The ambient temperature threshold above which pre-cooling has a performance benefit for cycling time trials in the heat.

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Introduction

- Endurance exercise performance progressively deteriorates as the surrounding ambient temperature (T_{amb}) increases (Tatterson et al., 2000; Tucker et al., 2005)

- Increase in heat storage results in a reduction in workload of up to ~7% (Tatterson et al., 2000)

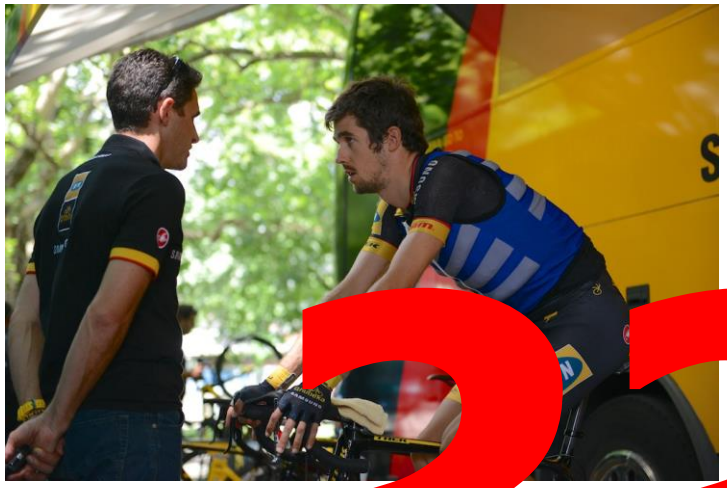
- Physiological drive to maintain homeostasis and ‘stable’ body temperature = reduction in metabolic heat production via reduced workload.

- Pre-cooling aims to increase the capacity for heat storage via initial reduction in body temperature

Introduction

- Pre-cooling (PC) practice has become commonplace; ~50% of athletes have a defined PC strategy (Périard et al., 2017)
- PC proposed to reduce core and/or skin temperature and increase heat storage capacity (Faulkner et al., 2015)
- Recent meta-analyses demonstrate beneficial effect of PC on endurance performance (Tyler et al., 2015; Wegmann et al., 2012)
- But…many studies conducted at 30°C or above

The Problem

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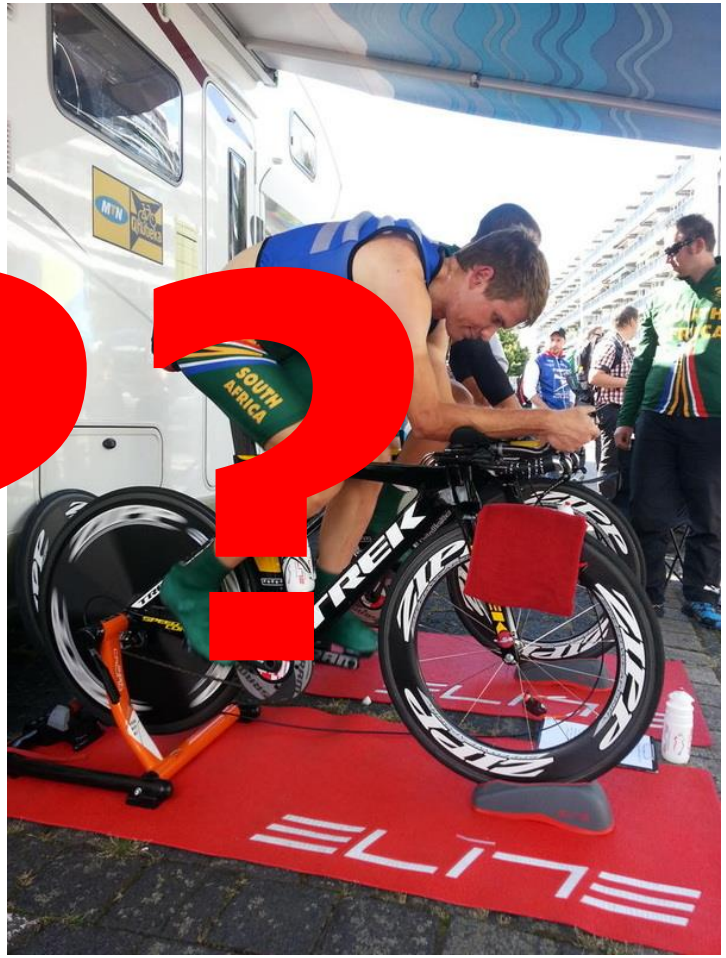

SOUTH AFRICA
TREK
ELITE

Aims

1. Identify the threshold temperature above which pre-cooling may be of benefit to cycling time trial performance.

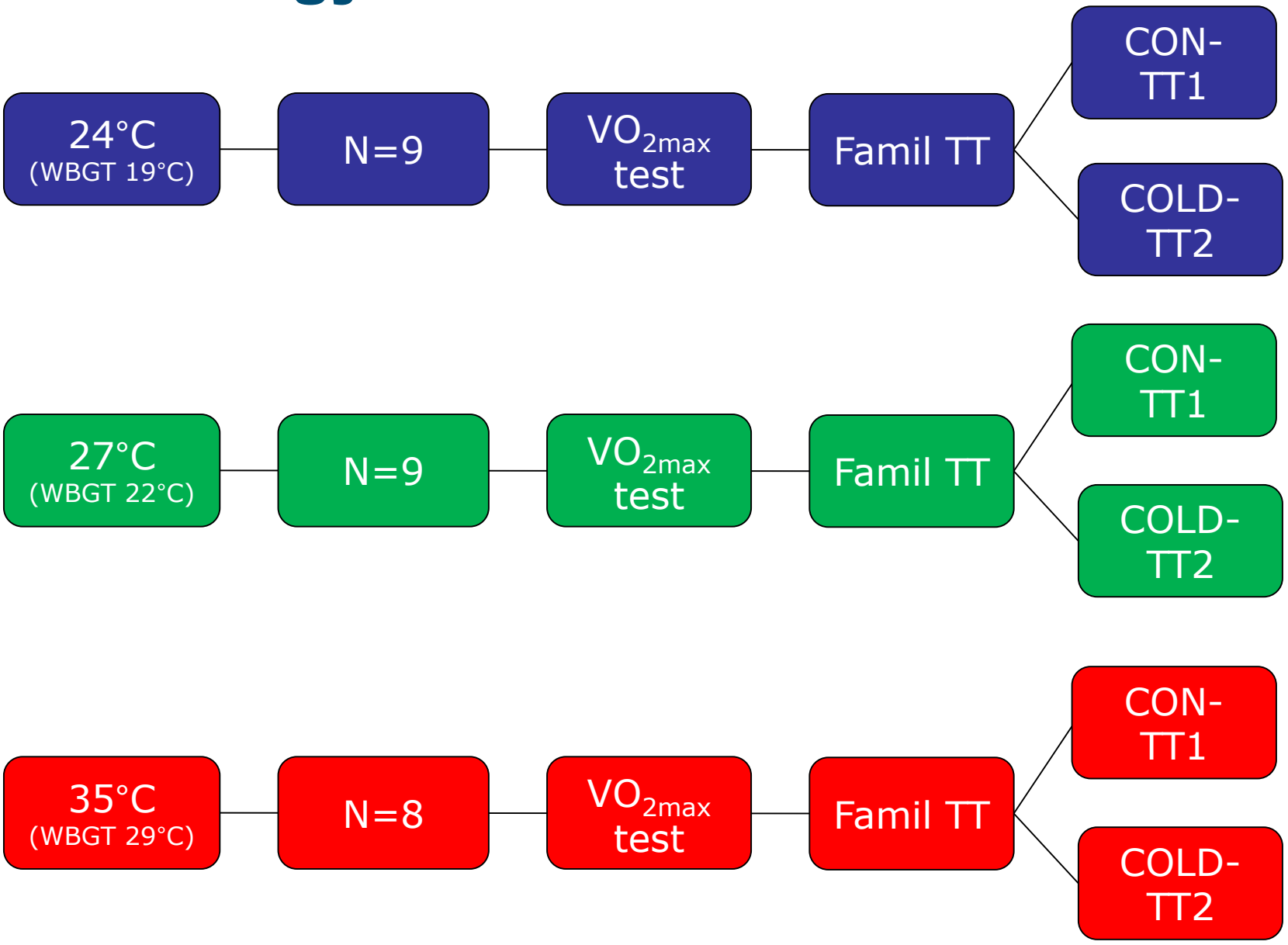
2. Consider thermoregulatory mechanisms that may lead to improved performance.

Hypothesis

1. Pre-cooling will improve time trial performance in all temperatures tested

2. The magnitude of the effect will be temperature dependent

Methodology



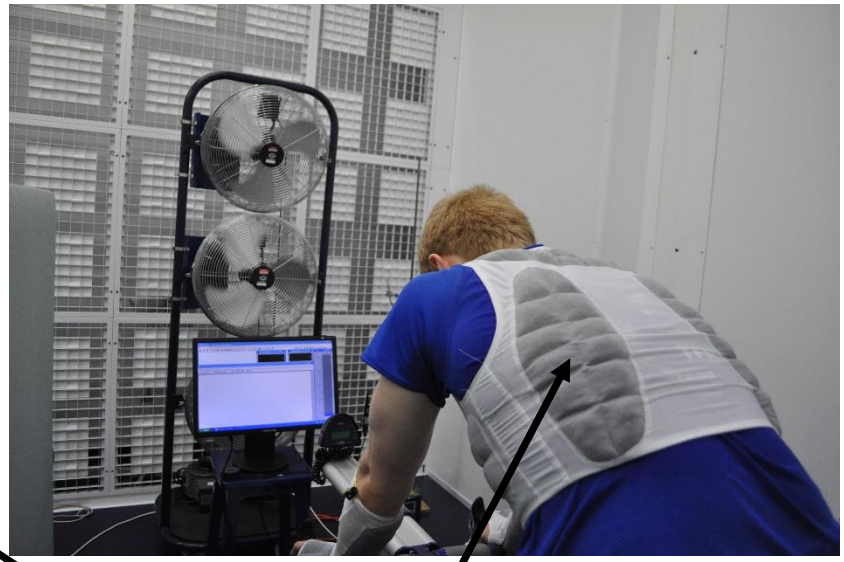
Rider Characteristics

T_{amb} (WGBT) (°C)	N	Age (yr)	Height (cm)	Mass (Kg)	VO_{2max} ($mL \cdot kg \cdot min^{-1}$)	Training F/wk	Performance Level*
24 (19)	9	23.6 ± 2.0	180.4 ± 3.2	72.6 ± 2.2	62.0 ± 0.6	≥3	3
27 (22)	9	24.2 ± 7.2	177.8 ± 5.0	72.4 ± 6.4	60.6 ± 6.2	≥3	3
35 (29)†	8	25.1 ± 6.1	178.9 ± 6.1	72.5 ± 5.1	61.3 ± 4.3	≥3	3

*Performance level from DePauw et al *Int J Sports Physiol Perform*. 2013;8:111-122.

†Data from Faulkner et al *Scand J Med Sci Sports*. 2015;25 Suppl 529 1(S1):183-189.

Cooling Vest Design



Gel cooling pouches

Experimental Design

30 min cooling (COLD) control (CON)

9 min WUP 150W, 200W 250W

5 min recovery, garment removed

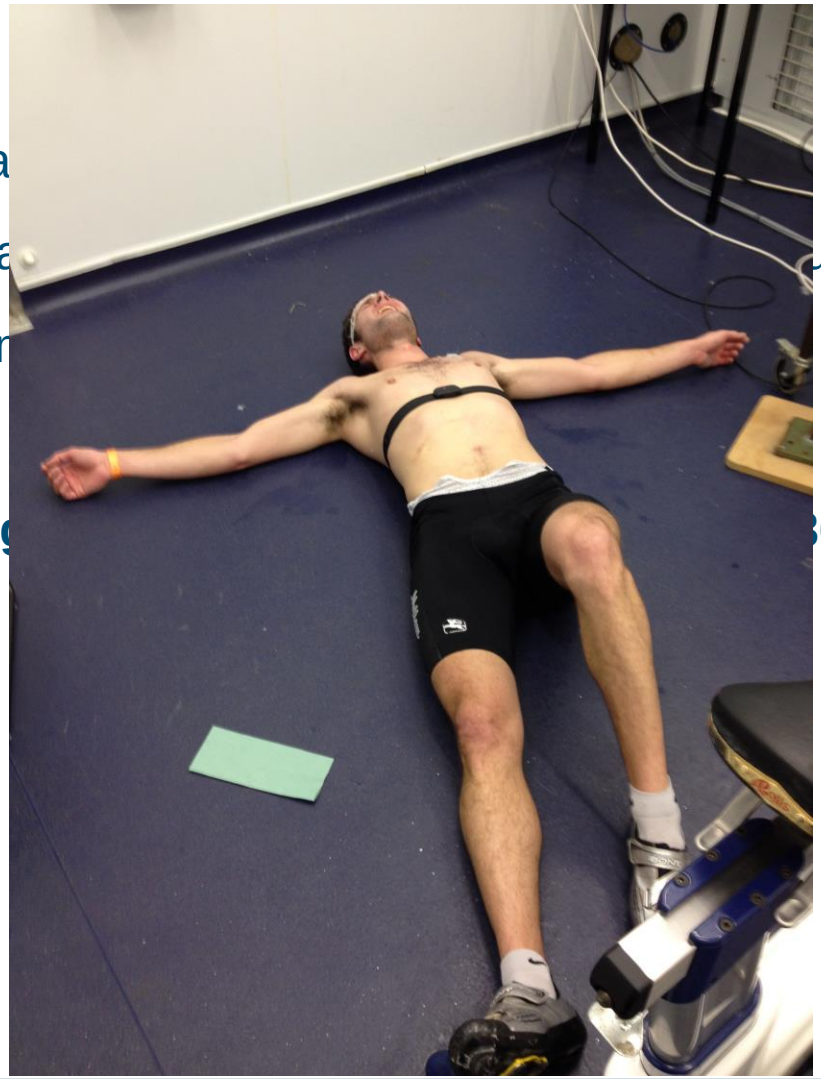
TT

T_{sk}, T_{gi}, T_{sens}, T_{comf}, RPE

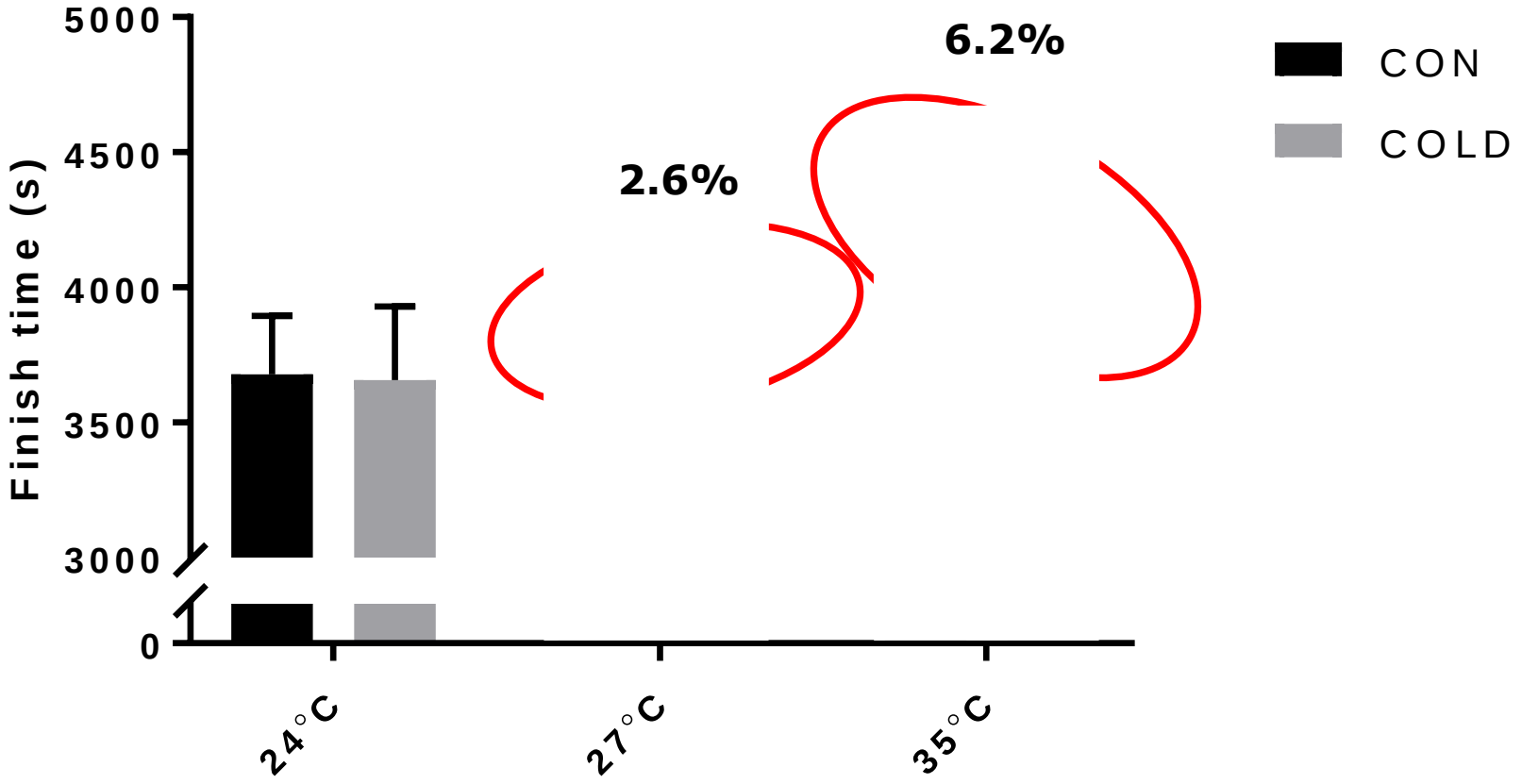
Time Trial Protocol

- Simulated time tria
- Linear mode, as ca ut
- ~60 minutes to cor

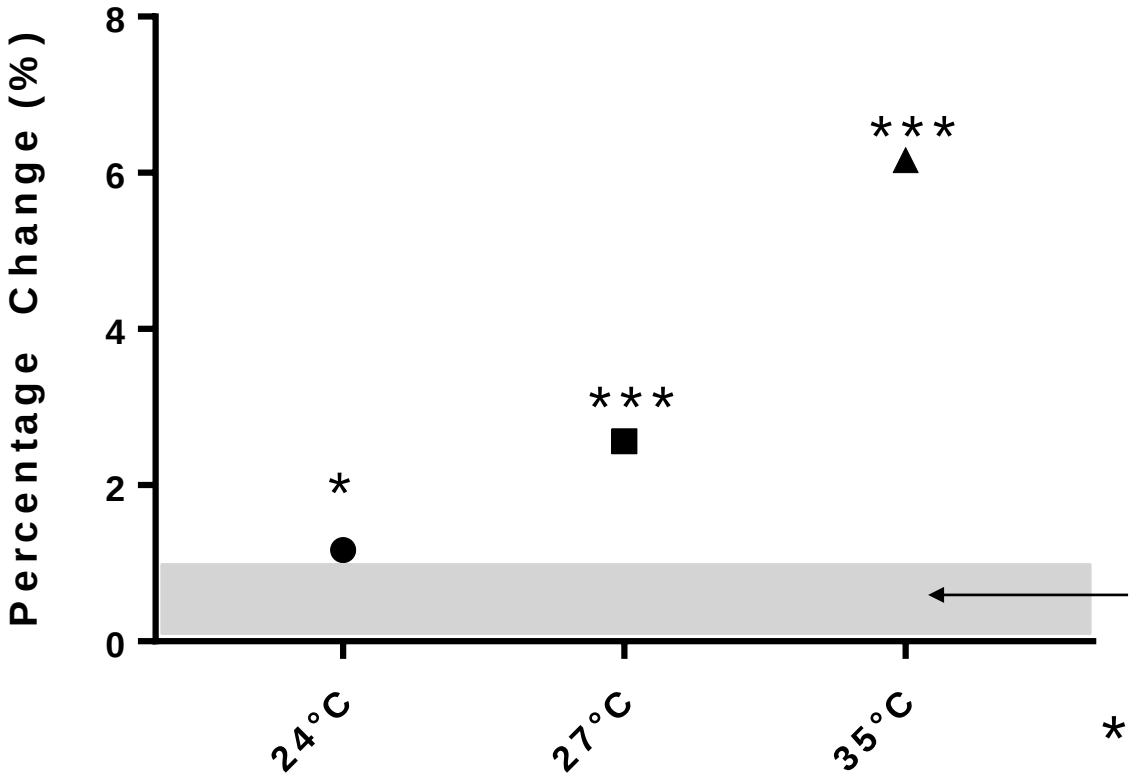
Targ 3600s



Results – Finish time



Results – Magnitude of effect

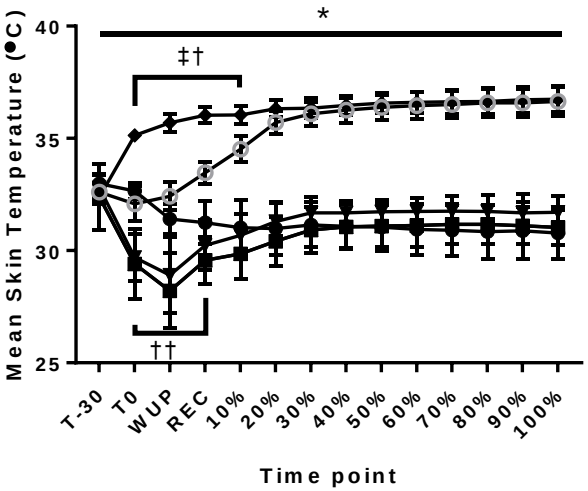


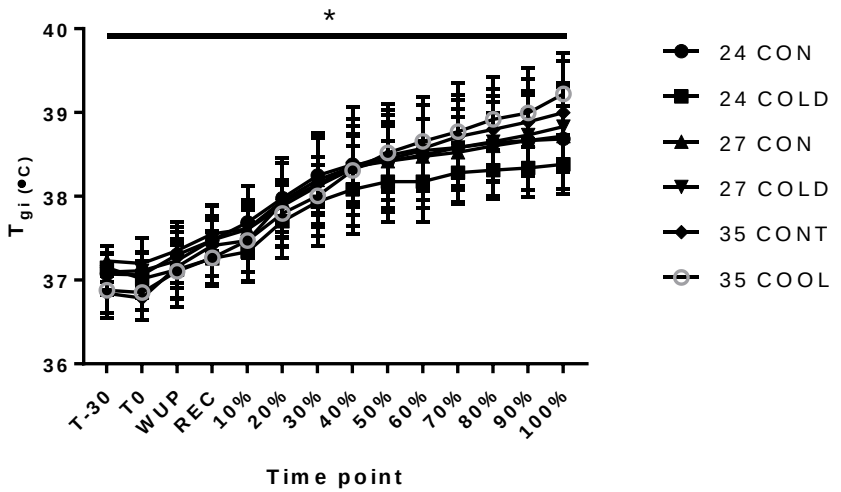
* = possible difference

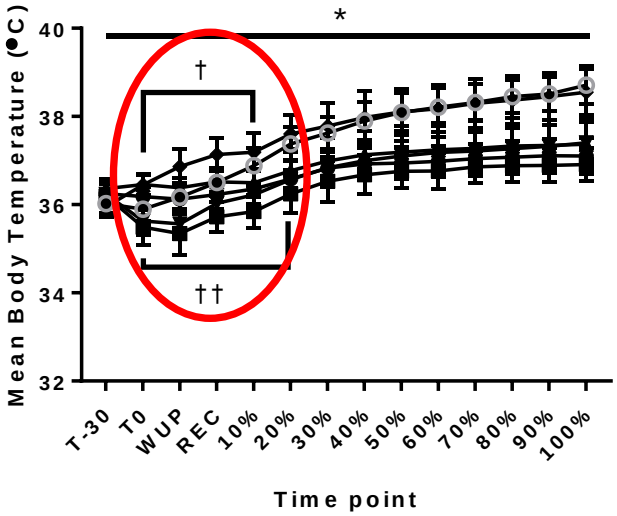
** = likely difference

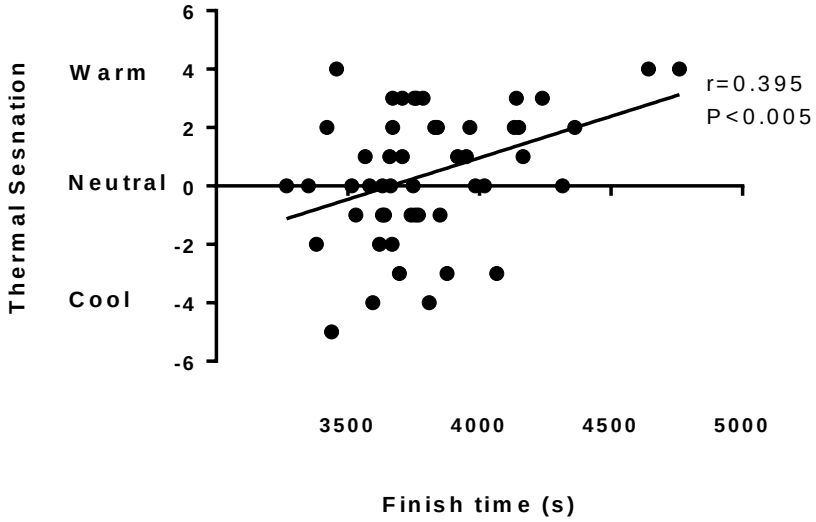
*** = very likely difference

Results – Thermal Data









So what...?

- When T_{amb} > 24°C evidence suggests using pre-cooling *very likely* to benefit TT performance.

- At ≤ 24°C there *does not* appear to be a *detrimental* effect of pre-cooling.

- Primary mechanism appears to be (partially at least) T_{sk} mediated and linked to T_{sens} at TT onset.

Practical Application

- When T_{amb} >24˚C or WBGT >19˚C, athletes and coaches should consider the implementation of a pre-cooling strategy aimed at reducing $\bar{T}_{sk}$ and T_{sens} prior to endurance performance.

- PC should be used in practice in order to allow the athlete to moderate their pacing strategy.

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Results – Power and pacing