Components and Effects of Exercise on the Immune System

The general function of the immune system is to free the body of foreign agents including bacteria, viruses, and malignant cells. The immune system identifies infectious agents and malignant cells because those agents and cells contain abnormal antigens in their cell membranes. The immune system can also restrain consequent formation of a tumour by counteracting factors responsible for its growth. The acute and longer-term effects of exercise training on immune system function are shown in **Table 1**.

Table 1. Components of the Immune System.

Immune System Component	Depiction
Innate immune system • Monocytes • Macrophages • Neutrophils • Natural killer cells	• Nonspecific response • Nonspecific killing response of tumour cells by phagocytosis and cytolysis
Acquired immune system • Cytotoxic T lymphocytes	• Antigen-specific response • Requires tumour antigens in association with class I major histocompatibility antigens

The immune system is responsible for mediating the interaction between an individual's internal and external environment. The immune system is divided into two major categories: innate and acquired responses. The innate immune system response is nonspecific and immediate, beginning within minutes of an attack. The reaction occurs without memory for the eliciting stimulus. This process is called inflammation. The innate immune system represents the initial line of defence against cancer.

The acquired, or adaptive, immune system is categorised by an antigen-specific response to a foreign antigen or pathogen and generally takes numerous days or

longer to activate. An important feature of acquired immunity is memory for the antigen, such that subsequent exposure leads to a more rapid and often more vigorous response.

Cancer therapies such as chemotherapy, radiation therapy, and surgery are known to be immune suppressive. The role this suppression of the immune system plays in the cure and recurrence rates during and after treatment of cancer is unknown. The important role exercise plays in modulating the immune system remains an area of active investigation.

Table 2. Effects of Exercise on the Immune System.

Component	Effect of Acute Exercise	Effect of Chronic Exercise
Innate Immune System		
NK cells	• Immediate increase in cell count and cytolytic activity. • Depressed for 2-24 h after strenuous exercise.	• NK cell count and activity increase, both in blood and in spleen.
Macrophages	• Immediate increase in monocyte and macrophage count. • Adherence is unchanged. • Increased phagocytosis with moderate activity.	• Response is unclear. Resting monocyte count is unchanged. May cause adaptations that alter exercise response.
Neutrophils	• Most PMN functions decrease significantly after strenuous exercise.	• Increase with moderate exercise.
Acquired Immune System		
T lymphocytes	• Moderate activity enhances cell proliferation, with depressed levels 30 min after exercise. • Vigorous activity causes a transient decrease in proliferation	• Regular, moderate exercise enhances cell proliferation.

NK = natural killer; PMN = polymorphonuclear leukocytes.