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Can intense training improve the physiological, hormonal, and immune responses in older people? Effect of advances in age.

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REVIEW ARTICLE

ABSTRACT

Most research studies investigated the impact of intense training on young and old people, when the deterioration in performance and the decrease in hormonal reactions appeared to happen much earlier, within the fourth decade. In addition, intense training (sprinting and weight training) affects plasma concentrations of hormones and metabolites in 40-year-olds, but what about the immune system? This brief review highlighted the majority of findings about aging and the effect of intense training on physiological, hormonal, and immune responses.

Keywords: training, immune response, aging, hormonal response.

INTRODUCTION

The process of advancing age is accompanied by one or more changes in biological functions (nervous, cardiovascular, respiratory, and immune systems), often associated with an increasingly strong susceptibility to disease and/or death at a very advanced age (Whitbourne, S. K. 2012). When people get older, their bodies change (anatomical and physiological changes) inside before you can see it on the outside. This can start happening a few years before you notice any differences. Many of these changes begin to appear gradually in the third decade of life and persist until death. Additionally, these changes are accompanied by a decline in physical aptitude or performance. This brief review highlighted the majority of findings about aging and the effect of intense training on physiological, hormonal, and immune responses.

Aging changes in physical performance

Aging is linked to a decrease in anaerobic performance. The drop in anaerobic performance is basically clarified by hormonal factors, metabolic factors, muscular factors, and other factors (such as nutrition). In addition, this process is accompanied by muscle wasting, a decrease in the speed of contraction (Aoyagi, Y., & Shephard, R. J. 1992), and a maximum force that would reach 35–40% between 20 and 80 years and accelerate after 50 years (Kirkendall, D. T., & Garrett, W. E. 1998).

When we turn 30 years, our muscles start to get weaker and smaller. This happens more and more as we get older. The peak of loss in muscle mass and strength occurs around the age of thirty, declines by 15% every ten years from the age of fifty, and reaches 30% of the maximum at the age of seventy. This reduction in muscle strength is due, in large part, to the decrease in the contractile properties of the muscle and mainly in the number of muscle fibers, such as type II fast fibers (Evans, W. J., & Lexell, J. 1995). In addition, it has been shown that this change in muscle typology induced by advancing age affects the quality of speed more than endurance (Azzabou, N., et al. 2015). The decline in performance reached about 1% per year and accelerated from the age of 40 years (7 to 13.5%) in elderly weightlifters. According to this author, this decline in anaerobic performance was also observed in sprinters and jumpers in athletics.

Aging changes in the immune system.

The immune system defends our body, in particular, against external aggressions but also allows us to influence the physiological response during physical exercise. The practice of sport leads to several modifications, such as the change in the distribution of circulating leukocytes involved in the innate and adaptive immune responses. (Fitzgerald, L. 1988) reported the effects of intensive exercise on the immune system: it increases the level of neutrophil monocytes, CD4+ T / CD8+ T lymphocytes, and NK during exercise, whereas after exercise there is a decrease in the level of CD4+ T / CD8+ T lymphocytes and the level of neutrophil monocytes, and NK remains high. Other immune system changes include impaired production of pro-inflammatory cytokines (IL-6, IL-1, and TNF alpha) (Charlton, R. A., et al 2018) and release of stress hormones, leading to the recruitment of mature lymphocytes more than naïve lymphocytes, as well as alterations in the phenomena of apoptosis of the mitotic potential.

Immune aging, or immunosenescence, is not a myth. It exists in the form of a complex and very heterogeneous remodeling that more particularly affects the cellular immune response, concomitant with a decrease in volume of all the lymphoid organs with age. Immunosenescence is probably the result of chronic antigenic stimulation, linked to autoantigens and/or infectious antigens, and occurring throughout life. It associates an alteration of the T repertoire by reduction of naïve cells and accumulation of memory cells with a reduction in the immune responses adapted to new antigens (Wang, Y., et al. 2022).

The effect of intense training on physiological, hormonal, and immune responses.

The alteration of physical performance depends on several factors, mainly: hormonal, metabolic, and muscular. Several studies showed that advancing age is accompanied by an alteration in metabolism, expressed by a decrease in the use of energy substrates and an alteration in glycolytic metabolism. In addition, it has been shown that lactate production decreases with age in older athletes (>50 years) (Mattern, C. O., et al. 2003). The use of energy substrates and the consumption of glucose, the main source of energy during physical effort, are dependent on the action of glycoregulatory hormones such as catecholamines, cortisol, insulin, and glucagon. The sympathoadrenergic system plays a very important role in many adaptations to rest and physical exercise. During intense physical exercise, it acts on the cardiovascular and respiratory systems and the metabolism by promoting muscle glycogenolysis (Sellami et al. 2014), hepatic and lipolysis. These adaptations to exercise act largely in the immune system. Pedersen and colleagues created a model to explain the potential role of these adaptations on the immune system. Catecholamines and the growth hormone GH normalize effects on neutrophils during exercise, while cortisol helps maintain lymphopenia and neutrocytosis after prolonged exercise. Lymphocyte subpopulations and NK and LAK cell activities are contributed by adrenaline and, to a lesser degree, noradrenaline to the acute effect of exercise. Although steroidal sex hormones can modulate the effects of exercise cytokines, stress hormones do not appear to be responsible for the increase in exercise cytokines. The increase in neutrophil counts that occurs after exercise is due to cortisol, and the immediate leukocytosis of exercise is attributed to catecholamines (Brolinson, P. G., & Elliott, D. 2007).

Other studies carried out on high-intensity interval training, or sprint interval training, have shown the benefits of this type of training on metabolic, physical, and, of course, health levels. In fact, studies comparing this type of training to cardio exercises with the continuous method have demonstrated its superiority in terms of fat elimination, although applied to shorter periods (Sellami et al. al. 2014). One of the first studies was conducted in 1994 by researchers at Laval University; they showed that a group of young adults who followed a 15-week high-intensity intermittent training program burned significantly more fat than those who followed a 20-week continuous endurance program (Tremblay et al. 1994). Other researchers have reported that subjects who did high-intensity interval training burned nearly 10% more calories in the 24-hour period following exercise than those who exercised continuously (Hunter, G. R., et al. 2001).

A study conducted at the Norwegian University indicates that subjects with metabolic syndrome who completed a 16-week high-intensity interval training program showed a decrease in the content of fatty acid synthesis for the enzyme favoring the production of fat, 100% higher than that of subjects who followed continuous exercises of moderate intensity (Trapp and Boutcher, 2007). The effects of more or less long-term exercise on hormonal regulation have been the subject of a great deal of research; The increase in catecholamines is immediately noticeable if the intensity of the exercise is sufficient to raise the heart rate by 30%. For sub-maximal exercises of long duration and constant load, the increase in plasma catecholamine is proportionally much greater during the anaerobic phase. Recent studies have revealed that there are interconnecting pathways between the endocrine, immune, and nervous systems (Athanasiou, N., et al.2023).

The main regulators of glucose metabolism, catecholamines, mediate the effects on neutrophils during exercise and contribute to the acute effect of exercise on NK and LAK cell activities. They act on anaerobic performance during physical exercise (Sellami et al. 2014). In the oldest longitudinal studies, endurance training has no effect on the plasma variation of these hormones or even a decrease and slightly stimulates the immune system (Issurin, V. B. 2019). Therefore, anaerobic training, whether of the sprint and/or bodybuilding type, would be interesting to study because it constitutes a particularly severe stress on the adrenal medulla, likely to reveal even a modest effect on the process of advancing age concerning the catecholaminergic and immune responses.

Resistance training has been shown to be much more effective than high-intensity endurance training in achieving improvements in testosterone levels. Endurance training induces a decrease in testosterone levels and an increase in cortisol levels in trained subjects compared to untrained subjects during exercise (Vingren, J. L., et al.2010). Although these studies indicate that weight training or sprint training would be very effective in young subjects as well as in those over 50, it is important to determine the physiological and immune adaptations linked to this type of training and in the subject trained according to advancing age (between the 3rd and 4th decades).

CONCLUSION

This type of training can influence the immune response in people aged around 40 and subsequently influence physical performance. Moreover, in recent studies on this type of training, no information has been highlighted on the role of diet in this process of physiological adaptation and/or described an adequate nutrition methodology. Therefore, it would be illegitimate to think that the addition of a balanced food strategy based on intermittent fasting would be a good compromise for the improvement of physiological, hormonal, and immune responses.

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