Bulletin n°16

Veille thermique
Période : mars 2024

Objectifs :

L'INRS est de plus en plus sollicité sur des questions concernant les activités en entreprise par forte chaleur : les activités en extérieur, l'été en période de canicule, mais aussi les activités en intérieur, dans des lieux aux conditions thermiques extrêmes. L'objectif de cette veille est de se tenir informé sur ces thématiques, dans une période où la problématique thermique croît avec les changements climatiques.

La bibliographie extraite de la base de données INRS-Biblio, permet la consultation des ressources en version PDF.

Les liens mentionnés dans le bulletin donnent accès aux documents sous réserve d'un abonnement à la ressource.

La validation des informations fournies (exactitude, fiabilité, pertinence par rapport aux principes de prévention, etc.) est du ressort des auteurs des articles signalés dans la veille. Les informations ne sont pas le reflet de la position de l'INRS.

Sommaire :

EPI, matériaux protecteurs/refroidissants

S. Kim, S. Lee, S. Shin and D. Lim.

Cooling performance measurements of different types of cooling vests using thermal manikin.

FASHION AND TEXTILES. 2024;11(1).

https://doi.org/10.1186/s40691-024-00381-z

This study compared the effectiveness of five commercially available cooling vests using three distinct thermal manikin test protocols. In addition, the constraints associated with each test protocol were elucidated, facilitating the identification of suitable evaluation methods for the different cooling vests. The cooling performances of the vests were evaluated using three thermal manikin test scenarios, incorporating the adaptations from Ciuha et al. (Ergonomics 64:625-639, 2021) and ASTM F2371-16, along with a modified protocol simulating the hot and humid weather in a South Korean summer. The results revealed substantial variations in the cooling performance across different test protocols, highlighting the importance of carefully selecting thermal manikin test methods. Moreover, the specific cooling vests exhibited immeasurable performance in certain test methods, which presents the limitations inherent in each testing scenario. For example, when evaluated with a non-sweating thermal manikin, the air-cooling vests exhibited the worst cooling performance, showing an average cooling rate of 1.0 W and cooling durations of five minutes. In contrast, the same vests demonstrated superior performance when assessed using the ASTM F2371-16 method, revealing an effective cooling rate of 114.8 W and sustained cooling durations exceeding eight hours. These results emphasize the lack of a one-size-fits-all evaluation method for cooling vests and the need for accessible guidelines to inform decision-makers aiming to enhance workplace safety and comfort.

Maladies liées à la chaleur

A. Kamal, A. F. Fahim and S. Shahid.

Simplified equations for wet bulb globe temperature estimation in Bangladesh.

INTERNATIONAL JOURNAL OF CLIMATOLOGY. 2024.

https://doi.org/10.1002/joc.8402

The increasing temperatures and shifts in meteorological conditions have heightened the vulnerability of Bangladesh's densely populated regions, known for their high heat and humidity, to potential health hazards. While the Wet Bulb Globe Temperature (WBGT) is a widely acknowledged and robust measure for evaluating heat stress in various occupational and outdoor environments, its widespread application is impeded by the complexity of calculations, the substantial computational resources required, and the need for specialized expertise, particularly in developing nations. Therefore, this study aimed to develop simplified equations for estimating WBGT in Bangladesh using meteorological variables. This study applied Liljegren's model on high-resolution reanalysis data of the European Centre for Medium-Range Weather Forecasts (ERA5) to calculate WBGT from 1979 to 2021. Subsequently, linear and nonlinear regressions were used to derive simplified equations for estimating Liljegren WBGT in Bangladesh. The quadratic regression models offer simplified equations for WBGT estimation. The model with only temperature (Ta) as an input estimates WBGT with an R2 of 0.967 and an RMSE of 0.716, effectively capturing a significant portion of WBGT variability. The inclusion of solar radiation (SR) with Ta improved the performance, with an R2 of 0.996 and an RMSE of 0.242. The best parsimonious model, with an R2 of 0.986 and an RMSE of 0.471, is derived when wind speed is considered with Ta and SR inputs, achieving an R2 of 0.993 and an RMSE of 0.331. Comprehensive graphical and statistical analyses confirm the high accuracy of all models. The three-input model notably demonstrates exceptional performance, attaining optimal values for critical metrics, including extreme WBGT. The results affirm the practical suitability of the derived models for accurate estimations of WBGT in Bangladesh. These equations provide simplified tools for assessing heat stress conditions, contributing to public health initiatives, occupational safety guidelines, and climate change adaptation strategies. This study in Bangladesh employed Liljegren's model and quadratic regression techniques to develop simplified equations for precise estimation of Wet Bulb Globe Temperature. These equations, incorporating temperature, solar radiation, and wind speed data, serve as vital tools for evaluating heat stress, and informing public health strategies, and climate adaptation efforts.

H. A. M. Daanen, I. Dijkstra, E. Abbink, I. J. de Jong, S. T. Wolf, C. Bongers, L. S. Hondema, T. M. H. Eijsvogels and B. R. M. Kingma.

Sex differences in thermophysiological responses of elderly to low-intensity exercise during uncompensable heat strain.

EUROPEAN JOURNAL OF APPLIED PHYSIOLOGY. 2024.

https://doi.org/10.1007/s00421-024-05457-8

The rising frequency of extreme heat events poses an escalating threat of heat-related illnesses and fatalities, placing an additional strain on global healthcare systems. Whether the risk of heat-related issues is sex specific, particularly among the elderly, remains uncertain. Methods 16 men and 15 women of similar age (69 +/- 5 years) were exposed to an air temperature of 39.1 +/- 0.3 degrees C and a relative humidity (RH) of 25.1 +/- 1.9%, during 20 min of seated rest and at least 40 min of low-intensity (10 W) cycling exercise. RH was gradually increased by 2% every 5 min starting at minute 30. We

measured sweat rate, heart rate, thermal sensation, and the rise in gastrointestinal temperature (Tgi) and skin temperature (Tsk). Results Tgi consistently increased from minute 30 to 60, with no significant difference between females and males (0.012 +/- 0.004 degrees C/min vs. 0.011 +/- 0.005 degrees C/min; p = 0.64). Similarly, Tsk increase did not differ between females and males (0.044 +/- 0.007 degrees C/min vs. 0.038 +/- 0.011 degrees C/min; p = 0.07). Females exhibited lower sweat rates than males (0.29 +/- 0.06 vs. 0.45 +/- 0.14 mg/m(2)/min; p < 0.001) in particular at relative humidities exceeding 30%. No sex differences in heart rate and thermal sensation were observed. Conclusion Elderly females exhibit significantly lower sweat rates than their male counterparts during low-intensity exercise at ambient temperatures of 39 degrees C when humidity exceeds 30%. However, both elderly males and females demonstrate a comparable rise in core temperature, skin temperature, and mean body temperature, indicating similar health-related risks associated with heat exposure.

Y. X. Cao, H. D. Li, H. G. Yang, X. J. Meng, D. Liu, J. X. Wang, X. Zhang and A. Li.

Research on the Effect of Spray Ventilation Cooling Systems on Human Physiological and Psychological Indexes.

BUILDINGS. 2024;14(3).

https://doi.org/10.3390/buildings14030691

Hot working environment not only affects work efficiency, but also poses a potential threat to the physical and mental health of staff. The current common method for dealing with high temperatures is spray-only or ventilation-only. To investigate the impact of different spray and ventilation modes on indoor high-temperature environments, this study examined their effects on indoor environmental parameters, average skin temperature, and psychological indicators. By establishing an experimental platform for high-temperature thermal environments, a spray ventilation cooling system was implemented, and its cooling efficacy in the indoor thermal environment was analyzed. The environmental classification of the high-temperature working environment under experimental conditions is provided based on the experimental data. A comparison and analysis of environmental parameters and physiological and psychological indicators between moderate and high-temperature environments were conducted. The combination of spray and ventilation modes resulted in a 5.3 degrees C reduction in air temperature, a 24.1% increase in average relative humidity, and a 3.3 degrees C reduction in average Wet-bulb Globe Temperature (WBGT). The cooling effect was increased by 2.3 degrees C and the average relative humidity was increased by 10.8% compared to spray-only and ventilation-only modes. In spray and ventilation mode, when the spray volume is increased by 15 mL/min, the air temperature is reduced by 8.2 degrees C, the average relative humidity is increased by 31.9%, and the average WBGT is reduced by 5.1 degrees C. This study has guiding significance for finding a reasonable cooling scheme to cope with indoor high-temperature environments.

M. Ihsan and H. C. Choo.

Recovery During Exercise Heat Acclimation: Will Post-Exercise Cooling Enhance or Interfere with Adaptation?

JOURNAL OF SCIENCE IN SPORT AND EXERCISE. 2024.

https://doi.org/10.1007/s42978-024-00274-z

Heat acclimation (HA) is regarded as the most important countermeasure to protect athlete health and performance when exercising in hot ambient conditions. HA involves passive or exercise heat stress applied intentionally to increase sweating, core temperature, and skin temperature. However, these

responses can lead to significant physiological stress, increasing the risk of accumulated fatigue and overreaching. Post-exercise cooling is an effective strategy to restore neuromuscular function and perceptive recovery following hyperthermia-induced fatigue. However, the influence of post-exercise cooling on heat adaptation remains largely unexplored. This review discusses the potential impact of this recovery modality on heat adaptation. Studies investigating the interaction between hot and cold exposures in the context of thermal adaptation were reviewed. The examined literature collectively indicates: (1) no impairments in heat adaptation when cold exposures did not interfere with the physiological responses attained during the heat stress, (2) marginal compromises in thermal impulse during heat stress did not diminish the magnitude of heat adaptation, and may be compensated through enhanced absolute training intensity (3) while substantial cooling during heat stress can potentially impair sudomotor adaptations to HA, it is reasonable to expect no impairments in this context as recovery-based cooling does not influence the physiological responses garnered during heat stress. It is acknowledged that this conclusion is based on exploratory findings, as direct data on the effects of recovery cooling interventions on heat adaptations are currently lacking.

J. J. Kunda, S. N. Gosling and G. M. Foody.

The effects of extreme heat on human health in tropical africa.

INTERNATIONAL JOURNAL OF BIOMETEOROLOGY. 2024.

https://doi.org/10.1007/s00484-024-02650-4

This review examines high-quality research evidence that synthesises the effects of extreme heat on human health in tropical Africa. Web of Science (WoS) was used to identify research articles on the effects extreme heat, humidity, Wet-bulb Globe Temperature (WBGT), apparent temperature, wind, Heat Index, Humidex, Universal Thermal Climate Index (UTCI), heatwave, high temperature and hot climate on human health, human comfort, heat stress, heat rashes, and heat-related morbidity and mortality. A total of 5, 735 articles were initially identified, which were reduced to 100 based on a set of inclusion and exclusion criteria. The review discovered that temperatures up to 60 degrees C have been recorded in the region and that extreme heat has many adverse effects on human health, such as worsening mental health in low-income adults, increasing the likelihood of miscarriage, and adverse effects on well-being and safety, psychological behaviour, efficiency, and social comfort of outdoor workers who spend long hours performing manual labour. Extreme heat raises the risk of death from heat-related disease, necessitating preventative measures such as adaptation methods to mitigate the adverse effects on vulnerable populations during hot weather. This study highlights the social inequalities in heat exposure and adverse health outcomes.

Outils et capteurs de mesure

J. Zmigrodzki, S. Cygan, J. Lusakowski and P. Lamprecht.

Analytical Analysis of Factors Affecting the Accuracy of a Dual-Heat Flux Core Body Temperature Sensor.

SENSORS. 2024;24(6).

https://doi.org/10.3390/s24061887

Non-invasive core body temperature (CBT) measurements using temperature and heat-flux have become popular in health, sports, work safety, and general well-being applications. This research aimed to evaluate two commonly used sensor designs: those that combine heat flux and temperature sensors, and those with four temperature sensors. We used analytical methods, particularly uncertainty analysis calculus and Monte Carlo simulations, to analyse measurement accuracy, which depends on the accuracy of the temperature and flux sensors, mechanical construction parameters (such as heat transfer coefficient), ambient air temperature, and CBT values. The results show the relationship between the accuracy of each measurement method variant and various sensor parameters, indicating their suitability for different scenarios. All measurement variants showed unstable behaviour around the point where ambient temperature equals CBT. The ratio of the heat transfer coefficients of the dual-heat flux (DHF) sensor's channels impacts the CBT estimation uncertainty. An analysis of the individual components of uncertainty in CBT estimates reveals that the accuracy of temperature sensors significantly impacts the overall uncertainty of the CBT measurement. We also calculated the theoretical limits of measurement uncertainty, which varied depending on the method variant and could be as low as 0.05 degrees C.

E. Tourula, M. Lenzini, A. Rhodes, S. E. Hetz and J. Pearson.

Facial fanning reduces heart rate but not tolerance to a simulated hemorrhagic challenge following exercise heat stress in young healthy humans.

AMERICAN JOURNAL OF PHYSIOLOGY-REGULATORY, INTEGRATIVE AND COMPARATIVE PHYSIOLOGY. 2024;326(3):R210-R9.

https://doi.org/10.1152/ajpregu.00180.2023

We investigated whether reducing face skin temperature alters arterial blood pressure control and lower body negative pressure (LBNP) tolerance after exercise heat stress. Eight subjects (1 female; age, 27 +/- 9 yr) exercised at similar to 63% Vo2max until core temperature had increased similar to 1.5 degrees C before undergoing LBNP to presyncope either with fanning to return face skin temperature to baseline (Delta-5 degrees C, Fan trial) or without (No Fan trial). LBNP tolerance was quantified as cumulative stress index (CSI; mmHg center dot min). Before LBNP, whole body and face skin temperatures were elevated from baseline in both trials (38.0 +/- 0.5 degrees C and 36.3 +/- 0.5 degrees C, respectively, both P < 0.001). During LBNP, face skin temperature decreased in the Fan trial (30.9 +/- 1.0 degrees C) but was unchanged in the No Fan trial (36.1 +/- 0.6 degrees C, between trials P < 0.001). Mean arterial pressure was not different between trials (P = 0.237) and was similarly reduced at presyncope in both trials (from 82 +/- 7 to 67 +/- 8 mmHg, P < 0.001). During LBNP, heart rate was attenuated in the Fan trial at Mid LBNP (146 +/- 16 vs. 158 +/- 12 beats/min, P = 0.036) and at peak heart rate (158 +/- 15 vs. 170 +/- 15 beats/min; P < 0.001). LBNP tolerance was not different between trials (321 +/- 248 vs. 328 +/- 115 mmHg center dot min, P = 0.851). In exercise heat-stressed

individuals, lowering face skin temperature to normothermic values suppressed heart rate thereby altering cardiovascular control during a simulated hemorrhagic challenge without reducing tolerance.

T. Falcone, S. Del Ferraro, V. Molinaro, L. Zollo and P. Lenzuni.

A real-time biphasic Kalman filter-based model for estimating human core temperature from heart rate measurements for application in the occupational field.

FRONTIERS IN PUBLIC HEALTH. 2024;12.

https://doi.org/10.3389/fpubh.2024.1219595

Early identification of hypothermia or hyperthermia is of vital importance, and real-time monitoring of core temperature (CT) of the workers exposed to thermal environments is an extremely valuable tool. From the existing literature studies, the model developed by Buller et al. in their study of 2013 that generates real-time estimates of CT from heart rate (HR) measurements using the Kalman filter (KF) shows good potential for occupational application. However, some aspects could be improved to reliably handle the existing very wide range of workers and work activities. This study presents a real-time CT estimation model, called the Biphasic Kalman filter-based (BKFB) model, based on HR measurement, with characteristics suited to application in the occupational field.Methods Thirteen healthy subjects (six female and seven male) were included in the study to perform three consecutive tasks simulating work activities. During each test, an ingestible CT sensor was used to measure CT and a HR sensor to measure HR. The KF methodology was used to develop the BKFB model.Results An algorithm with a biphasic structure was developed using two different models for the increasing and decreasing phases of CT, with the ability to switch between the two based on an HR threshold. CT estimates were compared with CT measurements, and with respect to overall root mean square error (RMSE), the BKFB model achieved a sizeable reduction (0.28 +/- 0.12 degrees C) compared to the Buller et al. model (0.34 +/- 0.16 degrees C).Discussion The BKFB model introduced some modifications over the Buller et al. model for a more effective application in the occupational field. It was developed using data collected from a sample of workers (heavily weighted toward middle-aged, not very fit, and with a considerable fraction of female workers), and it also included two different modeling of CT (for the up- and down-phases), which allowed for better behavioral modeling in the two different stages. The BKFB model provides CT estimates reasonably in comparison to the measured intra-abdominal temperature values in both the activity and recovery phases but is more practical and easier to use for a real-time monitoring system of the workers' thermal states.

C. N. Hintz and C. R. Butler.

Wearable and ingestible technology to evaluate and prevent exertional heat illness: A narrative review.

PM&R. 2024.

https://doi.org/10.1002/pmrj.13155

Exertional heat illness remains a constant threat to the athlete, military service member, and laborer. Recent increases in the number and intensity of environmental heat waves places these populations at an ever increasing risk and can be deadly if not recognized and treated rapidly. For this reason, it is extremely important for medical providers to guide athletes, service members, and laborers in the implementation of awareness, education, and measures to reduce or mitigate the risk of exertional heat illness. Within the past 2 decades, a variety of wearable technology options have become commercially available to track an estimation of core temperature, yet questions continue to emerge

as to its use, effectiveness, and practicality in athletics, the military, and the workforce. There is a paucity of data on the accuracy of many of these newer devices in the setting of true heat stroke physiology, and it is important to avoid overreliance on new wearable technology. Further research and improvement of this technology are critical to identify accuracy in the diagnosis and prevention of EHI.

A. A. Silverio, E. T. W. Ho, J. Ang and K. Esguerra.

Wearable microfluidic sweat collection platform with a calorimetric flow rate sensor for realtime and long-term sweat rate measurements.

JOURNAL OF MICROMECHANICS AND MICROENGINEERING. 2024;34(3).

https://doi.org/10.1088/1361-6439/ad2305

This work presents the design and fabrication of a wearable microfluidic patch-based system for sweat collection with a calorimetric flow rate sensor based on heat convection for measuring sweat rate (SR). The effects were predicted using a 3D multi-physics simulator and were verified on a fabricated patch made of polyimide layers. The sensor can detect surface temperature gradients of 302-312 K caused by fluid flowing thru the microfluidic channels at a rate of 0.5-23 mu g s-1 that fall within the physiological range of SR. Meanwhile, the relation between flow rate and temperature gradient is highly linear (Pearson r2 = 0.999) and repeatable. This work also demonstrates a low-cost method for patterning microfluidic channels on flexible substrates which can be used for mass production of wearable patches.

Travail dans une ambiance thermique extrême

S. M. Taggart, O. Girard, G. J. Landers and K. E. Wallman.

Heat exposure as a cause of injury and illness in mine industry workers.

ANNALS OF WORK EXPOSURES AND HEALTH. 2024;68(3):325-31.

https://doi.org/10.1093/annweh/wxae011

The objective of this study was to explore the association between ambient temperature and injuries and illnesses experienced by mine industry workers. Eleven years of de-identified data from a mine industry company in Australia was explored in regards to injuries and illnesses occurring due to outdoor exposure. Each case was filtered for reported symptoms, and meteorological data to match the location of the mine site and date reported were sourced. Of the 18 931 injuries and illnesses observed over the 11-year period, 151 cases of heat-related illness due to outdoor exposure were reported. Twenty-five conditions/symptoms of heat-illness were found, with the most prevalent being dehydration (n = 81), followed by heat rash (n = 40), dizziness (n = 24), and headache (n = 23). The mean number of symptoms reported by each worker was 2 +/- 1. There was a positive correlation between ambient temperature and injuries/illnesses (r2 = 0.89, P < 0.001), where, as temperature increased so did the number of reported heat-related illnesses. Underreporting of heat-related illness and injury in the mining industry is likely, which is a risk to the health and wellbeing of employees. Workers require industry specific training about the severity of heat stress and the associated prevention strategies.

C. Thompson, L. Ferrie, S. J. Pearson, B. Highlands and M. J. Matthews.

In the heat of the moment: the effects of extreme temperatures on the cognitive functioning of firefighters.

ERGONOMICS. 2024.

https://doi.org/10.1080/00140139.2024.2326584

Exposure to high temperatures can have detrimental effects on cognitive processing and this is concerning for firefighters who routinely work in extreme temperatures. Whilst past research has studied the effects of heat on firefighter cognition, findings are mixed, and no work has measured the time course of cognitive recovery. This study compared working memory, vigilance, and cognitive flexibility of 37 firefighters before and after they engaged in a live-fire training exercise with temperatures exceeding 115 degrees C. To assess recovery, cognition was measured on exiting the fire, then 20- and 40-minutes post-fire. Results showed impaired vigilance and cognitive flexibility (increased errors, slower responses) immediately after the fire, but recovery at 20-minutes. These findings indicate that a live indoor fire negatively impacts cognitive processing, but this effect is relatively short-lived and return to baseline functioning is seen 20-minutes after exiting the fire. The findings could be used to inform re-entry and cooling decisions. Acute heat stress may affect cognitive processing, posing a health and safety risk to firefighters. This study demonstrates impaired cognition following a firefighter training exercise in temperatures exceeding 115 degrees C. Cognition recovered as core body temperature returned to normal, providing evidence for a 20-minute cooling period following exposure to extreme heat.

Travail par fortes chaleurs et périodes de canicule

E. J. Tetzlaff, C. Cassan, N. Goulet, M. Gorman, B. Hogya and G. P. Kenny.

"Breaking down in tears, soaked in sweat, and sick from the heat": Media-based composite narratives of first responders working during the 2021 Heat Dome.

AMERICAN JOURNAL OF INDUSTRIAL MEDICINE. 2024.

https://doi.org/10.1002/ajim.23576

During the summer of 2021, a deadly, unprecedented multiday Heat Dome engulfed western Canada. As a result of this extreme heat event (EHE), emergency dispatchers received an unparalleled increase in incoming 911 calls for ambulance, police, and fire (as first responders) services to attend to hundreds of heat-vulnerable community members succumbing to the heat. With 103 all-time heat records broken during this EHE and indoor temperatures of nearly 40 degrees C, the first responders attending these calls faced extensive job demands and highly challenging operating conditions. Initial investigations have explored the health system-level impacts; however, little has been done to explore the impact on the first responders themselves. Therefore, this study aimed to improve our understanding of EHEs' impacts on the operational capabilities and health of first responders, specifically police, fire, ambulance, and dispatch services.MethodsA systematized review and content analysis of media articles published on the 2021 Heat Dome in Canada was conducted (n = 2909), and four media-based composite narratives were developed highlighting police, fire, ambulance, and dispatch services. The Job Demands-Resources (JD-R) model was applied as a theoretical framework for occupational burnout.ResultsThe media-based composite narratives highlighted that first responders faced record-breaking call volumes, increased mental-health-related claims, and exhaustive heat-related physiological stress. Using the JD-R model as a theoretical framework for occupational burnout, we identified three measures of stressful job demand: work overload (e.g., the surge in call volume, firefighters responding to medical emergencies), emotional demands (e.g., severe medical emergencies, sudden deaths, unresponsive patients, distraught family members), and physical demands (e.g., resuscitation in personal protective equipment, heat-related illness).ConclusionThe experiences described underscore the importance of supporting first responders during work in extreme heat conditions. These findings have important implications for addressing rising rates of burnout during and following public health crises, such as EHEs, a problem that is increasingly being recognized as a threat to the Canadian public healthcare system.

Y. Choi, S. Seo, T. Hong and C. Koo.

A Classification Model Using Personal Biometric Characteristics to Identify Individuals Vulnerable to an Extremely Hot Environment.

JOURNAL OF MANAGEMENT IN ENGINEERING. 2024;40(2).

https://doi.org/10.1061/JMENEA.MEENG-5495

The rise in heatwaves due to climate change is becoming a significant concern for outdoor workers, particularly leading to an increasing number of heat-related illnesses. To address the challenge, this study aimed to propose, as a process-based approach, a classification model using personal biometric characteristics to identify individuals who are vulnerable to extremely hot environments (i.e., high-risk groups). To this end, an experimental study was conducted, and experimental conditions were set in an environmental chamber by considering the extremely hot summer weather in Korea. With the data collected from a total of 70 people who voluntarily participated in the experiment, the classification

model was developed by adopting multiple methodologies such as time-series clustering, independent samples t-test, and machine-learning algorithms. Consequently, it was found that the classification performance was the best with the multilayer perceptron algorithm, resulting in 0.800 in terms of the area under the receiver operating characteristic (AUROC) and 0.811 in terms of the area under the precision-recall curve (AUPRC). This study creates new ground in identifying individuals vulnerable to extremely hot environments in the domain of management in engineering by employing machine-learning-based classification algorithms with personal biometric characteristics. The proposed approach can be realized by utilizing a simple and low-cost bioelectrical impedance method for estimating human body composition (such as body fat mass and skeletal muscle mass) before they are put into the field. It is expected to aid in providing a more systematic and individualized management system for proactively preventing personal heat-related illnesses.

D. Amaripadath, M. Santamouris and S. Attia.

Climate change induced heat stress impact on workplace productivity in a net zero-carbon timber building towards the end of the century.

BUILDING SIMULATION. 2024.

https://doi.org/10.1007/s12273-024-1116-7

Changing climate intensifies heat stress, resulting in a greater risk of workplace productivity decline in timber office buildings with low internal thermal mass. The impact of climate change induced heat exposure on indoor workplace productivity in timber office buildings has not been extensively researched. Therefore, further investigation to reduce the work capacity decline towards the end of the century is needed. Here, heat exposure in a net zero-carbon timber building near Brussels, Belgium, was evaluated using a reproducible comparative approach with different internal thermal mass levels. The analysis indicated that strategies with increased thermal mass were more effective in limiting the effects of heat exposure on workplace productivity. The medium and high thermal mass strategies reduced workplace productivity loss to 0.1% in the current, 0.3% and 0.2% in the midfuture, and 4.9% and 3.9% for future scenarios. In comparison, baseline with low thermal mass yielded a decline of 2.3%, 3.3%, and 8.2%. The variation in maximum and minimum wet-bulb globe temperatures were also lower for medium and high thermal mass strategies than for low thermal mass baseline. The study findings lead to the formulation of design guidelines, identification of research gaps, and recommendations for future work.

Page(s) web

Protecting Workers in High-Heat Industries. Mary Ann Merikoski, Oshonline.com, 1er mars 2024.

Safeguarding workers in high-heat settings with the right protective clothing involves understanding a bit about heat transfer, the work being done, and the best materials and technologies for the job.

https://ohsonline.com/Articles/2024/03/01/Protecting-Workers-in-High-Heat-Industries.aspx

Actualités mars 2024

- ## Travail par fortes chaleurs et périodes de canicule

L'UE est mal préparée à l'aggravation des risques liés au changement climatique, selon un projet de rapport. Challenges.fr, 7 mars 2024

Chaleur de plomb : Les travailleurs de l'extrême. La1ere.francetvinfo.fr, 13 mars 2024

Paludiers : une surproduction historique en 2022. Ouest-france.fr, 14 mars 2024

Les Vignerons Engagés se penchent sur la santé au travail à la chaleur. Vitisphere.com, 26 mars 2024

Chaleur : deux grandes organisations humanitaires appellent à la mobilisation avant l'été. AFP Infos Françaises (Presse), 28 mars 2024

Policy Watch: Countries slow to wake up to the mounting deaths from heat stress. Reuters.com, 18 mars 2024

High heat? Law should say get out of the kitchen: B.C. labour advocates. Pentictonwesternnews.com, 23 mars 2024

Phoenix to vote on heat safety regulation for contractors to protect outdoor workers. Azcentral.com, 26 mars 2024

ASSP, ANSI PUBLISH STANDARD FOR HEAT STRESS IN CONSTRUCTION. States News Services (Presse), 28 mars 2024

- ## Travail dans une ambiance thermique extrême

"On travaille en short et t-shirt toute l'année" : immersion au ZooParc de Beauval avec une soigneuse du dôme équatorial. Lejdc.fr, 3 mars 2024

Ce risque multiplié par deux lorsqu'une femme enceinte travaille dans une chaleur extrême. Parents.fr, 22 mars 2024

California wants to protect indoor workers from heat. That goal is now limbo. Npr.org, 23 mars 2024

Newsom administration delays landmark workplace heat safety rules over cost concerns. Latimes.com, 23 mars 2024

- ## Outils et capteurs de mesure

This wearable improved my fitness performance by tracking an often- overlooked metric. Zdnet.com, 12 mars 2024

Flexible temperature-pressure dual sensor based on 3D spiral thermoelectric Bi2Te3 films. Nature.com, 21 mars 2024

- **EPI, matériaux protecteurs/refroidissants**

LES EPI DE DEMAIN Connectés et plus sécurisés. Maison et Travaux PRO, p.14-15, 27 mars 2024

Adaptée aux évolutions climatiques NOUVELLE GÉNÉRATION D'EPI. Maison et Travaux PRO, p.16, 27 mars 2024

DuPont Announces 2023 North America Protection Innovation Award Winners. Pakistan Company Updates (Presse), 1 mars 2024