https://www.worklimate.it/

HOME THE PROJECT FORECASTS INFORMATION MATERIAL PUBLICATIONS ENGLISH

WORKLIMATE 2.0

Occupational heat stress, adaptation strategies, and prevention polices in Italy: insights from the Worklimate 2.0 Project

Project | Pubblications | Forecasts | Information Material | Events

National Call for Collaborative Research - (BRiC - 2022)
- Research Activity Plan 2022-2025. Topic ID n. 05/2022

"Occupational exposure to extreme outdoor temperatures. Intervention strategies and tools to counteract workers' heat stress and the evolution of the warning system."

PhD Marco Morabito
marco.morabito@cnr.it
National Research Council of Italy
Institute of BioEconomy
Department of Biology, Agriculture and Food Science

How did the Worklimate 2.0 project come about?

HEAT SHIELD

Funded by the
EU Horizon 2020
research and innovation programme under grant agreement No 668786

People

……..
Morabito Marco
Institute of Bioeconomy, Italy

Role in HEAT-SHIELD:
Contribution to the development of a prototype of heat warning system for workers and of occupational heat-wave vulnerability mapping, dissemination activities

e-mail: marco.morabito@cnr.it

Curriculum Vitae

……..

BRiC 2019

Research Activity Plan 2019-2021
Topic ID n. 06/2019

"Occupational exposure to extreme outdoor temperatures. Development of methodological tools and epidemiological studies for the characterization of injury risk."

WORKLIMATE
CLIMA LAVORO PREVENZIONE

WORKLIMATE

Impact of environmental thermal stress on workers' health and productivity: intervention strategies and development of an integrated weather-climatic and epidemiological heat-health warning system for various occupational sectors.

Started June 15th 2020
Finished December 15th 2022

BRiC 2022

Research Activity Plan 2022-2024
Topic ID n. 05/2022

"Occupational exposure to extreme outdoor temperatures. Intervention strategies and tools to combat workers' thermal stress and evolution of the alert system."

WORKLIMATE2.0
CLIMA LAVORO PREVENZIONE

WORKLIMATE 2.0

Extreme temperatures and impacts on health, safety and productivity: intervention strategies and technological, information and training solutions.

Starded May 15th 2023
In progress - estimated end May 15th 2025

Extreme temperatures and impacts on occupational health, safety and productivity: intervention strategies, information, training and technological solutions.

Start — **May 15th 2023**

End — **November 15th 2025**

U.O.1

Principal Investigator & Coordinator

Consiglio Nazionale delle Ricerche
Istituto per la BioEconomia

Supervisor & Coordinator

INAIL
ISTITUTO NAZIONALE PER L'ASSICURAZIONE CONTRO GLI INFORTUNI SUL LAVORO

WORKLIMATE2.0
CLIMA LAVORO PREVENZIONE

U.O.2

SST Azienda USL Toscana centro
Servizio Sanitario della Toscana

Azienda USL Toscana Centro – UFC Epidemiologia-UFS CeRIMP del Dipartimento di Prevenzione (Firenze)

U.O.3

SST Azienda USL Toscana sud est
Servizio Sanitario della Toscana

Azienda USL Toscana Sud Est – Laboratorio di Sanità Pubblica Agenti Fisici – (Siena)

U.O.4

DIEPI Lazio

Dipartimento di Epidemiologia, Servizio Sanitario Regionale Lazio\ASL Roma 1 (DIPEPI) (Roma)

U.O.5

CONSORZIO LaMMA

Consorzio LaMMA - Laboratorio di Monitoraggio e Modellistica Ambientale per lo sviluppo sostenibile (Sesto Fiorentino, Firenze)

U.O.6

ALMA MATER STUDIORUM UNIVERSITÀ DI BOLOGNA

Dipartimento di Scienze e Tecnologie Agro-alimentari (DISTAL) Università di Bologna (Bologna)

WORK GROUP

Filippo Ariani, Alessandra Binazzi, Andrea Bogi, Michela Bonafede, Raimondo Buccelli, Alfonso Crisci, Francesca de'Donato, Fabio De Francesco, Simona Del Ferraro, Pina Galzerano, Claudio Gariazzo, Rino Ghelfi, Claudia Giliberti, Bernardo Gozzini, Valentina Grasso, Daniele Grifoni, Giulia Guerri, Emanuela Giuli, Giulia Ionita, Miriam Levi, Alessandro Marinaccio, Agnese Martini, Alessandro Messeri, Paola Michelozzi, Vincenzo Molinaro, Stefano Monti, Marco Morabito, Antonio Moschetto, Francesco Pasi, Francesco Picciolo, Emma Pietrafesa, Meri Raggi, Stefano Secci, Nicola Stacchini, Edvige Sorrentino, Donatella Talini, Stefano Targetti, Daniele Viaggi

General aim of the project

The project aimed to enhance understanding of how extreme temperatures impact occupational health, safety, and productivity while developing and implementing technological solutions and intervention strategies tailored to specific work sectors.

WPs	TOPICS COVERED
WP1	**Epidemiological and economic analysis** relating to the estimation of social and business costs related to extreme temperatures.
WP2	**Perception and knowledge** of the risk linked to extreme temperatures in different work sectors, **meteorological and physiological monitoring** in selected companies and **identification and characterization of the effectiveness of wearable technologies** in relation to the prevention of thermal risk.
WP3	**Estimation of productivity loss** based on weather-climate monitoring and **development of an information tool** useful to companies for work planning.
WP4	**Implementation of a heat warning system** specific for the occupational sector also integrated with a prototype of a cold warning system.
WP5	**Training/information** aimed at employers implemented by the design and **development of serious games** (corporate video games).
WP6	**Results and scientific dissemination**.

Epidemiological evidences at national level

Environmental Research
Volume 269, 15 March 2025, 120844

Climate change and occupational health and safety. Risk of injuries, productivity loss and the co-benefits perspective

A. Marinaccio [a], C. Gariazzo [a], L. Taiano [a], M. Bonafede [a], D. Martini [b], S. D'Amario [b], F. de'Donato [c], M. Morabito [d]
Worklimate working group[1]

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https://doi.org/10.1016/j.envres.2025.120844

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Highlights

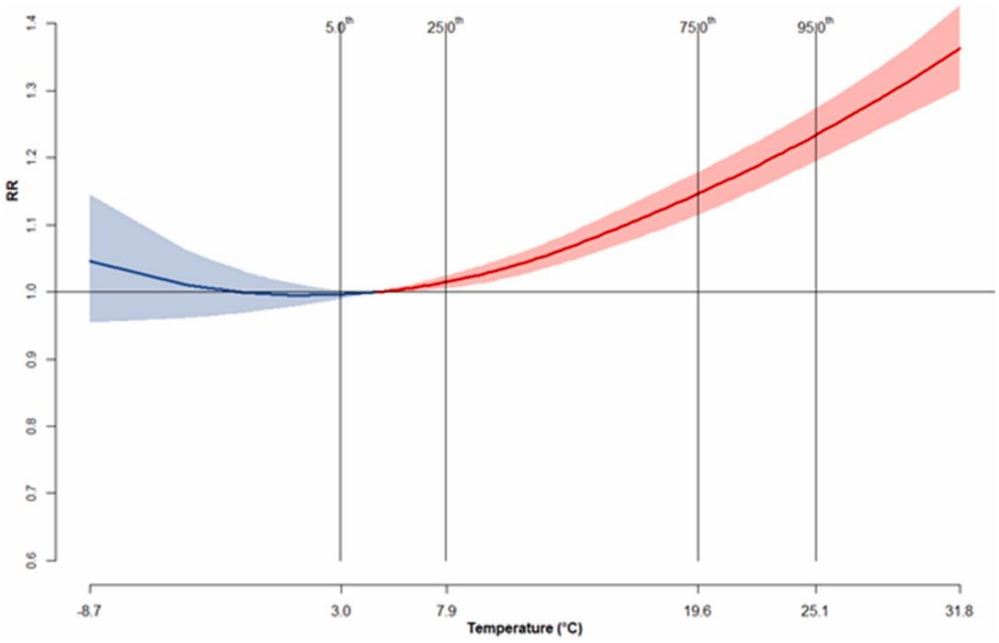
- The risk of occupational injuries increases significantly during heatwaves.
- More than 4000 injuries per year due to heat have been estimated in Italy.
- A decrease in productivity (until 80%) has been estimated during heatwaves.
- The compensation costs associated have been evaluated 49 million euros per year.
- The co-benefits analysis is crucial in the climate change adaptation strategies.

DRAWING. Time series-based approach (DLNM);

SETTINGS. 8092 Italian municipalities

DATA BASE. INAIL archives "industry, services, and agriculture sector (2014-2019);

DIMENSION. 2,381,771 injuries reported by INAIL in Italy in the period 2014–2019



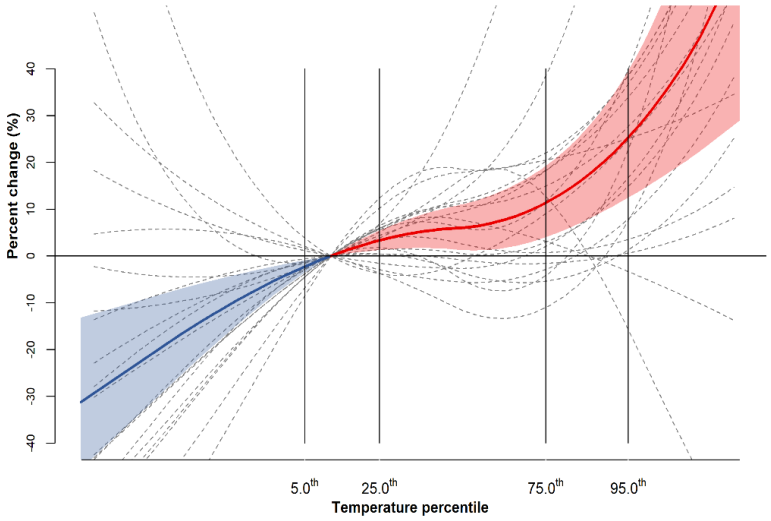
Epidemiological evidences at national level

Meta-Analysis › Environ Int. 2023 Jan:171:107677. doi: 10.1016/j.envint.2022.107677. Epub 2022 Dec 6.

Association between extreme temperature exposure and occupational injuries among construction workers in Italy: An analysis of risk factors

Claudio Gariazzo [1], Luca Taiano [2], Michela Bonafede [2], Antonio Leva [2], Marco Morabito [3], Francesca De' Donato [4], Alessandro Marinaccio [2]

N. 184,936 (2014-2019)



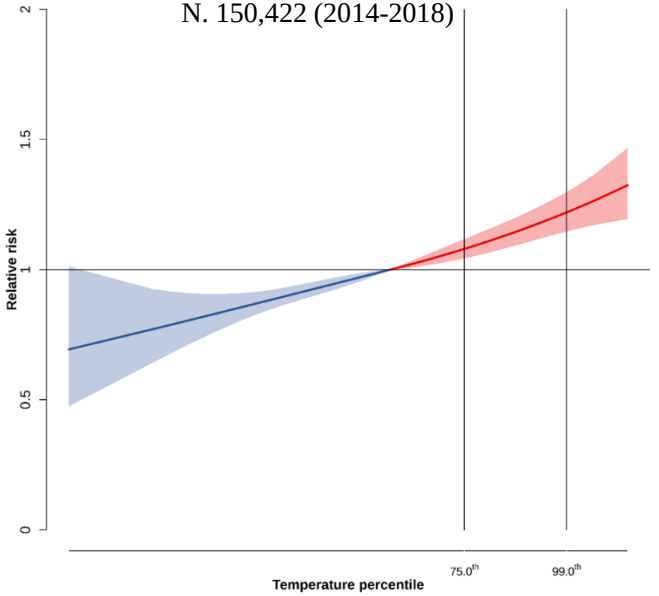
- Highest risk for **young unqualified workers** (< 35)
- The **attributable number** of heat-related construction injuries in the 6-year period studied was ***3,142***

› Int J Environ Res Public Health. 2023 Feb 4;20(4):2781. doi: 10.3390/ijerph20042781.

Effects of Temperatures and Heatwaves on Occupational Injuries in the Agricultural Sector in Italy

Chiara Di Blasi [1], Alessandro Marinaccio [2], Claudio Gariazzo [2], Luca Taiano [2], Michela Bonafede [2], Antonio Leva [2], Marco Morabito [3], Paola Michelozzi [1], Francesca K De' Donato [1], On Behalf Of The Worklimate Collaborative Group

N. 150,422 (2014-2018)



- Highest risk for **young workers (< 35)**, **occasional** and **self-employed workers**
- The **attributable number** of heat-related agricultural injuries in the 5-year period studied was ***2,050***

Surveys on heat risk perception of workers

Int J Environ Res Public Health. 2019 Mar 27;16(7):1090. doi: 10.3390/ijerph16071090.

Heat Stress Perception among Native and Migrant Workers in Italian Industries-Case Studies from the Construction and Agricultural Sectors

Alessandro Messeri [1,2], Marco Morabito [3,4], Michela Bonafede [5], Marcella Bugani [6], Miriam Levi [7], Alberto Baldasseroni [8], Alessandra Binazzi [9], Bernardo Gozzini [10], Simone Orlandini [11,12], Lars Nybo [13], Alessandro Marinaccio [14]

Int J Environ Res Public Health. 2021 Apr 7;18(8):3861. doi: 10.3390/ijerph18083861.

A Web Survey to Evaluate the Thermal Stress Associated with Personal Protective Equipment among Healthcare Workers during the COVID-19 Pandemic in Italy

Alessandro Messeri [1,2], Michela Bonafede [3], Emma Pietrafesa [3], Iole Pinto [4], Francesca de'Donato [5], Alfonso Crisci [1], Jason Kai Wei Lee [6,7,8,9,10,11], Alessandro Marinaccio [3], Miriam Levi [12], Marco Morabito [1,2], On Behalf Of The Worklimate Collaborative Group

Int J Environ Res Public Health. 2022 Jul 4;19(13):8196. doi: 10.3390/ijerph19138196.

Workers' Perception Heat Stress: Results from a Pilot Study Conducted in Italy during the COVID-19 Pandemic in 2020

Michela Bonafede [1], Miriam Levi [2], Emma Pietrafesa [1], Alessandra Binazzi [1], Alessandro Marinaccio [1], Marco Morabito [3], Iole Pinto [4], Francesca De' Donato [5], Valentina Grasso [6], Tiziano Costantini [5], Alessandro Messeri [6,7,8]; WORKLIMATE Collaborative Group

- **About 1/3** of the workers interviewed are unable to recognize the symptoms of heat stroke.
- **More than 40%** of workers do not know the priority actions to take when helping a colleague suffering from heat stroke or a heat-related illness.
- **Nearly 7%** of the workers interviewed never have convenient access to drinking water.

1. **Underestimation** by workers of the heat risks and **poor knowledge** of this phenomenon.
2. **Lack of awareness** of the degree of **individual susceptibility** to heat stress risk and the risks. associated with **dehydration**.
3. **Lack of individual and organizational measures** for the prevention of heat stress risks.
4. **Need for awareness and training** to improve the culture of safety in society and companies.

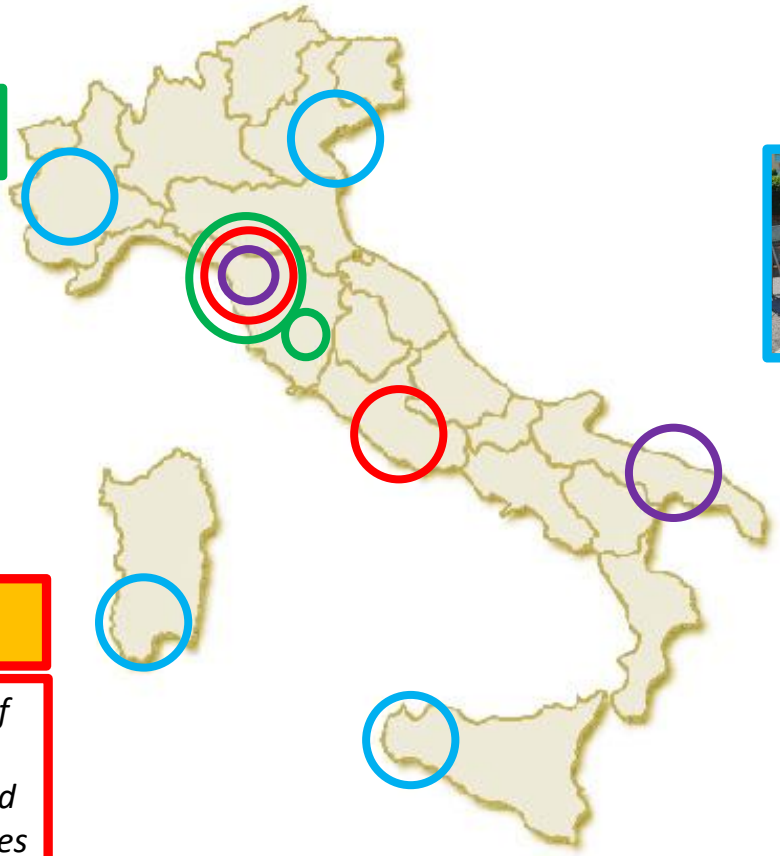
Case studies carried out during 2020-2024

1

Agriculture

Wine sector

Livestock sector



3

Multi-utility sector

Water sector

Environment sector

2

Construction

Involvement of cooperatives, companies, and construction sites

4

Logistics and Industry

Cycle delivery men

Warehousing activities

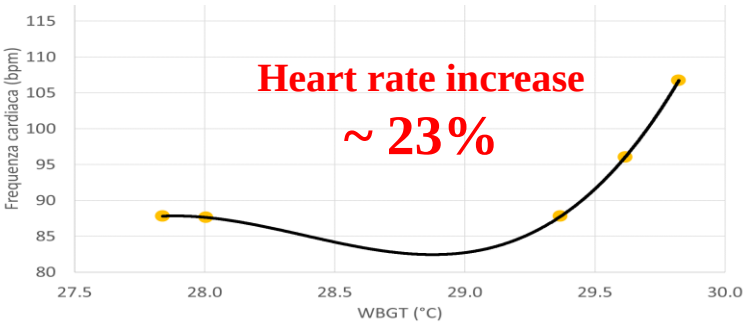
The organization of approximately **30 case studies** includes microclimatic monitoring at the company level and physiological monitoring of **around 200 workers** across various sectors.

Case studies carried out during 2020-2024

Monitoring and tests carried out

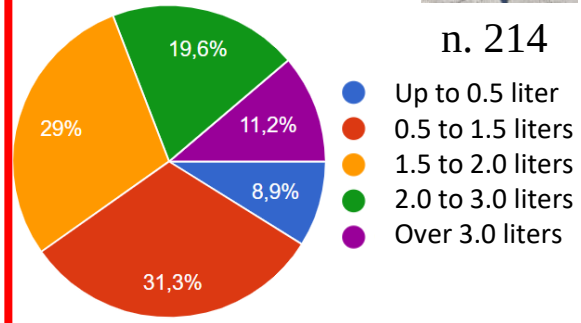
- Continuous **microclimatic monitoring**.
- Submission of a **questionnaire** for the subjective evaluation of thermal well-being/discomfort.
- Continuous **heart rate monitoring** with cardio-fitness bracelet.
- Spot measurement of **body temperature** and **thermographic mapping** with thermal imaging camera
- Testing of **ventilated jackets**, **cooling garments** or **high visibility work uniforms**

Relationship WBGT-HR
Vulnerable workers (Obese 1st class)



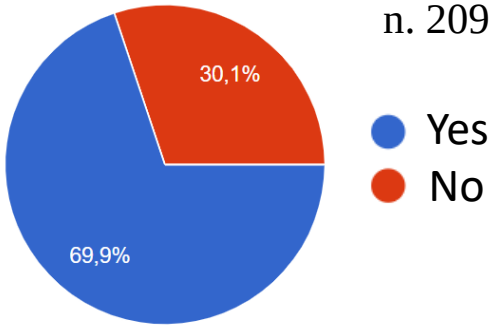
How much water workers drank during daily work activity?

n. 214



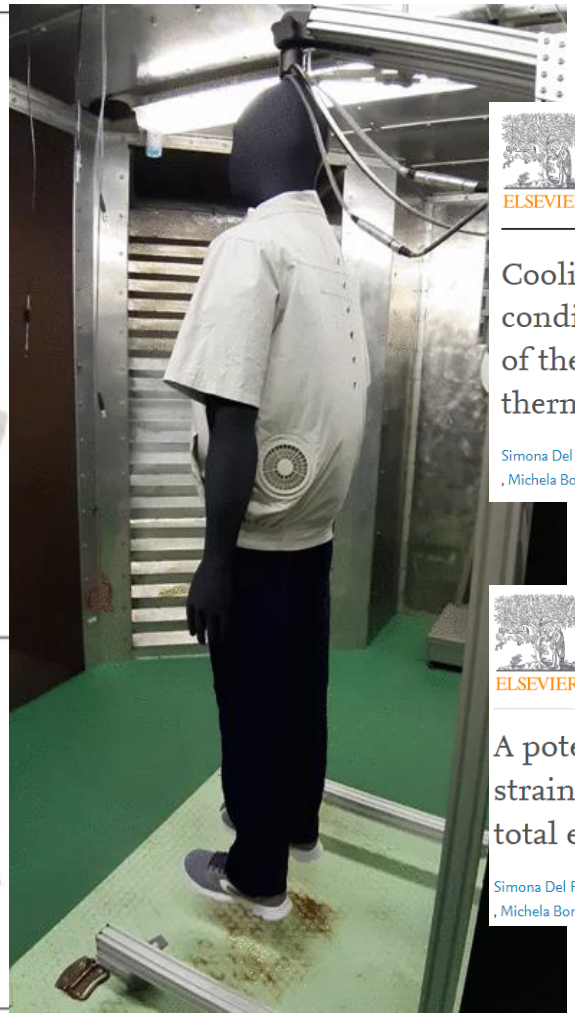
Were workers informed by their employer about the behaviours to adopt to counteract the effects of heat?

n. 209



Consiglio Nazionale delle Ricerche
marco.morabito@cnr.it

Technological solutions and operational procedures



ELSEVIER

International Journal of Industrial Ergonomics
Volume 86, November 2021, 103230

Cooling garments against environmental heat conditions in occupational fields: measurements of the effect of a ventilation jacket on the total thermal insulation

Simona Del Ferraro [a], Tiziana Falcone [a, b], Marco Morabito [c, d], Alessandro Messeri [c, d], Michela Bonafede [e], Alessandro Marinaccio [e], Chuansi Gao [f], Vincenzo Molinaro [a]

ELSEVIER

Environmental Research
Volume 212, Part D, September 2022, 113475

A potential wearable solution for preventing heat strain in workplaces: The cooling effect and the total evaporative resistance of a ventilation jacket

Simona Del Ferraro [a], Tiziana Falcone [a, b], Marco Morabito [c, d], Alessandro Messeri [e, f], Michela Bonafede [g], Alessandro Marinaccio [g], Chuansi Gao [h], Vincenzo Molinaro [a]

Ventilated jackets, if used correctly (according to protocols defined through experimental analyses), are effective individual protection tools in reducing the thermal stress of workers in conditions of exposure to extreme heat.

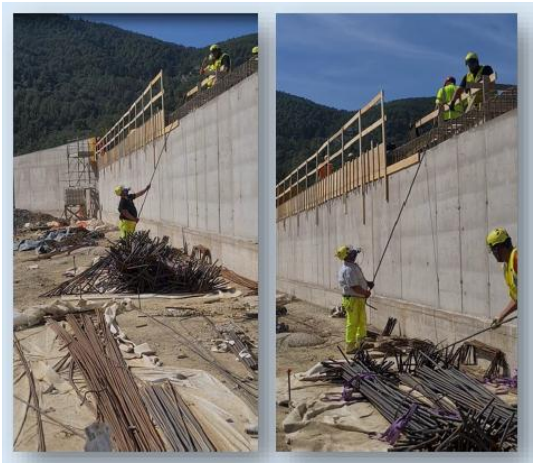
Technological solutions and operational procedures

During the summer of 2024, ventilated jackets were field-tested on workers engaged in various activities in the construction sector (road resurfacing)

Tying of reinforcement bars

Vibration of the concrete jet and cleaning of the concrete removed from the formwork.

Handling of long reinforcement bars



Main results

- The ventilated jacket has an **effect on the local temperatures of the trunk**, causing a decrease in T, slightly greater in the back area.
- **The effect of the fans does not seem to be constant** over time but tends to decrease over time.

The questionnaires highlight

- **Lower perception of sweating** and thirst in the test with the jacket;
- Shift of sensations towards «less hot» sensations in the test with the jacket
- The jacket **does not hinder movements** (86%), **is not heavy** (86%), does not slow down the worker during work (86%), reduces the sensation of heat;
- 86% of workers interviewed stated they would use the jacket if available;
- **Ventilation of jacket is not excessive**.

Development of information material

https://www.worklimate.it/en/information-material/

INFORMATION MATERIAL

INFORMATION BROCHURE ON HEAT-RELATED ILLNESSES, ON FACTORS THAT CONTRIBUTE TO THEIR ONSET AND RECOMMENDATIONS FOR EFFECTIVE PLANNING OF COMPANY INTERVENTIONS REGARDING THE PREVENTION OF MICROCLIMATE RISK, TO BE ADOPTED WITHIN THE SPECIFIC ORGANIZATION OF THE COMPANY PREVENTION SYSTEM.

Information on heat illnesses and the factors that contribute to their onset

READ

Chronic conditions that increase susceptibility to heat

READ

Decalogue for the prevention of heat illnesses in the workplace

READ

The importance of maintaining a good hydratattion status

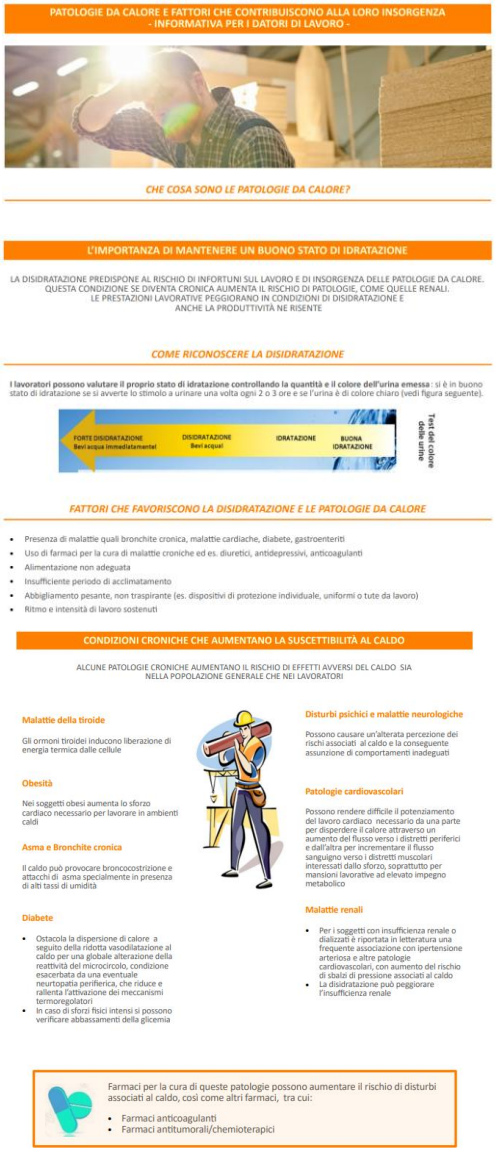
READ

Translated in:

- ROMÂNĂ
- ALBANESE
- FRANÇAIS
- हिन्दी
- العربية

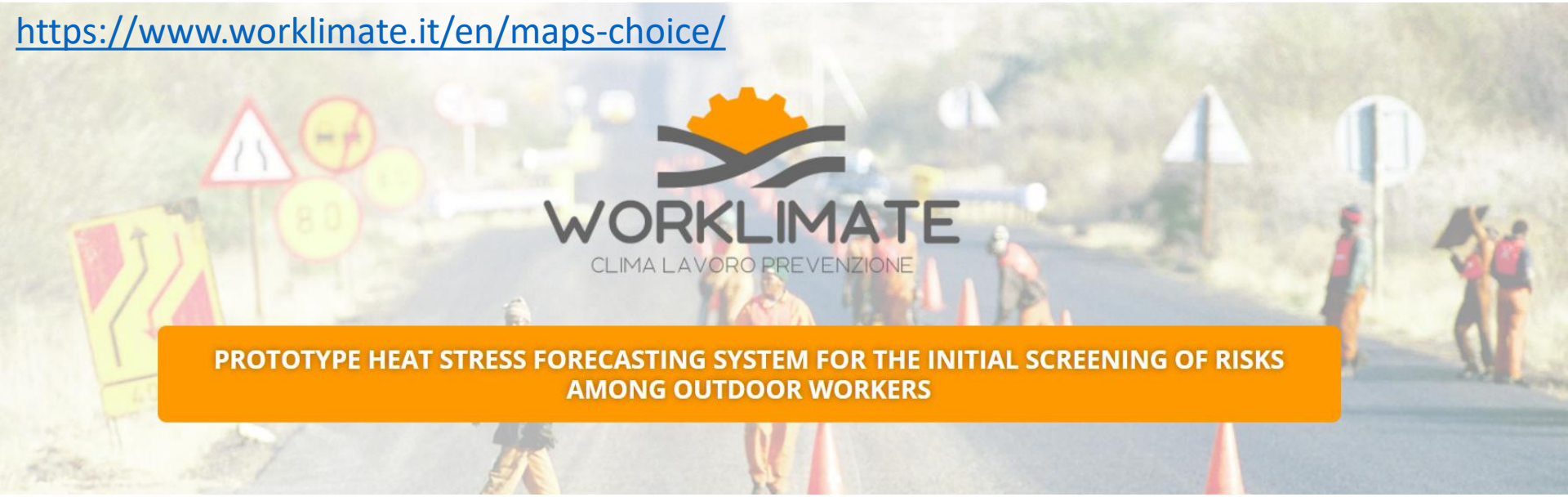
The importance of scheduled breaks for workers exposed to heat

READ



Development of the Worklimate forecasting platform

https://www.worklimate.it/en/maps-choice/



Experimental activity for use by workers, employers occupational safety and management professionals.

This section shows heat stress risk forecast maps for some non-acclimatized worker profiles developed on the basis of an indicator used in the occupational sector and selected within the project (Wet Bulb Globe Temperature, WBGT).

The maps show three-day heat stress risk forecast, at four time intervals during the day: 8:00, 12:00, 16:00 and 20:00 CET.

THE INFORMATION RELATES TO A HEALTHY WORKER, NOT ACCLIMATISED TO HEAT, EXPOSED TO DIRECT SUN OR SHADE AND ENGAGED IN INTENSE OR MODERATE OUTDOOR PHYSICAL ACTIVITY.

Find a forecasts

This forecast is intended as a decision support tool and needs to be integrated by the direct microclimatic onsite monitoring of the workplace.

Choose whether you work in the sun or shade

Working in the sun

Working in the shade

Working in the sun

Choose if you do intense or moderate physical activity

Intense physical activity

Moderate physical activity

view maps

Click the button to view the forecast

The forecast will soon be complemented by a mobile application that will allow personalised forecasts based on workers' personal characteristics (height, weight, physical activity, type of clothing worn) as well as the working environment (exposed to sun or shade).

WORKING IN THE SUN AND INTENSE PHYSICAL ACTIVITY

The heat risk national maps are provided by an experimental system of automatic forecasting obtained from a meteorological model affected by intrinsic uncertainty and therefore variable with the characteristics of the territory.

This information is a support to be used together with the existing tools and direct observation in the workplace.

SUN

Intense physical activity

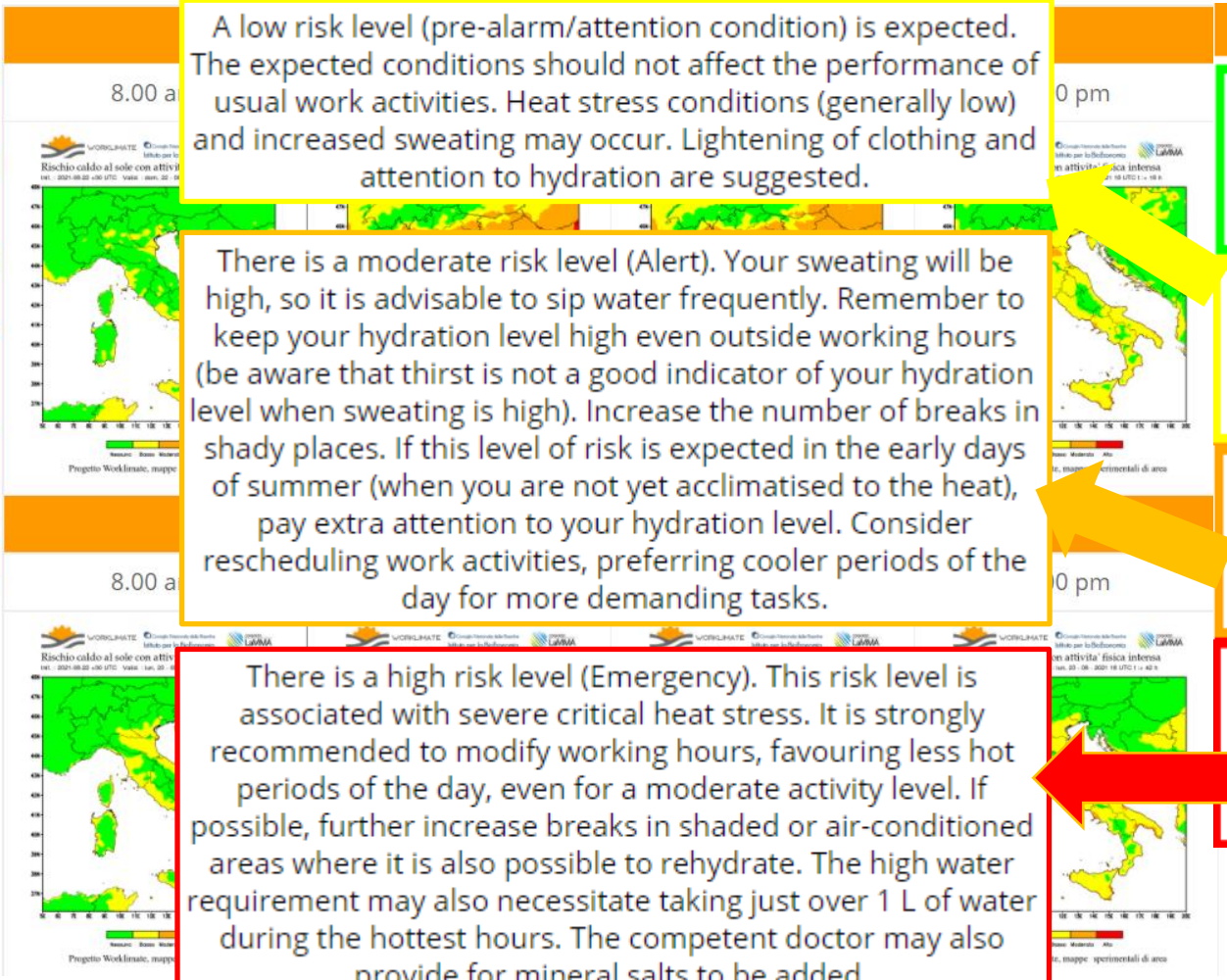
Moderate physical activity

SHADOW

Intense physical activity

Moderate physical activity

BACK TO CHOICE



A low risk level (pre-alarm/attention condition) is expected. The expected conditions should not affect the performance of usual work activities. Heat stress conditions (generally low) and increased sweating may occur. Lightening of clothing and attention to hydration are suggested.

There is a moderate risk level (Alert). Your sweating will be high, so it is advisable to sip water frequently. Remember to keep your hydration level high even outside working hours (be aware that thirst is not a good indicator of your hydration level when sweating is high). Increase the number of breaks in shady places. If this level of risk is expected in the early days of summer (when you are not yet acclimatised to the heat), pay extra attention to your hydration level. Consider rescheduling work activities, preferring cooler periods of the day for more demanding tasks.

There is a high risk level (Emergency). This risk level is associated with severe critical heat stress. It is strongly recommended to modify working hours, favouring less hot periods of the day, even for a moderate activity level. If possible, further increase breaks in shaded or air-conditioned areas where it is also possible to rehydrate. The high water requirement may also necessitate taking just over 1 L of water during the hottest hours. The competent doctor may also provide for mineral salts to be added.

RISK LEGEND

NONE

Maintain your usual work rhythm and hydration procedures.
Read More

LOW

Pay more attention to hydration and plan short breaks.
Read More

MODERATE

Sip water frequently and increase the number of breaks in cool places.
Read More

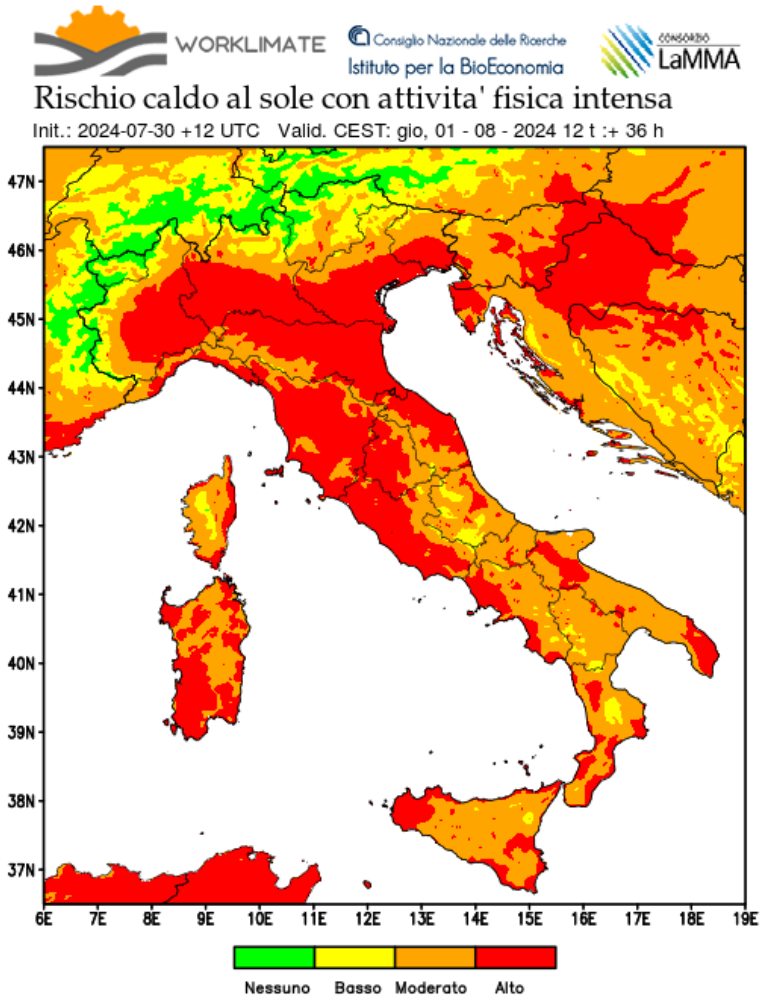
HIGH

Drink often, even a little more than 1 L/h and plan frequent breaks in shady places or conditioned areas.
Read More

Forecast of the heat risk for workers

engaged in intense physical activity

in the sun



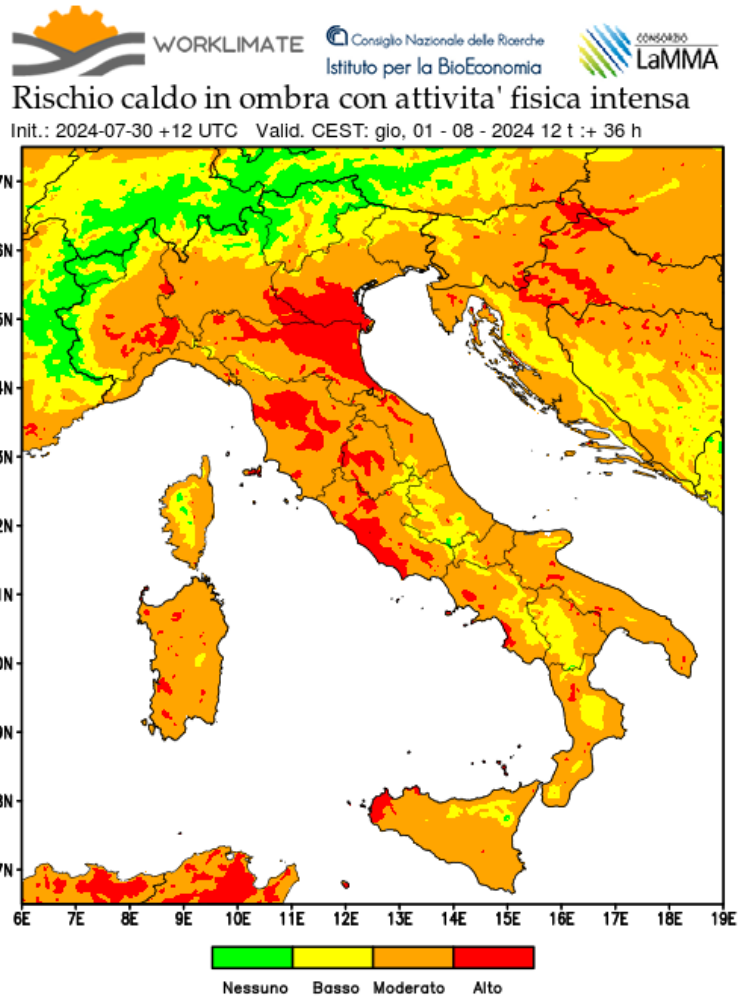
Progetto Worklimate, mappe sperimentali di area

12:00

Forecast of the heat-risk for workers

engaged in intense physical activity

in the shade



Progetto Worklimate, mappe sperimentali di area

During the summers from 2021 to 2024, the public health authorities in several Italian regions adopted restricted measures with force of law:

Issuance of Regional Ordinances for the Prevention of Heat Effects on Workers.

REGIONE PUGLIA

ORDINANZA DEL PRESIDENTE DELLA GIUNTA

N. 182 del Registro

OGGETTO: Attività lavorativa nel settore agricolo in condizioni di esposizione prolungata al Sole - ordinanza contingibile ed urgente per motivi di igiene e sanità pubblica

Bari, addì 26 giugno 2021

Il Presidente

Michele Emiliano

EMILIANO
MICHELE
26.06.2021
12:16:50 UTC

*All working activities in agriculture have been forbidden from 12:30 p.m. to 4 p.m when the "**HIGH**" heat risk level in the WORKLIMATE project forecast map (referred to 12 p.m.) is forecasted for a "not acclimatized healthy workers, exposed to the sun and engaged in intense physical activity".*

Occup Environ Med. 2022 Mar;79(3):215-216. doi: 10.1136/oemed-2021-107967. Epub 2022 Jan 12.

Research and public health prevention policies of occupational heat exposure in Italy

Alessandro Marinaccio [1], Michela Bonafede [2], Marco Morabito [3];
WORKLIMATE project Working Group

Collaborators, Affiliations + expand

PMID: 35022259 DOI: 10.1136/oemed-2021-107967

REGIONE PIEMONTE

ATTO 1/2024/XII **DEL 02/08/2024**

ORDINANZA DEL PRESIDENTE DELLA GIUNTA REGIONALE

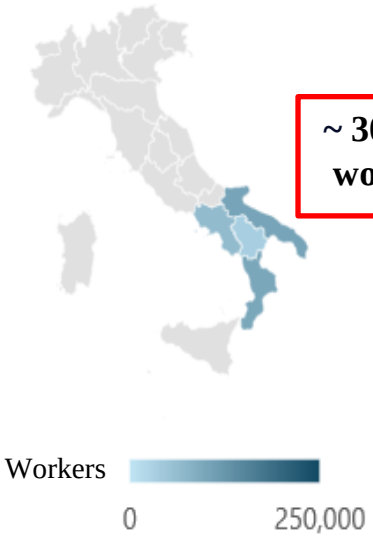
Subject: **Contingent and Urgent Ordinance for Hygiene and Public Health Reasons pursuant to Article 32 of Law 833/1978. Prevention Measures Across the Entire Regional Territory for Work Activities in the Agricultural and Floriculture Sectors, as well as in Construction Sites and Related Outdoor Workplaces Under Conditions of Direct and Prolonged Sun Exposure.**

During the summers from 2021 to 2024, the public health authorities in several Italian regions adopted restricted measures with force of law:

Issuance of Regional Ordinances

for the Prevention of Heat Effects on Workers

Workforce in Agriculture and Construction
in the Regions where
Regional Ordinances were in force in 2023



~ 300,000 workers

~ +460%

Workforce in Agriculture and Construction
in the Regions where
Regional Ordinances were in force in 2024

~ 1,700,000 workers

Practical Implications:
Policies to Mitigate the Impact of Heat on Employment

Italian Government — Presidency of the Council of Ministers

Ministry of Labour and Social Policies — EN

Home / Single Digital Gateway / Health And Safety At Work / Mandatory health and safety measures for all companies

Mandatory health and safety measures for all companies

Measures aimed at protecting health and safety at work provided for by Legislative Decree No 81 of 2008 apply to all private and public activity sectors and to all types of risk. Article 15 indicates the general measures to protect the health and safety of workers in the workplace. In some cases, references are made to specific regulations and implementing measures that determine the application of the general rules, taking into account the specificities of certain production sectors and certain work activities.

Relevant legislation

Legislative Decree 9 April 2008, n. 81

D.lgs. 9 aprile 2008, n. 81
Testo coordinato con il D.lgs. 3 agosto 2009, n. 106

Legislative Decree 81/2008 on Workplace Health and Safety

Which includes some recent **notes of the Italian National Labour Inspectorate (INL)** on the protection of workers against heat-related damage, **describing the operational tools and guidelines of the Worklimate Project**

Attuazione dell'articolo 1 della Legge 3 agosto 2007, n. 123 in materia di tutela della salute e della sicurezza nei luoghi di lavoro.

(Gazzetta Ufficiale n. 101 del 30 aprile 2008 - Suppl. Ordinario n. 108)
(Decreto integrativo e correttivo: Gazzetta Ufficiale n. 180 del 05 agosto 2009 - Suppl. Ordinario n. 142/L)

REV. SETTEMBRE 2024

DOTT. ING. GIANFRANCO AMATO - DOTT. ING. FERNANDO DI FIORE

IL PRESENTE TESTO NON RIVESTE CARATTERE DI UFFICIALITÀ. LE VERSIONI UFFICIALI DEI DOCUMENTI SONO PUBBLICATI SULLA GAZZETTA UFFICIALE DELLA REPUBBLICA ITALIANA A MEZZO STAMPA OPPURE SUI SITI WWW.ISPETTORATO.GOV.IT, WWW.LAVORO.GOV.IT, WWW.NORMATTIVA.IT. LE CONSIDERAZIONI ESPOSTE SONO FRUTTO ESCLUSIVO DEL PENSIERO DEGLI AUTORI E NON HANNO CARATTERE IN ALCUN MODO IMPEGNATIVO PER L'AMMINISTRAZIONE PUBBLICA DI APPARTENENZA. NON SI ASSUME NESSUNA RESPONSABILITÀ PER EVENTUALI DANNI SIA DIRETTI CHE INDIRETTI CAUSATI DALL'USO DEL PRESENTE TESTO.

CON IL SOSTEGNO DI ILA - ISPETTORI DEL LAVORO ASSOCIATI

QUESTA OPERA È RILASCIATA SECONDO LA SEGUENTE LICENZA CREATIVE COMMONS

HTTP://CREATIVECOMMONS.ORG/LICENSES/BY-SA/4.0/DEED.IT

INL
Direzione centrale tutela, sicurezza e vigilanza del lavoro

Nota del 02/07/2021, prot. n. 4639
Oggetto: tutela dei lavoratori - stress termico ambientale

INL
Direzione centrale per la tutela, la vigilanza e la sicurezza del lavoro

Nota del 26/07/2022, prot. n. 4753
Oggetto: Tutela dei lavoratori sul rischio legato ai danni da calore. Strumenti preventivi e indicazioni operative.

INL
Direzione Centrale per la tutela, la vigilanza e la sicurezza del lavoro

Nota del 13/07/2023, prot. n. 5056
Oggetto: Tutela dei lavoratori sul rischio legato ai danni da calore.

INL
Direzione Centrale per la tutela, la vigilanza e la sicurezza del lavoro

Nota del 21/07/2023, prot. n. 5291
Oggetto: Richieste di integrazione salariale per eventi meteo - temperature elevate.

Nel fare seguito a propria nota prot. n. 5056 del 13/07/2023 relativa alla "Tutela dei lavoratori sul rischio legato ai danni da calore", si trasmette Messaggio INPS n. 2729 del 20/07/2023 avente ad oggetto "Richieste di integrazione salariale per "eventi meteo" - temperature elevate."



Thank you for the attention

https://www.worklimate.it/

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