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Health effects of extreme heat and heat waves: a scoping review protocol

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Corresponding author:
Marta Roqué

mroque@santpau.cat

Author Affiliation:
Sant Pau Research Institute (IR-Sant Pau).

Solà, I; Vicuña, L; Tobías, A; Marí-Dell'Olmo, M; Bracchiglione, J; Roqué, M.

ADMINISTRATIVE INFORMATION

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Review Stage at time of this submission - Piloting of the study selection process.

Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 20 January 2026 and was last updated on 20 January 2026.

INTRODUCTION

Review question / Objective Question: What are the characteristics of systematic reviews addressing the health effects (association and impact) of extreme heat and heat waves?
Main objective: to synthesise the characteristics of systematic review studies on the health effects of extreme heat and heat waves on health.

The specific aims for this review are:
i) Summarize the terminology and definitions used of extreme heat and heat waves.
ii) Describe the methodological guidelines employed in the field of reviews evaluating the association between health outcomes and extreme heat and heat waves.
iii) Identify the health outcomes impacted by extreme heat and heat waves.
iv) Identify social inequalities and vulnerable populations whose health is affected by extreme heat and heat waves.
v) Identify research gaps to guide futures studies on the health outcomes of extreme heat and heat waves.

Rationale Extreme heat and heat waves are among the most relevant and measurable climate-sensitive environmental exposures (CSEEs), serving as key indicators for assessing the health effects of climate change(4). Extreme heat is commonly defined as unusually high temperature values that exceed typical thresholds for a given area(5), whereas heat waves refer to periods during which excess heat accumulates over consecutive days and nights of anomalously high temperatures(6). Despite these general definitions,, criteria for identifying heat waves vary substantially across institutions, regions, methodological frameworks, and scientific traditions (7).

The health effects of extreme heat have been widely documented in epidemiological and evidence-based research. Numerous studies report marked increases in mortality and morbidity from cardiovascular, respiratory, cerebrovascular, mental health, and maternal–child health outcomes, among others(8–12). Globally in 2023 each person was exposed on average to 13.8 heatwave days, almost twice the 1986–2005 baseline(4), and an estimated 489,000 deaths were attributable to heat exposure during 2000–2019(6). In Europe, around 1,672 deaths were reported during the summer of 2022 and 47,690 in 2023, representing the highest heat-related mortality burden since 2015(13,14). Moreover, projections suggest an excess death rate of 36.7, and 84.3 per 10,000 person-years for 2020-0254 and 84.3 for 2095-2099 in Europe under turure warming scenarios(16). Populations living in lower socioeconomic conditions face a heightened risk of heat-related health outcomes(17). Several factors contribute to this unequal vulnerability(18). Women show a higher risk of heat-related mortality, associated both with physiological differences and social factors such as the greater likelihood of living alone at older ages(19). Older adults, individuals with limited resources living in poorly insulated housing or without air conditioning, and residents of densely populated urban areas with low vegetation coverage are particularly vulnerable(20–22).

Given this scenario, health systems must be adequately prepared to respond to the impacts of extreme heat on population health. Climate adaptation planning and policy formulation require solid, updated, and accessible scientific evidence to guide public health decision-making. Systematic reviews (SRs) and other evidence synthesis approaches are for summarizing scientific literature, identifying knowledge gaps, and strengthening understanding of exposure–response relationships in climate risk contexts(23,25). However, existing SRs on heat-related health effects show notable methodological limitations, including the absence of published protocols, non-exhaustive search strategies, lack of risk-of-bias assessment, and limited appraisal of evidence certainty(11,26–28). These limitations reflect both the methodological particularities of SRs in climate-sensitive environmental exposures, where the absence of specific methodological guidelines tailored to environmental exposure reviews(29,30). As a result, substantial heterogeneity exists in quality and reproducibility.

Therefore, this scoping review aims to map and synthesise the available evidence from systematic reviews addressing the health effects of extreme heat and heat waves, with the objective of describing methodological approaches, key outcomes, and existing research gaps.

Condition being studied Any measurable human health outcomes such as diseases or deaths.

METHODS

Search strategy MEDLINE, Epistemonikos, GreenFILE, Environment Complete, Web of Science, and Scopus

Search conducted in PubMed (MEDLINE) on October 29, 2025.
Search number Query
14 #12 AND #13
13 #9 OR #10 OR #11
12 #1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8
11 ((MEDLINE[tiab] OR PUBMED[tiab]) AND (EMBASE[tiab] OR database*[tiab] OR Cochrane[tiab] OR CENTRAL[tiab]))
10 "systematic review*"[tiab]
9 systematic[sb]
8 "heat wave"[tiab:~3]
7 "heat waves"[tiab:~3]
6 heatwave*[tiab]
5 "heat exposure*"[tiab]
4 "high-temperature*"[tiab]
3 "hot temperature"[tiab:~3]
2 "hot temperatures"[tiab:~3]
1 "Hot Temperature"[Mesh].

Participant or population All human populations, regardless of sex, age, geographic location, or sociodemographic characteristics, to ensure a comprehensive understanding of population-level effects.

Intervention Not applicable.

Comparator Not applicable.

Study designs to be included Systematic reviews that synthesize the evidence on the health outcomes of extreme heat and heat waves. For the purposes of this study, a systematic review is defined as any study that has been indexed as such, explicitly identified by the authors in the title or abstract, or followed systematic review methods.

Eligibility criteria
Concept
The concept of interest includes scientific literature that quantitatively or qualitatively assess the health effects of extreme heat or heat waves, or that report disaggregated results specific to these

exposures. In contrast, studies focusing on other exposures within CSEE or artificial (non-natural) heat as environmental exposure will be excluded.

Context
This review will consider literature developed in any country or region that has experienced extreme heat or heat waves with measurable human health outcomes such as diseases or deaths, and may include data from hospitals, primary care centres, private clinics, or community-based sources.

Information sources We will conduct an electronic search strategy in MEDLINE, Epistemonikos, GreenFILE, Environment Complete, Web of Science, and Scopus, until October 2025. The initial search strategy for MEDLINE (Pubmed), without any search filters turned on, will be developed to identify relevant studies that provide keywords, and index terms, which will be used to create the full researched strategy.
This initial strategy will undergo peer reviewed following the Peer Review of Electronic Search Strategies (PRESS) guidance(35), to ensure its validity, and improve the final search strategy, which then will be adapted for the other databases(36). The PRESS review will focus exclusively on the technical quality of the search strategy; therefore, we will not change the eligibility criteria themselves. Finally, we will also conduct a backward and forward citation search to retrieve additional potentially eligible systematic reviews. No restrictions will be applied regarding year of publication or language. On the contrary, studies without full-text availability will be excluded.

Main outcome(s) Any measurable human health outcome such as diseases or deaths, including data from hospitals, primary care centres, private clinics, or community-based sources.

Data management All identified records from the search will be collated and uploaded into EndNote 20.5 (Clarivate, Philadelphia, PA 19130) and duplicate studies will be removed. After that, the unique records will be uploaded into Covidence (Veritas Health Innovation, Melbourne, Australia), where a sample of 25 titles and abstracts will be selected for a pilot screening by all researchers according to the eligibility criteria. In case of discrepancies, the team may revise the eligibility criteria. The criteria will be considered adequate once an agreement of at least 75% is achieved(37). Following the pilot test, titles and abstracts will be screened by two independent researchers against the inclusion criteria, solving discrepancies through consensus or by a third independent reviewer. Full-text screening of potentially relevant articles will follow the same procedure. The overall selection process will be presented in a PRISMA-ScR flow diagram(34).
Data to be extracted include:
- Systematic review details: title, aim, and review question.
- Inclusion/exclusion criteria: population, concept (exposure, health outcomes, inequity addressed), context, type of evidence source.
- Evidence source details and characteristics: citation details (authors, publication year, data of search, database searched, number of studies included, data extracted), country, participants details (age, sex), study design included, guidelines followed, source of information, assessments of risk bias, and assessment of the certainty of evidence.
- Details/results extracted from source of evidence (exposure metrics, confounders, and statistical analysis).
A data extraction template will be pilot tested by all researchers who will independently extract data from three studies and subsequently compare their results. Any disagreements will be resolved through discussion, and if necessary, the draft tool will be revised or modified. A finalized consensus-based template will then be used by one reviewer to complete the final data extraction, which will be verified by a second reviewer. In case of discrepancies, the previously established resolution strategy will be applied(38).

Quality assessment / Risk of bias analysis Following updated guidance for scoping reviews from Joana Bricks Institute (JBI), no quality assessment will be conducted.

Strategy of data synthesis The extracted data will be synthesized descriptively, and the result will be presented in tables, and narrative summaries focused on the questions assessed and the methodology for carrying them out. Moreover, a deductive framework will be developed using the Evimappr R package (https://github.com/nealhaddaway/evimappr) or similar, to produce an evidence map that identifies health conditions for which the impact of extreme temperatures and heat waves has been evaluated, according to the health outcomes assessed.

Subgroup analysis No subgroup analyses are planned.

Sensitivity analysis No sensitivity analyses are planned.

Language restriction No restrictions will be applied regarding language.

Country(ies) involved Spain.

Other relevant information This scoping review is part of the project "Informed decisions on climate-sensitive environmental exposures: Impact of heatwaves on health and the role of evidence synthesis" (https://osf.io/ht9xs/overview).

Keywords heatwave; environmental exposure; scoping review; informed decisions.

Dissemination plans This scoping review will be published as a open access article.

Contributions of each author

Author 1 - Ivan Solà - Review design, draft of the protocol, information specialist and search strategy development.
Email: isola@santpau.cat
Author 2 - Luis Vicuña - Review design, draft of the protocol.
Email: lvicuna@santpau.cat
Author 3 - Aurelio Tobías - Review design, draft of the protocol, selection of studies, evidence synthesis.
Email: aurelio.tobias@gmail.com
Author 4 - Marc Marí-Dell'Olmo - Review design, draft of the protocol, selection of studies, evidence synthesis.
Email: mmari@aspb.cat
Author 5 - Javier Bracchiglione - Review design, draft of the protocol, selection of studies, evidence synthesis.
Email: javier.bracchiglione@gmail.com
Author 6 - Marta Roqué - Review design, draft of the protocol, selection of studies, evidence synthesis.
Email: mroque@santpau.cat