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Immunological changes after dehydration resulting from physical effort in a hot environment

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Intensive exercise is well known to affect the immune function, leading to higher risk of infections and inflammatory processes in sportsmen^(1–3). Several factors are involved in the immune modulation, such as the intensity and duration of the physical activity as well as inter-individual variations^(4,5). Thus, the aim of the present study was to confirm the effects of intensive physical effort in a relatively short time period and high environmental temperature on variables of immune function and inflammatory markers. A total of twenty-two young male adults (age 21.2 (SD 1.7) years; V_{O2max} 55.4 (SD 3.6) ml/kg per min) volunteered to participate in an exercise session of 60 min on a treadmill ergometer at moderate speed (60% maximum aerobic speed) in hot environmental conditions (35°C and humidity 65%). Total leucocyte and lymphocyte counts, absolute values of T-lymphocyte CD8+, CD4+, CD3+, natural killer and CD19+ subsets and the capacity of cytokine production (IL-2, IL-4, IL-5, IL-10, interferon- γ and TNF α) were evaluated before and after exercise without rehydration. Several inflammation-related proteins (caeruloplasmin, C-reactive protein, C3 and C4) were also measured. The results show that absolute numbers of leucocytes and neutrophils increased while eosinophils decreased after the intensive exercise. In addition, caeruloplasmin, C3 and C4 levels also increased after exercise. In contrast, no changes in T-lymphocyte subsets or cytokine production were observed.

	Before exercise		After exercise	
	Mean	SD	Mean	SD
Leucocytes ($\times 10^9/l$)	5.73	1.48	8.84*	2.39
Neutrophils ($\times 10^9/l$)	3.56	1.10	6.83*	2.17
Lymphocytes ($\times 10^9/l$)	1.68	0.44	1.59	0.30
Eosinophils ($\times 10^9/l$)	0.17	0.13	0.08*	0.05
Caeruloplasmin (mg/l)	325.8	49.6	342.8*	56.3
C3 (g/l)	0.99	0.14	1.04*	0.13
C4 (g/l)	0.23	0.07	0.25*	0.07

Mean values were significantly different from those before exercise (Student's *t* test): **P*<0.05.

Since prolonged bouts of intensive exercise cause a temporary reduction in various aspects of immune function that usually lasts 3–24 h after exercise, the results confirm those from previous studies and suggest that 60 min exercise in a hot environment is enough to cause an immune system adaptation to these conditions leading to an increase in some immune cells and promoting inflammatory processes. Interestingly, these changes in immune cells have not altered the T-lymphocyte subsets and the capacity for cytokine production; therefore, immune cell function seems to be preserved in relatively-short-term acute exercise. Further research is necessary to determine to what extent habitual intensive exercise under high environmental temperature can impair the immune system.

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