to decrease this type of inflammation have been explored.

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Additionally, the use of Tregs to address immunologic conditions characterized by an overabundance of inflammation is being studied by scientists and the medical industry.

The results of the study offer a look into the cell activity that explains exercise's anti-inflammatory capabilities and highlight its significance in allowing the body to use its own immune powers, the investigators remarked. Scientists are attempting to create treatments for Tregs for particular diseases caused by abnormal inflammation. Additionally, the researchers observed that exercise could be a way to moderate inflammation in addition to properly adjusted therapies. Mathis pointed out that exercising is an effective method to strengthen the body's defenses and reduce inflammation. It is possible that exercise may also be increasing the activity of Tregs in other areas of the body, although this has only been examined in the muscle thus far.

The [benefits of exercise on the immune system](#) have been highlighted by Harvard Medical School. Ekaterina Pesheva wrote the original piece, though it may have been altered for length and style.

#### Article Source:

[Research](#) provided by Harvard Medical School. Original written by Ekaterina Pesheva.

#### Journal Reference:

*P. Kent Langston, Yizhi Sun, Birgitta A. Ryback, Amber L. Mueller, Bruce M. Spiegelman, Christophe Benoist, Diane Mathis. **Regulatory T cells shield muscle mitochondria from interferon- $\gamma$ -mediated damage to promote the beneficial effects of exercise.** Science Immunology, 2023; 8 (89) DOI: [10.1126/sciimmunol.adi5377](https://doi.org/10.1126/sciimmunol.adi5377)*

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