HEATS
Heat Exposure, Activity and Sleep
HEATS

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HEATS
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Heat Exposure and Urban Health

Cities are overheating
Overheating is a major challenge for human health, especially as night times get hotter.

Heat impacts lifestyles
Sleep and exercise, two of the three key pillars of health, are known to be affected by heat exposure.

Singaporean context
Singapore is getting warmer and has one of the most sleep-deprived populations in the world.

Short sleep is costly
Insufficient sleep is associated with significant economic costs and undesirable health outcomes.
Develop technological and behavioural solutions to improve sleep

**Project Aim**

**Heat Exposure**
Effects of heat on lifestyles of Singaporeans

**Cooling Homes**
Smart solutions to cool during sleep at home

**Cooling Dorms**
Solutions to cool during sleep in dorms

**Smartwatch Nudges**
Nudging for better sleep environments
Heat Exposure

Physiological Measures
- Skin temperature, heart rate, physical activity

Subjective Feedback
- Thermal comfort, sleep quality, neurobehavioural functions

Sleep Metrics
- Duration, wakefulness, efficiency, sleep stages

Bedroom Environments
- Temperature, humidity, CO\textsubscript{2}, PM\textsubscript{2.5}, noise, light
Combining data sources to characterise the impacts of activity and environmental exposures on sleep.
Cooling Homes

HEATS

Air conditioning
Automatically change operation and setpoint temperatures

Wearable Sensors
Monitor sleep and physiology as inputs to AC control algorithm

Smart Appliances
Control low-energy cooling devices based on sensors
Laboratory study of dynamic temperature control for air conditioners in Singaporean homes

![Temperature Change Graph](image-url)

- **Optimised Strategy**
  - Room Temperature: 27°C falling to 23°C
  - Time: 3 hours falling asleep, 1 hour waking up, 3 hours waking up

- **Typical**
  - Room Temperature: 23°C
Cooling Dorms

- **Design guidance**: Recommendations to support good sleep in dorms
- **Air movement**: Evaluate personal, standing, window, and ceiling fans in dorms
- **Sleep**: Monitor sleep of 50 workers in dorms using wearables
Randomised crossover design to rigorously test the success of interventions on sleep.
**Smartwatch Nudges**

**Natural Ventilation**
“Now is a good time to open your bedroom window for cooling”

**Air Conditioning**
“Turn on your air conditioning to help cool your bedroom”

**Home Appliances**
“Turn your bedroom fan on to cool yourself and help you fall asleep”

**Exercise Behaviours**
“Consider exercising regularly to improve sleep onset, duration and quality”
Prompts delivered to a smartwatch at the right time to nudge behaviours that can improve sleep.
Scientists worried by future warmer nights want to help workers, residents in S’pore sleep better

“A poorly rested person over time can never be healthy and productive. We need to have scalable and sustainable solutions to ensure proper rest. Without proper recovery, more problems ensue.”

Jason Lee

“Instead of having the AC on the entire night at a fixed temperature, the smart system can autonomously change the set point during the night to meet people’s needs.”

Stefano Schiavon
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