Effect of heat on maternal, newborn and child health (MNCH): from research to interventions

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29/04/2026

Thanks to Mian Bao, Darshnika Lakhoo, Nic Brink, Lebo Radebe, Margaret Brennan, Matthew Chersich

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Green > Climate

More than 62,000 people died in Europe's 2024 heatwave: Which country was hit the hardest?

India's Deadly Heatwave Melting Roads

The death toll from 113-degree heatwave in India surpasses 1,100.

By SUSANNA KIM
May 27, 2015, 10:08 PM

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Spain flood death toll expected to rise as dozens missing

30 October 2024

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Frances Mao BBC News and Bethany Bell BBC News, Valencia

Air pollution from fossil fuels 'kills 5 million people a year'

Of more than 8 million deaths worldwide from outdoor air pollution, 61% linked to fossil fuels, finds study

VOA

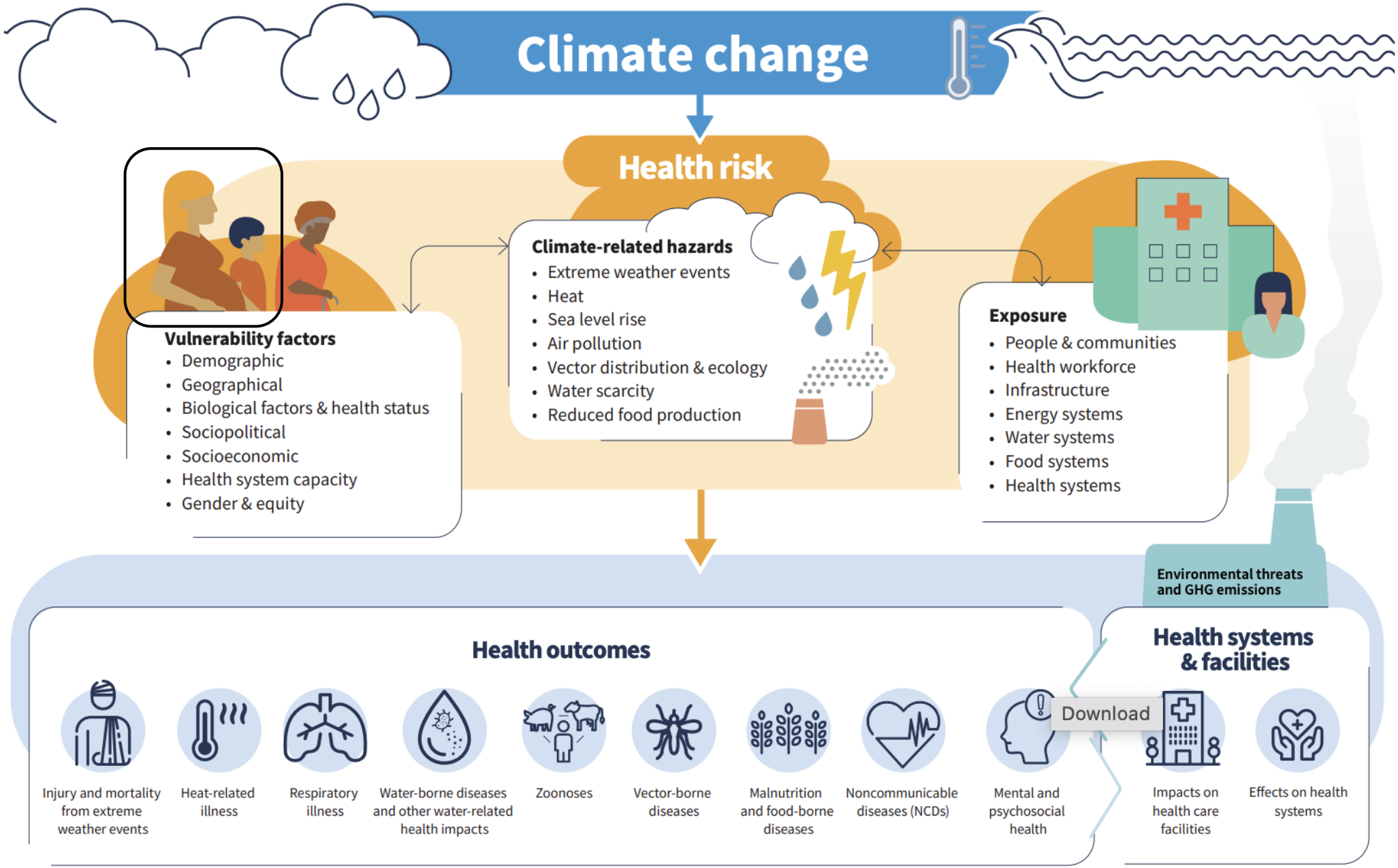
Drought led to 71,000 'excess deaths' in Somalia, report shows

Annual Death Toll from US Wildfire Smoke Could Climb to 70,000 by 2050, New Study Says

Reporter
M. Faiz Zaki

October 7, 2025 | 02:58 pm

TEMPO.CO, Jakarta - A recent study from the Stanford Doerr School of Sustainability


Climate change
Health risk
Vulnerability factors
• Demographic
• Geographical
• Biological factors & health status
• Sociopolitical
• Socioeconomic
• Health system capacity
• Gender & equity
Climate-related hazards
• Extreme weather events
• Heat
• Sea level rise
• Air pollution
• Vector distribution & ecology
• Water scarcity
• Reduced food production
Exposure
• People & communities
• Health workforce
• Infrastructure
• Energy systems
• Water systems
• Food systems
• Health systems
Environmental threats and GHG emissions
Health outcomes
Injury and mortality from extreme weather events
Heat-related illness
Respiratory illness
Water-borne diseases and other water-related health impacts
Zoonoses
Vector-borne diseases
Malnutrition and food-borne diseases
Noncommunicable diseases (NCDs)
Mental and psychosocial health
Health systems & facilities
Impacts on health care facilities
Effects on health systems
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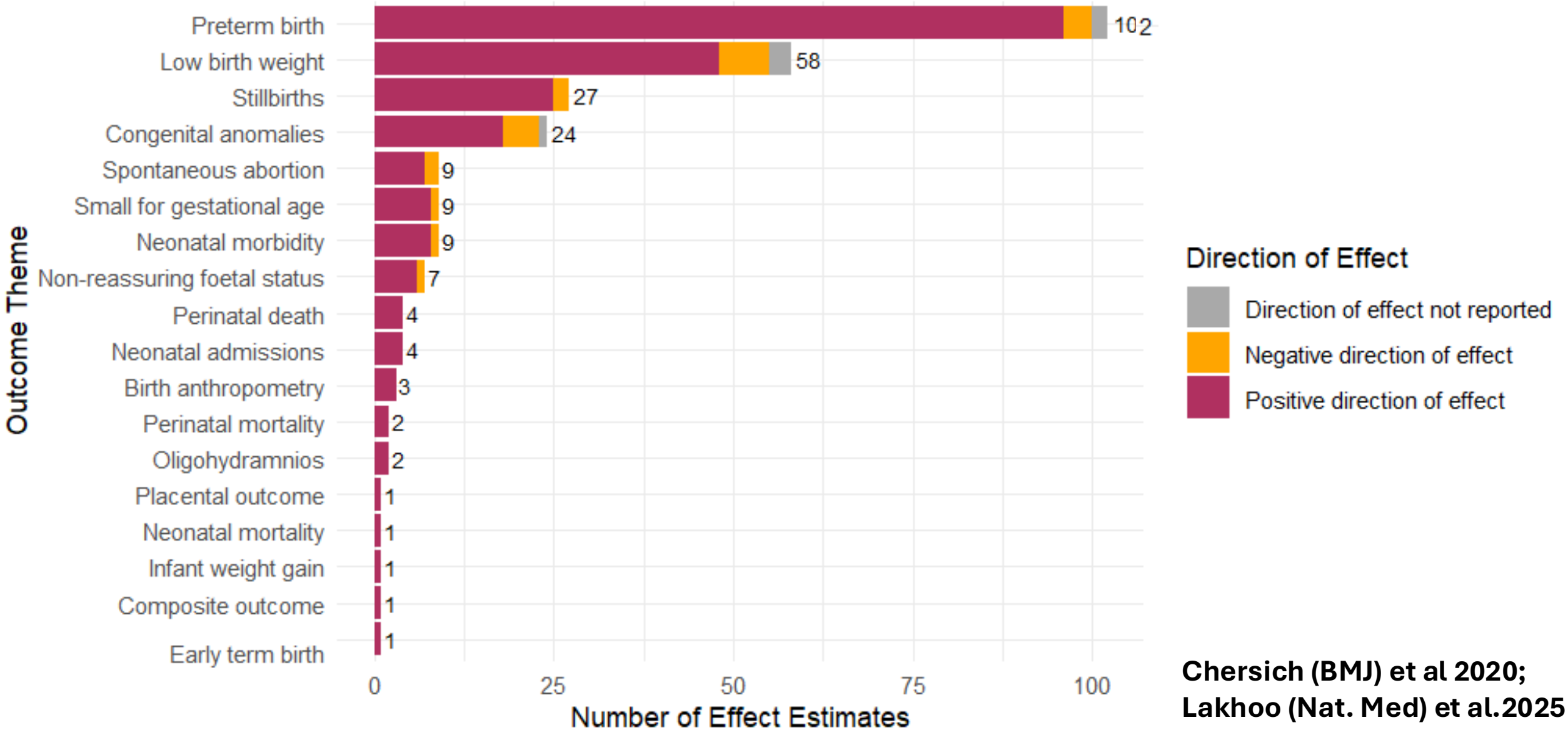
Source: WHO

Newborn health outcomes (n=197 measures)

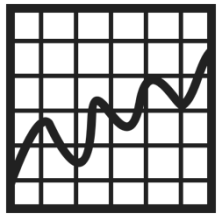


Chersich (BMJ) et al 2020; Lakhoo (Nat. Med) et al.2025

Needs for new epidemiological studies

1. High Quality Health Data

2. Heat Exposure Data

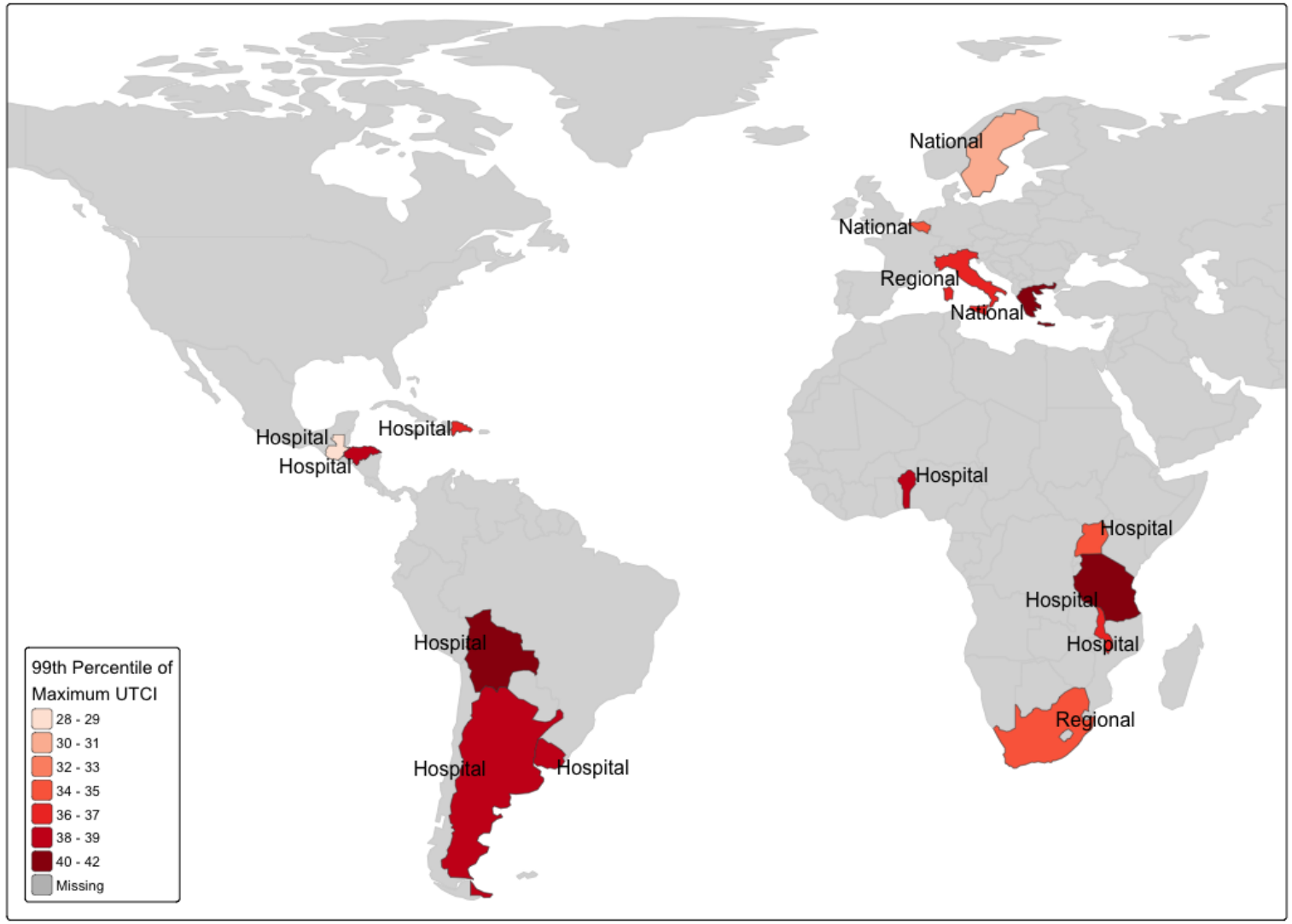


3. Standardised Statistical Analyses

Short-Term Heat Impacts in 15 Countries in Africa, Europe and Latin America and the Caribbean

Lead by: Lebohang Radebe, Wits Planetary Health Research, South Africa

Methods



We included **5 million singleton births** across 15 countries.

Outcomes:

- Preterm birth
- Stillbirth
- Low Apgar Score

Standardised Statistical Analyses

<u>Step 1:</u> Country-specific associations

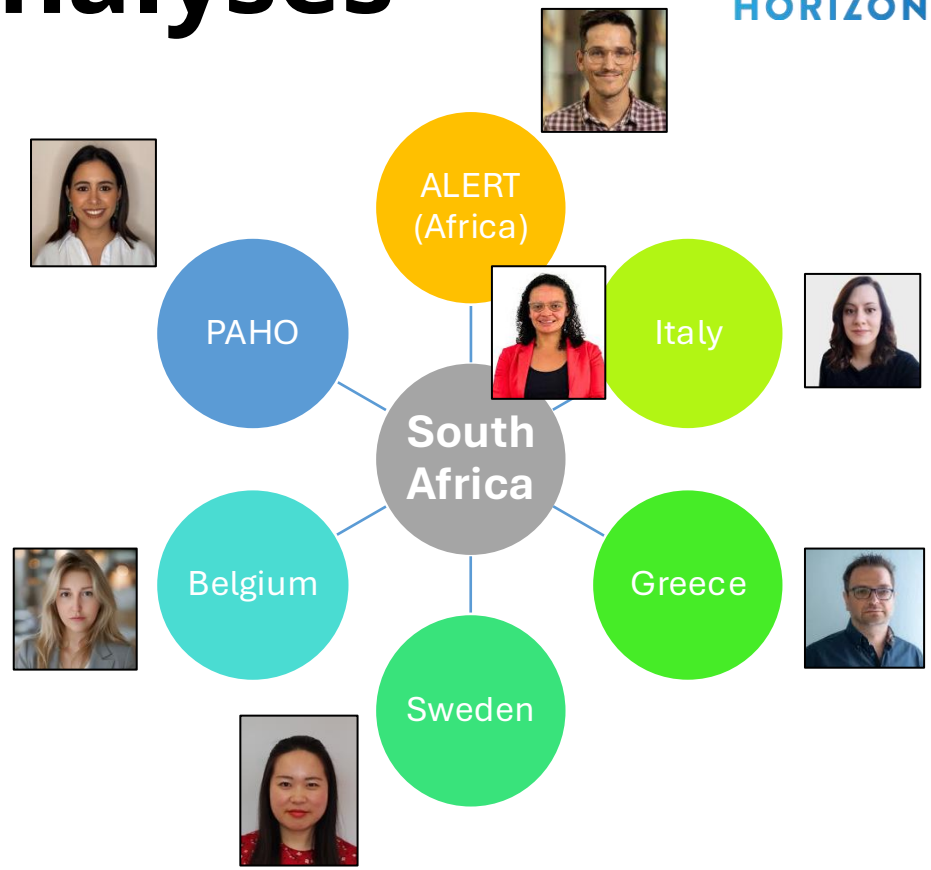
a) Study Design: Case-crossover

b) Heat Exposure: Distributed lag non-linear models (DLNM)- using UTCI as main exposure

c) Model: Conditional Logistic Regression

d) Comparison of risk: 75th vs the 99th

<u>Step 2:</u> Meta-analysis Estimates



Trimester-specific exposure to multiple heat indicators and adverse birth outcomes across four European countries

Lead by Mian Bao, Karolinska Institutet, Sweden

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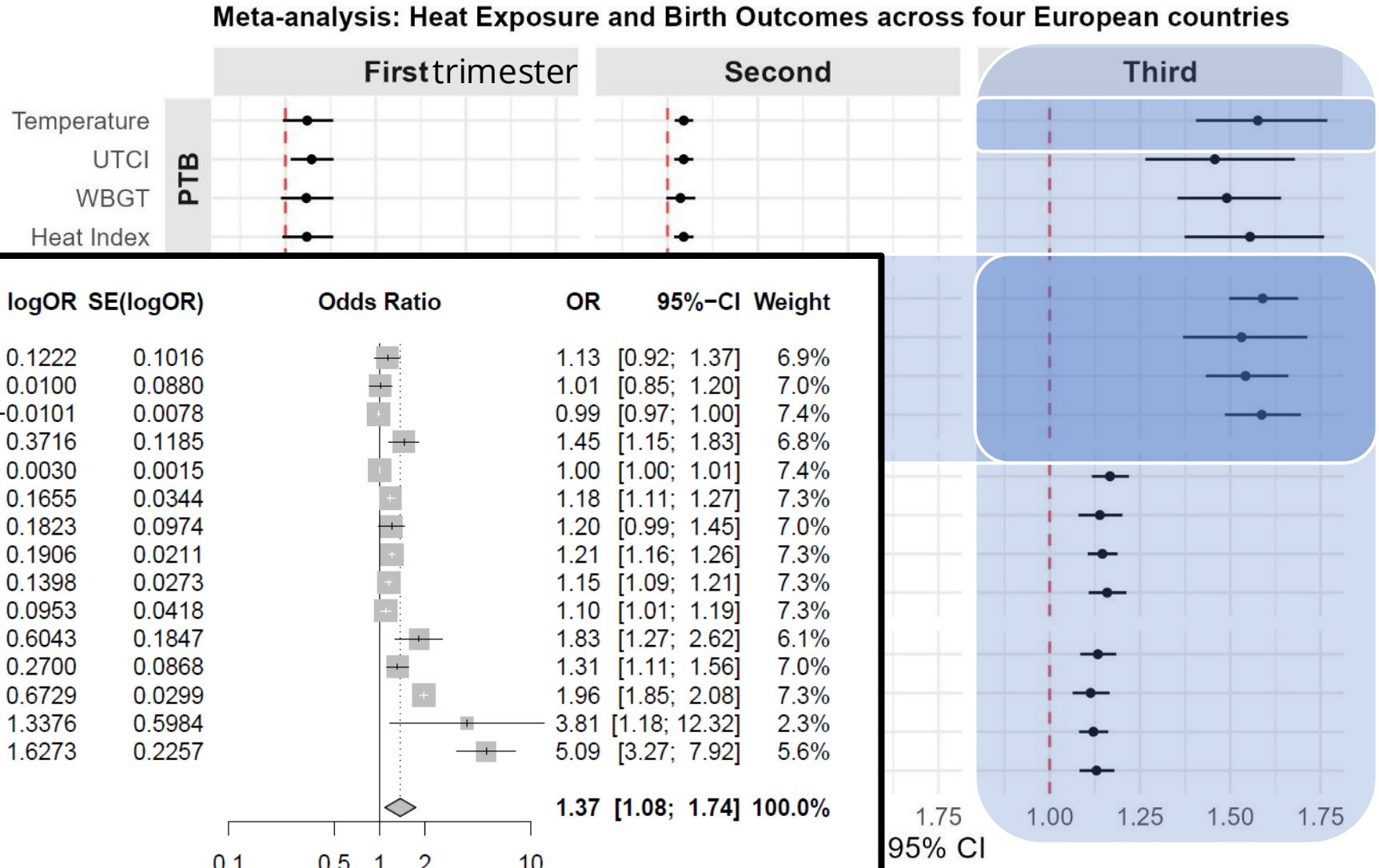
Trimester-specific exposure to multiple heat indicators and adverse birth outcomes across four European countries

Mian Bao [a,*], Federica Nobile [b,c], Michalis Koureas [d], Isabella Bottini [b,e], Elizaveta Fomenko [f], Chloe Brimicombe [g,h], Veronika Tirado [i], Varvara Mouchtouri [d], Christos Hadjichristodoulou [d], Petter Ljungman [c,j], Matthew Chersich [k], Debra Jackson [l,m], Stanley Luchters [n,o,p], Olof Stephansson [a,q], Massimo Stafoggia [b,c,1], Jeroen de Bont [c,1], for the HIGH Horizons Study Group

Heat and birth outcomes

Preterm birth



Study	logOR	SE(logOR)	Odds Ratio	OR	95%−CI	Weight
Wolf (2012) Saxony	0.1222	0.1016		1.13	[0.92; 1.37]	6.9%
Wolf (2012) Brandenburg	0.0100	0.0880		1.01	[0.85; 1.20]	7.0%
Liang (2016)	−0.0101	0.0078		0.99	[0.97; 1.00]	7.4%
He (2016)	0.3716	0.1185		1.45	[1.15; 1.83]	6.8%
Andalon (2016)	0.0030	0.0015		1.00	[1.00; 1.01]	7.4%
Ha (2017)	0.1655	0.0344		1.18	[1.11; 1.27]	7.3%
Giorgis−Allemand (2017)	0.1823	0.0974		1.20	[0.99; 1.45]	7.0%
Li (2018)	0.1906	0.0211		1.21	[1.16; 1.26]	7.3%
Guo (2018)	0.1398	0.0273		1.15	[1.09; 1.21]	7.3%
Son (2019)	0.0953	0.0418		1.10	[1.01; 1.19]	7.3%
Liu (2020)	0.6043	0.1847		1.83	[1.27; 2.62]	6.1%
Spolter (2020)	0.2700	0.0868		1.31	[1.11; 1.56]	7.0%
Wang (2020)	0.6729	0.0299		1.96	[1.85; 2.08]	7.3%
Hough (2022)	1.3376	0.5984		3.81	[1.18; 12.32]	2.3%
Wang (2023)	1.6273	0.2257		5.09	[3.27; 7.92]	5.6%
Random effects model (HK)				**1.37**	**[1.08; 1.74]**	**100.0%**

0.1 0.5 1 2 10

Heterogeneity: I^2 = 98.1%, τ^2 = 0.1647, p < 0.0001

Actions within MNCH programmes

Thanks to Anayda Portelas, scientist at WHO

Alexandra Czerniewska, Chloe Brimicombe, Alejandro Saez Reale, Joy Shumake-Guillemot, Alyssa Sharkey, Anayda Portela

How is maternal, newborn, and child health addressed in Heat Health Action Plans? A scoping review and content analysis

J Glob Health 2025;15:04157 Download PDF

Joe Strong, Rachael Barrett, Ziyaad Surtee, Maggie O'Hare, Francesca Conway, Anayda Portela

Interventions to reduce the effects of air pollution and of extreme heat on maternal, newborn, and child health outcomes: a mapping of the literature

J Glob Health 2025;15:04035 Download PDF

Building an evidence base

How is maternal, newborn, and child health addressed in Heat Health Action Plans? A scoping review and content analysis

https://jogh.org/wp-content/uploads/2025/06/jogh-15-04157.pdf

Key findings

Countries and WHO regions with HHAPs:

- We identified 83 plans from 24 countries (Table 2).
- The South-East Asian region contributed the most HHAPs overall (37 plans from three countries; 45%)
- The largest number of countries with HHAPs were found in the European Region (26 plans from 14 countries; 31%).
- Almost all of the plans were from countries classified as either high-income (n =41; 49%) or lower-middle income economies (n=39; 47%)

Table 2. Description of eligible HHAPs, by WHO region, World Bank income group classification [42], administrative level, publication year, and original language (n=83)

	HHAPs included, n (%)
Countries by WHO region	
African Region	1 (1)
South Africa (1N)	1 (1)
Americas Region	11 (13)
Argentina (1S)	1 (1)
Canada (1R, 4S)	5 (6)
USA (3R, 2S)	5 (6)
Eastern Mediterranean Region	2 (2)
Pakistan (1R, 1S)	2 (2)
European Region	26 (31)
Austria (1N, 3R, 1S)	5 (6)
Belgium (1R)	1 (1)
France (1N)	1 (1)
Germany (1N)	1 (1)
Italy (1N)	1 (1)
Lithuania (1S)	1 (1)
Luxembourg (1N)	1 (1)
Netherlands (2N)	2 (2)
North Macedonia (1N)	1 (1)
Portugal (1N)	1 (1)
Spain (1N, 3R, 1S)	5 (6)
Sweden (1N, 2S)	3 (4)
Switzerland (1N, 1R)	2 (2)
UK (1N)	1 (1)
South-East Asian Region	37 (45)
Bangladesh (1N)	1 (1)
India (1N, 14R, 20S)	35 (42)
Nepal (1N)	1 (1)
Western Pacific Region	6 (7)
Australia (5R)	5 (6)
New Zealand (1N)	1 (1)
Country income level by World Bank classification	
Low	0 (0)
Lower-middle	39 (47)
Upper-middle	3 (4)
High	41 (49)
Administrative level	
National	18 (22)
Regional	32 (39)
Subregional	33 (40)

HHAP – heat health action plan, N – national plan, R– regional plan, S – subregional plan, WHO – World Health Organization

Key findings

Activities targeted to MNC populations (Table 3):

- Most HHAPs (n=69; 83%) included at least one activity specified for at least one MNC population group.
- However, 14 (17%) HHAPs included no activities specified for MNC populations, despite all identifying one or more MNC population groups as high-risk.
- The most identified activity category for all population groups was '**informing, education and awareness raising**' (n = 64; 77%), followed by 'improving care in health service or schools' settings' (n=49; 59%).

Table 3. Assessment of risk, activities, and monitoring, by population group (n=83)*

	Newborns and infants	Children	Pregnant	Postpartum and/or breast-feeding	At least one MNC population
MNC populations identified at risk					
HHAP stated MNCH as a higher-risk population	32 (39)	69 (83)	43 (52)	12 (14)	70 (84)
Categories of activities targeted to MNC populations					
Informing, educating, and awareness raising	15 (18)	64 (77)	21 (25)	14 (17)	64 (77)
Providing direct material or financial assistance	0 (0)	15 (18)	3 (4)	1 (1)	15 (18)
Improving care in health services or school settings	11 (13)	47 (57)	12 (14)	5 (6)	49 (59)
Improving infrastructure in health services, community, or school settings	1 (1)	14 (17)	1 (1)	0 (0)	14 (17)
Improving working conditions for those who are pregnant/postpartum			16 (19)	0 (0)	16 (19)
Measurement and monitoring for MNC populations					
Outcome indicator	0 (0)	4 (5)	0 (0)	0 (0)	4 (5)
Process/other indicator	0 (0)	7 (8)	2 (2)	0 (0)	7 (8)
Other planned data collection	0 (0)	14 (17)	2 (2)	0 (0)	14 (17)

HHAP – heat health action plan, MNC – maternal, newborn, child
*Presented as n (%).

MNCH-relevant points across WHO/Europe HHAP guidance

GUIDANCE CHAPTER / CORE ELEMENT	MNCH-RELEVANT POINTS
Core element 1 — Governance	MNCH/vulnerable groups should be explicit in governance and accountability..
Core element 2 — Heat–health warning systems	Warnings should reach vulnerable groups via multiple channels and tailored messaging. Link warnings to action-oriented communications for pregnant women, parents/caregivers and adolescents.
Core element 3 — Vulnerable populations	Pregnant women and children are identified as higher-risk groups. Heat is linked to adverse pregnancy outcomes (e.g., preterm birth/low birth weight); map where groups/services are located (e.g., childcare/schools).
Core element 4 — Communication	Risk communication should be tailored, equity-aware and use trusted intermediaries. Monitor reach/engagement and whether messages translate into protective behaviours in households with children and in pregnancy.
Core element 5 — Health system resilience	Health services should identify/prioritize those at risk and adapt care pathways during alerts. Maternity/newborn discharge considerations (home temperature/support) and track longer-term outcomes for those born during extreme heat periods needs to be included.
Core element 6 — Reducing heat exposure	Cross-sector measures support cooling, hydration and safe environments. Education/childcare actions include indoor temperature monitoring, cool rooms, shade, water access and adapting schedules/activities.
Core element 7 — Surveillance	Surveillance should include morbidity and service-use signals, not only mortality. Track ED/ambulance/admissions/helpline calls and combine with spatial/socioeconomic data to identify inequities affecting families.
Core element 8 — Monitoring, evaluation and learning	MEL should be continuous with balanced structure–process–outcome indicators. Evaluate whether interventions reach vulnerable groups (including pregnant women/children) and whether impacts reduce over time.

Interventions to reduce the effects of air pollution and of extreme heat on maternal, newborn, and child health outcomes: a mapping of the literature

- A final inventory of 76 items were included; 61 items were evaluated.
- Interventions identified were primarily based in the Global North (n = 51), with the largest proportion in the USA (n = 17), while 32 items were based in the Global South.
- Fifty-seven items focused on air pollution, 18 on extreme heat, and one on both.
- Interventions were categorised in four adapted socioecological components:
  i. ***individual and household interventions (n = 30)***
  ii. ***community and service interventions (n = 18)***
  iii. ***structural interventions and urban landscape interventions (n = 15)***
  iv. ***policy interventions (n = 16).***
- Most items were focused on child health outcomes (n = 65).

Overall conclusions

- 🌞 Heat exposure has significant impacts on birth outcomes, particularly increasing the risks of preterm birth and stillbirth, with disproportionately stronger effects in LMICs
- 🔎 There is a critical gap in research on broader child health outcomes.
- 🌍 HHAP remain limited globally, with insufficient integration of MNCH measures.
- 📒 Effective interventions are often context-specific, highlighting the urgent need for targeted research to inform locally appropriate and scalable solutions.

Effect of heat on maternal, newborn and child health: results from the HIGH Horizon project

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02/04/2026

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