# Heat effects on workers in Europe

Prof. Andreas Flouris University of Thessaly, Greece





## Ccupational heat stress creates inequalities



## Occupational heat stress literature is growing

 $\prec$  Up to 2015, the literature on occupational heat stress comprised of **87 studies**  $\prec$  **71% of studies** on occupational heat stress have been <u>published after 2015</u>



Flouris et al., 2022; Temperature

## Addressing the lack knowledge in Europe



✓ Mission: to address the negative impacts of workplace heat stress on the health and productivity of workers in strategic European industries



Horizon 2020 European Union funding for Research & Innovation



Funded by the EU Horizon 2020 research and innovation programme (no.668786)



✓ HEAT -SHIELD mission: to address the negative impacts of workplace heat stress on the health and productivity of workers in strategic European industries





#### **Productivity assessment**

#### Health assessment



# Health impacts of occupational heat stress

 $\prec$  During or at the end of <u>a single work shift</u> in heat stress conditions

-35% of workers experience symptoms of physiological strain

### ≺ Mild

- heat rash
- heat syncope (dizziness/fainting)

### $\prec$ Severe

- heat exhaustion
- heat stroke
- fluid/electrolyte imbalances
- acute/chronic kidney injury

<section-header><section-header><text><text><text><text><text><text><text><text><text></text></text></text></text></text></text></text></text></text></section-header></section-header>	<section-header><section-header><text><text><section-header><text><text><text><text><text><text><text><text><text><text><text></text></text></text></text></text></text></text></text></text></text></text></section-header></text></text></section-header></section-header>			Articles
<ul> <li>A control of the control of the stand control of the control of the</li></ul>	Provide the control of the contro	Workers' health and productivi strain: a systematic review and	ty under occupational heat meta-analysis	<b>1</b>
<ul> <li>Methods Following CPUSMA guidelines for this systematic review and meta-studysis, we reached Pobbled and State Systematic review and meta-studysis is any lubar environment and a tay lead of the study of the study</li></ul>	<ul> <li>Interduction (TBISMA gradient for this vertexular review and metromismic were serviced probability of the service production of the ser</li></ul>	se unit or result. Patter Connect Connect Connect, Call (1992). Entiget Surmary Background Occupational heat strain (ie, the effect of en- workers' ability to live lexability and productive lives. We esti- health and productivity outcomes.	into Line open, using these experiences are a fee (1980) (ie, the effect of environmental heat stress on the bodyl directly threatene ductive lives. We estimated the effects of exceptional heat strain our workers'	
intersports in our measures, change it is continued along, desemble, between the texture of texture of the text	interreports most measurances, chang of incommendation, Assessments, Development and Evaluation analysis exceeded madern and and an evaluation of the control of the second and the second	Methods following PRISMA guidelines for take systemat Trabusc from datases inception to Fob 5.2015, for release accupational heat strain. No neutricinos on Language. Occupational beat strains was defined outsig international stratifications take and take and the strain and methods and listications. Takk and the strain and methods and listications take and take and take and methods and listications. Takk and take and take and methods and listications take and the relation and methods and listication number CAD 1020703271. Trafficing of 937 september take and the relation of the listication number CAD 1020703272. Trafficing of 0478 september take and and the take and the individuals workers from mome than the different occupation that individuals working a single work with motion has in the 24-37C disputibility of the take and the take and the take the individual working a single work with motion and the 24-37C disputibility of the take and the take and the strangenetic was increased by 0.27C [0.4-1.4]; 72 duality increased by 14-50 (0.0014); 0.014 septido work of the take (24-39C tradies working a single work of the take and the take (24-39C tradies working) and the take and the take and the strangenetic was increased by 0.27C [0.4-1.4]; 72 duality increased by 14-50 (0.0014); 0.014 septido work of the (24-39C tradies working working worked and part of the constraints of the year) expection of the take and the take and the anometic of the year) expection of the take and the take and the anometic of the year) expection of the take and the single working worked and the anometic of the year) expection of the take and the take anometic of the part of the year of the take anometic of the take anometic of the take anometic of the year) expection of the take anometic of	is review and metro-malvies, we wanched Polyberl and its review and metro-malvies, we wanched Polyberl and workers to tradies in any those of workers of the second second second second second second second second all models instaad of actual measurements, and any grey is were performed by low independent investigators. We startly the second meditions. The review protocol is available on PRESPECIO is were in the second is a second second second second second second second is a second second second second second second is a second second second second second second second second second secon	ar Density, Battis, Grove B. S. Barry, H. S. K. Karro, M. S. Karro, B. S. Barry, H. S. K. Karro, M. S. Karro, B. S. Karro, K. K. Karro, K. K. Karro, B. S. Karro, K. K. Karro, K. K. Karro, K. K. Karro, K. K. Karro, K. K. Karro, K. K. Karro, K. K. Karro, K. K. Karro, K. K. Karro, K. K. Karro, K. Karro, K. Karro, K. K. Karro, K. Karro, K. Karro, K. Karro, K. Karro, K. Karro, K. Karro, K. Karro, K. Karro, K. Karro, K. Karro, K. Karro, K. Karro, K. Karro, K. Karro, K. Karro
Proving CU Honizon 2020 revearch and innovation programme. Forming CU Honizon 2020 revearch and innovation programme. Introduction Interview Introduction Interview Introduction Interview Introduction Interview Inter	Fording CU Honicon 2020 revearch and innovation programme. Fording CU Honicon 2020 revearch and innovation programme. Introduction Portly a trid of the world's population in regularly correction in productively. privile, cand environmental Lost atteases on the hole and i. Then a subcomposible or group of the world's programme. The foreignment and the following the subcomposible or group of the world's programme. The foreignment are interest to the physiological effect or conventional lost atteases of the hole and i. Then a subcomposible or group of the world's programme. The foreignment are interest to the hole and i. Then a subcomposible or group of the world's programment here in the hole in the programment here in the independence of the world's programment here in the world's programment here in the independence of the programment here in the independence of the world's programment here in the independence of the programment in the programment in the	heterogeneity in our meta-analyses. Grading of Recommend needed moderate confidence for most results and very kor change in orine specific gravity) due to studies being funde interpretation Occupational heat strain has important health a public health problem. Concerted international action is in the anticiated ice in heat stress.	hations, Assessment. Development and Evaluation analysis to confidence in two cases (average core temperature and d by industry. h and productivity outcomes and abouid he recognised as seeded to mitigate its effects in light of climate change and	Consepondencetor Distantes o Hearns, Lovie Leiss atros, Departmentel Escala, Nichard, Heardy an Heasily, Indus (2007, Georg and Saaf son afgenal som
Copyright © 2018 The Auflanch, Published by Hewitz Lik. This is an Open Access attale under the CC BYAC-ND license. Introduction Non-2 attained and the work's population is required to compared to characterized attained and the second hearm of hearmore-paid hear to the provide paid of the second hearmore-paid hear to the provide paid of the second provide the heart of the second hearm modules (heart of the second hearm of the facility of conduct the paid readd are provide that the second at the paid of the second paid heart of the second heart of the work's population will be expected to paid readd are paid paid heart to the provide paid the paid of the paid paid of the paid paid of the second paid heart of the paid paid heart to the paid of the paid paid of the paid paid of the paid paid heart to the paid of the paid paid of the paid paid heart to the paid paid of the paid paid paid the paid of the paid paid paid the paid of the paid paid paid the paid paid the paid paid paid the paid paid paid the paid paid the paid paid paid the paid paid the paid paid paid the paid the paid paid the paid paid the paid paid the paid paid paid paid paid the paid paid paid paid paid paid the paid paid paid paid paid paid paid paid	Copyright © 2018 The Aufmergi, Published by Elevise 11d. This is an Open Access attick under the CC EVAC-ND literature. Introduction Starty a tried of the world's population in regulary Correspondenced by attacks on the hole and there a productively a synthese the access barrow of correspondenced by attacks on the hole and there a synthese synthese the access barrow of correspondenced by attacks on the hole and there a there are a synthese sy	Funding EU Horizon 2020 research and innovation program	nue.	
Introduction producible, prvets, and verdevenende inequality. Yourly a tried of two work's population in regularly Occupational four arrive refers to be physiclogical effect exposed to charac considers. I.e. exceed houses or foreirrencental bus teres on the house of the house	Introduction productivity productivity productivity productivity productivity productivity operation is regularly occupational heat arrain network to be physiclogical effect operation of the physiclogical effect operation of the physiclogical effect operation with the physiclogical effect operation effec	Copyright @ 2018 The Author(s). Published by Elsevier 11d license.	This is an Open Access article under the CC BY-NC-ND	
SAMPLE INVERT AND A COMPANY AND A CONTRACT OF A CONTRACT O	workers aware, when course, suscing negative effects on a some contractes, but only are designed for the general	Introduction Nearly a tried of the work's population is regularly equiped to chance consilters. Let caref benero demonspace of the state of the state of the state model of the state of the state of the state of the state model of the work's population will be reported to state reading any provident less state and state of the for- warding occupation less state and state of the for-	producióly, povety, nad wsiewomenie inequality. Gerupational heat armin televis to be physiological refect of correintenciola llosi states on the holy, and i. Luta mateir ingras, ou the skilling of workers to be includy and producing lines, energin 1 million ware. Holy star a producing lines, energin 1 million ware. Holy star a producing lines, energin 1 million ware. Holy star a protection lines, which for million ware. Holy star a visual star data with a for million ware. Holy star is a visual star data with a for million ware lines parts systems do matematical shous wardiartetty? <sup>14</sup> Warring, systems do matematical works of weak holy be per globed in the systems do matematical star holy and star should be shown and star should be shown a star weak and be been for should at	

Analyses using existing models estimating labour productivity

 ≺ Current EU wide <u>annual</u> damages are 830 billion € and will increase by a factor of five to 4 trillion € by 2060 if no mitigation/adaptation action

### Productivity losses are more widespread than we thought



Wet Bulb Globe Temperature (°C)

FAME LAB



## Mitigation strategies tested in HEAT-SHIELD

#### work-rest ratios



### hydration



#### mechanization



#### clothing



#### $\prec$ Personalized warning system

## HEAT-SHIELD early warning system – www.heat-shield.eu

✓ The HEAT-SHIELD platform can effectively protect from climate-related shocks, providing guidance to workers and employers early in advance

FAME LAB





# Heat effects on workers in Europe

Prof. Andreas Flouris University of Thessaly, Greece

