Extreme of Temperature: A Global Alarm

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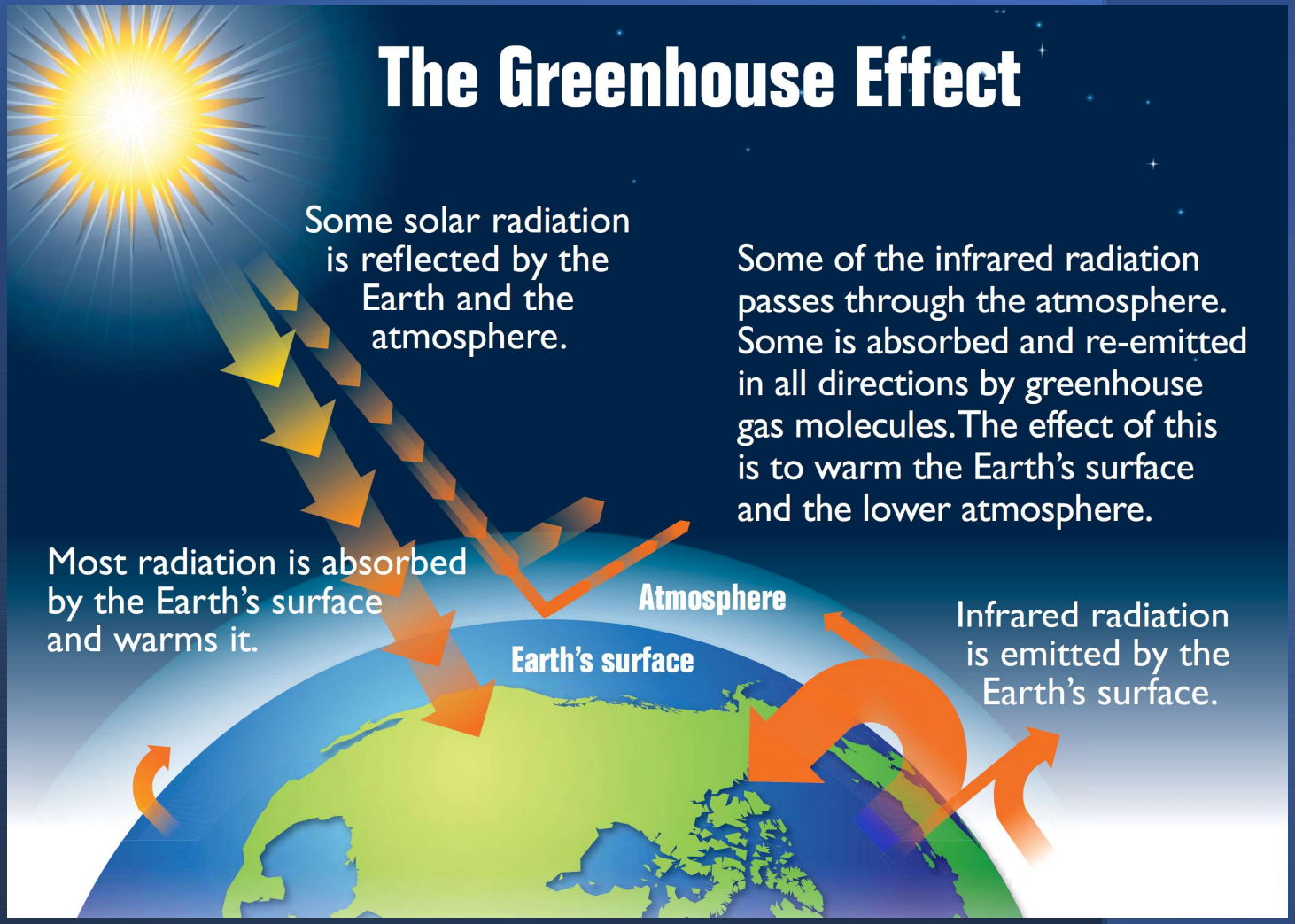
In nature there are neither
rewards nor punishments;
there are consequences.
Robert G. Ingersoll
quotefancy


The Greenhouse Effect
Some solar radiation is reflected by the Earth and the atmosphere.
Some of the infrared radiation passes through the atmosphere. Some is absorbed and re-emitted in all directions by greenhouse gas molecules. The effect of this is to warm the Earth's surface and the lower atmosphere.
Most radiation is absorbed by the Earth's surface and warms it.
Atmosphere
Earth's surface
Infrared radiation is emitted by the Earth's surface.

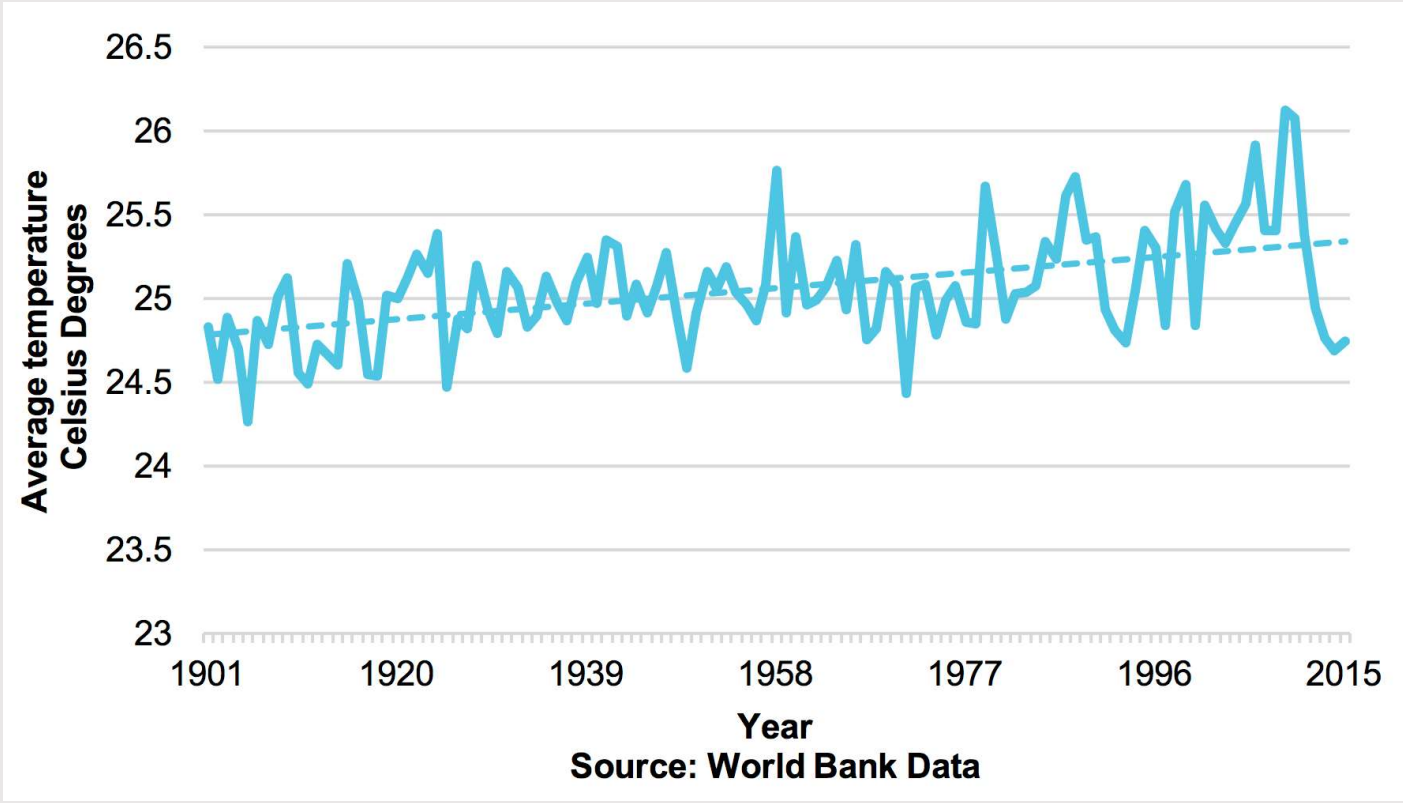
What is global warming

Global warming is an average increase in temperatures near the Earth's surface and in the lowest layer of the atmosphere.

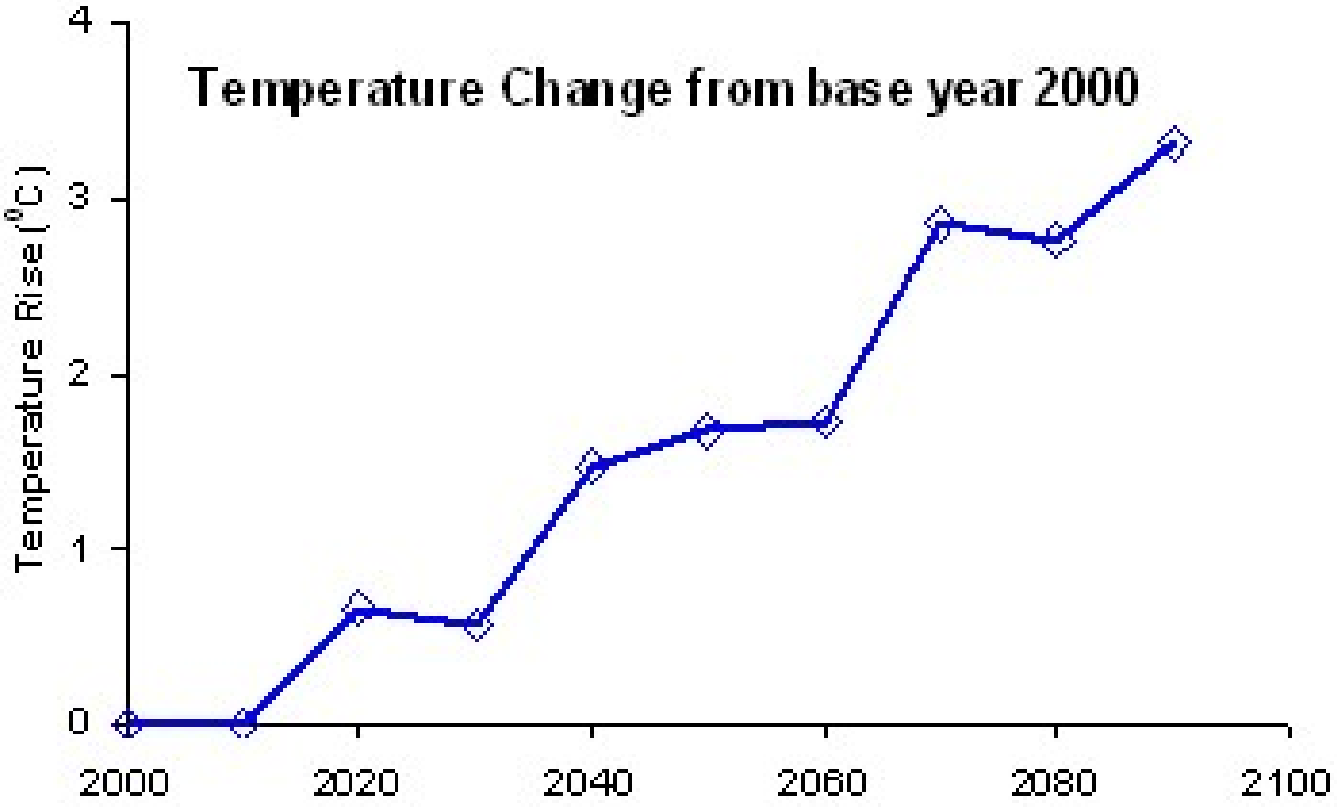
Increases in temperatures in our Earth's atmosphere can contribute to changes in global climate patterns

Global warming can be considered part of climate change along with changes in precipitation, sea level, etc.

Temperature is rising day by day



World will be hotter



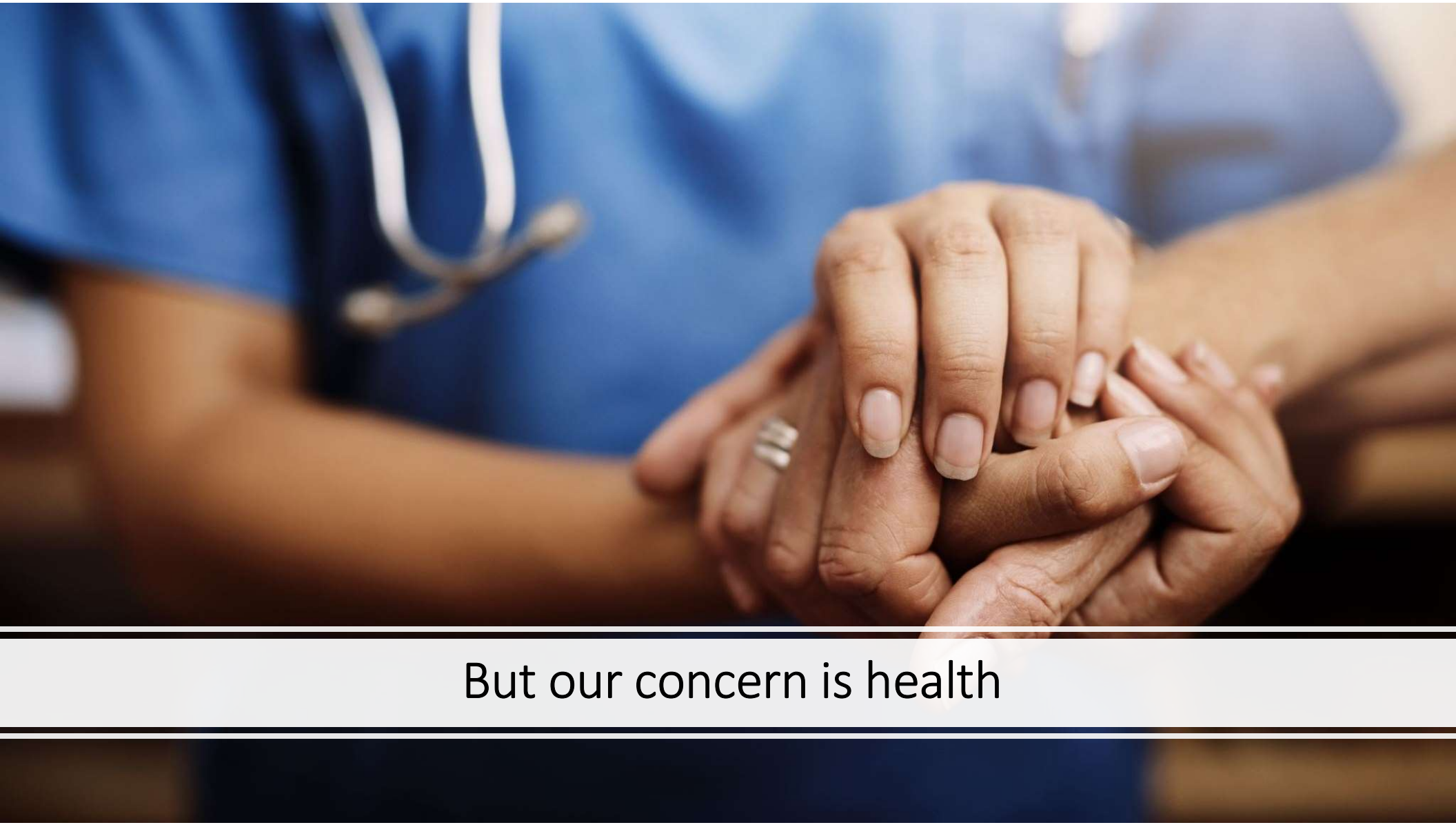
Effects of Climate Change…..

Effects of Climate Change….

Dhaka in hot season

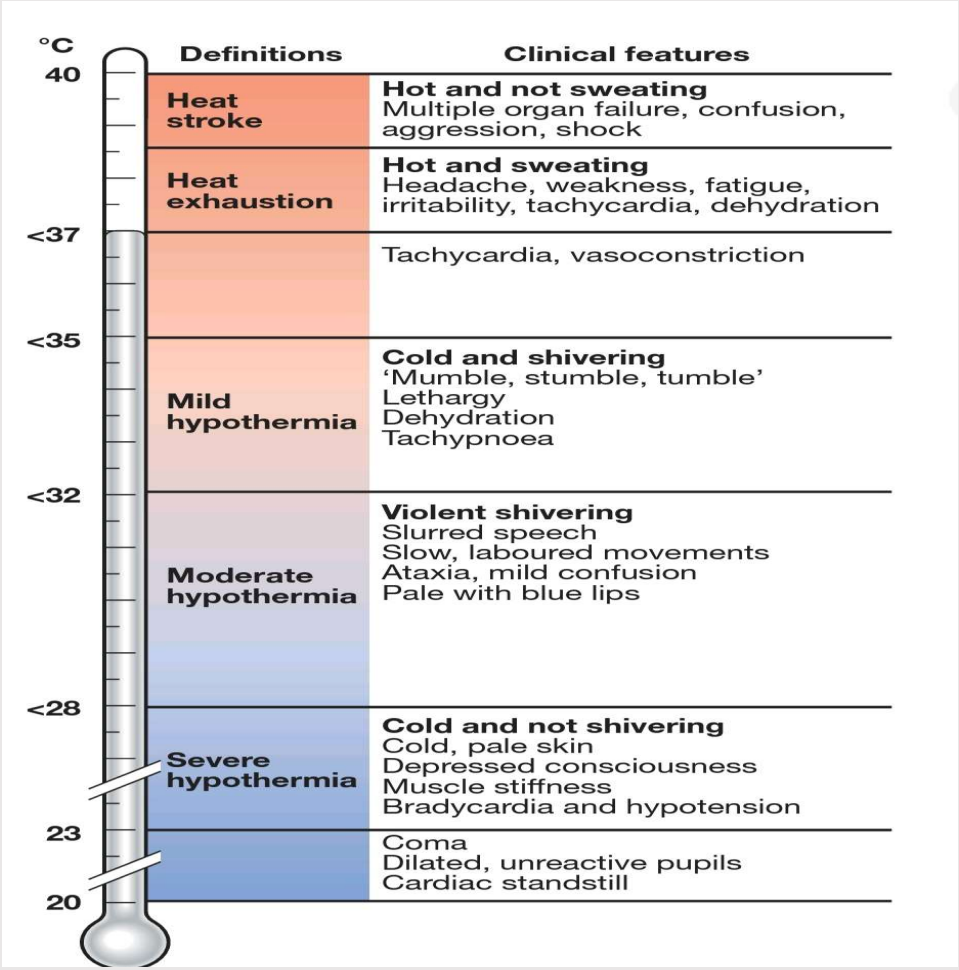
Heavy Rainfall

Cold Season



But our concern is health

What we already know



Effect of heat on health

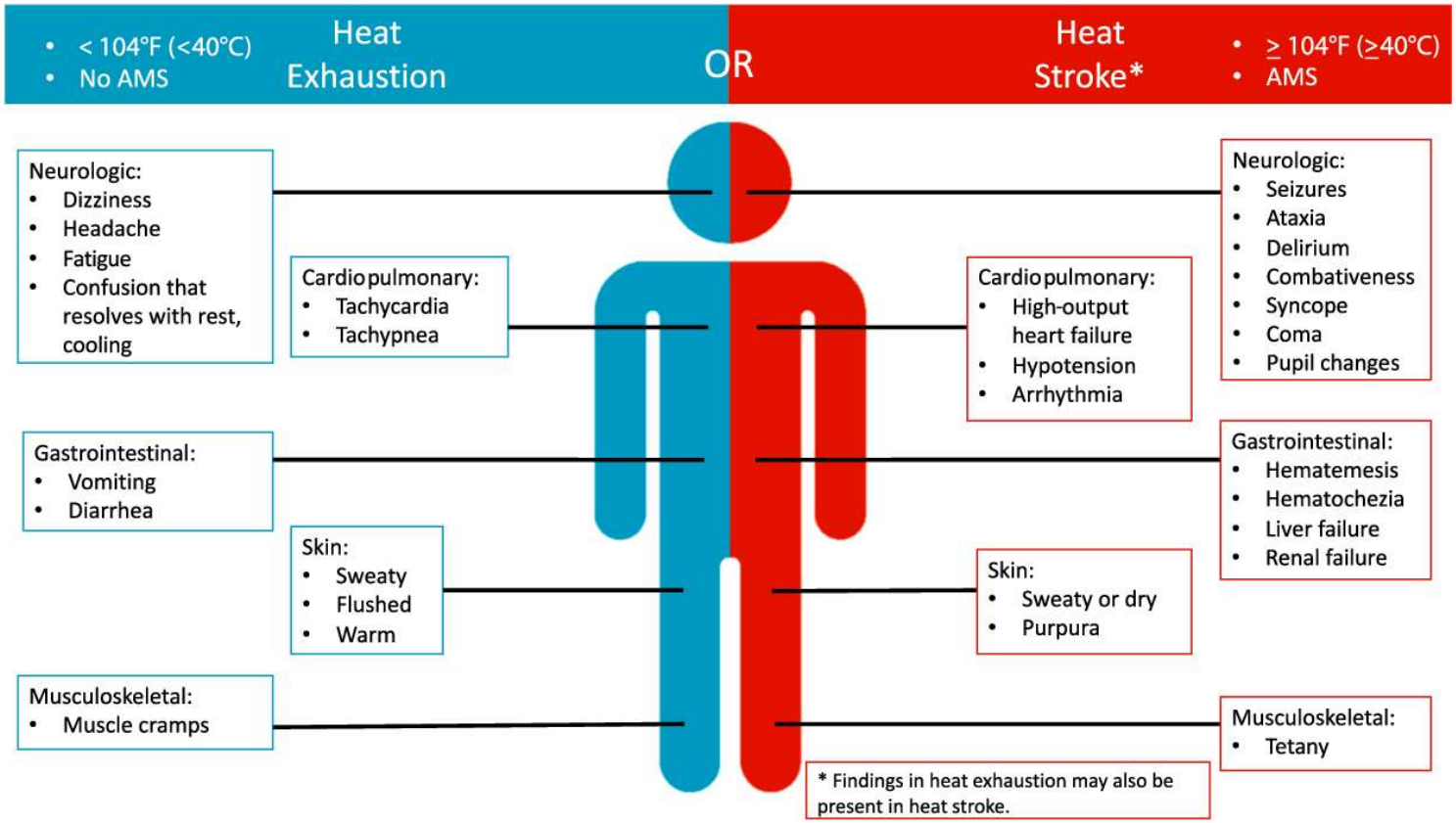


Figure 1. Clinical findings in heat exhaustion or heat stroke. AMS = altered mental status

Extreme Heat and Neurological Disease

- Extreme weather events and temperature fluctuations were associated with increased
  - Stroke incidence and severity
  - Migraine headaches
  - Hospitalization in dementia patients
  - Worsening of MS

- Increasing neuroinfectious diseases like
  - West Nile virus
  - Meningococcal meningitis
  - Tick-borne encephalitis

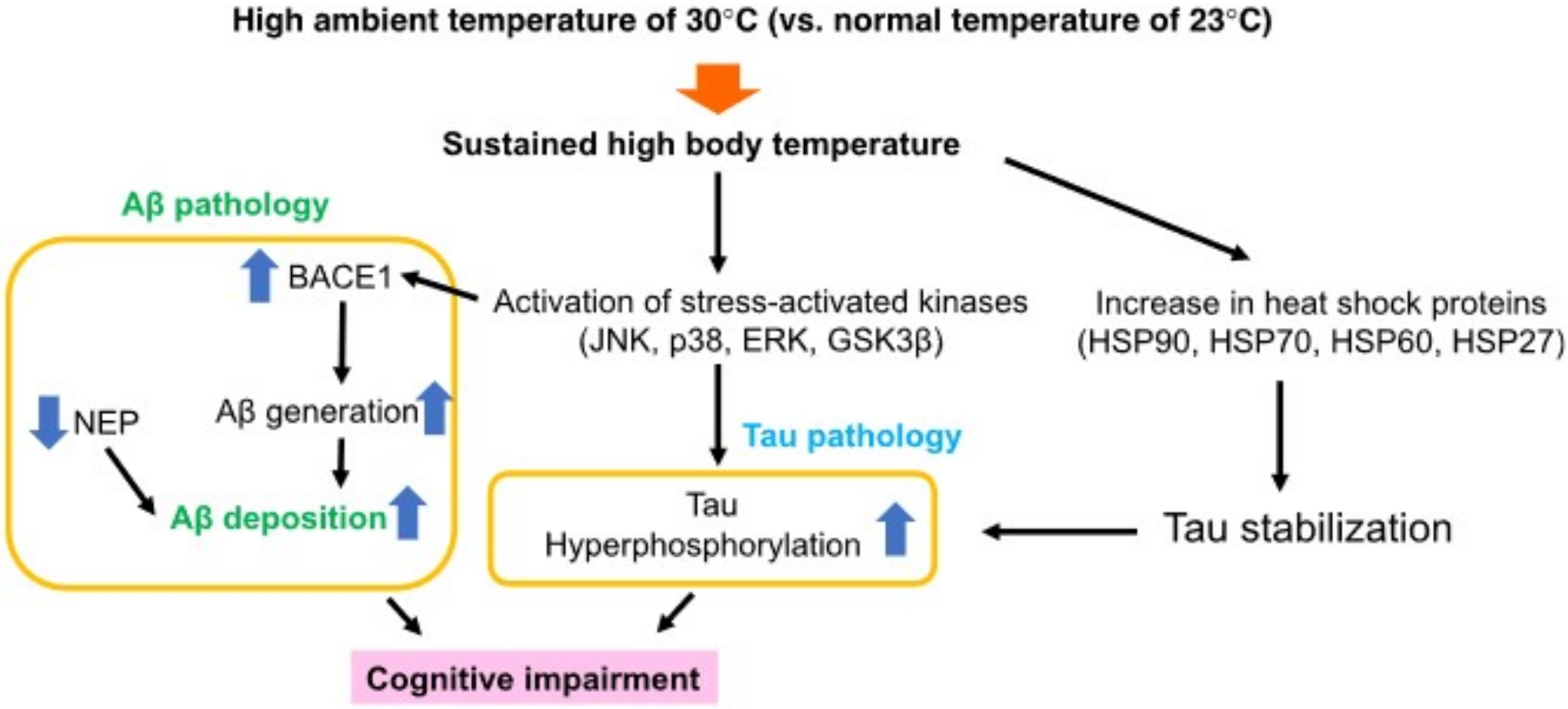
November 16, 2022, online issue of Neurology®

Neurodegenerative Diseases: Mechanism

Heat exposure induce oxidative stress as well as Tau pathology

Neuronal cells exposed to higher temperatures decrease superoxide dismutase (SOD) expression leading to cell death

Prolonged heat exposure can increase the levels of pro-inflammatory cytokines such as tumor necrosis factor-alpha (TNFa), interleukin-1 (IL-1), NF-kB signaling resulting in gliosis and decreases synaptic density


High ambient temperature of 30°C (vs. normal temperature of 23°C)
Sustained high body temperature
Aβ pathology
BACE1
Activation of stress-activated kinases
(JNK, p38, ERK, GSK3β)
Increase in heat shock proteins
(HSP90, HSP70, HSP60, HSP27)
NEP
Aβ generation
Aβ deposition
Tau pathology
Tau
Hyperphosphorylation
Tau stabilization
Cognitive impairment

Seizure: Role of Heat

Heat-induced activation of TRPV4 channels and NMDAR signaling

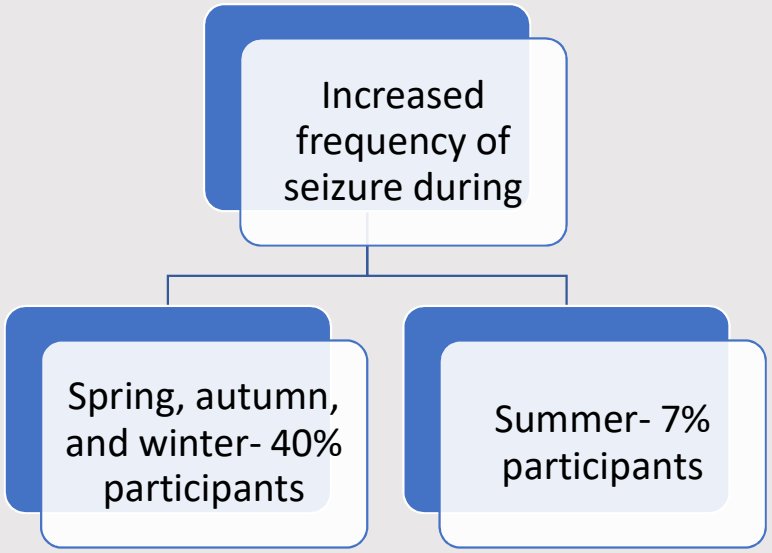
Hyperthermia can cause epileptiform discharges to form in cortical neurons by interfering with GABA signaling

Heat and Seizure

- 7.5% increased risk of seizure for every 1℃ increase in temperature.
- The risk was higher for poorly controlled epilepsy

Ismail et al., 2021

Seizure: Season-dependent Changes in Frequency



Neurology in a Changing Climate: A Scoping Review
Shreya Louis, Alise Carlson, Abhilash Suresh, Joshua Rim, MaryAnn Mays, Daniel Ontaneda, Andrew Dhawan
doi: https://doi.org/10.1101/2021.11.24.21266840

Stroke and Heat

- Elevated blood pressure
- Increased cholesterol levels
- Insulin resistance

Stroke: Effects of Heat

- Risk of stroke higher during heatwaves
- 7.0% increase in stroke hospitalizations with every 1℃ increase in temperature
- Highest for ischemic stroke

Madhavan, S., O'Donnell, M. J., Xavier, D., Diener, H. C., Rangarajan, S., & Yusuf, S. (2019). Association of stroke risk with temperature, humidity, and air pressure in low- and middle-income countries: a 13-country study of the INTERSTROKE cohort. The Lancet. Planetary health, 3(7), e318-e327

Wang, Y. C., Lin, Y. K., Lu, Y. C., Lin, C. S., Hsu, C. Y., & Cheng, T. J. (2017). Association between exposure to heat-related indices and hospitalization for stroke in Taiwan: a case-crossover study. BMJ open, 7(3), e014345

Alzheimer Disease

- Patients with AD often exhibit a higher core body temperature than healthy elderly control subjects
- Prolonged or excessive hyperthermia can damage CNS
- Sleep deprivation seen in AD is associated with a raised body temperature, which may cause cognitive impairment

nature/scientific report/Article number: 12273 (2022) ,Published: 18 July 2022

Dementia

One study from New England over 10 year showed

12% increased hazard of admission with mean increases of 1.5°C in the summer months

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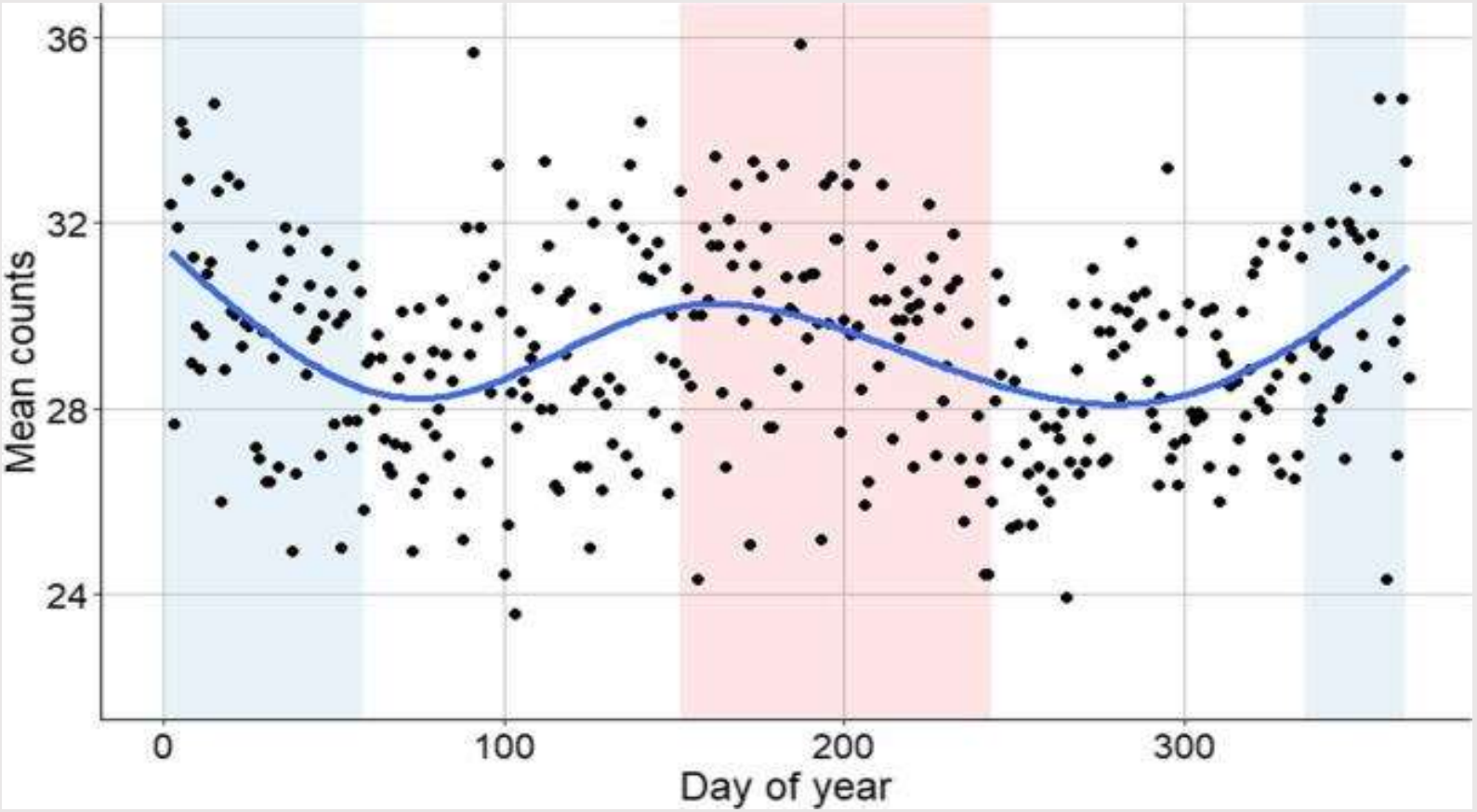
Dementia

Temperatures increases dementia-related hospital admissions by 4.5% per 1 °C rise in temperature above 17°C

Current and future burdens of heat-related dementia hospital admissions in England /Gong J, Part C, Hajat S/Environ Int. 2022 Jan 15



Gong J, Part C, Hajat S. Current and future burdens of heat-related dementia hospital admissions in England. Environ Int. 2022 Jan 15;159:107027. doi: 10.1016/j.envint.2021.107027. Epub 2021 Dec 7. PMID: 34890899; PMCID: PMC8739554

Multiple Sclerosis

8.81% increase in emergency department presentation with MS disease exacerbation per 1°C increase of temperature

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Headache

An increase in temperature by 5°C was associated with relative risk of headache presentation 1.042

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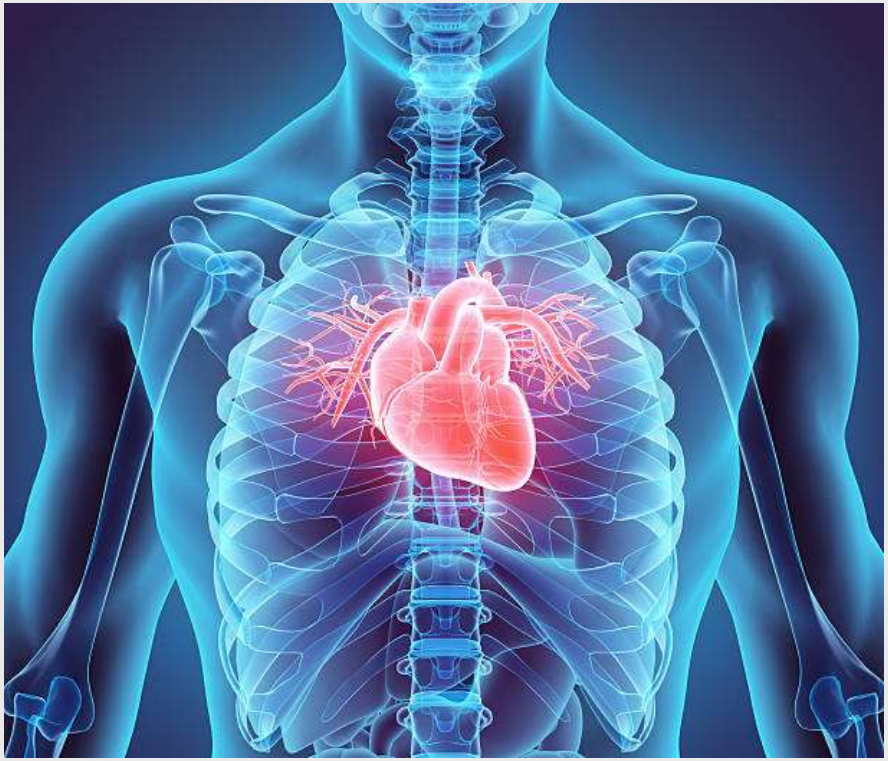
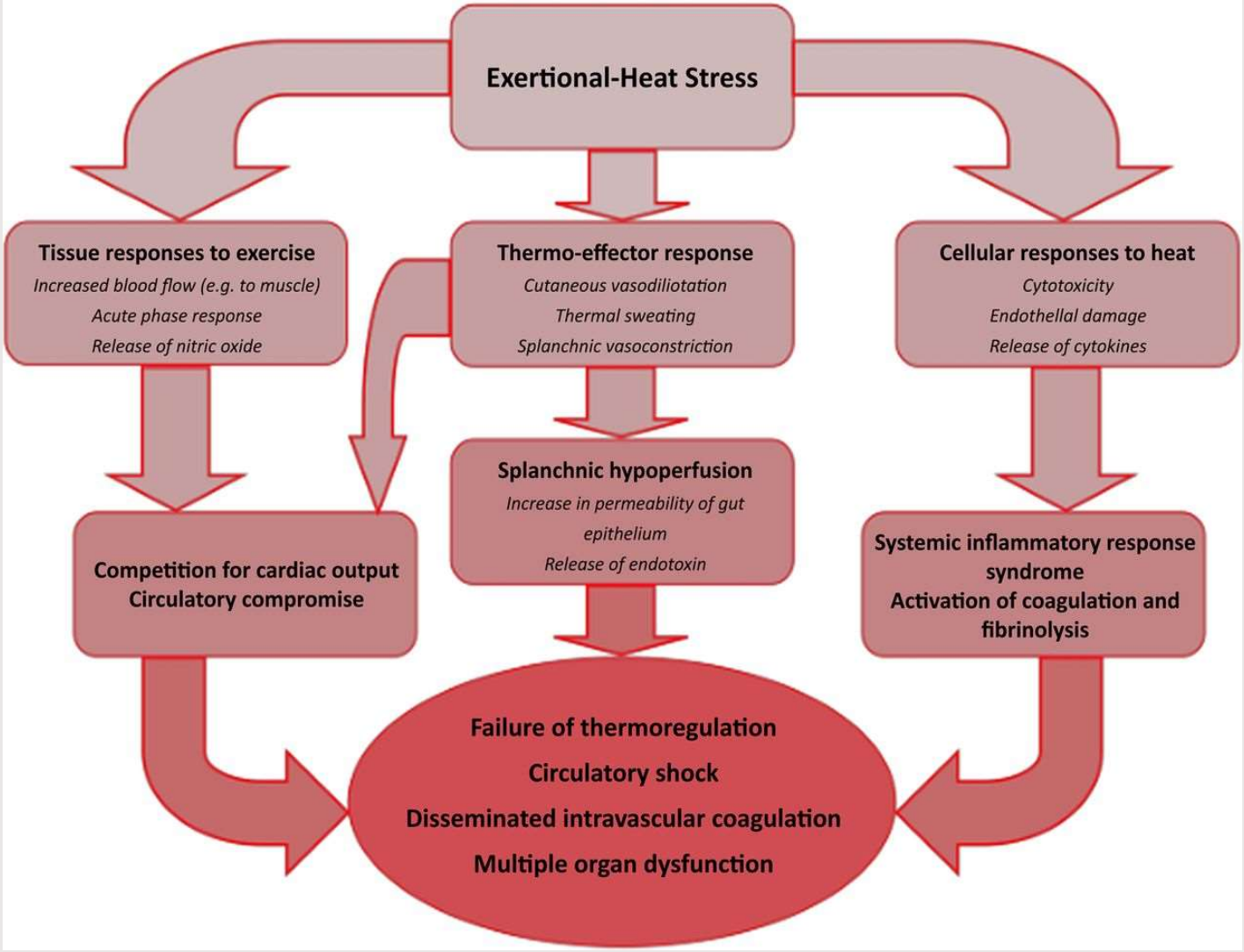
Cardiovascular Disease and Heat



Pathophysiology



Cardiovascular outcome

- From 7360, 282 articles reviewed systematically, and 266 were eligible for meta-analysis
- Substantial heterogenicity for both mortality and morbidity
- Results showed that a 1°C increase in temperature was positively associated with cardiovascular disease-related mortality

the lancet:June, 2022DOI:https://doi.org/10.1016/S2542-5196(22)00117-6

Circulation

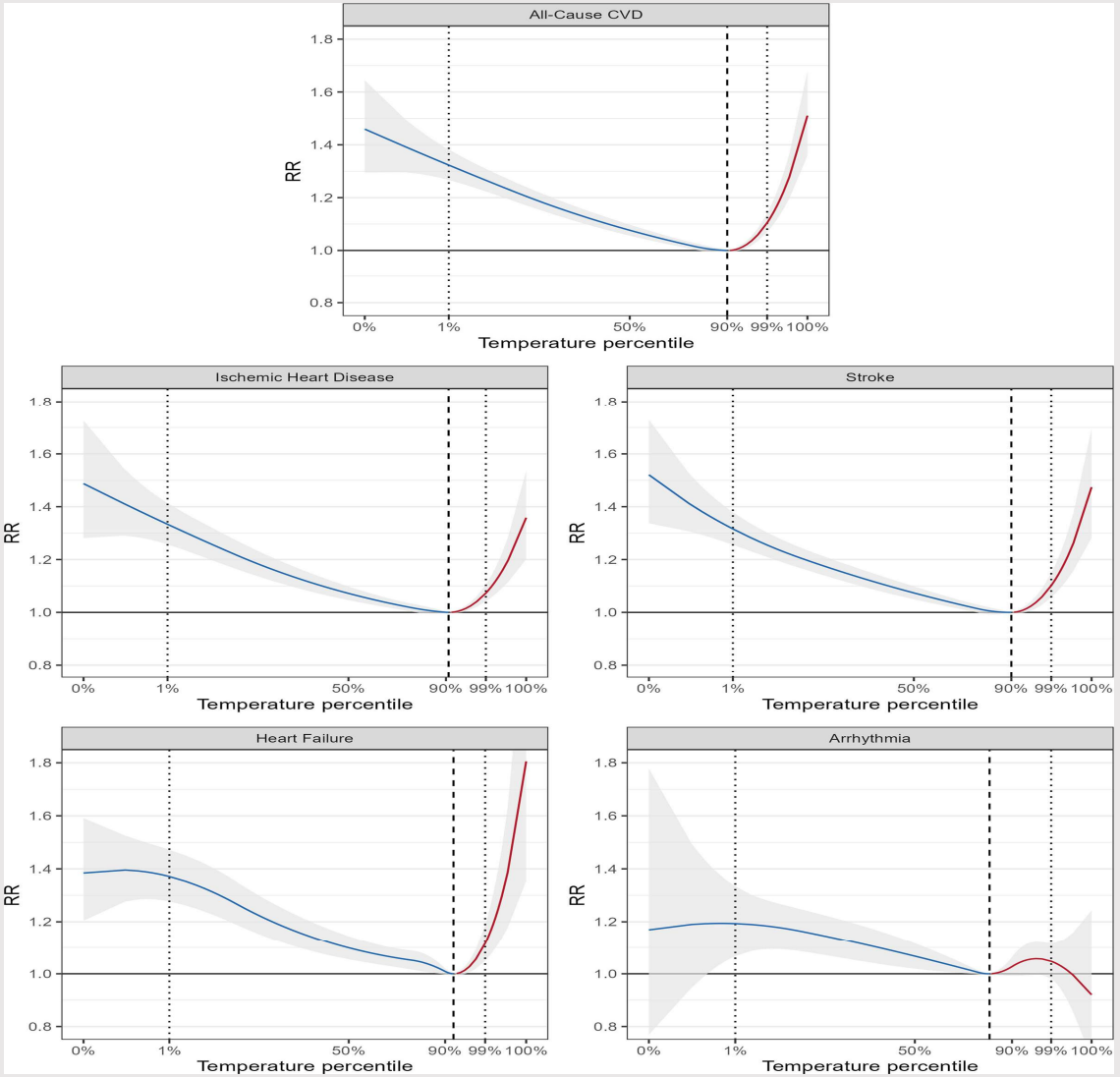
ORIGINAL RESEARCH ARTICLE

Associations Between Extreme Temperatures and Cardiovascular Cause-Specific Mortality: Results From 27 Countries

Barrak Alahmad, MD, MPH, PhD; Haitham Khraishah, MD; Dominic Royé, PhD; Ana Maria Vicedo-Cabrera, PhD; Yuming Guo, PhD; Stefania I. Papatheodorou, MD; Souzana Achilleos, ScD; Fiorella Acquaotta, PhD; Ben Armstrong, PhD; Michelle L. Bell, PhD; Shih-Chun Pan, PhD; Micheline de Sousa Zanotti Stagliorio Coelho, PhD; Valentina Colistro, PhD; Tran Ngoc Dang, PhD; Do Van Dung, PhD; Francesca K. De' Donato, PhD; Alireza Entezari, PhD; Yue-Liang Leon Guo, PhD; Masahiro Hashizume, PhD; Yasushi Honda, PhD; Ene Indermitte, PhD; Carmen Íñiguez, PhD; Jouni J.K. Jaakkola, PhD; Ho Kim, PhD; Eric Lavigne, PhD; Whanhee Lee, PhD; Shanshan Li, PhD; Joana Madureira, PhD; Fatemeh Mayvaneh, PhD; Hans Orru, PhD; Ala Overcenco, PhD; Martina S. Ragettli, PhD; Niilo R.I. Ryti, PhD; Paulo Hilario Nascimento Saldiva, PhD; Noah Scovronick, PhD; Xerxes Seposo, PhD; Francesco Sera, PhD; Susana Pereira Silva, MSc; Massimo Stafoggia, PhD; Aurelio Tobias, PhD; Eric Garshick MD; Aaron S. Bernstein, MD; Antonella Zanobetti, PhD; Joel Schwartz, PhD; Antonio Gasparrini, PhD; Petros Koutrakis, PhD

- ***Circulation.2023;147:35–46DOI:10.1161/CIRCULATIONAHA.122.0618***

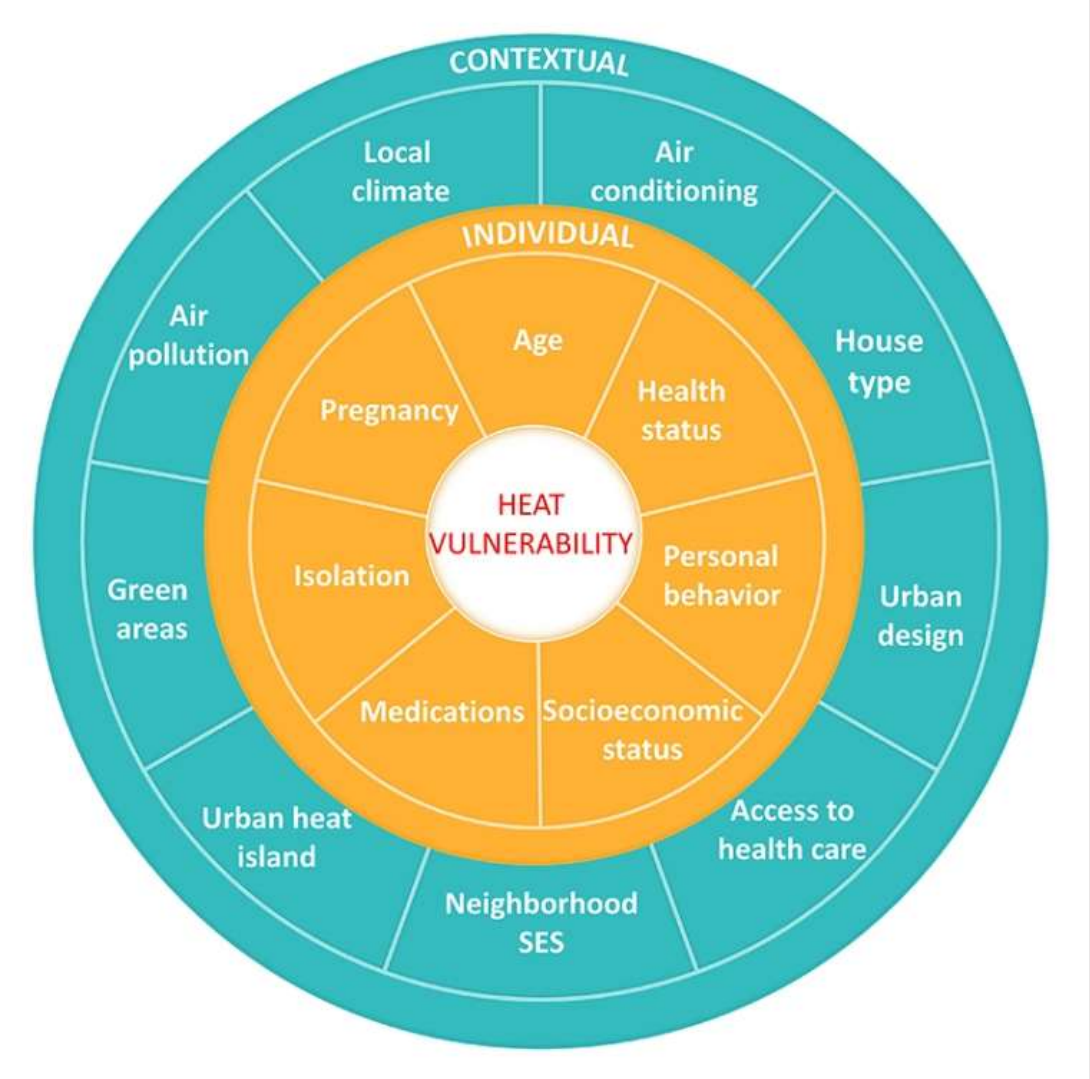
Pooled exposure–response relationships. Relationships are described as temperature percentiles and relative risk (RR) of different cardiovascular causes of death: Dashed line indicates the minimum mortality temperature. Dotted line indicates the 1st percentile (extreme cold) and the 99th percentile (extreme heat). X-axis was transformed from absolute temperatures (°C) to percentiles to enable a comparative application of the association. CVD indicates cardiovascular disease.



Vulnerability to adverse heat effects

- Older age (age >65 years)
  - comorbidities
  - use of medications
  - a decline in thermoregulatory function
- People with underlying medical conditions (CVD, lung diseases, diabetes, neurodegenerative diseases and mental health issues)
- Pregnant women

Individual and contextual factors influencing vulnerability to heat



Future Projection of Temperature-related Cardiovascular Impact

Study in Beijing projects 10.2% increases in mortality due to temperature-related CVD until 2070

Study in Augsburg, Germany, concluded that 18% and 63% increase of temperature-related MI cases per decade with a warming of 2°C and 3°C, respectively

Mental Health and Heat

Medical and Physical Health
- Changes in fitness and activity level
- Heat-related illness
- Allergies
- Increased exposure to waterborne and vector-borne illness

Mental Health
- Stress, anxiety, depression, grief, sense of loss
- Strains on social relationships
- Substance abuse
- Post-traumatic stress disorder

Community Health
- Increased interpersonal aggression
- Increased violence and crime
- Increased social instability
- Decreased community cohesion

Heat and Mental Health in Cities

Nasrin Aghamohammadi, Chng Saun Fong, Nik Daliana Nik Farid, Logaraj Ramakreshnan & Parshad Agha Mohammadi

Chapter | First Online: 06 October 2022

- Fifteen studies showed an increased suicide risk with heat ($P < 0.05$)
- Increased risks of mental health-related emergency department visits and admissions at higher temperatures

SpringerLink/Urban Overheating: Heat Mitigation and the Impact on Health

JAMA Psychiatry | Original Investigation

Association Between Ambient Heat and Risk of Emergency Department Visits for Mental Health Among US Adults, 2010 to 2019

Amruta Nori-Sarma, PhD, MPH; Shengzhi Sun, PhD; Yuantong Sun, MSc; Keith R. Spangler, PhD, ScM; Rachel Oblath, PhD; Sandro Galea, MD, DrPH; Jaimie L. Gradus, DMSc, DSc, MPH; Gregory A. Wellenius, ScD

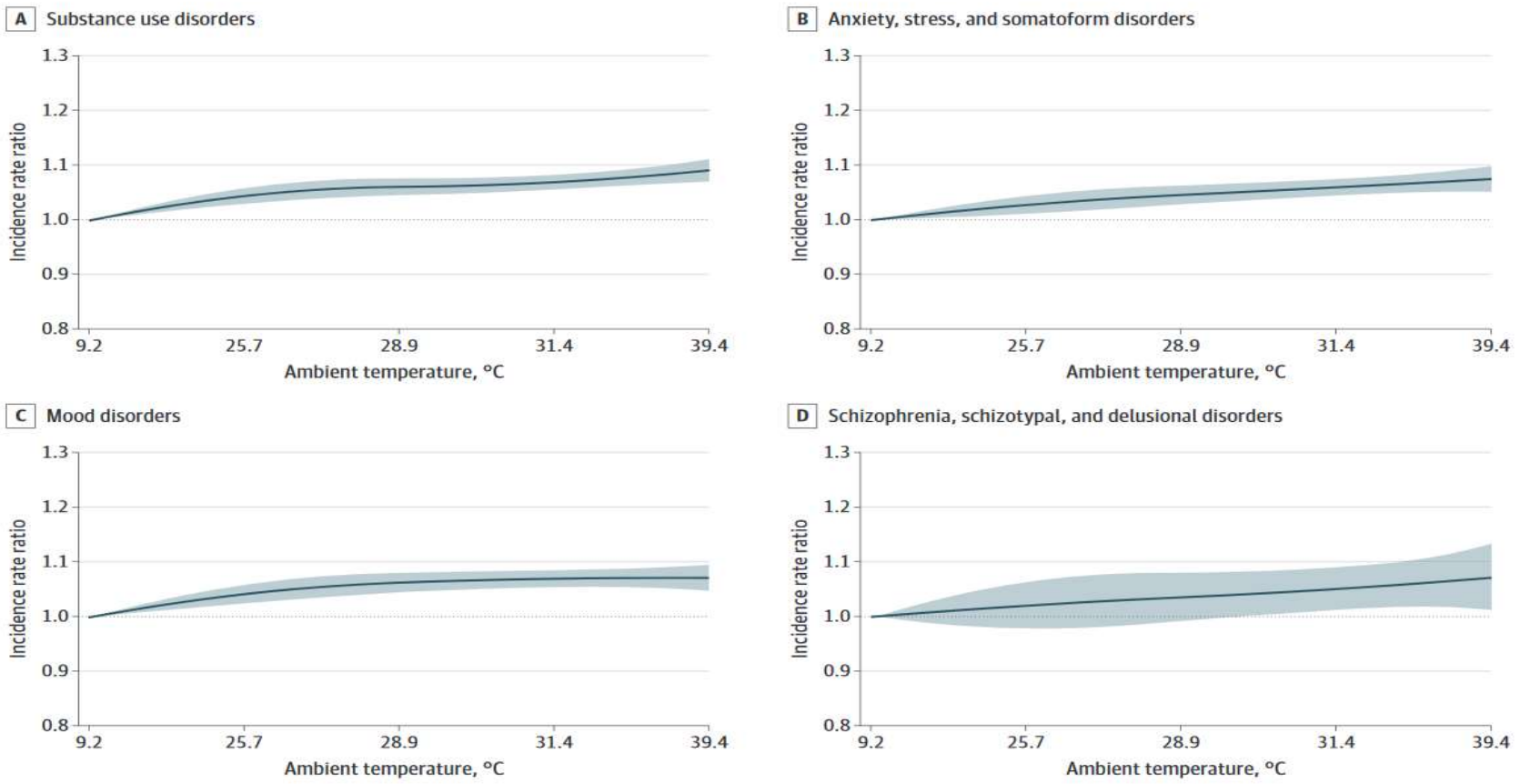
- Increased risk of ED visits at higher warm-season temperatures
  - any mental health condition
  - specific mental health conditions

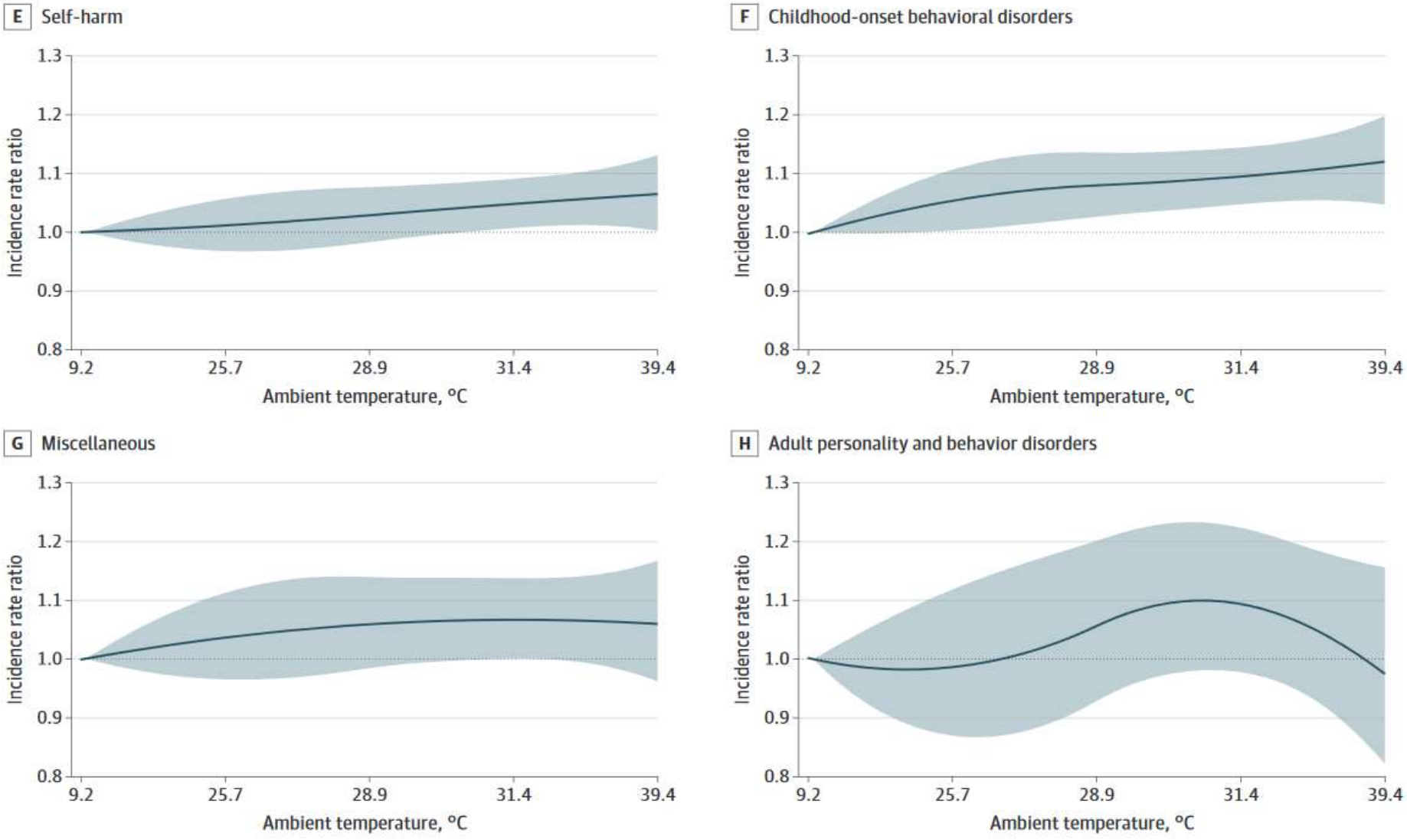
JAMA Psychiatry. 2022;79(4):341-349. doi:10.1001/jamapsychiatry.2021.4369

Days of extreme heat associated with higher rates of ED visits -

- Substance use disorders (IRR 1.08)
- Anxiety, stress-related, somatoform disorders (IRR 1.07)
- Mood disorders (IRR 1.07)
- Schizophrenia, schizotypal, and delusional disorders (IRR 1.05)
- Self-harm (IRR 1.06)
- Childhood-onset behavioural disorders (IRR 1.11)

Figure 3. Cumulative Exposure-Response Curve of the Association Between Warm-Season Temperatures and Emergency Department Visits for Specific Mental Health Conditions




E Self-harm
F Childhood-onset behavioral disorders
G Miscellaneous
H Adult personality and behavior disorders
Incidence rate ratio
1.3
1.2
1.1
1.0
0.9
0.8
9.2
25.7
28.9
31.4
39.4
Ambient temperature, °C

Also in Bangladesh…

Increase in mean temperature of 1°C :

Increased anxiety (p=0·046)

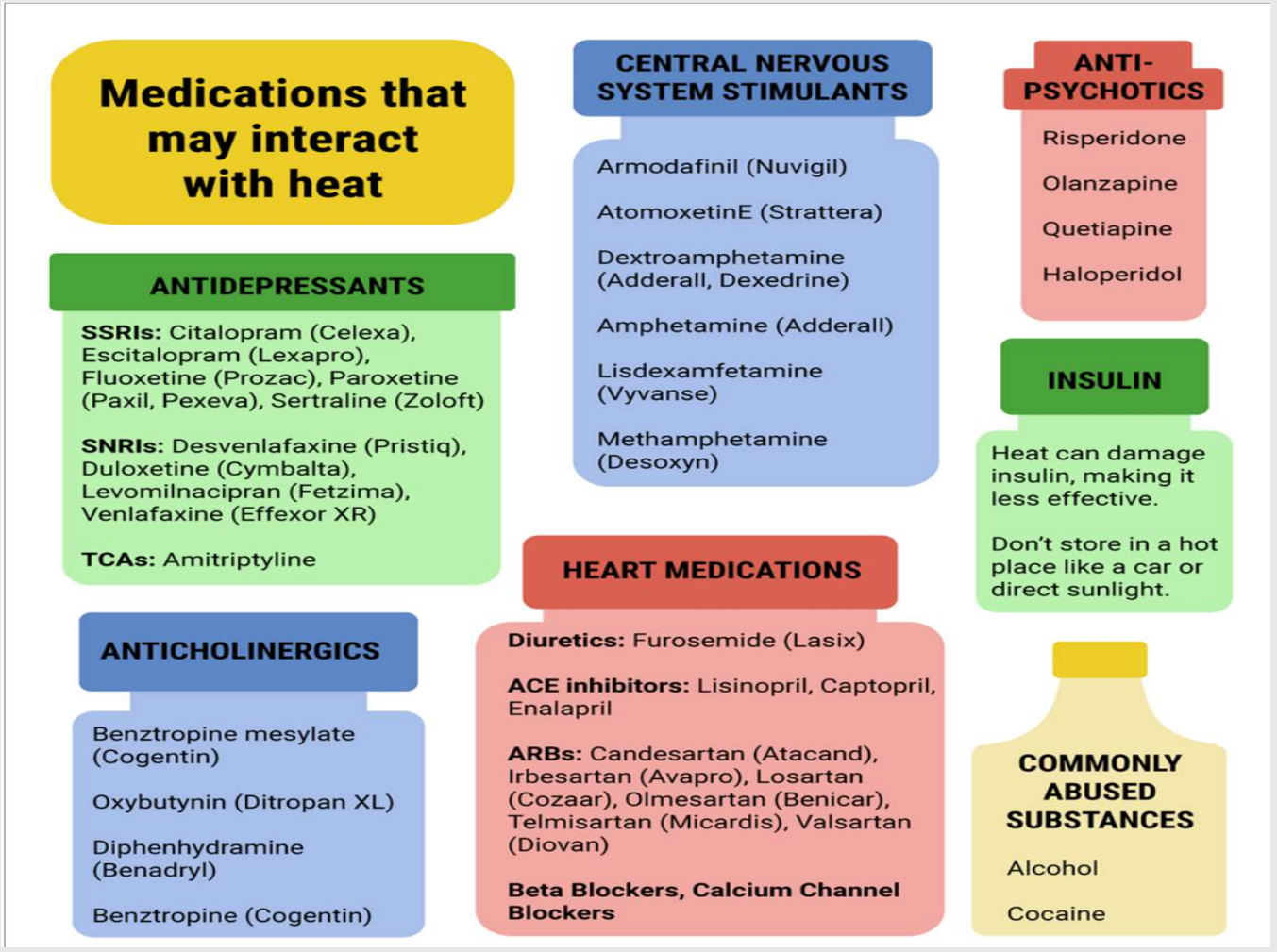
Increased co-occurring depression and anxiety (p=0·045),

Increased temperature was not associated with depression (p=0·15)

Lancet Planet Health 2023;:February,2023DOI:https://doi.org/10.1016/S2542-5196(22)00315-1

Heat-Drug interaction

- Heat can affect pharmacokinetic and pharmacodynamic activities
- Some drugs can interfere with normal thermoregulatory mechanisms, like
  - cardiac output
  - sweat rate
  - peripheral vasodilation
  - dehydration


Medications that may interact with heat
ANTIDEPRESSANTS
SSRIs: Citalopram (Celexa), Escitalopram (Lexapro), Fluoxetine (Prozac), Paroxetine (Paxil, Pexeva), Sertraline (Zoloft)
SNRIs: Desvenlafaxine (Pristiq), Duloxetine (Cymbalta), Levomilnacipran (Fetzima), Venlafaxine (Effexor XR)
TCAs: Amitriptyline
ANTICHOLINERGICS
Benztropine mesylate (Cogentin)
Oxybutynin (Ditropan XL)
Diphenhydramine (Benadryl)
Benztropine (Cogentin)
CENTRAL NERVOUS SYSTEM STIMULANTS
Armodafinil (Nuvigil)
AtomoxetinE (Strattera)
Dextroamphetamine (Adderall, Dexedrine)
Amphetamine (Adderall)
Lisdexamfetamine (Vyvanse)
Methamphetamine (Desoxyn)
HEART MEDICATIONS
Diuretics: Furosemide (Lasix)
ACE inhibitors: Lisinopril, Captopril, Enalapril
ARBs: Candesartan (Atacand), Irbesartan (Avapro), Losartan (Cozaar), Olmesartan (Benicar), Telmisartan (Micardis), Valsartan (Diovan)
Beta Blockers, Calcium Channel Blockers
ANTI-PSYCHOTICS
Risperidone
Olanzapine
Quetiapine
Haloperidol
INSULIN
Heat can damage insulin, making it less effective.
Don't store in a hot place like a car or direct sunlight.
COMMONLY ABUSED SUBSTANCES
Alcohol
Cocaine

BEAT THE HEAT

DRESS LIGHT

Wear loose-fitting clothing

STAY COOL

Stay somewhere with air-conditioning

LEARN

Stay informed and learn how to prevent, recognize and treat heat-related illnesses

EAT LIGHT

Avoid hot foods and heavy meals

STAY SAFE

Never leave infants, pets or children in parked cars

USE SUNSCREEN

Use sunscreen with SPF 15+ when going outside

STAY HYDRATED

Stay hydrated but avoid alcohol and liquids with large amounts of sugar

COOL DOWN

Take a cool shower or bath

Oregon Health Authority

Beat the Heat

- A ventilated hat/ mathal with a brim of at least 7.5 cm or an umbrella is the best option to protect the face

Preventing Heat-Related Illnesses

- Reduce strenuous activity
- Plan physical activities for cooler parts of the day
- Heat acclimatization is best achieved by exercising for 60 to 90 minutes in the heat, each day, for 9 to 14 days

We want

Let our hands put together to beat the heat

Thank You