Immunological changes after a single bout of moderate-intensity exercise in a hot environment

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This study was aimed to evaluate the possible changes caused by a single bout of moderate-intensity exercise in a hot environmental temperature on the immune function and on inflammatory markers. A total of 22 young male adults (VO2max 55.4 ± 3.6 ml·kg⁻¹·min⁻¹) volunteered to participate in an exercise session of 60 minutes on a treadmill ergometer at moderate speed (60% of the maximum aerobic speed) in hot environmental conditions (35 ºC and humidity 60%). Total leukocyte numbers, lymphocyte subsets (CD8+, CD4+, CD3+, NK and CD19+), cytokine production capacity by peripheral blood mononuclear cells (PBMCs) (IL-2, IL-4, IL-5, IL-10, IFN-γ and TNF-α) as well as the concentration of several inflammation related proteins (ceruloplasmin, C-reactive protein (CRP), complement factors C3 and C4) were evaluated before and after exercise. The results show that leukocyte and neutrophil absolute values increased (P<0.001) after the exercise period. In contrast, eosinophil values decreased (P<0.05) after the exercise. In addition, ceruloplasmin, C3 and C4 values (P<0.05) increased after exercise. No changes in T lymphocyte subsets, cytokine production, or CRP were observed. These data confirm previous studies suggesting that a 60 min exercise in a hot environment is enough to cause a physiologic adaptation to these special conditions leading to an increase of non-specific immune cells and promoting inflammatory processes. On the other hand, PCR val-
ues, lymphocyte subsets and the capacity of cytokine production by PBMC were not changed in a relatively short bout of exercise under these conditions in contrast with previous studies.

Key words: Physical exercise, Moderate intensity, Clinical trial, Immune system markers, Inflammatory markers.

Physical exercise has been shown to induce considerable physiological changes on the immune system (19). Besides, many different stressors are well known to disrupt the immune system. In view of this outcome, the understanding of the relationship between the impact of exercise on the immune system and infection risk has increased over recent years, even as potential tools for public health. Several studies provide evidence supporting that athletes and sportsmen are at increased risk of infections during periods of heavy training (the so-called “open window” of impaired immunity) (9, 17, 20). Nevertheless, although intensive exercise could lead to suppress the activity and levels of several immune cells, other immune functions may be stimulated by moderate physical activity (4, 6, 10). Therefore, the interactions between exercise, the immune response and the susceptibility to infection risk are influenced by the intensity, type and duration of the physical activity (16, 24).

It is also important to highlight that the immune responses observed following physical exercise are mediated by other factors, such as fluctuations in plasma cytokines and feedback from signalling leukocytes as well as the hydration status (11). Moreover, the immune response can also be affected by stressors such as temperature, altitude and stressful environments (e.g. during space flights) (16, 24, 26).

The consequence of heat stress in combination with exercise on the immune system and particularly on T-cell response is an important aspect in exercise physiology. In this direction, the precise effects of physical exercise and heat stress on immune function seem to be unclear (12, 14). In addition, the information about how the physical exercise of relatively short duration and under adverse conditions can affect the immune response is still scarce. Therefore, this study will evaluate the changes in immune function parameters and inflammatory markers in healthy moderately trained young adults after running 60 min at moderate intensity in high environmental temperature at 35 °C and 60% relative humidity (RH).

Material and Methods

Subjects and inclusion criteria.— Twenty-five healthy men participated voluntarily in this study [mean age ± s.d. = 21.27 ± 1.83 years, height = 178 ± 4 cm, body weight (BW) = 74.2 ± 6.4 kg, percentage body fat (PBF) = 14 ± 4.7%, maximal aerobic capacity (VO2max) = 55.4 ± 3.6 ml·kg⁻¹·min⁻¹]. Following presentation of the study protocol written informed consent was obtained from volunteers according to the Declaration of Helsinki as last revised by the World Medical Council at the 52nd General Assembly of the World Medical Association in Octo-