

EFFECTS OF PHYSICAL TRAINING ON THE HUMORAL IMMUNE RESPONSE OF OLDER ADULTS

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ABSTRACT

Objectives: The aging process is associated with a reduction in immune response. However, it is unknown to what extent resistance training can modulate this response in older adults. **Method:** A randomized clinical trial was conducted at the Evangelical University of Goiás (UniEVANGÉLICA), where older adult volunteers (aged 60 to 85 years) were randomized (n = 40/group) into a control group (no physical training) and a training group (physical training only). The training protocol was carried out for 3 months, with moderate intensity, 3 sessions per week, lasting approximately 50-60 minutes. Assessments were performed before the start of the protocol and after 3 months. Pulmonary immune response was assessed by measuring pro-inflammatory cytokines (IL-6 and TNF-alpha) and anti-inflammatory cytokines (IL-10 and Klotho) in exhaled breath condensate, in addition to nitric oxide levels in exhaled air (FeNO). The analyses were expressed as mean and standard deviation. A significance level of $p \leq 0.05$ was adopted for comparisons performed in the paired t-test and for multiparametric analyses. **Results:** The results showed that resistance training resulted in a significant decrease in the levels of pro-inflammatory cytokines IL-6 ($p < 0.0001$) and TNF-alpha ($p < 0.043$), while increasing levels of the anti-inflammatory cytokine IL-10 ($p < 0.0003$) and Klotho ($p < 0.0001$). In addition, resistance training increased nitric oxide levels in exhaled air ($p < 0.0072$) but levels remained within normal limits. **Conclusions:** Resistance training resulted in a decrease in pro-inflammatory pulmonary biomarkers and an increase in anti-inflammatory pulmonary biomarkers, demonstrating its usefulness in strengthening the pulmonary immune system.

Keywords: elderly; resistance training; pulmonary inflammation; cytokines.

INTRODUCTION

Aging causes significant changes in the immune response, a phenomenon known as immunosenescence. With advancing age, there is a decrease in the production of naive T cells and an increase in the proportion of memory T cells, which compromises the immune system's ability to respond to new antigens. In addition, B lymphocyte function is also impaired, resulting in less effective antibody production. Immunosenescence is also associated with a chronic low-grade inflammatory state called "inflammaging," which may contribute to the development of age-related chronic diseases such as atherosclerosis and neurodegenerative diseases. These factors combined make older adults more susceptible to infections, autoimmune diseases, and reduced vaccine efficacy (Santoro et al., 2021).

Strength training is seen as an essential tool for protecting against loss of strength and muscle mass, as well as bone mass. In this sense, following the

guidelines of the American College of Sports Medicine (ACSM), moderate-intensity cardiorespiratory training is recommended for an average of 30 minutes on 5 days per week, totaling 150 minutes per week, or vigorous to moderate training for 20 minutes on 3 days per week, totaling 75 minutes per week (GARBER et al, 2011). In addition, their guidelines also recommend resistance training, better known as weight training, 2-3 times a week for the main muscle groups involving neuromotor exercises, such as agility, balance, and coordination (GARBER et al, 2011). Therefore, the present study investigated how much 3 months of resistance training, performed 3 times a week, can modulate the immune system of older adults.

METHODS

Population and Study Design

Eighty elderly individuals (80) aged between 60 and 85 years, who had been sedentary for at least 1 year, were randomly divided into a control group (CG, n = 40) and a training group (TG; n = 40).

Resistance Training Protocol

Resistance training was performed for 3 months, 3 times a week, 50-60 minutes per session, at a moderate intensity corresponding to 75% of 1RM. Six exercises were performed, consisting of 4 sets of 15 repetitions, with a rest interval of 1 to 1.5 minutes between each set.

Collection, Processing, and Analysis of Condensed Air

Condensed air was obtained through breathing at tidal volume into a tube called RTube (Respiratory Research, USA), into which the volunteer breathed for a period of 15 minutes. After this period, the condensed air was collected and stored at -86°C for analysis of cytokine levels, growth factors, and anti-fibrotic proteins, as standardized in our laboratory (Moraes-Ferreira et al., 2022).

Measurements of Cytokine Levels, Growth Factors, and Anti-fibrotic Proteins

The levels of cytokines IL-6, TNF-alpha, IL-10, and Klotho were measured in the condensed air using DuoSet ELISA kits (R&D Systems, USA). Readings were performed according to the manufacturer's instructions, following routine procedures in our laboratory, using the SpectraMax i3 multi-reader (Molecular Devices, USA) (Moraes-Ferreira et al., 2022).

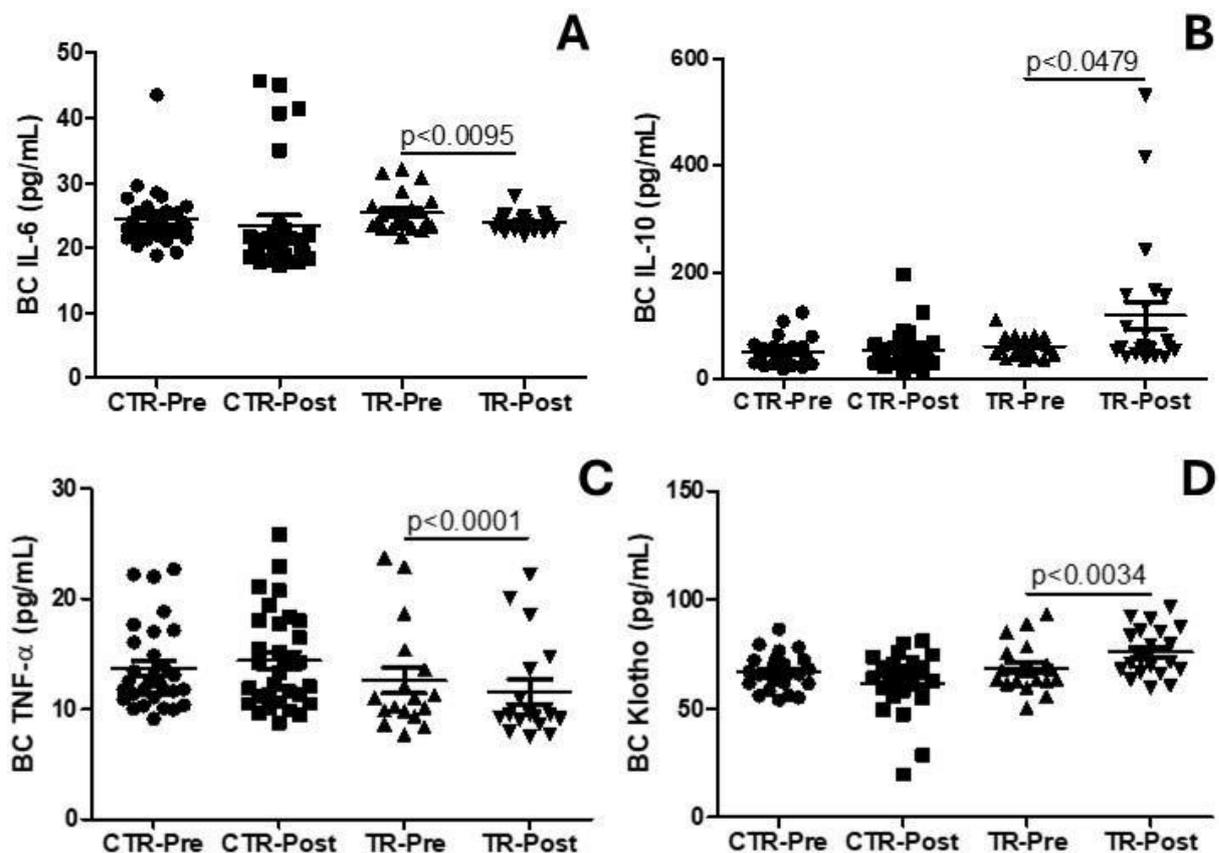
Statistical Analysis

GraphPad Prism 5.0 software was used for statistical analysis and graph construction. Data normality was assessed using the Kolmogorov-Smirnov test. Parametrically distributed data were evaluated using the ONE WAY ANOVA test followed by the Newman-Keuls test for comparison between all groups. Data with non-parametric distribution were evaluated by the ANOVA ON RANKS test followed by Dunn's test for comparison between groups. A value of $p < 0.05$ was considered statistically different.

RESULTS

The results presented in Figure 1 show the levels of pro-inflammatory cytokines (Figure 1A - IL-6 and Figure 1C TNF- α) and anti-inflammatory cytokines (Figure 1B - IL-10 and Figure 1D - Klotho).

Figure 1. Cytokine Levels in Condensed Air



Source: Author's own work.

CONCLUSION

Resistance training in older adults results in a decrease in pro-inflammatory pulmonary cytokines and an increase in anti-inflammatory cytokines, providing greater pulmonary protection to older adults.

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