

Heat on human health and work productivity: heat strain over heat stress

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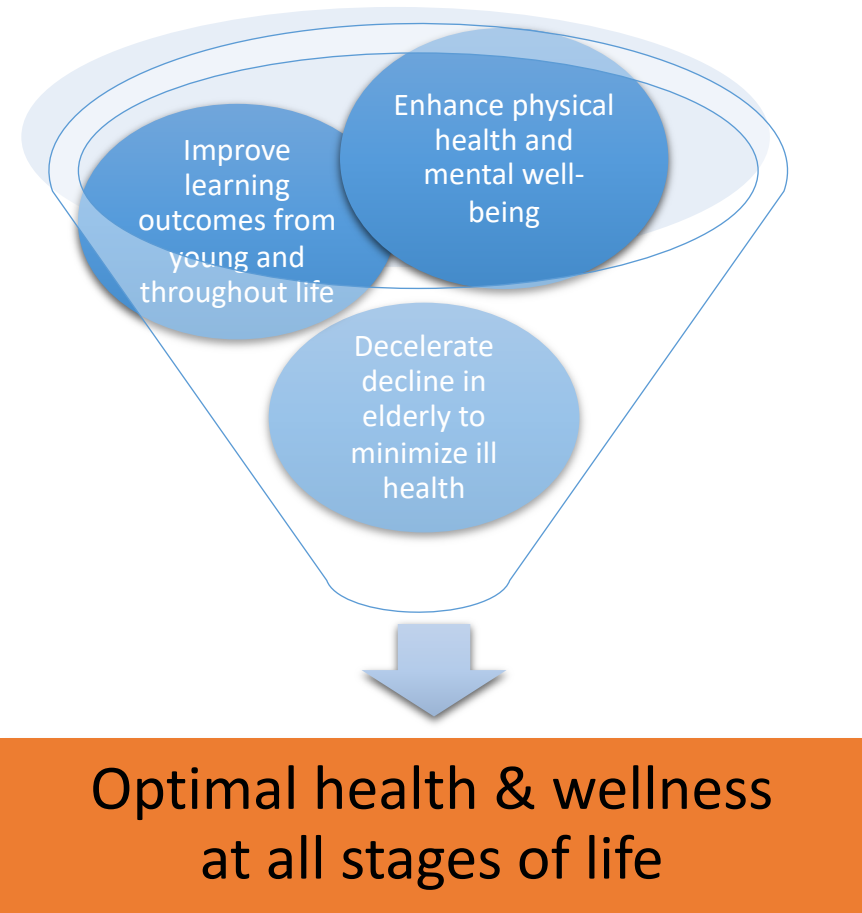
National University of Singapore

VISION

Maximising human potential for health & productivity

MISSION

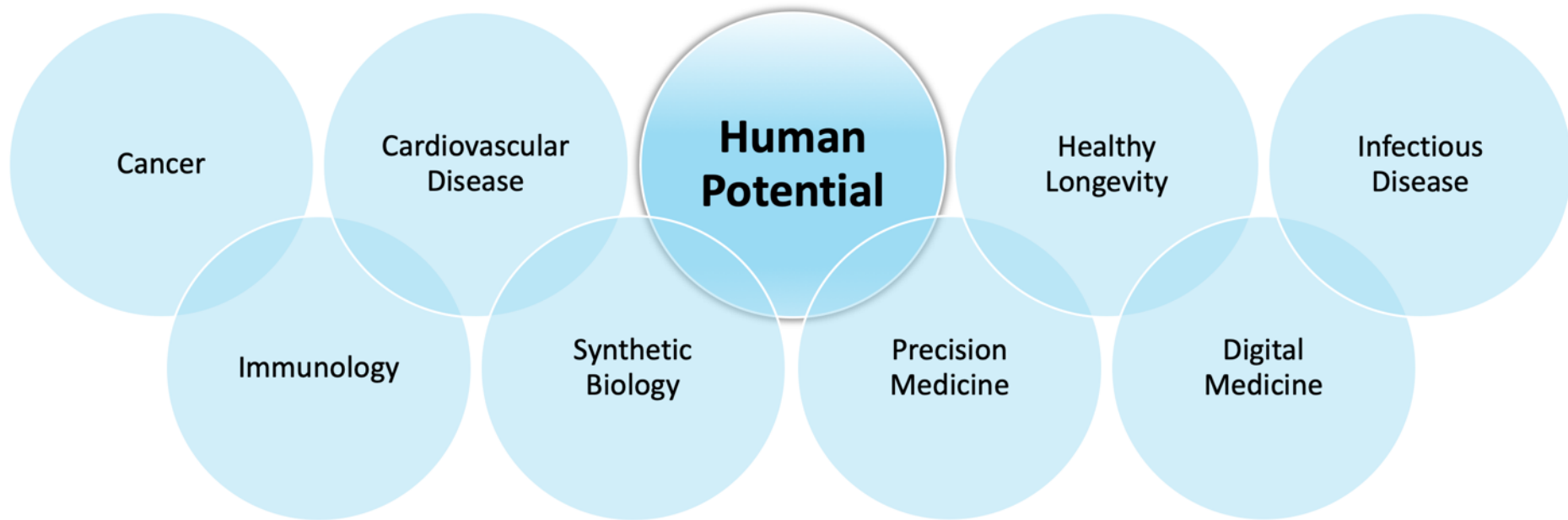
We seek to optimise developmental conditions from the early phases of life to maximise human potential during adulthood **in the changing environment**



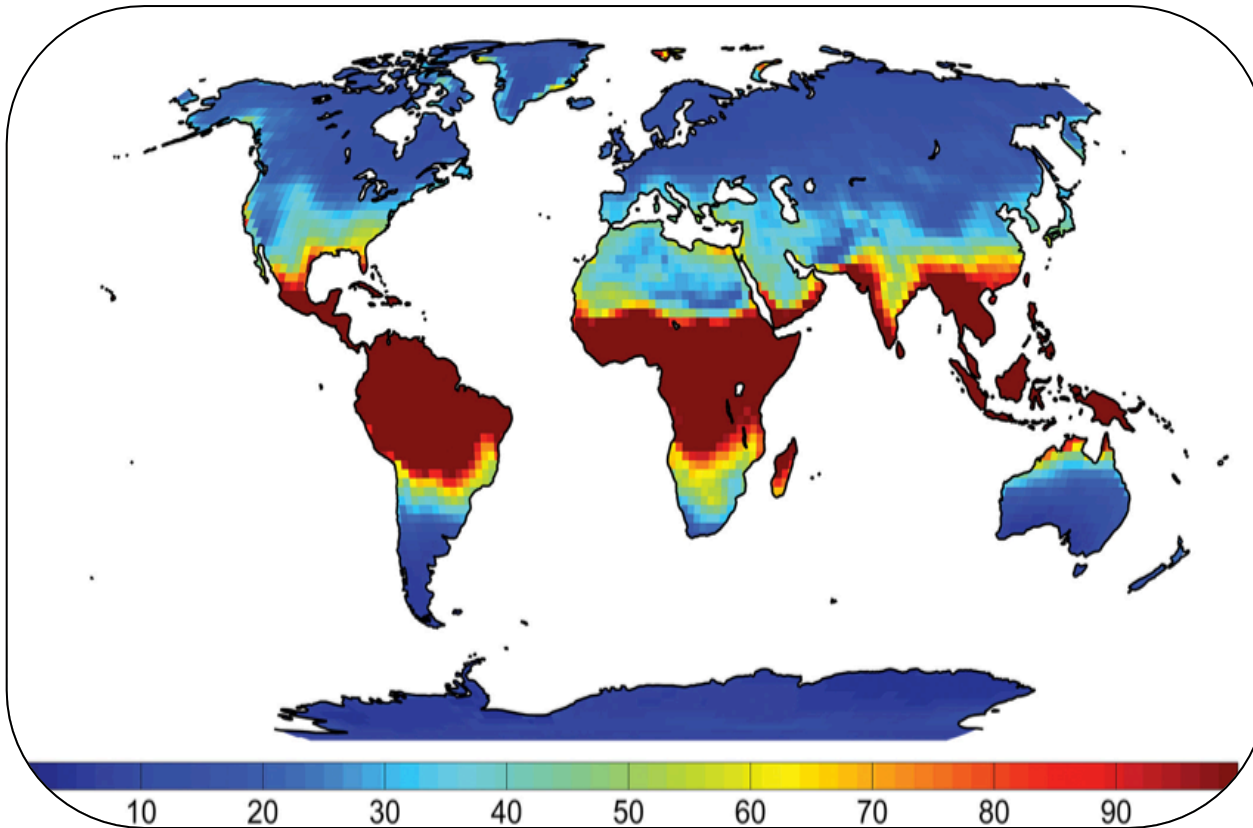
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Human Potential Translational
Research Programme
Yong Loo Lin School of Medicine

TRANSLATIONAL RESEARCH PROGRAMMES



The Problem




Average number of days
in 2050-2069 exceeding
mean maximum WBGT
for 1985-2004

Horton et al. 2016

The Problem

We set you thinking
TODAY
SUNDAY 02 SEPTEMBER 2018

Singapore **World** Big Read Opinion Visuals Brand Spotlight 8 DAYS 

Record 70,000 people sent to hospitals in Japan due to heat wave



Singapore

Death of NSF Dave Lee: MINDEF to prosecute those responsible for lapses in military court if no criminal charges filed



TENNIS AUSTRALIAN OPEN

**TENNIS NEWS – AUSTRALIAN
OPEN TWEAKS EXTREME HEAT
POLICY**



The Problem



Climate countdown Climate change

Rising temperatures will cause more deaths than all infectious diseases - study

Poorer, hotter parts of the world will struggle to adapt to unbearable conditions, research finds



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Science & Environment

Climate change: Summers could become 'too hot for humans'

By David Shukman
Science editor

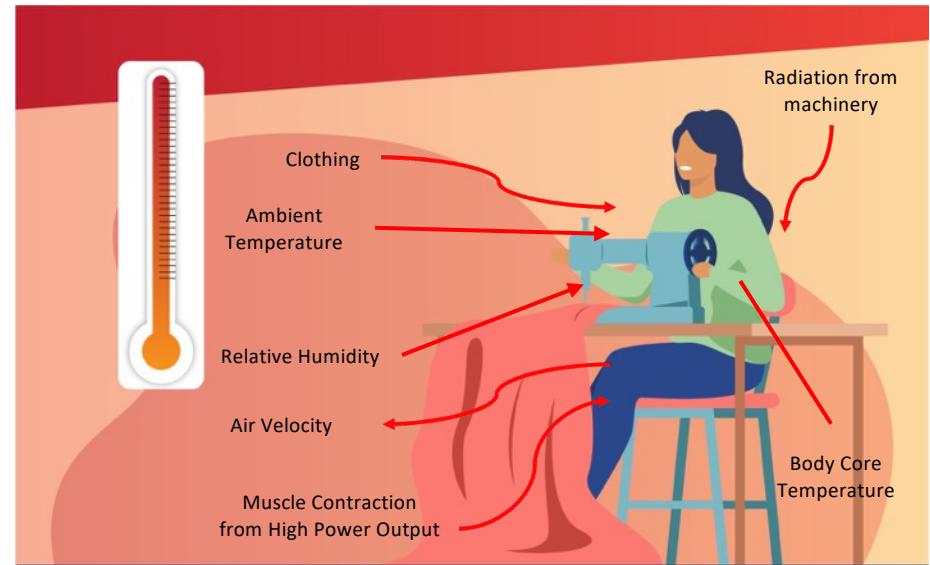
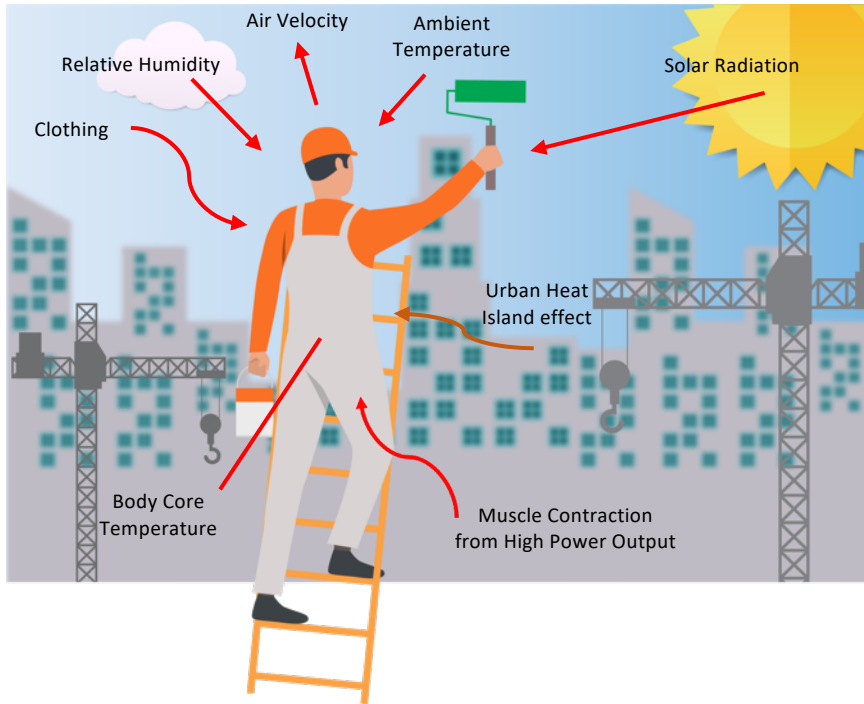
16 July 2020

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UK heatwaves



Heat Stress and Heat Strain

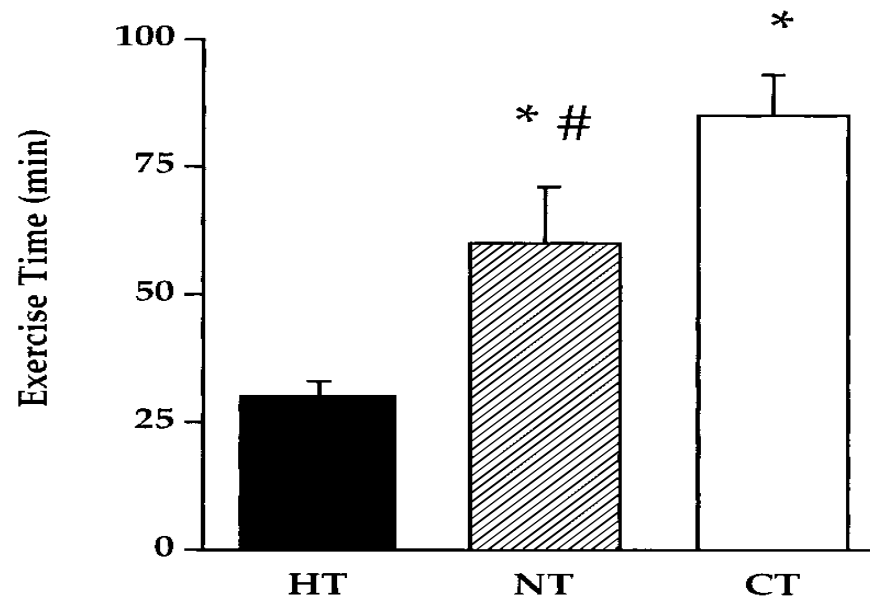


Heat Stress + Clothing + Exercise → **Heat Strain** ⚠

Old “Drug”, New Tricks?

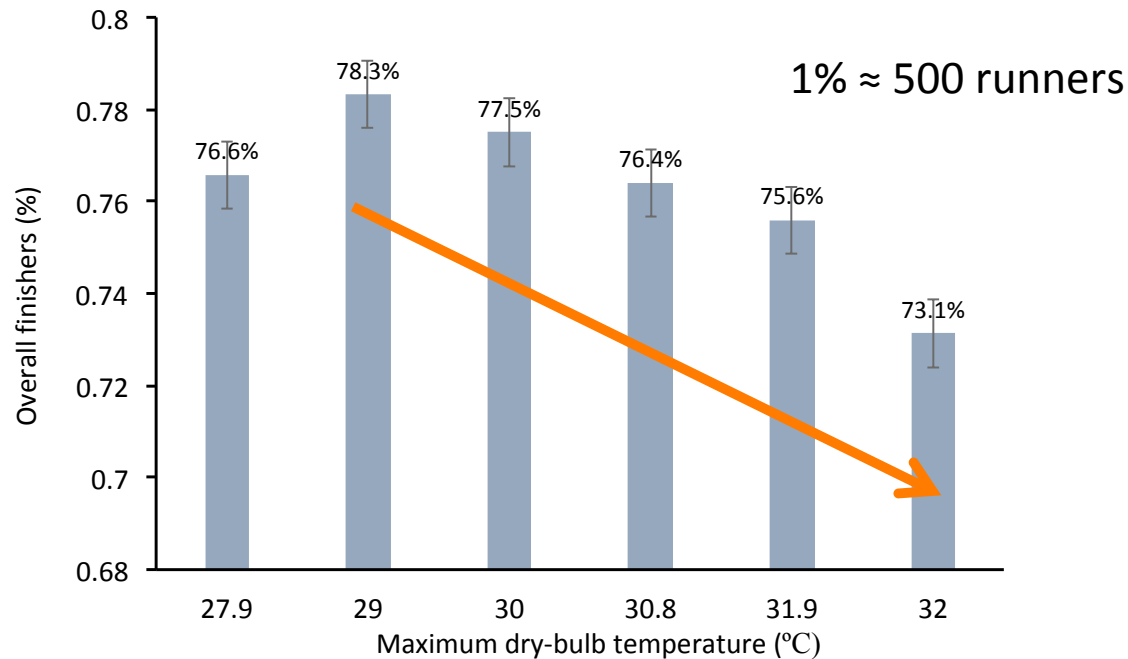


Exercise capacity is limited in the heat



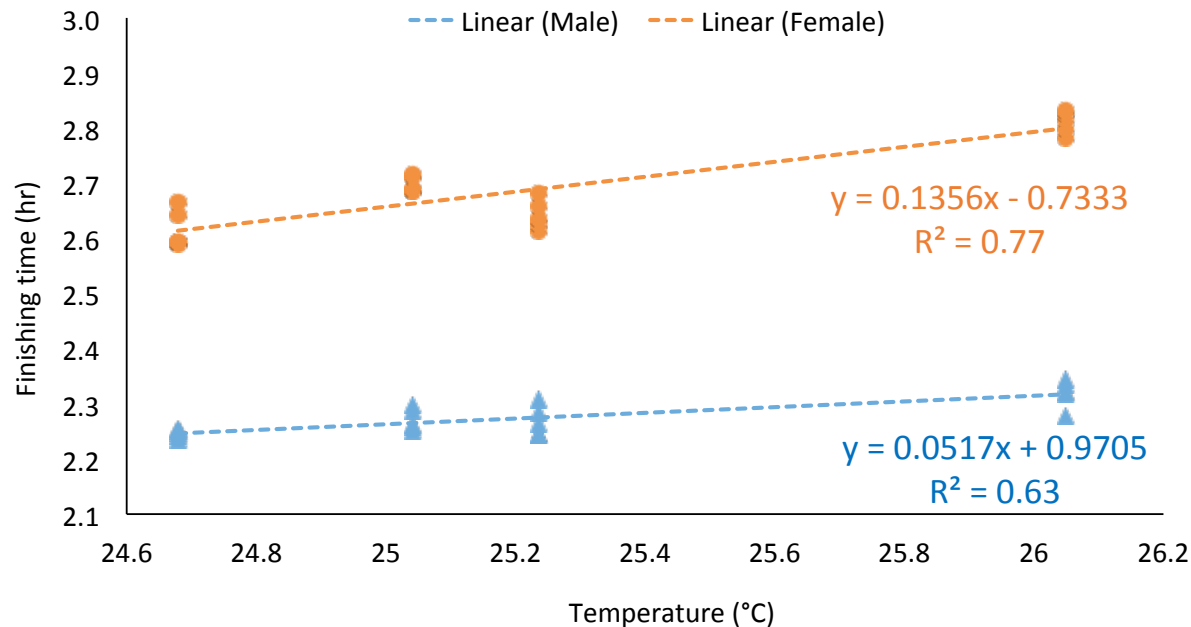
Exercise time to exhaustion during cycling at 70% peak pulmonary oxygen uptake in 40°C (HT), 20°C (NT), and 3°C (CT). Figure taken from Parkin et al., 1999.

Environmental Heat on Number of Finishers



Lee et al. (unpublished)

Environmental Heat on Endurance Performance



- For males, an additional 3.1 min for every 1°C increase in temperature
- For females, an additional 8 min for every 1°C increase in temperature

Lee et al. (unpublished)

The Problem



Indirect negative consequences of heat stress

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 CH¹, Bernard TE², Logan J².

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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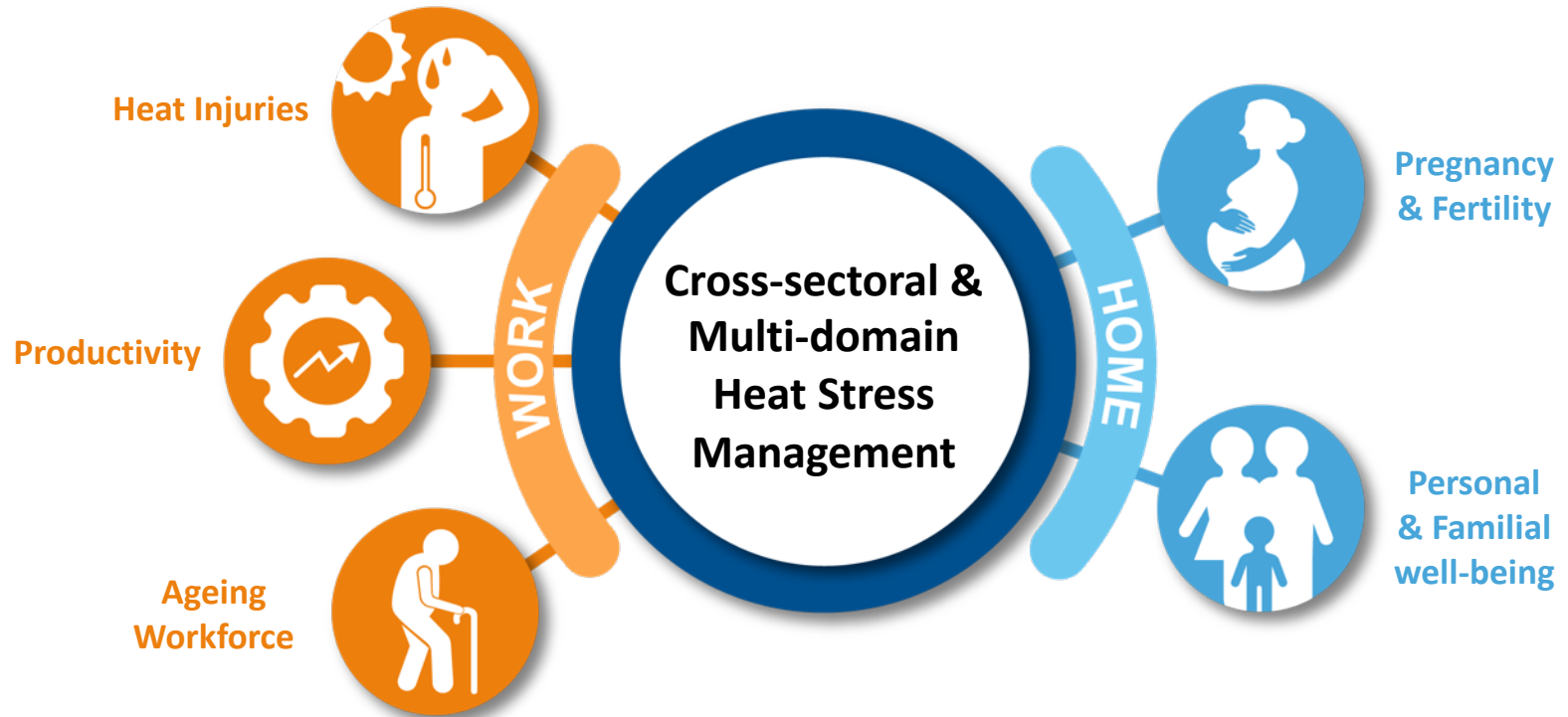
The Problem



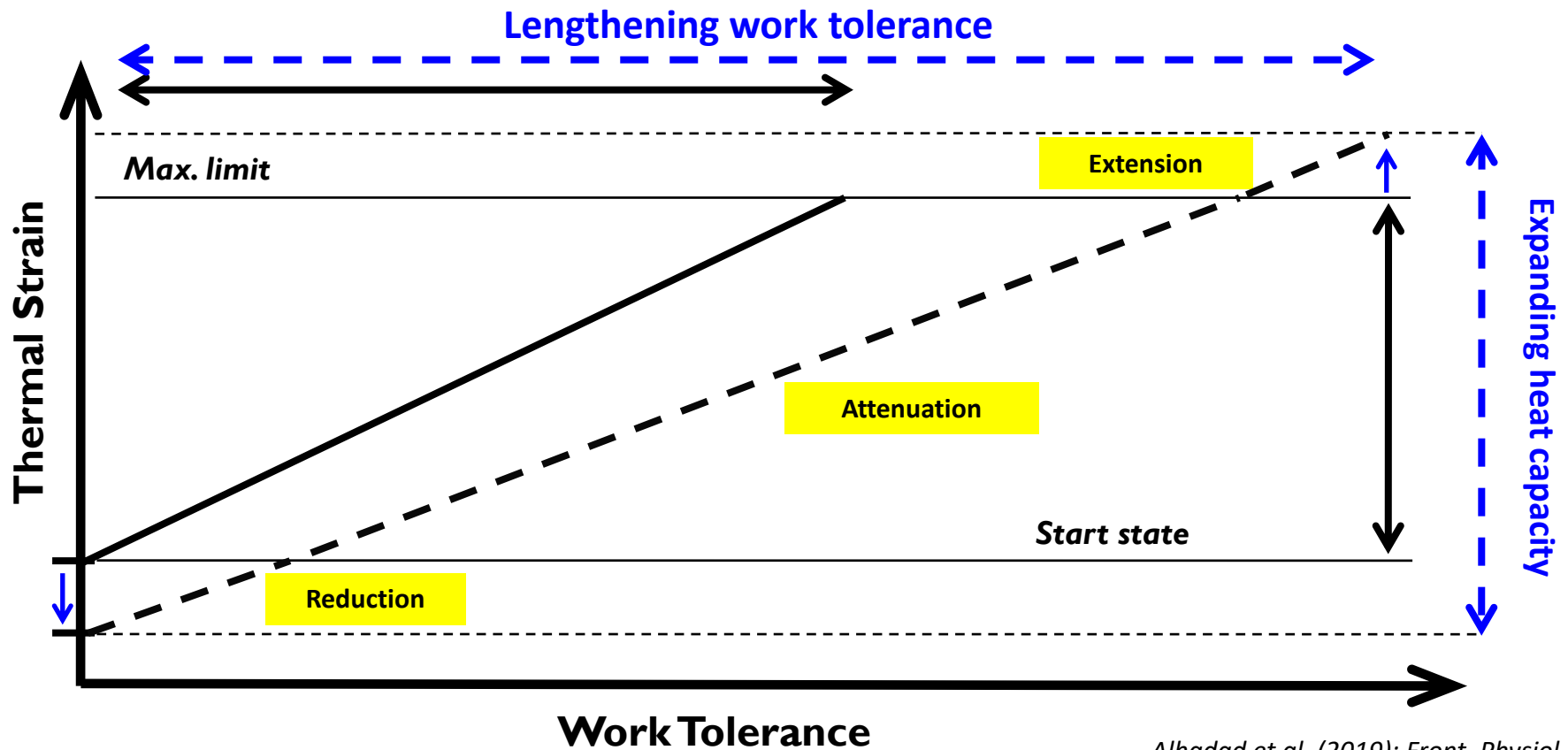
The Problem



| The Problem

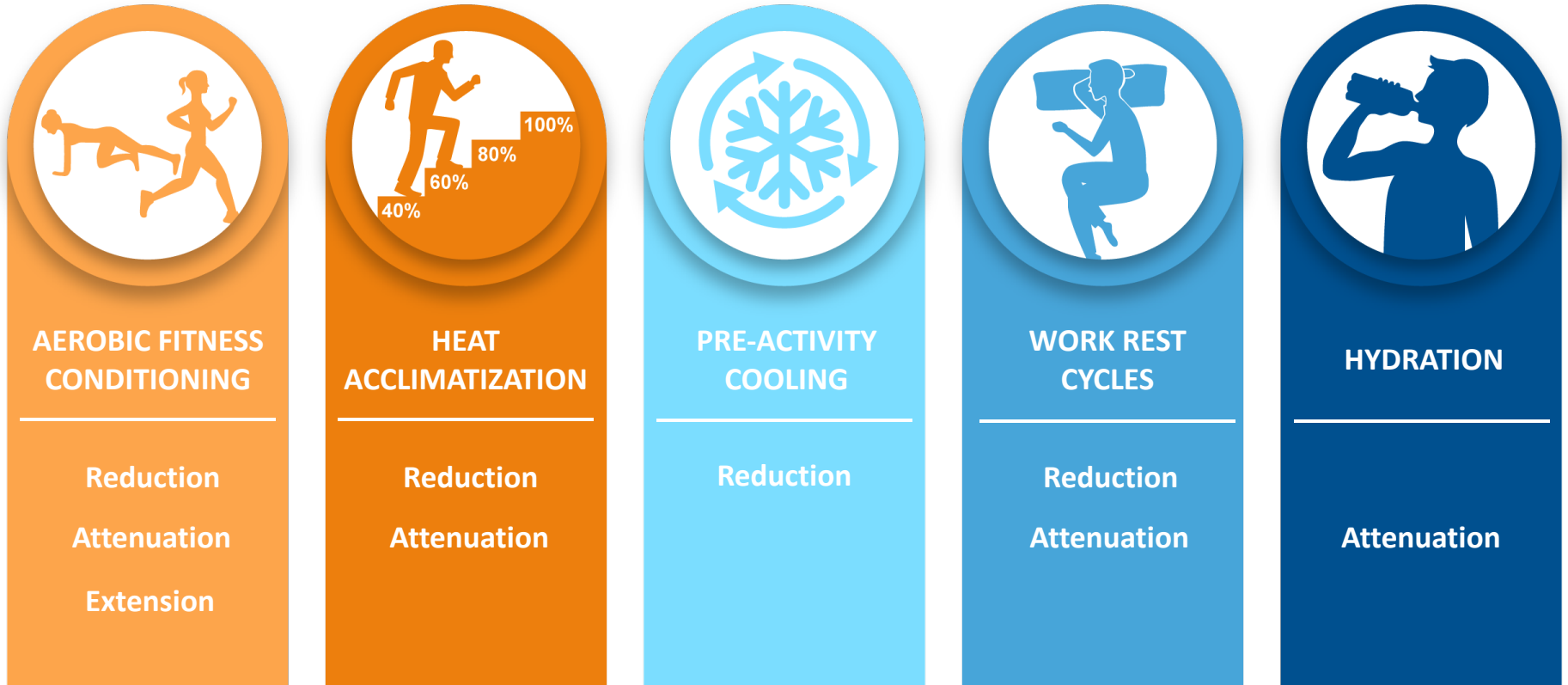


Solutions (Physiological)



Alhadad et al. (2019); Front. Physiol.

Solutions (Physiological)



Alhadad et al. (2019); Front. Physiol.



Article

Heat Stress and Thermal Perception amongst Healthcare Workers during the COVID-19 Pandemic in India and Singapore

Jimmy Lee ¹, Vidhya Venugopal ² , P K Latha ^{2,3} , Sharifah Badriyah Alhadad ^{4,5,6} ,
Clarence Hong Wei Leow ⁷ , Nicholas Yong De Goh ⁷, Esther Tan ¹, Tord Kjellstrom ^{8,9},
Marco Morabito ^{10,11} and Jason Kai Wei Lee ^{5,7,12,13,*}

3.5. Ice Slurry

Thirty-seven observations of thermal comfort ratings before and after ingestion of ice slurry were recorded amongst the 55 respondents in Singapore. The median rating improved from 2 (IQR 1–2) (warm) before ingestion to 0 (IQR 0–1) (neutral) after ingestion ($p < 0.001$).

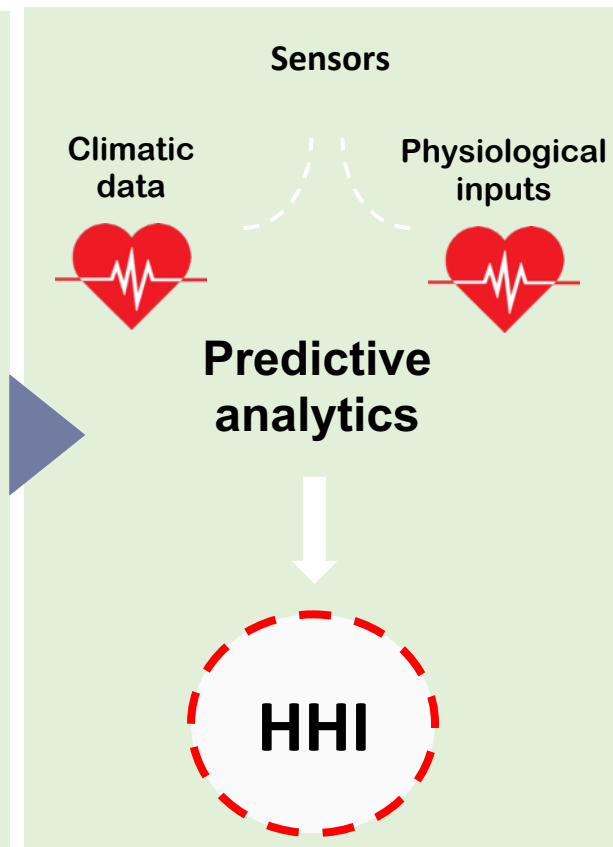
Perspectives...

Heat Health Index (Climatic **AND** Physiology)

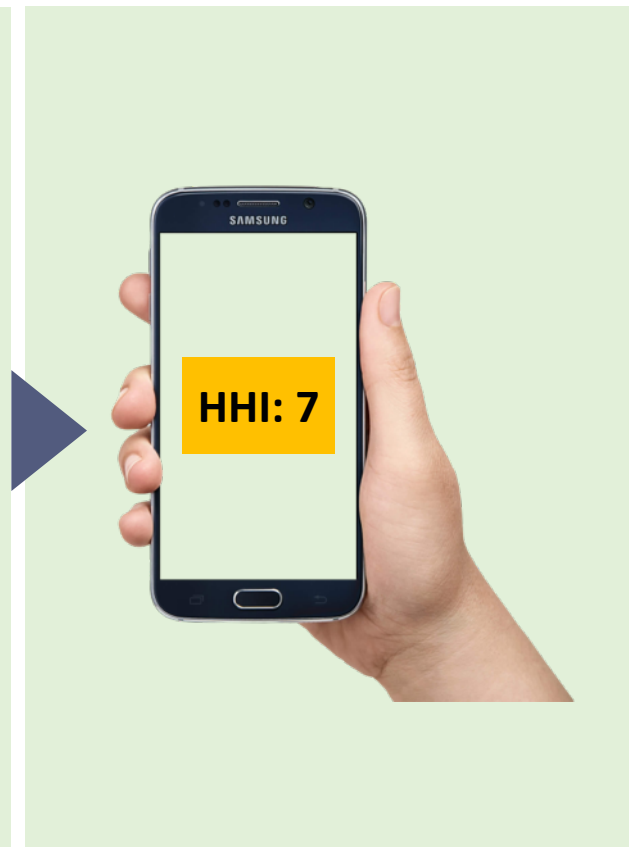
Sensor Data Extraction



Predictive Analytics



Control & Monitor



Health and Cost Effectiveness of a Heat Management Policy on Exertional Workers



Evaluating the effectiveness of labor protection policy on occupational injuries caused by extreme heat in a large subtropical city of China

Yanan Su ^{a, b, 1}, Liangliang Cheng ^{a, 1}, Wenjia Cai ^{c, d}, Jason Kai Wei Lee ^{e, f, g},
Shuang Zhong ^h, Siyu Chen ⁱ, Teng Li ^j, Xinfei Huang ^j ✉, Cunrui Huang ^{a, k, l} ✉

Quantification of the **societal impact** of heat health

Singapore

Death of NSF Dave Lee: MINDEF to prosecute those responsible for lapses in military court if no criminal charges filed



SAF captain who was discharged over NSF Dave Lee's death dies from cancer

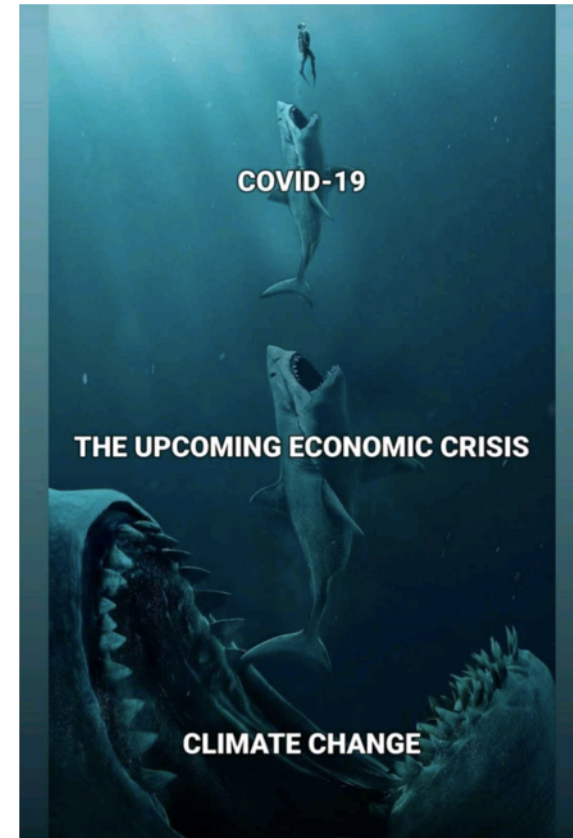
By LOUISA TANG



2020 on course to be hottest year since records began



Global Climate Report 2020, NOAA



THANK YOU

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