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Heat strain a threat to workers even in cooler periods: Study

Findings suggest heat-related injury is a persistent risk not tied only to the weather

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A 22-year-old indoor construction worker's core body temperature exceeded 38 deg C during the second half of his work shift and his heart rate remained elevated.

The acceptable core temperature, or the temperature of a person's internal organs, is about 37 deg C. At one point, his heat strain index reached a high level of eight out of 10.

These findings might not be surprising for an outdoor worker toiling in a heatwave, but the 22-year-old was working underground in a tunnel during a cooler period in December 2022, when the north-west monsoon was bringing rain and overcast skies.

A few construction workers may be working harder during cooler periods, crossing occupational thermal limits, researchers from the National University of Singapore (NUS) found, after profiling the heat strain risk of about 160 construction workers here during the hotter and cooler months of 2022.

Their findings suggest that heat-related injury is a persistent risk here that is not necessarily tied only to the weather, and that employers and workers should be aware of it at all times of the year, even in the cooler months.

The worker also worked through his lunch period, taking a break only afterwards, noted Associate Professor Jason Lee, director of the Heat Resilience and Performance Centre at the NUS Yong Loo Lin School of Medicine.

"Our message is for (construc-

tion companies and workers) to be vigilant at all times when it comes to exertional work," said Prof Lee, who also leads Project HeatSafe, an NUS-based programme that has been finding out how rising temperatures affect the health and productivity of people in South-east Asia.

During the hotter month of April and the cooler month of December in 2022, researchers from Project HeatSafe tracked the physiological demands on around 160 workers at two housing construction sites and one underground site.

Each worker – profiled over 24 hours – had to swallow a pill that continuously tracked his core temperature and sent measurements wirelessly to a handheld monitor. The workers were also geared up with chest straps, skin temperature buttons and smartwatches to measure their heart rates and activity, and their hydration levels were also recorded.

Their core and skin temperatures and heart rates were used to measure their physiological strain, which is a measure of heat strain.

A previous Project HeatSafe study, which measured the environmental conditions of 19 outdoor worksites in Singapore in 2022, found that workers were exposed to high heat stress conditions several times in the year.

The profiling study found that the workers' overall core temperatures and heart rates were slightly higher in rainy December than in sunny April.

Most showed low physiological strain across both periods and worked within safe physiological thresholds, said Ms Pearl Tan, HeatSafe's project manager. Even so, just one heat-related injury is one too many, she said.

Among the 160 workers, four – one of them the 22-year-old – showed signs linked to heat strain. Another employee who worried the researchers was a 35-year-old



Construction workers at a worksite in Woodlands who participated in the intervention study by Project HeatSafe. Researchers from the National University of Singapore profiled the heat strain risk of about 160 construction workers here during the hotter and cooler months of 2022, and found that a few workers may be working harder during cooler periods, crossing occupational thermal limits. ST PHOTOS: SHINTARO TAY



whose core temperature spiked to a dangerously high level of 39.4 deg C after three hours of strenuous work in the evening.

He was an indoor worker, and the researchers suspected that he was working near hot machinery at one point. When he started work in the morning, his core temperature was already elevated at 37.6 deg C.

"He was boiling. Looking at his heart rate – he was definitely working really hard. We hope it was a one-off (strenuous work day) for him. If someone is working at this rate for consecutive days, their health will certainly be compromised," said Prof Lee.

In October, the Ministry of Manpower made it mandatory for outdoor workers to be given breaks every hour when it gets too hot.

For instance, outdoor workers should get 15 minutes' rest if they perform heavy physical activity when Wet Bulb Globe Temperature (WBGT) readings are 33 deg C or higher.

WBGT readings take into account the effects of humidity, air temperature, wind speed and solar radiation.

Singapore has experienced El Nino conditions since the third quarter of 2023, which bring hotter and drier weather to the region. This phenomenon is expected to last till at least March 2024.

To help construction workers feel safer at work and maintain their productivity, Project HeatSafe trialled education and cooling interventions at a worksite in mid-2023. These included enforcing breaks under shelter, carrying cool water in insulated bottle sleeves, and wearing uniforms that are breathable and ultraviolet-protective.

Prof Lee said: "We are not looking at sophisticated interventions. They need to be low-cost and scalable."

Workers at a housing construction site in Woodlands, run by BHCC Construction, said the inter-

ventions made a difference.

Mr Karuppu Manikandan, 30, who has worked in Singapore for 12 years, said the new uniform made him feel more comfortable in humid conditions as the material helped to wick away sweat.

Ms Tan added that the workers who participated in the trial logged more steps at work, which could suggest higher productivity.

In a separate Project HeatSafe survey, researchers found that workers felt less productive during the hotter months, which could translate to lost income for workers, especially those not paid a fixed wage, such as a delivery or gig worker.

Among Singapore workers, reduced productivity on a hot day worked out to a \$21 reduction, which is about a quarter of their daily wage. In Vietnam, it was a \$5 reduction, about 41 per cent of their daily income.

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The Project HeatSafe interventions trialled at a worksite included carrying cool water in insulated bottle sleeves, and wearing breathable and ultraviolet-protective uniforms.