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How Does Exercise Impact Immune Functioning?

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Abstract
Exercise exerts a complex, dose-dependent influence on immune system functioning, characterized by both transient suppression and long-term protective adaptations. Acute bouts of intense and prolonged exercise stimulate an inflammatory response resembling that of infection or trauma, marked by increased production of proinflammatory cytokines, stress hormones, and oxidative stress. This response may temporarily impair immune defenses, creating a period known as the "open window," during which susceptibility to infection is elevated for several hours to days post-exercise. Factors such as excessive intensity, volume, or unfamiliar training stimuli further exacerbate this immunosuppressive effect.

Conversely, regular and appropriately prescribed exercise promotes immunoprotection by reducing chronic inflammation, enhancing immune surveillance, and improving regulation of inflammatory pathways. These benefits are influenced by individual characteristics including fitness level, training status, hormonal profile, and overall health. Effective immune support through exercise requires a balanced approach that integrates proper training load, recovery strategies, sleep, nutrition, and stress management.

Overall, while excessive or poorly managed exercise may compromise immune function in the short term, consistent and well-structured physical activity plays a critical role in strengthening immune health and reducing disease risk.

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1. Introduction

Traditionally held beliefs about exercise adversely impacting immune system functioning have been corroborated by Gleeson (2007) [2] which elucidated that the inflammatory response of a singular bout of intense and prolonged exercise mirrored that of infection, sepsis, or trauma. Similar to those conditions, exercise bouts trigger the release of proinflammatory cytokines, including tumor necrosis factor, and interleukins 6 and 10, C-recreative protein, and interleukin-1-receptor antagonists that, in concert, signal and ultimately perpetuate the secretion and adhesion of leukocytes to endothelial cells during injury. This response is pursuant to microtrauma, resulting from intentional metabolic or mechanical stress related to physical activity, more specifically, resistance training, or microtrauma, or a notable injury stemming from an isolated, sudden impact such as a fall, collision, or other blunt forces.

Hormonal secretion following an intense bout of exercise induced activity, specifically epinephrine and cortisol, blunt the secretion of leukocytes and impair cell mediated immunity and inflammation, thereby increasing the susceptibility of infection and modulating the morbidity and severity of illness. Exercise bouts consisting of a stimulus that is too novel, too frequent, too intense, and too voluminous to which the subject is accustomed have been found to increase pathogen infection risk (Murphy, 2008) [6]. There have been a considerable number of studies establishing the temporary ergolytic effects of acute exercise on immune system functioning, ranging from three to 72 hours post-exercise (Kakanis *et al*., 2010) [5]. Researchers and health and exercise professionals have dubbed this period of time characterized by temporary suppression of the immune system as "the open window".

Exercise evokes a hormetic effect, or dose-dependent response, meaning that incremental exposure over time can be beneficial, but amounts either too minimal or excessive may not elicit a desired response. Eliciting an optimal response is predicated upon a synergistic balance programming
parameters (e.g., frequency, intensity, time, and type) and recoverability which is mediated by a confluence of factors, including training age, fitness level, and health status, specifically endocrinological and metabolic health. Singular bouts of exercise have been implicated in temporarily suppressing immune system function as marked by increases in immune cell phenotypes, cortisol, and oxidative stress (Shi *et al*., 2019; Gleeson, 2007) [2, 9]. Based on the review of the literature, singular bouts of exercise at or above lactate threshold (55% of VO2max among untrained individuals; 85% of VO2max among trained individuals) (Howley & Thompson, 2017) [4] for periods of up to or more than one hour, contributed to temporary immunosuppression (Gleeson, 2007) [7]. However, regular exercise among individuals has been shown to yield immunoprotective benefits. Lower resting levels of C-reactive protein, a biomarker of inflammation, have been observed in physically active individuals in comparison to those who are overweight and unfit (Nieman & Wentz, 2019) [7]. Moreover, fitter individuals are believed to have improved control of inflammatory signaling pathways, which interact with adipose tissue and influence immune system functioning, particularly by stimulating various cellular and molecular changes throughout the body which initiate anti-inflammatory and antioxidant responses and support immunosurveillance (Nieman & Wentz, 2019) [7]. Differences in immune system responses among males and females are mediated by androgens, with males demonstrating higher cytokine production during infections in comparison to females (Hoffman, 2014) [3]. Further, androgens suppress the secretion of autoantibodies, whereas estrogen supports their production (Hoffman, 2014) [3].

To simultaneously curtail infection risk and facilitate the achievement of improved fitness qualities or biomotor skills, one must account for life stress, energy availability, sleep duration and quality, travel, and exposure to environmental or climate extremes beyond the hallmark exercise programming parameters of frequency, intensity, volume, and type. Athletes wishing to maintain optimal immune system functioning are recommended to undulate training stress throughout microcycles, incorporate active recovery sessions, incrementally manipulate loading parameters and never simultaneously. Additionally, life stressors should be quantified, monitored, and managed, and when applicable, ample periods for acclimatization and adjustment to time zone changes should be availed. Body, clothing, equipment, and hand hygiene should also be prioritized (Walsh, 2018) [10]. Additionally, athletes should aim for seven to eight hours or more of sleep which has been shown to bolster immune system functioning (Besedovsky *et al*., 2012) [1], whereas, deprivation, even for as little as a week, impedes phagocytosis (Said *et al*., 2019) [8], the body's process of engulfing, internalizing, and processing infectious agents, such as viruses and bacteria.

In summary, immune system performance and overall health can be achieved through regular exercise. During times of greater illness transmission and infection risk, athletes must practice both diligence and vigilance to optimize immune system function. Fitness and performance goals should be targeted and inputs, such as time and effort, should be quantified to calculate training load. Rest and recovery should be given equal, if not greater priority.

References

1. Besedovsky L, Lange T, Born J. Sleep and immune function. *Pflugers Arch Eur J Physiol*. 2012;463(1):121–137. doi:10.1007/s00424-011-1044-0.
2. Gleeson M. Immune function in sport and exercise. *J Appl Physiol*. 2007;103(2):693–699. doi:10.1152/japplphysiol.00008.2007.
3. Hoffman J. *Physiological aspects of sport training and performance*. 2nd ed. Champaign: Human Kinetics; 2014.
4. Howley ET, Thompson DL. *Fitness professional's handbook*. 7th ed. Champaign: Human Kinetics; 2017.
5. Kakanis MW, Peake J, Brenu EW, Simmonds M, Gray B, Hooper SL, *et al*. The open window of susceptibility to infection after acute exercise in healthy young male elite athletes. *Exerc Immunol Rev*. 2010;16(1):119–137.
6. Murphy EA, Davis JM, Carmichael MD, Gangemi JD, Ghaffar A, Mayer EP. Exercise stress increases susceptibility to influenza infection. *Brain Behav Immun*. 2008;22(8):1152–1155. doi:10.1016/j.bbi.2008.06.004.
7. Nieman DC, Wentz LM. The compelling link between physical activity and the body's defense system. *J Sport Health Sci*. 2019;8(3):201–217. doi:10.1016/j.jshs.2018.09.009.
8. Said EA, Al-Abri MA, Al-Saidi I, Al-Balushi MS, Al-Busaidi JZ, Al-Reesi I, *et al*. Sleep deprivation alters neutrophil functions and levels of Th1-related chemokines and $CD4^{+}$ T cells in the blood. *Sleep Breath*. 2019;23(4):1331–1339. doi:10.1007/s11325-019-01851-1.
9. Shi Y, Shi H, Nieman DC, Hu Q, Yang L, Tingting L, *et al*. Lactic acid accumulation during exhaustive exercise impairs release of neutrophil extracellular traps in mice. *Front Physiol*. 2019;10:709. doi:10.3389/fphys.2019.00709.
10. Walsh NP. Recommendations to maintain immune health in athletes. *Eur J Sport Sci*. 2018;18(6):820–831. doi:10.1080/17461391.2018.1449895.

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