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REVIEW ARTICLE

Transient Immune Deficit after Exercise and the Relationship with Immuno-Nutrition: A Short Review of the Literature

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Abstract

In order to understand the relationship of immune deficit after physical activity and its relationship with food supplementation with carbohydrates and polyphenols to mitigate this transient suppression, the objective of this review is to identify the factors that characterize the decline in immune function after physical exercise and stress the importance of immunonutrition in this context. The use of carbohydrates and polyphenols in physical activity practitioners to mitigate transient immune deficit. The evidence directs the moment after strenuous physical exercise, as a period in which there is a greater susceptibility to transient immune dysfunctions. There is an increase in numerous metabolites derived from the breakdown of muscle and liver glycogen, as well as an increase in lipids and oxylipins. The function of NK and neutrophil cells, various measures of T and B cell function, production of salivary IgA, delayed hypersensitivity response of the skin, increased expression of MHC-II in macrophages and other biomarkers of immune function are altered for several hours to days during recovery from prolonged and intensive resistance exercises. To reduce immune dysfunction, there are effective nutritional strategies that include increasing carbohydrate and polyphenol intake. The advantage of this nutritional strategy would also be its positive impact in reducing tissue/systemic inflammation and oxidative stress. Nutritional strategies considered most effective for athletes should include carbohydrates and polyphenols to optimize performance, improve immune activity and aid tissue recovery. The consumption of sugary beverages or fruits promotes a decrease in tissue and systemic inflammation, making the post-exercise environment less impaired from an immunological point of view. In addition, phenolic biotransformers circulate throughout the body, exerting numerous adjuvant effects on athletes, such as combating free radicals, and are beneficial to the general health of individuals.

Keywords

Physical activity, Exercise, Immunology, Nutrition

Introduction

Studies carried out over the years and evidence in the practice of medical clinic point out that the performance of daily physical activities has a positive impact on the health of patients [1]. Among the benefits, we can see: Maintenance or reduction of body weight, combat obesity and related diseases such as Diabetes Mellitus type 2 [2], maintenance of systemic blood pressure [3], improvement in cholesterol levels (LDL-HDL) [4], increased mobility and prevention of chronic osteoarticular diseases [5,6].

In contrast, strenuous physical exercise may not produce the same effects when compared to medium/small effort [7]. Physical exercises of high intensity or of prolonged duration can produce temporary negative effects when analyzing the levels of activity of cells involved in the defense process of the organism. Thus, athletes become susceptible to infections after rigorous training or competitive events [7-12].

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The tissue recovery process has a high energy demand and therefore the immune system cannot be physiologically effective. In order to reduce the immune deficit, it is evidenced whether the intra- and post-exercise intake of carbohydrates and polyphenols so that their derivatives act in the human body providing a less worn out environment [7].

The purpose of this review is to identify the factors that characterize the decline in immune function after physical exercise and to underline the importance of immunonutrition in this context. The use of carbohydrates and polyphenols in physical activity practitioners to mitigate the transient immune deficit.

Physical Exercise and its Influence on Cellular Metabolism

Regular aerobic exercise (< 60 min/intensity/moderate/vigorous) has a general anti-inflammatory influence, which can be identified through biomarkers such as: Tissue macrophages, immunoglobulins, neutrophils, cytotoxic T cells, immature B cells and inflammatory cytokines. These were found in lower levels in adults who have greater aerobic capacity/physical conditioning, due to the performance of activities in a consistent manner [7]. Tissue macrophages have improved antipathogenic activity and in parallel there is an enhanced reduction in immunoglobulins, anti-inflammatory cytokines, neutrophils, NK cells, cytotoxic T cells and immature B cells, which play a critical role in the defense activity of the organism and health. In addition, acute exercises preferentially mobilize NK cells and CD8+ T lymphocytes, which exhibit high cytotoxicity and tissue migration [13-16]. The stress hormones (epinephrine/cortisol) that can suppress the function of immune cells, and the pro-inflammatory cytokines, indicative of intense metabolic activity, do not reach high levels during a short duration and moderate exercise [14]. Exercises acquire extreme relevance when analyzing subgroups such as obese and sick, whose immunovigilance is improved to the detriment of systemic inflammation [17,18]. In the long term, the benefits generated by physical exercise are extremely relevant, identified by the improvement in glucose and lipid metabolism and by the continuous exchange of leukocytes between tissues and circulation [19,20].

Transitory Immune Dysfunction before Strenuous Physical Exercises

Evidence directs the moment after strenuous physical exercise, as a period when there is a greater susceptibility to transient immune dysfunctions [7]. There is an increase in countless metabolites derived from the breakdown of muscle and liver glycogen, as well as an increase in lipids and oxylipines. The function of NK and neutrophil cells, various measures of T and B cell function, salivary IgA production, delayed skin hypersensitivity response, major expression of histocompatibility complex II in macrophages and other immune function biomarkers are altered by several hours to days during recovery from prolonged and intensive resistance exercises [12,21]. Exercise-induced tissue injury/inflammation causes a strong immune response, so immuno-specific proteins are produced to regulate the innate immune response, with oxylipines involved in the initiation, mediation and resolution of this process [22-25]. Sin 1, S100-A8/A12 proteins, catelicidin antimicrobial peptide, a-actinin-1 and profilin-1 are involved in the defense of pathogens and in the chemotaxis and locomotion of immune cells. In parallel, other proteins, including serum amyloid A-4, myeloperoxidase, complement C4B and C7, plasma protease inhibitor C1, glycoprotein a-2-HS and glycoprotein a-1-acid increase chronically during recovery and are involved in infection response phase [23]. Transient immune dysfunction occurs due to the metabolic changes created, oxidative stress, psychological stress, muscle damage and systemic inflammation, where the cells of the immune system lose the ability to increase oxygen consumption rates, while the recovery process begins. Because of that, tissues become unable to generate enough energy to meet the organism's biosynthetic demands [7].

Immunonutrition: CHO and Polyphenols and their Effects on the Post-Exercise Immune System

To reduce immune dysfunction, there are effective nutritional strategies that include increased intake of carbohydrates and polyphenols. The advantage of this nutritional strategy would also be its positive impact in reducing tissue/systemic inflammation and oxidative stress [7]. Studies have reported the intake of carbohydrates (30 to 60 g/h) during prolonged resistance physical exercises (> 90 min) resulted in lower levels of stress hormone (epinephrine/cortisol) post-exercise and inflammation [26-28]. 6 to 8% carbohydrates in drinks or sugar-dense fruits like bananas (added to water) when ingested during physical activity, resulted in higher plasma glucose and insulin levels, lower stress-related hormones, as well as, adenocorticotropic hormone and growth hormone, less mobilization and oxidation of fatty acids and reduced systemic inflammation, measured by biomarkers such as, IL-6, IL-8, IL-1ra, IL-10, RNAm, neutrophil count, monocytes, phagocytosis of granulocytes. The effect of carbohydrate intake on reducing post-exercise inflammation is significant (30 to 40%), especially when there is only water intake in nightly fasting athletes [10,23,29-31]. Fruits have sugars and a wide variety of polyphenols that will turn into biologically active structures (flavonoids). When ingested they will not be absorbed by the small intestine and when they reach the colon the bacterial degradation will produce phenolics, which will be related to the fight against free radicals.

Biotransformed and reabsorbed phenolics (after phase 2 of hepatic conjugation) will have several bioactive effects, such as signaling of anti-inflammatory, antiviral, antioxidant and immunological cells [32-34]. When comparing the intake of a 6% sugary drink with the intake of bananas with water, during prolonged and intense physical exercises, there was an increase of at least 18 fruit-related metabolites. Molecules such as serotonin, dopamine, phenolics and xenobiotics shortly after being ingested, confer anti-inflammatory effects by combating the expression of cyclooxygenase-2 (COX-2) mRNA the next day [23]. Studies support the intake of fruits such as dates, raisins and bananas by athletes during training to provide sugars and polyphenols that will play an important role in metabolic recovery [7].

Conclusion

Nutritional strategies considered most efficient for athletes should include carbohydrates and polyphenols, to optimize performance, improve immune activity and assist in tissue recovery. The consumption of sugary drinks or fruits promotes a decrease in tissue and systemic inflammation, making the post-exercise environment less impaired from an immunological point of view. The number of neutrophils and circulating monocytes decreases and smaller amounts of stress-related hormones are identified. In addition, biotransformed phenolics circulate through the body, exerting numerous adjuvant effects on athletes, such as combating free radicals, being beneficial to the general health of individuals.

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