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ORAL PRESENTATIONS

17th August 2026

Oral Session 1 (9:45 - 10:45)

Theme: Environmental Stress and Health Related Outcomes

No	Abstract ID	Presenter	Affiliation	Title of Presentation
1	AB19	Rachel Cottle	Institute For Exercise And Environmental Medicine Texas Health Presbyterian Hospital, And University Of Texas Southwestern Medical Center, Dallas, TX, USA	Beta Blockers Do Not Augment Thermal Strain Of Older Adults Exposed To Hot And Dry Heat With Accompanying Activities Of Daily Living
2	AB20	Elizabeth Gideon	University Of Texas Southwestern Medical Campus	Thermal Responses To Occupational Work/Rest Cycles In Well Healed Burn Survivors In Hot, Dry And Humid Conditions
3	AB59	Michèle Renard	Human Potential Translational Research Programme, Yong Loo Lin School Of Medicine, National University Of Singapore, Singapore	Near-Body–Room Air Temperature Difference And Total Sleep Time In Singapore
4	AB67	Rachel Lau	Heat Resilience & Performance Centre, National University Of Singapore	Mortality Risk Of Individual And Co-Occurring Acute Clinical Features In Exertional Heat-Related Illnesses: A Systematic Review
5	AB71	Ruben Bambacht	Radboud University Medical Center	Physiological Responses To A Real-World MultipleDay Heatwave In Older Adults Living In High- And Low-Greenness Neighborhoods
6	AB139	Maria Koskolou	National And Kapodistrian University Of Athens, Greece	Is Thermoregulation Of Iron-Deficient Anemic Individuals Impaired During Exercise In Heat Or Cold?
7	AB207	Simin Huang	Exercise And Sports Science Programme, School Of Health Sciences, Universiti Sains Malaysia, Kubang Kerian, Kelantan, Malaysia	Rethinking Heat Intolerance In Obesity: A Scoping Review Of Exercise Thermoregulation And Passive Heat Therapy

AB19

Beta blockers do not augment thermal strain of older adults exposed to hot and dry heat with accompanying activities of daily living

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Introduction: Older adults experience the deleterious health effects of extreme heat events at a greater rate than any other age cohort. Beta blockers, commonly prescribed to older individuals with cardiovascular disease, attenuate sweat rate and skin blood flow responses to heat stress in young adults. However, little is known regarding the effect of beta blockers on thermoregulatory responses during heat exposure in older adults.

Purpose: We investigated whether metoprolol tartrate (cardio-selective) or propranolol (non-selective) augments elevations in core and skin temperatures in older adults exposed to hot and dry heat.

Methods: Nine older adults (6M; 72±6yrs) were exposed to 3-hours of ambient heating (44ºC, 20% rh), replicating peak environmental conditions of the 2021 Western North American heat wave, following a randomly applied (double-blinded) administration of an acute dose of propranolol (80 mg), metoprolol (100 mg), or placebo. To simulate heat generation associated with activities of daily living, participants performed intermittent bouts of light cycling (~3 METs) throughout.

Results: The increase in core temperature was not affected by propranolol (1.1±0.55°C; p=0.85) or metoprolol (1.3±0.59°C; p=0.99) compared to control (1.2±0.49°C). Similarly, there was no difference in the increase in skin temperature between propranolol (2.6±1.4°C, p=0.77) or metoprolol (3.0±1.1°C; p=0.33) and control (2.1±1.6°C), or in whole body sweat rate between propranolol (0.35±0.08 L/h, p=0.48) or metoprolol (0.34±0.08 L/h; p=0.47) and control (0.45±0.35 L/h).

Discussion: These data suggest that neither cardio-selective nor non-selective beta blockers augment the increase in core or skin temperatures in older adults exposed to hot and dry environmental conditions.

Key words: heat stress, aging, medications

AB20

Thermal responses to occupational work/rest cycles in well healed burn survivors in hot, dry and humid conditions

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Introduction: Impaired sweating and skin blood flow at grafted sites results in higher body temperatures during heat stress in burn survivors. Occupational heat standards, based on workplace conditions, prescribe rest periods to prevent overheating in hot working conditions. Importantly, nothing is known regarding the efficacy of rest cycles during simulated occupational work in hot, dry and humid conditions in burn survivors. Purpose: Identify the thermal responses during work/rest intervals in well-healed burn survivors in a hot, dry and a hot, humid environment. Methods: Eight well-healed burn survivors (2+ years post injury and 34 – 64% body surface area burn injured) completed two, three-hour heat exposures in both dry (40°C, 15% humidity) and humid (38°C, 40% humidity) conditions. Based on the National Institute for Occupational Safety and Health recommendations, burn survivors completed three rounds of a 30-minute exercise bout (4 METs) followed by 30 minutes of rest. Rectal and skin temperatures were measured throughout, and nude body mass was obtained pre- and post-heat stress. Results: Three hours of occupational heat stress resulted in no difference in the increase in core temperature between the dry (0.77 ± 0.34°C) and humid (0.69 ± 0.26°C) conditions (p = 0.352). Additionally, whole body sweat loss was not different between the dry (1.59 ± 0.16 L) and humid (1.46 ± 0.26 L) conditions (p = 0.08). Discussion: Occupational guidelines resulted in similar thermoregulatory responses in well-healed burn survivors between environmental conditions. However, further work is needed to identify the adequacy of these guidelines relative to non-burned individuals.

Keywords: thermoregulation, burn injury, workplace.

Near-Body–Room Air Temperature Difference and Total Sleep Time in Singapore

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Introduction High bedroom temperatures may disrupt sleep by limiting heat loss[1,2]. Bedroom air temperature may misrepresent the bed microclimate shaped by bedding, clothing, and airflow. A near-body–room air temperature difference may better capture exposure.

Purpose
To estimate, within-person associations of bedroom air temperature, near-body temperature, and their difference with total sleep time (TST) and test effect modification by AC use.

Methods Fifteen adults (45.5±11.8 years; 11 females) contributed 944 nights. Bedroom air temperature (Atmocube) and near-body temperature (iButton on watch strap) were averaged over each sleep period (+1-hour prior). The temperature difference was calculated as near-body minus bedroom air temperature. AC was coded on/off from nightly self-report. TST (min) was derived from Apple Watch. Participant fixed-effects OLS was used.

Results
Median TST was 391.7 min [335.5, 439.0]. Bedroom air temperature was 28.6°C [27.1, 29.5] and near-body temperature 31.1°C [30.2, 31.8]. AC use occurred in 46.2% of sleep periods. In bedroom-only models, a within-person +1°C increase in bedroom temperature was associated with +7.6 min increase in TST (95% CI 1.8, 13.4), opposite to the expected direction. The bedroom temperature association attenuated when accounting for the temperature difference (B=+2.0 min/°C, 95% CI −7.9,

11.9). The temperature difference was not associated with TST due to uncertainty in the estimate (B=−5.4 min/°C, 95% CI −11.5, 0.6). Associations were similar regardless of self-reported AC use.

Discussion These preliminary models suggest the temperature difference could better reflect sleep-relevant thermal exposure than bedroom air temperature alone; however full-sample analyses is required given the imprecision of estimates.

Keywords: Indoor climate, Tropical setting, Nighttime heat exposure, Wearable sensing, Sleep duration

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Mortality Risk of Individual and Co-Occurring Acute Clinical Features in Exertional Heat-Related Illnesses: A Systematic Review

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Introduction

In our warming world, exertional Heat-Related Illnesses (HRIs) are a growing public health concern with substantial mortality [1,2]. However, early recognition of patients at greatest mortality risk is challenging due to nonspecific acute clinical features.

Purpose

To systematically evaluate the mortality risk associated with individual and co-occurring acuteclinical features occurring within 24 hours following onset of exertional HRIs in individuals aged 18 to 65 (PROSPERO: CRD42024560456).

Methods

A systematic search of relevant databases was conducted from inception to March 2025. Englishlanguage
Case reports and Case series involving individuals aged 18-65 were included. Risk Ratios (RRs) were restricted to features occurring in ≥5% of cases to reduce bias.

Results

A total of 508 cases (mean age: 28.3±9.7 years) from 231 studies met the inclusion criteria. Overall mortality was 20.5%. The top three acute clinical features with the highest mortality risk were diarrhoea (7%, RR=2.28, 95%CI [1.49, 3.49]), coma (21%, RR=1.86, 95%CI [1.32, 2.64]), and dry skin (12%, RR=1.81, 95%CI [1.21, 2.72]. The top three co-occurring acute clinical features demonstrating the greatest mortality risk were dry skin and unconscious state (6%, RR=2.67, 95%CI [1.76, 4.04]), dry skin and loss of consciousness (6%, RR=2.57, 95%CI [1.69, 3.91]), and collapse (conscious) and seizure (7%, RR=2.46, 95%CI [1.64,3.69]).

Discussion

Acute clinical features, particularly when co-occurring, were associated with increased mortality risk.This emphasizes the value of assessing feature clusters to enhance clinical decision-making and outcomes. Additional feature permutations and their associated RRs can be explored in the Heat Illness Avatar [3].

Keywords: Heat strain, exertional heat stroke, prevalence, risk ratio

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AB71

Physiological responses to a real-world multiple-day heatwave in older adults living in high- and low-greenness neighborhoods

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Introduction: Heatwaves contribute to heat-related morbidity and mortality among older adults. Yet, real-world evidence of multiple-day heat exposure on thermophysiological outcomes and the impact of neighborhood greenness remains unknown.

Purpose: To examine (1) the effects of a multiple-day heatwave on thermoregulatory strain in older adults in their home environment, and (2) whether neighborhood greenness impacted these effects.

Method: An observational field study was conducted during a five-day national heatwave in the Netherlands, including 45 adults (≥60 years) living in either a low-greenness (n=15) or high-greenness (n=30) neighborhood based on the Normalized Difference Vegetation Index. Continuous measurements of skin temperature (T_{skin}), core temperature (T_{core}), heart rate, ambient temperature, and physical activity were collected. Hydration status and thermal perception were assessed daily.

Results: Outdoor temperatures increased progressively across the heatwave (maximal Wet-Bulb Globe Temperature: 26.5-35.5°C). Mean T_{skin} rose from 33.5±0.5°C on day 1 to 34.2±0.4°C on day 5 (p_{time}<0.001), while T_{core} showed circadian variation (36.5-37.5°C) without upward drift. Mean sitting time on day 1 was 9.7±2.0 hours and increased to 11.1±1.9 hours on day 5 (p_{time}=0.009). Heart rate, hydration status, and physical activity remained stable throughout the heatwave. 87% of the participants reported a hot thermal sensation at least one heatwave day. The results did not differ between the high- and low-greenness group.

Discussion: Older adults experienced mild thermoregulatory strain during sustained heat exposure, primarily reflected in elevated T_{skin}, sitting time, and perceived thermal stress. Neighborhood greenness did not impact these heat-related physiological strain.

Word count: 242

Keywords: heat stress, thermoregulation, environmental health, urban greenness, built environment

AB139

Is thermoregulation of iron-deficient anemic individuals impaired during exercise in heat or cold?

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Introduction: Anemia and iron deficiency affect cardiovascular response and induce metabolic and hormonal disturbances essential for temperature regulation; most studies have been conducted at rest or using artificially induced anemia [1-3].

Purpose: To examine temperature regulation and cardiovascular responses of iron-deficient anemic humans during exercise in heat and cold.

Method: Thermoregulatory and cardiovascular parameters were examined in 9 (5 females, 4 males) anemic (ANM) and 9 (5 females, 4 males) non-anemic (CON) subjects ([Hb]: 11.8 ± 0.4 vs 14.1 ± 0.9 g/dl; ferritin: 14.7 ± 9 vs 56.7 ± 12 ng/ml; $p < 0.001$) during prolonged cycling (at 10% below ventilatory threshold until rectal temperature (T_{re}) rise of 1°C or completion of 1-hr exercise), in cold (C: 11°C), hot (H: 33°C), and thermoneutral (TN: 22°C) environments (40%RH).

Results: In C, ANM had smaller T_{re} rise and lower skin temperature (T_{sk}) values compared to CON ($p < 0.05$); moreover, only CON increased their metabolism ($\dot{V}O_2$) and their mean arterial pressure compared to TN ($p < 0.05$). In H, the two groups did not differ in T_{re} ($p > 0.05$), but ANM exhibited higher cardiovascular drift, as reflected by increased heart rate and reduced stroke volume ($p < 0.01$).

Discussion: Individuals with chronic mild iron-deficiency anemia showed reduced thermoregulatory capacity in C and experienced higher cardiovascular stress in both C and H compared to controls. These findings are of practical and clinical significance, since the level of anemia and the environmental temperatures studied occur in sports, work, recreational activities, and various diseases.

Keywords: anemia, heat, cold, temperature regulation, cardiovascular response

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AB207

Rethinking Heat Intolerance in Obesity: A Scoping Review of Exercise Thermoregulation and Passive Heat Therapy

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Introduction: Obesity is widely considered a risk factor for exertional heat illness [1]. However, whether obesity independently impairs thermoregulation remains unclear, as many studies fail to control for metabolic heat production (Hprod) and body morphology [2]. Consequently, the assumed heat intolerance in obesity may reflect biophysical artifacts rather than intrinsic physiological dysfunction. Meanwhile, passive heat therapy has emerged as a promising cardiometabolic intervention [3], yet its relevance for obese populations remains poorly synthesized.

Purpose: This review aimed to (1) determine whether obesity independently impairs thermoregulatory responses during active heat stress when Hprod is controlled, and (2) evaluate cardiometabolic effects of passive heat exposure in overweight/obese adults.

Methods: Five databases were searched from inception to March 2026 to identify experimental and intervention studies assessing thermoregulatory or cardiometabolic responses to active or passive heat exposure in adults with overweight/obesity without clinical comorbidities.

Results: Sixteen studies met the inclusion criteria. During active heat stress, differences in core temperature and sudomotor responses between obese and lean individuals were substantially reduced when absolute Hprod and external workload were matched. In contrast, passive heating interventions (e.g., hot water immersion, sauna) were associated with improvements in cardiometabolic markers, including reductions in fasting glucose, endogenous glucose production, and mean arterial pressure.

Discussion: The assumed heat intolerance in obesity largely reflects biophysical heat load differences rather than intrinsic thermoregulatory dysfunction. Since weight-bearing exercise generates high heat loads, passive heat therapy represents a promising, low-barrier exercise mimetic for improving cardiometabolic health in obese populations [4,5].

Keywords: obesity, thermoregulation, passive heating, cardiometabolic health, heat stress
ICEE 2026 Abstract

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17th August 2026
Oral Session 2 (14:00 - 14:30)
Theme: Environmental Stress and Health Related Outcomes

No	Abstract ID	Presenter	Affiliation	Title of Presentation
1.	AB10	Charlotte Stevens	Skin Sensing Research Group, School of Health Sciences, University Of Southampton	Microvascular, Inflammatory And Perceptual Effects Of Localized Cooling On Skin Tissue Tolerance To Mechanical Loading In Spinal Cord Injury Patients
2.	AB217	Xiang Ren Tan	Heat Resilience & Performance Centre, National University Singapore	Temporal Mapping Of The Incidence Of HeatRelated Illnesses In Singapore
3.	AB218	Navya U. Amaratunga	Heat Resilience & Performance Centre, National University Singapore	Spatial Region As An Independent Predictor Of Heat-Related Illnesses In Singapore

AB10

Microvascular, inflammatory and perceptual effects of localized cooling on skin tissue tolerance to mechanical loading in spinal cord injury patients

Charlotte Stevens[1,2], Ralph Gordon[1,2], Sara Bergstrand[3], Amanda Feldt[3], Denisse Marginean[4], Bijar Ghafouri[4], Peter Worsely[2], Davide Filingeri[1,2]

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Introduction:

Pressure ulcers (PUs) are wounds arising from prolonged mechanical loading of the skin (1). We recently demonstrated in healthy adults that skin cooling reduces post-reactive hyperaemia and increases skin tolerance to mechanical loading (2, 3). However, whether the benefits of skin cooling translate to individuals at risk of PU, such as spinal cord injury (SCI) patients, remains unclear.

Purpose:

To investigate microvascular, inflammatory and perceptual effects of localized cooling on skin tissue tolerance to mechanical loading in SCI patients.

Method:

10 SCI patients (6M:4F; 57±9 yr; injury T1-S1; n = 5 complete vs. n = 5 incomplete) completed two sessions consisting of 25-min mechanical loading (60 mmHg) followed by 20-min unloading (17mmHg) of the sacrum, delivered with a thermo-mechanical indenter set at 38°C (control) or 16°C (cooling). Skin blood flow at the sacrum was measured continuously throughout the protocol, skin sebum was collected pre- and post-loading to assess inflammation (e.g. IL-1α / YKL-40), and participants' thermal acceptability was recorded via a Likert scale.

Results:

Post-reactive hyperaemia area under the curve following loading was reduced by ~3.5-fold with skin cooling (16°C) compared to no-cooling (-9426; 95% CI [6215, 12636]; p=0.001). Cooling also reduced skin blood flow by ~2.2-fold during loading (p<0.001); yet this did not upregulate skin inflammatory biomarkers (IL-1α: -775.8 pg.ml^{-1}, YKL-40: -384.4 pg.mL^{-1}). 6 of 7 patients with sensation at the sacrum reported cooling to be thermally 'clearly acceptable'.

Discussion:

Our findings provide evidence that skin cooling reduces post-reactive hyperaemia and increases skin tolerance to mechanical loading also in individuals at risk of PU such as SCI patients.

Keywords: Cooling, pressure ulcers, skin blood flow.

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AB217

Temporal Mapping of the Incidence of Heat-related Illnesses in Singapore

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Introduction

Global warming adversely impacts human health and well-being. Heat-related illnesses (HRI) can result from exposure to hot humid environments, exacerbated by urban heat island effect. Singapore is a tropical country with perpetual humid heat, yet local data on the burden of HRI are lacking [1].

Purpose

To investigate the impact of environmental temperature on the incidence and temporal distribution of HRI across age groups in Singapore.

Methods

High resolution weather data were obtained from Metereological Services Singapore, and anonymised hospital records (e.g. emergency department (ED) attendances, hospital admissions) were obtained from government administrative and health records. Descriptive analysis was conducted to summarise demographics and HRI incidence stratified by time periods.

Results

From 2006 to 2022, there were 3,022 HRI-related ED attendances and 1,113 HRI admissions. HRI attendances peaked in 2014 (n=368) which had a record dry spell while HRI admissions were highest in 2018 and 2019 (n=99; n=98 respectively). Hotter years were not associated with increased HRI cases. Across the months for all years, HRI cases were highest in May (n=326) which recorded the second highest mean maximum temperature (32.1°C). HRI incidence was highest among those aged 18-39 years old (73%).

Discussion

Incidence of HRI did not correspond directly with changes in environmental temperature, possibly linked to high prevalence of air-conditioning [2], heat-avoidant behaviours, or underdiagnosis of HRI. Young adults may be vulnerable to HRI due to higher participation in outdoor activities or work. Future work should explore associations between outdoor exposure, physical activity duration and risk of HRI.

Keywords: Heat stroke, Heat disorders, Epidemiology, Heat stress, Climate change

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Acknowledgement:

This study made use of anonymised data retrieved from Singapore government administrative and health records. This study was supported by the Trusted Research and Real-World-Data Utilisation and Sharing Tech platform (“TRUST Platform”) jointly developed by the Ministry of Health and Smart Nation and Digital Government Office and Synapxe. The views expressed are those of the author(s) are not necessarily those of the Government, project investigators or institutional partners. We thank all participants and research staff who made the study possible.

AB218

Spatial region as an Independent Predictor of Heat-Related Illnesses in Singapore

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Introduction

Heat-related illnesses (HRI) present a growing public health challenge in Singapore where high temperatures and humidity persist throughout the year. While age and sex are known modulators of HRI risk [1], it remains unclear whether HRI risk is independently influenced by spatial characteristics within Singapore.

Purpose

To characterise the regional significance for HRI by integrating age and sex-specific demographics as well as factors on clinical disposition, across five spatial regions in Singapore.

Methods

A retrospective analysis of Emergency Department (ED) records from 2006 to 2022, was conducted, identifying HRI cases via ICD codes. To assess region as an independent predictor of admission, nested binomial Generalized Linear Models (GLM) were compared using the Likelihood Ratio Test (LRT). Models were adjusted for age, sex, comorbidities, triage status, and admission time.

Results

Of 3,022 HRI ED attendances, 2,932 cases (1,086 admitted) were analysed. HRI admissions were concentrated in the Western (38%) and Central (36%) regions. These areas showed a higher demographic burden with males aged 18–39 years. Inclusion of region significantly improved model fit

$(LRT\text{: } \chi^2(4) = 34,\ p < 0.01)$indicating that spatial region serves as an independent predictor of admission after controlling for patient and clinical factors.

Discussion

HRI burden varies significantly by demographics and regions. Predominance amongst young males in the West [2] likely reflects residents in industrial zones performing manual labour prone to exertional heat stress. HRI risk is likely elevated in the Central and Western regions due to the urban heat island effect with denser urban structures compared to the North, with more vegetation cover and cooling [2].

Keywords: Heat disorders, Geospatial modelling, Demographic vulnerability, Climate Change, Urban heat island effect

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Acknowledgement

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17th August 2026
Oral Session 3 (15:15 - 16:15)
Theme: Heat Acclimation and Human Performance

No	Abstract ID	Presenter	Affiliation	Title of Presentation
1	AB3	Timo Van Den Bogaard	Vrije Universiteit Van Amsterdam	Responsiveness Of The CALERA Research Sensor To Heat-Acclimation-Induced Reductions In Rectal Temperature.
	AB27	Sofia Pappa	Maastricht University	The effect of combined passive and active heat acclimation to enhance heat tolerance and cardiovascular health in older, overweight adults
	AB48	Naomi Estelle Ng	National University Of Singapore	Impact Of Isothermic Heat-Acclimatisation On Gut Microbiota Adaptations And Intestinal Barrier Function
	AB75	Thomas Derouck	Université Du Québec À Trois-Rivières	An Occupational Heat Acclimation Approach Combining Overdressing With Heart RatePrescribed Exercise
	AB108	Koen Levels	Dutch Ministry Of Defense	Heat Acclimatisation: Translating Scientific Evidence Into Military Practice
	AB149	Nic Daniels	Univerisity Of Otago	Heat Acclimation In A Warming World: Are We Weighing Up The Costs?
	AB224	Eric Tsz-Chun POON	Department Of Sports Science And Physical Education, The Chinese University Of Hong Kong, Shatin, Hong Kong, China	High-Intensity Interval Training For Heat Acclimatisation: Beyond Traditional Methods

Responsiveness of the CALERA Research Sensor to heat-acclimation-induced reductions in rectal temperature

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Introduction: Military personnel and athletes increasingly use non-invasive methods to estimate body core temperature (T_c) during heat acclimation (HA). The CALERA Research Sensor (CRS) is a popular wearable for this purpose, but its use during HA requires validation. **Purpose:** This study determined the responsiveness of the CRS to changes in resting and end-exercise T_c induced by HA as well as the criterion validity for determining the thermal dose, defined as time spent with a $T_c \geq 38.5$ °C.

Method: Fifteen participants completed a nine-day controlled-hyperthermia HA protocol. T_c was continuously monitored prior to and during heat exposures using both the CRS (T_{crs}) and a rectal temperature (T_{re}) probe. This study assessed the responsiveness and criterion validity using a Bland-Altman analysis and intraclass correlation coefficient (ICC). Additionally, the analyses included a linear mixed model to further analyze the responsiveness.

Results: T_{crs} showed limited responsiveness to HA-induced changes in resting and end-exercise Tre with substantial bias (≥ 0.10 °C, limits of agreement from ≤ -0.40 °C to ≥ 0.60 °C) and limited agreement (ICC ≤ 0.53). Additionally, resting and end-exercise T_{re} decreased to a greater extent than T_{crs}, which showed a downward trend during end-exercise, during the nine-day HA ($P < 0.001$). The CRS underestimated thermal dose (-20 minutes, limits of agreement from -60 to 21 minutes) and showed limited agreement with T_{re} (ICC = 0.57) in estimating the thermal dose.

Discussion: These results indicate that the current version of the CRS underestimates both HA-induced changes in T_{re} and the thermal dose during controlled hyperthermia.

Keywords: Calera research sensor, responsiveness, validation, non-invasive body core temperature measurement, heat acclimation.

AB27

The effect of combined passive and active heat acclimation to enhance heat tolerance and cardiovascular health in older, overweight adults

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Introduction: Climate change escalates extreme heat events globally [1]. The threat for heat-related complications is pronounced among vulnerable populations, such as older, overweight individuals [2]. Heat acclimation (HA) enhances heat tolerance and mitigates adverse health effects [3]. Previous research focused on benefits of active HA for exercise performance in extreme temperatures [4]. Such protocols do not apply to heat-vulnerable populations in realistic (pre-)heat wave conditions.

Purpose: This study aimed to assess a combined passive-and-active HA approach on thermophysiological and cardiovascular responses in overweight, older adults.

Method: Ten volunteers (69±6y, BMI 28.7±2.1kg/m^2) completed a passive HA week (6h/d, 29-35°C) combined with low-to-moderate cycling (30min/d, 40%W_{max}). Temperature during HA ramped up by 3°C/2 days, realistically mimicking the days leading up to a heat-wave. A 180min heat stress test (28-45°C, 10K/h) was conducted pre- and post-HA. Analyses included random-effect modelling with three comparison timepoints: baseline (28°C), mid-test, and end-test (45ºC).

Results: Core temperature decreased by 0.1±0.3ºC across timepoints, while skin temperatures remained unchanged post-HA. Heart rate decreased at baseline (ΔHR=4±11bpm; p=0.013) and end-test (ΔHR=3±15bpm; p=0.033). Systolic and diastolic BP and MAP decreased by 7±16, 4±11, and 5±11mmHg post-HA (all p<0.05). Forearm skin blood flow decreased mid-test (p=0.009) and trended lower at 45°C (p=0.057). Baseline local arm and leg sweat rates remained unchanged but increased at 45°C (p=0.017).

Discussion: Combined passive-and-active HA enhanced thermoregulation and reduced cardiovascular strain in older, overweight adults during heat stress. These findings may augment heat-action guidelines regarding preparatory action to enhance heat tolerance in vulnerable populations.

Keywords: heat acclimation, thermoregulation, cardiovascular health, resilience.

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AB48

Impact of Isothermic Heat-Acclimatisation on Gut Microbiota Adaptations and Intestinal Barrier Function

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Introduction:
Isothermal clamping (ITC) based heat-acclimatisation is an effective strategy to improve heat tolerance. As the gut microbiota support intestinal barrier integrity [1], its adaptive responses to heat-acclimatisation warrant investigation to determine whether the gut microbiota can be targeted to enhance barrier function alongside physiological adaptations.

Purpose:
Investigate how gut microbiota composition responds to ITC and whether any adaptations are associated with reduced intestinal barrier perturbation following exertional hyperthermia.

Method:
38 participants completed a PRE heat response test (HRT), 10 training sessions (ITC or control (CON)), and a POST HRT. HRT involved a 65-min treadmill walk (T_{db}: 34.1±0.1°C, RH: 69±2%). Blood was collected before (BEF) and after (AFT) each HRT to measure intestinal barrier markers (Claudin-3 (CLDN-3), intestinal fatty acid-binding protein (I-FABP) and lipopolysaccharide-binding protein (LBP)). During ITC, participants (n=18; 24±4 years) performed walk-run cycles to maintain core temperature >38.5°C for 30-min per session, while CON participants (n=20; 25±3 years) completed four calisthenic sets. Fecal samples were collected pre-, during, and two weeks post-intervention to profile gut microbiota composition through 16S rRNA sequencing.

Results:
BEF-AFT fold-change in CLDN-3, LBP and I-FABP was similar between HA and CON in PRE and POST HRT (all $p>0.05$). No trial×time interaction was observed for gut microbiota composition at the phylum or genus level (all $p>0.05$).

Discussion:
ITC alone did not induce gut microbiota adaptations to mitigate intestinal barrier perturbation during exertional hyperthermia. Combining ITC with nutritional interventions may be necessary to achieve both thermoregulatory adaptations and enhanced intestinal barrier integrity to limit microbial translocation and subsequent inflammatory responses during exertional hyperthermia.

Keywords:
Heat-acclimatisation, heat stress, gut microbiota, intestinal epithelial integrity

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An Occupational Heat Acclimation Approach Combining Overdressing with Heart Rate-Prescribed Exercise

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Introduction: Expanding access to heat acclimation (HA) remains a priority in occupational settings. Overdressing in temperate environments has been proposed as a more accessible HA strategy than environmental heat exposure [1], while prescribing exercise intensity based on a controlled heart rate (%HRmax) has been shown to regulate heat strain during HA [2]. However, no study has combined these strategies to determine if they induce sufficient typical HA adaptations.

Purpose: To determine whether a 10-session HA protocol combining overdressing with %HRmax prescribed exercise intensity maintains consistent heat strain across sessions and induces meaningful adaptations relevant to occupational performance.

Methods: Ten healthy adults will complete a 10-session HA protocol consisting of 60-min treadmill walking at 80%HRmax while wearing firefighter protective clothing. Pre- and post-HA assessments include: (1) a passive heat stress test assessing sudomotor function and cutaneous vascular responses and (2) a firefighting simulation task measuring thermal, cardiovascular and perceptual strain, isometric strength and cognitive performance [3].

Results: Data collection is currently in progress, with four participants (one woman) enrolled (age: 24±3 years, body mass: 70.6±10.1 kg, waist circumference: 76±6 cm, body mass index: 22±2 kg/m2; peak oxygen consumption: 51.4±1.2 $mL \cdot kg^{-1} \cdot min^{-1}$). Data collection and statistical analyses will be finalized by early June 2026.

Discussion: We hypothesize that this combined approach will sustain heat strain across sessions, promoting thermoeffector adaptations and improving occupational task tolerance.

Keywords: Heat acclimation, Thermoregulation, Occupational heat stress. *Abstract– ICEE 2026*

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AB108

Heat acclimatisation: Translating scientific evidence into military practice

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Introduction: Heat acclimatisation is essential to prevent exertional heat illness and optimize military performance in hot environments. Although scientific guidelines clearly define its key prerequisites, implementation is often constrained by limited time and logistical challenges.

Purpose: To evaluate the implementation of a practical, science-based, personalised heat acclimatisation strategy for a large group of military personnel before and during deployment in extremely hot conditions.

Method: In this observational study, a personalised heat acclimatisation protocol was implemented in 144 soldiers prior to and during the initial phase of deployment in extremely hot conditions (~42°C). All personnel, including soldiers, commanders, and physical trainers, were instructed on the physiological rationale of heat acclimatisation and on the use of a provided smartwatch with the updated ECTemp algorithm[1], serving to monitor estimated core body temperature and guide training intensity. Participants were instructed to achieve a core body temperature >38.0 °C for 60–90 min·day^{-1} over 10–14 consecutive days. Successful acclimatisation was evaluated based on daily peak core temperature, cumulative minutes >38.0 °C, and the number of completed acclimatisation days.

Results: Soldiers completed a median of 10 acclimatisation days (IQR: 4; Q_1=7, Q_3=11). Median peak core temperature was 38.22°C (IQR: 0.43°C; Q_1=38.01, Q_3=38.44). Median time above 38°C was 48 minutes (IQR: 31; Q_1=31, Q_3=62).

Discussion: Individualised physiological feedback, for example on a smartwatch supports scalable implementation of heat acclimatisation protocols in military populations and may enhance effectiveness. Nevertheless, appropriate execution in large groups under time and logistical constraints remains challenging, particularly achieving sufficient time >38°C.

Keywords: heat stress, adaptation, core temperature, military population.

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Nic Daniels, Brendon Roxburgh, Jim Cotter

Title

Heat acclimation in a warming world: Are we weighing up the costs?

Key words

Heat acclimation, climate change, equitability.

Introduction

Heat acclimation/acclimatisation improves performance in and tolerance of hot environments. However, creating heat stress artificially or travelling to hot environments requires energy, contributing to climate change. Currently, no consideration is given to the energy use or greenhouse gas emissions caused by various acclimation/acclimatisation methods, much less the multifaceted benefits of utilising one's own heat.

Purpose

Consider the unspoken costs and immense opportunities of environmental ergonomics. Specifically, the interconnectedness between people's actions, the heat strain they experience, their heat tolerance, and in turn, their simultaneous contribution to the heat stress experienced by themselves, others currently alive, and mostly of future lives.

Method

Energetic estimates and broader effects of heat acclimation/acclimatisation methods were evaluated.

Results

Methods based on endogenous rather than supplemental- or wholly-exogenous heat production are more sustainable by orders of magnitude, and can approach 0 MJ of additional energy required when working/exercising in insulative clothing. By comparison, five-day exposures via travelling to hot countries (~1,517 MJ/1,000pkm), hot-water immersion (~108 MJ), exercising in environmental chambers (~36 MJ), and post-exercise electric saunas (~7 MJ) incur far greater costs. Activities that prevent emissions (e.g. active transport) not only counteract these costs but have large and more robust co-benefits, including improving heat tolerance and its durability, and cross adaptation.

Discussion

Mainstream methods of heat acclimation/acclimatisation are inequitable for the same major reasons as air-conditioning [1]. Value lies in considering their relative costs, including increasing the heat-illness risk of vulnerable human and non-human current and future lives, and whether the potential benefits are worthwhile.

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AB224

High-intensity Interval Training for Heat Acclimatisation: Beyond Traditional Methods

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Introduction: High-intensity interval training (HIIT) is a widely adopted and time-efficient training modality for enhancing athletic performance, reflecting the intermittent demands of many sports activities. Compared with moderate-intensity continuous training heat acclimatisation (MICT-HA), high-intensity interval training heat acclimatisation (HIIT-HA) may induce greater metabolic heat production, potentially leading to more pronounced heat adaptations. However, evidence regarding the effectiveness of HIIT-HA remains inconsistent.

Purpose: To systematically evaluate the physiological adaptations and performance impacts following HIIT-HA.

Method: A scoping review was conducted in accordance with the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR). Five databases (PubMed, Web of Science, Cochrane library, Scopus, and SPORTDiscus) were searched until February 2026. Randomized controlled trials comparing HIIT in heat and temperate conditions, and HIIT-HA versus MICT-HA were included.

Results: Based on 14 studies involving 318 participants (218 classified as well-trained according to the definitions used in the original articles), a range of physiological responses (e.g., heart rate, core and skin temperature, and sweating rate) were evaluated. Compared with baseline, consistent thermoregulatory adaptations were observed particularly reductions in core temperature (up to 0.5 ℃) and skin temperature (ranging from 0.26 to 0.8 ℃) following HIIT-HA. Greater heat-induced adaptations were observed for core temperature (0.26 ℃ vs. 0.06 ℃) and heart rate (7.94 bpm·min^{-1} vs. 4.67 bpm·min^{-1}) following HIIT-HA compared with MICT-HA. HIIT-HA demonstrated potential to enhance time-trial performance, with improvements ranging from -1.7% to 16%. In contrast, adaptations in time-to-exhaustion performance were inconsistent, with reported changes ranging from a 22% reduction to a 29% improvement.

Discussion: Existing evidence demonstrates that HIIT-HA elicits meaningful physiological adaptations, which may confer distinct advantages over traditional heat acclimation strategies. However, improvements in athletic performance appear to be task-specific. Future studies directly comparing HIIT-HA with conventional approaches are warranted.

Keywords: HIIT, High temperature, Hot environment, Performance

17th August 2026
Oral Session 4 (16:30 - 17:30)
Theme: Heat Acclimation and Human Performance

No	Abstract ID	Presenter	Affiliation	Title Of Presentation
1.	AB45	Jun Qiu	Shanghai Research Institute Of Sports Science (Shanghai Anti-Doping Agency)	Effects Of 4-Week Heat Acclimation Training Combined With Whey Protein Supplementation On Energy Metabolism In Endurance Athletes
2.	AB52	Paris Sklavakis-Fotopoulos	University Of Maastricht	Inter-Individual Variability And Patterns In Heat Acclimation Responses In Young And Overweight Older Adults
3.	AB213	Xin Kuang	Shanghai University Of Sport	Comparative Efficacy Of HIIT And MICT In Heat Acclimation For Enhancing Executive Function Under Thermal Stress
4.	AB215	He Liu	Shanghai University Of Sport	Effects Of Different Durations Of Active Heat Acclimation Training On Executive Function
5.	AB216	Yifan Ren	Shanghai University Of Sport	The Effect Of Different Duration Of Heat Acclimation On Endurance Exercise Capacity, Thermoregulation And Autonomic Nervous System: Short-Term Vs. Long-Term
6	AB220	Kevin John	University Of Canberra Research Institute For Sport And Exercise	Sex-Differences In Adaptations To Post-Exercise Hot Water Immersion Heat Acclimation

AB45

Effects of 4-Week Heat Acclimation Training Combined with Whey Protein Supplementation on Energy Metabolism in Endurance Athletes

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Introduction: Exercise in hot environments alters substrate metabolism, typically increasing carbohydrate (CHO) use and decreasing fat oxidation, potentially impairing endurance. Pre-exercise protein intake may adjust this balance under thermoneutral conditions [1,2], but its impact during long-term heat training remains unclear.

Purpose: This study examined whether combining heat acclimation training with pre-exercise whey protein supplementation improves energy metabolism in endurance athletes.

Methods: Fifteen male endurance athletes were randomized into a control (CON, n=7) or protein group (PRO, n=8). Both completed 4 weeks of heat acclimation (35°C, 70% RH, 3 sessions/week). The PRO group consumed pre-exercise whey protein. Assessments included pre- and post-intervention body composition, resting metabolic rate, blood analysis, and an incremental exercise test to exhaustion in the heat, with energy metabolism measured via indirect calorimetry.

Results: Post-intervention, both groups improved time to exhaustion and decreased exercise CHO utilization. However, only the PRO group demonstrated significantly reduced fat mass, increased fat-free mass, higher total energy expenditure, and increased fat oxidation compared to both baseline and the CON group. Resting metabolic rate remained unchanged. Post-training, the PRO group also exhibited increased high-density lipoprotein, total cholesterol, and higher low-density lipoprotein compared to the CON group.

Discussion: While heat acclimation alone and combined with whey protein both enhanced endurance, the addition of pre-exercise whey protein further optimized body composition, increased lipid utilization during exercise, and promoted favorable metabolic adaptations under heat stress.

Keywords: heat acclimation training , whey protein, energy metabolism, athlete

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AB52

Inter-individual variability and patterns in heat acclimation responses in young and overweight older adults

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Introduction: Increasingly intense heat waves have become an important concern to public health [1]. Structured repeated heat exposure (heat acclimation, HA) can increase tolerance to heat stress, however, responses vary across individuals [2]. Discerning response patterns can improve our understanding of heat adaptation and its underlying mechanisms.

Purpose: The current study is an exploratory analysis of inter-individual variability and patterns in HA responses across thermoregulatory and cardiovascular parameters.

Method: Data from two passive [3, 4] and one hybrid HA study [In preparation] were pooled (n=32). A 150-minute passive heat stress test featuring an incremental temperature ramp was completed before and after HA in all three studies. Spearman correlations were calculated between endpoint (minutes 135-145) changes across the physiological parameters, their baseline values (minutes 35-55) prior to HA and anthropometric characteristics.

Results. All three studies resulted in decreased core temperature and blood pressure after HA, and one in heart rate reduction. Endpoint change ranges (median) were -0.43 to +0.14oC (-0.10oC) for core temperature, -11.1 to +14.5bpm (-2.1bpm) for heart rate and -18 to +16mmHg (-3.33mmHg) for systolic blood pressure. Spearman correlation analysis showed no significant correlations in the endpoint changes between the three parameters, their baselines or with age and body composition.

Discussion: The range of responses suggests a considerable degree of inter-individual variability, independent of (assessed) individual characteristics. Interestingly, a strong response in one parameter did not predict the magnitude or direction of the response of the others. Further research should explore response determinants across thermoregulatory and cardiovascular parameters.

Keywords: heat-acclimation, thermoregulation, cardiovascular health

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Comparative Efficacy of HIIT and MICT in Heat Acclimation for Enhancing Executive Function Under Thermal Stress

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Introduction: Hot environments impair performance and cognition, particularly executive function (EF)[1]. Heat acclimation (HA) confers physiological benefits, but its effects on EF are unclear. While traditional HA uses moderate-intensity continuous training (MICT), high-intensity interval training (HIIT) is also effective[2][3]. Currently there were no studies investigate the effects of different exercise types of HA on EF under heat exposure.

Purpose: This study aimed to compare the HIIT and MICT HA protocols in modulating EF and thermoregulatory capacity.

Method: Forty healthy, heat-unacclimated males were randomized into four groups (n=10): thermoneutral (20°C) MICT or HIIT, and hot (32°C) MICT (H-MICT) or HIIT (H-HIIT). Participants completed 10 consecutive days of training. HIIT involved 3-min bouts at 80% W_{max} with 2-min recovery, while MICT was continuous at 50% W_{max}. Pre- and post-intervention, EF (working memory, inhibitory control, cognitive flexibility) and physiological responses (core temperature [T_{core}], skin temperature [T_{skin}], heart rate [HR]) were assessed under heat.

Results: Heat-acclimated groups (H-HIIT/H-MICT) demonstrated significant reductions in resting T_{core}, T_{skin}, and HR post-intervention (all $p<0.05$). Both HA protocols enhanced working memory (reaction time [RT] decreased: H-HIIT 16.0%, H-MICT 8.9%) and inhibitory control, while H-HIIT uniquely improved cognitive flexibility (RT decreased 13.1%, switching cost decreased 49.0%, $p<0.05$); no significant improvements occurred in thermoneutral groups.

Discussion: Both HIIT and MICT induced heat adaptation and enhanced core EF under thermal stress. HIIT-based HA superiorly improved cognitive flexibility and complex task performance, offering a time-efficient strategy for rapid environmental adaptation. These findings inform heat acclimation strategies for climate-vulnerable populations.

Keywords: heat acclimation, executive function, moderate-intensity continuous training, high-intensity interval training

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AB215

Effects of Different Durations of Active Heat Acclimation Training on Executive Function

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Introduction: Heat exposure induces physiological heat stress that can impair cognitive performance, particularly executive functions, reducing efficiency and safety in hot environments. Heat acclimation (HA) improves thermoregulation and reduces physiological strain[1][2], yet its effects on executive function remain unclear.

Purpose: This study examined the effects of different durations of AHA training (5-day vs. 10-day) on executive function during heat exposure.

Method: Forty healthy male college students were randomly assigned to four groups (n = 10): 10-day high-intensity interval training heat acclimation (10d HIIT-HA), 5-day HIIT-HA, 10-day moderate-intensity continuous training heat acclimation (10d MICT-HA), and 5-day MICT-HA. HIIT consisted of 3-min intervals at 80% Wmax with 2-min passive recovery, while MICT was performed continuously at 50% Wmax. Executive function was assessed on Day 0, Day 7, and Day 14 after 30 min of heat exposure (32 °C). Tasks measured working memory, inhibitory control, and cognitive flexibility. Reaction time (RT) and accuracy were recorded. Physiological indicators included heart rate (HR), mean skin temperature (T_{skin}), and core temperature (T_{core}).

Results: After 10 days of HA, HR, T_{skin}, and T_{core} decreased, indicating improved thermal adaptation, whereas after 5 days, only HR and T_{core} decreased. Working memory RT improved after 10-day HA in both groups but after 5-day HA only in HIIT. Inhibitory control RT improved after both durations, while cognitive flexibility improved only after 10-day HIIT-HA.

Discussion: 10-day AHA produced greater physiological adaptation and executive function improvements than 5-day HA, suggesting longer protocols may better maintain cognitive performance in hot environments.

Keywords: heat acclimation, executive function, heat exposure, high-intensity interval training, thermoregulation

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AB216

The effect of different duration of heat acclimation on endurance exercise capacity, thermoregulation and autonomic nervous system: short-term vs. long-term

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Introduction: Exercising under heat stress exacerbates physiological strain, impairing endurance capacity. While high-intensity interval training (HIIT) is increasingly integrated into heat acclimation (HA) paradigms, the efficacy of short-term HIIT-HA remains equivocal.

Purpose: This study compared adaptations in thermoregulation, autonomic nervous system (ANS) modulation, and exercise heat tolerance following short-term (SHA) versus long-term (LHA) HIIT-HA.

Method: Twenty-four unacclimated participants were randomized into 5-day SHA or 10-day LHA cohorts. The HA protocol comprised daily HIIT (8×3-min cycling at 80% Wmax, 2-min passive recovery) at 32°C. Pre- and post-acclimation, participants completed a time-to-exhaustion (TTE) trial at 60% Wmax (32°C). Core temperature (Tcore), skin temperature (Tskin), and heart rate variability (HRV) were monitored continuously to assess thermal and autonomic strain.

Results: Post-intervention, LHA significantly prolonged TTE, whereas SHA yielded no significant performance enhancement. Tcore was attenuated at rest and recovery in SHA, and comprehensively across all phases in LHA. Tskin decreased during exercise and recovery in SHA, and at rest in LHA. Both cohorts demonstrated blunted heart rate responses. Time-domain (SDNN, RMSSD) and parasympathetic (Ln HF) HRV indices increased significantly in both groups. Distinctively, SHA elevated pNN50 and Ln LF during recovery, alongside an augmented LF/HF ratio during exercise.

Discussion: Thermoregulatory adaptations from short-term HIIT-HA appear mechanistically linked to enhanced autonomic modulation. However, an extended HA stimulus (LHA) elicits more profound physiological adaptations, translating to superior endurance capacity under heat stress.

Keywords: Heat acclimation;HIIT;Autonomic nervous system;Heart rate variability

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AB220

Sex-differences in adaptations to post-exercise hot water immersion heat acclimation

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Introduction: Heat acclimation (HA) adaptations attenuate thermal and physiological strain during exercise in the heat. However, contention remains regarding whether a similar magnitude of adaptations is realised across the same HA time frame in males and females.

Purpose: This study compared thermoregulatory adaptions between sexes following post-exercise hot water immersion (HWI) HA.

Methods: 28 trained runners (14 females) completed an initial (PRE) heat response test (HRT) which was repeated following 5 (MID) and 10 days (POST) of HA. HA consisted of 3 post-exercise HWI and 2 standalone HWI sessions/week for 2 weeks. Preliminary analyses were conducted using linear-mixed models with data presented as mean and [95% confidence intervals].

Results: There was no sex or interaction effect for rectal temperature (T_{re}; p=0.479), heart rate (HR; p=0.795) and skin temperature (T_{sk}; p=0.632). A main effect of session was noted for all three variables between PRE and POST, with T_{re} reduced by 0.4 [0.2, 0.5] °C (p<0.001), T_{sk} by 0.4 [0.1, 0.7]°C (p=0.005) and HR by 7 [0, 12] beats.min^{-1} (p=0.055). A significant interaction effect was noted for whole-body sweat rate, with only males displaying a significant increase of 119 [27, 211] mL.h^{-1} (p=0.007) from PRE to MID and 147 [55, 239] mL.h^{-1} (p<0.001) from MID to POST.

Discussion: These results suggest that males and females experience a similar reduction in thermal strain following HWI HA. However, only males seem to improve sweating capacity following this passive HA strategy.

Keywords: Biological sex, passive hyperthermia, Heat adaptations.

17th August 2026
Oral Session 5 (17:30 - 18:30)
Theme: Clothing & Human-Environment Interaction

No	Abstract ID	Presenter	Affiliation	Title of Presentation
1.	AB32	Meg Rankin	The Australian National University	Investigating Complex Conditional Relationships Between the Indoor Thermal Environment and Sleep During Summertime Heat Stress in Australia: A Feasibility Study
2.	AB39	Patarawadee Sainiyom	Human Potential Translational Research Programme, Yong Loo Lin School of Medicine, National University of Singapore, Singapore	Cooling vest preserves cognitive performance following exertional heat stress
3.	AB170	Jae-Yeon Jung	College of Human Ecology, Seoul National University	Effect of a Cervical Pillow on Sleep Quality, > Psycho-physiological Responses During a 7Hour Nocturnal Sleep
4.	AB181	Titis Wijayanto	Universitas Gadjah Mada	Effects of Clothing Color on Thermoregulatory Responses During Exercise Under Simulated Solar Radiation

AB32

Investigating Complex Conditional Relationships Between the Indoor Thermal Environment and Sleep During Summertime Heat Stress in Australia: A Feasibility Study

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Introduction: Climate change is driving elevated nighttime temperatures associated with poorer sleep [1]; however, relationships between the ambient environment and sleep remain understudied in real-world settings [2].

Purpose: We aimed to 1) assess the feasibility of a field-based environmental and sleep monitoring study and 2) explore conditional relationships between the indoor thermal environment, perceptions, and objective sleep outcomes.

Method: Seven adults (3F/4M; 60±7y) living in Canberra (cool temperate climate [3]) were monitored for two months during the 2024-2025 Australian summertime. Bedroom ambient temperature (T_a) and relative humidity (RH) were recorded continuously using HeatSuite© [4]. Subjective sleep quality, thermal perception, and wellbeing were assessed 4x daily via smartwatch surveys integrated with HeatSuite (Bangle.js2 [4]). Objective sleep was monitored via a Somfit wearable [5] during nine nights of moderate (outdoor day: 10.5-28.6°C, 21.0-91.0%RH; bedroom overnight: 17.2-26.9°C, 27.0-57.4%RH) and ten nights of warm (outdoor day: 18.1-36.8°C, 10-100%RH; bedroom overnight: 18.1-30.3°C, 31.1-70.0%RH) conditions. Feasibility was assessed via compliance [4] and acceptability (comfort, usability, burden). Exploratory analyses were conducted using Dynamic Bayesian Networks (DBN).

Results: Individual compliance ranged from 58-81% for surveys and 63-100% for sleep monitoring. All participants reported comfort and low burden, 71% reported usability. DBN analysis identified conditional associations between preceding indoor thermal conditions, thermal perceptions, and objective sleep outcomes (i.e. total sleep time, wake after sleep onset and non-rapid eye movement stage three sleep).

Discussion: Field-based data collection integrating HeatSuite and Somfit was feasible. Exploratory DBN modelling suggested conditional relationships between preceding indoor thermal conditions, thermal perceptions and objective sleep outcomes.

Keywords: Sleep, Indoor Environment, Hot Weather, Field Study, Dynamic Bayesian Networks.

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Cooling vest preserves cognitive performance following exertional heat stress

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Introduction: Wearing personal protective equipment (PPE) limits heat dissipation, predisposing healthcare workers (HCWs) to hyperthermia. The resulting cardiovascular and neural stresses compromise cognition, particularly attentional focus, problem-solving, and short-term memory[1]. Although carbon-based cooling vests have demonstrated physiological benefits in HCWs[2], their effectiveness in preserving cognition under heat stress remains unclear.

Purpose: To examine the effectiveness of carbon-based cooling vests in mitigating PPE-associated cognitive changes.

Method: Sixteen healthy participants completed two randomized crossover trials: PPE only (PPE) and PPE with cooling vests (PPE+Vest). Each trial comprised four 25-min phases of simulated medical tasks at 32°C and 70% RH, followed by a simulated cognitive task (SCT). Body core temperature (T_c), skin temperature (T_{sk}), and heart rate (HR) were continuously recorded, while computerized cognitive tasks (CCT), including Multitasking and N-back tests, were performed before and after each trial. Neurophysiological responses were evaluated using event-related potentials (ERP).

Results: Mean physiological strain was higher in PPE (PPE vs PPE+Vest; T_c:38.2±0.5°C vs 37.5±0.3°C; T_{sk}: 36.1±0.7°C vs 35.4±0.5°C; HR:113±20bpm vs 97±16bpm; $p \leq 0.001$). SCT error rates were reduced during the final phase in PPE+Vest (0.2±0.9%) compared with PPE (3.1±3.6%; $p=0.009$). CCT behavioural responses were comparable across conditions (error rates, $p=0.741$; reaction time, $p=0.406$), whereas ERP neural processing was faster in PPE+Vest (-120±133) than PPE (38±125; $p=0.003$).

Discussion: Since T_c remained below the 39°C threshold associated with cerebrovascular and neurotransmitter dysfunction[3], the decline in SCT cognitive in PPE may be attributed to thermal discomfort[4]. By alleviating this thermal discomfort, the cooling vest effectively preserved cognitive performance.

Keywords: Occupational heat exposure, Mental task performance, Personal cooling, Executive function

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Effect of a Cervical Pillow on Sleep Quality, Psycho-physiological Responses During a 7-Hour Nocturnal Sleep

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Introduction: A comfortable sleep environment is shaped by both ambient conditions and bedding properties [1]. In particular, supportive pillows have been shown to enhance sleep quality and reduce cervical discomfort.
Purpose: This study aimed to verify the efficacy of a newly developed cervical pillow by continuously monitoring physiological responses and sleep behavior over a 7-h sleep period. Sleep questionnaire and interview were conducted as well.
Method: Eight healthy males participated in two experimental conditions (control vs. cervical pillow) at an ambient temperature of 24°C and 46%RH. During sleep, physiological variables (EEG, core/skin temperature, heart rate) and bed microclimate were measured. Sleep quality was assessed using an actigraphy and standardized questionnaire. Cervical muscles properties were evaluated pre- and post-sleep.
Results: The delta-wave ratio was higher with the cervical pillow than with the control, particularly during the final hour of sleep (P = 0.054, Cohen's d = 0.82). Distal skin temperatures (hand and forearm) increased more rapidly during sleep onset with the cervical pillow than with the control. Post-sleep measurements showed greater reductions in cervical muscle stiffness and tension with the cervical pillow ($P < 0.05$). Subjective assessments indicated lower morning fatigue and greater comfort with the cervical pillow; five of eight participants (63%) preferred it.
Discussion: These findings suggest that the cervical pillow enhances both physiological and subjective aspects of sleep by promoting proper head–neck alignment, highlighting its potential as a simple intervention to improve sleep quality.

Keywords: Sleep quality, Cervical pillow, Electroencephalography (EEG), Bed microclimate

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AB181

Effects of Clothing Color on Thermoregulatory Responses During Exercise Under Simulated Solar Radiation

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Introduction: Clothing color influences radiative heat gain due to differences in solar absorptivity. However, evidence remains limited regarding clothing color effects on thermoregulatory responses during exercise under controlled solar irradiance.

Purpose: This study examined the effects of clothing color on physiological and perceptual measures during exercise under simulated solar radiation in a tropical hot and humid environment.

Method: Ten healthy male participants completed three randomized trials wearing identical polyester T-shirts in white, grey, and black in a controlled environment (35.4°C; 54.6% RH; 635 W/m²; WBGT 30.3°C). Participants ran for 40 minutes at 70% HRmax. Physiological and perceptual responses were evaluated using a repeated-measures design.

Results: Clothing color significantly affected total sweat loss ($p = .012$), with lower evaporative loss observed in grey compared to white and black. Upper-limb temperature demonstrated a significant color-by-time interaction ($p = .004$), with black showing a lower temperature trajectory during exercise. Changes in mean skin temperature differed between colors ($p = .021$), with a smaller increase in black compared to white. Tympanic temperature ($p = .102$), thermal comfort, and thermal sensation ($p > .05$) were not significantly influenced by clothing color.

Discussion: Clothing color differentially influenced peripheral thermoregulatory responses under simulated solar load. Grey was associated with reduced evaporative output, black with lower local skin temperature dynamics, and white with greater whole-body skin temperature increases, while internal and perceptual responses remained unchanged. These findings highlight the nuanced role of clothing color in surface heat exchange during exercise in hot and humid environments.

Keywords: Clothing color, Physiological responses, Perceptual responses, Solar radiation

ORAL PRESENTATIONS

18th August 2026

Oral Session 6 (9:45 - 10:30)

Theme: Heat Stress and Human Performance

No	Abstract ID	Presenter	Affiliation	Title Of Presentation
1.	AB51	Naomi Michiko	National University Of Singapore	Effects Of Isothermic Conditioning On Cerebral Haemodynamics And Neuromuscular Function During Exertional Hyperthermia
2.	AB68	Robin De Korver	Eindhoven University Of Technology	Enhancing Thermophysiological Predictions During Occupational Heat Stress Through Improved Skin Blood Flow Modeling
3.	AB73	Amine Dahhak	Montreal Heart Institute	Effect Of The Summer Season On The Neural Control Of Heat Loss Thermoeffectors In Young Adults
4.	AB81	Ivo Vincenes Sibarani	Universitas Gadjah Mada	Combined Effects Of Environmental Heat And Virtual Height On Postural Control And Cognitive Performance
5.	AB153	Sharifah Maimunah Syed Mud Puad	Faculty Of Education, Universiti Kebangsaan Malaysia	Heat Stress, Internal Cooling, And Cognitive Performance During Exercise: A Systematic Literature Review

AB51

Effects of Isothermic Conditioning on Cerebral Haemodynamics and Neuromuscular Function During Exertional Hyperthermia

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Introduction
Exertional hyperthermia induces central nervous system (CNS) perturbations, leading to impairments in cerebral haemodynamics and neuromuscular function [1,2]. While isothermic conditioning (IC) induces heat acclimatisation [3,4], its effects on mitigating such CNS alterations during exertional hyperthermia remain unclear.

Purpose
To investigate cerebral oxygenation and muscle activation during exertional hyperthermia following IC.

Methods
Twenty-three healthy males (age = 25±4 years, body mass index = 21±2 kg/m^2, body fat percentage 15±4%, VO_2max = 46±4) completed a heat-response test before (PRE) and after (POST) 10 sessions of IC (n=11) or calisthenics (CON; n=12) over three weeks. Each test comprised a 65-min treadmill walk at 34.1±0.1°C dry bulb temperature and 70±2% relative humidity. At 15-minute intervals, participants performed maximal voluntary contractions (MVC) and submaximal (40% MVC) handgrip contractions (sMVC) with concurrent right brachioradialis muscle electromyography (EMG) measurements. Motor cortical oxyhaemoglobin (Δ[HbO]) and deoxyhaemoglobin (Δ[HbR]) were continuously monitored using functional near-infrared spectroscopy. Cortical activation (Δ[Hbdiff]) was calculated as Δ[HbO]−Δ[HbR]. Δ[Hbdiff]/EMG indexed cortical activation per unit EMG. Two-factor repeated measures ANOVA assessed changes over time.

Results
A time effect was observed for contralateral Δ[Hbdiff] and Δ[Hbdiff]/EMG (p<0.05), increasing across PRE and POST during MVC but not sMVC in IC and CON. Bilateral Δ[Hbdiff] and Δ[Hbdiff]/EMG remained similar between PRE and POST in both groups during MVC and sMVC (p>0.05). This was accompanied by decreased muscle activation (p<0.05) with no PRE-POST differences.

Discussion
IC did not attenuate heat-induced alterations in cortical activation or neuromuscular function during exertional hyperthermia. This suggests thermal adaptation alone may be insufficient to elicit motor cortical adaptations.

Keywords: heat acclimatisation, exercise neuroscience, brain activation, motor function, exertional heat stress

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Enhancing Thermophysiological Predictions During Occupational Heat Stress Through Improved Skin Blood Flow Modeling

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Introduction: Human thermophysiological models, such as ThermoSEM [5], are widely used to predict core and skin temperature responses to occupational and environmental heat stress. Skin blood flow (SBF) regulates core-to-skin heat transfer and can influence evaporative heat loss via its effect on skin temperature. Previous studies have reported limitations in SBF-related predictions [1-2], yet model performance under high metabolic heat stress, where accurate SBF predictions become increasingly important, remains insufficiently investigated.

Purpose: To evaluate whether integrating the cardiovascular SBF model of Kraning and Gonzalez [3] into ThermoSEM improves predictions of rectal temperature and mean skin temperature during exercise in dry heat.

Method: The Kraning-based SBF formulation, accounting for metabolic rate and dehydration effects [3], was implemented in ThermoSEM. Simulations replicated 83 trials from 25 males exercising for 90min under varying metabolic (200–500W) and environmental (30–45°C) conditions [4]. Predicted rectal and mean skin temperatures were compared with measurements.

Results: The standard SBF model [5] systematically overpredicted rectal temperature (RMSE up to 0.97°C) and underpredicted mean skin temperature (RMSE up to 3.0°C). The Kraning-based SBF reduced rectal temperature RMSE by 66% or 0.48°C for P1–P3 and 27% or 0.11°C for P4–P7 and mean skin temperature RMSE by 65% or 1.52°C for P1–P3 and 17% or 0.37°C for P4–P7.

Discussion: Incorporating the metabolically driven SBF formulation of Kraning and Gonzalez [3] improved ThermoSEM's robustness under metabolic heat stress by enhancing core-to-skin heat redistribution. Future work should address inter-individual variability and refine regime transitions in SBF control.

Keywords: Cardiovascular model, Heat stress, Skin Blood Flow, Thermophysiological model, Evaporative cooling

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AB73

Effect of the summer season on the neural control of heat loss thermoeffectors in young adults

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Introduction: Evidence remains unclear as to whether or not seasonal acclimatization improvers thermoregulatory function during heat stress. To date, studies have focused on thermoeffector output, whereas no studies have considered the effect of seasonal acclimatization on the underlying neural control.

Purpose: This study tested the hypothesis that the neural control of heat loss thermoeffectors is improved during the summer months.

Method: Twenty-four adults (27 ± 5 y; 14 males and 10 females) were exposed to passive heat stress during non-summer (October-May) and summer (July-September) months. Skin sympathetic nerve activity (SSNA), local sweat rate (LSR), and cutaneous vascular conductance (CVC) were measured continuously while oesophageal temperature rose by 1.2°C using a water-perfused suit. Whole-body sweat rate (WBSR) was also calculated from changes in nude body mass. Mean body temperature (Tb) was calculated as a weighted average of oesophageal and mean skin temperatures to identify onset thresholds via segmented linear regression. Comparisons were made using paired t-tests and reported as mean differences (summer minus non-summer) with 95% confidence interval.

Results: Baseline esophageal temperature did not differ between seasons (0.03°C [-0.12, 0.14], p=0.85). The onset threshold for increases in SSNA (-0.04°C [-0.18, 0.17], p=0.96), LSR (0.03°C [-0.09, 0.12], p=0.652), and CVC (0.04°C [-0.11, 0.18], p=0.621) also did not differ between seasons. In contrast, WBSR was greater during summer (77 mL/h [29, 125], p=0.003).

Discussion: These results suggest that the neural control of heat loss thermoeffectors is not improved during the summer months, despite an improvement in whole-body sweating capacity.

Keywords: Thermoregulation, Heat stress, Seasonal adaptation.

Combined Effects of Environmental Heat and Virtual Height on Postural Control and Cognitive Performance

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Introduction: Construction workers are frequently exposed to high temperatures and elevated working heights, both of which may increase accident risk through physiological strain, cognitive impairment, and postural instability [1–5]. However, their combined effects remain underexplored in controlled settings.

Purpose: This study investigated the combined effects of environmental temperature and virtual height on postural balance during cognitive and task-oriented activities.

Method: A within-subject design was employed with two air temperatures (24 °C and 32 °C) and three virtual heights (0 m, 5 m, and 20 m). Twelve healthy male participants completed six randomized sessions. At each height level, participants performed visual exploration, a simulated welding task, and the Trail Making Test (TMT-A and TMT-B). Postural stability was assessed using center-of-pressure (COP) metrics.

Results: Elevated temperature significantly increased postural sway across tasks. During visual exploration, higher air temperature increased RMS AP, mean COP velocity, and 95% ellipse area, with a significant temperature × height interaction for RMS AP ($p < 0.05$). In the welding task, temperature increased RMS ML and ellipse area, while height independently affected the ellipse area ($p < 0.05$). For TMT-A and TMT-B, higher temperature prolonged completion time and increased sway parameters, whereas height primarily influenced mediolateral stability ($p < 0.05$).

Discussion: Thermal load produced broader and more consistent impairments in postural balance and cognitive performance than virtual height exposure. These findings suggest that elevated temperature may represent a more pervasive occupational risk factor during cognitively demanding work at height.

Keywords: Environmental temperature, Virtual height, Postural balance, Cognitive performance

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AB153

Heat Stress, Internal Cooling, and Cognitive Performance During Exercise: A Systematic Literature Review

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Introduction: Exercising in hot environments elevates thermal and perceptual strain and can impair cognitive functions that are important for skilled, dynamic sport performance. Internal cooling (ice slurry/crushed ice, cold fluids, menthol) is widely used, yet cognitive effects remain unclear.

Purpose: To synthesize evidence on internal cooling during exercise heat stress on cognitive performance.

Method: The study protocol was registered in PROSPERO (CRD420251109008). A systematic literature search was performed in PubMed, Web of Science, Scopus, and SPORTDiscus from inception to 30 Sep 2025. We included controlled human studies under heat stress comparing internal pre- and/or per-cooling (ice slurry/crushed ice/cold beverage and/or menthol ingestion or mouth rinse) with control during exercise and reporting objective cognitive outcomes. Risk of bias was assessed using the Cochrane Risk of Bias Tool.

Results: Fifteen studies met inclusion criteria. Internal cooling consistently preserved complex cognitive performance (higher-load working memory and executive-control measures), attenuating heat-related decrements versus control. Effects on simpler cognitive outcomes were mixed. Ice slurry/crushed ice ingestion showed the most consistent cognitive protection, particularly when administered pre- and/or during exercise under higher heat strain.

Discussion: Internal cooling, especially ice slurry/crushed ice, may help protect complex cognition during exercise in the heat. Standardized reporting of cooling dose, timing and thermal strain, and sport-relevant decision-making measures, is needed to refine applied recommendations.

Keywords: heat stress, internal cooling, cognitive performance, cognitive function

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18th August 2026
Oral Session 7 (10:45 - 11:45)
Theme: Heat Stress and Human Performance

No	Abstract ID	Presenter	Affiliation	Title Of Presentation
1.	AB4	Gabriel May Moe Kyaw	National University Of Singapore	A Systematic Review Of Adverse Nighttime Heat Thresholds And Associated Effects On Sleep, Comfort, And Health
2	AB9	Aaron Petersen	Victoria University	Training In A Hot Environment Impairs The Anabolic Response To Resistance Training
3	AB95	Chee Chong Shawn Tan	National University Of Singapore	Ophthalmological Responses During Exhaustive Exercise In The Heat
4	AB96	Yudai Tomita	University Of Tsukuba	TRPV3 Channels Contribute To Cutaneous Vasodilation During Local Heating TRPV3 Channels Contribute To Cutaneous Vasodilation During Local Heating Via Nitric Oxide Synthase Mechanisms In Young Adults
5	AB98	Akira Katagiri	University Of Tsukuba	Inter-Exercise Cold Air Inhalation Mitigates Elevations In Core Temperature During Intermittent Exercise In The Heat
6	AB212	Xiang Gao	Shanghai University Of Sport	Time Course Of Inhibitory Control And Prefrontal Hemodynamic Responses During Passive Heat Exposure And Exercise At Different Intensities In The Heat
7	AB219	Brad Clark	University Of Canberra Research Institute For Sport And Exercise	Heat Stress Mitigation Policy Implementation In A Professional Sport: An Observation Study

AB4

A Systematic Review of Adverse Nighttime Heat Thresholds and Associated Effects on Sleep, Comfort, and Health

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Introduction As climate change accelerates, nighttime heat is increasingly recognised as an important, yet under-characterised determinant of health. Higher nighttime temperatures are associated with poorer sleep, impaired recovery, and increased morbidity and mortality risks [1]. However, extreme nighttime temperature thresholds vary widely, limiting cross-study comparability, local risk assessment, and the precision of heat–health guidance.

Purpose

To systematically synthesise extreme nighttime temperature thresholds across studies and evaluate their alignment with reported health outcomes.

Methods This PROSPERO-registered review was conducted following PRISMA 2020 guidelines [2]. Searches were conducted across four databases (PubMed, Scopus, Web of Science Core Collection and Science Direct) from inception to August 2025. Studies examining extreme nighttime temperature (defined using any metric or threshold or explicitly described) were eligible for inclusion, including climatological analyses and studies assessing health or comfort outcomes.

Results

Across 163 included studies, thresholds varied substantially. Percentile-based thresholds were most common (n = 75, 51.4%), with the 90th percentile being the predominant cut-off (n = 45, 60.0%). Absolute thresholds were also widely used (n = 56, 38.4%), with 20 °C being the most common cut-off (n = 28, 50.0%). Only nine studies derived outcome-based thresholds for the general public, with mortality/morbidity thresholds around 27.5–27.8 °C (corresponding to the 68th –78th percentiles) and sleep-related thresholds around 25 °C.

Discussion Empirically-derived thresholds lie above commonly-used absolute thresholds but below the conventional 90th percentile, highlighting a potential misalignment between prevailing definitions and observed outcome risks. As such thresholds remain limited and context-specific, future research should prioritise outcome-based evaluation of nighttime temperatures.

Keywords: Nocturnal heat, climate-health, warm night, heat exposure, high temperature

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Training in a hot environment impairs the anabolic response to resistance training

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Introduction

Whole-body or localised heating can augment acute responses to resistance exercise. However, it is unknown whether whole-body heating improves adaptations to long-term resistance training.

Purpose

We investigated the effects of training in a hot environment on adaptations to resistance training.

Methods

Eighteen males undertook 10-weeks of full body resistance training three days per week in 23°C, RH 25% (CON, n=8), or 40°C, RH 30% (HEAT, n=10). Strength, speed, agility, force and body composition were assessed at pre-, mid- (week five) and post-intervention. Vastus-lateralis biopsies were taken pre- and post-intervention. Gastrointestinal temperature and vastus lateralis temperature were measured via ingestible telemetric capsule and indwelling thermistor, respectively.

Results

Peak gastrointestinal and muscle temperature were not significantly different between CON (38.0±0.2°C; 36.0±0.5°C) and HEAT (38.2±0.1°C; 36.8±0.6°C). Leg press 1 RM increased similarly in both CON (50.25 ± 13.99 kg, $p<0.05$) and HEAT (32.75 ± 5.89 kg, $p<0.05$) while bench press 1RM showed no improvement in either group. No improvements were observed in sprint time, agility, or peak force in either group. Total body and appendicular lean mass increased in CON only by 3.2% and 2.8%, respectively. Upper body lean mass increased and lower body lean mass was unchanged, with no differences between groups. Type I and Type II muscle fibre cross-sectional areas increased only in CON by 27% and 33%, respectively. Myonuclear density increased by 11% only in CON, whereas satellite cell content increased similarly in HEAT and CON. Markers of the mTOR signalling pathway (total and phospho- Akt, mTOR, p70S6k, 4E-BP1, rpS6) were largely similar between HEAT and CON.

Discussion

Despite no significant effects on core or muscle temperature, resistance training in a hot environment impaired muscle hypertrophy but had no effect on performance adaptations.

Keywords: heat, exercise, muscle, resistance training

Ophthalmological Responses during Exhaustive Exercise in the Heat

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Introduction Exertional heat stroke can cause acute and long-term visual dysfunction [1, 2]. However, ophthalmological responses associated with exhaustive exercise in the heat remain unexplored.

Purpose
To examine ophthalmological changes during exhaustive exercise in the heat.

Methods Eleven healthy participants (5 females; age: 27 ± 4 years; maximal aerobic capacity: 43 ± 3 ml/kg/min) completed a treadmill load-carriage march in a hot-humid environment (35.2 ± 0.2°C, RH = 71 ± 2%). Participants performed repeated 1-h exercise bouts interspersed with approximately 30-min rest until volitional exhaustion. Gastrointestinal temperature (Tgi) and heart rate (HR) were recorded. Intraocular pressure (IOP), central corneal thickness (CCT), corneal endothelial cell density (CD), cell size variation (CV) and hexagonality (HEX) were assessed pre-exercise, after the first bout (B1), and upon exhaustion.

Results
Mean work tolerance was 117 ± 27 min, with mean Tgi and HR reaching 39.3 ± 0.4°C and 161 ± 17 bpm at exhaustion. Mean IOP across both eyes was 24% higher at exhaustion compared to B1 (p=0.044, *g*=0.79), with a large effect in the right eye (B1: 11.4 ± 3.2 mmHG, exhaustion: 14.6 ± 3.6 mmHG, p=0.044, *g*=0.88). CCT, CD, CV and HEX remained unchanged following exhaustive exercise in the heat (all p>0.05).

Discussion IOP increased after exhaustive exercise in the heat, despite stable corneal endothelial morphometry. Elevated IOP increases mechanical stress on optic nerves and lowers optical perfusion [3], predisposing individuals to visual impairments. This underscores the importance of elucidating the mechanisms underlying IOP increase following exertional heat exhaustion and their implications for visual function.

Keywords: Exertional heat stroke, hyperthermia, tonometry, intraocular pressure, visual impairment

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AB96

TRPV3 Channels Contribute to Cutaneous Vasodilation during Local Heating via Nitric Oxide Synthase Mechanisms in Young Adults

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Introduction: Nitric oxide synthase (NOS) is a crucial mediator of cutaneous vasodilation during local skin heating [1]. We recently reported that pharmacological activation of transient receptor potential vanilloid 3 (TRPV3) channels mediates cutaneous vasodilation via NOS-dependent mechanisms [2]. However, it is unclear whether this channel mediates cutaneous vasodilation during local skin heating via activating NOS.

Purpose: The aim of the present study was to test the hypothesis that TRPV3 channels contribute to cutaneous vasodilation during local heating via NOS-dependent mechanisms.

Method: Participants were eleven healthy young adults (5 females). Cutaneous vascular conductance (CVC) was assessed at four forearm sites treated with: 1) 5% DMSO (vehicle control), 2) 10 mM TRPV3 74a, a TRPV3 channel antagonist, 3) 20 mM L-NAME, a nonselective NOS inhibitor, or 4) combination of both. Local skin temperature at each site was increased from 28°C to 42°C (1°C/5 min), with inhibitors/blockers administered intradermally via microdialysis.

Results: From 35°C to 42°C, CVC at the TRPV3 74a treated site was lower than vehicle control site (all $P < 0.005$). L-NAME alone (≥ 35°C) and combination of TRPV3 74a and L-NAME (≥ 36°C) reduced CVC relative to the vehicle control site (all $P < 0.042$), with no difference between these two sites (all $P > 0.468$).

Discussion: TRPV3 channels contribute to cutaneous vasodilation during local skin heating, and this response appears to be mediated via NOS pathway. Future studies are warranted to examine whether TRPV3 channels also modulate cutaneous vasodilation during whole-body heating.

Keywords: Microcirculation, Nitric oxide synthase, TRP channels

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Inter-exercise cold air inhalation mitigates elevations in core temperature during intermittent exercise in the heat

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Introduction: In hot environments, lowering inspired air temperature throughout exercise attenuates increases in core temperature [1, 2]. However, whether inhaling cooled air limited to rest intervals during intermittent exercise mitigates core temperature elevations remains unclear.

Purpose: To test the hypothesis that during intermittent exercise in the heat, inter-exercise cooled air inhalation would alleviate elevations in core temperature, with greater effects at lower generated air temperatures.

Method: Thirty-one males participated one of three experiments conducted using different cooling devices, generating air temperatures of 13.5°C (study 1: n = 9), 1.7°C (study 2: n = 11), and –10.4°C (study 3: n = 11). Participants performed moderate-intensity (60% of peak oxygen uptake) intermittent exercise (eight sets of 5-min exercise + 3-min rest) in the heat (35°C, 50% relative humidity). During each rest period, participants inhaled either ambient air (35°C, control trial) or cold air as described above (cold-air trial).

Results: In study 1, inspired air temperature in the cold-air trial achieved ~26°C, and esophageal (core) temperature increased similarly in control and cold-air trials. In studies 2 and 3, the inspired cold air temperature was ~14°C, and esophageal temperature was lower in the cold-air trial compared to the control trial.

Discussion: Our cooling device was capable of generating substantially cold air; however, under the present experimental configuration, the reduction in inspired air temperature may be limited. Nevertheless, inhalation of cold air (~14°C), but not cool air (~26°C), during inter-exercise may be an effective strategy to mitigate hyperthermia during prolonged intermittent exercise in the heat.

(250/250 words)

Key words: Airway temperature, Exercise performance, Heat stroke, Internal cooling, Occupational safety

AB212

Time Course of Inhibitory Control and Prefrontal Hemodynamic Responses During Passive Heat Exposure and Exercise at Different Intensities in the Heat

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Introduction: Maintaining inhibitory control under heat stress is critical for individuals required to respond rapidly and accurately in thermally demanding settings. Although heat exposure is generally associated with cognitive impairment, recent evidence suggests that moderate-intensity exercise in the heat may preserve inhibitory control better than passive heat exposure alone. Whether this effect changes over time and differs across exercise intensities remains unclear.

Purpose:
This study compares the time course of inhibitory control during passive heat exposure and low- or moderate-intensity cycling in the heat, and its association with prefrontal hemodynamic responses.

Method: Twenty healthy adults will complete three randomized crossover visits involving passive heat exposure, low-intensity cycling in the heat, and moderate-intensity cycling in the heat. Each 40-min session will include Flanker assessments every 8 min and continuous monitoring of prefrontal hemodynamics with fNIRS. Outcomes will include reaction time, accuracy, an integrated efficiency index, heart rate, and thermal strain indicators.

Results: Data collection is ongoing. Statistical analyses will examine condition-by-time differences in cognitive performance and prefrontal hemodynamic responses.

Discussion: This study may provide practical insight into how long inhibitory control can be sustained during work or exercise in hot environments. The findings may help inform heat-management and task-allocation strategies for populations such as firefighters, motorsport personnel, and other workers who must maintain rapid and accurate responses under thermal stress.

Keywords
Heat stress, inhibitory control, exercise intensity, fNIRS

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Heat stress mitigation policy implementation in a professional sport: An observation study

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Introduction: Sports governing bodies around the world implement environmental heat stress mitigation policies to safeguard athlete health. However, to date there have been limited observations of the real-world implementation of these policies in professional settings.

Purpose: This study observed the real-world implementation of a heat stress mitigation policy in a men's and women's professional football league.

Methods: Heat stress policy implementation was observed in 11 men's and 13 women's matches over the 2024-25 season. Ambient temperature, relative humidity, black-globe temperature, wind speed and wet-bulb globe temperature (WBGT) (Kestrel 5400 series, Nielsen- Kellerman, Pennsylvania) were recorded pitch-side by the research team 30 min prior to kick off, at kick off, at the start and end of half-time, and full time. Pitch-side ambient temperature and WBGT were compared with measurements collected by competition officials and published online at the conclusion of matches.

Results: Pitch-side ambient temperature collected by the research team was 1.4±1.6°C higher (P=0.274) and WBGT was 2.0±1.6°C higher (P=0.028) than official competition measurements across the 24 matches. Based on the environmental conditions measured by competition officials, cooling breaks were implemented in seven matches. In contrast, based on pitch-side measurements by the research team, cooling breaks could have been implemented in an additional three matches.

Discussion: Challenges associated with accurate assessment of hyper-local environmental heat stress impaired the effective implementation of a heat stress mitigation policy in professional football. Further research should explore the barriers, facilitators and enablers for effective implementation of heat stress policies in professional sports settings.

Keywords: Heat illness, heat stress, hydration, cooling breaks.

18th August 2026
Oral Session 8 (11:45 - 12:45)
Theme: Nutrition and Hydration Strategies in Challenging Environments

No	Abstract ID	Presenter	Affiliation	Title Of Presentation
1.	AB60	Jessica Loke	National University Of Singapore	The Effects Of Cold And Ice-Based Beverage Ingestion On Performance- And Safety-Related Outcomes: A Systematic Review
2.	AB70	Tingyu Chloe Chen	National University Of Singapore	Effect Of Ice Slurry Ingestion On Thermal And Cardiovascular Strain In Elite Ultimate Frisbee Athletes
3.	AB92	Kunanya Masodsai	Faculty Of Sports Science, Chulalongkorn University, Thailand	Hydration Status During Simulated Half- And Full Topical Marathon Runners
4.	AB97	Junto Otsuka	Laboratory For Exercise And Environmental Physiology, Niigata University, Niigata, Japan	Hydration Efficacy Of Slow- And Fast-Absorption Carbohydrate-Electrolyte Beverages: A Comparison In Metered Ingestion
	AB208	Marilyn Ong Li Yin	Exercise And Sports Science Programme, School Of Health Sciences, Universiti Sains Malaysia, Kubang Kerian, Kelantan, Malaysia	Caffeinated Versus Decaffeinated Coffee: Thermoregulatory Responses And Finger-Prick Metabolic Assessment During Exercise In The Heat

The Effects of Cold and Ice-Based Beverage Ingestion Beyond Physiological and Perceptual Outcomes: A Systematic Review

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Introduction

Cold and ice-based beverages are practical strategies to attenuate heat strain. While their physiological and perceptual benefits during heat exposure are well-established, their effects on performance and safety outcomes remain elusive.

Purpose

To systematically assess the impacts of cold and ice-based beverage ingestion, beyond known physiological and perceptual outcomes.

Methods

A registered, PRISMA-guided systematic review searched four databases for human RCTs comparing ingested fluids at differing temperatures and/or forms during heat exposure.

Results

Fifty-seven studies met the inclusion criteria, with five reporting novel outcomes. Such outcomes included psychomotor performance, risk-taking behavior, and gait. One study reported similar reaction and response times between ice slurry and control during simulated taekwondo combat [1]. In separate studies, ice slurry reduced risk-taking behavior in healthcare workers [2], and step width variability during treadmill walking, indicative of improved gait stability [3]. Some studies also reported higher end-exercise body core temperatures (Tc) with ice slurry than control [4, 5].

Discussion

Evidence on fluid ingestion for cooling has broadened to encompass performance- and safety-related outcomes. Findings suggest limited enhancement of psychomotor performance with ice slurry, which might reflect insufficient thermal strain elicited by the exercise protocol for performance benefits to manifest. Safety-related findings, including lowered risk-taking behavior and enhanced gait stability, highlight the role of ice slurry in accident and injury prevention. However, elevated end-exercise Tc with ice slurry may be caused by cooler thermal sensation facilitating greater work output, raising safety concerns if physiological limits are exceeded. Given limited studies investigating these measures, further research is needed to clarify these effects and their underlying mechanisms.

Keywords

Fluid ingestion, Ice slurry, Cold fluids, Cooling strategies, Heat strain

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AB70

Effect of Ice Slurry Ingestion on Thermal and Cardiovascular Strain in Elite Ultimate Frisbee Athletes

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Introduction

Intermittent team sports such as Ultimate Frisbee impose substantial thermal load, increasing athletes' thermal strain and risk of exertional heat illness [1]. While ice slurry ingestion is an effective per-cooling strategy during prolonged continuous exercise, its efficacy when consumed *ad libitum* in intermittent field-based exercise remains unclear [2].

Purpose

To investigate the effects of *ad libitum* ice slurry ingestion on thermal and cardiovascular strain during elite-level Ultimate Frisbee training.

Methods

Eleven elite Ultimate Frisbee athletes (5 females; 26±4years) completed two randomised crossover training sessions ingesting a sports drink *ad libitum* as ice slurry (ICE) or ambient drink (AMB). Core temperature (T_c), heart rate (HR), relative humidity (RH), dry bulb temperature (T_{db}), fluid intake, and body mass were recorded; estimated sweat loss was calculated from body mass loss and fluid intake.

Results

Environmental conditions were hot and moderately humid (T_{db}: 32.5±0.9°C, RH: 45±8%) across both sessions. Both mean and maximum values of T_c and HR, and rate of T_c change were comparable between conditions (all p>0.05). Mean fluid intake was lower during ICE compared to AMB (1.5±0.5L vs. 2.2±0.7L, p<0.05). However, mean estimated sweat loss did not differ between conditions (p>0.05).

Discussion

The comparable T_c and HR responses, alongside similar estimated sweat loss between conditions, indicate that ice slurry ingestion permitted lower fluid intake without compromising thermal or cardiovascular strain. The greater cooling capacity of ice slurry likely helped maintain thermophysiological responses despite reduced fluid intake. These findings support per-cooling ice slurry ingestion as a practical cooling strategy during intermittent exercise in the heat.

Keywords: Hyperthermia, Intermittent Sport, Sports Drink, Cooling, Thermoregulation

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AB92

Hydration Status during Simulated Half- and Full Topical Marathon Runners

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Abstract

Dehydration during long distance running impairs performance. However, fluid intake during marathon sustaining performance and rehydration depend mainly on individual's behaviors. This study aimed to examine the effects of hydration status on physiological, metabolic, and performance-related responses during the simulated half and full marathon running. Participants were categorized into four groups by 2% of body mass losses: dehydrated half-marathon (DH21, n=46), well-hydrated half-marathon (WH21, n=36), dehydrated marathon (DH42, n=36), and well-hydrated marathon (WH42, n=18). Water and sport drinks were freely provided and recorded at 1-km station along the simulated running track. Anthropometric, cardiovascular, and biochemical variables were assessed at rest and post-exercise. Dehydration is detected in 56% (46/82 subjects,) and 66% (36/54 subjects) half- and full marathon, respectively. Dehydrated groups significantly exhibit the largest body mass (BM) losses (DH21 -3.19%; WH21 -1.05%; DH42 -4.34%, WH42 -1.12%) than its counterpart. Total fluid and water intake in WH42 is higher than DH42 whereas those in DH21 and WH21 remained the same, and no significant difference of sports drink among the groups. Even under *ad libitum* condition, greater negative water replacements are detected, in DH21 (BM loss -2.12±0.11 kg, 500 ml fluid intake), DH42 kg (BM loss -2.74±0.20 kg, 1,500 ml fluid intake) and minor in WH21 group (BM loss -0.71±0.09 kg, 500 ml fluid intake). Whilst WH42 shows positive water replacement (smaller BM loss -0.70±0.12 kg, 2,000 ml fluid intake). More than half of runners presented dehydration even though fluid intake was ~1500 ml. Weight loss unavoidably appears even in well-hydrated runners.

Keywords: Half-marathon, Full marathon, Dehydration, Well-hydration, Fluid intake

Hydration efficacy of slow- and fast-absorption carbohydrate-electrolyte beverages: a comparison in metered ingestion

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Introduction: Ingestion of carbohydrate beverages over a short period (e.g., ~30 min) enhances fluid retention (e.g., reduced urinary output) compared with water at rest [1], with greater effects reported for slowly absorbed carbohydrates such as isomaltulose [2, 3]. However, it remains unclear whether carbohydrate effects are preserved when ingested in a metered manner over an extended period.

Purpose: We compared the hydration efficacy of fast- and slow-absorption carbohydrate beverages when drinks were ingested over 2 hours.

Method: In a randomized, double-blind, crossover design, 16 healthy young adults (4 women) ingested either 1 L of water (CON), a mixture of 3.25% glucose and 3.25% fructose (G+F), or 6.5% isomaltulose (ISO) over 2 hours (250 ml every 30-min). Hydration responses were assessed during ingestion and for an additional 2 hours.

Results: Carbohydrate beverages increased blood glucose during the 2-hour ingestion period, with a greater response in G+F than in ISO (all *P* Ò0.015), reflecting their fast- and slow-absorption characteristics. Cumulative urine volume was lower with G+F or ISO than with CON, with no difference between carbohydrate beverages over the 4-hour period (all *P* Ó 0.183). Plasma osmolality was higher during ingestion with carbohydrate beverages compared with CON (all *P* Ò0.031).

Discussion: Metered ingestion of carbohydrateï electrolyte beverages over 2 hours improved fluid retention compared with water, regardless of carbohydrate absorption rate, likely due to maintenance of plasma osmolality. Timing and volume of beverage ingestions (e.g., metered or bolus) may affect carbohydrate absorption rate-specific effects on hydration efficacy.

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Keywords: fluid balance, carbohydrate, isomaltulose

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AB208

Caffeinated versus Decaffeinated Coffee: Thermoregulatory Responses and Finger-Prick Metabolic Assessment During Exercise in the Heat

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Introduction: Coffee is a major dietary source of caffeine and may influence metabolic responses during exercise without impairing thermoregulation in hot environments [1,2]. However, most studies examine isolated caffeine supplementation rather than coffee consumption, and finger-prick capillary blood sampling remains underutilised for monitoring metabolic responses during exercise in the heat [3].

Purpose: To examine the effects of caffeinated (CAF) and decaffeinated (DECAF) coffee on thermoregulatory responses and metabolic blood markers during moderate-intensity exercise in the heat, with metabolic markers measured using repeated finger-prick sampling.

Method: Seventeen moderately active women (25.5 ± 3.6 years) completed a double-blind randomised crossover trial involving ingesting CAF and DECAF coffee. After ingestion, participants performed 30 min of brisk walking at 60% heart rate reserve in a climate-controlled chamber (30°C, 70% RH). Finger-prick capillary blood samples were collected at baseline, post-ingestion, post-exercise, and 10 min post-exercise to measure cholesterol, glucose, lactate, and triglycerides.

Results: Thermoregulatory responses did not differ between CAF and DECAF trials ($p > 0.05$). Cholesterol and glucose levels were similar. However, lactate ($p = 0.014$) and triglyceride levels ($p = 0.002$) differed significantly.

Discussion: CAF coffee did not impair thermoregulation during moderate-intensity walking in the heat. However, differences in lactate and triglyceride levels suggest that CAF coffee may influence metabolic responses during exercise, potentially through altered substrate utilisation and lipid mobilisation [4,5]. Repeated finger-prick sampling enabled metabolic responses to be monitored and may offer a practical minimally invasive approach for metabolic assessment in exercise-heat studies.

Keywords: caffeine, finger-prick blood sampling, thermoregulation, exercise in heat, metabolic responses

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18th August 2026
Oral Session 9 (16:15 - 16:30)
Theme: Sensor Technology for Thermal Physiology

No	Abstract ID	Presenter	Affiliation	Title Of Presentation
	AB132	Eric Enrique Corrêa Rodrigues	Brock University, St. Catharines, Ontario, Canada	Wired Versus Wireless Sensors: Agreement For Measuring Mean Weighted Skin Temperature During Passive Thermal Stress
	AB225	John Chan	Department Of Sports And Health Sciences, Academy Of Wellness And Human Development, Faculty Of Arts And Social Sciences, Hong Kong Baptist University, Hong Kong, China	Stakeholders' Perceptions Of Sensor-Integrated Smart Garments In Elite Sports: Benefits, Barriers And Adoption

Wired versus wireless sensors: Agreement for measuring mean weighted skin temperature during passive thermal stress

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Introduction: Skin temperature is widely used in science and is especially relevant for thermal physiology research, yet various temperature measurement technologies exist with unclear agreement among them[1]. Both wired and wireless sensors are commonly used, but their interchangeability during mild thermal stress remains unclear.

Purpose: This study assessed agreement between two wireless technologies [iButtons (12 sites) and eTemp wireless sensors (12 sites)] and wired thermocouples (7 sites) for measuring skin temperature and calculating mean weighted skin temperature (T_{mws}) during passive exposure to varying ambient temperatures.

Method: Twelve participants stood in an environmental chamber (50% relative humidity) for 100 minutes: baseline moderate (23°C, 10 minutes), then warm (30°C), cool (18°C), and return to moderate (23°C, each 30 minutes). Skin temperatures were recorded simultaneously at every minute using all three sensor types at multiple body sites. T_{mws} was calculated using the Ramanathan 4-site formula[2]. Agreement was assessed using mean bias, mean absolute error (MAE), and root mean squared error (RMSE).

Results: Mean bias was 0.99–1.08°C between wireless sensors and thermocouples, with MAE of 1.24°C and RMSE of 1.73–1.75°C, with only 31% of measurements within 0.5°C. When calculating T_{mws}, mean bias was 1.00–1.04°C for wireless-thermocouple comparisons, with corresponding MAE of 1.01–1.09°C and RMSE of 1.18–1.33°C.

Discussion: Thermocouples showed persistent bias versus wireless sensors, suggesting researchers should exercise caution when performing wired-wireless comparisons.

Keywords: skin temperature, thermometry, iButton, eTemp, thermocouple

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Stakeholders' perceptions of sensor-integrated smart garments in elite sports: benefits, barriers and adoption

Introduction: Sensor-integrated smart garments enable real-time physiological monitoring while offering a less obtrusive and ergonomically designed alternative to conventional wearable devices. However, their adoption in elite sports appears limited [1].

Purpose: To examine stakeholders' perceptions of the benefits, barriers and adoption potential of sensor-integrated smart garments in elite sports.

Methods: Between May and August 2026, a cross-sectional survey was conducted across three stakeholder groups: (i) athletes, (ii) support staff (coaches, sports scientists, and researchers), and (iii) textile and wearable technology manufacturers. The survey assessed perceived value, barriers to adoption, functional integration, measurement quality, and user experience using Likert-scale (1-7), multiple-choice, and ranking questions. Between-group differences were analysed using Kruskal-Wallis and chi-squared tests, supported by descriptive and frequency analysis.

Results: A total of 130 responses were received (43 athletes, 68 support staff, 19 manufacturers). Interest differed between stakeholder groups ($p = 0.039$), with athletes reporting lower interest (mean score = 2.2/7, 1 = 'not at all interested' to 7 = 'extremely interested') than support staff (5.4/7) and manufacturers (5.0/7). Most respondents (63.2%) indicated a preference for using smart garments over conventional wearables, perceived greater value in their use and anticipated increased use of these technologies in elite sports. The most frequently reported barriers to adoption were comfort (83.3%) and data accuracy (76.5%).

Conclusion: Stakeholders generally reported positive perceptions of sensor-integrated smart garments and their potential application in elite sports. However, comfort and data accuracy remain important barriers to adoption. Addressing these challenges may support the wider implementation of smart garment technologies in elite sport.

Keywords: smart garments, stakeholder perceptions, elite sports, wearable technologies

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18th August 2026
Oral Session 10 (17:30 – 18:15)
Theme: Climate Extreme and Occupational Population

No	Abstract ID	Presenter	Affiliation	Title Of Presentation
1.	AB18	Nuno Koch Esteves	Thermosenselab, Skin Sensing Research Group, School Of Health Sciences, University Of Southampton, Southampton, UK	THERMO-CARE: Cost-Effective Interventions To Improve Heat Resilience Of Healthcare Staff In Hospitals In The United Kingdom
2.	AB58	Daniel Moore	Deakin University	The Cumulative Effects Of Three Consecutive Days Of Simulated Occupational Heat Stress On Physiological Strain And Physical And Cognitive Performance In Young Adults
3.	AB118	Mounir Ait Ali Braham	Université Du Québec À Trois-Rivières	Physiological Strain Among Construction Workers During A Full Work-Shift: A Comparison Of Warm And Temperate Days
4.	AB193	Ga-Young Lim	Indiana University Bloomington	Personal And Occupational Factors Associated With Hyperthermia In Construction Workers In The Summer

THERMO-CARE: Cost-Effective Interventions to Improve Heat Resilience of Healthcare Staff in Hospitals in the United Kingdom

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Introduction: Heatwaves are increasing in frequency and intensity in the United Kingdom (UK), yet many hospitals have limited cooling capacity, creating risks to healthcare staff wellbeing, performance, and patient safety [1, 2]. Implementation of national guidance on heatwave response is variable and the evidence base for sustainable, staff-centred mitigation remains limited [2].

Purpose: THERMO-CARE aims to co-design and evaluate sustainable, user-centred interventions to strengthen the heat resilience of healthcare staff across diverse UK hospitals.

Using multidisciplinary expertise, this project is developing preliminary evidence in support of three objectives: (*i*) conduct pilot heatwave readiness assessments in selected hospitals using systems-based frameworks (AcciMap); (*ii*) co-design programme theories for equitable staff-centred cooling interventions; (*iii*) identify candidate outcomes and evaluation methods for cost-effectiveness and environmental impact analyses.

Methods: THERMO-CARE integrates consultative roundtables, systems analysis of overheating risks, participatory co-design workshops with healthcare staff, and structured evaluation planning to define productivity, health, and safety outcomes.

Results: Using overheating incidents data from two representative hospitals, preliminary results indicate incidents cluster during warmer periods, are frequently identified through monitoring and staff vigilance, and are managed through local adaptive responses. Yet, the recurrence of similar incidents within and across heat seasons suggests that, while detection and response mechanisms are active, sustained periods of heat can exceed the stabilising capacity of existing environmental controls in some settings.

Discussion: This preliminary phase is supporting the development of critical evidence and frameworks to inform an equitable, scalable, and low-carbon strategy for protecting healthcare staff during extreme heat in UK hospitals.

Word Count: 249/250

Keywords: heatwaves, hospital overheating, occupational heat stress, systems analysis, co-design

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AB58

The Cumulative Effects of Three Consecutive Days of Simulated Occupational Heat Stress on Physiological Strain and Physical and Cognitive Performance in Young Adults

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Introduction: Workers often complete long shifts over consecutive days in hot environments [1–2], but it is unclear whether there is a cumulative impact on health and performance, which should be considered in occupational heat stress guidance.

Purpose: To quantify whether physiological strain increases, and physical and cognitive performance decline across three consecutive days of simulated occupational heat stress using established work-rest guidance.

Method: Twenty physically active young adults (5-females) completed two 3-day randomized crossover trials. Each day comprised a 30-min seated baseline followed by ~8 h of moderate-intensity work (30-min work: 30-min rest). Trials differed only by environment: hot (35°C, 63%RH; 31°C WBGT) or control (18°C, 53%RH; 14°C WBGT). Body core temperature, heart rate, physical and cognitive performance were assessed at start-of-shift and end-of-shift daily. Participants wore a T-shirt, shorts and running shoes, and consumed water ad libitum.

Results: End-of-shift core temperature and heart rate were higher in the hot versus control across days ($p \leq .001$), with no cumulative (day-to-day) increases in either condition ($p \geq .182$). Physical and cognitive performance were not negatively impacted by condition or day.

Discussion: When performing cycles of moderate-intensity work and rest in a hot-humid environment over three days, physiological strain and physical and cognitive performance did not progressively worsen in physically active young adults. This suggests that occupational heat-stress guidance may not need to consider cumulative impacts of work in the heat under select conditions while wearing athletic clothing with ad libitum water access, although larger confirmatory studies are needed in broader populations and conditions.

Keywords: Heat strain, Industrial, Work, Occupational Physiology

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AB118

Physiological Strain among Construction Workers during a Full Work-shift: a Comparison of Warm and Temperate Days

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Introduction: Heat exposure during a workday can increase the risk of heat-related illnesses and occupational accidents [1]. However, few field studies have quantified the effect of heat on the physiological responses during a typical workday, particularly through direct comparisons between warm and temperate workdays [2].

Purpose: This study aimed to quantify the impact of a warm day on the physiological responses of outdoor construction workers.

Methods: Eighteen male (34±10 years) construction workers from various trades completed a full workday during warm (dry temperature: 25.2±1.4°C, relative humidity: 73.1 ±5.7%, WBGT: 21.5±1.6°C) and temperate (dry temperature: 18.3±2.0°C, relative humidity: 52.5±13.1%, WBGT: 14.0±2.1°C) summer days. Total workday energy expenditure was estimated by work-tasks documentation. Gastrointestinal temperature and heart rate were measured continuously. Hydration status was estimated from changes in nude body mass.

Results: Total workday energy expenditure was similar during warm and temperate days (-184 Kcal [-429, 60], p=0.13). Mean and peak gastrointestinal temperatures throughout the workday was greater (0.14°C [0.03, 0.24], p<0.01) and (0.18°C [0.01, 0.36], p<0.05) during the warm compared with temperate days), respectively. However, mean and peak heart rate were similar between warm and temperate days, (4 bpm [-5, 14], p=0.36) and (12 bpm [-3, 26], p=0.35), respectively. The relative change in nude body mass was similar between the warm and temperate days (-0.4 % [-1.0, 0.1], p=0.12).

Discussion: Compared to a temperate workday, a typical work shift on a warm day increased thermal strain (by ~0.14°C), but fluid and cardiac strain were similar among outdoor construction workers.

Keywords: Thermal stress, Occupational health, Construction workers, Body core temperature

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AB193

Personal and Occupational Factors Associated with Hyperthermia in Construction Workers in the Summer

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Introduction: The personal and occupational factors contributing to elevated core temperature in construction workers in the summer are unclear.

Purpose: To identify factors associated with hyperthermia in construction workers.

Method: Data were collected from 182 workers (39 ± 11 y; 7 females) over one work shift. Initial independent variables were age, sex, race, ethnicity, body mass index, mean arterial pressure (MAP), pre- and post-shift urine specific gravity (USG), peak wet bulb globe temperature (WBGT), and intense work duration (% workday). The dependent variable was core temperature estimated (ECTemp) from continuous heart rate (HR). Analyses included bivariate correlations, Functional Generalized Additive Models (FGAM) and Functional Logistic Regression, which accounted for the dependence of ECTemp on HR.

Results: ECTemp was positively correlated with intense work duration ($r = 0.67$, $p < 0.0001$) and peak WBGT ($r = 0.20$, $p = 0.009$) and inversely correlated with age ($r = -0.27$, $p < 0.001$). The FGAM showed strong model fit (adjusted $R^2 = 0.87$), with significant nonlinear effects for intense work duration ($F = 6.45$, $p < 0.001$). The logistic regression model was significant ($\chi^2(11) = 103.5$, $p < 0.0001$). Hyperthermia odds increased 6% per 1% increase in intense work duration (OR = 1.06 [0.998–1.13]) and were 2.2x higher with greater post-shift USG (OR = 2.23[0.96–5.8]), whereas BMI was inversely associated with hyperthermia risk (OR = 0.87[0.74–1.00]).

Discussion: Intense work duration was consistently associated with higher ECTemp. Occupational factors are key to managing hyperthermia risk in construction.

Keywords: Occupational heat stress, Hyperthermia, Construction workers

ORAL PRESENTATIONS
19th August 2026
Oral Session 11 (15:00 - 15:30)
Theme: Gravitational Physiology

No	Abstract ID	Presenter	Affiliation	Title Of Presentation
1.	AB110	Sara Podgornik	The Jožef Stefan Institute	Interaction Of Simulated Hypoxic Microgravity Confinement And (In)Activity: Impact On Sleep Quality
2.	AB111	Jack Fortune	The Jožef Stefan Institute	Development Of And Adherence To Artificial Gravity And Resistive Vibration Exercises During 60-Days Of Hypoxic 6° Head-Down Tilt Bed Rest: The BRAVE Study
3.	AB163	Igor Mekjavic	Jozef Stefan Institute	Rehabilitation During 60-D Hypoxic 6° Head Down Tilt Bed Rest Without And With Vibration Resistance Exercise Countermeasure. The BRAVE Study

AB110

Interaction of simulated hypoxic microgravity confinement and (in)activity: Impact on sleep quality

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Introduction: Sleep is a vital process for the body and the brain, accounting for 30% of our daily 24-hour cycle [1]. Environmental changes, such as hypoxia and microgravity, can disrupt sleep, particularly reducing the time spent in N3 and REM sleep stages and leading to periodic breathing and more frequent apnoeas [2, 3]. As space travel is expected to become more common and longer, including anticipated missions to Mars, it is crucial to understand how conditions such as hypoxia and microgravity interfere with sleep during long-duration space missions [4].

Purpose: The objectives of the study were to assess the effects of microgravity exposure and hypoxia on overall sleep quality and to investigate whether different exercise interventions (horizontal resistive vibration exercise; HRVE, and horizontal resistive vibration exercise with artificial gravity; HRVE+AG) would attenuate the effects of these conditions on sleep quality.

Method: Male participants (N=24) underwent a 90-day study comprising three phases: a 15-day baseline, a 60-day 6° head-down tilt hypoxic bed rest period (HRVE, HRVE+AG, or control group), and a 15-day recovery phase. Participants underwent sleep recordings to monitor sleep stages and breathing (polysomnography; PSG) at baseline and at the start, halfway, and end of the bedrest period.

Results: Hypoxic exposure significantly increased apnoea events and reduced minimal blood oxygen saturation. Sleep efficiency and N2/N3 percentages remained stable, with high inter-individual variability.

Discussion: Findings indicate that hypoxia primarily affects respiratory stability without altering overall sleep macrostructure. The exercise interventions were insufficient to improve breathing, and individual variability requires further exploration.

Keywords: microgravity, hypoxia, sleep

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Development of and Adherence to Artificial Gravity and Resistive Vibration Exercises During 60-Days of Hypoxic 6° Head-Down Tilt Bed Rest: The BRAVE Study

Jack Fortune[1,2], Riccardo G. Sorrentino[1], Spiros Zamantzas[1,2], Victorien Faivre-Rampant[1,2], Lydia Tsoutsoubi[1], Adam C. McDonnell[1], Jason T. Fisher[1], Sara Podgornik[1,2], Leonidas G. Ioannou[1], Urša Ciuha[1], Igor B. Mekjavic[1]

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Introduction

Long-duration spaceflight induces profound musculoskeletal and sensorimotor deconditioning due to microgravity [1]. Exercise countermeasures remain essential; however, current in-flight systems lack a head-to-foot gravitational vector. Artificial-gravity (AG), delivered via centrifugation, has been proposed as a comprehensive countermeasure, yet evidence regarding its long-term feasibility, tolerability, and adherence during chronic exposure remains limited [2], [3].

Purpose

This study evaluated whether a structured exercise protocol combining artificial gravity with resistive vibration exercise (AGRVE), compared with horizontal resistive vibration exercise (HRVE), can be safely implemented with high adherence and tolerability during 60 days of hypoxic head-down tilt bed-rest.

Method

Sixteen male participants completed a 60-day 6° head-down tilt bed-rest intervention under normobaric hypoxia (FIO_2 = 0.14). Participants were allocated to AGRVE (n = 8) or HRVE (n = 8) and performed identical 30-min resistance-vibration exercise sessions 5 days a week at light and moderate intensities. Training adherence, motion sickness, delayed-onset muscle soreness (DOMS), and eight-repetition maximum (8RM) strength were assessed throughout the intervention.

Results

Training adherence was high in both groups (AGRVE: 96.3%; HRVE: 98.5%). Motion sickness occurred only in the AGRVE group and declined significantly across repeated exposures ($p < 0.001$). DOMS remained low in both groups (typically 0–3/10). Both groups demonstrated significant improvements in 8RM strength ($p < 0.001$), with no between-group differences.

Discussion

Structured resistive-vibration exercise, with or without artificial gravity, can be reliably implemented during prolonged hypoxic bed rest. These findings provide critical operational evidence supporting the feasibility of progressive AG-based exercise protocols for future long-duration spaceflight countermeasures.

Keywords: artificial gravity, bed rest, resistive vibration exercise, hypoxia, countermeasures

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AB163

Rehabilitation during 60-d hypoxic 6° head down tilt bed rest without and with vibration resistance exercise countermeasure. The BRAVE study

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Introduction: Current exercise on the International Space Station does not fully prevent muscle and bone loss. The European Space Agency is therefore investigating whether exercise performed in artificial gravity could enhance training outcomes using the 6° head-down tilt bed rest model.

Aim: To evaluate infrared thermography (IRT) as a tool for detecting exercise-induced musculoskeletal injury during bed rest and exercise countermeasures.

Method: Twenty-four healthy male participants completed a 60-day hypoxic 6° head-down tilt bed rest campaign and were allocated to control, horizontal resistive vibration exercise (HRVE), or artificial gravity resistive vibration exercise (AGRVE) groups. Physiotherapy was delivered at regular intervals and on request. Infrared thermographic images were collected at baseline in the standing position, daily during bed rest, and throughout recovery. Regions of interest included the skin overlying the vastus medialis and vastus lateralis, previously identified as highly active during resistive vibration exercise. Longitudinal temperature changes were analysed using mixed-effects models, and Hedges' g effect sizes were calculated.

Results: The control group reported immobilization-related muscle pain, increased neck and back tension, and trigger points in postural muscles. Exercise groups experienced similar tension alongside additional lower-limb soreness from training. Physiotherapy targeting the quadratus lumborum, paravertebral and trapezius muscles, together with the quadriceps and calf muscles, reduced pain and improved recovery. IRT successfully identified problematic regions, enabling timely initiation of physiotherapy and improved training continuity.

Discussion: IRT detected delayed onset muscle soreness and demonstrated potential as a non-invasive monitoring tool for musculoskeletal adaptations relevant to spaceflight countermeasure development.

Acknowledgements This study was supported by the European Space Agency and the Slovene Research and Innovation Agency (ARIS, Programme grant no. P2-0076). Sara Podgornik and Spiros Zamantzas are recipients of an ARIS Young Research Grant.
Keywords: artificial gravity, bed rest, infrared thermography, space medicine

19th August 2026
Oral Session 12 (15:30 - 16:00)
Theme: Human Responses to Water Immersion and Submersion

No	Abstract ID	Presenter	Affiliation	Title Of Presentation
	AB104	Coen Bongers	Radboud University Medical Center	Non-Linear Rectal Temperature Response To Cold Water Immersion In Exertional Heatstroke Patients
	AB113	Georgia Philpot	University Of Birmingham	Cardiovascular Strain During Combined HighIntensity Interval Exercise And Hot Water Immersion: A Two-Part Comparative Study
	AB183	Anastasios Makris	School Of Physical Education And Sport Science, National And Kapodistrian University Of Athens, Athens, Greece	The Spleen At Work: Increase In Hemoglobin Concentration During Laboratory Static Apnea And Dynamic Pool Dives In Trained Freedivers

AB104

Non-linear rectal temperature response to cold water immersion in exertional heatstroke patients

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Introduction: Cold water immersion (CWI) is the gold standard treatment for EHS. Although a non-linear core temperature response during CWI has been suggested, high resolution rectal temperature (T_{rec}) data during treatment are limited.

Purpose: To examine the T_{rec} response during CWI treatment using continuous measurements, and to assess potential sex differences.

Method: We included n=31 recreational athletes (26% female) with EHS during Dutch running events treated with CWI. After admission to the medical facilities, clothing was removed and a T_{rec} probe was inserted before immersion in an ice bath (4.6±1.6°C). T_{rec} was continuously measured throughout treatment at 10-sec intervals, and treatment was continued until T_{rec}≤38.9°C.

Results: Initial T_{rec} and peak T_{rec} during treatment were 41.5±0.5°C and 41.7±0.6°C, with no sex differences(p=0.08 and p=0.22, respectively). Average cooling rate was 0.14±0.06°C/min and did not differ between sexes(p=0.31). A non-linear T_{rec} response was found during CWI treatment, with a lower cooling rate in the first five minutes (0.09±0.10°C/min) compared to the remainder of treatment (0.19±0.07°C/min, p<0.001). Average time till peak T_{rec} was 49±62 seconds and in n=4 participants T_{rec} was higher than initial T_{rec} after 5 min of CWI. Average time until T_{rec} dropped below initial T_{rec} was 153±126 seconds. No sex differences were observed in T_{rec} response characteristics(p>0.05).

Discussion: High-resolution T_{rec} data collected during CWI in EHS patients confirmed a non-linear response, with notably lower cooling rates in the first five minutes. This non-linear response might be explained by the excessive residual heat load in active muscles after cessation of exercise.

Keywords: Excessive hyperthermia, exercise, heat-illness, ice bath cooling, thermoregulation

AB113

Cardiovascular Strain During Combined High-Intensity Interval Exercise and Hot Water Immersion: A Two-Part Comparative Study

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Keywords: HIIE, Water Immersion, Cardiac Haemodynamics, Blood Pressure

Introduction

Combining high-intensity interval exercise (HIIE) with hot water immersion (HWI) may augment cardiovascular outcomes, as HIIE provides cardiovascular and metabolic stimuli, while HWI promotes blood pressure (BP) reductions [1].

Purpose

To compare thermal and cardiovascular responses to 30-min HIIE plus 30-min HWI (41˚C; ExHWI) with 30-min HIIE plus 30-min thermoneutral WI (35˚C; ExTWI), and 60-min time-matched HWI (HWI60).

Methods

Twelve healthy adults completed each comparison. HIIE involved 5x1-min intervals at 100% W_{max} (277±63W). WI was waist level during 30-60-min of HWI60 and measurements, and neck-level otherwise. Cardiac haemodynamics, rectal temperature (T_{re}), heart rate (HR) and BP were compared with linear mixed models. Area under the curve (AUC) was calculated to quantify total cumulative strain.

Results

ExHWI elicited a greater HR (15075±1278 beats) than ExTWI (13644±1132 beats; p<.001) and HWI60 (11921±1407 beats over 60 min; p<.001). T_{re} was similar across ExHWI (5655±25 ˚C·min) and HWI60 (5647±25 ˚C·min, p=.622), and lower in ExTWI (5602±32 ˚C·min; p<.001). Exercise drove similar cardiac output increases across ExHWI (27.2±7.3 L up to 40-min post) and ExTWI (25.4±5.4 L; p=.216), with less increase in HWI60 (21.7±4.8 L; p=.004) and minimal stroke volume differences (*condition:* p≥.473). ExHWI and HWI60 produced greater

diastolic BP reductions (∆25±9 and ∆23±7 mmHg) than ExTWI (∆18±8 mmHg; *p*=.003) at end-immersion. Systolic BP rose immediately-post ExTWI (∆15±8 mmHg; *p*=.017).

Discussion

ExHWI induced the highest integrated thermal-cardiovascular strain, while ExTWI elicited a weaker response. HWI60 provided a comparable thermal stimulus to ExHWI, with lower cardiac strain. Thus, HWI60 may provide an alternative thermal stimulus, albeit with lower metabolic stimuli.

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AB183

The spleen at work: Increase in hemoglobin concentration during laboratory static apnea and dynamic pool dives in trained freedivers

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Introduction
The human spleen acts as a dynamic reservoir of erythrocytes and may contribute to oxygen boosting during apnea through contraction-induced increases in circulating hemoglobin ([Hb]; [1]). Increased [Hb] has been demonstrated during static [1, 2] and dynamic apneas [3]; Exercise alone also induces spleen contraction and elevates circulating erythrocytes [4], so superimposing exercise on apnea may augment the spleen-mediated Hb response. Only one study has directly compared static and dynamic apneas within the same individuals to determine whether exercise enhances the apnea-induced spleen contraction.

Purpose
To reveal if the Hb-increase from spleen contraction is enhanced with exercise added to the apnea.

Method
Twenty-five trained freedivers, following a 10-min prone rest, underwent static apneas (1, 2 and 3 min) with facial immersion in cold water in a laboratory setting, with 2-min rest between apneas. On a separate day, after 10-min resting immersion, the same participants performed dynamic apneas in a pool (25m, 50m, 75m and 100m) using bifins, with 5-min rest between dives. Capillary [Hb] was measured in duplicate before and after apnea/dives.

Results
Baseline [Hb] did not differ between conditions. Across apneas, mean (SD) [Hb] increased by 3.1(5.7)g/L ($p<0.05$). Across dynamic apneas, [Hb] increased by 3.9(5.8) g/L after 75 m and by 4.7(7.5) g/L after 100 m (both $p<0.01$). Absolute post-apnea [Hb] was higher after dynamic apneas (142 (11.7)g/L), than after static apneas (138.8 (11.9)g/L; $p<0.05$).

Discussion.
Dynamic apneas resulted in higher post-apnea [Hb] compared to static apneas, suggesting that exercise may augment the spleen-mediated response.

Key words: spleen, hemoglobin, static apnea, dynamic apnea

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ORAL PRESENTATIONS
20th August 2026
Oral Session 13 (9:30 - 10:30)
Theme: Sex Specific Responses to Heat Stress

No	Abstract ID	Presenter	Email	Affiliation	Title Of Presentation
1.	AB8	Shoji Leach	shoji.leach@kcl.ac.uk	King's College London	Impact of sex and menstrual cycle hormones on gastrointestinal permeability during exertional hyperthermia
2.	AB89	Rekha Shanmugam	rekha@ehe.org.in	Sri Ramachandra Institute of Higher Education and Research	Occupational Heat Stress, Sleep Quality, and Adverse Pregnancy Outcomes: Evidence from Working Pregnant Women: A cohort study in Tamil Nadu, India
3.	AB93	Nikitha D	nikithad0511@gmail.com	Sri Ramachandra Institute of Higher Education and Research	Heat Stress, Muscle Injury, and Productivity loss: Examining Gender Differences among Outdoor Workers in Tamil Nadu, India
4.	AB122	Mariska Andrade	ma19ah@brocku.ca	Brock University	Determining the molecular difference between biological men and women following acute heat exposure
5.	AB199	Nadja Bastiaens	nadjabastiaens@yahoo.de	International Postgraduate School Jozef Stefan, Ljubljan, Slovenia	Vascular adaptations to simulated 3-d heatwave exposure in healthy female participants assessed by ultrasound: HELIA study
6.	AB206	Angela Heinrich	angela.mona.22@gmail.com	Jožef Stefan Institute, Jožef Stefan International Postgraduate School, Université de Caen Normandie, SpaceMed	Cognitive Performance During and Following Prolonged Heat Stress in Female Workers
7.	AB209	Sang-Hyun Roh	rohsh@snu.ac.kr	Research Institute for Human Ecology, Seoul National University, Seoul, Korea	Sex differences in onset time of cutaneous thermal sensations and heat flux: Impact of contact temperatures at 42, 46, and 50oC

Impact of sex and menstrual cycle hormones on gastrointestinal permeability during exertional hyperthermia

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Introduction: Hyperthermia can increase gastrointestinal permeability [1, 2], allowing microbes to leak from the intestinal lumen to the hepatic portal and potentially systemic circulation [2]. However, the extent to which sex and menstrual cycle hormones impact the risk of increased gastrointestinal permeability during heat stress is unclear.

Purpose: The primary aim was to investigate the effects of sex and menstrual cycle hormones on gastrointestinal permeability during exertional hyperthermia.

Method: Participants were 24 healthy young adults (12-male, 24±3 years; 12-female, 23±2 years). The hyperthermia trial involved a +1.5 °C increase in intestinal temperature, induced via water-perfused suit, combined with light cycling (40 W). In separated control (rest, no heat) and hyperthermia trials, regional gastrointestinal permeability was assessed by measuring the urinary excretion of orally ingested lactulose/rhamnose (L/R, 1g each) ratio and sucrose (10g) excretion. Data are presented as the change in excretion from control to hyperthermia.

Results: Pooled analysis of all participants identified that hyperthermia increased small intestinal permeability (Δ L/R = 0.012 ± 0.029 ug/ml, $p = 0.063$). There were no sex differences at this group level ($p = 0.93$). However, we identified a strong positive correlation between Δ L/R and baseline estradiol concentration within females ($r = 0.95$, $p < 0.001$). Stomach/duodenal permeability did not increase with hyperthermia, nor were there any differences between the sexes.

Discussion: Acute exertional hyperthermia caused a modest rise in small intestine permeability, where the extent of that rise was strongly correlated with plasma estrogen in female participants. Future studies should confirm if estrogen plays an independent role in modulating heat-induced gastrointestinal permeability.

Keywords: Gastrointestinal permeability, Estradiol, Hyperthermia

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Occupational Heat Stress, Sleep Quality, and Adverse Pregnancy Outcomes: Evidence from Working Pregnant Women: A cohort study in Tamil Nadu, India

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ABSTRACT

Introduction: Occupational heat stress is an increasing maternal health concern in tropical regions where pregnant women engage in moderate-to-heavy manual labor. Heat exposure during pregnancy may induce physiological heat strain(PHS) and disrupt sleep, potentially increasing the risk of adverse pregnancy outcomes(APOs). However, prospective evidence linking occupational heat exposure, sleep quality disturbances(SQDs), and APOs remains limited.

Purpose: To examine the association between occupational heat exposures, SQD, and APOs among working pregnant women.

Method: A prospective cohort study was conducted among 800 working pregnant women in Tamil Nadu, India (2017–2019; 2021–2022). Participants were recruited at 8–14 weeks' gestation and followed through delivery. Occupational heat exposure was assessed each trimester using Wet Bulb Globe Temperature. PHS indicators included core body temperature(CBT) and urine specific gravity(USG), measured pre- and post-shift. SQDs were assessed using a structured questionnaire. Primary outcomes included miscarriage and a composite APO endpoint.

Results: Overall, 47.3% of women experienced high occupational heat exposure, and 15.5% reported SQDs. Among heat-exposed women, 17.4% demonstrated elevated CBT and 29.6% had moderate dehydration. Heat exposure was associated with increased risk of miscarriage(AOR:2.4; 95%CI:1.0–5.7) and any APO(AOR:2.3; 95% CI:1.4–3.8). Among heat-exposed women, 38% reported concurrent SQDs, and the risk of APO was 2.9 times higher among those with both heat exposure and sleep disturbance(COR:2.9; 95%CI:1.5–5.6).

Discussion: Occupational heat stress is associated with PHS and APOs, and SQDs may amplify this risk. Workplace heat mitigation strategies and maternal sleep health interventions, including prenatal yoga, may help reduce these risks in hot-climate settings.

Keywords: Occupational heat stress, sleep quality, adverse pregnancy outcomes, maternal health, prospective cohort

Heat Stress, Muscle Injury, and Productivity loss: Examining Gender Differences among Outdoor Workers in Tamil Nadu, India

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ABSTRACT

Introduction: Rising temperatures pose significant health risks to manual outdoor workers, such as those in agriculture and brick kilns. Occupational heat stress can cause muscle damage, indicated by elevated Creatine phosphokinase (CPK) levels, potentially reducing productivity.

Purpose: To examine gender differences in the effects of occupational heat stress on muscle damage, grip strength, and productivity among outdoor workers.

Methods: A cross-sectional study was conducted among 266 outdoor workers in Tamil Nadu, India (2025). Heat stress was assessed using the QuestTemp 3M Wet Bulb Globe Temperature monitor, core body temperature (CBT), and urine specific gravity (USG) in accordance with standard protocols. Pre and post-shift serum Creatine phosphokinase (CPK) levels were measured in a subset (n=74) as a marker of muscle damage. Handgrip strength was assessed using a Jamar handheld dynamometer, and heat-related productivity loss was evaluated using the modified & validated HOTHAPS questionnaire.

Results: WBGT exceeded safe limits (AVG±SD:30.8±3.1°C), with higher exposure among women than men (56% vs 44%). Women exhibited greater physiological strain (CBT, USG), with 76% compared to 51% of men among heat-exposed workers. Post-shift CPK was elevated in women (49% vs 24%) and was significantly associated with reduced left (OR:3.0; 95%CI: 1.0–9.8) and right handgrip strength (OR:4.1; 95%CI: 1.0–16.7). Overall productivity declined by (78% vs 54%), particularly among women.

Discussion: Occupational heat stress impairs muscle function and productivity, with women disproportionately affected, potentially due to limited access to welfare facilities. Gender-specific heat mitigation strategies and further research are needed to protect outdoor workers in hot-climate settings.

Keywords: Occupational heat stress, physiological heat strain, productivity loss, Muscle grip strength.

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AB122

Title:

Determining the molecular difference between biological men and women following acute heat exposure

Introduction:

While acute heat stress induces genomic changes in immune cells of young adults [1], the influence of ovarian hormones on the molecular response remains unclear, despite their documented role in thermoregulation [2,3,4,5].

Purpose:

Examine the molecular response to acute heat stress in low (A), high endogenous (B), and high exogenous (C) levels of ovarian hormones.

Methods:

Males (A; n=11), mid-luteal females (B; n=10), and monophasic oral contraceptive users (C; n=9) underwent a 20-min far-infrared sauna session (60ºC, 20% RH). Core/skin temperature, heart rate, and thermal perception were recorded every 5 minutes. Plasma extracellular heat shock protein 70 (HSP70) and peripheral blood mononuclear cell RNA were analyzed from blood collected at baseline, 1-hr, 4-hrs, and 24-hrs post-sauna using ELISA and RNA sequencing, respectively.

Results:

Timepoint effects were observed in all physiological measures (Δ0.4±0.2 ºC; Δ34±23 beats·min^{-1}). Group A (37.1±0.2 ºC) had a lower core temperature than groups B (37.5±0.2ºC) and C (37.4±0.2 °C). Skin temperature (39.6±0.5 °C) and heart rate (121±11 beats·min^{-1}) were not different between groups. Group C perceived greater thermal discomfort at the 20-min timepoint compared to groups A and B. Group C perceived hotter thermal sensation than group A. Extracellular HSP70 results were not different between timepoints and groups (0.8±0.8 ng·ml^{-1}). RNA sequencing results will be presented at the conference.

Discussion:

While males had a lower core temperature throughout the sauna than both female groups, ovarian hormones did not influence extracellular HSP70 levels. Forthcoming results will determine whether ovarian hormones modulate genetic changes to acute heat exposure.

Keywords:

Ovarian hormones, Far-infrared sauna, Extracellular HSP70, Core temperature, RNA sequencing

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AB199

Vascular adaptations to simulated 3-d heatwave exposure in healthy female participants assessed by ultrasound: HELIA study

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INTRODUCTION

Heatwaves pose an increasing risk to human health and occupational performance, particularly among female workers, who remain underrepresented in environmental physiology research. Heat exposure elevates body temperature, drives vasodilation, and increases demands on baroreflex blood pressure control, which can potentially impair orthostatic tolerance. However, the vascular mechanisms supporting cardiovascular adaptation and recovery during and after heatwave exposure remain incompletely understood.

PURPOSE

We examined central and peripheral vascular function during a controlled laboratory heatwave and recovery in healthy women and assessed cardiovascular regulation during orthostatic stress.

METHOD

Eight healthy women (20-35 years) completed a 9-day campaign in Planica: 3-day baseline (neutral), 3-day heatwave (work: 35.5 ± 0.3 °C; rest: 26.3 ± 0.8 °C), and 3-day recovery (neutral). On selected days, ultrasound (Vivid IQ, GE) measured diameter and pulsed-wave Doppler velocity in the right common carotid, brachial, and femoral arteries (with an angle ≤ 60°). Measures were obtained non-invasively during 10 min supine rest and 10 min 60° head-up tilt, including heart rate, stroke volume, and cardiac output (Finapres).

RESULTS

Preliminary analyses reveal heatwave-induced brachial hyperaemia, with elevated TAMV and volumetric flow returning fully to baseline during recovery. A significant Phase × Posture interaction indicates amplified orthostatic reduction in brachial perfusion during heatwave. Femoral responses were dominated by posture, and carotid parameters were unaffected. Integration of Finapres haemodynamic data and sensitivity analyses are ongoing.

DISCUSSION

These findings advance understanding of vascular and haemodynamic adaptation to heat stress in women and may inform occupational guidance for extreme heat exposure.

KEYWORDS

heatwave, vascular function, ultrasound, orthostatic stress, women

AB206

Cognitive Performance During and Following Prolonged Heat Stress in Female Workers

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Introduction: Climate change is projected to increase the frequency, intensity, and duration of heat waves, progressively shifting occupational environments toward conditions currently considered extreme. Previous controlled confinement studies examining simulated heat-wave exposure were conducted exclusively in male participants [1], and sex-specific effects on cognitive performance remain insufficiently understood.

Purpose: This study investigated changes in cognitive performance during prolonged simulated heat stress and examined whether potential impairments persist or recover in the post-heat phase in healthy female participants.

Method: Nine females were confined for ten consecutive days under controlled ambient conditions. Following a familiarisation day, participants completed three 3-day phases (pre-, during-, and post-heat stress), each including standardized sleep periods. During each day, participants performed a simulated work shift comprising two physical activity sessions and a cognitive test battery administered at fixed time points across the day. The battery included the line-bisection task, finger tapping test, continuous attention test, Corsi block tapping test, task-switching test, and a saccade test with eye tracking. Ambient conditions were hot during heat exposure (work: 35.4 °C; rest: 26.3 °C) and temperate during the pre- and post-heat phases (work: 25.4 °C; rest: 22.3 °C).

Results: Data collection has been completed. Statistical analyses are currently underway to quantify changes in attention, executive function, working memory, and oculomotor performance across experimental phases.

Discussion: This study will provide novel sex-specific evidence on cognitive responses during and

following prolonged heat stress. The findings are expected to contribute to a better understanding of cognitive resilience and recovery under climate-related thermal stress.
Word count: 250

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Keywords: heat stress, cognitive performance, climate change, female adaptation, extreme environments

AB209

Sex differences in onset time of cutaneous thermal sensations and heat flux: Impact of contact temperatures at 42, 46, and 50°C

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Introduction: Comprehensive investigations into sex differences in cutaneous thermal sensations spanning from non-noxious to noxious levels and across different contact intensities still remain limited.

Purpose: This study investigated sex-related differences in the onset times for perceiving warmth, hot, and heat pain sensations evoked by contact heat temperature at 42, 46, and 50°C.

Method: Eight healthy males and eight females participated. Peltier stimulator (6.25 cm^2) was applied to the bare skin of left anterior thigh to maintain surface temperature at 42, 46, and 50°C.Onset times to perceive warmth, hot, and heat pain sensations and heat flux at the stimulator surface were recorded during trials.

Results: At the lower contact temperature of 42°C, females perceived heat pain significantly earlier than males and onset times for warmth, hot and heat pain were clearly distinguished. However, as contact temperature increased to 46 and 50°C, sex differences in onset time for heat pain decreased with onset times for hot and heat pain overlapping. While no sex differences in heat flux were observed during initial heat exposure, females showed significantly lower heat flux than males during prolonged heat exposure.

Discussion: These results suggest that a contact temperature of around 42°C serves as an effective boundary for sex differences in heat pain perception and classification of hot versus heat pain sensations. The lower heat flux in females implies that skin temperature of females would be closer to the contact temperatures and it induced shorter onset time to heat pain in females.

Keywords: Sex differences, Cutaneous thermal sensations, Conductive heat, Contact temperature, Heat flux

20th August 2026
Oral Session 14 (11:30 - 12:00)
Theme: Aging Population in Extreme Environment

No	Abstract ID	Presenter	Email	Affiliation	Title Of Presentation
	AB6	Jericho Wee	jericho_wee@u.nus.edu	Heat Resilience and Performance Centre, Yong Loo Lin School of Medicine, National University of Singapore, Singapore	Heat Tips The Balance: Exertional Heat Stress Impairs Postural Stability In Older Adults
	AB76	Jesse Schwartz	jessecooper.schwartz@hdr.qut.edu.au	Queensland University Of Technology	Representation Of Middle-Age And Older Adults In Exercise Thermoregulation Research: A Systematic Review
	AB222	Antony Stadnyk	antony.stadnyk@uts.edu.au	School Of Sport, Exercise & Rehabilitation, Faculty Of Health, University Of Technology Sydney, Australia	Effects Of Extreme Heat Events In Older Australians: A Scoping Review

AB6

Heat Tips the Balance: Exertional heat stress impairs postural stability in older adults

Jericho WEE1,9, Shawnda A MORRISON1,2, Michèle Renard1,9, Pearl MS TAN1, Clarence HW LEOW1, Melvin KS LEOW1,3,4,5,6, Johan G ERIKSSON1,3,7, Jason KW LEE1,8,9
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9 Heat Resilience & Performance Centre, Yong Loo Lin School of Medicine, National University of Singapore, Singapore

Introduction: Older adults are predisposed to greater heat-related health risks than younger adults [1]. Research on heat-related impairments in physical function and road safety behaviours in this age group is limited.

Purpose: To evaluate the functional capacity of older adults from exertional heat stress. Findings in this study may augment heat-health advisories and strategies.

Methods: Twenty-three older men and women (age:67±4 years; VO2peak:29±6 $mL \cdot kg^{-1} \cdot min^{-1}$) completed six treadmill trials (random order) at Low- (34±4% VO_2reserve, VO_2R) or Moderate-intensity (64±5%VO_2R), up to 60 minutes across three wet-bulb globe temperatures (WBGT) (Mild: 26.3±0.4°C; Elevated: 32.0±0.6°C; Severe: 34.1±0.5°C). Physiological parameters, including rectal temperature (Tre) and heart rate (HR) were monitored continuously. Pre- and post-exercise functional tests included postural balance and a virtual-reality road crossing task (VR).

Results: End Tre and HR increased progressively with exercise intensity and heat stress, such that the highest physiological strain was observed in moderate-intensity exercise in Elevated (Tre:38.5±0.4°C; HR:144±8bpm) and Severe (Tre:38.6±0.4°C; HR:153±10bpm) conditions. Postural instability was greater following moderate-intensity exercise in Severe WBGT only (pre-postΔ:+511mm[95%CI:236–787mm]; $p<0.001$;~22% higher). Delta Tre was positively associated with postural instability ($r=0.478$,$p<0.001$). Near misses ($p=0.002$) and attention to traffic ($p<0.001$) in VR decreased after exercise, independent of heat stress.

Discussion: Moderate-intensity exercise in extreme heat (WBGT>34.0°C) compromises postural balance in older adults, with greater thermal strain associated with poorer balance. Fewer near misses despite reduced attention to traffic suggest preserved pedestrian behaviour after exercise, independent of environmental heat stress. This study underscores the need to integrate fall risk messaging into heat-health guidelines for outdoor exercise for older adults.
[250 words]
Keywords: ageing, elderly, fall risk, hyperthermia, postural balance

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Representation of Middle-Age and Older Adults in Exercise Thermoregulation Research: A Systematic Review

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Introduction: Understanding how age influences human exercise thermoregulation during exertion is increasingly important as middle-aged and older adults participate widely in sports and physical activities. Although these age groups exist in thermoregulation studies, their representation in literature appears limited, creating critical knowledge gaps for health and performance
Purpose: This systematic review aims to quantify the representation of age within exercise thermoregulatory research published between 2015-2025.
Method: A systematic search of PubMed, Medline, and SportDiscus was commenced in February 2026 using relevant MeSH terminology and Boolean operators. Eligible studies included interventional or observational studies involving exercise or vigorous occupational work that reported thermoregulatory measures (i.e. rectal or skin temperature). Exclusion criteria included: epidemiological, retrospective, and meta-analysis/review studies, protocols involving only passive heating/cooling with no exercise component, and any animal studies. Screening procedures were conducted independently by two reviewers.
Results: The search identified 5994 articles in Covidence. Duplicates were removed and initial screening excluded 3341 irrelevant articles, leaving 1483 studies requiring further assessment, and 419 conflicts pending resolution. Participant count and age characteristics (mean, standard deviation, and ranges) will be extracted from all relevant articles. Age distribution will be assumed to be normal and proportion of participants across age brackets will be calculated.
Discussion: Preliminary screening suggests a large body of thermoregulatory research but potentially limited inclusion of middle-aged and older adults. Quantifying these patterns will help identify demographic gaps, inform future study design, and support improved age-relevant guidance for health and performance.

Keywords: Thermal strain, age demographics, environmental physiology, human performance

AB222

Effects of extreme heat events in older Australians: a scoping review

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Introduction: In Australia, climate change is driving more frequent and extreme heat events (EHE), with days above 35°C projected to double by mid-century.[1] Concurrently, an ageing population will see the population aged 65+ doubling, and those 85+ tripling.[2] Older people are vulnerable to heat stress due to impaired thermoregulation compounded by chronic diseases and polypharmacy. The current impacts of EHE in older Australians is not known, but may help identify opportunities for heat-health risk prevention, adaptation, and mitigation.

Purpose: We conducted a scoping review examining physical, psychosocial, and socioeconomic impacts of EHE on older Australians and their effects on morbidity and mortality.

Method: A comprehensive search of 10 databases, including MEDLINE, Scopus, and Web of Science identified original peer-reviewed research involving Australians aged 65+.

Results: Analysis included 91 studies. EHE were related to increased all-cause mortality across Australia on extreme temperature (and subsequent) days, with clear associations between heat stress and cardiovascular, respiratory, and renal morbidity. In people aged 75+, longer-duration EHE contributed to ≤14-fold increases in ambulance callouts and 19-fold increases in heat-related hospital admissions compared to shorter EHE.[3] Multi-morbidity had multiplying effects on heat vulnerability, with ≤35-fold increases in ED presentations/admissions in those aged 65+.[4]

Discussion: This review highlights the critical challenge these converging issues pose. EHE effects on older Australians in the current climate demonstrate the impending risks of the doubling of heatwave days and aged population, with surge demand for urgent care likely to exceed capacity. Collaborative interdisciplinary approaches are needed to prevent, adapt to, and mitigate heat-health risks.

Keywords: heat-related illness, heat strain, elderly, public health, aged care

Word count: 248

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20th August 2026
Oral Session 15 (15:15 – 16:15)
Theme: Thermal Comfort and Perception

No	Abstract ID	Presenter	email	Affiliation	Title Of Presentation
	AB47	Mohammad Fakhrulreza Bin Suhaimi	mfrezza93@gmail.com	Kookmin University	Perceptual Quantification for Comfort-Based Radiant Heating Management in Vehicles
	AB69	Mandy Peggen	mandy.peggen@radboudumc.nl	Radboudumc	Impact Of Neighborhood Greenness On Thermal Perception And Behavior During A Dutch Heatwave
	AB166	Gineesh Gopi	tggineesh@kookmin.ac.kr	Kookmin University	Towards Near-Infrared ImageBased Thermal Comfort Discrimination For OccupantCentric Climate Control In Electric Vehicles
	AB187	Alexander Patrician	amdpatrician@gmail.com	University Of British Columbia	Harnessing Continuous Thermal Perception To Investigate Thermal Overshoot
	AB214	Ni Sun, Xinyan Zheng	zhengxinyan0513@163.com	Shanghai University Of Sport	Effects Of Mild Thermal Deviations On Cognitive Performance In Indoor Environments: The Role Of Thermal Comfort Physical Activity Level
	Theme: Skin Wettedness and Thermal Behaviour				
	AB115	Ralph Gordon	R.J.F.H.Gordon@soton.ac.uk	University Of Southampton	Skin Tolerance To Mechanical Shearing At The Heel: The Role Of Temperature, Moisture, And Interface Material Properties

AB47

Perceptual Quantification for Comfort-Based Radiant Heating Management in Vehicles

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Introduction: Localized radiant heating is used in cold vehicle cabins to improve occupant comfort while reducing reliance on air-based heating. While its effect on skin temperature has been established [1], the perceptual response in terms of thermal sensation and comfort remains insufficiently defined under transient cold exposure.

Purpose: This study aims to quantify how localized physiological warming contributes to local thermal sensation and supports perceptual evaluation for comfort-based radiant heating management.

Method: Human subject experiments were conducted in a vehicle cabin under cold conditions with localized radiant heating. Local and overall thermal sensation and comfort votes were collected. A validated Tanabe multi-segment thermophysiological model was used to simulate skin temperature responses and was validated against measured data (RMSE < 1 °C). A counterfactual scenario without radiant heating was generated under identical conditions to isolate the physiological effect. The resulting differences were evaluated using established local and overall thermal sensation and comfort models [2–4].

Results: Localized radiant heating increased local skin temperatures in exposed regions (ΔT_{skin} ≈ 2–5 °C) and produced corresponding changes in predicted local thermal sensation (ΔLS ≈ 1–3 scale units). This corresponds to an approximate sensitivity of 0.3–1.0 sensation units per °C. Responses varied across segments due to non-uniform radiant exposure.

Discussion: Localized increases in skin temperature can produce meaningful perceptual shifts without requiring uniform warming of the cabin. The quantified relationship between temperature and sensation provides a basis for evaluating the perceptual effectiveness of localized heating and supports comfort-based thermal management strategies.

Keywords: localized radiant heating, thermal sensation, thermal comfort, comfort-based thermal management, transient cold exposure

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AB69

Impact of neighborhood greenness on thermal perception and behavior during a Dutch heatwave

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Introduction: Heatwaves pose significant health risks. While green spaces may mitigate heat effects through cooling, the impact of neighborhood greenness on thermal perception and behavior of citizens during a heatwave remains largely unknown.

Purpose: To explore the impact of neighborhood greenness on thermal perception and behavior of Dutch adults during a heatwave.

Methods: For this observational study, Dutch citizens completed online questionnaires before, during, and after a five-day national heatwave. Questions included individual characteristics, thermal perception (i.e., thermal comfort, thermal sensation, perceived heat-related burden), and heat-mitigation measures during the heatwave. Normalized Difference Vegetation Index was calculated based on participants' postal code and used to classify participants in low-, medium-, or high-greenness groups based on tertiles.

Results: N=1656 participants (66 years [IQR=56-73], 43% male) were included. Participants in the high-greenness group had lower odds of thermal discomfort (adj. OR=0.77, 95%CI: 0.61-0.97), perceived heat-related burden (adj. OR=0.76, 95%CI: 0.61-0.94), and warmer thermal sensation in the indoor (adj. OR=0.60, 95%CI: 0.48-0.75) and outdoor environment (adj. OR=0.71, 95%CI: 0.56-0.90) compared to the low-greenness group. Adjusting clothing (79%), increasing fluid intake (72%), and reducing physical activity (70%) were the most frequently indicated personal heat-mitigation measures, while keeping windows/doors or curtains/shutters/blinds closed (96%) and ventilate through opening windows/doors (95%) were the most frequently reported in-house heat-mitigation measures, with no differences in frequency of measures between greenness groups (all p>0.05).

Discussion: Neighborhood greenness improved thermal perception but did not affect heat-adaptive behavior, indicating that urban greening can enhance comfort and resilience to heat without reducing protective behavior.

Keywords: Heat stress, thermal comfort, thermal sensation, heat-mitigation measures, living environment

AB166

Towards Near-Infrared Image-Based Thermal Comfort Discrimination for Occupant-Centric Climate Control in Electric Vehicles

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Introduction: Thermal comfort management strategies that lower ambient setpoints while using personal heating devices (PHDs) are effective for energy savings in cold environments [1], especially during the winter operation of electric vehicles [2]. However, practical implementation requires reliable regulation of PHDs based on occupant preferences, which are closely related to transitions between comfort and discomfort [3]. Simultaneously, physiological indicators have gained interest as markers of thermoregulatory burden and discomfort [4]. Near-infrared (NIR) facial imaging presents a spatially-structured, illumination-invariant, and non-contact approach to capturing underlying thermophysiological changes manifested on the face.

Purpose: Nevertheless, it remains uncertain whether control-relevant information for PHD regulation can be reliably extracted from NIR facial images within cold cabin environments.

Method: We investigate the viability of using NIR facial imaging to classify cold discomfort, comfort, and warm discomfort states induced by seat heater operation in a 16 °C cabin. One participant underwent multiple sessions transitioning from cold discomfort to seat heater-induced comfort and warm discomfort. Deep learning and explainable AI techniques were employed to assess image-based discrimination and facial cue relevance.

Results: Although the comfort states were temporally aligned with the experimental protocol, perturbation analyses confirmed that discrimination depended on structured facial features (F1 score of 0.82). Furthermore, class activation mapping revealed an increasing focus on the nose–cheek region corresponding to transitions from cold discomfort to comfort and then to warm discomfort, with attention percentages of 62%, 69%, and 80%, respectively.

Discussion: These results demonstrate the feasibility of within-subject discrimination of comfort states for occupant-centric PHD control using NIR facial imaging.

Keywords: Electric vehicles, Personal heating devices, Thermal comfort, Near-infrared imaging, Deep learning.

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AB187

Harnessing continuous thermal perception to investigate thermal overshoot

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Keywords: Thermal sensation, thermal comfort, thermal overshoot

250/250 word limit

Introduction: Thermal sensation and comfort are commonly assessed to quantify an individual's satisfaction with their thermal environment. Currently, Likert and visual analogue scales require perceptual data to be collected at discrete timepoints. Yet, discrete timepoints limit our resolution, particularly when perceptual shifts in sensation and comfort are transient and unpredictable. **Purpose:** Our objectives were to 1) develop a tool that enables continuous perceptual measurement with high efficacy during human testing, and 2) utilize continuous thermal perceptual tracking to explore the phenomenon of thermal overshoot. **Methods:** Fourteen healthy young participants (30±4 years, 1.9±0.2 kg/m^2; matched for sex, age, body mass index, and physical activity status) visited the laboratory on two separate days within the same week, and underwent blinded fluctuations in ambient temperature (min 15°C, max 35°C) in a repeated measures design. Participants utilized a novel perceptual slider tool, to continuously reflect (and thus record) their sensation and comfort. Thermal overshoot was derived during the cooling portion of the protocol (from 35-15°C over 9 minutes), and quantified as the difference in observed thermal sensation and a linear response in thermal sensation (as per mean skin temperature). **Results:** The perceptual slider tool demonstrated high between-day repeatability of thermal sensation (R^2=0.85, P<0.001) and thermal comfort (R^2=0.70, P<0.001). Thermal overshoot was evident in all participants, which was equivalent in-magnitude to an overshoot of ~2.5 thermal sensation categories, within 2.1±1.1 min. **Discussion:** By continuously measuring perceptual metrics, we will be able to better understand the interplay between psychophysical and physiological relationships of sensation and comfort.

AB214

Effects of mild thermal deviations on cognitive performance in indoor environments: the role of thermal comfort physical activity level

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Introduction: Ambient temperature is a critical component of indoor environmental quality that influences cognitive performance[1]. While research often focuses on extreme thermal exposure, less attention is given to the mild thermal deviations common in indoor settings[2].

Purpose: This study investigated the associations of specific mild thermal deviations (10°C and 32°C) and moderate physical activity with cognitive performance, thermophysiological responses, and subjective perception[2].

Method: In a structured experimental design, 48 participants were randomly assigned to cold (10°C), thermoneutral (22°C), or warm (32°C) conditions. Each participant completed two sessions—passive rest and moderate-intensity cycling—to compare activity levels under fixed temperatures. Cognitive performance was assessed using the Attention Network Test (ANT) and Stop-Signal Task (SST).

Results: Exposure to 10°C decreased mean skin temperature, while 32°C increased both core and skin temperatures. Both cold and warm conditions reduced thermal comfort and impaired performance in attentional and inhibitory tasks. Thermal comfort was positively correlated with cognitive accuracy across all conditions. During active exposure, reaction time patterns differed from passive sessions, suggesting activity level modifies cognitive responses to thermal deviations.

Discussion: These findings demonstrate that even mild departures from thermoneutrality trigger measurable physiological changes and cognitive impairments. Accounting for occupant activity patterns is essential for a comprehensive understanding of cognitive functioning. These results provide evidence-based guidance for climate control in environments where executive function is critical.

Keywords: Ambient temperature, Thermal comfort, Cognition, Thermoregulation, Physical activity

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AB115

Skin tolerance to mechanical shearing at the heel: the role of temperature, moisture, and interface material properties

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Introduction: Pressure ulcers can develop from prolonged mechanical loading combined with shear forces at the skin [1]. Our laboratory has shown that cooling can reduce the coefficient of friction (CoF) at representative skin sites [2]. However, how cooling interacts with different textiles, at varying saturation levels, at the heel remains unclear.

Purpose: To examine how temperature, interface material properties, and moisture saturation influence the physiological tolerance of human skin to mechanical shear stress.

Method: Twelve healthy adults (6M:6F; 25±4yr; 171±11cm; 72±10kg) completed eight sessions across two laboratory visits. Visits differed by the temperature condition of a thermo-mechanical device delivering repeated shearing to the posterior heel: 16°C (cooling) or 36°C (control). Each session assessed textile type (cotton vs. polyester) and saturation (dry vs. wet). CoF was derived from normal and tangential forces recorded at the device and presented as area under the curve (s). Skin hydration was estimated from heel skin conductance (μS).

Results: CoF was higher when textiles were saturated (38.8s, 95% CI [30.5s, 47.2s]; $p<0.001$) and when cooled (11.3s, 95% CI [2.0s, 20.6s]; $p=0.024$), compared with dry and control conditions. Textile type showed no effect (5.3s, 95% CI [-3.1s, 13.8s]; $p=0.181$), nor did interactions between variables ($p>0.05$). Conductance revealed greater post-shearing skin saturation with wet textiles (-0.30μS, 95% CI [-0.45μS, -0.15μS]; $p<0.001$) compared with dry (-0.14μS, 95% CI [-0.31μS, 0.39μS]; $p=0.119$).

Discussion: These findings suggest textile choice is less critical than maintaining dry materials at the heel, such as for immobile patients, to minimise shear-related tissue damage.

Keywords: Cooling, pressure ulcer, tissue viability.

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20th August 2026
Oral Session 16 (16:15 – 17:00)
Theme: Humidity and Its Impact on Thermoregulation

No	Abstract ID	Presenter	email	Affiliation	Title Of Presentation
	AB25	Raagavi Mani	raagavimani@u.nus.edu	National University of Singapore	Affordable And Sustainable Solutions To Improve Sleep Among Outdoor Workers In Non-Air-Conditioned, Multi-Occupancy Dormitory In The Tropics
	AB80	Hui Cheng Choo	huichengchoo@gmail.com	High Performance Sport Institute	Thermoregulatory Responses To Exercise In Dry And Humid Heat In Tropically Habituated Males
	AB189	Cynthia Ly	c.ly@maastrichtuniversity.nl	Maastricht University	Energy & Substrate Metabolism During 8-Hour Continuous Exposure To Varying Combinations Of Humidity, Air Quality And Indoor Temperature (Combined Results Of Two Studies)

AB25

Affordable and Sustainable Solutions to Improve Sleep among Outdoor Workers in Non-Air-Conditioned, Multi-Occupancy Dormitory in the Tropics

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Introduction Outdoor workers residing in non-air-conditioned dormitories are routinely exposed to high heat day and night, which can compromise sleep and therefore recovery, health and safety [1, 2]. Affordable, practical solutions are therefore needed to ensure workers' recovery and performance.

Purpose
Evaluate the effectiveness of smart-controlled fan ventilation to reduce nighttime room temperatures and improve sleep, alongside complementary interventions such as warm-colour lighting and personal sleep aids.

Methods Twenty-nine male outdoor workers (age:32±6y; BMI:23.1±6.4kg/m2) across five non-air-conditioned, multi-occupant dormitory rooms underwent a crossover study (two 3-week periods) comparing control (CON) and intervention (INT) conditions. Interventions included smart-controlled ventilator fans (~67L/s flow rate), installation of warm-colour lighting (3000K), and personal sleep aids (personal fan, light control, eye mask and earplugs). Air temperature, relative humidity (RH), and carbon dioxide (CO2) were continuously measured. Sleep outcomes including time in bed (TIB), total sleep time (TST), sleep efficiency (SE), sleep onset latency (SOL), and wake after sleep onset (WASO) were assessed using actigraphy.

Results
Across 999 night-time sleep periods, INT was associated with cooler room temperatures (-0.7°C; CON:30.3°C, INT:29.6°C), higher RH (1%; both:78%) and improved ventilation (-121ppm CO2; CON:613ppm, INT:496ppm) (all $p<0.05$). Sleep improved in INT, with a 12.3-minute increase in TST, 2.4% improvement in SE, 2.2-minute reduction in SOL, and an 8.4-minute decrease in WASO (all $p<0.05$), while TIB was similar ($p=0.602$).

Discussion Affordable, low-energy ventilation cooling**,** thermal comfort and lighting interventions can create a more sleep-conducive environment in warm, multi-occupancy dormitories, supporting recovery and well-being in outdoor workers in tropical climates.

Keywords: Temperature, Indoor, Recovery, Ventilation, Field-based

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Thermoregulatory Responses to Exercise in Dry and Humid Heat in Tropically Habituated Males

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Keywords: Endurance, Cardiovascular strain, Hyperthermia, Core body temperature, Heat acclimatisation

Introduction

Athletes chronically exposed to hot-humid (HH) climates may develop lower sweat rate and greater core-to-skin temperature gradient [1]. It is unclear whether they experience greater thermal strain when exercising in hot-dry (HD) conditions with higher ambient temperature and greater evaporative potential compared with HH.

Purpose

To investigate whether HD exercise elicits greater thermal strain than HH in tropically habituated males.

Methods

Twelve recreationally trained men completed 60 min of cycling at 60%$\dot{V}O_{2peak}$ in HD (41.4 ± 0.2°C, 31.6 ± 2.0% relative humidity [RH], 31.8 ± 0.4°C wet-bulb globe temperature [WBGT]) and HH (32.6 ± 0.3°C, 87.3 ± 2.9%RH, 31.3 ± 0.2°C WBGT) in a counterbalanced order. Gastrointestinal temperature (T_{gi}), heart rate (HR), skin temperature (T_{sk}), blood lactate (BLa), perceptual and sweat responses were assessed.

Results

T_{gi} and HR increases were comparable between conditions ($P > 0.05$), while T_{sk} and thermal sensation increased more in HD ($P < 0.05$), with greater thermal discomfort at 60 min ($P = 0.037$). Whole-body sweat loss was ~0.27 L greater in HD ($P = 0.078$), with earlier local sweating onset ($P = 0.001$). Local sweat rate and perceived exertion increases were similar between conditions at any 15-min epoch ($P > 0.05$). No differences were observed for BLa or sweat sodium concentration ($P > 0.05$).

Discussion

Elevated T_{sk} and thermal sensation in HD reflect higher ambient temperature rather than impaired thermoregulation, while the earlier sweating onset likely results from the higher T_{sk}. Collectively, tropical habituation did not impair thermoregulation during submaximal exercise in dry heat.

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AB189

Energy & substrate metabolism during 8-hour continuous exposure to varying combinations of humidity, air quality and indoor temperature (combined results of two studies)

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Extreme heat can impair heat dissipation, leading to physiological changes, including decreased metabolic rates to cope with the additional heat load. Moreover, less is known about prolonged exposures of 8 hours during daily activities.

The main research objective was to examine how high relative humidity (30% vs 70%) or reduced ventilation (100L/min vs 500L/min) in combination with heat affects physiological parameters at neutral room temperatures (23 or 25°C) or high temperatures (32 or 35°C) during prolonged, acute exposure (>8h).

Participants participated in 4 conditions across 2 separate studies. The samples consisted of 18 and 22 healthy adults of both sexes between 18-39 years. Each test day consisted of 8 hours in a climate-controlled metabolic chamber (Omnical, Maastricht Instruments). The main physiological measures were core temperature (CT), skin temperature (ST), and energy expenditure (EE). As well as a tablet-based cognitive test (Creyos, Canada).

EE did not differ significantly across sessions with varying combinations of temperature, humidity, and ventilation levels. ST increased by 1.8˚C and 3.2˚C at 32˚C and 35˚C, respectively. CT increased by 0.25˚C in all high-temperature conditions compared to low-temperature conditions. No cognitive test score changes observed.

Mild heat strain is noticed in all high-temperature conditions. However, no noticeable differences are observed within the same temperature conditions between high and low humidity or ventilation. With increased and prolonged heatwaves, the heat gain observed will persist under sustained high-temperature exposure without effective mitigation strategies. Future directions could include 24-hour exposures to assess the impact of exposure on sleep and whole-body metabolism.

Keywords: Heat, Humidity, Air Quality, Thermophysiology, Metabolism

20th August 2026
Oral Session 17 (17:15 - 18:15)
Theme: Clothing and Human-Environment Interaction

No	Abstract ID	Presenter	Affiliation	Title Of Presentation
	AB16	Grant Simmons	Nike Sport Research Lab	3D Printed TPU Sports Bra Eliminates The Thermal 'Bra Tax' For Female Athletes Exercising
	AB53	Aislin Fields	University of Southampton, UK	In The Heat age and long-term medical conditions on clothing choices for exercise in summer and winter – a mixed-methods investigation
	AB188	Nicola Gerrett	Gentherm Inc.	The Impact Of A Heated Effleurage Or Heated Tapotement Massage On Low Back Discomfort From A Seat
	AB210	Kalev Kuklane	Netherlands Institute For Public Safety	Heat Stress Development In Structural Firefighting Scenario And Predicted Heat Strain
	AB223	Chuansi Gao	Lund University	Heat And Maternal Health: An Early Warning System App Motherheat Alert

3D Printed TPU Sports Bra Eliminates the Thermal 'Bra Tax' for Female Athletes Exercising in the Heat.

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Introduction: Wearing a sports bra reduces sweating efficiency (SE) because of fabric sweat retention that increases the sweat loss requirement. Bra designs that reduce sweat absorption may improve this thermal burden for female athletes.

Purpose: Determine whether a 3D Printed TPU Sports Bra eliminates the negative impact of bras on SE during exercise in the heat.

Methods: Twelve females exercised in 40C / 20%RH on three separate days wearing no sports bra, a standard sports bra, or a prototype non-absorbent sports bra (3D Printed from TPU) while wearing the same t-shirt, shorts, shoes and socks. Each study visit involved cycling for 45 minutes at a moderate intensity over a pan of mineral oil, situated above a high precision scale. Evaporated sweat loss (ESL; g) was measured as the change in mass of the combined subject+ergometer+oil pan system during exercise; total sweat loss (TSL; g) was measured as the change in nude mass from beginning to end-exercise. SE (%) was calculated as ESL/TSL*100; core body temperature was measured via ingestible pill. Data were analyzed using a 1-way RM ANOVA.

Results: Compared to exercising without a bra, wearing a standard sports bra increased TSL (810.2±134.0g vs. 786.0±118.3g; $p=0.045$) and decreased SE (82.0±4.5% vs. 86.1±3.8%; $p<0.001$). These negative impacts were eliminated when wearing the prototype bra (TSL=789.3±141.8g, $p=0.78$; SE=85.2±4.7%, $p=0.11$). There were no differences in ESL ($p=0.09$) or core temperature ($p=0.66$) between conditions.

Conclusions: Wearing a 3D printed TPU Sports Bra eliminates the negative impact of traditional sports bras on SE and TSL during exercise in the heat.

Key Words: thermoregulation, sweating, clothing

AB53

Impact of age and long-term medical conditions on clothing choices for exercise in summer and winter – a mixed-methods investigation

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Introduction

Clothing choices during exercise in heat and cold are powerful thermal behaviours, often thought to be driven by thermal protection. However, to what extent other factors contribute to choices and their individual variability is unknown.

Purpose

This study investigated how different themes contribute to clothing choices in exercise in summer and winter, and the individual variation with age and the presence of long-term conditions.

Method

An anonymous online survey (n=101) was completed by healthy young (18-30 years, n=51) and older adults (60+ years, n=25), and by Multiple Sclerosis (n=11) and Spinal Cord Injury (n=14) patients. Participants ranked and rated (Likert scales) the importance of four themes on their clothing choices for exercise in summer and winter. Representative participants further discussed the survey's themes in focus groups (n=16).

Results

Participants ranked themes in the following order: temperature (most important), logistics, sensation, aesthetics (least important). Ranking order was consistent across different age groups and in healthy vs clinical groups. However, clinical groups rated the importance of environmental conditions during exercise higher than healthy participants (strongly agree vs agree, $p=0.012$). Clinical participants reported the necessity for clothing to maintain warmth in lower limbs, whilst healthy participants described how "it is more my internal temperature / comfort that drives (choices), less so the environment".

Discussion

The survey indicated consensus amongst participants of temperature being a key driver of clothing choices. Differences between groups were identified, however of greater note was the inter-individual variability in how themes were interpreted and incorporated into clothing choices.

Keywords**:** Thermal behaviour, clothing, individual variability

The impact of a heated effleurage or heated tapotement massage on low back discomfort from a seat

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Introduction: Many adults experience lower back pain (LBP) throughout their lifetime. Non-pharmacological treatments exist in the form of heat or massage, but these modalities are rarely combined.

Purpose: We examined the impact of two different heated massage protocols from an automotive seat on LBP within the time constraints of a typical commute.

Method: Seventeen adults (8 female) with chronic, non-specific LBP (~6/10 initial back pain) evaluated a heated-effleurage or heated-tapotement massage - completed in a randomized order - applied to the lower back, upper thighs, and gluteal region while seated in an automotive seat. Both days, a 20-min baseline-control preceded a 20-min heated massage, with a 30-min rest between sessions, where seat and skin temperature, subjective LBP, subjective back tightness, thermal comfort, and thermal sensation were reported throughout. Before and after each 20-min session, participants had the viscoelastic properties of their lower back muscles assessed with a myotonometer.

Result**s:** Seat surface temperature increased during the heated-massage, increasing skin temperature, thermal sensation, and thermal comfort ($p \leq 0.039$) vs control. Both heated-massage conditions reduced subjective LBP ($p \leq 0.023$) and tightness ($p \leq 0.032$) at 20-min, but occurred at 10-min for the tapotement-massage ($p=0.003$). Increased tissue elasticity was observed in the heated-tapotement condition ($p \leq 0.031$).

Discussion: A heated massage from an automotive seat can alleviate LBP, which may be partially explained by increases in tissue pliability along the posterior chain musculature. These findings indicate that heated massage delivered within typical commute times offer a convenient method to reduce experienced lower back pain.

Keywords: Low Back Pain, Heated Massage, Myotonometry, Pain Perception, Non-Pharmacological Intervention

AB210

Heat stress development in structural firefighting scenario and predicted heat strain

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The fire services have almost always operated in protective clothing for (structural) firefighting, even when it concerns non-fire-related incident leading to high physical burden and overload. This conflicts with the current ideas for sustainably deployable firefighters. Introducing modularity into firefighter clothing system allows combining different clothing layers to achieve optimal protection. As the incident scenarios differ, then a tool for optimal protection selection is useful.

We aimed to evaluate traditional (T) and modular (M) protective clothing systems for structural internal firefighting scenario (SIF) and to validate two Predicted Heat Strain (PHS, ISO7933) algorithms for this scenario.

Four firefighters wearing T and four M, performed pre-work and recovery at room temperature, and intermittent activities in a climate-controlled room (T_a=44.4±0.2°C under intermittent radiation (4 kW/m^2), RH=27.8±1.6%, v_a<0.15 m/s). Clothing insulation (M>T) and evaporative resistance (M<T) were determined on a thermal manikin. Skin (T_{sk}) and rectal temperatures (T_{rec}) in T and M, and PHS predictions with two online tools: FAME Lab (PHSFL) and Lund University PHS (PHSLU), were compared.

There were no significant differences between T and M in T_{sk} and T_{rec}, while reaching highest recovery T_{rec} took over 5 min longer in T than in M. Experimental T_{rec} did not differ significantly from the PHSLU predictions. For PHSFL, T_{rec} became significantly lower at the end of heat exposure and during recovery. Experimental T_{sk} was initially lower than predicted by PHSFL. In both models the predicted T_{sk} decreased more rapidly than the measured values after stopping radiation, and stayed lower throughout the recovery period.

With slightly higher insulation and lower evaporative resistance, M seemed to perform slightly better than T. Model and human data difference relates to not considering thermal mass of the clothing system and its heat content. PHSFL did not count with clothing moisture permeability leading to considerable deviation from experimental results.

Keywords: firefighter, protective clothing, predicted heat strain, heat stress, physiological responses

AB223

Heat and maternal health: an early warning system app MotherHeat Alert

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Introduction

Climate change has increased the frequency and intensity of extreme heat events worldwide. Heat stress poses significant health risks for everyone, but pregnant and postpartum women, infants, and young children are particularly vulnerable. It is essential to implement targeted protection and adaptation strategies to safeguard these groups.

Objective

This study aims to create an easy-to-use digital tool that delivers heat warnings, offers protection advice, raises awareness about heat-related health risks, and reduces negative health outcomes for vulnerable populations.

Method

The MotherHeat Alert app, developed as part of the High Horizons project, is a personalized early warning system and smartphone application. It uses the Universal Thermal Climate

Index (UTCI) and country-specific UTCI thresholds based on local climate and health data, especially preterm birth outcomes, UTCI heat stress categories and user profiles. The app's recommendations were developed with local stakeholders. Testing involved 459 participants, including pregnant and postpartum women, health workers, and community health workers in South Africa, Sweden, and Zimbabwe. Post-Study System Usability Questionnaire (PSSUQ) was used to evaluate the usability of the MotherHeat Alert app with a 7-point scale ranging from strongly agree (1) to strongly disagree (7).

Results and Discussion

The MotherHeat Alert prototype was developed with risk warning, protection recommendations and research functionalities. When a heat warning is triggered, users receive advice in English or local languages. Preliminary results based on the cohort in South Africa showed high overall usability with a mean score of 1.76. Self-reported heat health knowledge increase due to the implementation of the MotherHeat Alert was predominantly large to very large in both the pregnant cohort (n=55/70), and the postpartum cohort (n=72/82). Ongoing evaluation shows the app can support climate adaptation for maternal health. Wider deployment is possible after improvements based on user feedback, adapted thresholds and advice messages.

Keywords: heat and maternal health, early warning system, MotherHeat Alert app

ORAL PRESENTATIONS

21st August 2026
Oral Session 18 (9:45 - 10:45)
Theme: Heat Stress and Human Performance

No	Abstract ID	Presenter	Affiliation	Title Of Presentation
1	AB83	Lu Meng	Niigata University	Non-Invasive Evaluation Of Acetylcholine-Induced Cutaneous Vasodilation: Reliability, Exercise Training Effects, And Sex Differences
2	AB131	Mohammed Ihsan	United Arab Emirates University	Core Temperature And Physiological Strain During Elite Squash Tournament Match Play: Implications For La28
3	AB136	Lennart Teunissen	Training Medicine And Training Physiology, Dutch Ministry Of Defense, Utrecht, The Netherlands	Mitigation Of Exertional Heat Illness In The Dutch Army
4	AB140	Hsen Hsouna	University Of Montreal	A Field Study To Evaluate The Effect Of A Warm Summer Day On Physical And Cognitive Performance Of Construction Workers In A Continental Climate
5	AB172	Josh Elliott	University Of Canberra	Heat Training Practices In Elite And World-Class Athletes: A Review Of Preparation Strategies For Competition In Hot Outdoor Environments

21th August 2026
Oral Session 18 (09:45 – 10:45)
Theme: Heat Stress and Human Performance

Non-invasive evaluation of Acetylcholine-Induced Cutaneous Vasodilation: Reliability, Exercise Training Effects, and Sex Differences

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Introduction: Non-invasive assessments of acetylcholine (Ach)- and sodium nitroprusside (SNP)-induced cutaneous vasodilation, including nitric oxide (NO) contribution, may be useful for widespread evaluations of microvascular function across populations differing in sex and exercise-training status [1]. However, its methodological validity has not been established. **Purpose:** Using transdermal iontophoresis, we evaluated the within-site and test-retest reliabilities of Ach- and SNP-induced cutaneous vasodilation and examined the effects of exercise training and sex on these responses, as well as on cholinergic sweating. **Methods:** Thirty-seven healthy young adults (22 males, 15 females; 15 trained and 15 untrained) iontophoretically received Ach (0.01% and 0.1%) followed by 2% SNP with local heating (~43°C) at three forearm sites to induce maximum response, one of which was pretreated with L-NAME (a NO synthase inhibitor). Skin blood flow (PU) and cutaneous vascular conductance (CVC, PU/mmHg), expressed as absolute and $\%CVC_{max}$, were assessed. Ach- and pilocarpine-induced sweating were measured on the contralateral forearm. The protocol was repeated after ≥7 days in 15 participants. **Results:** Between-site agreement without L-NAME was poor for all microvascular indices. Test-retest reliability was moderate-to-good for CVC (ICC = 0.65–0.85) but was significantly attenuated by L-NAME pretreatment. Trained individuals exhibited greater SNP-induced CVC and cholinergic sweating ($P \leq 0.001$). No sex differences were observed in CVC, whereas males showed higher sweat rates ($P < 0.001$). **Discussion:** In iontophoresis, CVC provides a reliable non-invasive index of ACh- and SNP-induced cutaneous vasodilation, whereas L-NAME pretreatment may compromise its validity. Exercise training and sex differentially influence cutaneous vasodilatory and sweating responses.

Keywords: Acetylcholine, cutaneous vasodilation, sweat rate, exercise training

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Core Temperature and Physiological Strain During Elite Squash Tournament Match Play: Implications for LA28

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Introduction: Squash will debut at the Los Angeles 2028 Olympic Games, yet data on thermal strain in elite players are limited [1]. **Purpose:** To describe core temperature (Tc) and physiological strain index (PSI) during elite squash play and explore predictors of peak Tc. **Method:** Eight players (tier 4 [elite/international]) [2] were monitored during 19 matches played indoors (WBGT 18.3°C). Intestinal Tc and heart rate (HR) were recorded from rest through knock-up (KU) and games 1–5. PSI was calculated from Tc and HR [3]. Peak Tc was classified as modest (38.5–39.4°C) or marked hyperthermia (≥39.5°C) [4]. Linear regressions related peak Tc to HR- and RPE-based load, WBGT and hydration indices. **Results:** Tc increased from 37.37 ± 0.21°C at rest to 38.16 ± 0.26°C at KU, reaching 39.31 ± 0.55°C by game 3 and 39.5–39.7°C in games 4–5. Peak Tc was 39.46 ± 0.53°C; 9/19 matches elicited modest and 8/19 marked hyperthermia, with 3/19 ≥40.0°C. PSI rose from 4.25 ± 1.02 at KU to 7.92 ± 1.17 by game 3 and ≥8.3 in games 4–5. Peak PSI was 8.24 ± 1.12, while 3, 10 and 6 matches were classified as moderate (5–6), high (7–8) and very high (9–10) strain, respectively [3]. HR-based load explained 12% of peak Tc variance ($R^2 = 0.12$, $p = 0.14$); other predictors accounted for ≤8% ($p > 0.20$). **Discussion:** Elite squash play induces modest-to-marked hyperthermia and high physiological strain despite “low-risk” indoor WBGT. These findings extend previous work [1] and support targeted heat-training and in-play cooling strategies.

Keywords: squash, core temperature, hyperthermia, physiological strain index, LA28

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Mitigation of Exertional Heat Illness in the Dutch Army

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Introduction: Exertional heat illness (EHI) is a substantial threat for health and employability of military personnel. It requires a robust chain of measures mitigating drop- out and health consequences. **Purpose:** We aim to present an overview of the current chain of measures for EHI mitigation in the Dutch army. **Methods:** The EHI program is categorized into 1) prevention, 2) detection and 3) treatment of EHI. **Results:** *Prevention.* We developed different group/individual acclima(tiza)tion programs, from preliminary home-based protocols, to more or less standardized programs integrated in deployment[1]. Further, we use a customized heat-app, providing advice on work/rest-ratio and drinking, based on WBGT, gear, and acclimatization status. Finally we use a thermal manikin to study thermal properties of our military gear. *Detection.* For preliminary signaling of possible EHI in a military group, we use the ARMOR heat monitor, which displays the heart rate-based Estimated Core Temperature (ECTemp)[2] of all group members in a dashboard, optionally combined with a 'wobble index' and/or GPS location. The ECTemp algorithm is also used as a smartwatch application, for self-monitoring. *Treatment.* For urgent treatment of EHI in a field setting, a compact device for tarp-assisted cooling with oscillations (TACO) was developed. Provided with sufficient water, TACO proved to cool hyperthermic persons very effectively[3]. Finally, as end of the chain, two months after suffering from EHI, a soldier is called for our customized heat strain test. **Discussion:** This 1-hour treadmill walking test in incompensable heat stress (40°C, 44%RH), has been found to be a repeatable, practical and valuable tool for assessing return-to-duty.

Keywords: heat illness, acclimatization, ECTemp, cooling, heat strain test

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A field study to evaluate the effect of a warm summer day on physical and cognitive performance of construction workers in a continental climate

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Introduction: Occupational injuries are more frequent during work in hot environments [1], which may be caused by impairments in cognitive and/or physical performance [2]. However, few field studies have quantified the impact of occupational heat exposure on cognitive and physical performance during a typical workday. **Purpose:** This study aimed to quantify the effects of a warm summer workday on physical and cognitive performance of outdoor construction workers in a continental climate. **Methods:** Eighteen male construction workers (34 ± 10 years) completed a warm (WBGT: 21.5 ± 1.6°C) and temperate (WBGT: 14.0 ± 2.1°C) workday. Cognitive performance (reaction time, error rate, omission rate), maximal voluntary contraction (handgrip dynamometer), and perceptual responses (thermal sensation, thermal comfort, perceived effort, and subjective fatigue) were measured before, during and after each workday. **Results:** Reaction time was higher during the warm day (+34 ms [2, 66], p=0.03), with no day × time interaction (p=0.48). There was no day × time interaction for error (p=0.75) or omission rates (p=0.98). Maximal voluntary contraction did not differ between workdays (p=0.55). Thermal sensation (+39 units [28, 49], p=0.001) and discomfort (+34 units [18, 50], p=0.001) were greater during the warm day, whereas perceived effort (p=0.79) and subjective fatigue (p=0.45) did not differ between days. **Discussion:** These result show that the cognitive and physical performance of construction workers are not impaired by a warm workday, despite greater thermal sensation and discomfort. This study contributes to understanding the effects of occupational heat exposure on physical and cognitive performance.

Keywords: Heat stress, Occupational health, Construction workers, Physical performance, Cognitive performance

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Heat Training Practices in Elite and World-Class Athletes: A Review of Preparation Strategies for Competition in Hot Outdoor Environments

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Introduction: Elite athletes are recommended to integrate heat acclimation and acclimatisation when preparing for competition in hot conditions, however current guidelines largely derive from laboratory studies in non-elite cohorts. Practical constraints often limit heat-training implementation in high-performance environments, with real- world practices poorly documented. **Purpose:** This review synthesises observational evidence of heat-training practices in elite and world-class athletes and evaluates how these approaches align with current guidelines. **Method:** Twelve observational studies involving elite and world-class athletes preparing for competition in hot outdoor environments were reviewed. Data regarding heat-training structure, environmental conditions, monitoring practices, and reported physiological adaptations were compared with current guidelines. **Results:** Heat acclimatisation interventions spanned 5 days to 11 weeks, while heat acclimation mostly involved 6–28 sessions completed over 8 days to 7 weeks. Most interventions used sport-specific active sessions in environmental conditions similar to or more severe than competition. Active exposures lasted ~25–160 min, with passive exposures 15–60 min and typically post-exercise. Studies reported reductions in exercise heart rate (4–21 beats·min^{-1}) and core temperature (0.2–0.6 °C), alongside changes in plasma volume (no change to +23%). Final heat interventions were generally completed within 4 weeks of competition. **Discussion:** Heat-training practices in elite athletes vary widely in session frequency and duration to accommodate athlete needs and training demands, with limited reporting of protocols preventing robust evaluations against recommendations. Nonetheless, adaptations across heart rate, core temperature and plasma volume were evident. Greater consistency in documentation is needed to fully assess heat-training approaches in high-performance settings.

Keywords: Heat training, Thermoregulatory adaptations, High-performance sport, Physiological monitoring, Evidence-based guidelines.

21st August 2026
Oral Session 19 (11:00 - 11:45)
Theme: Heat Stress and Human Performance

No	Abstract ID	Presenter	Affiliation	Title Of Presentation
1	AB11	Rebecca Mcclintock	Naval Health Research Center	Development Of An Enhanced Heat Tolerance Test: Warfighter Physiological And Cognitive Responses To Heat And Thermoneutral Conditions
2	AB40	Rei Hattori	University of Tsukuba	Topical Application of Cinnamaldehyde, a TRPA1 Channel Agonist, to Human Skin Enhances Cutaneous Vasodilation and Reduces Core Temperature during Exercise in the Heat
3	AB94	Kodai Yamaji	University Of Tsukuba	ATP-Sensitive Potassium Channels Contribute To Nitric Oxide Synthase-Mediated Cutaneous Vasodilation During High-Intensity Exercise In The Heat.
4	AB184	Emma Atkinson	U.S Army Research Institute Of Environmental Medicine	Differential Thermal Response Patterns To Heat Stress May Provide An Early Indicator Of Increased Exertional Heat Stroke Risk
5	AB197	Igor Mekjavic	Jozef Stefan Institute	Predicting Deep Body Temperature With Quantitative Infrared Thermography (QIRT): HELIA Study

21th August 2026
Oral Session 19 (11:00 – 11:45)
Theme: Heat Stress and Human Performance

Development of an Enhanced Heat Tolerance Test: Warfighter Physiological and Cognitive Responses to Heat and Thermoneutral Conditions

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Introduction: Managing physiological strain during exercise in hot environments is a persistent challenge for military operations [1]. The heat tolerance test (HTT) is widely used to guide return-to-duty decisions after exertional heat illness (EHI) [2, 3], yet current protocols cannot distinguish true heat intolerance from poor fitness and rarely assess cognition despite its diagnostic relevance in heat stroke. These limitations may reduce interpretability of HTT outcomes. To address this gap, an enhanced HTT (eHTT) incorporating a thermoneutral (TN) comparison trial and cognitive testing was developed. **Purpose:** To determine whether a dual-condition HTT framework improves detection of heat-specific physiological strain beyond exercise alone. **Methods:** Nineteen active duty service members (16 male, 3 female) completed two randomized 120-min treadmill walks (5.0 km/h, 2% grade): TN (23 °C, 40% RH) and heat (40 °C, 40% RH). Core temperature (T_{core}), heart rate (HR), skin temperature, and physiological strain index (PSI) were measured continuously. Thermal sensation (TS), rating of perceived exertion (RPE), and cognitive performance (simple reaction time, antisaccade, SynWin) were assessed. Cluster-based permutation testing and paired *t* tests compared trials. **Results:** Forty-two percent met traditional HTT failure criteria in heat despite no EHI history, whereas none failed in TN. HR diverged within 5 min, PSI by 23 min, and T_{core} by 51 min (all $p < .001$). Heat produced greater HR ΔAUC, ΔT_{core}, peak PSI, sweat rate, TS, and RPE ($p < .05$). Cognitive performance was unchanged. **Conclusion:** A dual-trial eHTT isolated heat-specific physiological strain and demonstrated that conventional HTT criteria alone can misclassify healthy personnel. This work introduces a more precise, context-driven framework for interpreting HTT outcomes and represents a meaningful step toward evidence-based refinement of return-to-duty evaluations. Validation in heat-injured populations is warranted.

Keywords: Thermoregulation, Hyperthermia, Exertion, Performance

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Topical Application of Cinnamaldehyde, a TRPA1 Channel Agonist, to Human Skin Enhances Cutaneous Vasodilation and Reduces Core Temperature during Exercise in the Heat

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Introduction: Transient receptor potential ankyrin 1 (TRPA1) channels are thermosensitive ion channels and are activated by pungent compounds such as cinnamaldehyde [1]. As topical application of cinnamaldehyde to human skin induces skin vasodilation [2], application over a larger skin surface may augment heat dissipation and attenuate increase in core temperature during exercise in the heat. **Purpose:** To test the hypothesis that topical application of a TRPA1 channel agonist would enhance skin vasodilation and attenuate the increase in core temperature during exercise in the heat. **Methods:** Eleven young adults underwent whole-body (except for the head and neck, hands, feet, and clothed areas) application of either a control solution (CON) or 1% cinnamaldehyde (CA), a TRPA1 channel agonist, followed by cycling exercise at 50% peak oxygen uptake in a hot environment (35°C). Skin blood flow, sweat rate, rectal temperature, heart rate, and blood pressure were continuously recorded. **Results:** Skin blood flow was higher in CA than in CON from immediately after application at rest through the early stages of exercise ($P<0.036$). Rectal temperature was lower in CA than in CON from 5 min before exercise onset through 20 min of exercise ($P<0.034$). No differences were observed in sweat rate or cardiovascular responses. **Discussion:** These findings suggest that enhanced cutaneous vasodilation following topical cinnamaldehyde application promoted heat dissipation, resulting in an attenuated increase in core temperature before and during the early stages of exercise. Topical cinnamaldehyde application may represent a potential non-invasive strategy for mitigating heat strain during exercise in the heat.

Keywords: TRPA1 channels, cinnamaldehyde, cutaneous vasodilation, thermoregulation

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ATP-sensitive potassium channels contribute to nitric oxide synthase-mediated cutaneous vasodilation during high-intensity exercise in the heat.

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Introduction: Nitric oxide synthase (NOS) contributes to cutaneous vasodilation during moderate-intensity exercise in the heat [1]; however, this response is partly attenuated during high-intensity exercise [2]. Since ATP-sensitive potassium (K_{ATP}) channels mediate NOS-dependent cutaneous vasodilation [3], K_{ATP} channel-induced cutaneous vasodilation may also be attenuated during high-intensity exercise. **Purpose:** We hypothesized that the contribution of K_{ATP} channels to cutaneous vasodilation during high-intensity exercise is attenuated relative to lower-intensity exercise. **Methods:** Thirteen young adults performed three-stage incremental exercise: 1) moderate (80% VT_1), 2) heavy (Midpoint VT_1-VT_2), and 3) severe (105% VT_2). Throughout the exercise, cutaneous vascular conductance (CVC) was measured at four forearm skin sites treated with 5% DMSO. After recovery, the same exercise was conducted, while the four sites were treated with either: 1) 5% DMSO (control), 2) Glibenclamide (K_{ATP} channels inhibitor) 3) L-NAME (NOS inhibitor), or 4) Glibenclamide and L-NAME. The change in CVC between the first and the second session (ΔCVC) at each site was calculated. **Results:** During heavy and severe exercise, ΔCVC at the K_{ATP} channels inhibition site was lower than the vehicle control site (both $P \leq 0.025$). Regardless of exercise intensity, ΔCVC at the NOS inhibition site and the K_{ATP} channels and NOS inhibition site were lower than the vehicle control site (both $P \leq 0.019$), with no difference between the two sites ($P > 0.999$). **Discussion:** K_{ATP} channels contribute to NOS-dependent cutaneous vasodilation during high-intensity exercise in the heat. Thus, K_{ATP} channels and NOS are candidates for increasing heat dissipation during exercise in the heat.

Keywords: heat loss, high-intensity exercise, cutaneous vasodilation, nitric oxide synthase, ATP-sensitive potassium channels.

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Differential thermal response patterns to heat stress may provide an early indicator of increased exertional heat stroke risk

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Introduction: Exertional heat stroke (EHS) remains a consistent challenge for military and occupational communities around the world. Recent work has demonstrated during prolonged military ruck marches, differential physiological response patterns can be observed between individuals who experienced an EHS and those who did not, hours before the EHS occurred [1]. **Purpose:** We sought to determine if these patterns could be observed in days prior to the EHS event, thereby allowing early identification of high-risk individuals. **Methods**: Heart rate (HR), chest skin temperature (Tsk), and estimated core temperature (Tect) were collected during a 6-mile ruck march, 2-days before six individuals experienced an EHS (5M, 1F; 23±4y, 1.7±0.1m, 79.9±11.7kg, 7:40±0:32mm:ss). Eighteen controls (CONT; 3 per EHS case) were matched for age, height, weight and one-mile runtime (N=18M, 22±3y, 1.8±0.1m, 81.2±7.5kg, 7:40±0:34mm:ss). Mean HR, Tect, and Tsk responses were compared (ANOVA) between the first and second 3-miles and between EHS and CONT. **Results:** HR and Tect were similar between EHS and CONT and across time points. Tect-Tsk and Tsk diverged over time ($p=0.003$ and $p=0.002$, respectively). Tect-Tsk increased in CONT (1.81±0.93 to 2.49±1.17°C, $p<0.001$), but remained the same in EHS (1.5±0.4°C). Tsk increased in EHS (36.7±0.4 to 37.3±0.5°C, $p=0.006$) and was similar across time in CONT (36.1±0.9 to 36.0±1.2, $p=0.22$). **Discussion:** We found individuals at risk of EHS can be identified by their differential core-to-skin temperature gradient response during a ruck march 2 days prior to their actual EHS event. These early indicators can inform leadership, allowing timely interventions to prevent catastrophic illness.

Keywords: exertional heat stroke, physiological monitoring, heat illness prevention

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Predicting deep body temperature with quantitative infrared thermography (QIRT): HELIA study

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Introduction: During the COVID-19 pandemic, infrared thermography (IRT) was widely used for workplace fever screening. However, previous work showed major limitations in predicting core temperature from skin temperature, with large increases in skin temperature during moderate work in 40 °C conditions despite minimal changes in rectal or aural temperature, resulting in false-positive fever detection. We therefore evaluated (i) the relationship between skin temperature measured by IRT and contact thermistors and (ii) the ability of IRT to predict core temperature during a simulated heatwave. **Methods:** Five healthy females (24 ± 2.2 y) completed a 9-day laboratory study consisting of two 3-day normothermic periods (25 °C day/22 °C night) surrounding a 3-day heatwave (35 °C day/26 °C night). Participants performed light stepping exercise daily. Skin temperature at the forehead, fingertip and forearm was measured simultaneously using a FLIR E96 infrared camera and contact thermistors (iButtons). Gastrointestinal temperature (Tgi) was measured using an ingestible telemetry pill. Finger blood flow was estimated from the forearm–fingertip temperature gradient. Measurements were taken before and after exercise at five daily timepoints. Data were analysed using two-way ANOVA and Hedges' g effect sizes. **Results**: IRT and thermistor skin temperatures were positively correlated ($r = 0.56$, $p < 0.001$), but IRT forehead temperature showed a weak negative correlation with Tgi ($r = -0.24$, $p = 0.001$). Heatwave conditions increased peripheral blood flow and skin temperature at all timepoints. However, neither IRT nor thermistor skin temperature correlated with Tgi. **Discussion**: Although IRT accurately reflects skin temperature, it cannot reliably predict core body temperature.

Key words: heatwave, infrared thermography, temperature,

21st August 2026
Oral Session 20 (12:30)
Thermoregulatory Sweating

No	Abstract ID	Presenter	Affiliation	Title Of Presentation
1	AB64	Hui Wang	Niigata University	Association Between Pilocarpine-Induced Sweating And Heat Stress-Induced Sweating Across Exercise And Passive Heating Modalities

21th August 2026
Oral Session 20 (12:30)
Theme: Thermoregulatory Sweating

Association Between Pilocarpine-Induced Sweating and Heat Stress-Induced Sweating Across Exercise and Passive Heating Modalities

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Introduction: It remains unknown whether peripheral sweat gland function, assessed using pharmacologically induced cholinergic sweating, is associated with sweating responses during exogenous or endogenous heat stress. Pilocarpine-induced sweating has been shown to correlate with relative intensity-based exercise sweating [1], but heat-stress modalities (e.g., passive or active-heat stress) should be taken into account for physiological interpretations. **Purpose:** To retrospectively examine the association between pilocarpine-induced sweating and heat stress–induced sweating across different sweat-induction modalities. **Methods:** Data from five laboratory studies (118 participants) were retrospectively analyzed, including time- and core temperature-controlled passive heating, cycling at relative intensity or matched evaporative requirement (E_{req}) (200W/m^2), and running at fixed velocities. Pilocarpine (1%)-induced sweating was assessed as an index of cholinergic sweat gland function using iontophoresis. Associations between pilocarpine-induced sweat rate and local (e.g., forearm) or whole-body sweat rate during heat stress were examined using linear regression analysis. **Results:** Forearm sweat rate during core temperature-controlled (+0.8°C) passive heating, but not during time-controlled heating ($r = 0.220$, $p = 0.313$), was positively correlated with pilocarpine-induced forearm sweat rate ($r = 0.510$, $p < 0.001$). Significant positive correlations were also observed in two %VO_{2max}-based exercise studies ($r \leq 0.789$, $p < 0.001$). Whole-body sweat rate was positively correlated with pilocarpine-induced sweating during time-controlled passive heating ($r = 0.728$, $p < 0.001$), but not during running at fixed velocities or cycling matched for E_{req} ($p \geq 0.763$). **Discussion:** Pilocarpine-induced sweating was associated with local sweating althoughthe strength and significance of this relationship vary depending on the heat-stress modalities.

Keywords: sweat gland function, pilocarpine iontophoresis, heat stress, exercise sweating, retrospective analysis.

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21st August 2026
Oral Session 20 (16:15 – 17:15)
Theme: Cold Environments: Survival, Adaptation and Performance

No	Abstract ID	Presenter	Affiliation	Title Of Presentation
1	AB77	Chuan Li	China University Of Mining And Technology–Beijing	Difference Between Whole-Body Stability And Extremity Cooling Risk: Validating Ireq And Csi In Cold Windy Environments
2	AB126	Nathan Bartman	Brock University	Optimizing Weighted Mean Skin Temperature Measurement Sites
3	AB178	Hojoon Lee	Department Of Fashion And Textiles, Seoul National University, Seoul, Korea	Localized Radiant Heating Enhances Driver Thermal Comfort But Creates Spatial Asymmetry In A Cold Electric Vehicle Cabin At –7oc
4	AB196	Yue Yu	Hong Kong Baptist University	Forecast-Ready Bias Correction For Wind-Chill Risk In Alpine Winter Venues

Difference between whole-body stability and extremity cooling risk: Validating IREQ and CSI in cold windy environments

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Introduction: People are often exposed to cold wind environments. Standard metrics such as IREQ (ISO 11079) [1] and the Cold Stress Index (CSI) [2] focus on overall balance and may mask serious risks of localized cooling. **Purpose**: To evaluate the IREQ model by comparing predicted Duration Limited Exposures (DLE) with experimentally observed limits based on mean skin temperature (neutral/minimal thresholds) and finger temperature (15°C dexterity, 10°C pain). Additionally, the original CSI was compared with a modified peripheral cold strain index (CSIp) to assess wind sensitivity. **Methods**: Twelve males walked for 40 min (4 $km \cdot h^{-1}$) in a climatic chamber (-15°C, 40% RH) under four wind speeds (0.1, 2.0, 4.0, 6.0 $m \cdot s^{-1}$) wearing 2.8 clo. Rectal (eCelsius capsules) and skin temperatures (iButton loggers) were monitored to calculate cold exposure time limits. **Results**: Rectal temperature increased by 0.45°C, indicating no risk of hypothermia. The original CSI remained low (peak 1.0–1.6). The modified CSIp increased markedly, peaking at 7.0 at 6.0 m/s. The IREQ predicted whole-body limit (0.8 h) overestimated the observed mean skin temperature threshold (0.38 h) at 6.0 m/s. More critically, extremity cooling occurred most rapidly, with finger dexterity (15°C) and pain (10°C) thresholds reached in just 0.15 h and 0.25 h, respectively. **Discussion**: The original CSI underestimated risk, whereas CSIp effectively reflected peripheral strain. Relying on whole-body DLE predictions for exposure limits may inadvertently expose workers to frostbite. Safety limits should follow the "weakest link" principle, defining permissible exposure by the most vulnerable body part.

Keywords: Cold windy environments, IREQ model, Cold Strain Index (CSI), extremity cooling, occupational safety.

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Optimizing Weighted Mean Skin Temperature Measurement Sites

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Introduction: Calculating mean weighted skin temperature (T_{mws}) can be accomplished with several weighted formulas developed in the 20th century. Most are based on regional surface area [1] without guidance on the exact measurement location [2]. This may be problematic with large regions such as chest or thigh [3]. **Purpose:** Identify the most representative locations for T_{mws} measurement through comparing 98 different locations to the unweighted mean (T_{sk_98}) and develop a more accurate formula. **Methods:** Forty-eight (18 male) adults ((mean±standard deviation) 27±11 years, 66±14 kg) were taped with 98 DS1921H iButtons (Analog Devices, Inc., USA)) on the right side covering the head (9), arm (19), hand (5), torso (30), leg (32), and foot (3), with temperature recorded every minute (0.125°C resolution). Participants stood in an environmental chamber for 100 minutes beginning at 23℃, 50% relative humidity and adjusted to 30℃, 18℃, and 23℃ at 10, 40, and 70 minutes, respectively. A least absolute shrinkage and selection operator (LASSO) regression was applied to the 98 measurements to reduce the number of sites as predictors of T_{sk_98} with the goal to capture >95% variation. **Results:** Eight sites were identified as predictive of >98% (R^2 = 0.9841) of T_{sk_98}, better than three variants of the Ramanathan formula (RAM_1 R^2 = 0.8909, RAM_2 R^2 = 0.7746, RAM_3 R^2 = 0.9023) with lowest mean bias (0.0040℃), mean absolute error (0.1509℃), and root mean squared error (0.1940℃). **Discussion:** A new data-driven, reduced-sensor model can outperform anatomically defined regional averaging approaches, creating more accurate measurements of T_{mws}.

Keywords: Formula, equation, accuracy, gold-standard

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Localized Radiant Heating Enhances Driver Thermal Comfort but Creates Spatial Asymmetry in a Cold Electric Vehicle Cabin at –7°C

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Introduction: In cold environments, electric vehicle (EV) cabin heating must balance energy efficiency and occupant thermal comfort. Localized radiant heaters have been introduced to reduce HVAC load and have been shown to induce region-specific perceptual responses [1]. **Purpose:** This study investigated the impact of radiant heating on thermoregulatory and perceptual responses in an EV cabin pre-exposed to –7°C. **Methods:** Eight healthy young males participated in four randomized seating conditions: driver seat (surface temperature 110°C of radiant heater applied to underneath steering, center console side panel, lower door panel, and footwell near pedals), front passenger seat, rear seat behind driver, and rear seat behind passenger. The vehicle was pre-conditioned at –7°C for 12 h in a climate chamber. During 30 min of exposure, gastrointestinal temperature, 10-site skin temperatures, heart rate, clothing microclimate temperature and humidity, and subjective ratings (thermal sensation, comfort, shivering) were recorded. Data were analyzed using RM ANOVA and nonparametric tests ($P < 0.05$). **Results:** After 30 min, cabin air temperature near the driver reached 12.2 ± 0.5°C, whereas rear-seat air temperature remained significantly lower (1.8 ± 2.3°C; $P < 0.001$). Core body temperature remained 37.0°C across all conditions. However, forehead (33.1 ± 0.6°C > 32.0 ± 0.8°C), abdomen (33.7 ± 1.9°C > 32.4 ± 1.9°C), and calf skin temperatures (29.6 ± 2.5°C > 27.5 ± 1.6°C) were significantly higher in the driver seat compared with the front passenger seat ($P < 0.05$). Whole-body thermal sensation improved more rapidly in the driver seat, reaching 1.0 ± 1.2 (“slightly warm”) at 15 min and 1.4 ± 1.1 at 20 min. Significant differences among the four seating positions were observed at 15 min (P = 0.029) and 20 min (P = 0.034), with the driver seat showing higher scores than the passenger (0.1 ± 1.8 at 15 min, 0.5 ± 2.0 at 20 min) and rear seats (0.4 ± 1.7, -0.4 ± 1.6 at 15 min, 0.5 ± 1.7, 0.3 ± 1.4 at 20 min). **Discussion:** Under –7°C conditions, driver-focused radiant heating maintained core body temperature across all seats while producing markedly superior local thermal comfort in the driver position.

Keywords: Skin temperature, Localized radiant heating, Cabin microclimate, Cold exposure, Human thermoregulation

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Forecast-Ready Bias Correction for Wind-Chill Risk in Alpine Winter Venues

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Introduction: Mountain venues and routes show strong temperature, humidity and wind gradients that coarse background fields often miss, limiting wind-chill and cold-stress risk monitoring. **Purpose:** We aim to produce operational 1 km hourly near-surface products for Alpine venues/routes using station-informed bias correction. **Methods:** We paired hourly observations from 74 Alpine stations (Jan–Apr 2025, UTC; Meteostat) with hourly ERA5-Land background sampled at station locations (near-surface temperature, dew point, and 10-m wind components). Terrain predictors on a 1-km EPSG:3035 grid were prepared in Google Earth Engine and attached to stations, together with hour/month sine–cosine time features. Residual models (observation minus background) were trained with station-grouped cross-validation. At inference, background fields were corrected by adding predicted residuals, with physical consistency enforced (dew point ≤ temperature; wind speed/direction derived from corrected wind components). **Results:** Across Jan–Apr 2025, temperature RMSE improved from 5.33 to 3.15 °C (−40.9%), with R^2 increasing from 0.33 to 0.77 and bias shifting from −3.18 to +0.77 °C. Dew point RMSE improved by ~31% with R^2 reaching ~0.78. Wind components showed consistent error reductions versus baseline (typically ~10–22% depending on component and station group). **Discussion:** These results support operational cold-environment risk monitoring in complex terrain. Next, we will (i) adapt the same correction framework to WRF hindcast/forecast backgrounds to improve forecast-time robustness, and (ii) implement a low-latency rolling station-error patch with versioned rollback for operational deployment.

Keywords: cold environments, wind chill, mountain microclimate, bias correction, machine learning, WRF

ICEE 2026

POSTER PRESENTATIONS

18th August 2026
Poster Presentation 1 (14:30 - 15:30)
Theme: Environmental Stress and Health Related Outcomes

No	Abstract ID	Presenter	Affiliation	Title Of Presentation
1	AB23	Hikaru Enomoto	Sagami Women's University	Heatstroke In East And Southeast Asian Countries
2	AB62	Lily Rozana Joehann Aung	Heat Resilience & Performance Centre, Yong Loo Lin School of Medicine, National University of Singapore, Singapore	The High Cost of Delivery: Physiological Impacts of Prolonged Heat Exposure on Delivery Riders
3	AB159	Masahiro Horiuchi	National Institute of Fitness and Sports in Kanoya	Japanese steam sand bath heat therapy mediates comparable reductions in blood pressure with smaller discomfort and respiratory strains than hot water immersion and sauna

AB23

Heatstroke in East and Southeast Asian Countries

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Introduction: Exacerbated by global warming, the thermal environments in which people live have become increasingly hot. Heatstroke is now widely recognized as a social problem. Asian countries are no exception; however, differences in climate, culture, and social conditions may influence awareness of heatstroke across countries.

Purpose: We aimed to investigate whether heatstroke is recognized as a growing concern in social problem in Asian countries and to examine the availability and characteristics of related statistical data.
Method: A questionnaire survey was conducted among researchers engaged in thermal environment–related studies in five countries: Japan, Korea, Taiwan, Singapore, and Indonesia. The survey covered statistics on the number of heatstroke victims in each country, awareness of heatstroke as a social problem, occupational health measures to prevent heatstroke, and the prevalence of air conditioning in homes and schools.

Results: Heatstroke was recognized as a social problem in all five countries, but the availability, definitions, and detail of official statistics differed markedly. In 2024, Japan recorded an estimated 2,160 heatstroke deaths (17 per million population), far exceeding rates in Korea (0.7) and Taiwan (1.9). No 2024 heatstroke statistics were available for Singapore and Indonesia. Awareness of risks among elderly was widely reported, and occupational prevention measures existed in all countries. However, household and school air-conditioning prevalence varied substantially.

Discussion: Heatstroke is a significant public health concern across the countries, and prevention strategies are shaped by social, cultural, and economic contexts. Differences in heat stroke classification, reporting systems, and healthcare frameworks likely underlie international discrepancies.

(249 words)

Keywords: Heatstroke, Thermal Environment, Cross-national Comparison, Asian Countries

Ab62

The High Cost of Delivery: Physiological Impacts of Prolonged Heat Exposure on Delivery Riders

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Introduction

Delivery riders often work shifts exceeding 12 hours [1], enduring hot and humid weather in uniforms with insufficient moisture-vapour permeability that impede heat dissipation [2]. The prolonged occupational heat stress can increase physiological demands and risks of developing kidney-related disorders [3].

Purpose

To characterise physiological strain and kidney stone formation in delivery riders.

Methods

Twenty-three delivery riders (age: 44±8 years; rider experience: 4±2 years; weekly working hours: 48±15 hours) underwent baseline and three-month follow-up kidney ultrasounds to assess stone formation, with a physiological monitoring session in-between the ultrasounds. Heart rate (HR), core (Tc), and skin temperature (Tsk) were recorded, and physiological strain index (PSI) calculated. Wet bulb globe temperature (WBGT) was estimated via distance-based weighting of participants' locations to the nearest weather stations to account for spatial variation in heat exposures.

Results

Shifts lasted 9±3 (4.5-13) hours. Mean Tc was 37.5±0.3 (37.2-37.9) °C. 26% of participants exceeded 38°C, indicative of occupational heat strain [4]. Peak Tc, HR, Tsk and PSI occurred mid-shift, coinciding with peak lunchtime delivery from 11am-2pm. Although mean PSI was low (4.2±0.2) (2.0-7.3), 83% had 7≤peak PSI≤9 indicating high strain and 9% reached peak PSI>9, indicating maximal strain. No kidney stones were observed during the follow-up ultrasound.

Discussion

Despite experiencing low occupational environmental heat stress of WBGT<31°C [5], riders had high peak Tc and PSI, suggesting high physiological strain at low environmental exposures. Future longitudinal ultrasound follow-ups and physiological profiling is needed to assess
kidney stone formation and determine the effects of physiological strain on kidney stone impairments in delivery riders.

Keywords: Occupational heat stress, delivery riders, kidney-related disorders

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Japanese steam sand bath heat therapy mediates comparable reductions in blood pressure with smaller discomfort and respiratory strains than hot water immersion and sauna

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Introduction: Heat therapies have been reported to reduce resting arterial blood pressure. However, hyperthermia imposes physiological and perceptual strains. To acquire a habit of heat therapy, it is ideal to develop a modality that offers therapeutic benefits with minimal strain. We hypothesized that the unique Japanese traditional steam sand heat therapy lowers blood pressure with minimum physiological and perceptual strains.

Methods: Fourteen healthy young males underwent three heating procedures, each lasting 20 min: (1) steam sand bath (~ 50 °C), (2) hot water bath (~ 41 °C), or (3) sauna (~ 80 °C) in a randomized counter-balanced manner. Cardiorespiratory responses and perceptions were assessed before, during, and after each heating.

Results: Core temperature increased in the following order: hot water bath > sauna > steam sand bath (all $p < 0.001$ at end heating). Partial pressure of end-tidal carbon dioxide remained stable during the steam sand bath, whereas it decreased in both the hot water bath and sauna conditions (both $p < 0.001$ at end heating). Mean and diastolic arterial blood pressures declined at the end of recovery (all $p < 0.001$), with similar responses across conditions (all $p > 0.39$). Thermal comfort at the end of heating was lower (i.e., more comfortable) in the steam sand bath compared to the other two conditions (both $p < 0.001$).

Discussion: Our results indicate that the traditional Japanese steam sand bathing may provide blood pressure-lowering benefits with reduced respiratory and perceptual strains compared to hot water bath and sauna. These reduced strains may enhance its feasibility as a sustainable and habitual form of thermal therapy.

Keywords: Antihypertensive, Passive heat therapy, Respiration, Safe health prescription, Thermal comfort

18th August 2026
Poster Presentation 1 (14:30 - 15:30)
Theme: Clothing and Human-Environment Interaction

No	Abstract ID	Presenter	Affiliation	Title Of Presentation
1	AB41	Kameda Maho	Hokkaido University	Feasibility Of Estimating Clothing Insulation Using Infrared Thermography In A Thermoneutral Environment
2	AB63	Suhyeon Yeom	Seoul National University	Thermodynamic Characteristics Of Skin Penetration By Local Radiant Heaters For Wearable Heating Applications
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AB41

Feasibility of Estimating Clothing Insulation Using Infrared Thermography in a Thermoneutral Environment

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Keywords: infrared thermography, clothing insulation, mean skin temperature, thermal comfort, non-contact temperature measurement

Introduction

Accurate estimation of clothing insulation (Icl), which varies individually, is essential for improving indoor thermal comfort. However, questionnaire-based and contact-type temperature measurements are difficult to apply in real environments.

Purpose

This study examined a simple, non-contact method to estimate Icl using infrared thermography (IRT).

Methods

Twenty-one healthy male students wearing 0.787 clo uniform cloth participated under thermoneutral conditions. Thermal images of the face, hands, and whole body were captured using IRT. Skin and cloth surface temperature were simultaneously measured using thermistor as reference values. Mean skin temperature ($MSTthermistor$) based on the Hardy and DuBois 7-point method was compared with a 2-point weighted average of forehead and hand temperatures ($MSTWA\_thermistor$). The same two regions extracted from IRT images ($MSTWA\_IRT$) were also compared. Mean clothing surface temperature from whole-body IRT images ($MCTIRT$) was compared with Ramanathanss -point method ($MCTthermistor$). Clothing insulation calculated from MST , MCT and heat loss was compared between values obtained using thermistor ($Icl\_thermistor$) and IRT (Icl_IRT).

Results Significant correlations were found between $MSTthermistor$ and ($MSTWA\_thermistor$ ($R^2 = 0.55$, $p < 0.001$; MAE = 0. 97°C) and between $MSTWA\_IRT$ and ($MSTWA\_thermistor$ ($R^2 = 0.23$, $p < 0.01$; MAE = 0. 75°C). ($MCTthermistor$ and $MCTIRT$ were also significantly correlated ($R^2 = 0.201$, $p < 0.05$; MAE = 0.895°C). Icl_IRT was significantly higher than $Icl\_thermistor$ (MAE44 = 0. 6 clo, $p < 0.001$).

Discussion

Although IRT showed moderate validity, discrepancies in MCT and regional skin temperature influenced Icl estimation. Improvements in terms of environmental conditions and surface temperature evaluation are required.

AB63

Thermodynamic Characteristics of Skin Penetration by Local Radiant Heaters for Wearable Heating Applications

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Introduction: Radiant heaters emit infrared energy that interacts with skin tissue in a wavelength-dependent manner [1]. However, systematic evaluation of heat penetration remains limited.

Purpose: We investigated thermodynamic characteristics of skin penetration by radiant heaters with different infrared emission properties.

Method: Four heaters with distinct emission characteristics were evaluated: a graphene sheet, a halogen lamp, a carbon-fiber wired heater, and a CNT film heater. Porcine back skin was exposed to radiant heat for 60 min in a controlled environment. Tissue temperatures were measured at the surface (0 cm) and three depths (4, 6, and 8 mm). The heat flux of the four heaters was standardized using a reference skin.

Results: The carbon-fiber heater produced the highest surface temperature (36.4 ± 2.5 °C). At 8 mm, graphene (29.6 ± 1.6 °C) and halogen (28.7 ± 1.8 °C) maintained higher internal temperatures than carbon fiber (27.4 ± 1.5 °C) and CNT (27.8 ± 1.2 °C). The largest surface-to-depth ΔT at 8 mm occurred with carbon fiber (8.9 ± 1.6 °C), while smaller values were observed with graphene and halogen. Skin hydration decreased in all conditions, with the greatest reduction under carbon fiber ($\Delta = -35$) and the smallest under graphene ($\Delta = -9$).

Discussion: The graphene heater maintained higher temperatures at 8 mm in depth with a smaller ΔT, indicating more uniform heat distribution. It also showed the smallest reduction in skin hydration ($\Delta = -9$), suggesting reduced superficial dehydration. These findings indicate that graphene heaters provide more effective radiant heating by enabling deeper tissue penetration and more uniform temperature distribution across tissue depth.

Keywords: radiant heat, skin penetration, wearable heating

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AB204

Effects of Various Commercial Cooling Garments on Reducing Heat Strain in a Hot and Humid Environment: A Pilot Study

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Introduction: Occupations with the highest incidence of heat-related illnesses during the summer include construction workers, elderly agricultural workers, military personnel, and logistics delivery workers.

Purpose: This study aimed to identify effective cooling garments for reducing heat strain among workers during the summer by collecting commercially available cooling garments and comparing their wearing performance.

Methods: Eight commercially available cooling garments were selected: (1) an air neck cooler, (2) an ice neck band, (3) an air-circulated vest, (4) a fan vest, (5) a cool-air vest, (6) an ice-pack vest, (7) a PCM vest, and (8) a liquid-cooling vest. One young male participated in eight trials conducted at 36°C and 65%RH. Each trial lasted 70 min.

Results: No substantial differences were observed among the eight cooling garment conditions in rectal/auditory canal temperatures, heart rate, total sweat loss, or rating of perceived exertion. In contrast, mean skin temperature differed across conditions, with the highest value observed in the ice-pack vest (35.4°C) and the lowest in the liquid-cooling vest (32.4°C). During the recovery, the fan vest was the only condition in which mean skin temperature decreased (by 0.44°C). For all cooling vest conditions, humidity inside the clothing decreased immediately after donning. The subject reported feeling the least hot and least uncomfortable when wearing the liquid-cooling vest, and the least humid when wearing the fan vest.

Discussion: Commercially available cooling garments did not produce substantial differences in core temperature or heart rate. However, the liquid-cooling vest was the most effective in reducing mean skin temperature, while the fan vest appeared to enhance sweat evaporation, contributing to decreased skin temperature during recovery.

Keywords: Hyperthermia, heat strain, body cooling, liquid cooling garment

18th August 2026
Poster Presentation 1 (14:30 - 15:30)
Theme: Heat Stress and Human Performance

No	Abstract ID	Presenter	Affiliation	Title Of Presentation
1	AB29	George Woon Lukic	Universiti Malaya	Comparing the Effect of Full Versus Partial Range of Motion Training on Hypertrophy and Strength Development
2	AB57	Hui Wen Darine Choo	High Performance Sport Institute	The Effects Of Carbonated Cold Water Immersion Of The Arm During Half-Time On Intermittent Exercise Performance In The Heat
3	AB78	Aoka ICHIKAWA	University Of Tsukuba	Hyperoxic Air Inhalation Does Not Affect Gastrointestinal Damage Or Function Following High-Intensity Running In The Heat
4	AB100	Damien Bovalino	Victoria University	Effects Of Short-Term Heat Acclimation On Endurance Cycling Performance In The Heat
5	AB125	Jinhao Wang	Shanghai Research Institute Of Sports Science (Shanghai Anti-Doping Agency)	Effects Of High-Temperature And High-Humidity Training On Laser Run Performance In Modern Pentathlon
6	AB127	Chenhao Tan	Shanghai Research Institute Of Sports Science (Shanghai Anti-Doping Agency)	EEG Characteristics Of Incremental Exercise To Exhaustion In Hot Environments: Evidence From Professional Athletes
7	AB156	Koji Muraishi	Rikkyo University, Meijigakuin University	Exploring Factors Influencing The Decline Rate In Intermittent Exercise Performance Under Heat Stress: A Correlation Analysis Using Heat Tolerance Tests

AB29

COMPARING THE EFFECT OF FULL VERSUS PARTIAL RANGE OF MOTION TRAINING ON HYPERTROPHY AND STRENGTH DEVELOPMENT

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Introduction: By manipulating range of motion (ROM) in resistance training, a partial ROM (pROM) at long-muscle-lengths may produce similar or superior hypertrophy to full ROM (fROM), while strength outcomes are equivocal [2]. Importantly, the response to pROM training appears to be muscle- and exercise-specific [1].

Purpose: To investigate hypertrophy and strength development of using fROM and pROM in the bench press exercise.

Method: Twenty-two untrained males completed an eight-week, two sessions per week withinparticipant intervention training with a unilateral Smith machine bench press. fROM and pROM protocols were randomly assigned to each arm. Pre- and post-test assessments included muscle thickness of the triceps brachii (TB), anterior deltoid (AD), and three sites of the pectoralis major (PM) using B-mode ultrasound, one-repetition maximum (1RM) fROM bench press and isometric maximal voluntary contraction (MVC) simulating two positions of the bench press ROM: bottom point (joint angle one) and half point (joint angle two).

Results: There were significant ($p < 0.05$) time effects from pre-test for muscle thickness in the TB, AD, PM, 1RM, MVC joint angles one and two; however, there were no significant betweenprotocol effects.

Discussion: For the bench press, omitting the top half of the ROM did not meaningfully impact hypertrophy and strength outcomes, likely due to the non-substantial tension contributed by that portion. pROM may be used as a viable alternative to fROM in the bench press for both fitness trainers and trainees based on personal preference, allowing for another efficient method towards hypertrophy and strength goals. Future work may investigate other muscle groups or exercises.

Keywords: range of motion, bench press, ultrasound, 1RM, maximal voluntary contraction

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AB57

The Effects of Carbonated Cold Water Immersion of the Arm During Half-time on Intermittent Exercise Performance in the Heat

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Introduction

Intermittent sport that involves complex motor cognitive tasks and exposure to moderate-to-high heat stress may benefit from cooling strategies [1]. Extremity cold water immersion (CWI) is a practical cooling strategy [2], and carbonated water immersion (CO_2WI) may augment cooling via cutaneous vasodilation and heat exchange [3].

Purpose

To investigate the effect of arm CO_2WI during half-time on intermittent exercise in the heat.

Method

Ten recreational athletes (8 M, 2 F) completed 2 x 39 min sprint cycling (34.63 ± 0.49°C, 54.2 ± 1.8% relative humidity [RH]) interspersed by a 13-min single arm cooling (21.79 ± 0.76°C, 64.5 ± 2.4%RH) in CWI (9.56 ± 0.60°C), CO_2WI (9.37 ± 0.51°C) and control (CON) conditions. Rectal (T_{re}) and skin temperature (T_{sk}), heart rate (HR), working memory (serial 7), peak (PPO) and mean power output (MPO), perceptual responses and whole-body sweat loss (WBS) were assessed.

Results

CO_2WI reduced T_{sk} more than CON (-1.18°C, $p = 0.007$), and CWI (-0.38°C, $p= 0.038$). During cooling, T_{re} reduction was 0.15°C greater in CWI versus CON ($p = 0.031$). When normalised to the first half, the percentage decrease in MPO was 4.2% greater in CON versus CWI ($p = 0.055$), whereas the percentage change in PPO was similar between conditions ($p = 0.280$). Perceptual responses, working memory, HR and WBS did not differ ($p > 0.05$).

Discussion

Half-time cooling via CWI or CO_2WI_2 did not decrease T_{re} or improve thermal perception appreciably more than CON. Hence, no ergogenic effects on physical or cognitive performance were observed.

Keywords

Team sport; Mid-cooling; Repeated sprint performance; Cognitive function; Artificial carbonic acid water

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AB78

ICEE 2026 – Abstract

Hyperoxic Air Inhalation Does Not Affect Gastrointestinal Damage or Function Following High-Intensity Running in the Heat

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Introduction: High-intensity exercise under heat-stressed conditions may cause gastrointestinal injury and impair digestion and/or absorption [1]. One possible factor mediating these responses is a reduced oxygen supply associated with gastrointestinal ischemia [2]. If so, hyperoxia inhalation may mitigate these detrimental influences.

Purpose: To determine the effects of hyperoxic air inhalation on gastrointestinal damage and digestive/absorptive capacity after high-intensity running in the heat.

Method: Eight healthy adults (one female) performed intermittent high-intensity running (5 min at 75% of maximal oxygen uptake with 2-min rest) under three randomized conditions: 1) 20°C while breathing room air (Control), 2) 25°C while wearing a windbreaker and breathing room air (Heat), or 3) 5°C while wearing a windbreaker and breathing ~40% O_2 (Heat+O_2). Fifteen minutes after running, participants consumed a glycoprotein beverage and rested for two hours. I-FABP (an intestinal injury marker), blood glucose and amino acid concentrations, heart rate, subjective nausea, perceived exertion, and breathing effort were recorded.

Results: I-FABP was higher in Heat and Heat+O_2 than in Control without difference between the two conditions. No between-condition differences were observed in blood glucose or amino acid concentrations. Subjective nausea was higher in Heat than in Control and Heat+O_2, with Heat+O_2 comparable to Control. Heart rate, perceived exertion, and breathing effort were lower in Heat+O_2 than in Heat.

Discussion: Hyperoxia inhalation during high-intensity running in the heat does not affect gastrointestinal damage and function, but it alleviates cardiac and perceptive stress. This approach might be used for reducing these stresses in occupational and athletic settings.

(250/250 words)

Keywords: Running, gastrointestinal damage, Heat stress

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AB100

Effects of Short-Term Heat Acclimation on Endurance Cycling Performance in the Heat

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Introduction

Heat acclimation (HA) training is an established tool to maximise physiological adaptations and enhance endurance performance in hot environmental conditions [1]. While most HA research has focused on males [2], recent research has uncovered physiological variances to established heat protocols [3] and sex-specific differences in thermoregulatory responses [4, 5].

Purpose

This study examined whether short-term HA using an emerging protocol, controlled heart rate (HR), in tier-two trained females and males, improves 1) 20 km cycling performance in the heat, and 2) physiological markers of HA.

Method

Sixteen trained cyclists (8 females, 8 males) completed five consecutive 110-minute HA sessions (40°C, 40% RH), while maintaining a HR equivalent to that at 65% of $\dot{V}O_2$max. Pre- and post-testing included a 30-minute heat stress test (40°C, 40% RH) and 20 km time-trial (33°C, 40% RH).

Results

Both sexes improved time-trial performance, females increased mean power by 4.9% and reduced duration by 2.0%, while males improved power by 6.7% and reduced duration by 2.6%. Females showed significant reductions in peak HR (−15.9 beats·min^{-1}) and peak core temperature (−0.33°C). Males demonstrated significant reductions in peak core temperature (−0.30°C) and expansion of plasma volume (3.5%). Perceptual measures improved across both groups.

Discussion

The controlled HR STHA protocol effectively enhanced thermoregulatory adaptation and performance in hot conditions. Females exhibited broader physiological adaptation, whereas males showed greater performance gains. The findings support the practical application of controlled HR based HA for athletes preparing for competition in the heat.

Keywords

heat acclimation, endurance performance, thermoregulation, sex differences.

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AB125

Effects of High-Temperature and High-Humidity Training on Laser Run Performance in Modern Pentathlon

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Introduction: High-temperature and high-humidity environments challenge physical adaptability and athletic performance during competition.
Purpose: This study investigates whether 10 sessions of high-temperature and high-humidity training enhance physical adaptation and laser run performance in modern pentathletes.
Methods: Seven elite pentathletes completed a crossover trial comprising 10 training sessions in either a control (23°C, natural humidity) or a simulated hot-humid environment (35°C, 70% relative humidity), separated by a 4-week washout. Sessions alternated continuous (60-70% VO_2max) and sprint (80-90% VO_2max) treadmill running. Assessments included blood biomarkers, thermoregulation, cognitive function (spatial cueing, Stroop tasks), and physical capacity tests.
Results: Hot-humid training significantly increased sweating rate and IL-6, while decreasing resting heart rate, maximum core temperature, physiological strain index, and epinephrine ($p < 0.05$). Cognitive tests revealed faster reaction times and improved attention post-training. Performance metrics showed upward trends in relative VO_2max, anaerobic threshold, and laser run times. These improvements outperformed the control group, which exhibited significant declines in relative average power.
Discussion: Hot-humid training induces positive cardiovascular and thermoregulatory adaptations, effectively reducing physiological stress. It enhances reaction speed, attention, and environmental tolerance without compromising shooting accuracy or anaerobic capacity. Ultimately, this protocol demonstrates a substantial positive effect on aerobic capacity and overall laser run performance.

Keywords: High temperature and high humidity, Modern pentathlon, Laser run

AB127

EEG Characteristics of Incremental Exercise to Exhaustion in Hot Environments: Evidence from Professional Athletes

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Introduction: This study investigates the EEG characteristics of professional athletes during incremental exercise to exhaustion in hot environments, addressing central nervous system mechanisms and task-specific fatigue patterns.
Purpose: To provide a more comprehensive understanding of the central neural activity associated with exhaustion induced by incremental load exercise in a hot environment.
Methods: Eleven professional athletes completed incremental exercise tests to exhaustion in hot (35°C) and temperate environments. Resting-state EEG (eyes-open and eyes-closed) was recorded before and after exercise, analyzing power spectral density across δ, θ, α, β, and γ bands.
Results: While subjective fatigue was similar across conditions, neural responses varied by temperature. In the eyes-open state, β and γ power were higher in the heat, with β power increasing post-exercise only in the hot environment. In the eyes-closed state, post-exercise δ, α, and β power increased, with δ, β, and γ bands showing higher under heat stress.
Discussion: Incremental exercise primarily elicits α activity, while heat exposure drives δ and γ activity, reflecting bottom-up emotional processing. The intensified β-band response in the heat suggests heightened demands for top-down cognitive control and emotional regulation [1, 2]. These findings contribute to exercise fatigue theory by showing that exhaustion in elite athletes involves active neuro-cognitive processing rather than mere physical depletion. Future research should explore these EEG signatures as biomarkers for heat acclimation and performance assessment.

Keywords: fatigue, incremental exercise, hot environment, EEG, athlete

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AB127

EEG Characteristics of Incremental Exercise to Exhaustion in Hot Environments: Evidence from Professional Athletes

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Results: While subjective fatigue was similar across conditions, neural responses varied by temperature. In the eyes-open state, β and γ power were higher in the heat, with β power increasing post-exercise only in the hot environment. In the eyes-closed state, post-exercise δ, α, and β power increased, with δ, β, and γ bands showing higher under heat stress.
Discussion: Incremental exercise primarily elicits α activity, while heat exposure drives δ and γ activity, reflecting bottom-up emotional processing. The intensified β-band response in the heat suggests heightened demands for top-down cognitive control and emotional regulation [1, 2]. These findings contribute to exercise fatigue theory by showing that exhaustion in elite athletes involves active neuro-cognitive processing rather than mere physical depletion. Future research should explore these EEG signatures as biomarkers for heat acclimation and performance assessment.

Keywords: fatigue, incremental exercise, hot environment, EEG, athlete

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AB156

Exploring Factors Influencing the Decline rate in Intermittent Exercise Performance Under Heat Stress: A Correlation Analysis Using Heat Tolerance Tests

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The present study aimed to identify the factors influencing the rate of performance decline during intermittent exercise under hot versus cool conditions, using exploratory analysis based on thermoregulatory and physiological responses during a heat tolerance test (HTT). Ten male university soccer players participated in three experimental trials. The intermittent soccer performance test (iSPT) [1] was conducted under cool (16 °C, 50% rh) and hot (36 °C, 50% rh) conditions. The iSPT comprised two 45-min halves, each comprising identical 15-min blocks. The HTT employed the Israeli Defense Forces model, involving a 2-h walk at 5 km/h−1 with a 2% gradient at 40 °C and 40% rh [2]. The results indicated significantly lower total distance covered and high-speed running distance during iSPT in hot conditions compared with cool conditions. Correlation analysis was conducted between the rate of performance decline in the iSPT and thermoregulatory responses during the HTT. The results revealed a significant positive correlation between the decline rate in high-speed running distance in the iSPT and the mean thermal circulatory ratio over both the first 60-min and the entire 120-min duration of the HTT ($p < 0.05$). These findings suggest that athletes who made a decline in performance under hot conditions are more adversely affected by heat stress than those who maintain their performance, even under the same exercise load. Furthermore, it has been suggested that even a short 60-min HTT may be useful as a screening tool for predicting performance decline levels prior to heat exposure.

Keywords: hot condition, intermittent exercise performance, heat tolerance test, thermoregulatory responses

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18th August 2026
Poster Presentation 1 (14:30 - 15:30)
Theme: Nutrition and Hydration Strategies in Challenging Environments

No	Abstract ID	Presenter	Affiliation	Title Of Presentation
1	AB36	Kyoko Fujihira	Tokyo University of Technology	Glycemic and gastrointestinal responses to temperature-varied rice porridge in healthy adults: a randomised crossover trial
2	AB145	Jiaojiao Lu	Shanghai Research Institute of Sports Science (Shanghai Anti-doping Agency)	Effects of Exercise Heat Stress on Gut Barrier Function and Microbiota During Heat Acclimation in Elite Modern Pentathlon Athletes: An Exploratory Study
3	AB182	Juthamard Surapongchai	Faculty Of Physical Therapy, Mahidol University, Nakhon Pathom, Thailand	Hydration Benefits And Behavioral Time Cost Of Prescribed Versus Ad Libitum Drinking During Half-Marathon Running In Older Adults

AB36

Glycemic and gastrointestinal responses to temperature-varied rice porridge in healthy adults: a randomised crossover trial

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Introduction: Postprandial hyperglycaemia is a risk factor for diabetes and cardiovascular disease [1]. Cool foods may suppress postprandial blood glucose elevation by delaying gastric emptying [2].

Purpose: We investigated the effects of rice porridge temperature on postprandial blood glucose levels and digestive dynamics.

Method: Fourteen healthy males participated in a randomised crossover trial. Participants consumed 400 g of rice porridge (carbohydrates: 54.4 g, 240 kcal) at either 8°C (Cold) or 60°C (Hot). Capillary blood samples were collected 13 times to analyze blood glucose levels, including fasting and up to 240 minutes postprandial. During fasting and up to 300 minutes postprandial, breath samples were collected 15 times to evaluate gastric emptying rate, and 6 times to assess exhaled breath hydrogen concentration. Gastrointestinal temperature was measured continuously. The amount of resistant starch was measured to evaluate dietary fibre within the rice porridge.

Results: Peak blood glucose time were delayed by approximately 10 min in Cold compared with Hot ($p=0.013$). Cold exhibited lower gastrointestinal temperatures immediately after and at 10, 15, 20, 50, 60, 75, and 90 minutes post-ingestion than Hot (all $p<0.05$), and delayed gastric emptying was observed at 5 minutes post-ingestion ($p=0.020$). No differences in the area under the postprandial blood glucose curve ($p=0.783$), breath hydrogen levels ($p=0.712$), or resistant starch content ($p=0.230$) were observed between the trials.

Discussion: Temperature of rice porridge can potentially modulate postprandial glycemic response by lowering gastrointestinal temperature and delaying initial digestion.

Keywords: food temperature, glucose metabolism, digestion, absorption
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AB145

Effects of Exercise Heat Stress on Gut Barrier Function and Microbiota During Heat Acclimation in Elite Modern Pentathlon Athletes: An Exploratory Study

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Introduction: Exercise in extreme heat and humidity can compromise gut barrier integrity and alter microbiota homeostasis. However, these physiological responses in elite athletes remain poorly understood.
Purpose: This study aims to investigate the effects of extreme heat and humidity during exercise on gut barrier function, microbiota composition, and metabolic responses in elite athletes.
Method: Five national-level modern pentathlon athletes completed nine 60-minute treadmill heat acclimation sessions (35°C, 85% relative humidity) at 70-80% VO2max. Pre-, mid-, and post-training assessments included blood biomarkers (LBP, LPS, FABP2), intestinal permeability (lactulose/mannitol ratio), gut microbiota composition, short-chain fatty acids (SCFAs), and physiological variables.
Results: Heat stress significantly elevated LBP and plasma LPS, and increased small intestinal permeability. The epithelial injury marker FABP2 did not markedly increase. The dominant gut microbiota remained stable with no significant diversity shift, though rare taxa were transiently suppressed. Unexpectedly, butyrate-producing core taxa were selectively enriched post-exercise, while overall SCFA concentrations showed negligible changes.
Discussion: Acute exercise under thermal stress impairs gut barrier function and promotes endotoxin translocation, which appears to reflect immune activation rather than direct epithelial damage. The unexpected stability of the microbiota and enrichment of beneficial bacteria highlight the complexity of gut adaptation to extreme heat. Larger-scale investigations are warranted to validate these findings and further elucidate these adaptive mechanisms.

Keywords: exercise heat stress; gut barrier permeability; heat acclimation; gut microbiota; short-chain fatty acids

AB182

Hydration Benefits and Behavioral Time Cost of Prescribed Versus Ad Libitum Drinking During Half-Marathon Running in Older Adults

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Introduction: Older adults exhibit reduced thirst sensitivity and altered fluid regulation, increasing risks of dehydration during prolonged exercise in warm environments [1]. Prescribed drinking (PD) strategies are commonly recommended to reduce body mass loss; however, their practical implications during endurance events remain unclear [2].

Purpose: To compare prescribed drinking (PD) and ad libitum drinking (AD) on hydration, physiological responses, perceptual measures, running performance, and behavioral time cost during a half-marathon among older adult runners.

Method: Nine older male runners (58 ± 4 y) completed two 21.1-km outdoor trials in warm conditions (~23–24 °C; ~82–85% RH). In AD, participants consumed water voluntarily at designated stations. In PD, individualized fluid volumes (70% of sweat loss) with sodium replacement (100% of sweat Na^+ loss) were provided. Gastrointestinal temperature, heart rate, fluid balance, blood indices, perceptual ratings, and total time cost of drinking (deceleration + drinking + acceleration) were measured.

Results: PD significantly reduced body mass loss compared with AD (−0.9 ± 0.2% vs −2.1 ± 0.5%, $p < 0.01$) and lowered thirst perception ($p < 0.05$). However, gastrointestinal temperature, heart rate, plasma volume changes, and total running time were similar between strategies. PD required more frequent drinking and resulted in a greater total time cost (3.9 ± 1.7 min vs 2.8 ± 1.3 min, $p = 0.04$), without affecting overall completion time.

Discussion: Prescribed drinking improved hydration control and reduced perceived thirst in older runners exercising in warm conditions [3,4], albeit with a modest behavioral time cost [5]. Hydration strategies for recreational endurance athletes should balance physiological benefits with practical considerations during competition.

Keywords: Half-Marathon/ Running performance/ Older adults/ Dehydration/ Fluid replacement

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18th August 2026
Poster Presentation 1 (14:30 - 15:30)
Theme: High Altitude Physiology and Ergonomics

No	Abstract ID	Presenter	Affiliation	Title Of Presentation
1	AB90	Xi Wang	Shanghai Research Institute Of Sports Science	The Characteristics Of Metabolic Changes Before And After Repeated-Sprint Training In Hypoxia Based On Non-Targeted Metabolomics In Elite Athletes

AB90

The Characteristics of Metabolic Changes before and after Repeated-Sprint Training in Hypoxia Based on Non-Targeted Metabolomics in Elite Athletes

Introduction Repeated-sprint training in hypoxia (RSH) can performance and reduces body fat in obesity, but metabolic changes in elite athletes are underexplored in China.

Purpose To characterize plasma metabolic profile alterations in elite athletes after 2-week RSH using untargeted metabolomics, and analyze associations with blood lipids and body composition.

Methods Plasma samples, body composition, and blood lipids were collected from 11 elite athletes before and after 2-week RSH. Metabolites were detected via LC-MS and GC-MS, with differential metabolites screened and key pathways identified via KEGG enrichment. Correlations between metabolites and clinical indices were evaluated.

Results (1) 20 differential metabolites were identified: 17 lipids were significantly up-regulated, while 1 amino acid and 2 carbohydrate derivatives were down-regulated. (2) KEGG analysis linked metabolites to HIF-1, cAMP, and sphingolipid pathways. (3) Post-training, total cholesterol ($P < 0.05$) and HDL-C ($P < 0.001$) increased; triglycerides decreased ($P < 0.01$). Minor, non-significant reductions in body weight, fat, FMI, and FFM were observed. (4) TC correlated negatively with PI (16:0/22:4) and D-fructose; HDL-C correlated negatively with D-fructose and β-D-glucuronic acid. Body fat and FMI positively correlated with carnitine derivatives.

Discussion RSH promotes lipid decomposition, fatty acid utilization, and reduces carbohydrate accumulation, benefiting lipid metabolism. Further research is needed.

Keywords non-targeted metabolomics, repeated-sprint training in hypoxia, differential metabolites, lipid metabolism, body composition, athlete

18th August 2026
Poster Presentation 1 (14:30 - 15:30)
Theme: Climate Extreme and Occupational population

No	Abstract ID	Presenter	Affiliation	Title Of Presentation
1	AB61	Zhexin Zhang	Heat Resilience & Performance Centre, Yong Loo Lin School Of Medicine, National University Of Singapore, Singapore	Perceptions, Attitudes And Behaviours Of Delivery Riders Towards Occupational Heat Stress And Kidney Health
2	AB135	Livia Delattre	Université Du Québec À Trois-Rivières	Risk Of Heat Injury Among Firefighters According To Ambient Temperature And Humidex
3	AB185	Bethany Skinner	University Of Birmingham	The Influence Of Rest And Water On Self-Paced Exercise In Hot Conditions

AB61

Perceptions, Attitudes and Behaviours of Delivery Riders Towards Occupational Heat Stress and Kidney Health

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Introduction

Delivery riders experience prolonged heat exposure which in combination with physical exertion and recurrent dehydration, may elevate the risk of developing exertional heat illnesses (EHI) and kidney-related disorders [1,2]. Riders' perspectives can affect the effectiveness of strategies implemented, but is currently underexplored [3].

Purpose

To explore delivery riders' perceptions, attitudes, and behaviours regarding occupational heat stress, and its impacts on kidney health.

Method

Twenty-three delivery riders (age: 44±8 years; working hours/day: 9±2 hours) completed pre- and post-shift questionnaires on thermal sensation and satisfaction, and semi-structured post-shift interviews. Interviews were audio-recorded, transcribed verbatim, and analysed using thematic analysis.

Results

Four main themes emerged: (1) The inherent nature of delivery work promoting behaviours that increases EHI-risk and kidney-related disorders; (2) Misalignment between thermal perception and perceived personal susceptibility to EHI (e.g., 80% reported hot working conditions and 60% thermal dissatisfaction but 48% felt there was no EHI-risk); (3) Insufficient awareness of work-related impact on kidney health (i.e., 65% perceive no effect); and (4) Inadequate organisational support.

Discussion

Riders' willingness to continue despite perceived hot working conditions, is likely due to the piece-rate, time-sensitive nature of delivery work, highlighting the need for strategies that address structural constraints. Their perceived invulnerability to EHI is of concern and may limit adoption of heat mitigation strategies. This, together with limited understanding of kidney-related health risks suggests that existing organisational efforts, currently limited to general heat advisories, are inadequate. More targeted and proactive measures such as mandatory heat-safety training, parametric insurance and tailored educational campaigns are required to drive behavioural change.

Keywords: heat stress, gig workers, risk perception, kidney-related disorders

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AB135

Risk of heat injury among firefighters according to ambient temperature and humidex

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Introduction: Despite heat-related illness (HRI) being common among firefighters1, little is known about risk by dry temperature and humidex.

Purpose: To assess the risk of HRI in firefighters according to dry temperature and humidex.

Methods: Municipal records from four fire departments (2003–2025) were screened for HRI2. Each case was matched to hourly climate data3 to assign dry temperature and humidex. Cases were grouped in dry temperature (≤15°C, 15–18°C, 18–21°C, 21–24°C, 24–27°C, ≥27°C) and humidex (≤20, 20–25, 25–30, 30–35, 35–40, ≥40). HRI risk was calculated as cases per hour and relative risks (RR) were calculated.
Results: Ninety-two HRI cases were identified. Compared with 18–21°C, risk appears significantly lower ≤15°C (RR=0.09, 95%CI=0.04–0.18), but not different at 15–18°C (RR = 0.49, 95%CI=0.21–1.14) or 21–24°C (RR=1.20, 95%CI=0.60–2.43). Risk seems significantly greater at 24–27°C (RR=3.63, 95%CI=1.95–6.73) and ≥27°C (RR=9.94, 95%CI=4.09–24.17). Using 20–25 humidex as reference, risk appears significantly lower ≤20 (RR=0.11, 95%CI=0.05–0.22), not different at 25–30 (RR=0.78, 95%CI=0.37–1.64) or 30–35 (RR=1.91, 95%CI=0.93–3.91), but significantly higher at 35–40 (RR=2.67, 95%CI=1.07–6.64) and ≥40 (RR=6.31, 95%CI=1.40–28.48).

Discussion: Firefighters appear particularly at risk of HRI at ≥24°C or ≥35 humidex.

Results will inform more specific HRI prevention recommendations.
Keywords: Heat related injury, firefighters, occupational heat stress.

AB185

The Influence of Rest and Water on Self-Paced Exercise in Hot Conditions

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Introduction: Rising global temperatures are intensifying occupational heat stress, requiring a reassessment of work-rest guidelines.

Purpose: This study aimed to examine the influence of a mandatory rest and water break on work rate and physiological responses during self-paced exercise in hot conditions.

Methods: Twelve participants (6 female; 23 ± 3 yrs) completed two 2-h self-paced cycling time trials in hot conditions (38°C, 30% relative humidity): REST (10-min seated rest after 1-h, access to cool water water) and NO-REST (no mandatory rest, access to tepid water). Power (Watts), rectal temperature (T_{Core}), skin temperature (T_{Skin}), and heart rate (HR) were recorded throughout. Paired *t*-tests (REST vs. NO-REST) and two-way RM ANOVAs (*trial* [REST vs. NO-REST] x *time*) were performed.

Results: When cycling, mean and total power output were similar between trials (mean: NO-REST 89 ± 28 W vs. REST 94 ± 27 W, p=.10; total: NO-REST 10,626 ± 3,276 W vs. REST 10,168 ± 2,903 W, p=.19). Area under the curve (AUC), maximum, and average T_{Core} and T_{Skin} were similar between trials (p>.27). HR at 1:10-h was lower during REST compared to NO-REST (−41 ± 18 bpm; p<.01). HR was similar between trial conditions at all other timepoints (p>.18). AUC and average HR were similar between trials (p>.12).

Discussion: Despite a mandatory 10-minute rest, cycling work rate was similar between trials. Although HR showed a transient reduction following rest, thermal strain was comparable between trials. These findings have implications for worker productivity and health in hot environments.

18th August 2026
Poster Presentation 1 (14:30 - 15:30)
Theme: Cold Environments: Survival, Adaptation, and Performance

No	Abstract ID	Presenter	Affiliation	Title Of Presentation
1	AB74	Martin Barwood	Leeds Trinity University, Leeds, West Yorkshire, U.K	Heated seats for soccer substitutes to enhance performance, perception and health prior to pitch entry
2	AB150	Birhanu Zeleke Tilinti	Environmental Ergonomics, Faculty Of Engineering, Hokkaido University, Sapporo, Japan	Effects Of 4-Week Beetroot Consumption On Local Blood Circulation During Vascular Occlusion And Hand Cold Immersion: A Single-Group Pilot Study In Healthy Adults

AB74

Heated seats for soccer substitutes to enhance performance, perception and health prior to pitch entry

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Introduction. Pre-pitch entry warm-up routines in professional soccer substitutes are limited by rules and available space. Consequently, substitutes cool down whilst spending time sat idle on sports car seats awaiting pitch entry.

Purpose. We investigated whether supplementary heating through the car seat, reversed this effect enhancing pre-pitch entry health, performance and perception; we hypothesized it would (H_1).

Method. Seventeen, trained male soccer players (20 [2]yrs; height 1.81 [0.1]m; 76.8 [9.7]kg) completed two simulated soccer matches. Participants warmed-up, sat on heated (HOT-SEAT) or unheated (CONTROL) seats for 45-minutes, re-warmed up, followed by 15-minutes seated rest. They completed performance tests post warm-up, at "half-time", and after 60-minutes. They then completed 30-minutes soccer match simulation. Measures were deep body temperature (gastrointestinal pill; T_{GI}), thermal image surface temperature, seat temperature (T_{seat}), sweat production, thermal sensation (TS). Paired t-test and ANOVA compared data (0.05 alpha).

Results. T_{seat} was higher in the HOT-SEAT condition (38.9 [2.5]°C) than CONTROL (25.8 [1.9]°C; t= 16.46, p<.0001) creating skin>core gradient. This didn't result in higher T_{GI} (37.2 [0.2] vs 37.2 [0.3]°C; t= .39, p=.70) but did increase TS (16.4 [1.4] vs 10.3 [1.4]cm t= 10.9, p<.0001); participants felt "hot" vs "neutral". Surface temperature increased. Fifteen metre sprint speed (2.6 [0.1] vs 2.7 [0.2]s; t= 2.38, p=.03) and flexibility (15.0 [7.1] vs 13.2 [6.7]cm; t= 2.38, p=.04) were enhanced at half-time but not pre-pitch entry. Sweating didn't change (grand mean △1.2 [0.5]L).

Discussion. Heated substitute seat enhanced performance metrics at half-time, reduced injury risk (i.e., greater flexibility) without adversely affecting perception.

Keywords. Heated seat, neuromuscular recruitment, sprint speed, flexibility, thermal sensation.

AB150

Effects of 4-Week Beetroot Consumption on Local Blood Circulation During Vascular Occlusion and Hand Cold Immersion: A Single-Group Pilot Study in Healthy Adults

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Introduction: Cold exposure challenges peripheral circulation and reduced tissue oxygenation (StO_2), increasing the risk of cold injury. Effective endothelial vasomotor control is therefore essential for maintaining peripheral perfusion. Dietary nitrate (NO_3^-)-rich beetroot (BR) may enhance nitric oxide-mediated vasodilation [1]. However, the effects of long-term BR supplementation on microvascular and endothelial responses during cold exposure remain unclear.

Purpose: This study aimed to investigate the effects of four-week BR consumption on peripheral microvascular function during vascular occlusion (VO) and hand cold immersion in healthy adults.

Method: Ten healthy males (age 20.8 ± 1.0 yr) completed pre- and post-intervention tests, which included 20-min immersion of the left hand in 15°C water followed by rewarming, and a VO test. Whole-body skin temperature (Tsk), skin blood flow (SkBF) at the dorsal hand, fingertip, forearm, and StO_2 at the forearm using near-infrared spectroscopy, were continuously measured.

Result: The left-hand palm showed slightly higher Tsk during the mid-immersion phase in the post-intervention ($p < 0.05$), while other sites remained unchanged. Recovery speed of the dorsal-hand SkBF was significantly faster in the post-intervention ($p < 0.05$). However, the post-intervention recovery speed of the palm was slower than pre-intervention. During the VO test, SkBF and StO_2 showed no significant difference.

Discussion: BR supplementation did not produce consistent changes in peripheral vascular responses during VO and hand cold immersion. These findings guide the design of larger placebo-based comparative studies to clarify the effects of BR on peripheral circulation, including targeted population selection, protocol optimization, and more sensitive endpoints.

Key Words: Nitrate, Tissue oxygenation, Vascular occlusion

Reference

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ICEE 2026

POSTER PRESENTATIONS

21st August 2026
Poster Presentation 2 (14:30 - 15:30)
Theme: Environmental Stress and Health Related Outcomes

No	Abstract ID	Presenter	Affiliation	Title Of Presentation
1	AB28	Sofia Pappa	Maastricht University	Energy metabolism and thermoregulatory responses to 32h heat exposure in healthy, young adults
2	AB34	Jun'ya Takakura	National Institute for Environmental Studes, Japan	Datasets for Connecting Global Climate Projections with Local Individual Heat Exposure and Physiological Consequences
3	AB88	Alexandros Sotiridis	School Of Physical Education And Sport Science, National And Kapodistrian University Of Athens, Athens, Greece	Low Fitness And Tobacco Smoking Act Additively To Reduce The Second Ventilatory Threshold

AB28

Energymetabolismand thermoregulatory responses to 32h heat exposure in healthy, young adults

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Introduction: The progression of climate change is exposing individuals to elevated temperatures, with increasing prevalence of extreme heat events globally [1]. Ambient temperature influences energy metabolism and whole-body physiology [2]. Most research is limited to short durations, not reflecting real-world scenarios. Prolonged heat, including warmer sleeping environments and alternating fasted-postprandial phases during daily living, may induce a distinct physiological state influencing metabolism, thermoregulation, and sleep at night and the following day.

Purpose: This study aims to assess the effect of 32h heat exposure, simulating heat-wave conditions, on energy metabolism, thermoregulation, cardiovascular parameters and sleep in healthy, young adults.

Methods: In a randomized-crossover design, 13 males and females (18-35y, BMI 18.5-25kg/m2) are exposed to 32h dry heat (35ºC day/28ºC night) and thermoneutral conditions (25ºC day/18ºC night) with standardised clothing. Participants enter the room at 10:00 until 18:00 the following day. Energy requirements are calculated individually to provide standardised meals. Whole-body energy expenditure is measured using indirect room calorimetry. Thermoregulatory and cardiovascular responses are measured continuously. Metabolic and inflammatory markers are assessed by frequent blood sampling. Sleep quality is assessed by accelerometry and questionnaires. Brain-MRI is performed to assess vascular and glymphatic function post-heat.

Results: Preliminary data will be presented at the conference, as the study is ongoing.

Discussion: This study will deliver essential knowledge into how prolonged heat alters human health and metabolism under future heat-wave conditions. Although older individuals are at greater risk, this study includes younger individuals to detect physiological responses due to greatermetabolic flexibility and thermoregulatory capacity.

Keywords: Energy metabolism, thermoregulation, sleep quality, heat exposure.

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Datasets for Connecting Global Climate Projections with Local Individual Heat Exposure and Physiological Consequences

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Introduction: Climate change poses significant challenges to humans, including physiological thermal stresses. Although climate models are well developed and future simulations are available [1], a large gap remains between individual physiological outcomes and simulated climate change due to coarse data resolution.

Purpose: The purpose of this study is to develop a climate simulation dataset that can more easily be used by researchers in thermal physiology. The dataset shall include the thermally relevant variables (e.g., air temperature, relative humidity), or combined indices (e.g., wet-bulb globe temperature) at an hourly resolution, covering all global land areas in the future.

Method: Future climate projections from the Coupled Model Intercomparison Project Phase 6 [1] are used as input. We applied machine-learning-based statistical downscaling techniques to enhance the spatial [2] and temporal [3] resolutions and generated the refined datasets.

Results: The outputs are three-dimensional gridded climate datasets (namely, air temperature,relative humidity, air pressure, wind speed, solar radiation, and wet-bulb globe temperature) defined by longitude, latitude (0.05° resolution), and time (1-hour resolution). For example, simulated future climate conditions in Kuching can be extracted from the corresponding grid cell at any time point in the 21st century.

Discussion: The produced results can be used, for example, to decide the experimental conditions for climate chambers to investigate the expected physiological thermal strains under future climate change. It can also serve as input for numerical thermal simulation models [4]. We also plan to distribute the dataset through our web platform.

Keywords: climate change, simulation, downscaling, thermal stress

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AB88

Low fitness and tobacco smoking act additively to reduce the second ventilatory threshold

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Introduction: Acute cigarette smoking reduces endurance time at maximal exercise [1]. We have recently shown a higher hemoglobin mass but a lower peak aerobic speed in moderate smokers across different fitness levels [2]

Purpose: To examine whether tobacco smoking impairs the ability to perform high-intensity exercise by virtue of a lower second ventilatory threshold (VT2).

Method: Thirty young males were divided into independent groups (CS-MF, CS-LF, NS-MF and NS-LF) based on smoking status (CS; chronic smokers and NS; non-smokers) and aerobic fitness level (MF; more fit and LF; less fit). CS had been smoking> 10 cigarettes·day− 1 at least for the last three years. Assessed using cardiopulmonary exercise testing, an age-adjusted VO2peak higher or lower than the 60th percentile was selected as the threshold criterion for MF and LF groups, respectively, as described previously [2]. VT2 was estimated using the nadir point in the ventilatory equivalent for carbon dioxide-running speed curve [3]. A two-way ANOVA was performed to detect mean differences.

Results: The main effect for smoking status ($p = 0.001$) on VT2 was only reflected in higher values for NS-LF compared to CS-LF (+3.09 km·h− 1, $p = 0.005$), whereas the difference between MF groups was not of sufficient magnitude (+1.29 km·h− 1, $p = 0.445$). Expressed as %VO2peak, smoking status did not affect VT2 (main effect: $p = 0.425$). Discussion: A differential effect of chronic tobacco smoking is observed on VT2 in individuals of a lower fitness level. Hemoglobin mass should be dissociated from endurance performance in the population of smokers.

Keywords: carboxyhemoglobinemia, CO-rebreathing, anaerobic threshold, enduranceperformance.

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21st August 2026
Poster Presentation 2 (14:30 - 15:30)
Theme: Clothing and Human-Environment Interaction

No	Abstract ID	Presenter	Affiliation	Title Of Presentation
1	AB38	Yoon Jeong Baek	Institute of Human Ecology, Seoul National University	Effects of Wet Cooling Sheet Temperature on Physiological Heat Strain Relief with Ice Packs in a Hot Environment
2	AB147	Karl Friedl	US Army Research Institute of Environmental Medicine	Staying Warm When Dry Is Impossible: Biophysical Lessons from Indigenous Arctic Clothing Systems
3	AB205	Yonghyun Cho	Department of Mechanical and Aerospace Engineering, Seoul National University	Uniform Moisture Accumulation but Regional Differences in Thermal Sensation during Arm and Leg Exercise in Fully Encapsulated Protective Clothing

AB38

Effects ofWet Cooling Sheet Temperature on Physiological Heat Strain Reliefwith Ice Packs in a Hot Environment

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Introduction: To prevent and mitigate heat-related illnesses in soldiers, our team identified the most effective body cooling regions [1] and confirmed their efficacy in hot- humid conditions [2]. Because water is often limited in summer field settings, it remains important to determine whether wet– sheet cooling remains effective with warmer water.

Purpose: This study investigated whether wet cooling sheet temperatureswith ice gel packs affect the alleviation of heat strain in military personnel in a hot environment.

Method: Eight healthy males participated in three randomized crossover trials in a climate chamber (33° C, 50%RH). Each trial consisted of 10-min rest, 50-min exercise, and 30- min cooling. During the cooling, a wet sheet covered the trunk and thighs, replaced every minute. Rectal temperature, skin temperatures, heart rate, thermal sensation, thermal comfort,sweat sensation, and evaporative heat loss from sheet mass change were measured. Effects were analyzed using RM-ANOVA (< 0.05)

Results: Across conditions, rectal temperature decreased by 0.9 ± 0.2° C from peak by the end of cooling, with no differences between conditions. Mean skin temperature showed a nonsignificant trend to decrease with greater reductions at lower sheet temperatures, while evaporative heat loss was similar (190– 220 kcal h^{-1}) Thermal sensation and comfort improved earlier at 20° C and 24° C than at 28° C during the early cooling (<0.05), but differences disappeared by the end.

Discussion: These findings suggest that cooling remains comparable with moderately warmer water, and that a 20 – 28° C sheet temperature can still meaningfully lower body temperature. Thus, wet-sheet cooling may be practical when water is limited.

Keywords: Evaporative heat loss, Military combat suit, Rectal temperature, Heat-related disorder, Cooling intervention.

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StayingWarmWhen Dry Is Impossible: Biophysical Lessons fromIndigenous Arctic Clothing Systems

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Introduction: Modern cold-weather clothing systems emphasize lightweight insulation,moisture wicking, and membrane-based weather protection. Yet across the Arctic and sub-Arctic, Indigenous cold-dwelling populations developed clothing systems that sustained human performance and survival at temperatures routinely below − 30 ° C—without synthetic fibers, waterproof membranes, or active heating.

Purpose: Identify how traditional Arctic clothing systems have been optimized not to keep the wearer dry or maximally insulated, but to keep the wearer functional when moisture, wind, and prolonged exposure made perfection impossible.

Method: This narrative review compared the cold weather clothing customs and behaviors of several indigenous cold-dwelling groups: Mongolians, Tuvans, Greenlandic Inuits, and Saami – based on published reports.

Results: Common design principles recur across cultures: loose, volumetric garments that preserve air layers and circulation; animal-derived fibers that insulate when damp and buffer moisture; deliberate separation of skin microclimate control from bulk insulation; and modular, repairable components that allow recovery after wetting or freeze– thaw events. Caribou/reindeer fur, musk ox qiviut, seal skin, and wool form the unbeatable natural toolkit for cold weather because they insulate when damp, manage moisture intelligently, and preserve circulation. Specific feature combinations vary between the groups based on climate requirements ranging from maritime to continental Arctic.

Discussion: Revisiting traditional cold-weather clothing design offers actionable insights for improving thermal resilience, moisture tolerance, and comfort stability in modern occupational, military, and outdoor environments. Indigenous cold systems occupy stable positions within a moisture–insulation design space, whereas modernmodular systems require active usermanagement to remainwithin optimal performance regions.

Keywords: cold temperature, heat loss, environmental exposure

AB205

UniformMoisture Accumulation but Regional Differences in Thermal Sensation during Armand Leg Exercise in Fully Encapsulated Protective Clothing

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Introduction: Introduction: Although fully encapsulated protective clothing provides critical barrier protection, it substantially disrupts thermoregulatory processes by restricting heat and moisture exchange between the body and the external environment. Consequently, the resulting thermal burden may vary depending on the type of work performed (e.g., upper-limb or lower-limb tasks).

Purpose: This study aimed to investigate clothing microclimate characteristics and subjective perceptions while wearing fully encapsulated protective clothing during arm and leg exercise.

Methods: Eight young males participated in two experimental conditions: upper-limb exercise (ARM) and treadmill walking (LEG) at 20 ° C and 50%RH. Total sweat rate was estimated from changes in body mass. Clothing microclimate humidity was continuously monitored at the chest, back, and thigh. Thermal sensation and wetness sensation were assessed every 10 min for the whole body and selected body regions.

Results: Total sweat rate did not differ significantly between conditions (LEG: 631 ± 19 g/h vs. ARM: 694 ± 91 g/h). Clothing microclimate humidity reached 99%RH by the second exercise bout at the chest, back, and thigh, with no differences between conditions. However, during the second exercise bout, the legs and feet were perceived as significantly hotter in the LEG condition than in the ARMcondition < 0.05). No substantial differences were observed in whole-body or regional wetness sensation between conditions.

Discussion: Under fully encapsulated conditions, localized (thermal sensation corresponded to the active body region—subjects felt hotter in the legs and feet during leg exercise. However, wetness sensation and clothing microclimate humidity increased to near-maximal levels across all measured regions, regardless of exercise type, indicating uniformly elevated moisture accumulation inside the protective clothing.

Keywords: protective clothing, clothing microclimate, exercise-mode dependent, wetness sensation

21st August 2026
Poster Presentation 2 (14:30 - 15:30)
Theme: Heat Stress and Human Performance

No	Abstract ID	Presenter	Affiliation	Title Of Presentation
1	AB13	Tianyu Zhang	University Of Otago	Adverse Effects Of Dehydration On Exertional Tolerance In Typical Contexts Might Be Overestimated
2	AB56	Kayoung Cho	Seoul National university	Dissociation Between Cooling Perception and Heat Storage Following Topical 0.9% L-Menthol During Passive Heating
3	AB84	Kosuke Higuchi	University Of Hokkaido	Regional Differences In Thermoregulatory Responses During Mild Heat Exposure
4	AB116	Nicole Yeo	Heat Resilience & Performance Centre, Yong Loo Lin School Of Medicine, National University Of Singapore, Singapore	Speech Changes During Volitional Exhaustion In The Heat
5	AB164	Tomomi Fujimoto	Niigata University of Health and Welfare	Effects of Topical Capsaicin Application to the Thigh on Quadriceps Muscle Function and Hemodynamics
6	AB173	Yumi Okamoto	Niigata University of Health and Welfare	Thermoregulatory Responses and Running Performance During a Competitive Female Soccer Match in a Cool Environment: A Preliminary Observation
7	AB176	Hoyeon Jung	Department of Fashion and Textiles, Seoul National University, Seoul, Korea	Effects of Alcohol Intake and Sleep Deprivation on Physiological Burden While Wearing Firefighter Protective Clothing in a Hot Environment

Adverse effects of dehydration on exertional tolerance in typical contextsmight be Overestimated

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Introduction: Effects of heat-induced dehydration have been studied mostly as an imposed novel and substantive stressor (≥2% BM loss) with little opportunity for behavioural regulation. This ignores potential habituation effects and the most commonecologically-valid contexts of heat-induced dehydration.

Purpose: To examine the rate andextent of habituation to heat-induced dehydration of a ma gnitude relevant to most people in acute contexts.

Methods: Ten healthy, recreationally active participants (5 males, 5 females) completed ten 90-min trials on separate days as follows: (i) Two euhydrated exercise familiarisation trials in temperate (20° C) air, (ii) initial euhydration and dehydration (no fluid) trials in hot air (40° C, 38%RH), (iii) four dehydration habituation sessions (two in 40° C air, two in 40° C water), (iv) final euhydration and dehydration trials. Trials included three 30-min blocks of treadmill-then-cycling exercise at heart rate 130 bpm before 5-min cycling at self-regulated intensity to maintain positive affect.

Results: Bodymass decreased ~1.5±0.5% in dehydration ($p<0.001$) but not euhydration (~0.2 ±0.4%). Self-selected work rate was 30±24% lower in dehydration (43±31W) than euhydration (51 ±30W, $p<0.001$), before but not after habituation (51±33 vs 56±32W, $p=0.505$). Dehydration tended to increase perceived exertion during controlled intensity before ($p=0.067$) but not after habituation ($p=0.651$). Ratings of expected feeling state before the initial dehydration trial were lower than after habituation trials ($p=0.028$).

Discussion: Participants habituated rapidly to repeatedly-imposed mild dehydration, as evidenced by improved anticipatory feeling state and the absence of work rate attenuation.
Keywords: heat, dehydration, habituation, behaviour

Dissociation Between Cooling Perception and Heat Storage Following Topical 0.9% LMenthol During Passive Heating

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Introduction: Menthol can be used as a sensory cooling strategy through activation of cutaneous TRPM8 receptors, independent of actual tissue cooling [1, 2, 3]. However, these effects on thermoregulatory sweating, heat storage, and the perceptual and physiological responses during heat exposure require further clarification. Purpose: This study aimed to investigate the effects of 0.9% topical menthol application on sweat gland activation, thermo-physiological variables, and perceptual responses during passive heat exposure.

Methods: Ten young males completed Menthol and Control condition in a climate chamber (30° C, 73% RH). After 10-min rest, subjects immersed their lower legs in 42° C water for 60 min, resulting in a total 70 min-trial. Measurements included total and local sweat rates, active sweat gland density (ASGD), core (Tre) and mean skin temperatures (T sk), and subjective perceptual ratings.

Results: Menthol application tended to reduce total and local sweating with decreasing ASGD across multiple body regions. In contrast, Tre(P <0.1),_Tsk, and heat storage were significantly higher in the Menthol condition during heating (Ps<0.05). At rest, menthol reduced peripheral skin temperature and increased the core-to-skin temperature right before heat exposure. Despite physiological thermal strain, subjects reported cooler thermal sensations and thermal comfort in final (all Ps<0.05).

Discussion: Topical menthol induces perceptual cooling while attenuating sudomotor activation and slightly increasing core heat storage during passive heating. Such sedentary activity in hot environments, 0.9% topical menthol appears to enhance thermal comfort without imposing an additional physiological heat strain, highlighting a dissociation between perceived cooling and physiological thermoregulation.

Keywords: Menthol concentration, Passive heating, Sweat rate, Active sweat gland, Body temperature

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AB84

Regional Differences in Thermoregulatory Responses duringMildHeat Exposure

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Introduction: When comparing WBGT threshold increasing heatstroke incidence across Japan, residents of colder regions develop heatstroke at lower WBGT (Oka et al. 2023). Such variation may reflect differences in habitual heat exposure and acclimatization.

Purpose: This study investigated whether thermoregulatory responses to mild heat exposure differ between residents of subarctic and temperate climatic regions within Japan.

Method: Healthy adult men from Hokkaido (HKD, n=45) and Fukuoka (FKO, n=38) were tested during summer (2023– 2025). After baseline measurement at 27 ° C, 50% RH, ambient temperature increased to 36 ° C over 25 min, followed by 90 min at 36 ° C, 50% RH. Rectal temperature (Tre), skin temperature, skin blood flow, local sweat rate, and RR intervals were continuously measured. Subjective ratings were recorded every 15 min, and total sweat loss was estimated from body-mass change.

Results: Tre did not increase significantly in either group, suggesting mild heat stress. Total sweat loss was significantly higher in HKD ($p<0.05$), whereas mean skin temperature was consistently higher in FKO ($p<0.05$). Only in the HKD decreased Tre significantly at the end. Sympathetic activity estimated from RR interval variability and thermal discomfort were transiently higher in HKD.

Discussion: HKD exhibited excessive sweating responses, which might be due to hypersensitivity to unhabituated heat. In contrast, FKO maintained core temperature with less sweating by enhancing dry heat loss from the skin.

Keywords: Heatstroke,WBGT, Heat acclimatization, Sweating response, Heat habituation
Reference
Oka et al. Prediction of climate change impacts on heatstroke cases in Japan’ s 47 prefectures with the effect of long-termheat adaptation. EnvRes 232, 116390, 2023

AB116

Speech Changes During Volitional Exhaustion in the Heat

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Introduction: Early detection of exertional heat stroke (EHS) remains challenging [1]. Speech production integrates cognitive and motor functions [2,3], yet remains an underexplored biomarker despite documented speech impairment in EHS cases.

Purpose:
To explore changes in speech temporal features as potential digital biomarkers for early EHS detection.

Methods: Ten healthy participants (5 females; age: 28±4 years; VO2max: 43±3 l/kg/min) performed repeated exercise bouts of one-hour loaded (18 kg) treadmill walks (4 km/h, 2%incline) separated by 30-minutes rest in hot-humid conditions (35.2±0.2° C, 71 ±2% RH) until volitional exhaustion or when gastrointestinal temperature (Tgi) reached 40 ° C for one minute. A three-task speech battery (reading [4], counting and weekday recitation) was recorded at baseline and 56th minute of each bout. An additional speech battery was recorded within 10 minutes of exercise cessation for four participants. Speech temporal features were extracted and compared across timepoints.

Results: Speech rate changes during the first bout varied across individuals (n=10; reading -6% to +20%; counting -19% to +61%; weekday recitation -13% to +77%). Within 10 minutes of exhaustion, four participants showed consistent within-individual changes in speech rate across tasks: two increased (mean +27%) and two decreased (mean -23%). Silence percentage increased in three of the four participants from baseline to exhaustion (reading: 5% to 20%) while one decreased (- 3%).

Discussion: These preliminary findings suggestthat while speech temporal features may exhibit inter- individual variability, within-individual changes may emerge when approaching exertional heat exhaustion. This highlights temporal and other speech-derived features as potential non-invasive digital biomarkers for early EHS detection. Further evaluation is warranted.

Keywords: Exertional heat stroke, speech analysis, speech battery, speech temporal parameters

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Effects of Topical Capsaicin Application to the Thigh on QuadricepsMuscle Function and Hemodynamics

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Introduction: Capsaicin, a pungent compound derived from chili peppers, activates the transient receptor potential vanilloid 1 (TRPV1) channel [1]. Topical application of capsaicin activates TRPV1 expressed on primary afferent sensory neurons, inducing heat sensations and cutaneous vasodilation [2]. However, it remains unclear whether the effects of topical capsaicin are limited to the cutaneous layer or extend to deeper tissues, such as skeletal muscle and deep blood vessels, potentially influencing exercise performance.

Purpose: This study investigated the effects of topical capsaicin on maximal exercise performance, neuromuscular function, and skeletal muscle blood flow.

Methods: Eight healthy young men underwent topical application of either (1) 0.1% capsaicin solution (Cap) or (2) a capsaicin-free vehicle solution (Con) to the thigh. Thermal sensation and comfort, vastus lateralis muscle temperature, and femoral artery blood flow were assessed before and 1 h after application. Subsequently, peak power torque and root mean square (RMS) amplitude of the vastus lateralis electromyogram (EMG), as an index of muscle activation, were measured during maximal voluntary knee extension.

Results: Thermal sensationwas higher in the Cap than in the Con trial ($P < 0.05$). No significantmain effects or interactions were observed for muscle temperature or femoral artery blood flow ($P>0.05$). Maximal knee extension torque and RMS amplitude of the vastus lateralis EMG did not differ between conditions ($P>0.05$).

Discussion: Although topical capsaicin elicited heat sensation, it did not alter deeper vascular or muscular responses, and exercise performance during maximal effort remained unchanged. (245/250 words)

Keywords: TRPV1, exercise performance, femoral artery blood flow, electromyography
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AB173

Thermoregulatory Responses and Running Performance During a Competitive Female SoccerMatch in a Cool Environment: A Preliminary Observation

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Introduction: Female soccer has grown in popularity. Repeated high-intensity intermittent exercise during soccermatches involves significant thermoregulatory strain [1], potentially increasing heatstroke risks regardless of the season. However, core body temperature (Tco) responses and running performance during competitive female soccer matches remain unclear.

Purpose: This study examined thermoregulatory responses and running performance during a competitive female soccer match in a cool environment.

Methods:Eleven female collegiate players (1 goalkeeper, 4 defenders, 4 midfielders, 1 forward) participated in a 90-min match with a 10-min halftime at an ambient temperature of ~15.2℃. Running metrics were normalized to individual playing time and expressed per minute for each half. Tco, measured via an ingestible telemetric capsule, and heart rate were continuously monitored. Body weight loss and fluid intake were assessed for each half.

Results: Tco reached 39.0 ± 0.3℃ and 39.1 ± 0.3℃ at the end of the first and second halves, respectively. The number of accelerations and decelerations was lower in the second than the first half (= 0.036), whereas total, high-speed running (19-21 km/h), and sprint (≥ 23 km/h) distances were unchanged (all ≥ 0.149). Heart rate did not differ between halves (P= ≥ 0.138), while body weight loss was greater in the first than the second half (P = 0.004).

Discussion: This study demonstrates that Tco can reach ~39° C

during a female soccer match even in cool environments. Future studies are needed to clarify Tco responses and their relationships with running performance during matches played in the heat.

Keywords: women’ s soccer, female athletes, thermoregulation, GPS, intestinal pill system.
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AB176

Effects of Alcohol Intake and Sleep Deprivation on Physiological BurdenWhile Wearing Firefighter Protective Clothing in a Hot Environment

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Introduction: Firefighting while wearing heavy personal protective equipment (PPE) imposes substantial thermal and cardiovascular strain [1,2]. Although U.S. guidelines recommend 6– 8 h of sleep and alcohol abstinence before duty [3], Korean regulations provide no explicit criteria for sleep duration or alcohol restriction [4,5].

Purpose: This study investigated the effects of total sleep deprivation and pre-shift alcohol intake on thermoregulatory, cardiovascular, inflammatory, and perceptual responses during intermittent exercise in firefighting PPE under heat stress.

Methods: Nine healthy males completed three trials: Control (8-h sleep), Sleepless (no sleep), and Alcohol (360 mL distilled liquor followed by 8-h sleep). Each trial involved ~90-min intermittent treadmill exercise in a climatic chamber (32 ± 0.2oC, 63 ± 2%RH) with full firefighting PPE (16.3 kg). Rectal and skin temperatures, heart rate, inflammatory markers (IL-6, TNF-α, CRP), and subjective responses were measured. Repeated-measures ANOVA and nonparametric tests were applied ($P < 0.05$).

Results: Rectal temperature was higher in Sleepless and Alcohol than Control ($P < 0.01$). Work tolerance time was significantly reduced in Alcohol compared with Control ($P < 0.05$). Baseline IL-6 was elevated in both experimental conditions ($P < 0.05$). Heart rate and mean skin temperature did not differ significantly among conditions. Ratings of perceived exertion and thermal discomfort were consistently greater in Sleepless and Alcohol (< 0.05).

Discussion: Alcohol intake and sleepdeprivation increased internal heat storage, amplified perceptual strain. These findings highlight lifestyle factors as critical determinants of heat tolerance and support pre-shift strategies for firefighter safety.

Keywords: Firefighters, Personal protective equipment, Sleep deprivation, Alcohol, Heat Strain

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21st August 2026
Poster Presentation 2 (14:30 - 15:30)
Theme: Human Responses to Water Immersion and Submersion

No	Abstract ID	Presenter	Affiliation	Title Of Presentation
1	AB22	Keiji Hayashi	University of Shizuoka, Junior College	Cooling effect of low-temperature carbonated water immersion
2	AB168	Darren Lim	Sport Physiology Department, Sport Science and Medicine Centre, High Performance Sport Institute, Sport Singapore, Singapore	Effect of Exogenous Carbon Dioxide on Human Thermoregulation: A Systematic Review

AB22

Cooling effect of low-temperature carbonated water immersion

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Introduction: Cold water immersion is often applied for recovery from hyperthermia. Immersion in carbonated water causes cutaneous vasodilation and promotes heat transfer. Thus, low-temperature carbonated water immersion may have a greater cooling effect than tap water immersion.

Purpose: To investigate whether the cooling effect oflow-temperature carbonatedwater immersion is more effective than tap water immersion.

Methods: [Experiment 1] Participants were immersed in a 40 ° C bath to raise their body temperature, and then theirwhole body was immersed in carbonated or tapwater at 25 ° C until their body temperature dropped to the baseline level. [Experiment 2] The study protocol was almost the same as Experiment 1, except the participants only immersed their lower body during cooling. The cooling time and cooling rate were compared between sessions.

Results: [Experiment 1] Cooling time was significantly shorter in carbonated water session than in tap water session ($p < 0.05$), and the cooling rate was significantly greater in the carbonated water session than in the tap water session ($p<0.05$). [Experiment 2] There was no significant difference in cooling time and cooling rate between sessions.

Discussion: Even at 25 ° C, the cooling effect of carbonated water immersion was greater than that of tap water immersion in the case of whole-body immersion. However, the cooling effect of carbonated water was not obtained by cooling the lower body. These results suggest that to obtain the cooling effect of carbonated water, a larger the cooling area is necessary.

Keywords: CO2-richwater, body temperature, cutaneous vasodilation, skin blood flow

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Effect of Exogenous Carbon Dioxide on Human Thermoregulation: A Systematic Review

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Introduction: Carbon dioxide (CO_2) balneotherapy is a common practice to treat peripheral vascular disorders. The vasodilatory effects of CO_2 via inhalation, topical application, or water immersion (WI) have been studied, and emerging research is investigating thermoregulatory responses during CO_2 exposure [1,3].

Purpose: Tosystematically characterise thermoregulatory responses to exogenous CO_2 exposure in healthy humans and summarise associated physiological outcomes where reported.

Methods: We searched PubMed/MEDLINE, SPORT Discus,Web of Science, and Embase from inception to January 2026 for peer-reviewed randomised controlled trials in healthy humans assessing core body temperature (Tcore) during exogenous CO_2 exposure versus control; other outcomes (skin temperature
(Tskin), sweating, skin blood flow(skBF), thermal perception (TS), autonomic indices) were extracted when reported.

Results: Out of 6,944 records, 10 studies were included (CO_2 WI, n = 7; CO_2 inhalation, n = 3). CO_2 WI consistently increased skBF at immersed sites [1,3], whereas CO_2 inhalation generally had no effect. CO_2 WI generally decreased Tcore [1-3], while Tskin was typically similar versus WI [2,3]. CO_2 WI did not meaningfully alter whole-body or local sweating [2,4]. Heart rate was generally unchanged during CO_2 WI [2,4]; one study reported greater parasympathetic activity [3], and one inhalation study reported higher heart rate under ormothermic conditions [5]. TS and thermal comfort findings were mixed [1-4].

Discussion: Exogenous CO_2 —particularly CO_2 WI—appears to increase local cutaneous perfusion and may modify whole-body heat balance by enhancing peripheral heat exchange. Evidence for effects on Tskin, sweating, heart rate, and TS remains limited, inconsistently reported, or under-characterised, supporting the need for more comprehensive trials in healthy humans.

Keywords: Vasomotor tone, CO2 bathing, tympanic temperature, cutaneous blood flow, carbonated water

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21st August 2026
Poster Presentation 2 (14:30 - 15:30)
Theme: Ethnicity and Environmental Resilience

No	Abstrac ID	Presenter	Affiliation	Title Of Presentation
1	AB161	Kaisei Okamoto	Hokkaido University	Estimation Of Individual Metabolic Rate Based On Morphological Parameters Detected From Regular Image
2	AB175	Joo-Young Lee	Department of Fashion and Textiles Seoul National University, Seoul, Korea	Cold-Induced Vasodilation in Young Mongolians: Climatic Background and Hand Morphological Associations
3	AB211	Hayato Arizumi	Hokkaido University, Japan	Regional Differences in Thermoregulatory Responses to Mild Cold among Residents of Different Climate Zones: Implications for Mid- to Long-Term Cold Adaptation

AB161

Estimation of Individual Metabolic Rate Based onMorphological Parameters Detected fromRegular Image

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Introduction:Metabolic rate (M) is an element to calculate PredictedMean Vote (PMV), a model evaluating thermal comfort. However, practically PMV is calculated using M as constant value because its individual measurement is challenging. Therefore, this study focused on the formula for estimating M using morphological parameters [1].

Purpose:This study explored the individual M assessment through height (H) and weight (W) prediction based on morphological parameters detected from upper body image.

Methods: This study conducted a segment measurement using calibrated upper body images formaking formulae for prediction (n = 88) and an expired gas analysis experiment incorporating anthropometric measurements for accuracy verification (n = 22).

Results:Shoulder width was the best predictor of H and W, and M predicted from shoulder width was significantly associated with M predicted from self-reported H and W, with coefficients of determination of 0.821 for men and 0.627 for women ($P < 0.01$). Furthermore, predicted M values fell within the range of actual measurements, demonstrating reasonable validity for this evaluation method during periods of low metabolic activity.

Discussion: The M estimation method using shoulder width possesses a certain degree of validity and is considered to contribute to improving the accuracy of individual PMV estimation.

Keywords:Metabolic rate, PMV, Shoulderwidth, Expired gas analysis

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Cold-Induced Vasodilation in YoungMongolians: Climatic Background andHand Morphological Associations

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Introduction: Mongolia experiences prolonged and severe winters, with ambient temperatures often falling below − 30oC. Although urbanization has reduced traditional nomadic cold exposure, young Mongolians remain intermittently exposed to extreme cold. Cold-induced vasodilation (CIVD) is a key indicator of peripheral cold tolerance [1,2]. However, CIVD characteristics of modern Mongolian youth remain insufficiently investigated.

Purpose: This study compared CIVD responses of young Mongolians with other populations across diverse climatic and exposure backgrounds and explored associations between CIVD parameters and hand morphological characteristics.

Methods: Nineteen young Mongolians (13 males, 6 females) underwent a 60-min trial involving 30-min immersion of the third finger in 4oC water following a 10-min rest, with 20-min recovery. CIVD parameters (Tmin, Tmax, Tmean, Trcv, onset time, frequency)were compared with previously reported data from other populations (young Koreans,older Korean haenyeos, temperates and tropicals) [1,3]. Hand length, circumference, and wrist circumference were measured. Correlation analyses were conducted (< 0.05).

Results: Young Mongolians demonstrated higher Tmin, Tmax, Tmean, and Trcv compared with temperates and tropicals (< 0.05). Earlier CIVD onset and greater wave frequency were observed relative to tropical individuals. Significant positive correlations were found between hand morphological variables and CIVD responses, particularly Tmax, Tmean, and recovery temperature (r = 0.46– 0.61, P<0.05).

Discussion: Despite growing up in modern indoor environments, Young Mongolians showed enhanced peripheral cold tolerance compared with populations from temperate and tropical backgrounds. Associations between hand morphology and CIVD parameters suggest that both climatic background and anatomical factors contribute to cold-induced vascular responses.

Keywords: Peripheral cold tolerance, Acclimatization, Cold-water immersion, Hand anthropometry, Cross-climatic comparison

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Regional Differences in Thermoregulatory Responses toMild Cold among Residents of Different Climate Zones: Implications forMid- to Long-TermCold Adaptation

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Introduction: Thermal comfort varies among individuals and is influenced not only by physical characteristics but also by residential environment. Cross-ethnic studies have demonstrated metabolic and insulative cold adaptations across climatic regions, and residents of cold climates may exhibit higher basal metabolic rates [1]. However, few studies have compared cold adaptation capacity between residents of cold and temperate zregions within the same ethnic population.

Purpose: This study compared cold adaptation capacity between residents of a cold region (Hokkaido) and a temperate region (Fukuoka) In Japan, and additionally examined birthplace influence within Hokkaido residents.

Methods: Healthy men aged ≥18 years were recruited from Hokkaido (n=34) and Fukuoka (n=40). Hokkaido participants were divided into Hokkaido-born (n = 13) and non– Hokkaido-born (n = 21) subgroups. During winter, participants underwent mild cold exposure in a climate chamber (baseline in 27℃, decreased to 19° C over 20 min, followed by 70 min at 19° C). Rectal and skin temperature, skin blood flow (SkBF), cardiovascular variables, respiratory gas, and subjective responses were measured.

Results: Hokkaido residents showed significantly higher absolute SkBF ($P < 0.05$) and higher resting oxygen consumption ($P < 0.05$), with lower respiratory exchange ratios ($P < 0.05$), while rectal temperature was maintained comparably. Within Hokkaido residents, Hokkaido-born participants exhibited lower SkBF ($P < 0.05$) and lower skin temperature ($P < 0.05$).

Discussion: Compared with temperate-region, cold-region residence was associated with an elevated resting metabolic rate, suggesting early metabolic adaptation.
In contrast, long-term residence in cold appeared to promote insulative adaptation characterized by enhanced peripheral vasoconstriction.

Keywords: Cold adaptation, Metabolic adaptation, Insulative adaptation, Birth-place, Climate region
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21st August 2026
Poster Presentation 2 (14:30 - 15:30)
Theme: Thermal Comfort & Perception

No	Abstract ID	Presenter	Affiliation	Title Of Presentation
1	AB7	Takako Fukazaw	Kyoto University of Education	Effects of Under-Bust Compression on Thermoregulatory Evaporation and Sweating in Young and Elderly Females
2	AB177	Makhliyo SK Soatova	Department of Fashion and Textiles, Seoul National University, Seoul, Korea	Self-identified Cold and Heat Tolerance and Behavioral Thermoregulation

Effects of Under-Bust Compression on Thermoregulatory Evaporation and Sweating in Young and Elderly Females

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Introduction: Skin pressure is known to inhibit sweating and redistribute sweat responses across the body surface [1, 2]. It remains, however, unclear whether these pressure-related effects are also observed in elderly individuals, who exhibit age-related reductions in sweating function.

Purpose: This study examined the effects of mild under-bust compression on local and whole-body evaporation and sweat rates in young and elderly females. Methods: Five young (21.7 ± 0.9 yr) and five elderly (66.0 ± 4.2 yr) healthy females stayed in a thermoneutral environment (28 ° C, 50%RH). Two conditions were applied: no compression and under-bust compression corresponding to a 5% reduction in circumference. Participants remained seated at rest, followed by lower-leg and foot immersion in 42 ° C water and a recovery period. Local evaporation and sweat rates were measured at the forehead, chest, scapula, forearm, and thigh, together with body mass loss. Results: Under-bust compression reduced whole-body weight loss by -19 ± 14% in young and -16 ± 22% in elderly females (n.s.). Sweat rate significantlydecreased at the forearm and significantly increased at the chest (both $p<0.01$), with noage-group differences. Evaporation rate decreased at most sites under compression;however, no significant condition effect was detected. Overall evaporation was significantly higher in young than in elderly females ($p<0.01$), with similar directionalpatterns in both groups.

Discussion: The approximately 16-19% reduction in whole-body mass loss under compression was primarily attributable to decreased evaporation rather than altered sweat production. These findings indicate that mild under-bust compression modifies regional moisture transport and evaporative heat loss, underscoring the role of clothing-induced skin pressure in thermophysiological regulation and thermal comfort assessment.

Keywords: evaporation, sweating, clothing pressure, females, aging

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Self-identified Cold and Heat Tolerance and Behavioral Thermoregulation Among UrbanMongolians: A Survey Study

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Introduction:Mongolia has traditionally been characterized by strong cold adaptation due to prolonged exposure to extreme winter climates. However, rapid urbanization and widespread indoor heating have substantially altered daily thermal exposure patterns. Previous studies have primarily focused on physiological cold adaptation, while behavioral thermoregulation and indoor– outdoor exposure patterns remain underexplored [1].

Purpose: This survey-based study examined contemporary cold and heat tolerance among urban Mongolians by investigating subjective thermal sensitivity, environmental exposure, and behavioral thermoregulation strategies.

Methods: A face-to-face survey was conducted with 200 Mongolian residents of Ulaanbaatar (39.0 ± 10.7 years). The questionnaire included demographics, heat- and cold-related symptoms (past 5 years),
self-identified thermal tolerance, preferred indoor temperatures, clothing behavior, use of winter accessories, outdoor exposure time, and bathing frequency. Outdoor air temperature and humidity on the survey day (28.3oC, 47%RH) were measured on-site. Descriptive statistics and frequency analyses were performed.

Results: Heat-related symptoms (28.0%) were more prevalent than cold-related symptoms (10.5%). Although 49.0% perceived themselves as cold tolerant, winter shivering reports were relatively low (27.0%). Preferred indoor temperatures averaged 17.3 ± 9.9oC in summer and 14.5 ± 16.5oC in winter. Subjects reported − 25.1 ± 9.3oC as the temperature they considered “cold,” yet daily outdoor exposure remained limited (156 ± 143 min in winter). The 55% of respondents self-identified as heat-tolerant. Many respondents reported high subjective heat tolerance (55.5%).

Discussion: Despite persistent self-identified cold tolerance, reduced shivering experience and strong reliance on indoor heating may indicate a potential decline in physiological cold adaptation. Concurrently, self-reported increases in heat tolerance and the prebalence of heat-related symptoms suggest shifting thermoregulatory patterns influenced by urban lifestyles and modern heating and cooling environments.

Keywords: Cold tolerance, Heat tolerance, Behavioral adaptation, Indoor–outdoor exposure, Continental climate

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21st August 2026
Poster Presentation 2 (14:30 - 15:30)
Theme: Humidity and Its Impact on Thermoregulation

No	Abstract ID	Presenter	Affiliation	Title Of Presentation
1	AB144	Kudo Ryuki	Hokkaido University	The Impact Of Humidification In Winter Heating Rooms On The Physiological And Psychological Responses Of Occupants

AB144

The Impact of Humidification inWinter Heating Rooms on the Physiological and Psychological Responses of Occupants

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Introduction: In recent years, indoor humidity has tended to decrease during winter due to changes in building materials and ventilation systems, leading to an increased risk of negative effects from dryness. [1]

Purpose: The purpose of this study was to clarify the physiological and subjective responses of occupants to humidification in a heated indoor environment during winter.

Methods: Seventeen adults (33.6 ± 12.9 years) participated in an experiment conducted in an experimental house installed in a climatic chamber reproducing winter outdoor environment. Two environmental conditions were examined: a Dry condition (23℃, 20% RH) for 120min, and a Humid condition in which humidity was increased from 20%to 60% over 30 min and then maintained at 60% RH for 90 min. Skin temperature, body weight, skin hydration, insensible perspiration, maximum interblink interval (MBI), and blinking frequency were measured. Thermal sensation, thermal comfort, humidity sensation, and humidity comfort were also evaluated.

Results: No significant differences were observed between the conditions in mean skin temperature, thermal sensation, thermal comfort, or insensible perspiration. However, under the Humid condition, skin hydration and MBI increased, total body water loss decreased, and nasal dryness sensation was alleviated Discussion: These findings suggest that when humidification induces only minor changes in SET*, its thermal impact on occupants is limited, although it effectively modifies skin dryness, reduces respiratory water loss, and alleviates nasal dryness sensation, which those are known to be sensitive to changes in humidity [2]. Further studies with more precisely controlled environment are required to clarify the thermal effects of humidification and their influence on humidity perception.

Keywords: Humidification, SET*, Insensible perspiration, Humidity perception.
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21st August 2026
Poster Presentation 2 (14:30 - 15:30)
Theme: Cold Environments: Survival, Adaptation, and Performance

No	Abstract ID	Presenter	Affiliation	Title Of Presentation
1	AB30	Do-Hee Kim	Research Institute of Human Ecology, Seoul National University, Seoul, Korea	Local Cold Tolerance among North Korean Defectors: A Generational Perspective on Finger Cold-Induced Vasodilation
2	AB133	Nathan Bartman	Brock University	Is Cold-Induced Muscle Performance Impairment Due To Reduced Oxygen Availability?
3	AB154	Hisaki Kamada	Faculty of Engineering Hokkaido University,	Effect of Four-Week Dietary Nitrate Supplementation via Beetroot Juice on Cold-Induced Thermogenesis: A Single-Group Pilot Study in Healthy Adults

Local Cold Tolerance among North Korean Defectors: A Generational Perspective on Finger Cold-InducedVasodilation

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Introduction: Cold-induced vasodilation (CIVD) is a paradoxical peripheral vascular response protecting extremities from cold injury. North Korean defectors (NKDs) survived chronic cold and nutritional deprivation, comprising two groups: the Arduous March Generation (AMG), who endured severe famine and cold during formative years (1994–1998) [1, 2], and the Jangmadang Generation (JMD), raised under improved conditions [3]. Early-life cold exposure and physique may influence vascular adaptation, warranting generational comparison.

Purpose: This study compared finger CIVD responses between AMG (born 1964– 1982) and JMD (born 1989– 2004), and examined anthropometric associations with CIVD parameters.

Methods: Twenty-four NKDs (14 males, 10 females; 10 AMG, 14 JMD) underwent a 60-min trial: 10-min rest, 30-min cold water immersion at 4.0 ± 0.1° C, and 20-min recovery. Finger skin temperatures were recorded continuously via thermistors. CIVD parameters (min, max, onset, mean, amplitude, frequency, and resistance index of frostbite (RIF)) and anthropometric data (height, weight, BMI, waist circumference) were collected [4].

Results: AMG showed significantly higher max than JMD (14.2 ± 2.6 vs. 11.9 ± 2.6° C, = 0.049) and lower finger thermal sensation at 50 min (= 0.008). All subjects achieved maximum RIF scores (9.0), exceeding population norms (5-6) [5]. BMI and waist circumference positively correlated with min (r = 0.574, 0.566) and negatively with onset.

Discussion: Both generations showed exceptional peripheral cold tolerance. AMG demonstrated enhanced vasodilatory capacity, possibly reflecting early-life cold exposure, though causality remains unclear. Greater body size was associated with higher min and shorter onset, suggesting body sizemodifies local cold tolerance.

Keywords: North Korean defectors, Hunting reaction, Peripheral cold adaptation, Generational differences

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Is Cold-InducedMuscle Performance Impairment Due to Reduced Oxygen Availability?

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Introduction: Muscle performance is impaired in cold environments[1], possibly due to vasoconstriction limiting blood flow and oxygen availability[2]. Whole-body exercise performance with mild core temperature reduction was restored to thermoneutral levels when breathing hyperoxic (40% oxygen) air[3].We replicated this with single-joint muscle exercise to study whether oxygen availability contributes to cold-induced local muscle function impairment.

Purpose: Compare thermoneutral and normoxic triceps surae work capacity with normoxic cooling or cooling with hyperoxia.

Method: Thirteen volunteers (age 21±2.8 years) performed plantarflexion exercise in a cross-over design under three conditions while controlling breathing air and muscle temperature: warm-muscle, FiO2=0.21 (CON); cold-muscle, FiO2=0.21 (COLD-NORM); and cold-muscle FiO2=0.40-0.50 (COLD-HYPER). Exercises included 5-second maximum voluntary isometric contraction (MVIC) and dynamic 30-repetitions power test at 20% MVIC where torque, power, and surface electromyography of the calf (EMG) were recorded. Muscle temperature was assessed via needle probe.

Results: Muscle temperature decreased in both cold conditions by 4.5±2.0℃ ($p<0.001$). MVIC torque was not different in COLD-NORM (71.0±25.9 Nm) and COLD-HYPER (70.1±27.9 Nm) compared to CON (72.6±24.4 Nm, $p=0.753$), yet soleus EMG was elevated in COLD-HYPER to 144±11% of CON ($p=0.021$). Among conditions, mean power during dynamic exercise was lower in both cold conditions (CON: 311.1±20.9 W, COLD-NORM: 247.0±19.7 W, COLD-HYPER: 251.5±29.1 W, $p=0.042$) but fatigue rate from the first 5 to the last 5 repetitions was not (CON: 9.6±11.4%, COLD-NORM 9.7±11.8%, COLD-HYPER: 15.0±6.8%, $p=0.542$).

Discussion: The decrease in performance from cold was not reversed with hyperoxia, suggesting that cold-induced muscle capacity impairment is not from altered oxygen availability.

Keywords: hypothermia, hyperoxia, neuromuscular, electromyography, plantarflexion
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Effect of Four-Week Dietary Nitrate Supplementation via Beetroot Juice on Cold-Induced Thermogenesis: A Single-Group Pilot Study in Healthy Adults

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Introduction: Non-shivering thermogenesis, mediated by brown adipose tissue (BAT), contributes to cold tolerance. Dietary nitrate, abundant in beetroot, is reduced to nitric oxide, which promotes vasodilation and may enhance metabolic activity. Animal studies suggest that chronic nitrate intake induces browning of white adipose tissue and increases thermogenesis [1] . However, human evidence remains limited.

Purpose: This pilot study aimed to investigate whether four-week dietary nitrate supplementation via beetroot juice enhances cold-induced thermogenesis in healthy young men.

Methods: A whole-body mild cold exposure test was conducted before and after the intervention. Ten healthy adults (age 20.8 ± 1.0 years) first rested for 20 minutes in a thermoneutral environment (27° C, 40% relative humidity) to obtain baseline measurements of all variables. The ambient temperature was then gradually reduced to 19° C over 20 minutes, followed by 100 minutes of rest in supine position in mild cold. Skin temperatures at the supraclavicular and chest regions, expired gas and skin blood flow were continuously recorded.

Results:After the intervention, a trend toward an increase in the supraclavicular-to-chest skin temperature difference, which is a surrogate measure of BAT activity [2], was observed. However, no significant differences were found in energy expenditure between pre- and post-intervention tests.

Discussion: These findings suggest that four-week beetroot juice supplementation might induce activation of BAT-induced thermogenesis in supraclavicular region but does not significantly enhance whole-body metabolic response. Further investigation is required with larger placebo-based comparative studies design to clarify the effects of BR on BAT activity, including targeted population selection, protocol optimization, and more sensitive endpoints.

KeyWords: Nitrate, Beetroot, Brown adipose tissue, Non-shivering thermogenesis

References

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