EVIDENCE-BASED GUIDELINES TO BOOST HEALTH AND WORK PRODUCTIVITY IN A WARMING WORLD

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Occupational heat stress = conditions under which a worker’s body is storing heat

- Harsh environmental conditions
- Insulated and/or impermeable protective clothing
- Increased metabolic heat from physically demanding tasks
Workers in physically demanding jobs and/or hot regions often experience heat strain which is typically not recognized.

- 80% of miners (Tanzania)
  
  Meshi et al., 2018, Ann Glob Health

- 75% electric utility workers (US)
  
  Meade et al., 2015, J Occup Environ Hyg
occupational heat stress raises the likelihood for heat-related pathologies reduces productivity

Sawka & Pandolf, 2001

Ioannou et al., Under preparation
EXISTING GUIDELINES
ASSESSING OCCUPATIONAL HEAT STRESS

Wet-Bulb Globe Temperature (WBGT) --- largest evidence base for use in occupational settings

Thresholds for work in hot environments based on WBGT:

- North Atlantic Treaty Organization (NATO)
- Cypriot Ministry of Labour (CMOL)
- Greek Ministry of Labour (GMOL)
- Singapore Armed Forces (SAF)
- US National Institute for Occupational Safety and Health (NIOSH)
- US Occupational Safety & Health Administration (OSHA)
- International Organization for Standardization (ISO)
- American Conference of Governmental Industrial Hygienists (ACGIH)
- American Industrial Hygiene Association (AIHA)
- Infrastructure Health & Safety Association (ISHA)
- Japan Society for Occupational Health (JSOH)
- New South Wales Nurses and Midwives’ Association (NSWNMA)

Max work intensity permitted:
- Very High
- High
- Moderate
- Low
- None
Populations living in different parts of the world can acclimatize to the local environmental conditions – here, mortality rises at different temperature levels across 13 cities.

Gasparrini et al., 2015; Lancet
Natural acclimatization occurring during the course of a summer reduces heat strain, particularly in older individuals (>55 years)

- here, heat storage was lower after the summer in older adults, but not in their young peers

Notley et al., In press, Exp Physiol
RE-INDUCTION OF ACCLIMATIZATION

Re-acclimatization schedule for work in the heat after routine absence or illness

- Routine absence or illness
  - <4
  - 4-5
  - 6-12
  - 13-20
  - >20

- Percent of full work assignment

Days after worker has returned to duty
Daily water requirements for work in hot environments based on WBGT:
Simple tools for detecting hypo-hydration and determining the adequacy of day-to-day water loss replacement in healthy, active, low-risk populations of workers.
SHORTCOMINGS & CHALLENGES
PROTECTING A WORKFORCE THAT’S CHANGING

- **Older workers** are the **fastest growing** labour pool (EU Commission, 2018; CDC, 2012; Stats Canada, 2018)
- **Obesity** and **lack of physical fitness** have reached **epidemic levels**
- **Prevalence of chronic diseases** (e.g., diabetes) that affect thermoregulation is rapidly increasing

- here, thresholds for age, fitness, and body composition / morphology beyond which heat stress risk is higher

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Flouris et al., 2017, Temperature

Notley et al., 2019, JAMA
WORK RATE VARIES ACROSS JOBS & COUNTRIES

- Mining (conventional)
- Mining (production drilling)
- Electrical utilities (ground work)
- Agriculture (potato harvesting; Greece)
- Construction (conventional; Spain)
- Mining (manual shotcrete)
- Mining (manual bolting)
- Electrical utilities (manual pole work)
- Agriculture (grape picking; Cyprus)
- Construction (conventional; Qatar)
- Mining (general services)
- Mining (production ore transport)
- Electrical utilities (bucket work)
- Agriculture (green fodder cultivating; Qatar)
- Tourism & services (conventional; Greece)

Kenny et al., 2012, J Occup Environ Hyg; Meade et al., 2015, J Occup Environ Hyg; Ioannou et al., Under Preparation
GLOBAL WARMING IS NOT UNIFORM ACROSS THE EARTH

+ 1.5°C: Change in average temperature of hottest days

+ 2.0°C: Change in average temperature of hottest days

IPCC, Global Warming of 1.5 °C, 2018
CONSIDERATIONS FOR IMPROVING PROTECTION
Mission: to address the negative impacts of workplace heat stress on the health and productivity of workers in strategic European industries
Mission: to develop and evidence-based heat mitigation plan for Qatar
Mission: assessing and managing occupational heat stress risk in Greek industries

Supported by the Greek Ministry of Labour and Social Affairs
**Mission**: understanding heat stress for workers in the electric power industry and providing recommendations for mitigation (work with Dr. Glen Kenny at Univ. Ottawa)

Funded by the Electric Power Research Institute
Adaptation strategies

- Work-rest ratios
- Hydration
- Mechanization
- Clothing

Vulnerable workers

Personalized warning system
PERSONALIZED WARNING SYSTEM

- Online platform providing forecasts and guidance up to 30 days in advance
- Designed for workers and employers
BUILD YOUR PROFILE

Be kind. This information will let us calculate your heat alert threshold.

Let's start with the basic information

**Email** (required)

m.morabito@ibimet.cnr.it

**Password** (required)

********

**Street Name**

**Nr**

**ZIP**

**City**

**Country (EU)**

select

**NEXT**
PERSONALIZED WARNING SYSTEM

Short term heat stress risk

- **Wednesday**: 666
  - 05/22/2019

- **Thursday**: 666
  - 05/23/2019

- **Friday**: 66
  - 05/24/2019

- **Saturday**: 666
  - 05/25/2019

- **Sunday**: 666
  - 05/26/2019

**HEAT STRESS RISK LEVELS**

- **NOT SIGNIFICANT**
- **LOW**
- **MODERATE**
- **HIGH**

**Hydration**
- Drink about half a liter of water per hour
- Drink about a liter per hour
- Drink more than a liter of water per hour

**Work breaks**
- No further breaks are needed
- Small breaks
- Increase the number of breaks with cooling
- Frequent breaks in shadow or cooled area

**LONG TERM RISK**

**EDIT PROFILE**
According to your profile's features, the heat stress threshold is expected to exceed in the next five days, in the area you selected.

Please check the suggestions indicated in your profile.

Heat Shield Staff
### Long term heat stress risk

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### Heat stress risk levels

- **Not significant**
- **Low**
- **Moderate**
- **High**
WORKING IN THE HEAT?

Dehydration is a serious threat to your health

Hydration is about maintaining your body’s water and electrolytes stores by ingesting fluid and salt to match the amounts you lose through sweating.

70% OF EUROPEANS WORKING IN HIGH HEAT ARE DEHYDRATED

THIRST

30°C +

DOES IT PROTECT?

Thirst may not be sufficient to secure that you stay hydrated in hot conditions.

WATER AND SALT

Read these steps to secure adequate daily water and salt intake.

HABITS

DAY-TO-DAY

It is not only about hydrating at work. Hydrating at home is equally important.

BALANCE

Find your balance. Hydration needs vary from person to person.

SWEAT LOSS

Your water needs may be high if you are a “heavy-sweater”.

ELECTROLYTES

If your blood pressure is normal, extra salt to your meals may help.

STAY PROTECTED

Get support personalized to your needs at www.heat-shield.eu

Funded by EU Horizon 2020 grant agreement No 668786
HEAT AFFECTS YOUR HEALTH AND PRODUCTIVITY

HOT FACTs upon which you can ACT to minimize the detrimental effects on your organization’s performance

ACCIDENTS - WORKERS’ HEALTH - ORGANIZATION PERFORMANCE

Heat stress impairs physical and mental work capacity
Substantial productivity losses surpassing 15% on hot days
Heat increases work injuries, leads to accumulated fatigue & acute sickness
Frequent work in the heat causes chronic health hazards (e.g., doubled risk of kidney disease)

Request the development of a heat mitigation plan for your organization

Create a buddy system and take breaks (e.g., 2-5 min per hour) that protect health and maintain productivity
Ensure your work uniform is safe, comfortable, and made from breathable fabrics that reflect radiation
Plan outdoor and physically demanding work in the cooler parts of the day
Ensure easy access to drinking water at all times via water stations, personal water bottles, etc.

STAY PROTECTED Get personalized support at www.heat-shield.eu

Funded by EU Horizon 2020 grant agreement No 668786
TAKE HOME MESSAGES ON GUIDANCE
Employers should prepare and have available at the work site a copy of their **risk assessment and heat mitigation plan**

Employers should ensure that all employees undergo **initial medical examination** upon recruitment followed by **annual health checkups** to prevent, diagnose, and manage chronic disease and assist workers to remain fit for duty, considering in particular conditions and symptoms related to work in hot environments.

Employers should ensure that **medical, safety, and welfare staff are readily available for support and care**.
Employers should provide training (upon recruitment and at the start of each summer period) to all employees on occupational heat stress.

Recommended actions:

- **Training should cover** the impacts of physical exertion, clothing, personal protective equipment, dehydration, and sleep deprivation, as well as on first aid and how to observe their colleagues for alertness and signs or symptoms of heat-related illness.

- Employers should reinforce these messages using large signs throughout the work site in the workers’ languages.

- Employers should train supervisors on how to monitor weather reports and how to respond to heat advisories. These training procedures should include designating a person to be available to ensure that emergency procedures are invoked when appropriate.

- Employers should closely supervise newly recruited employees, particularly for the first 14 days of their employment. This is especially important for workers who have been recruited during the summer season and are not been acclimatized.
GUIDANCE FOR HYDRATION

Employers should ensure that all employees have free and continuous access to fresh, pure, and suitably cool drinking water throughout the work shift.

Recommended actions:

- Maintaining one or more water stations located as close as practicable to where employees are working, and in no case at a distance that employees cannot reach within 5 minutes.
- Providing each outdoor worker with a water bottle to carry with them throughout their work shift.
- Frequently reminding employees to drink water on a regular basis and to re-fill the water bottle when needed.
- Employers should adopt practical tools for diagnosing hypo-hydration and should provide employees with training regarding their usage.
Employers with outdoor places of employment should provide access to shade

Recommended actions:

- Maintaining one or more shaded areas sufficient to accommodate 25 percent of the employees on the work shift at any time, located as close as practicable to where employees are working, within a distance that employees can reach within 5 minutes.

- Providing air-conditioned rest areas to be used during breakfast / lunch / dinner breaks that are large enough to fit all workers in each work shift.

- The cool parts of the day should be prioritized when performing outdoor work to limit occupational heat stress exposure.
Employers should provide workers appropriate personal protective equipment, including loose, light-coloured, and durable clothing made from breathable fabrics to maximize heat evaporation.

Employees should be encouraged to take a break for cooling-down in the shade if they feel they need to do so to protect themselves from overheating.
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