

## Summary

### **Effect of thermal exposure on blood antioxidative status and concentration of brain-derived neurotrophic factor (BDNF) in blood serum of cross-country skiers**

Cross-country skiing is a winter endurance sport that requires a high level of physical capacity. Sprints and endurance efforts, repeating in short time intervals and in changing environmental conditions during competitions period, require the regeneration capability, the maintenance of constant force level and the endurance of fatigue abilities, which makes them especially significant for this discipline. Cross-country skier effort has changing characteristics: long-distance efforts are mainly based on oxygen metabolism, while sprint efforts are dominated by anaerobic metabolism.

Maintenance the balance between production and removal of reactive oxygen and nitrate species (RONS) is necessary to reduce the negative impact of oxidative stress in endurance sports. Enzymes such as superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPx), glutathione reductase (GR) and non-enzymatic compounds such as glutathione (GSH), uric acid (UA) and heat shock protein 72 (HSP72) take part in this balance restoration. As indicator of organism's antioxidative potencial efficacy is also used plasma total antioxidative capacity (TAS). In turn, the concentration of malonedialdehyde (MDA) and total oxidative capacity (TOS) are used to assess the level of oxidative stress.

Whole-body cryotherapy (WBC) and sauna baths are two of many interventions, that are used for regeneration of cross-country skiers during transition periods. The research on wellness treatment and after-effort regeneration suggests that sauna baths and WBC might be a good strategy to reduce skeletal muscle damage and limit the escape of cellular enzymes (CK and LDH) into the bloodstream. In addition, both treatments can affect the improvement of well-being and cognitive functions, however, the mechanism of their action remains unclear.

The main aim of the study was to assess the influence of a single and a series of 10 thermal exposures: WBC and sauna baths, on the antioxidative status of blood and BDNF level in blood of cross-country skiers during the transition period. The study was conducted within the research project no 0050/RS4/2016/54 funded by the Ministry of Science and Higher Education under the Academic Sports Development programme.

The activity of enzymes: SOD, CAT, GPx, GR, concentration of non-enzymatic antioxidative compounds such as GSH and KM, total antioxidative capacity (TAS), oxidative stress markers: MDA and TOS and OSI as oxidative stress indicator were used to assess the prooxidative-antioxidative balance. The concentration of heat shock proteins (HSP72) and markers of muscle cell membrane damage (CK and LDH) were determined in blood. The concentration of BDNF and its precursor proBDNF were also analyzed.

The results found that:

1. The increase in oxidative stress under the influence of a single WBC treatment caused beneficial changes in the blood antioxidant status of ski runners. These changes mainly consisted in increasing the activity of antioxidative enzymes (SOD, GPx and GR), concentrations of non-enzymatic antioxidants (GSH and KM) and the level of HSP72 proteins. It seems that the reduced level of TOS after a series of 10 treatments may indicate the adaptation of players to the cold.
2. Favorable changes in blood antioxidant status caused by a single sauna session were also maintained after a series of 10 treatments. The consequence of these changes was the shift of blood prooxidative and antioxidant balance towards antioxidant reactions.
3. Reducing the OSI after a series of 10 treatments WBC sauna bathing indicates a favorable effect on blood antioxidant capacity. However, only after sauna baths this indicator significantly decreased.
4. Series of 10 WBC treatments and sauna baths reduce the "escape" of CK and LDH cell enzymes into the blood, as a result of the shift of pro-oxidative-antioxidant balance towards antioxidant reactions.
5. Series of WBC treatments and sauna baths slightly increase the proBDNF and BDNF levels in blood serum. The consequence of the increase in the concentration of these neurotrophins may be acceleration of mental regeneration and improvement of cognitive functions in the athletes.