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Effects of Different Cryotherapy Models on Timing Sequence Recovery of Exercise Induced Muscle Damage in Middle and Long Distance Runners

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Objective Exercise induced muscle damage (EIMD) is one common physiological phenomenon in competitive sports and mass sports. Water immersion recovery and whole body cryotherapy (cryostimulation) (WBC) has become one of the fast recovery methods adopted by high level athletes in the world. The aim of this study was to compare the water immersion recovery and WBC from timing sequential recovery on EIMD, subjective scales, biochemical indicators, exercise performance indicators.

Methods Twelve middle and long distance runners from Beijing Sport University were recruited in this study (exercise performance is secondary level in China). All participants performed four models in four weeks which included rest control (CON), cold water immersion (CWI), contrast water therapy (CWT) and whole body cryotherapy (cryostimulation) (WBC) separated by one week. The subjects needed to complete the EIMD exercise program, includes two parts: the treadmill running and the jump step. The individual speed of treadmill running was based on the individual VO_{2max} . running including 5 sets and total time is about 90 min. Every set consist of 6 min flat running, 6 min uphill running and 6 min downhill running. The speed of the treadmill was stable in different stages. The slope of the uphill running is $(+6, +5, +4, +3, +2)$, and the slope of downhill running is $(-8, -7, -6, -5, -4)$. The jump was performed 20 times separated by 30 s via special step (height is 40 cm). After the EIMD exercise program, the subjects were treated with different recovery methods immediately after exercise, 24 h, 48 h, 72 h after exercise, while CON group received no intervention. The CWI group was immersed in 15 °C cold water for 12min, and the CWT groups was immersed in 15°C cold water for 1min and 38°C hot water for 1min with 6 cycles. The whole body cryotherapy (cryostimulation) group was immersed in special chamber (-110---140°C) for 3 min. The three interventions were immersed body to the position of shoulders. The indexes including subjective scales (VAS scale, RPE scale, Borg scale, WHO deep sleep scale, PQSI scale), biochemical indicators (creatine kinase, lactate dehydrogenase, myoglobin, interleukin-6, C reactive protein, SICAM-1), exercise performance indicators (vertical jump height, grip, running distance). The indexes was collected in different periods (i.e. Before exercise, immediately after exercise, Post1h, Post 24h, Post 48h, Post 72h, Post 96h after exercise etc.).

Results (1) Subjective scales. From results of VAS scale, RPE scale, and Borg scale, the WBC had best recovery effects than the other three interventions ($P < 0.05$). The recovery effect of the CWI group was similar with the CON group. From results of WHO deep sleep scale and PQSI scale, the WBC group had better recovery effects than CON group ($P < 0.05$). (2) Biochemical indicators. From results of CK, Mb and SICAM-1, the WBC group had better recovery effect than the other three groups ($P < 0.05$). In the LDH, the WBC group had similar effects with the CWT group ($P > 0.05$). From results of CRP and IL-6, the WBC group had better recovery effects than the other three groups ($P < 0.05$). (3) Exercise performance indicators. From results of vertical jump, WBC had lower decrease than the other three groups ($P < 0.05$). From results of the grip, of the WBC and CWT groups have significant

retentive effects than CON group ($P < 0.05$), but there was no significant difference between CON and CWI groups ($P > 0.05$).

Conclusions (1) Through combine the treadmill running and the jump step exercise program, Can effectively lead to human body appear the EIMD. (2) WBC has positive effects on the subjective scale, biochemical indicators, exercise performance indicators associated with EIMD. For middle and long distance runners EIMD, compared with CWI CWT, WBC effect is better. (3) CWI and CWT has a positive effect on some subjective scales, biochemical indicators, and exercise performance indicators related to EIMD. However, the positive effect of CWI and CWT is lower than WBC in the extent of action and timing sequence. (4) For the middle and long distance runners EIMD timing sequence recovery effects, WBC have better effects, Followed by CWT, CWI effect is not significant.