

# Experiences from Singapore and Southeast Asia

Jason KW LEE Ph.D., FACSM

Associate Professor, Human Potential TRP

Director, Heat Resilience and Performance Centre

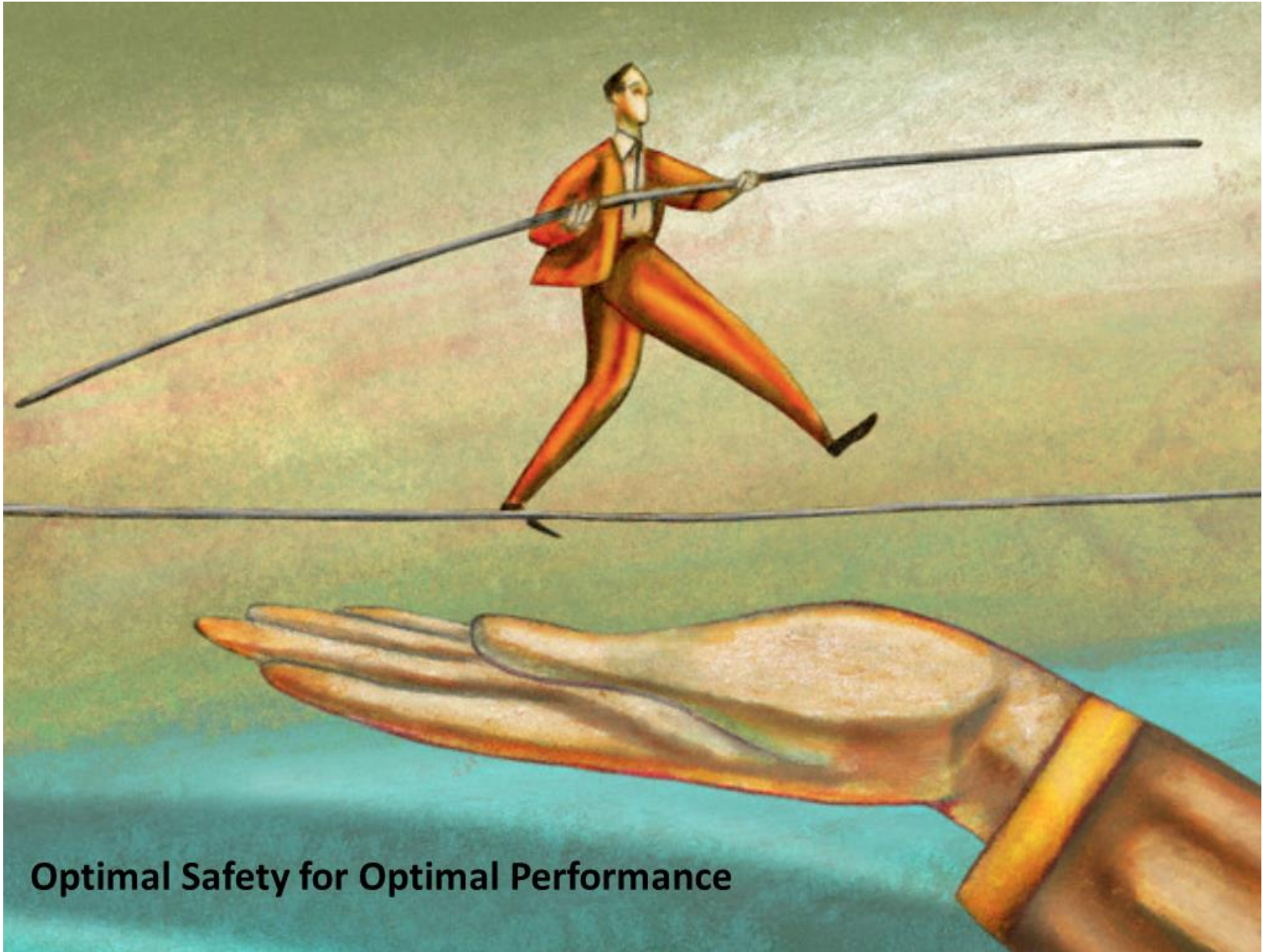
Yong Loo Lin School of Medicine



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of Singapore

National University of Singapore





**Optimal Safety for Optimal Performance**

# Summary

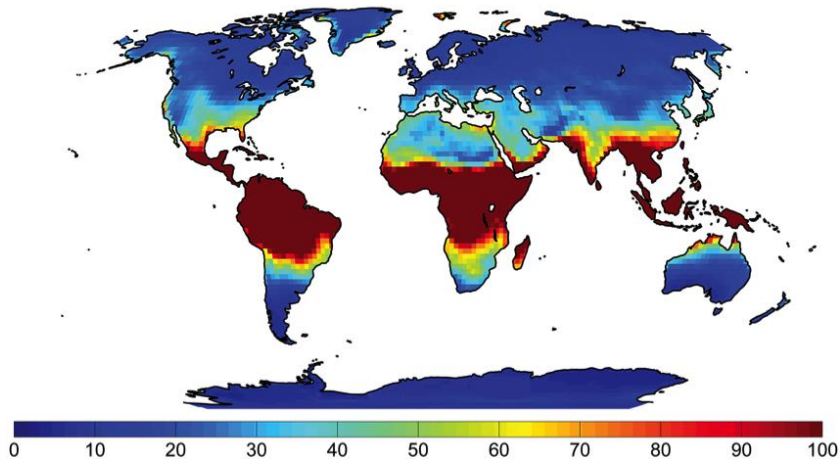
1. Optimal safety **does not** compromise but enhances productivity
2. Solutions are there but **use them correctly**
3. Heat stress can **induce more than** just heat injuries and performance degradation

## 'Endless record heat' in Asia as highest April temperatures recorded

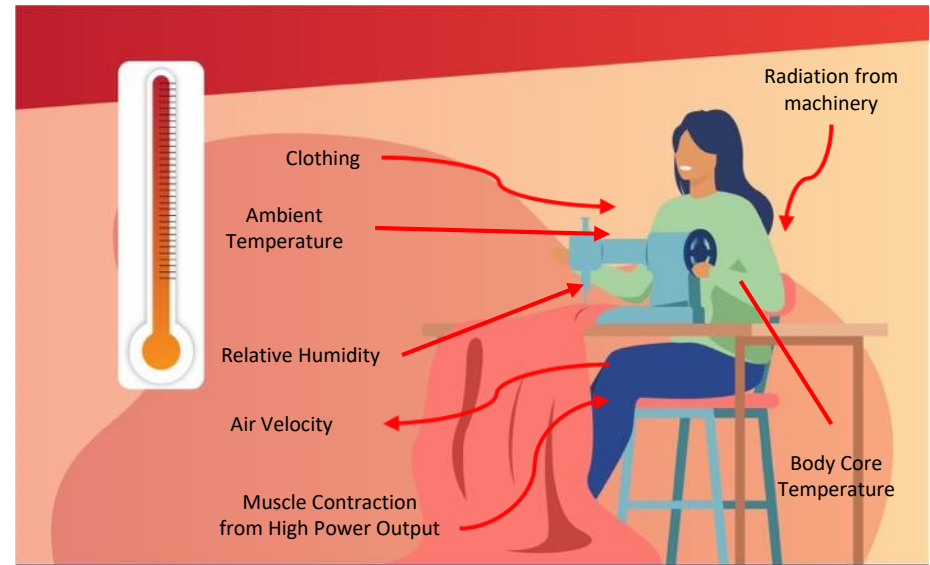
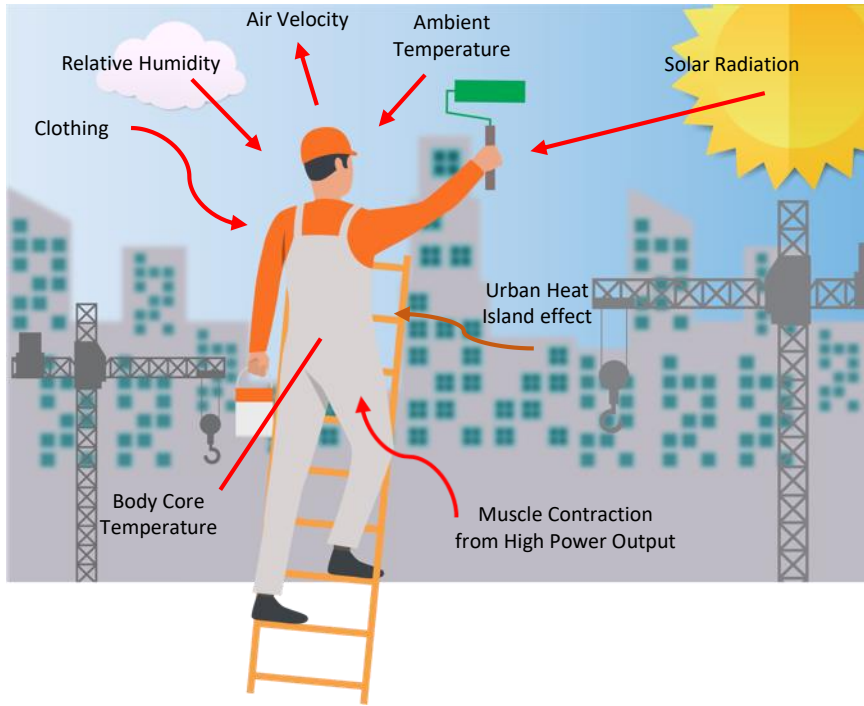
**Record figures for month recorded in Thailand, Myanmar, Laos, Vietnam, China and South Asia**



Workers move blocks of ice into a storage unit at a market during heatwave conditions in Bangkok. Photograph: Lillian Suwanrumpha/AFP/Getty Images



# Heat Stress and Heat Strain



**Climate + Clothing + Exercise  
(Heat Stress)**



**Heat Strain** 

# The Problem



# Heat stress increases risk taking

Appl Ergon. 2017 Jul;62:150-157. doi: 10.1016/j.apergo.2017.02.018. Epub 2017 Apr 6.

## Effects of heat stress on risk perceptions and risk taking.

Chang CH<sup>1</sup>, Bernard TE<sup>2</sup>, Logan J<sup>2</sup>.

### ⊕ Author information

#### Abstract

Exposure to extreme heat at work is a serious occupational hazard, as exposure can result in heat-related illnesses, and it has been linked to increased risk of accidents and injuries. The current study aimed to examine whether heat exposure is related to changes in individuals' psychological process of risk evaluation, and whether acclimatization can mitigate the effect of heat exposure. A study with quasi-experiment research design was used to compare participants' risk perceptions and risk-taking behaviors at baseline, initial exposure to heat, and exposure after acclimatization across male participants who were exposed to heat (N = 6), and males (N = 5) and females (N = 6) who were in the control group who were exposed to ambient temperature. Results show that participants perceived the same risky behaviors to be less risky ( $p = 0.003$ ) and demonstrated increased risk-taking behaviors ( $p = 0.001$ ) after initial heat exposure. While their risk perceptions returned to baseline level after acclimatization, their risk-taking behaviors remained heightened ( $p = 0.031$ ). Participants who were not exposed to heat showed no significant fluctuation in their risk perceptions and risk-taking. Our findings support that risk-related processes may explain the effects of heat exposure on increased accidents and injuries beyond its direct impact on heat-related illnesses.

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32 lives lost: Workplace fatalities in S'pore in 2022

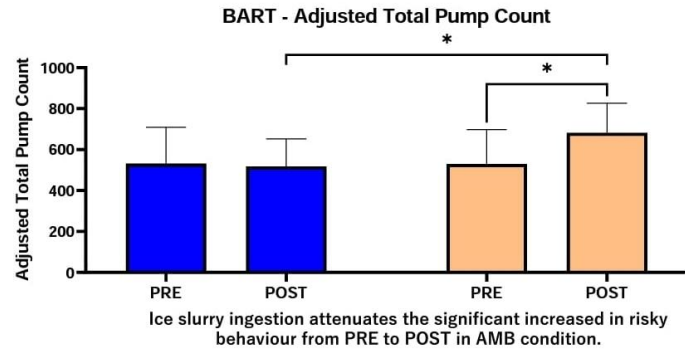


*“Participants who were not exposed to heat showed no significant fluctuation in their risk perceptions and risk-taking. Our findings support that risk-related processes may explain the effects of heat exposure on increased accidents and injuries beyond its direct impact on heat-related illnesses.”*

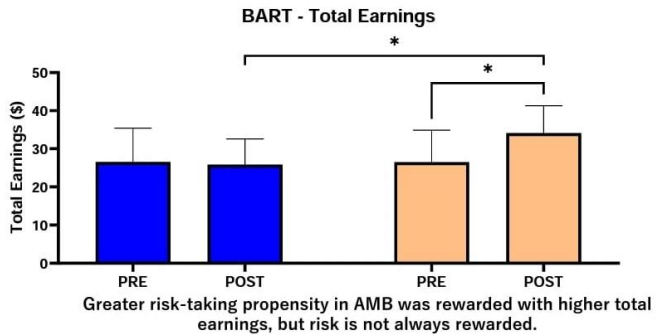


# Heat stress increases risk taking

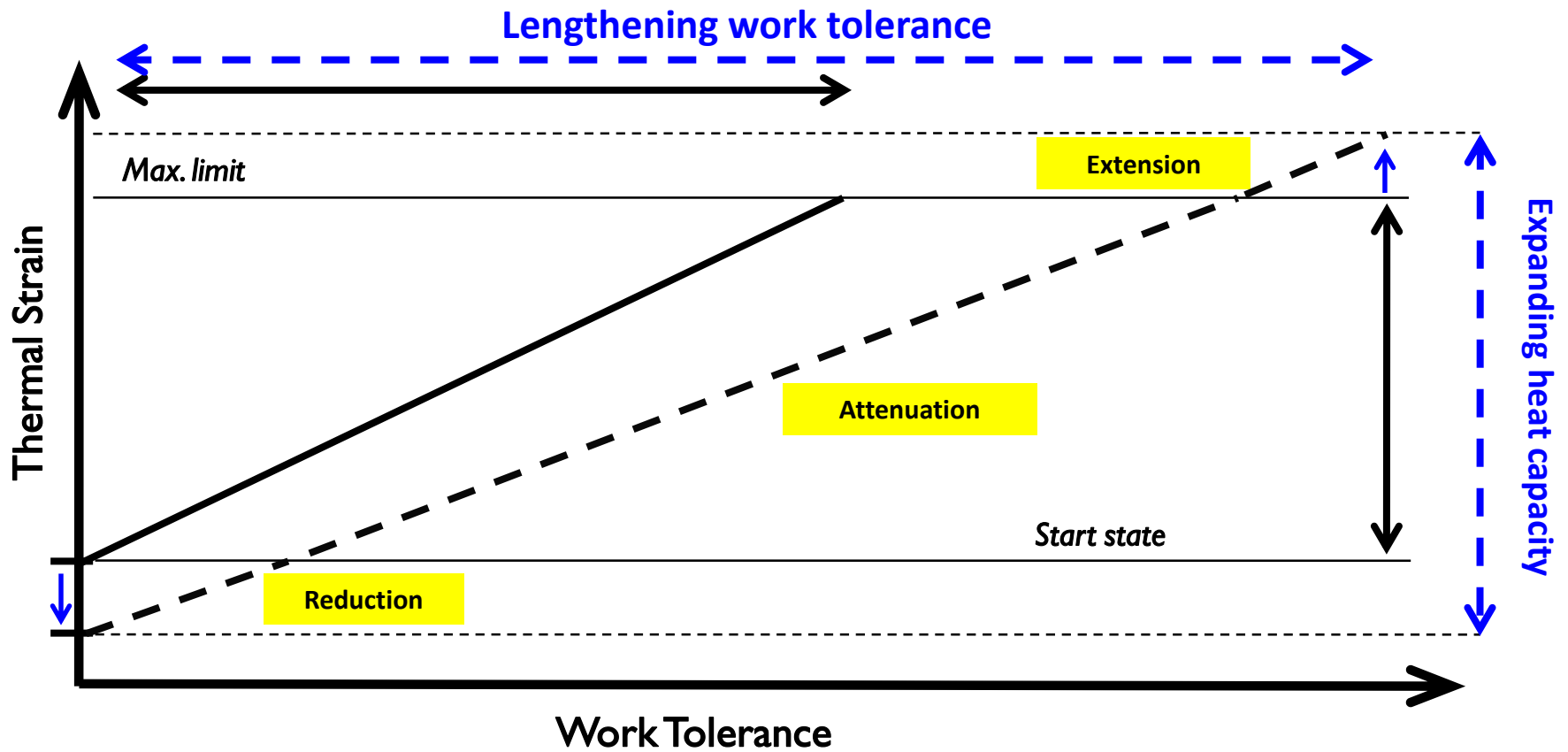
Cognitive Task BART (1) – Adjusted Total Pump Count



Cognitive Task BART (2) – Total Earnings



# Solutions (Physiological)



# STRATEGIES

# Behavioural

## Aerobic fitness

## Heat acclimatisation

## Pre event cooling

## Fluid intake

# Solutions (Physiological)



**AEROBIC FITNESS  
CONDITIONING**

Reduction  
Attenuation  
Extension



**HEAT  
ACCLIMATIZATION**

Reduction  
Attenuation



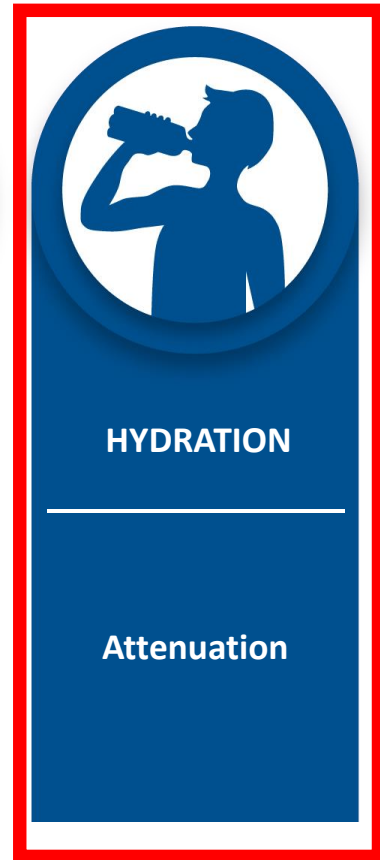
**PRE-ACTIVITY  
COOLING**

Reduction



**WORK REST  
CYCLES**

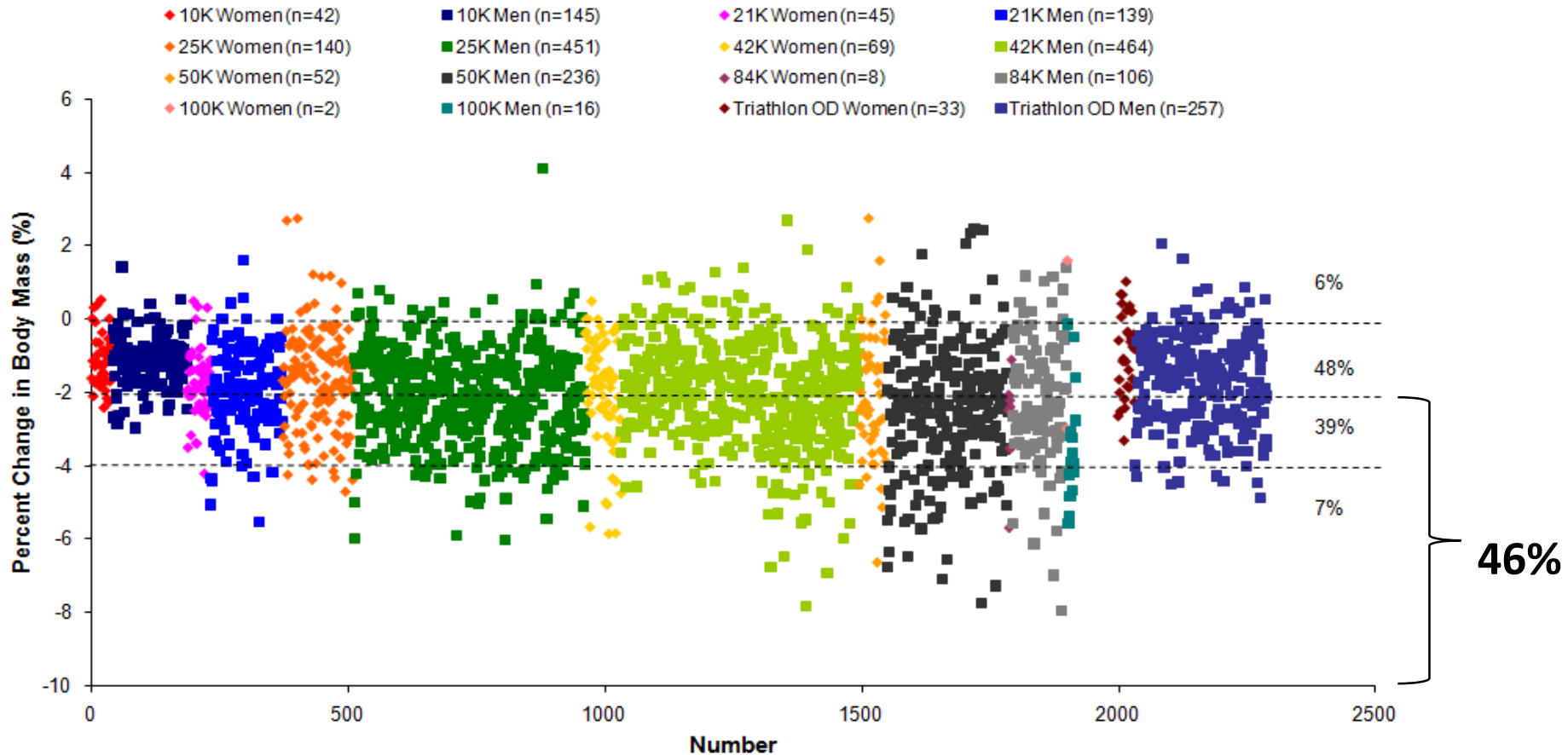
Reduction  
Attenuation



**HYDRATION**

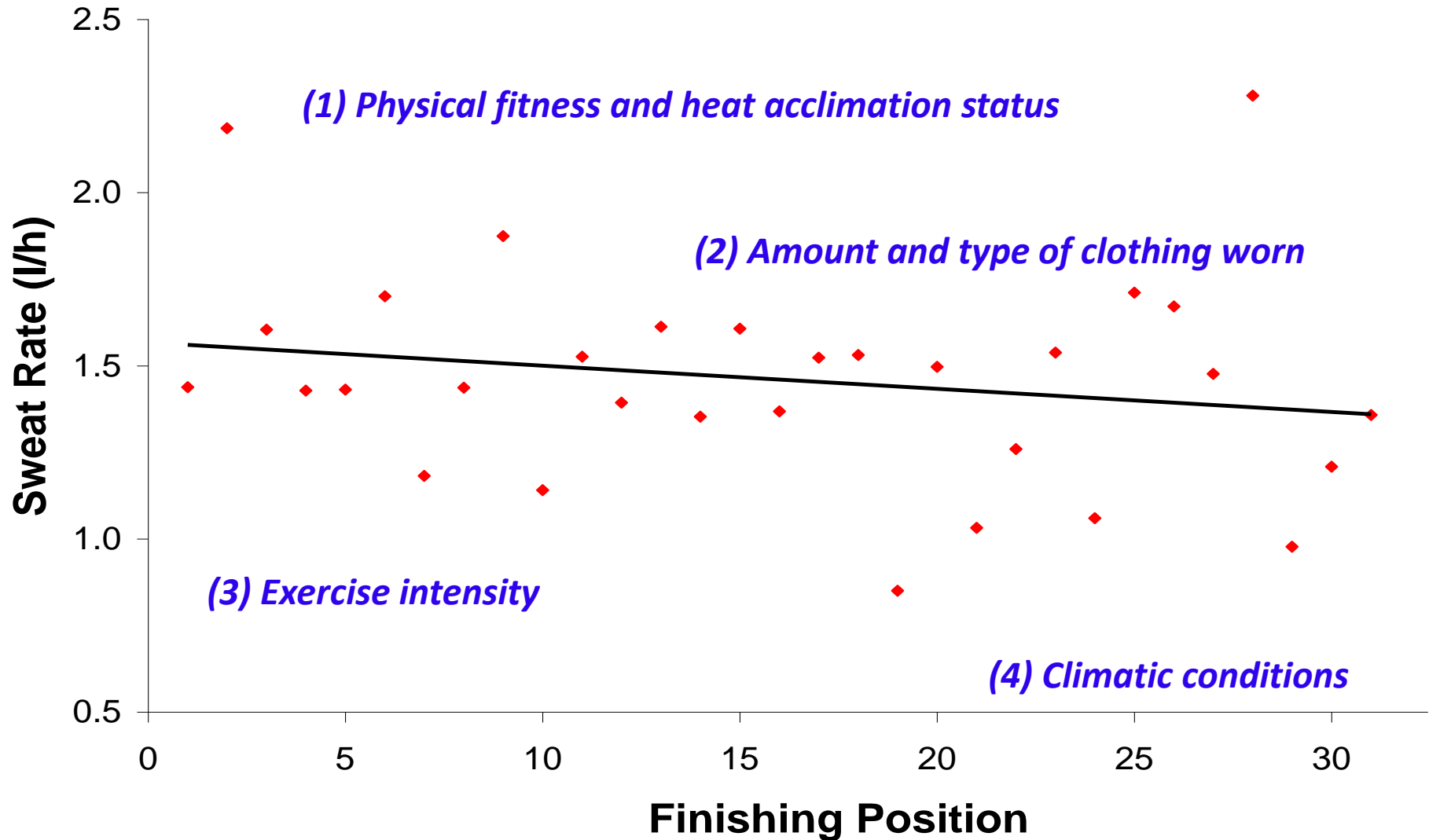
Attenuation

# Dehydration following races in the tropics (n=2206)

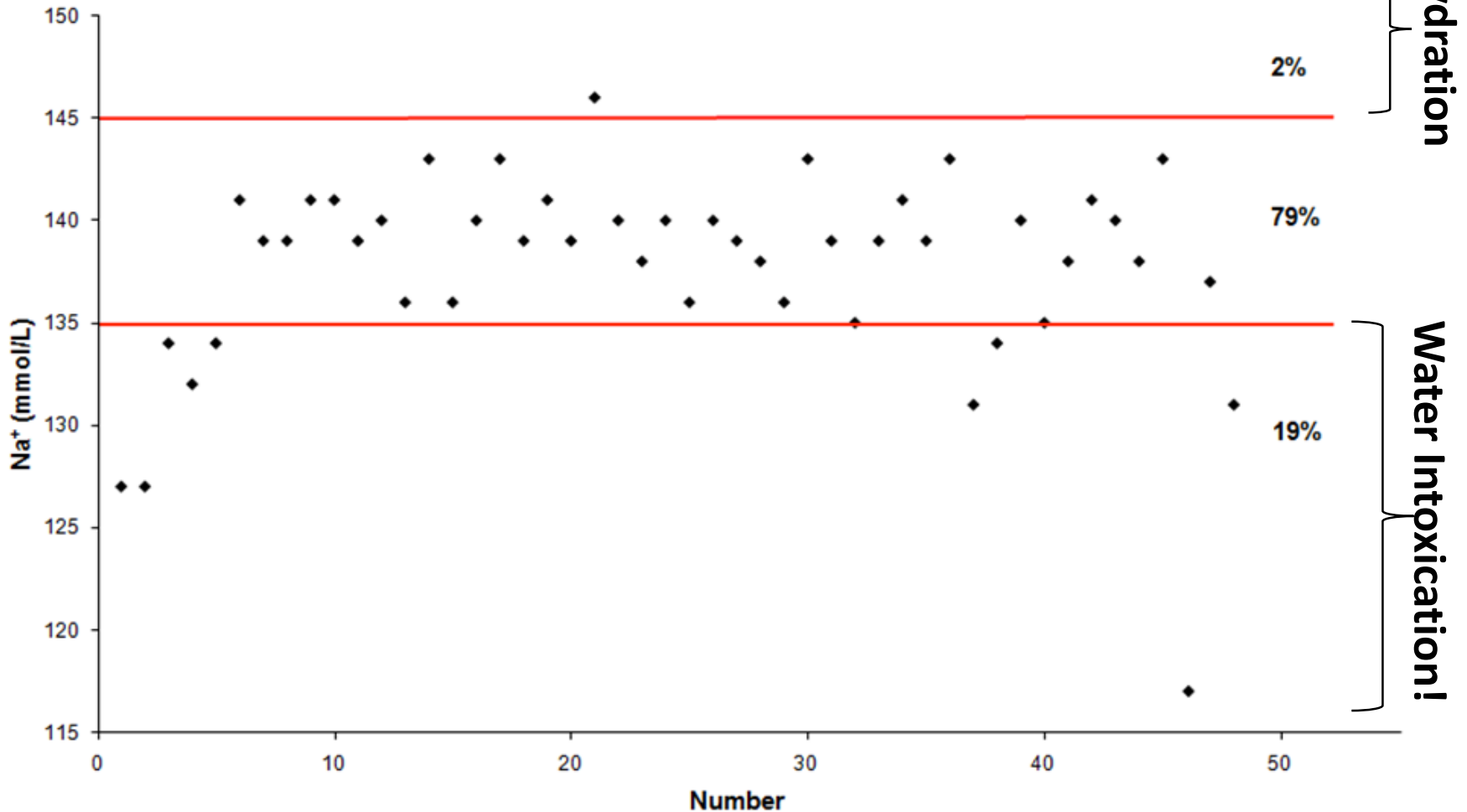


- Acute dehydration (>2% body mass loss) does not compromise health

# Half marathon individual sweat rates (n=31)



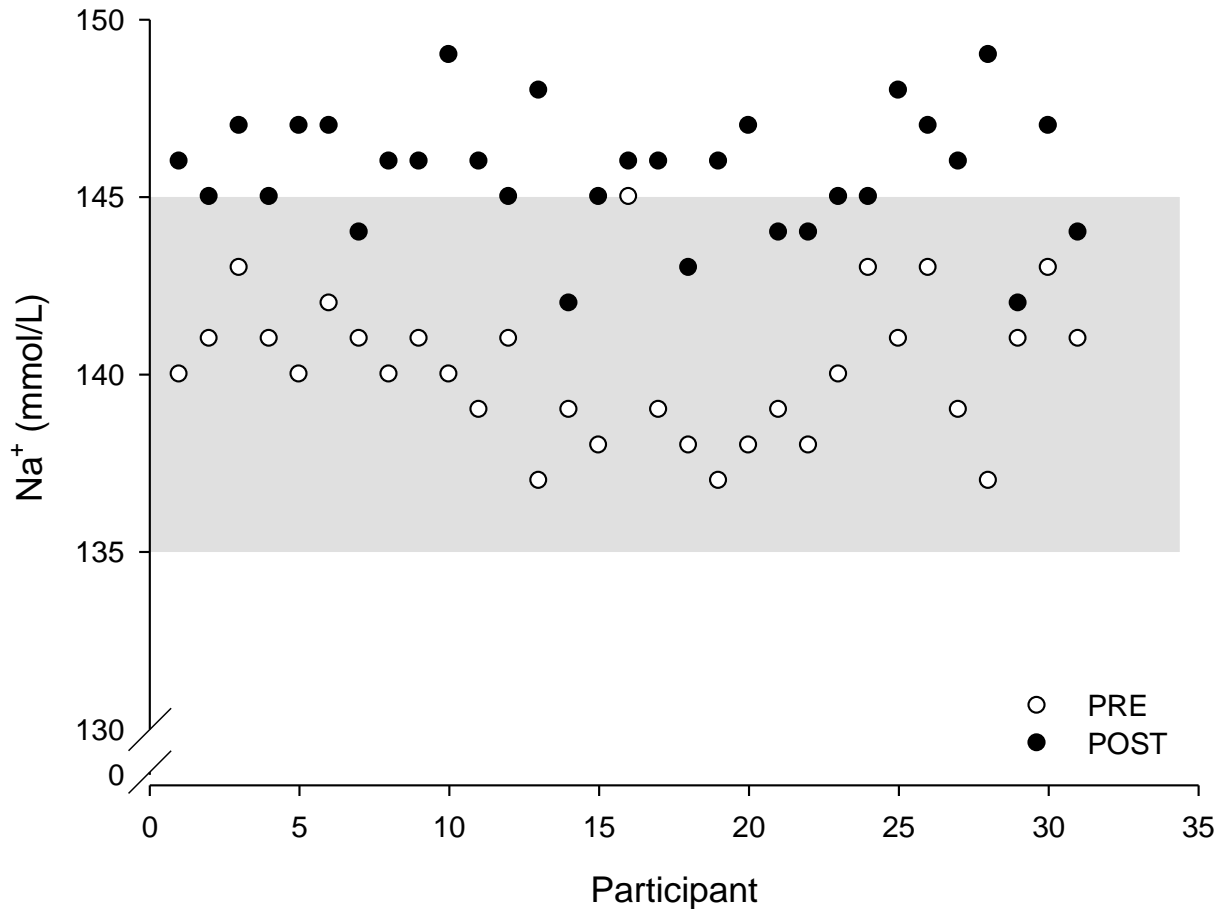
# Prevalence of Exercise Associated Hyponatremia at Onsite Endurance Medical Tents: 2009 to 2011 (n=48)



Tan et al. (2016) Sports Med

# Individual plasma sodium concentration Pre and Post AHM Race (n=31)

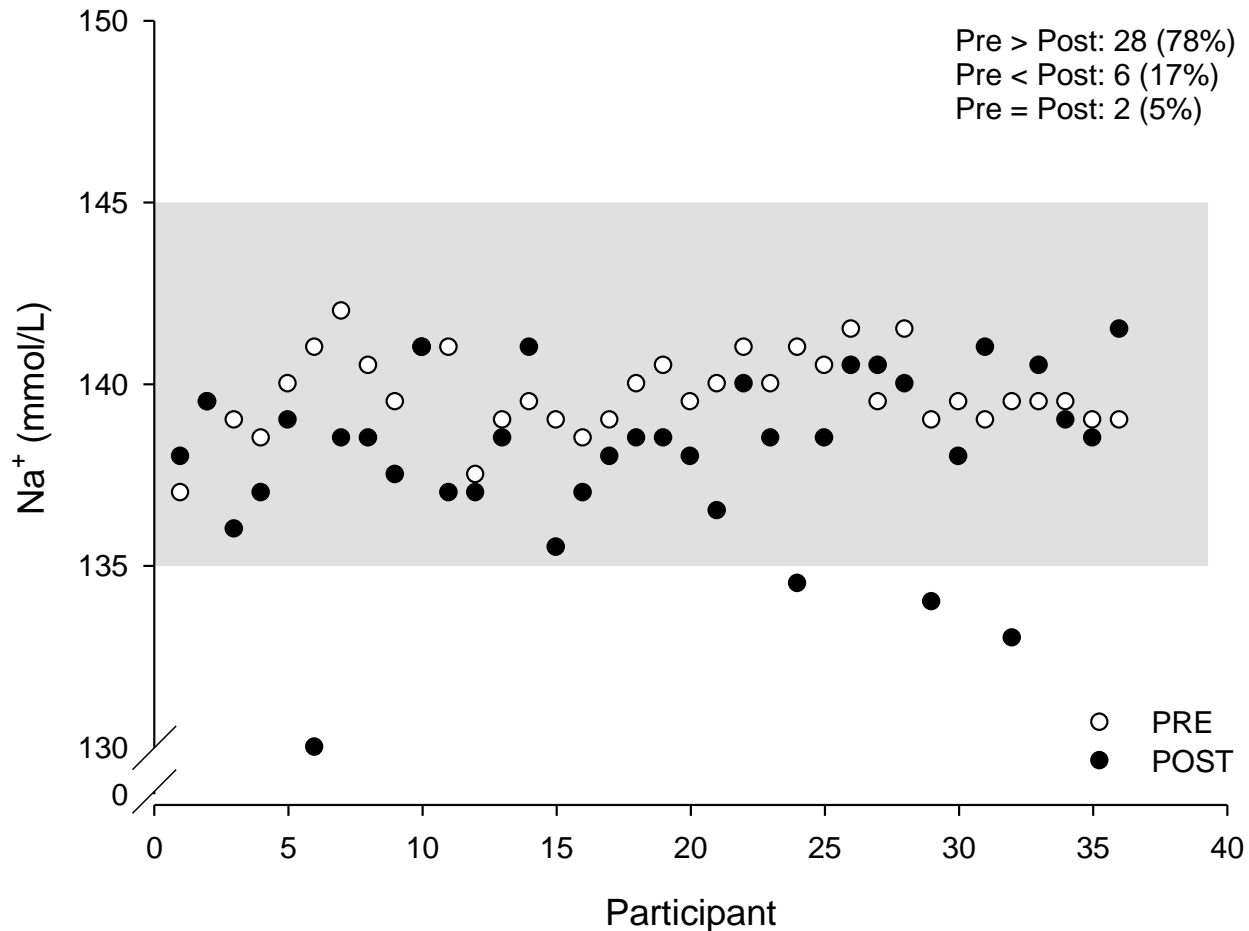
Pre < Post: 31 (100%)



- **Several were dehydrated but everyone was well**

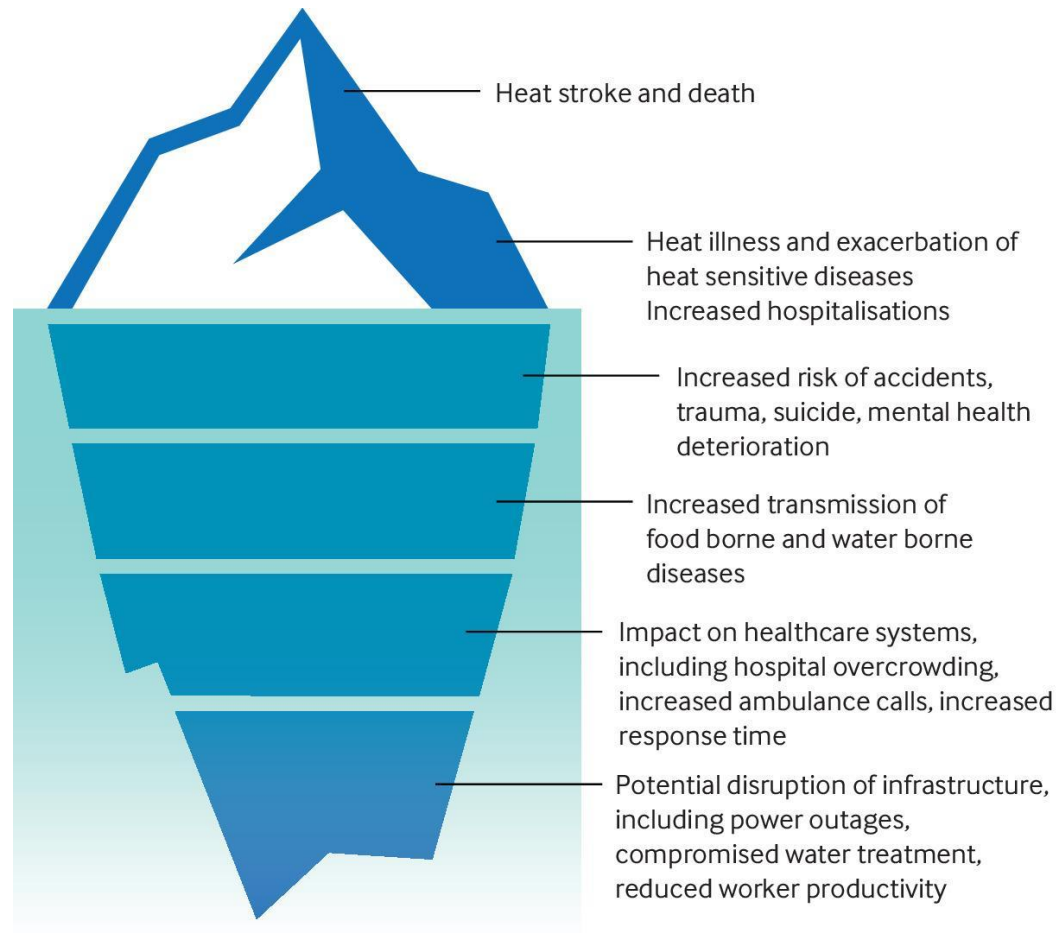


## Individual plasma sodium concentration Pre and Post RM (n=36)



- **No dehydration post RM ( $\text{Na}^+ \geq 145 \text{ mmol/L}$ ) but several were hyponatremic**

# Excessive heat stress can result in many less visible impacts



C Sorensen et al. *BMJ* 2022;378:bmj-2022-070762



# Heat increases Chronic Kidney Disease (non-traditional)



*Article*

**Pathophysiological Mechanisms by which Heat Stress Potentially Induces Kidney Inflammation and Chronic Kidney Disease in Sugarcane Workers**

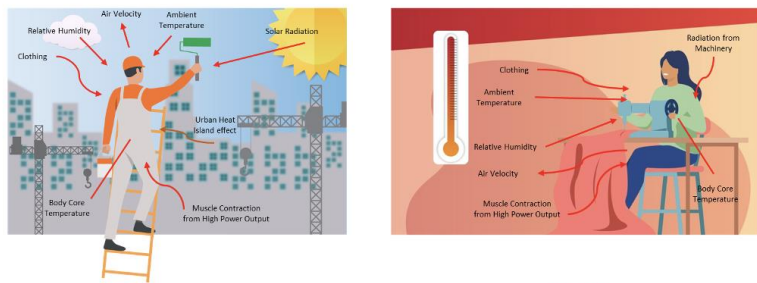


# A multidisciplinary approach to augment occupational health and work productivity in a warming world



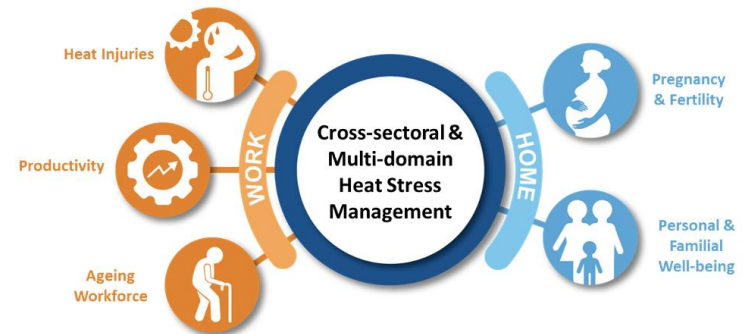
Follow us on Twitter:  
[@ProjectHeatSafe](https://twitter.com/ProjectHeatSafe)

## Heat Strain in Occupational Populations



Heat Stress + Clothing + Exercise → **Heat Strain** ⚠️

## Project HeatSafe's Multidisciplinary Approach



## Methodology



1. Profile in-situ environmental conditions at worksites



2. Administer surveys



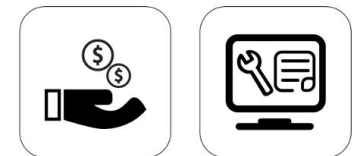
3. Physiology and Ethnography field case studies



## Expected Outcomes

- ✓ Economic analysis of work productivity loss due to the heat
- ✓ Impact of heat strain on workers' physiology and performance
- ✓ Social and knock-on impacts of heat on workers and their families
- ✓ Potential interventions to adopt in occupational settings

## Evaluating Interventions



Cost-effectiveness

Logistics



Sustainability

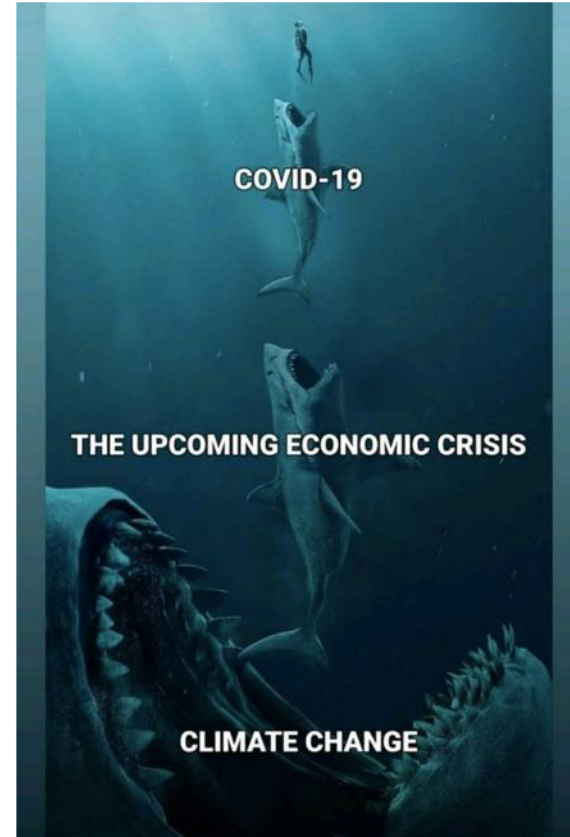
Productivity



# WARNING!



*Global Climate Report 2020, NOAA*



# Summary

1. Optimal safety **does not** compromise but enhances productivity
2. Solutions are there but **use them correctly**
3. Heat stress can **induce more than** just heat injuries and performance degradation

# Heat Resilience and Performance Centre (HRPC)



## DISCOVER

Discovery of Heat Mechanisms

## OUR FOCUS



## DETECT

Ensuring Heat Health Readiness



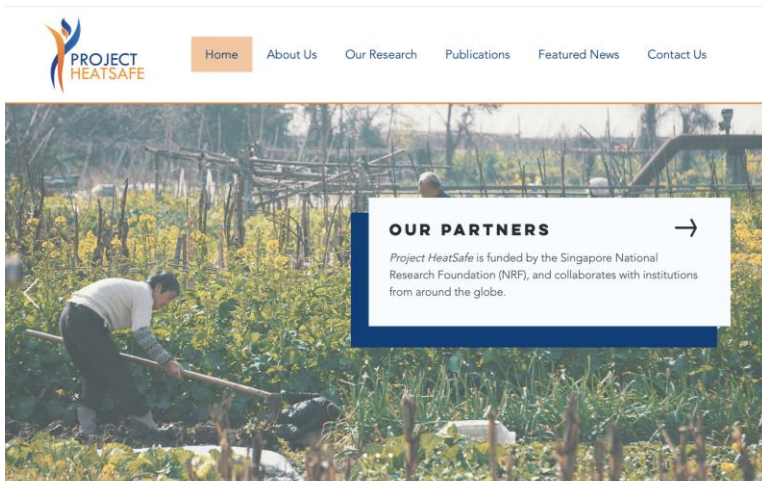
## STRENGTHEN

Optimising Heat Resilience

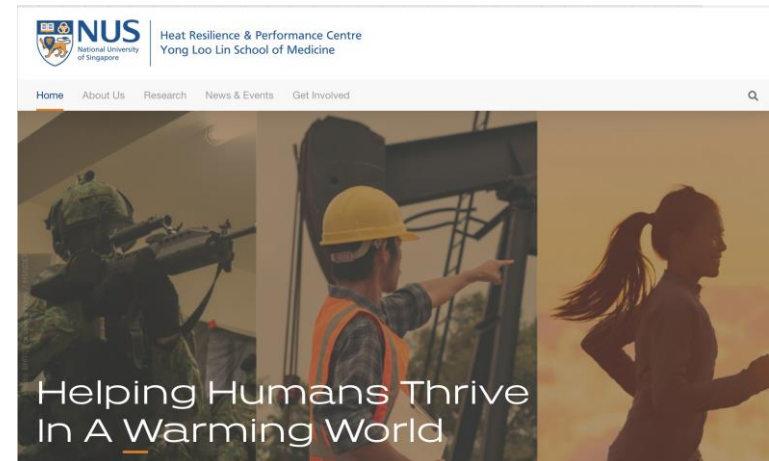


<https://www.youtube.com/watch?v=OqvClg-RbmY>

# Key Enablers



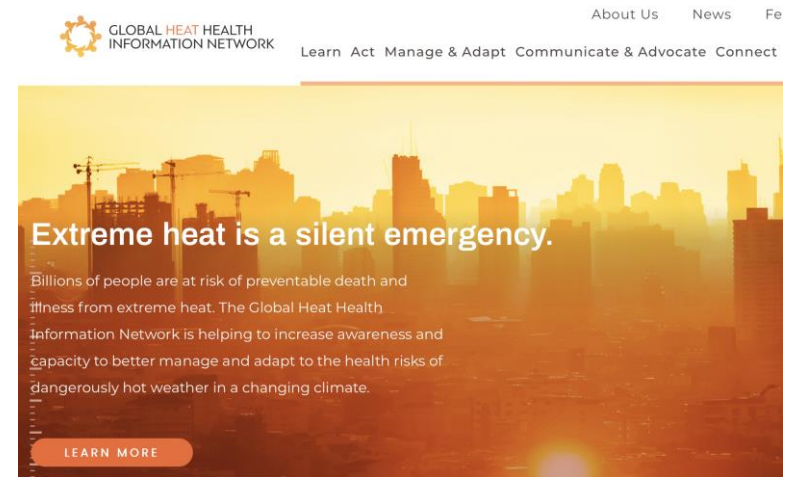
<https://www.heatsafe.org>



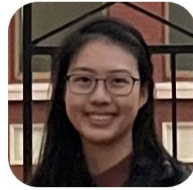
<https://medicine.nus.edu.sg/hrpc/>



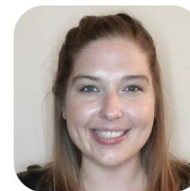
<https://www.icohsctf.org>



<https://ghhin.org>



Human Potential Translational  
Research Programme  
Yong Loo Lin School of Medicine



Heat Resilience & Performance Centre  
Yong Loo Lin School of Medicine



**Thank You**