Uniklinikum Würzburg

Hitze und das Herz-Kreislauf-System

„Hitze Kompakt“ am 11. Juni 2024 - Ärztenetz Eutin-Malente

Fabian Kerwagen
Deutsches Zentrum für Herzinsuffizienz am Universitätsklinikum Würzburg
Task Force *Planetare Gesundheit* der Deutschen Gesellschaft für Kardiologie (DGK)

DGK. Deutsche Gesellschaft für Kardiologie – Herz- und Kreislaufforschung e.V.

Deutsches Zentrum für Herzinsuffizienz Würzburg

Agenda

1. Klimawandel in Europa:
   2024 Europe Lancet Countdown on health & climate change

2. Epidemiologie: Extremtemperaturen & kardiovaskuläre Mortalität

3. Thermoregulation: Funktion, Dysfunktion, Interaktion

4. Pathophysiologie hitze-bedingter kardiovaskulärer Mortalität

5. Hitze und Luftverschmutzung

2024 Europe *Lancet* Countdown on health and climate change

Deutsches Zentrum
für Herzinsuffizienz
Würzburg

Countdown

The 2024 Europe report of the *Lancet* Countdown on health and climate change: unprecedented warming demands unprecedented action

Kim R van Daalen, Cathryn Tonne, Jan C Semenza, Joacim Rocklöv, Anil Markandya, Niheer Dasandi, Slava Jankin, Hicham Achebak, Joan Ballester, Hannah Bechara, Thessa M Beck, Max W Callaghan, Bruno M Carvalho, Jonathan Chambers, Marta Cirah Pradas, Orin Courtenay, Shouro Dasgupta, Matthew J Eckelman, Zia Farooq, Peter Fransson, Elisa Gallo, Olga Gasparyan, Nube Gonzalez-Reviriego, Ian Hamilton, Risto Hänninen, Charles Hatfield, Kehan He, Aleksandra Kazmierczak, Vladimir Kendrovski, Harry Kennard, Gregor Kiesewetter, Rostislav Kouznetsov, Hedi Katre Kriit, Alba Llabrés-Brustenga, Simon J Lloyd, Martín Lotto Batista, Carla Maia, Jaime Martinez-Urtaza, Zhifu Mi, Carles Milà, Jan C Minx, Mark Nieuwenhuijsen, Julia Palamarchuk, Dafni Kalatzi Pantera, Marcos Quijal-Zamorano, Peter Rafaj, Elizabeth J Z Robinson, Nacho Sánchez-Valdivia, Daniel Scamman, Oliver Schmoll, Maquins Odhiambo Sewe, Jodi D Sherman, Pratik Singh, Elena Sirotkina, Henrik Sjödin, Mikhail Sofiev, Balakrishnan Solaraju-Murali, Marco Springmann, Marina Treskova, Joaquin Triñanes, Eline Vanuytrecht, Fabian Wagner, Maria Walawender, Laura Warnecke, Ran Zhang, Marina Romanello, Josep M Antò, Maria Nilsson, Rachel Lowe

Executive summary

Record-breaking temperatures were recorded across the

Heat-related deaths are estimated to have risen across most of Europe, with an average increase of 17·2 deaths

Lancet Public Health 2024
Published Online

Quelle: van Daalen et al, *Lancet Plan Health* (2024)

2024 Europe *Lancet* Countdown on health and climate change

Deutsches Zentrum für Herzinsuffizienz Würzburg

"Temperatures in Europe are warming at **twice** the rate of the global average, threatening the health of populations across the continent and leading to unnecessary loss of life […]"

Countdown

The 2024 Europe report of the *Lancet* Countdown on health and climate change: unprecedented warming demands unprecedented action

Kim R van Daalen, Cathryn Tonne, Jan C Semenza, Joacim Rocklöv, Anil Markandya, Niheer Dasandi, Slava Jankin, Hicham Achebak, Joan Ballester, Hannah Bechara, Thessa M Beck, Max W Callaghan, Bruno M Carvalho, Jonathan Chambers, Marta Cirah Pradas, Orin Courtenay, Shouro Dasgupta, Matthew J Eckelman, Zia Farooq, Peter Fransson, Elisa Gallo, Olga Gasparyan, Nube Gonzalez-Reviriego, Ian Hamilton, Risto Hänninen, Charles Hatfield, Kehan He, Aleksandra Kazmierczak, Vladimir Kendrovski, Harry Kennard, Gregor Kiesewetter, Rostislav Kouznetsov, Hedi Katre Kriit, Alba Llabrés-Brustenga, Simon J Lloyd, Martín Lotto Batista, Carla Maia, Jaime Martinez-Urtaza, Zhifu Mi, Carles Milà, Jan C Minx, Mark Nieuwenhuijsen, Julia Palamarchuk, Dafni Kalatzi Pantera, Marcos Quijal-Zamorano, Peter Rafaj, Elizabeth J Z Robinson, Nacho Sánchez-Valdivia, Daniel Scamman, Oliver Schmoll, Maquins Odhiambo Sewe, Jodi D Sherman, Pratik Singh, Elena Sirotkina, Henrik Sjödin, Mikhail Sofiev, Balakrishnan Solaraju-Murali, Marco Springmann, Marina Treskova, Joaquin Triñanes, Eline Vanuytrecht, Fabian Wagner, Maria Walawender, Laura Warnecke, Ran Zhang, Marina Romanello, Josep M Antò, Maria Nilsson, Rachel Lowe

Executive summary

Record-breaking temperatures were recorded across the

Heat-related deaths are estimated to have risen across most of Europe, with an average increase of 17·2 deaths

Lancet Public Health 2024
Published Online

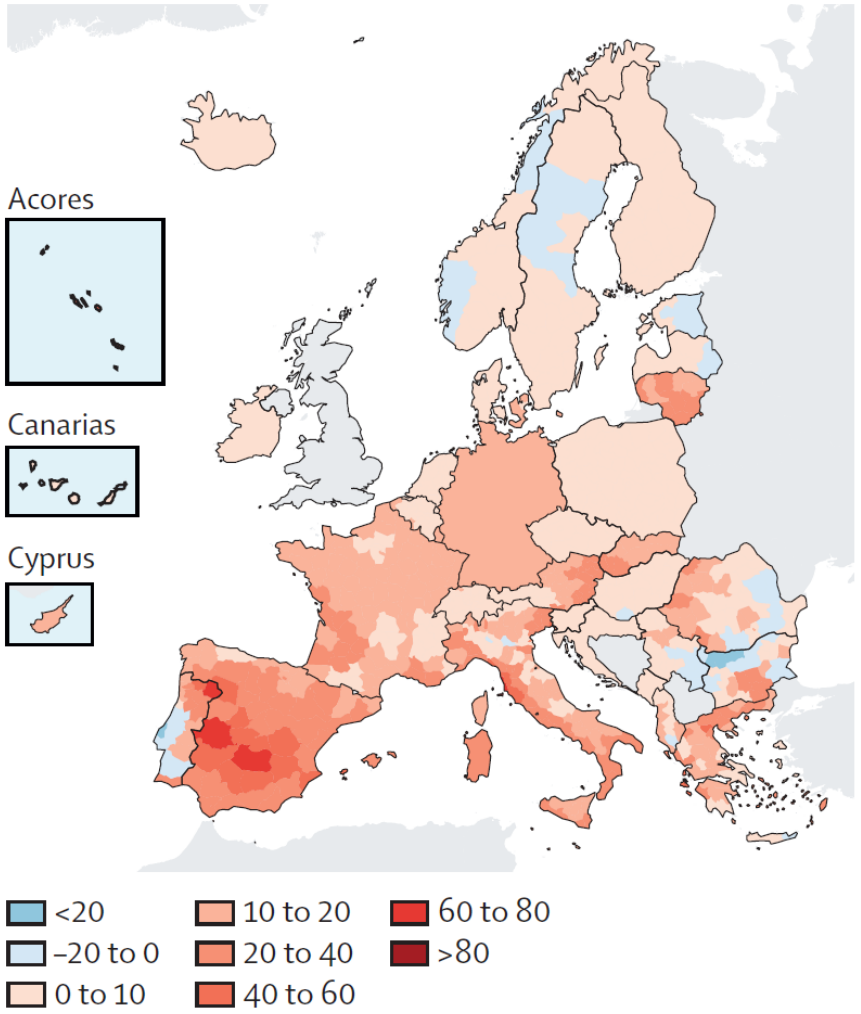
Quelle: van Daalen et al, *Lancet Plan Health* (2024)

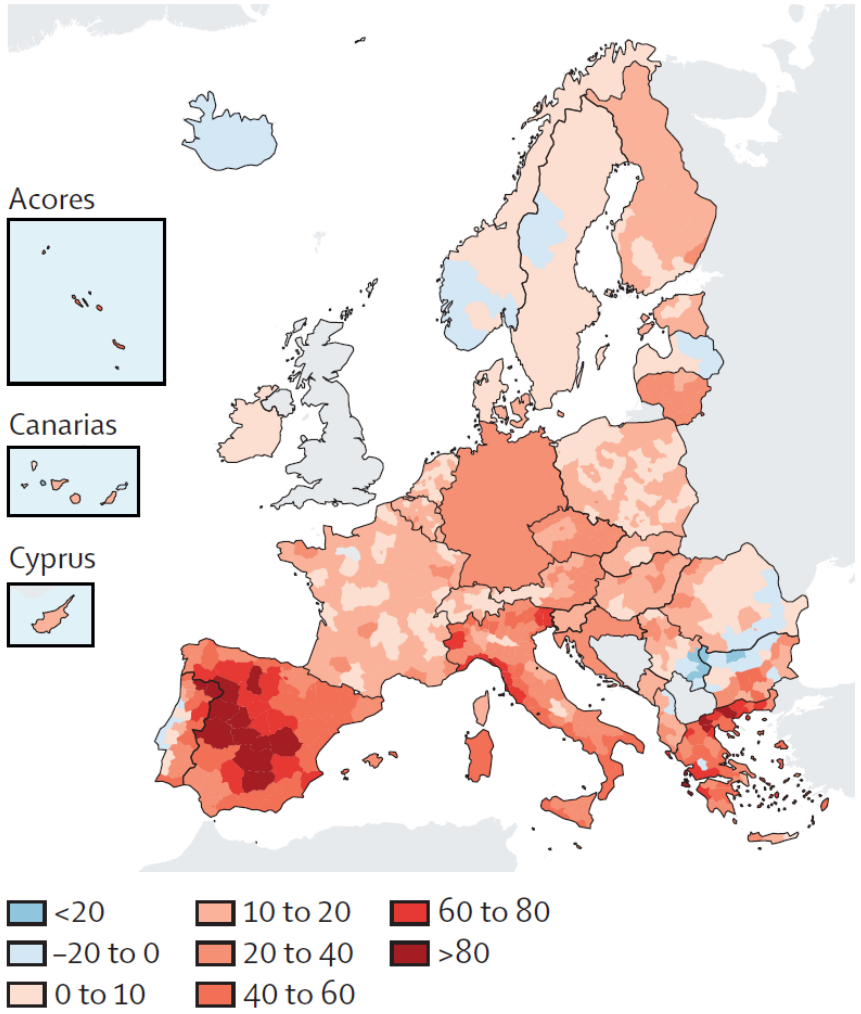
2024 Europe *Lancet* Countdown on health and climate change

Deutsches Zentrum für Herzinsuffizienz Würzburg

Im Mittel eine Zunahme von 17 Hitzetote pro 100.000 Einwohner zwischen 2003–12 and 2013–22

♂





♀

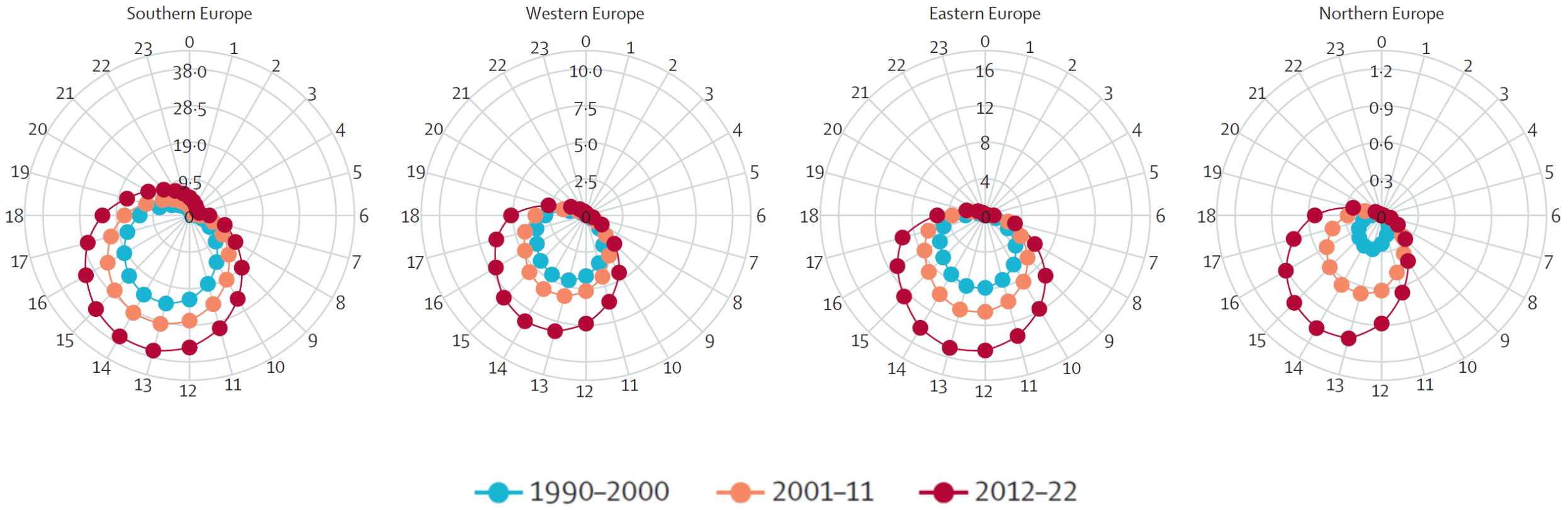
Faktor 2x!!!

Quelle: van Daalen et al, *Lancet Plan Health* (2024)

2024 Europe *Lancet* Countdown on health and climate change

Deutsches Zentrum für Herzinsuffizienz Würzburg

Zunahme der jährlichen Risikostunden pro Person für körperlich aktivitätsbedingten Hitzestress (Aktivitäten mittlerer Intensität, z.B. Fußballspielen oder Fahrradfahren)



Quelle: van Daalen et al, *Lancet Plan Health* (2024)

Extreme Temperaturen und kardiovaskuläre Mortalität

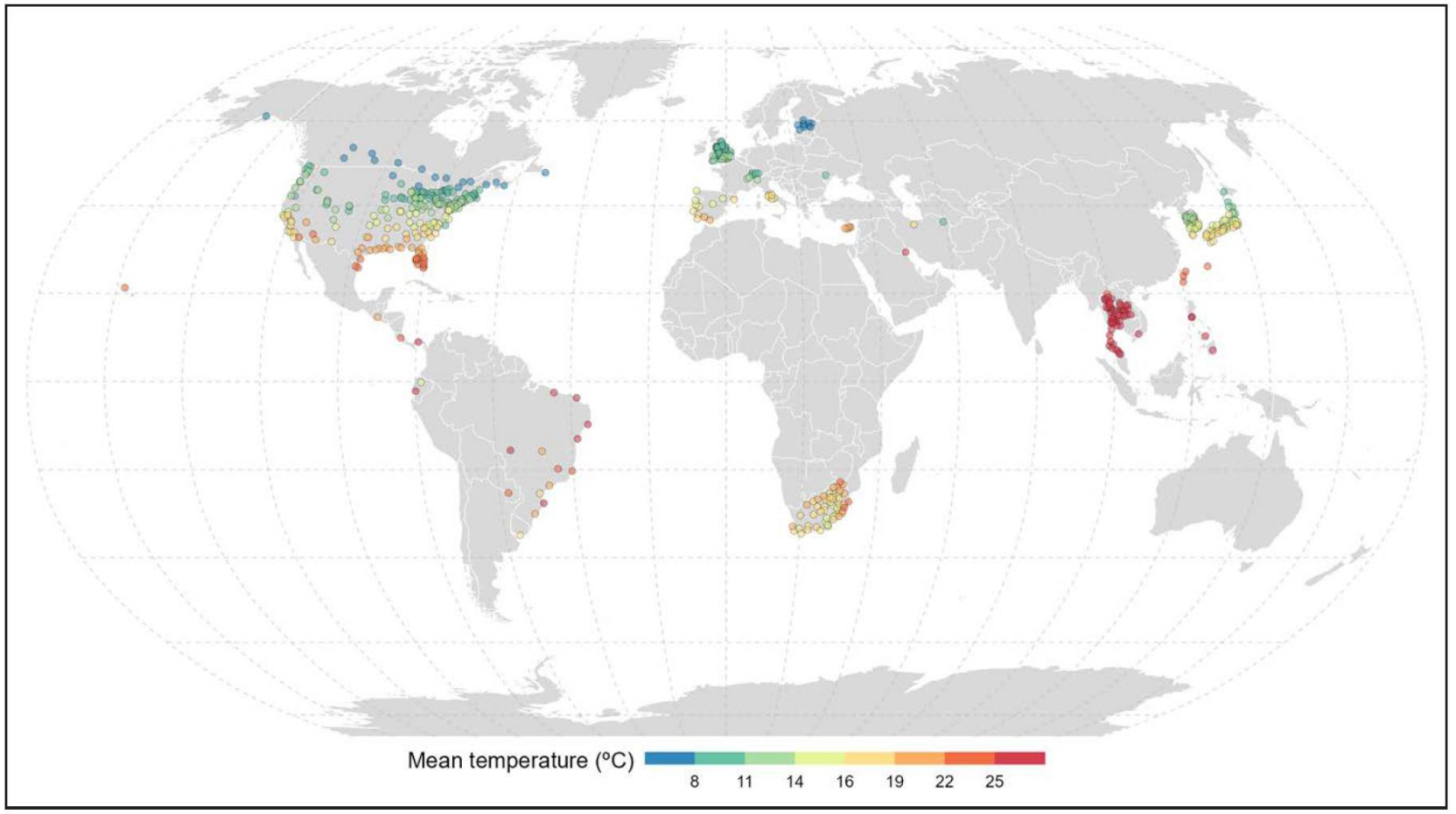
Deutsches Zentrum
für Herzinsuffizienz
Würzburg

567 Städte aus 27 Ländern (verschiedene Klimazonen)

Zeitraum **1979 – 2019**

32 154 935 kardiovaskuläre Todesfälle

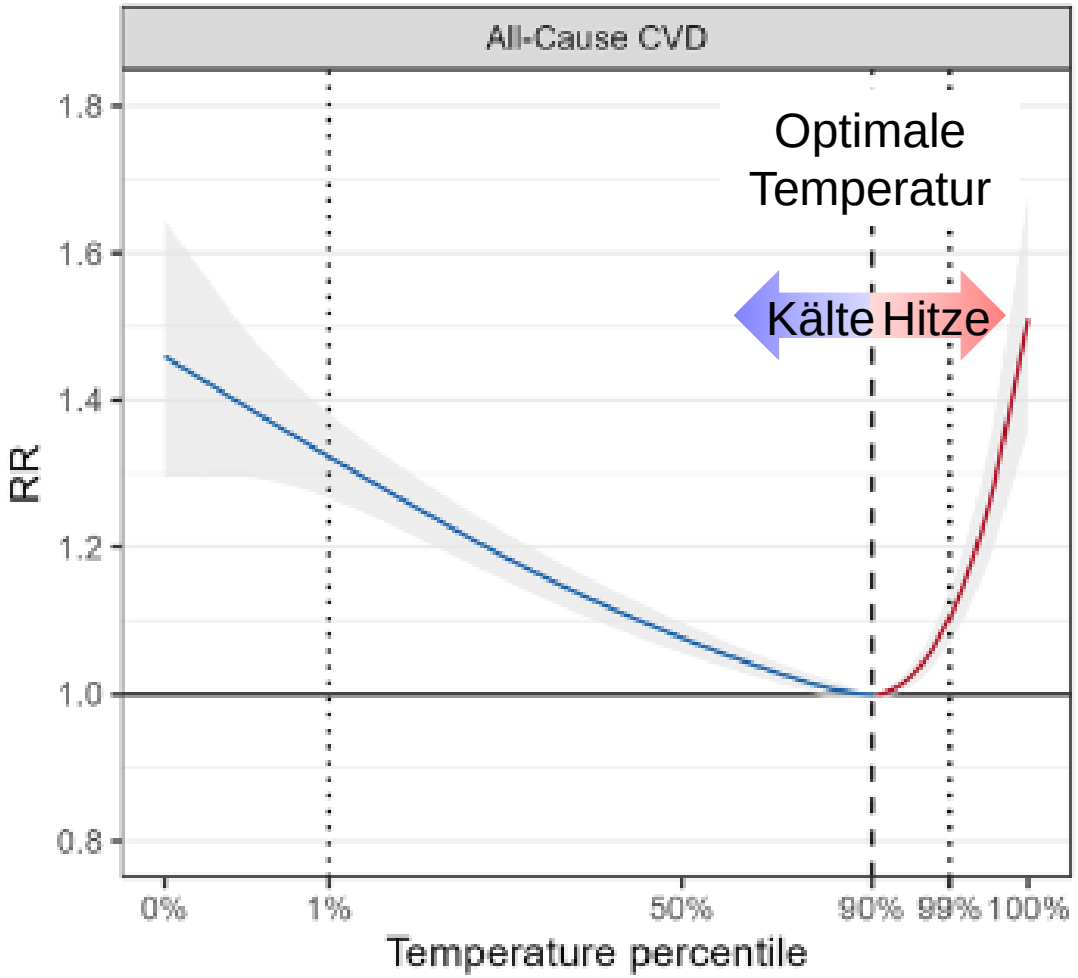
- 11 745 880 KHK
- 9 351 312 Apoplex
- 3 673 723 Herzinsuffizienz
- 70 859 Arrhythmien



Quelle: Alahmad et al, *Circulation* (2023)

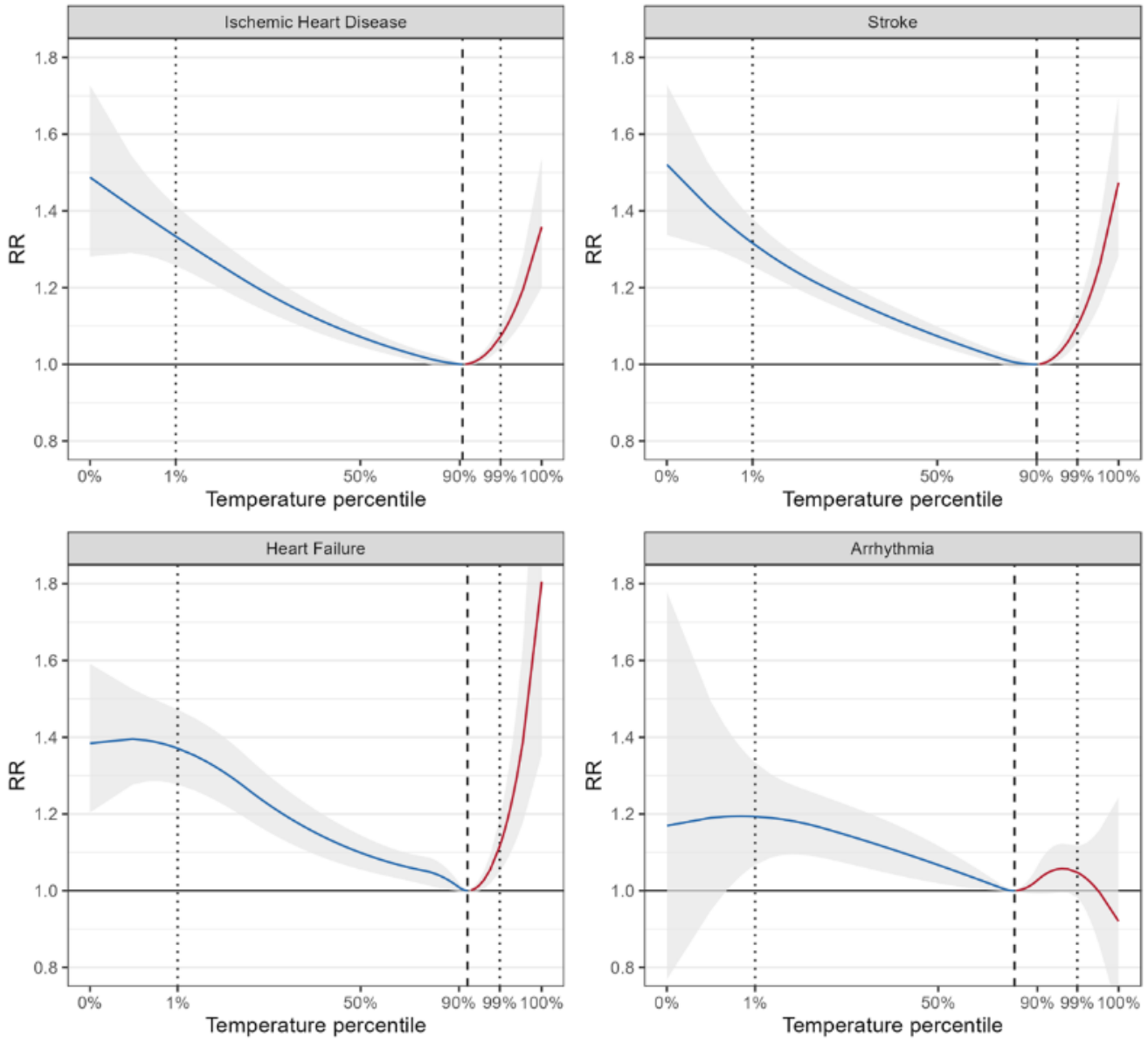
Extreme Temperaturen und kardiovaskuläre Mortalität

Deutsches Zentrum
für Herzinsuffizienz
Würzburg



Quelle: Alahmad et al, *Circulation* (2023)

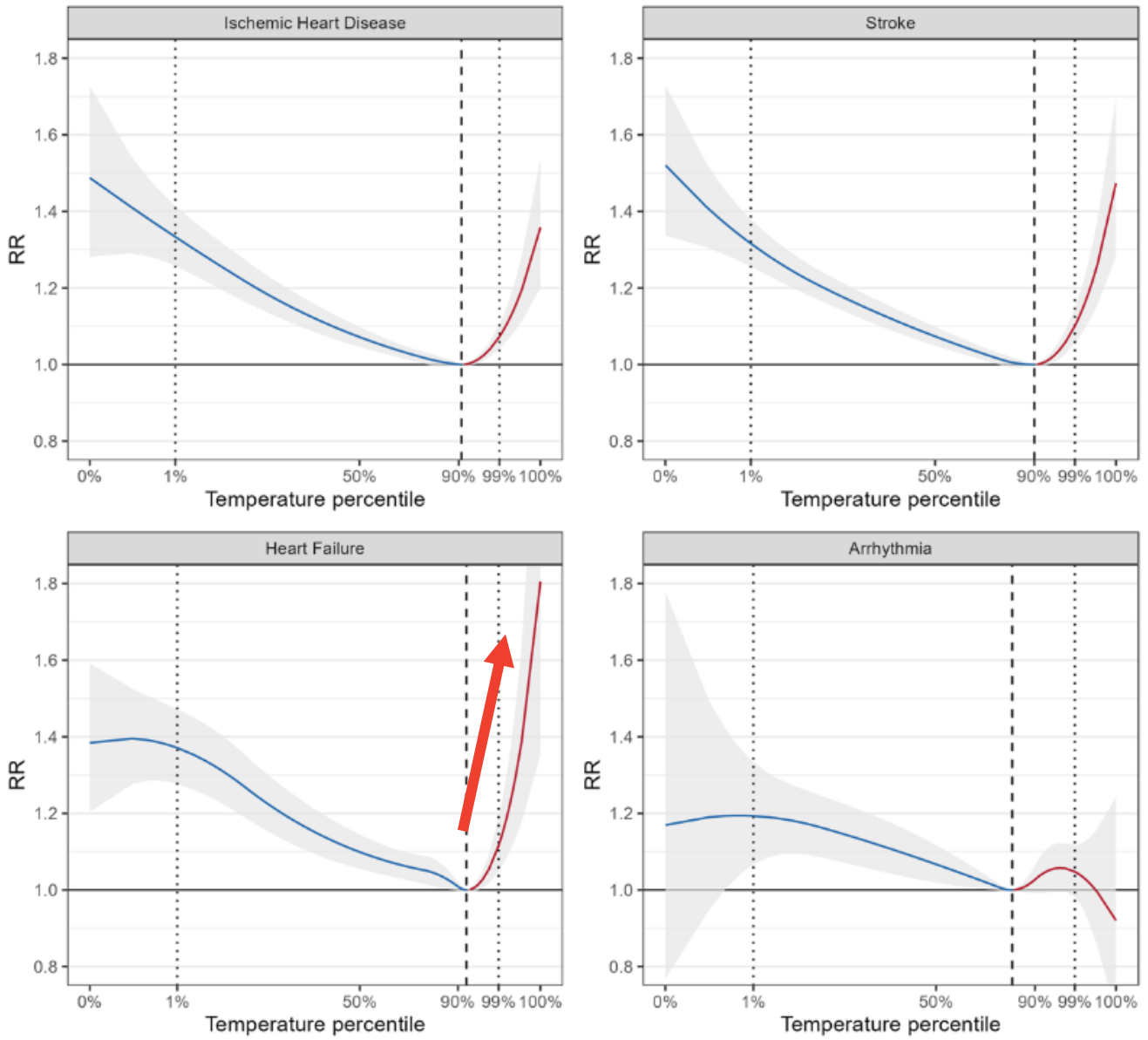
Extreme Temperaturen und kardiovaskuläre Mortalität



Quelle: Alahmad et al, *Circulation* (2023)

Extreme Temperaturen und kardiovaskuläre Mortalität

Deutsches Zentrum
für Herzinsuffizienz
Würzburg



Quelle: Alahmad et al, *Circulation* (2023)

Extreme Temperaturen und kardiovaskuläre Mortalität

Meta-Analyse (18 Studien) mit Patienten >65 Jahren mit n = 3,933,398 Todesfällen

Fazit: Ein Temperaturanstieg von 1°C erhöht die kardiovaskuläre Mortalität um 3.44%!

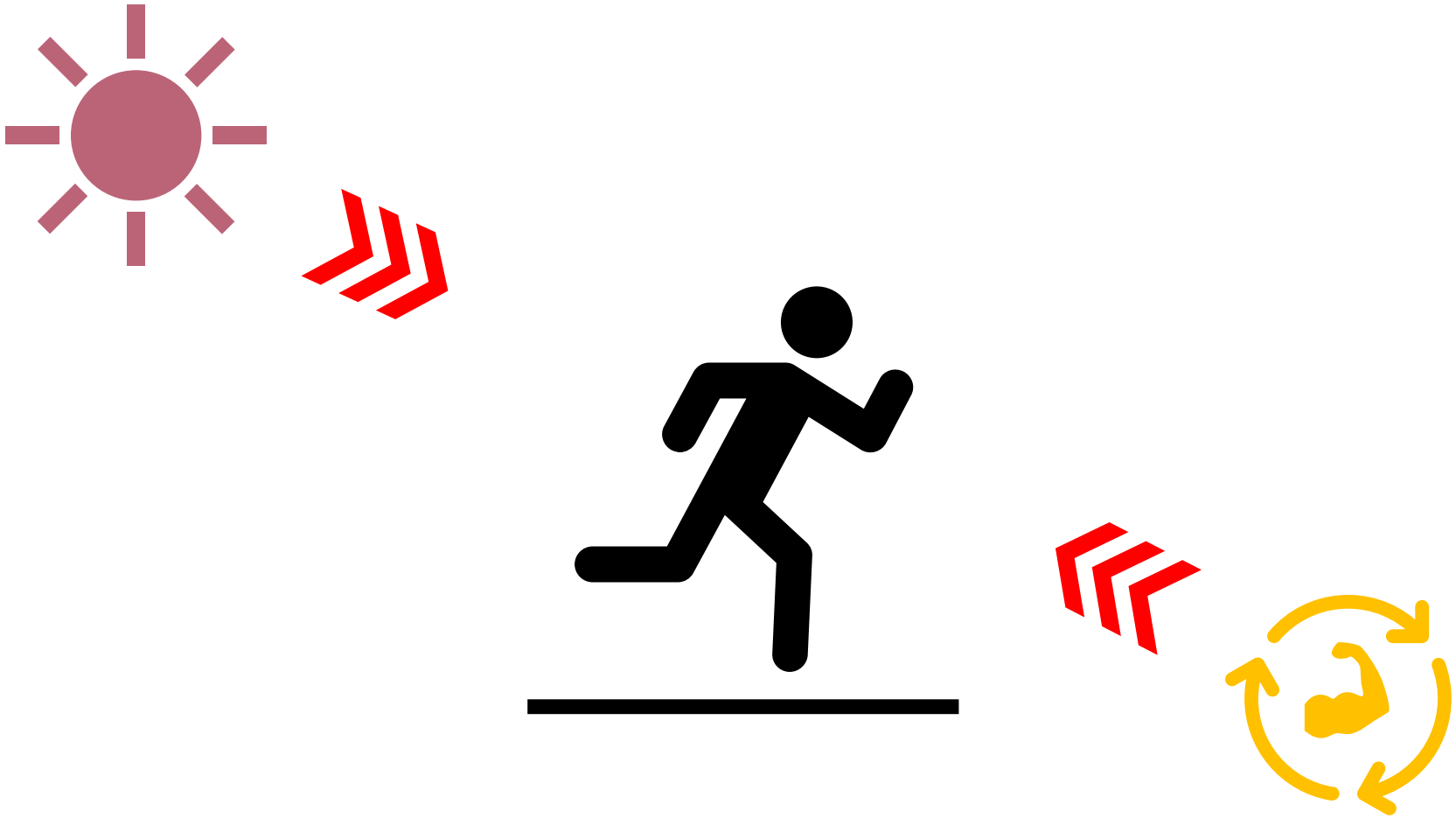
ICD-10 code	Cause of death (k > 2)	Mortality heat		
		% change (95% CI)		
Cerebrovascular				
I60–I69	All cerebrovascular disease	1.40(0.06–2.75)*	↑	k = 3, I^2 = 70.2%, p = 0.0349, n = 224,026
I60–I69 I61–I62, I64	Overall	1.40(0.06–2.75)*	↑	k = 3, I^2 = 70.2%, p = 0.0349, n = 224,026
Cardiovascular				
I20–I25	Ischemic heart disease	1.62(0.24–3.03)*	↑	k = 3, I^2 = 81.5%, p = 0.0045, n = 411220[a]
I00–I99	All cardiovascular disease	3.79(3.40–4.18)*	↑	k = 31, I^2 = 99.3%, p = <0.0001, n = 1,319,818 [a, b, c]
I21–23, I20, I50, I00–I99, I20–I25, I27.9, I70, I26–I28, I44, I45	Overall	3.44(3.1–3.78)*	↑	k = 41, I^2 = 99%, p = <0.0001, n = 2,147,349 [a, b, c]
Respiratory				
J00–J99	All respiratory disease	2.32(2.02–2.62)*	↑	k = 26, I^2 = 92.8%, p = <0.0001, n = 367,468
J09–J19, J40–44, J45–J46, J00–J99	Overall	3.60(3.18–4.02)*	↑	k = 31, I^2 = 97.5%, p = <0.0001, n = 599,458 [c]

Quelle: Bunket et al, *eBioMed* (2016)

Thermoregulation: Gesamtwärmebelastung

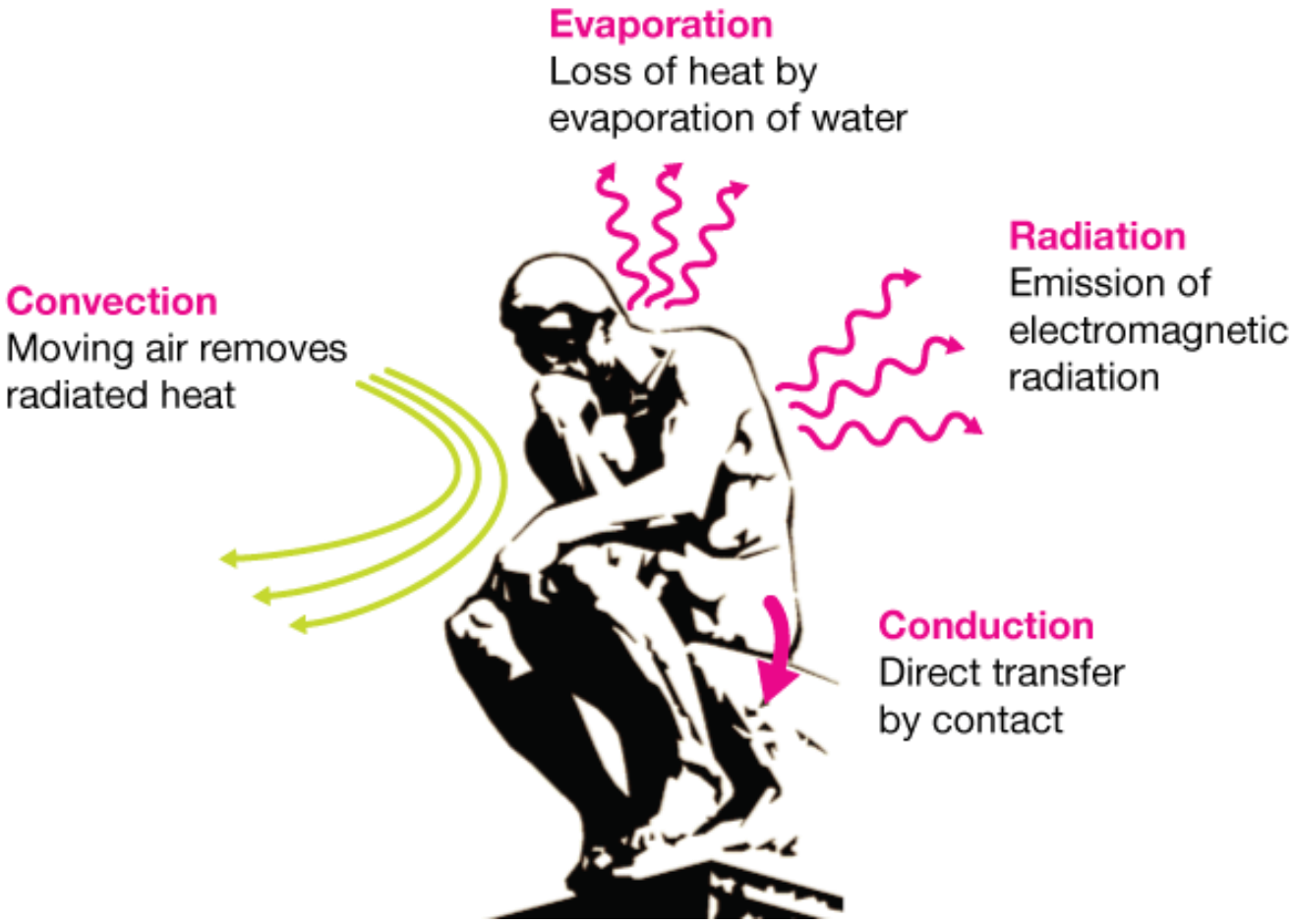
Deutsches Zentrum
für Herzinsuffizienz
Würzburg

Strahlung
(Sonne)
= extern



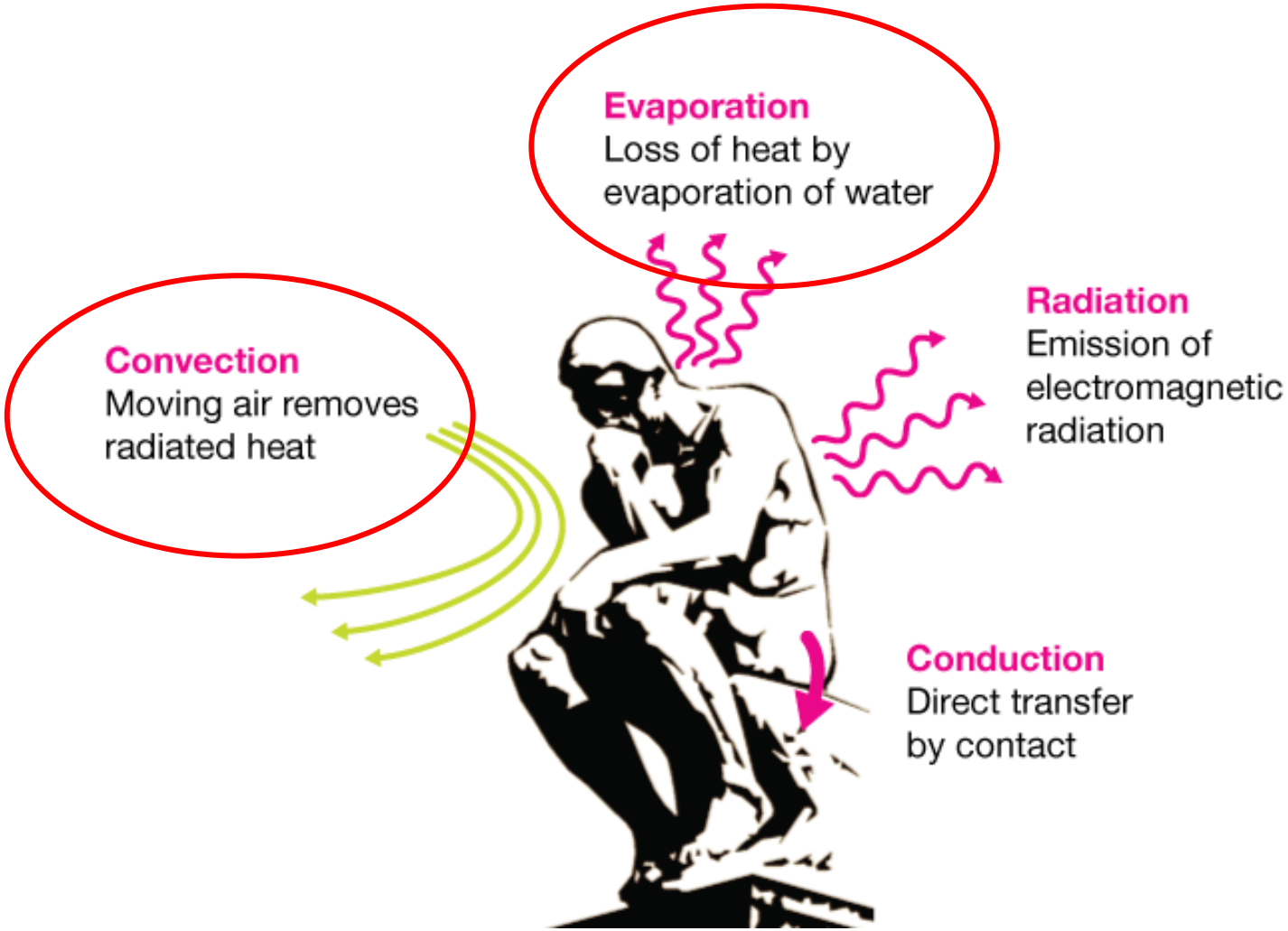
Metabolismus
(Sport)
= intern

Thermoregulation: Ziel = Körperkerntemperatur 37°C



Quelle: http://xaktly.com/HeatTransfer.html

Thermoregulation: Ziel = Körperkerntemperatur 37°C

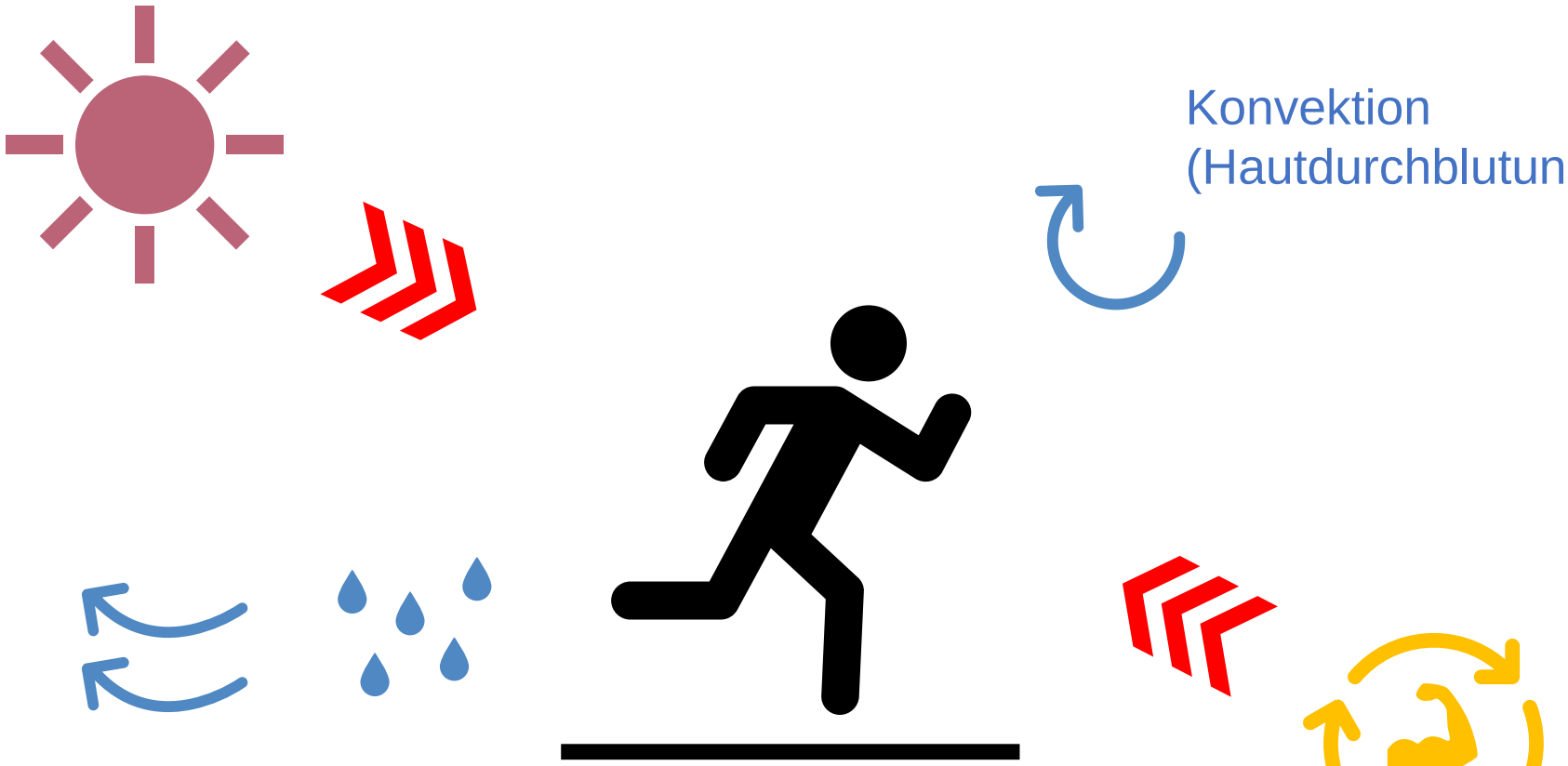


Quelle: http://xaktly.com/HeatTransfer.html

Thermoregulation

Deutsches Zentrum
für Herzinsuffizienz
Würzburg

Strahlung
(Sonne)
= extern

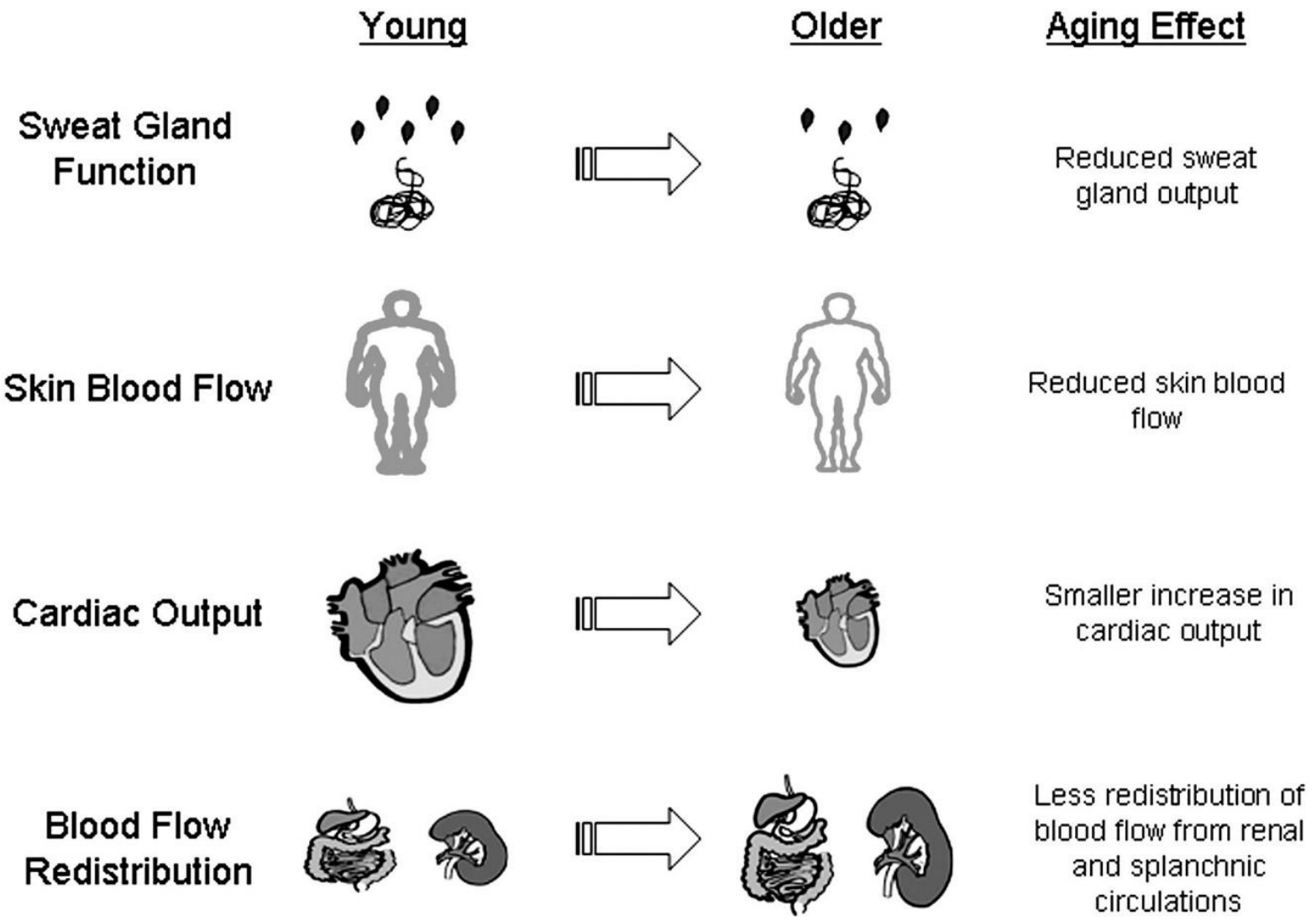


Konvektion
(Hautdurchblutung)

Evaporation
(Schweiß)

Metabolismus
(Sport)
= intern

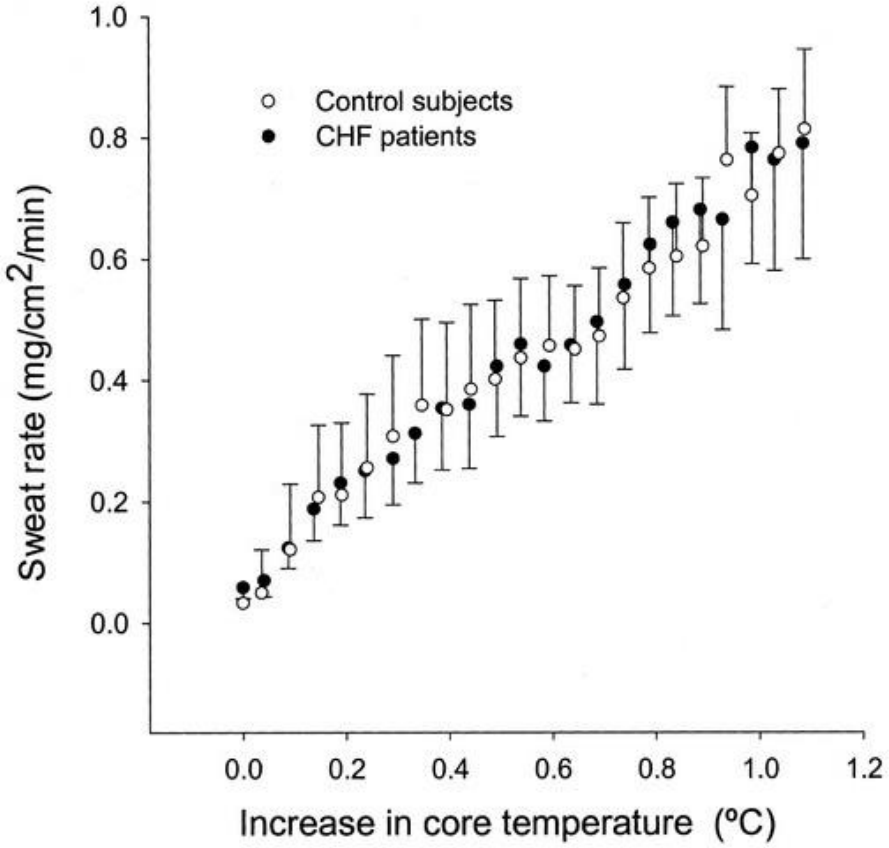
Thermoregulation und Alter



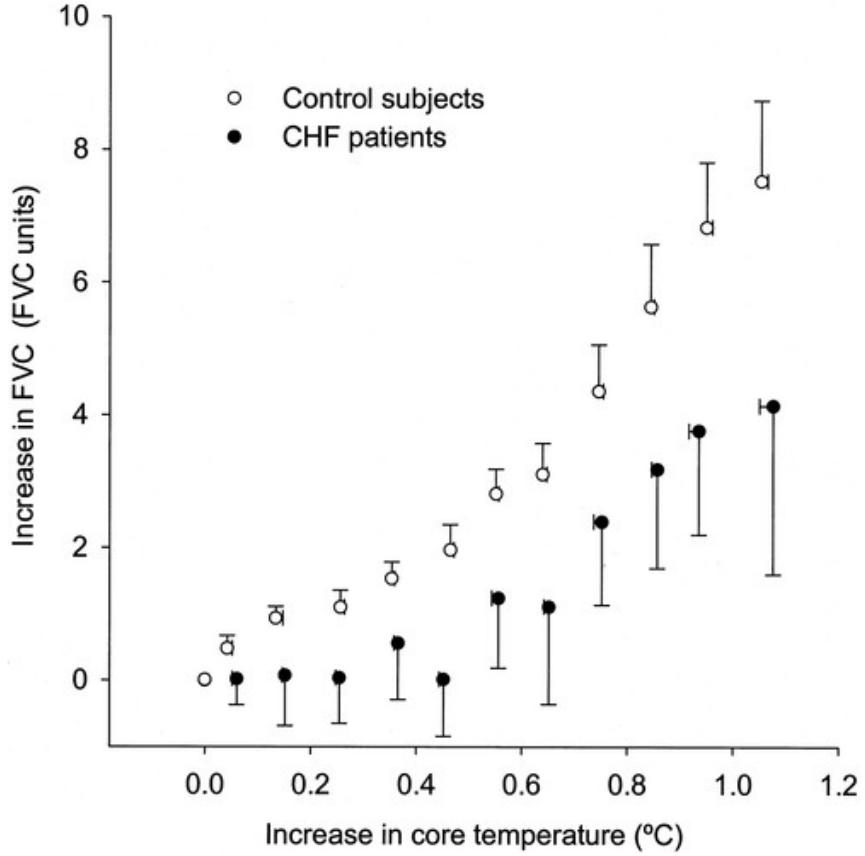
J Appl Physiol 95: 2598–2603, 2003;
10.1152/japplphysiol.00202.2003.

Thermoregulation und Herzinsuffizienz

Schweißproduktion



Hautdurchblutung



Quelle: Cui et al., *Circulation* (2005)

Thermoregulation und Herzinsuffizienz

Vor allem die **kutane Vasodilatation** ist bei Herzinsuffizienz **eingeschränkt**!

Authors	Environment/Mode	Sample size	Thermoregulatory Responses*	
			Sweating	Skin Blood Flow
Morgan and Nadas [22]	Pilocarpine iontophoresis	CON = 17; HF = 14	↑	--
Zelis et al., [31]	Cycling exercise in a thermo-neutral laboratory	CON = 12; HF = 9	--	↓
Cui et al., [23]	Water-perfused suit (water temperature ~46°C)	CON = 14; HF = 14	↔	↓
Green et al., [30]	Whole-body chamber heating at 38°C	CON = 7; HF = 7	--	↓
Cui et al., [24]	Water-perfused suit (water temperature ~46°C)	CON = 9; HF = 9	↓	↓
Balmain et al.,[37]	Cycling exercise in a 30°C laboratory environment	CON = 8; HF = 10	↔	↓

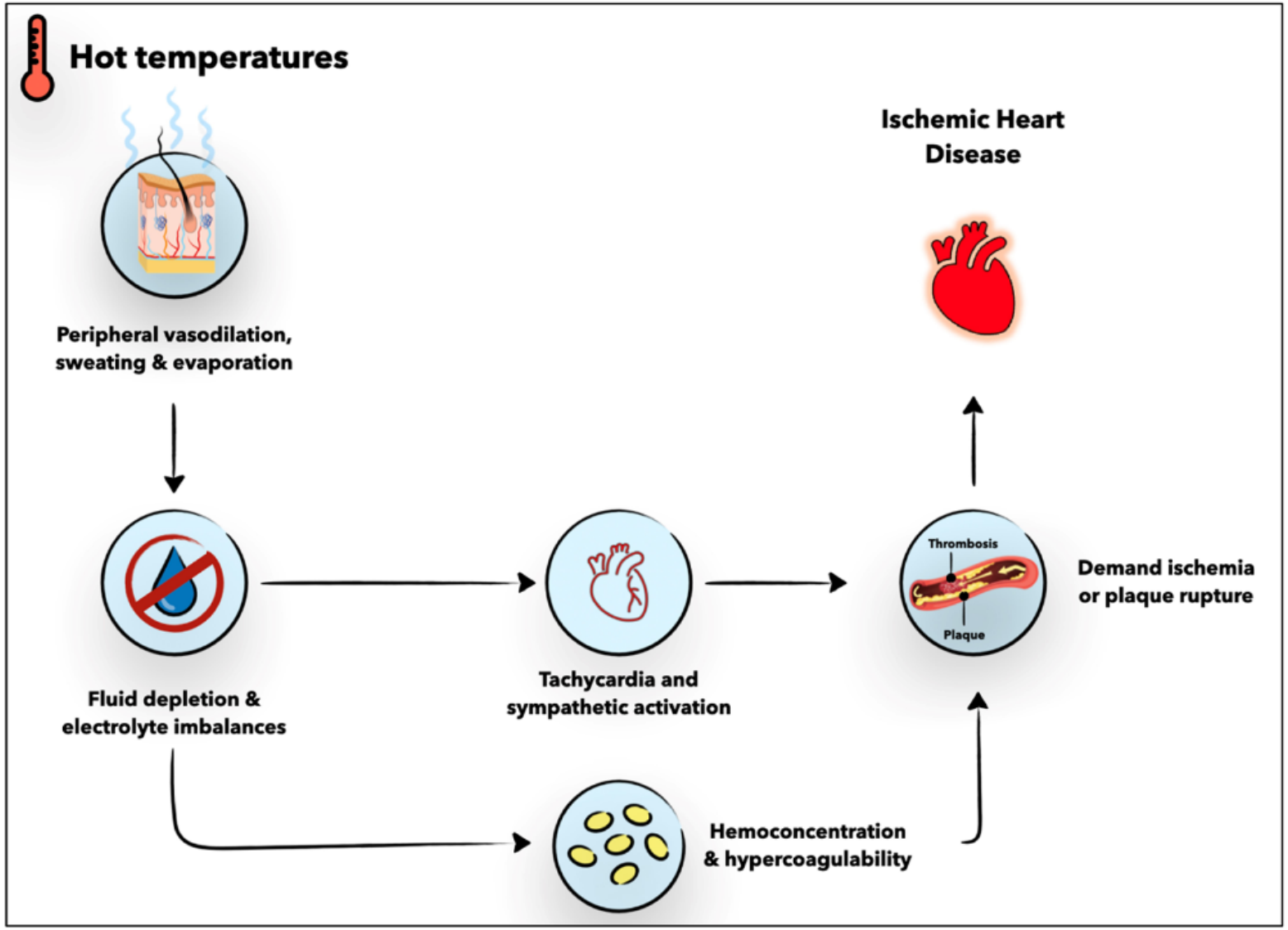
*arrows indicate the magnitude of response in heart failure patients (HF) compared to age- and gender-matched healthy controls (CON), where: ↔ indicates that there was no significant difference in the response between HF and CON; ↑ indicates a significantly greater increase in HF compared to CON; ↓ indicates a significantly smaller increase in HF compared to CON; -- indicates that the response was not assessed.

Quelle: Balmain et al., *J Card Fail* (2017)

Thermoregulation und Medikamente

- **Dehydrierung/Hyponatriämie (z.B. Diuretika)**
- Reduzierte Schweißproduktion (Anticholinergika, H1-Blocker 1. Gen, z.B. Clemastin)
- Temperaturregulation/Kognition/Verminderte Aufmerksamkeit
  (v.a. Neuroleptika, wie z.B. Olanzapin, Risperidon, oder Quetiapin; Opiode)
- **Einfluss auf kutane Vasodilatation (z.B. β-Blocker)**
- **Reduziertes Durstempfinden (z.B. ACE-Hemmer)**
- Verstärkte AM-Wirkung durch rascheres Anfluten (z.B. Insulin, Pflaster i.A.)
- Verstärkte AM-Wirkung durch **reduzierte (renale) Elimination** (alle Medikamente mit renaler Elimination)

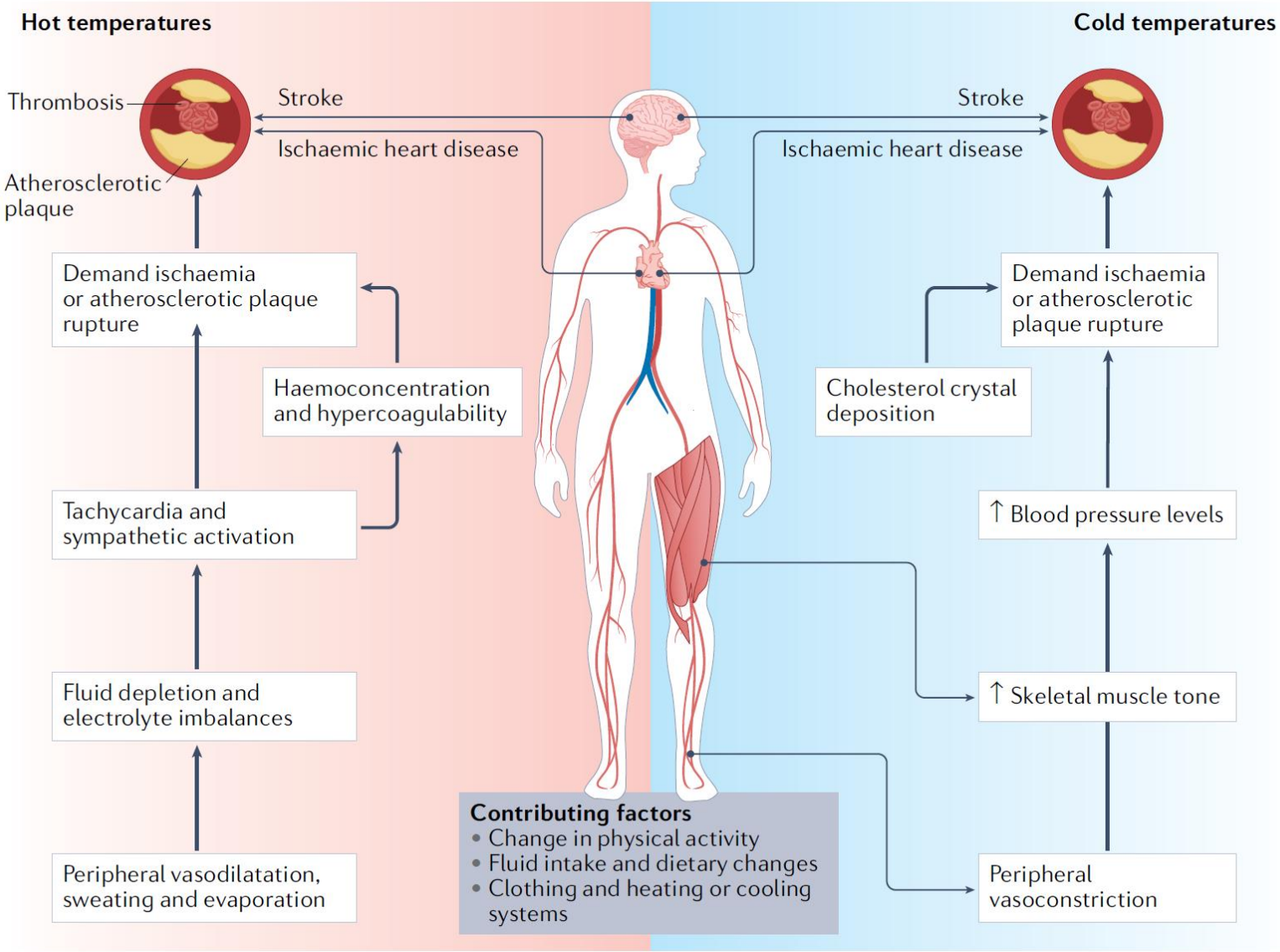
Pathophysiologie hitze-bedingter kardiovaskulärer Mortalität



Quelle: Desai et al, *Yale J Biol Med* (2023)

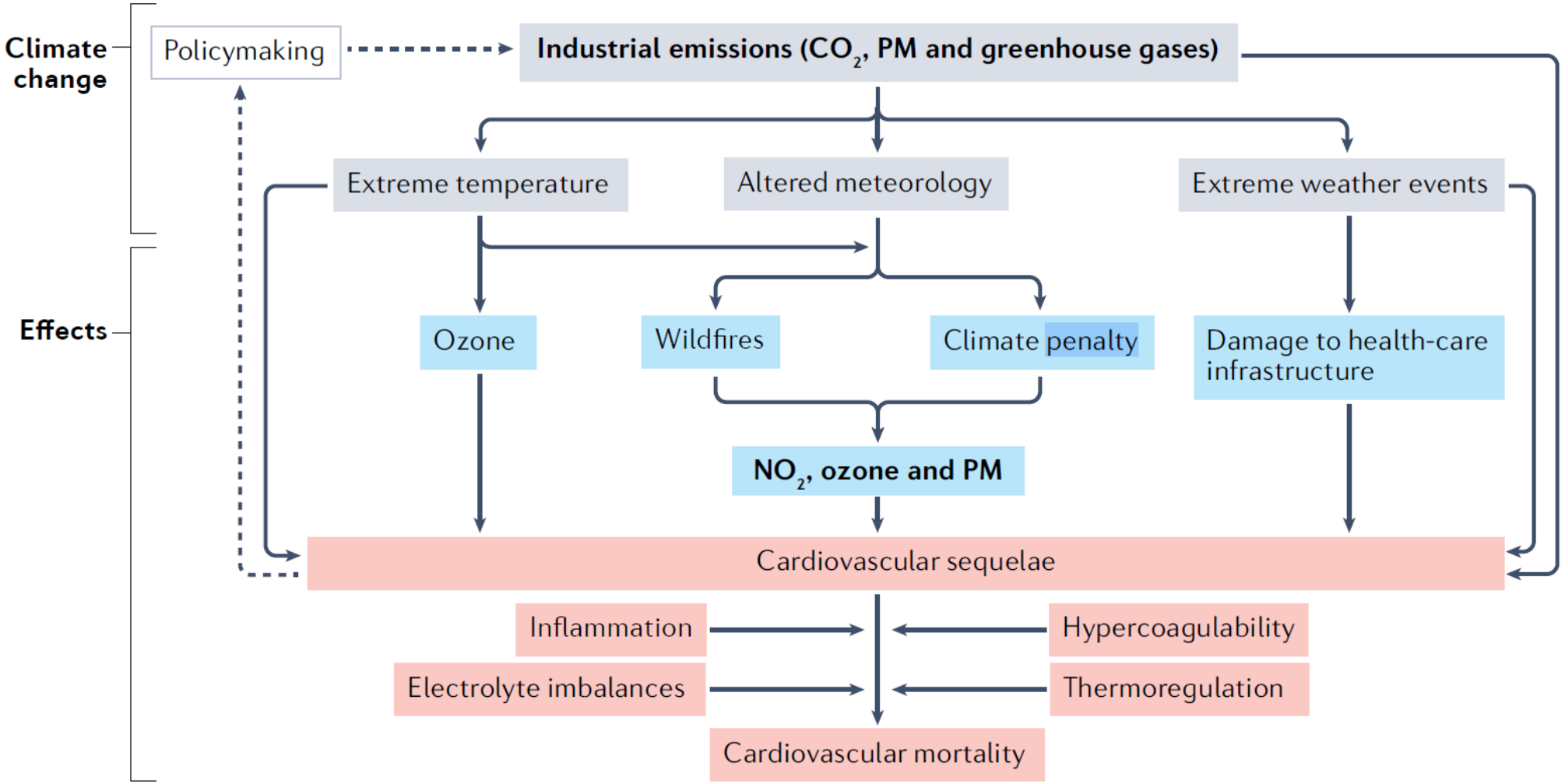
Pathophysiologie hitze-bedingter kardiovaskulärer Mortalität

Deutsches Zentrum
für Herzinsuffizienz
Würzburg



Quelle: Khraishah et al, *Nat Rev Card* (2022)

Hitze und Luftverschmutzung

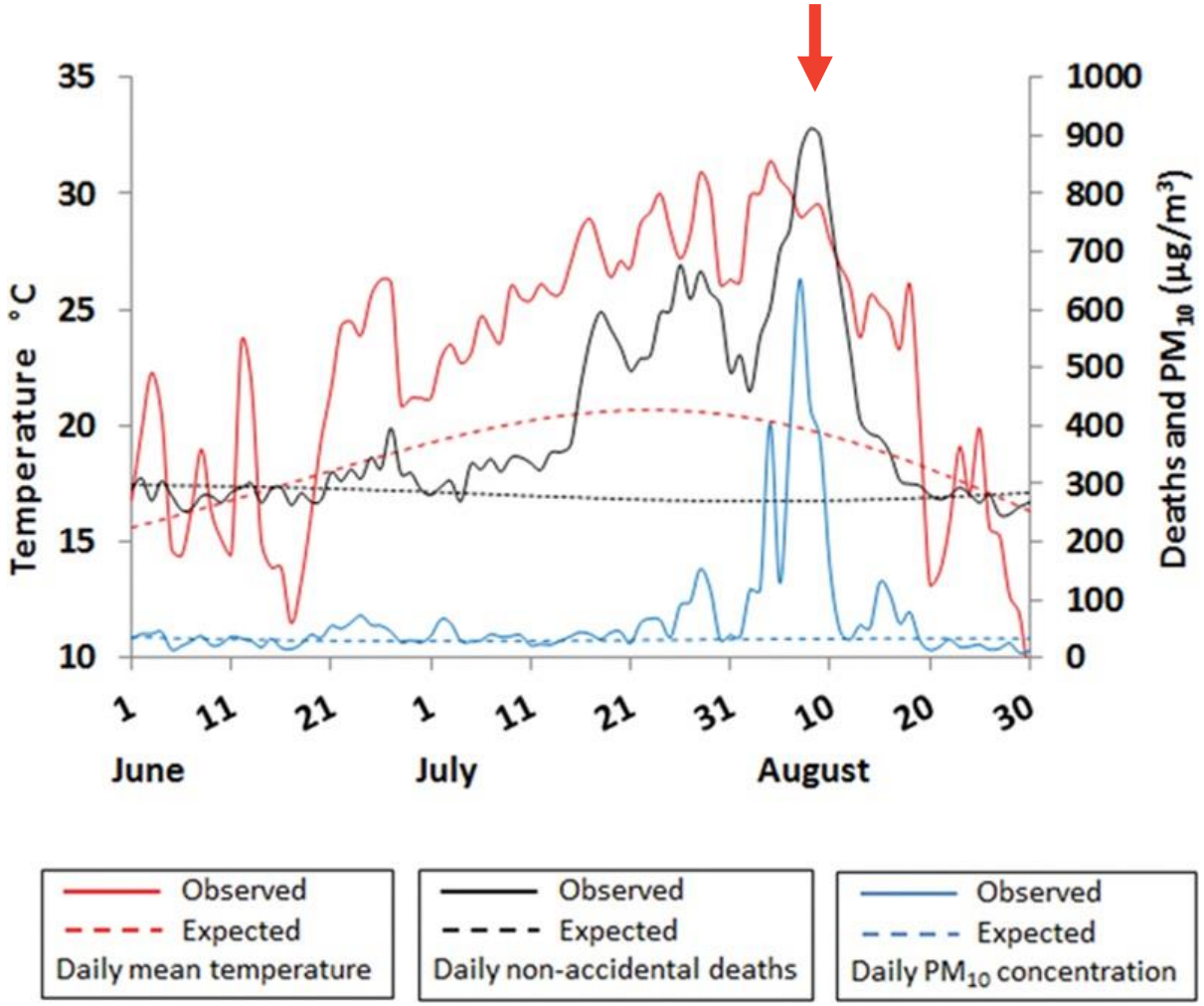


Quelle: Khraishah et al, *Nat Rev Card* (2022)

Hitze und Luftverschmutzung

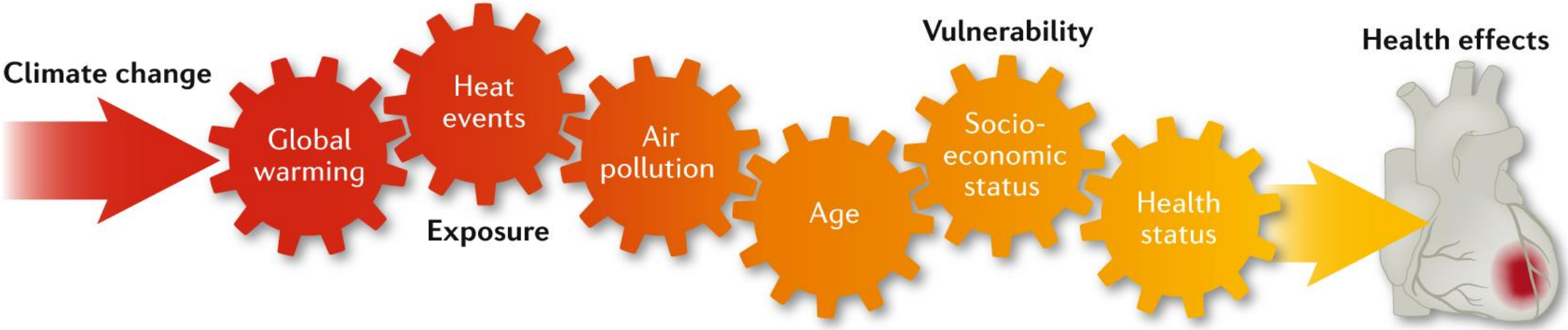
Deutsches Zentrum
für Herzinsuffizienz
Würzburg

Mortality Related to Air Pollution with the Moscow Heat Wave and Wildfire of 2010



Quelle: Shaposhnikov et al, *Epidemiology* (2014), www.spiegel.de

Vielen Dank für Ihre Aufmerksamkeit!



Quelle: Peters & Schneider, *Nature Reviews Cardiology* (2021)