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Torso and facial/head pre-cooling and anaerobic cycling performance in a hot and humid environment

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Abstract

Background: It has been demonstrated that cooling athletes before (pre-cooling) enabled a higher level of power output developed during exercise (Tyler et al., 2015, British Journal of Sports Medicine, 47, 7-13), increased thermal comfort rates, lowered core and skin temperatures, and enabled a greater capacity of heat storage (Kay et al., 1999, Journal of Sports Sciences, 17, 937-944). However, there is in fact no consensus on the effect of precooling athletes prior to an anaerobic exercise.

Purpose: The aim of this study was to analyse the effects of torso and facial/head cooling strategy on a single cycling all-out sprint under a hot and moist environment.

Methods: Nine trained male cyclists (mean ± SD; age: 21.7 ± 1.9 years, height: 180 ± 4.5 cm, body mass: 71.7 ± 4.8 kg, VO_2max: 51.5 ± 10.6 $mL.min^{-1}.kg^{-1}$) volunteered for this study. We asked participants to perform, under a hot and moist environment (29.5 °C ; 75.6 % Relative Humidity), a Wingate test (WT) on a cyclo-ergometer after wearing a cooling jersey (IceShirt, Vtherm Inc., Roche Lez Beaupré, France) and a headband (Coolmor Cooling Head Band, Roshgo Co., Atlanta, GA, USA) for the cooling condition or without cooling intervention (control condition) during the warm-up. Perceptual (thermal sensations and perceived exertion), physiological (heart rate, skin and rectal temperatures) and power output (mean, peak power output and fatigue indexes) data were assessed during the WT.
Results: The results revealed (Table 1) that cooling significantly decreased ($P < 0.05$) the fatigue index (44.7 ± 6.8 % in the cooling condition vs 53.1 ± 5.2 % in the control condition) and the mean loss of power per second ($P < 0.05$) (20.1 ± 4.4 W.s-1 vs 26.1 ± 4.2 W.s-1 in the cooling and control conditions, respectively). In addition, during the warm-up, a significant improvement ($P < 0.01$) in thermal comfort was found associated with a significant decrease ($P < 0.05$) of skin temperature. However, no significant effect of pre-cooling was observed on any of the peak and mean power output, rectal temperature, heart rate and perceived exertion.

Discussion: The main finding is that the cooling method used this study did not have significant adverse effects on power output performance but decreased the fatigue index. This result can be seen as a greater capacity to maintain a higher level of performance. The possible link between hypothalamus and regulation of activity has been demonstrated in the animal (Caputa et al., 1986, Pflugers Archives, 1406, 184-189), where hypothalamic warming reduced running speed. Aramada Da Silva et al. (Aramada Da Silva et al, 2004, European Journal of Applied Physiology, 91, 563-571) postulated that cooling of the face may minimize also the cerebral blood flow in the cerebral artery which has been strongly associated with hyperthermia. In the present study, we suggested that facial/head cooling may have a comparable effect on cyclists, by decreasing hypothalamic temperature, reducing the fatigue index and by increasing the thermal comfort.

Conclusion: Our results suggest that fatigue index improvement might be beneficial during 30 s sprint, that requires a constant and high level of power output, (e.g. 500m women track cycling). However, further investigations carried out on the field are encouraged to confirm the results of the present study.

Table 1: Power output data during a Wingate test (n = 9). * Significant difference between conditions.

		Control Condition		Cooling Condition		Statistical Data	
		Mean	SD	Mean	SD	*P*	Effect Size
Peak Power		1125.7 W	121.9 W	1030.3 W	103.8 W	0.069	0.84
		15.8 W/kg	1.6 W/kg	14.5 W/kg	1.8 W/kg	0.074	0.77
Mean Power		749.9 W	76.2 W	747.9 W	54.0 W	0.944	0.03
		10.5 W/kg	1.2 W/kg	10.5 W/kg	1.0 W/kg	0.937	0.03
Minimum Power		525.8 W	67.3 W	566.9 W	63.6 W	0.230	-0.63
		7.4 W/kg	0.9 W/kg	7.9 W/kg	0.9 W/kg	0.221	-0.62
Fatigue Index	Percentage	53.1 %	5.2 %	44.7 %	6.8 %	0.040 *	1.4
	Loss of Power	26.1 W/s	4.2 W/s	20.1 W/s	4.4 W/s	0.027 *	1.38

Key words: Body Temperature, Power Output, Sprint

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