Gli effetti dell'esposizione a microclima caldo sul corpo umano e le patologie da calore

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La prevenzione delle patologie da calore nei luoghi di lavoro: linee di indirizzo del Gruppo Tecnico Interregionale Salute e sicurezza sul lavoro

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Esposizione al rischio calore

nature climate change
LETTERS
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Global risk of deadly heat

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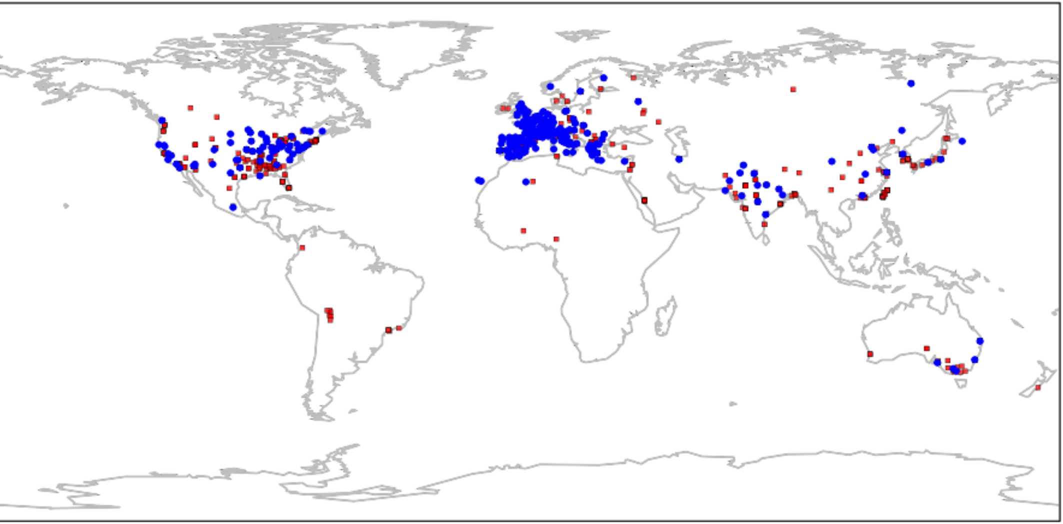
- Secondo una **pubblicazione del 2017**, l'impatto dell'aumento delle temperature sulla salute della popolazione globale è destinato a peggiorare nel corso del secolo: attualmente, **la quota di popolazione mondiale esposta ad una "soglia di letalità" da calore eccessivo per un tempo ≥ 20 giorni/anno è del 30% circa**

- **Tale percentuale**, secondo i dati, **aumenterà inesorabilmente fino al 48%**, anche considerando una riduzione dei gas serra, come previsto dagli obiettivi di tutti gli enti che cercano di contrastare il cambiamento climatico



re 1 | **Geographical distribution of recent lethal heat events and their climatic conditions. a**, Places where relationships between heat and mortality been documented (red squares) and where specific heat episodes have been studied (blue squares). **b**, Mean daily surface air temperature and

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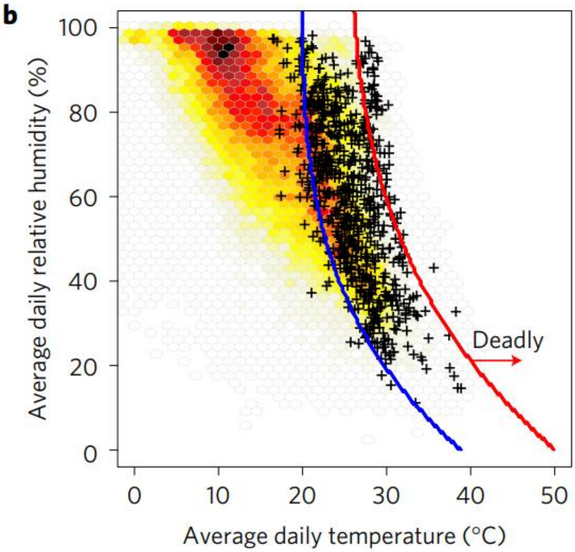

Figure 1 | Geographical distribution of recent lethal heat events and their climatic conditions. a, Places where relationships between heat and mortality have been documented (red squares) and where specific heat episodes have been studied (blue squares). **b**, Mean daily surface air temperature and relative humidity during lethal heat events (black crosses) and during periods of equal duration from the same cities but from randomly selected dates (that is, non-lethal heat events; red to yellow gradient indicates the density of such non-lethal events). Blue line is the SVM threshold that best separates lethal and non-lethal heat events and the red line is the 95% probability SVM threshold; areas to the right of the thresholds are classified as deadly and those to the left as non-deadly. Support vectors for other variables are shown in Supplementary Fig. 2.

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The fact that temperature and relative humidity best predict times when climatic conditions become deadly is consistent with human thermal physiology, as they are both directly related to body heat exchange[2–4]. First, the combination of an optimum body core temperature (that is, ~37 °C), the fact that our metabolism generates heat (~100 W at rest) and that an object cannot dissipate heat to an environment with equal or higher temperature (that is, the second law of thermodynamics[22]), dictates that any ambient temperature above 37 °C should result in body heat accumulation and a dangerous exceedance of the optimum body core temperature (hyperthermia[5]). Second, sweating, the main process by which the body dissipates heat, becomes ineffective at high relative humidity (that is, air saturated with water vapour prevents evaporation of sweat); therefore, body heat accumulation can occur at temperatures lower than the optimum body core temperature in environments of high relative humidity. These properties help to explain why the boundary at which temperature becomes deadly decreases with increasing relative humidity (Fig. 1b) and why in our results some heat mortality events occurred at relatively low temperatures (Fig. 1b). These consequences of temperature and humidity are why both of these variables are included in traditional thermal indices such as humidex[26] and wet-bulb globe temperature[22,27].

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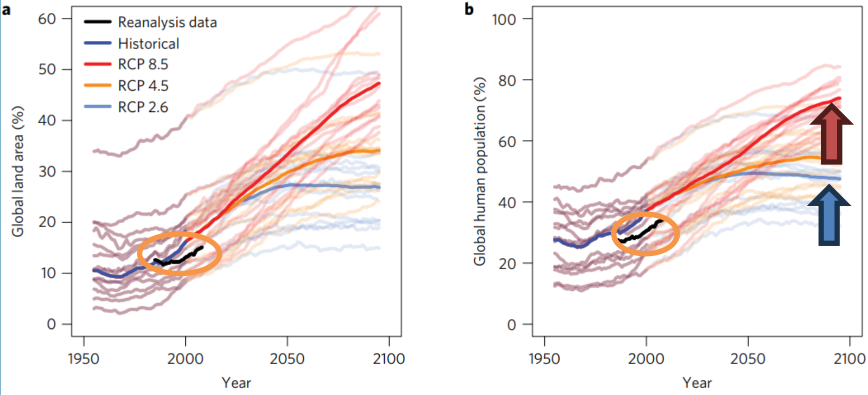

igure 2 | **Current and projected changes in deadly climatic conditions. a**,**b**, Area of the planet (**a**) and percentage of human population (**b**) exposed to imatic conditions beyond the 95% SVM deadly threshold (red line in Fig. 1b) for at least 20 days in a year under alternative emission scenarios. Bold lines re the multimodel medians, black lines are the results from reanalysis data and faded lines indicate the projections for each Earth System Model. Time eries were smoothed with a 10-year-average moving window. Area of the planet and human population exposed to different lengths of time are shown in upplementary Fig. 4. Results correcting for climatological mean biases between the reanalysis data and each Earth System Model are shown in upplementary Figs 8 and 10.

r study underscores the current and increasing threat to n life posed by climate conditions that exceed human ther-ulatory capacity. Lethal heatwaves are often mentioned as a nsequence of ongoing climate change, with reports typically past major events such as Chicago in 1995, Paris in 2003, oscow in 2010[1–6]. Our literature review indicates, however, thal heat events already occur frequently and in many more worldwide than suggested by these highly cited examples. nalysis shows that prior lethal heat events occurred beyond eral threshold of combined temperature and humidity, and oday nearly one-third of the world's population is regularly ed to climatic conditions surpassing this deadly threshold. The f the planet and fraction of the world's human population ed to deadly heat will continue to increase under all emission ios, although the risk will be much greater under higher

Trend in continuo aumento delle aree e della popolazione esposte ad una soglia di calore letale (**da 30% a 48% alla fine di questo secolo**)
Riscaldamento più consistente nelle aree temperate
Attenzione ad invecchiamento della popolazione e a contesti urbani (isole di calore)

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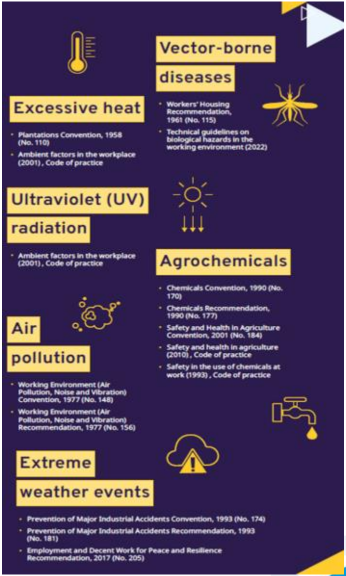
emission scenarios. By 2100, almost three-quarters of the world's human population could be exposed to deadly climatic conditions under high future emissions (RCP 8.5) as opposed to one-half under strong mitigation (RCP 2.6). While it is understood that higher latitudes will undergo more warming than tropical regions[30], our results suggest that tropical humid areas will be dispropor-tionately exposed to more days with deadly climatic conditions (Fig. 5a), because these areas have year-round warm temperatures and higher humidity, thus requiring less warming to cross the deadly threshold (Fig. 4 and Supplementary Fig. 6). The consequences of exposure to deadly climatic conditions could be further aggra-vated by an ageing population (that is, a sector of the popula-tion highly vulnerable to heat[2–4]) and increasing urbanization (that is, exacerbating heat-island effects[2–4]). Our paper emphasizes the importance of aggressive mitigation to minimize exposure to deadly climates and highlights areas of the planet where adaptation will be most needed.

Il punto di vista ILO

30 Aprile 2024

The report "Ensuring safety and health at work in a changing climate" presents critical evidence related to six key impacts of climate change on OSH, which were chosen for their severity and the magnitude of their effects on workers: excessive heat, ultraviolet (UV) radiation, extreme weather events, workplace air pollution, vector-borne diseases and changes in agrochemical use. It includes the most pertinent



Il punto di vista ILO

Work-related health impact

Every year

22.85 million
occupational injuries

18,970
work-related deaths

2.09 million
DALYs attributable to excessive heat.

Global burden of occupational exposures

Every year, at least

2.41 billion
workers
exposed to excessive heat.

ILO. Ensuring safety and health at work in a changing climate. 2024, ISBN 9789220405079

Lavoratori particolarmente a rischio

- **Women workers** may be at increased risk due to their job roles, such as in subsistence agriculture, and during different life stages; pregnancy-related complications include hypertension, miscarriages and stillbirths (Desai and Zhang 2021; UNICEF 2023).

- **Men workers** are most likely to carry out heavy manual labour, for example in construction and agriculture, often in hot conditions, and are therefore at high risk of many climate change impacts (Fatima et al. 2021).

- **Young workers** are often exposed to excessive heat in sectors such as agriculture, construction and waste management and tend to be more likely to have a serious accident at work than older adults, as they may lack maturity, skills, training and experience (EU-OSHA n.d.).

- **Older adult workers** are particularly susceptible to climate-related hazards, as they are less able to tolerate stress due to slower metabolisms, weaker immune systems and an increased disease burden (Carnes et al. 2014).

ILO. Ensuring safety and health at work in a changing climate. 2024, ISBN 9789220405079

Lavoratori particolarmente a rischio

- **Workers with a disability** experience disproportionately higher rates of social risk factors, such as poverty and lower educational attainment, that contribute to poorer health outcomes during extreme weather events or climate-related emergencies (Gamble et al. 2016).

- **Workers with pre-existing health conditions** may be particularly impacted by climate change risks, as these may exacerbate pre-existing health conditions, including chronic illnesses such as diabetes and heart, kidney and respiratory diseases (Carnes et al. 2014).

- **Migrant workers** are frequently employed in high-risk, physically demanding occupations, for example as harvest workers, and may be unable to understand OSH procedures and training materials due to language barriers (Schulte et al. 2023).

- **Workers in the informal economy** are among the workers most at risk of climate change hazards, as they are frequently lacking OSH protections, key services and infrastructure (Dodman et al. 2023). Due to financial concerns, **informal workers**, as well as many **own-account workers**, may also be unable to stop work, even when their health is at risk from extreme climate events.

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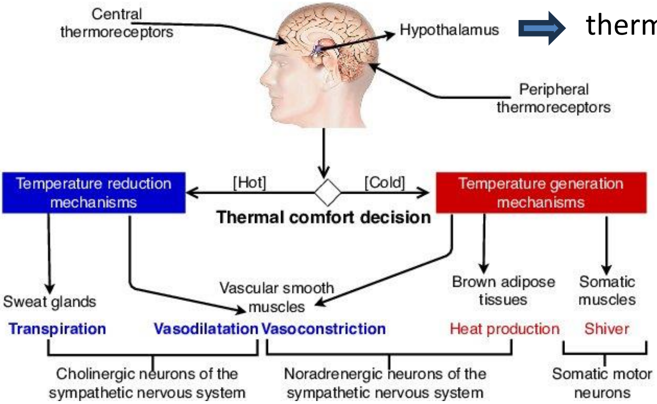
La termoregolazione



→ thermostat

+ perspiration (lungs)

Nkurikiyeyezu, K, et al. (2019). **Thermal Comfort and Stress Recognition in Office Environment**. In *Proceedings of the 12th International Joint Conference on Biomedical Engineering Systems and Technologies (BIOSTEC 2019) - HEALTHINF*; ISBN 978-989-758-353-7; ISSN 2184-4305, SciTePress, pages 256-263.

In a neutral temperature environment, the human metabolic rate produces more heat than is necessary to maintain the core body temperature in the range of 36.5–37.5°C.

Loscalzo J, Fauci A, Kasper D, Hauser S, Longo D, Jameson J. eds. Harrison's Principles of Internal Medicine, 21e. McGraw-Hill Education; 2022. Accessed June 09, 2025. https://accessmedicine.mhmedical.com/content.aspx?bookid=3095&sectionid=259856983

La termoregolazione

The body dissipates heat into the environment via four mechanisms:

1. **evaporation** of skin moisture is the single most efficient mechanism of heat loss but becomes progressively ineffective as the relative humidity rises to >70%
2. **radiation** of infrared electromagnetic energy directly into the surrounding environment occurs continuously (conversely, radiation is a major source of heat gain in hot climates)
3. **Conduction:** the direct transfer of heat to a cooler object
4. **Convection:** the loss of heat due to air currents

Both ineffective when the environmental temperature exceeds the skin temperature!

Loscalzo J, Fauci A, Kasper D, Hauser S, Longo D, Jameson J. eds. Harrison's Principles of Internal Medicine, 21e. McGraw-Hill Education; 2022. Accessed June 09, 2025. https://accessmedicine.mhmedical.com/content.aspx?bookid=3095&sectionid=259856983

La termoregolazione

Factors that interfere with the evaporation of diaphoresis significantly increase the risk of heat illness

- dripping of sweat off the skin
- constrictive or occlusive clothing
- dehydration
- excessive humidity

Loscalzo J, Fauci A, Kasper D, Hauser S, Longo D, Jameson J. eds. Harrison's Principles of Internal Medicine, 21e. McGraw-Hill Education; 2022. Accessed June 09, 2025. https://accessmedicine.mhmedical.com/content.aspx?bookid=3095&sectionid=259856983

Il processo di acclimatazione

The regulation of this heat load is complex and involves the central nervous system (CNS), thermosensors, and thermoregulatory effectors. The central thermostat activates the effectors that produce **peripheral vasodilation and sweating**. The **skin** surface is in effect the **radiator** and the principal location of heat loss, since **skin blood flow can increase 25–30 times** over the basal rate. This dramatic increase in skin blood flow, coupled with the maintenance of peripheral vasodilation, efficiently radiates heat. At the same time, there is a **compensatory vasoconstriction of the splanchnic and renal beds**.

Acclimatization to heat reflects a constellation of physiologic adaptations that permit the body to lose heat more efficiently. This process often **requires one to several weeks** *of* **exposure and work in a hot environment**. During acclimatization, the thermoregulatory set point is altered, and this alteration affects the onset, volume, and content of diaphoresis. **The threshold for the initiation of sweating is lowered, and the amount of sweat increases, with a lowered salt concentration**. **Sweating rates can be 1–2 L/h in acclimated individuals during heat stress**. Plasma volume expansion also occurs and improves cutaneous vascular flow. The **heart rate lowers**, with a **higher stroke volume**. After the individual leaves the hot environment, <u>**improved tolerance to heat stress dissipates rapidly**</u>, the plasma volume decreases, and de-acclimatization occurs within weeks.

Loscalzo J, Fauci A, Kasper D, Hauser S, Longo D, Jameson J. eds. Harrison's Principles of Internal Medicine, 21e. McGraw-Hill Education; 2022. Accessed June 09, 2025. https://accessmedicine.mhmedical.com/content.aspx?bookid=3095&sectionid=259856983

Diagnosi differenziale

Patologie da calore

Cardiovascular inefficiency	**Age extremes, Beta/calcium channel blockade, Congestive heart failure, Dehydration, Diuresis, Obesity, Poor physical fitness**
Central nervous system illness	Cerebellar injury, Cerebral hemorrhage, Hypothalamic cerebrovascular accident, Psychiatric disorders, Status epilepticus
Impaired heat loss	**Antihistamines**, **Heterocyclic antidepressants**, **Occlusive clothing**, **Skin abnormalities**
Endocrine and immune-related illness	Diabetic ketoacidosis, Multiple-organ dysfunction syndrome, Pheochromocytoma, Systemic inflammatory response syndrome, **Thyroid storm**
Infectious illness	Cerebral abscess, Encephalitis, Malaria, Meningitis, Sepsis syndrome, Tetanus, Typhoid

Loscalzo J, Fauci A, Kasper D, Hauser S, Longo D, Jameson J. eds. Harrison's Principles of Internal Medicine, 21e. McGraw-Hill Education; 2022. Accessed June 09, 2025. https://accessmedicine.mhmedical.com/content.aspx?bookid=3095&sectionid=259856983

Diagnosi differenziale

Patologie da calore

Toxicologic illness	Amphetamines, Anticholinergic toxidrome, Cocaine, **Dietary supplements**, Hallucinogens, Malignant hyperthermia, Neuroleptic malignant syndrome, **Salicylates**, Serotonin syndrome, Strychnine, **Sympathomimetics**, Withdrawal syndromes (ethanol, hypnotics)

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Tutti coloro che presentano condizioni di questo tipo avranno un'alterata capacità di adattamento alle alte temperature e potranno essere meno performanti nell'adattamento

Ipersuscettibili al rischio calore

Disabilità termiche e suscettibilità al calore

Condizioni di ipersuscettibilità al calore (ISO 28803:2012)

Gravidanza

Ipertensione

Cardiopatie

Diabete

Altre patologie endocrine

Patologie renali e/o dialisi

Disturbi psichici

(fonte: portaleagentifisici.it/fo_microclima_index.php?lg=IT#sensibili)

Disabilità termiche e suscettibilità al calore

Condizioni di ipersuscettibilità al calore (ISO 28803:2012)

(fonte: portaleagentifisici.it/fo_microclima_index.php?lg=IT#sensibili)

Disabilità termica	Effetto termico della disabilità	Tipo di ambiente	Patologia originata
Alterazioni della termoregolazione corporea	Impedimento alla sudorazione/congestione da calore	Caldo	Lesioni del midollo spinale/età/patologie neurologiche (lebbra)
	Iperproduzione termica cinetica	Caldo	Paralisi cerebrale
	Iperproduzione termica endogena	Caldo	Ipertiroidismo, morbo di Graves, lesioni ipotalamiche, etc…
Alterazioni della percezione termica	Paralisi termorecettori	Caldo/freddo	Lesioni del midollo spinale/età/patologie neurologiche (lebbra
Peggioramento di altre disabilità	Infarto	Caldo/freddo/sbalzi termici	Infarto miocardico/cerebrale/di altra sede
	Effetti pressori	Caldo/freddo/sbalzi termici	Disturbi ipertensivi
	Alterazione cutanea da sudorazione	Caldo	Epidermolisi bollosa ereditaria, etc…

Il rischio nel mondo del lavoro

Examples of workers at high-risk

Workers in agriculture, environmental goods and services (natural resource management), construction, refuse collection, emergency repair work, transport, tourism and sports.

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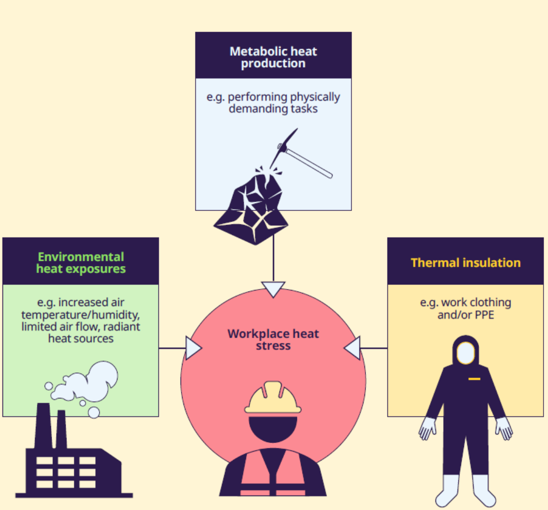
Figure 2: Factors which increase heat-stress risks



Effetti sulla salute (dei lavoratori)

Primary health impacts

Heat stress, heatstroke, heat exhaustion, rhabdomyolysis, heat syncope, heat cramps, heat rash, cardiovascular disease, acute kidney injury, chronic kidney disease, physical injury.

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Principali effetti del calore

- Acuti/a breve termine
- A lungo termine
- Psicologici
- Infortunistici

Effetti acuti

Minori

- **Edema da calore**: lieve gonfiore localizzato alle estremità nei primi gg di esposizione significativa. È dovuto alla vasodilatazione superficiale e alla mobilitazione dei fluidi interstiziali in risposta al calore -> NO diuretici, peggiorano la risposta al calore!
- **Sudamina** (miliaria rubra, lichen tropicus): rash eritematoso maculo-papulare, pruriginoso, che appare nelle aree coperte. È dovuto al blocco dei pori delle ghiandole sudoripare da detriti dello strato corneo, con infiammazione dei dotti ghiandolari, che si dilatano, si rompono e producono vescicole. Il sintomo principale è il prurito.

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Effetti acuti

Minori

- **Sincope da calore**: tipicamente associata a **sforzo fisico**, ad **età avanzata**, **stazionamento sul posto prolungato** in ambienti caldi. È dovuta all'ipotensione da diminuzione del tono vascolare legata alla vasodilatazione, ed è più tipica di chi non è acclimatato o ha delle condizioni (**verificare**!) che rendono più difficoltosa l'acclimatazione. Si risolve con idratazione e abbassamento della T corporea.

- **Hyperventilation tetany**: in alcuni soggetti l'esposizione a calore induce iperventilazione, con alcalosi respiratoria, parestesie e spasmi muscolari non dolorosi delle estremità. Si resolve tranquillizzando il soggetto, rimuovendo l'esposizione a calore e cercando di contenere l'iperventilazione.

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Effetti acuti

Maggiori

- **Crampi da calore**: tipici di un soggetto **a riposo** non acclimatato dopo sforzo intenso in un ambiente caldo e umido (i crampi dell'atleta insorgono durante l'esercizio, si risolvono spontaneamente ma durano a lungo). Sono **intermittenti e dolorosi** spasmi della muscolatura scheletrica che compaiono in un **soggetto molto sudato che ha bevuto molta acqua o altri fluidi ipotonici o ha un basso livello di Na pre-esercizio, e generalmente non è acclimatato.** Sono dovuti al calo di Na, K e acqua dovuto alla profusa sudorazione accoppiata all'ingestione di fluidi ipotonici. Solitamente si risolvono con la somministrazione di soluzioni reidratanti orali (tavolette o bustine).
- **NB: alto rischio per lavoratori sui tetti, vigili del fuoco, forze dell'ordine, lavoratori delle fonderie, agricoltori, giardinieri**

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Effetti acuti

Maggiori

- **Esaurimento da calore**: dovuto a perdita eccessiva di acqua e/o Na. Rispetto al colpo di calore, il soggetto resta vigile e ha ancora una **minima capacità di termoregolazione**, tuttavia la **T corporea aumenta** (gen. ≤40,5 °C). Soggetto spesso molto sudato! Sintomi: **malessere generale, cefalea, vertigini e stordimento, atassia, nausea, crampi muscolari, possibile ipotensione con lipotimia e sincope, tachicardia sinusale**. Richiede immediato abbassamento della T corporea e trattamento infusivo EV.

- **Colpo di calore**: **perdita completa della capacità termoregolatoria**. T nucleare gen.> 40,5 °C. **Triade** diagnostica: esposizione a **calore**, alterazioni della **coscienza** (inizialmente spesso assenti), **rialzo** termico.

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Effetti acuti

Maggiori

- **Colpo di calore**: Sintomi prodromici: **malessere generale, cefalea, vertigini e stordimento, atassia, nausea, crampi muscolari, possibile ipotensione con lipotimia e sincope, tachicardia (anche non sinusale), sintomi psichiatrici**. Molto simili ad esaurimento da calore. Il quadro solitamente subisce un **peggioramento improvviso** quando la pressione è troppo bassa per mantenere un'adeguata perfusione viscerale => vasocostrizione superficiale che arresta lo scambio di calore e determina ipertermia. **Soggetto spesso NON sudato!! E' un'emergenza medica! Richiede immediato abbassamento della T corporea (se ritardato, possible danno epatico con rialzo AST, ALT, IR acuta, CID, MOFS)** e trattamento avanzato.

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Effetti acuti

Typical Manifestations of Heatstroke

CLASSIC	EXERTIONAL
Older patient	Younger patient
Predisposing health factors/medications	Healthy condition
Epidemiology (heat waves)	Sporadic cases
Sedentary	Exercising
Anhidrosis (possible)	Diaphoresis (common)
Central nervous system dysfunction	Myocardial/hepatic injury
Oliguria	Acute renal failure
Coagulopathy (mild)	Disseminated intravascular coagulation
Mild lactic acidosis	Marked lactic acidosis
Mild creatine kinase elevation	Rhabdomyolysis
Normoglycemia/calcemia	Hypoglycemia/calcemia
Normokalemia	Hyperkalemia
Normonatremia	Hyponatremia

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Recap

Table 1. Types Of Heat Illnesses[2-9]

Heat edema	Benign, self-limiting condition, usually seen in the lower extremities after heat exposure; secondary to prolonged cutaneous vasodilation.
Heat rash	A dermatologic condition caused by plugging of sweat ducts and the ensuing inflammatory eruption that follows; also known as lichen tropics, prickly heat, miliaria rubra.
Heat cramps	Exercise-associated muscle contractions believed to be secondary to loss of electrolytes (such as sodium), which occurs mainly after cooling.
Heat tetany	Carpopedal spasm and paresthesia secondary to hyperventilation.
Heat syncope	Transient loss of consciousness or collapse during heat exposure followed by a relatively rapid return to baseline; elevated core temperature is not necessary to make the diagnosis.
Heat exhaustion	An illness of mild to moderate severity secondary to loss of salt and water during exposure to heat. Symptoms are wide-ranging and may include fatigue, rapid pulse, profuse sweating, vomiting, and weakness without central nervous system involvement. Core temperature may be low, normal, or high (but < 40°C [104°F]) .
Heat stroke	Core temperature ≥ 40°C (104°F) with central nervous system dysfunction/encephalopathy. Classic: Passive hyperthermia secondary to impaired mechanisms for heat dissipation or inability to escape heated environment (generally develops slowly, over days). Exertional: Hyperthermia associated with participation in sport or occupation leading to heat exposure (develops relatively rapidly).

Santelli J, Sullivan JM, Czarnik A, Bedolla J. Heat illness in the emergency department: keeping your cool. Emerg Med Pract. 2014 Aug;16(8):1-21; quiz 21-2. PMID: 25422847.

Effetti a lungo termine

- **Aumento di prevalenza di patologie cardiovascolari**
- **Aumento di prevalenza di patologie renali**: insufficienza renale acuta, sequele di IRA

15% of individuals who typically or frequently worked under heat stress (minimum of 6 h per day, 5 days per week, for 2 months of the year) experienced kidney disease or acute kidney injury.

Flouris, AD., et al. 2018. «Workers' Health and Productivity under Occupational Heat Strain: A Systematic Review and Meta-Analysis». The Lancet Planetary Health 2 (12): e521–31. https://doi.org/10.1016/S2542-5196(18)30237-7.

- **Diminuzione della produttività ->** stimato da **ILO nel 2019 come perdita del 2,2% delle ore totali di lavoro nel mondo, fino al 5% in aree agricole molto** calde (sudest asiatico, Africa occidentale) **-> tendenza alla riduzione del PIL globale di 2400 miliardi di dollari nel 2030.**
- **Aumento del livello di stress lavoro-correlato**

Evidenze di letteratura

Esposizione a calore estremo determinerà aumento di mortalità e morbidità dovute a colpo di calore.

De Blois J et al. The Effects of Climate Change on Cardiac Health. Cardiology. 2015;131(4):209-17. doi: 10.1159/000398787. Epub 2015 May 12. PMID: 25997478.

Passando da T= 25°C a T= 35°C si assiste ad un aumento del 23% del ricorso a cure mediche, con picco di +52% per aritmie e ipertensione.

Bupa Chile. 2023. «Bupa Chile Presented Study 'Climate Change and Health' with the UC Global Change Center».

Exposure to **extreme heat** and physical exertion during fire suppression **activates platelets, increases thrombus formation**, impairs vascular function, and **promotes myocardial ischemia** and injury in healthy firefighters.

Hunter et al. Circulation. 2017;135:1284–1295. DOI: 10.1161/CIRCULATIONAHA.116.025711

Evidenze di letteratura

283 agricultural workers; 35 participants had **incident AKI over the course of a work shift** (12.3%). Workers **who experienced heat strain had increased adjusted odds of AKI** (**1.34**, 95% CI 1.04 to 1.74). **Piece rate work** was associated with **4.24 odds** of AKI (95% CI 1.56 to 11.52). **Females paid by the piece** had **102.81 adjusted odds** of AKI (95% CI 7.32 to 1443.20).

Moyce S, et al. Occup Environ Med 2017;74:402–409. doi:10.1136/oemed-2016-103848

L'**IRC ad eziologia ignota** ha subito un forte aumento di prevalenza nelle regioni rurali delle Americhe, del Medio Oriente, dell'India e dell Africa, soprattutto tra agricoltori e chi svolge lavori manuali gravosi. Per il solo Centro-America si stima che oltre 20'000 persone siano morte in 10 anni per IRC.

Ramirez-Rubio O, et al. 2013. «An Epidemic of Chronic Kidney Disease in Central America: An Overview». J Epidemiol Community Health 67 (1): 1–3. https://doi.org/10.1136/jech-2012-201141.

Effetti psicologici

During or at the end of a work shift under heat stress, 35% of workers experienced occupational heat strain, while 30% reported productivity losses.

Flouris AD, et al. 2018. «Workers' Health and Productivity under Occupational Heat Strain: A Systematic Review and Meta-Analysis». The Lancet Planetary Health 2 (12): e521–31. https:// doi.org/10.1016/S2542-5196(18)30237-7.

Measures targeting adequate hydration, self-pacing, work-rest regimes, provision of shade and appropriate sanitation facilities need to be matched with **improved psychosocial work conditions** such as optimal work hours, job autonomy and control, and social supports to ensure safe working conditions in changing climates.

Amoadu M, et al. Impact of climate change and heat stress on workers' health and productivity: A scoping review. The Journal of Climate Change and Health, Volume 12, 2023, 100249, ISSN 2667-2782. https://doi.org/10.1016/j.joclim.2023.100249.

Altri effetti

- **Aumento del rischio infortunistico** (sudore delle mani, appannamento di occhiali e DPI, vertigini, sensazione di stordimento, alterazione della capacità di giudizio e dello stato di viglianza)
- **Aumento della volatilità delle sostanze chimiche**

Ambienti particolarmente a rischio

- Outdoor workers in lavori che richiedono sforzo fisico

+ divise e DPI!

- Indoor workers in ambienti non adeguatamente ventilati, in cui non è possibile regolare bene la temperatura

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