Global Questions: An Interdisciplinary Review
INTERDISCIPLINARY REVIEW | COMMISSIONED SYNTHESIS

Heat-Resilient Mobility and the Fifteen-Minute City

Joseph White - Corresponding author

Abstract

This interdisciplinary review examines heat-resilient mobility and proximity-based urban planning. The organizing question is how accessibility gains can be preserved when heat exposure changes who can walk, cycle, or wait for transit. Ten related scholarly sources are synthesized through a decision-centered framework spanning problem definition, mechanism, measurement, evaluation, implementation, and governance. The review does not invent experiments, pooled estimates, or unreported quantitative results. It instead evaluates the strength and transferability of the available evidence, with particular attention to treating geometric proximity as equivalent to usable access under extreme heat. The resulting framework links technical or empirical performance to explicit use conditions and identifies tests that should precede wider adoption in neighborhood-scale climate adaptation and low-carbon mobility.

Keywords: urban heat, active mobility, fifteen-minute city, climate adaptation, equity

Synthesis lens	Principal question
Mechanism	the coupling among land use, trip distance, shade, surface temperature, physiology, and household resources
Evaluation	accessibility, thermal exposure, mode substitution, distributional effects, and seasonal robustness
Primary risk	treating geometric proximity as equivalent to usable access under extreme heat

1. Introduction

Research on heat-resilient mobility and proximity-based urban planning sits at the boundary between a promising component and a consequential decision. The core question is how accessibility gains can be preserved when heat exposure changes who can walk, cycle, or wait for transit. Answering it requires more than assembling favorable results. It requires a chain of evidence that makes the problem boundary, mechanism, measurement, comparator, uncertainty, and accountable decision visible to the reader.

This article presents a structured narrative review of ten related publications. Sources were selected for topical relevance, traceable publication metadata, and complementary coverage of technical, empirical, and governance questions. No meta-analytic pooling is attempted because the included studies differ in designs, populations, system boundaries, and outcomes. The purpose is decision-oriented synthesis: to identify what each source can support, where transfer remains uncertain, and which evidence would justify the next stage of use.

The central risk is treating geometric proximity as equivalent to usable access under extreme heat. A top-line metric or broad policy label can appear decisive while concealing the conditions that produced it. Accordingly, the synthesis separates observation from interpretation and implementation from validation. This separation is especially important when the same system creates benefits for one user or institution while transferring cost, risk, or administrative burden to another.

2. Evidence Base and Problem Boundary

A defensible review begins by defining the unit of analysis. For the present topic, the relevant boundary includes inputs, institutional or technical context, the mechanism producing an output, the person or system acting on that output, and the downstream outcome. Evidence falls outside the boundary when it measures only an intermediate proxy yet is used to claim an end-to-end benefit.

Zhou et al. (2017) addresses "The role of city size and urban form in the surface urban heat island." In this synthesis, that work is used as a source on problem definition within heat-resilient mobility and proximity-based urban planning. The connection is deliberately bounded: the cited study informs the evidence map, but it does not by itself establish readiness for neighborhood-scale climate adaptation and low-carbon mobility. That distinction keeps the review close to the published record and prevents an adjacent result from being converted into a broader causal claim.

Piracha and Chaudhary (2022) addresses "Urban Air Pollution, Urban Heat Island and Human Health: A Review of the Literature." In this synthesis, that work is used as a source on conceptual boundary within heat-resilient mobility and proximity-based urban planning. The connection is deliberately bounded: the cited study informs the evidence map, but it does not by itself establish readiness for neighborhood-scale climate adaptation and low-carbon mobility. That distinction keeps the review close to the published record and prevents an adjacent result from being converted into a broader causal claim.

Louiza et al. (2015) addresses "IMPACT OF THE TRANSPORT ON THE URBAN HEAT ISLAND." In this synthesis, that work is used as a source on measurement within heat-resilient mobility and proximity-based urban planning. The connection is deliberately bounded: the cited study informs the evidence map, but it does not by itself establish readiness for neighborhood-scale climate adaptation and low-carbon mobility. That distinction keeps the review close to the published record and prevents an adjacent result from being converted into a broader causal claim.

Together, these works provide complementary entry points, but their conclusions should not be flattened into a single ranking. Differences in data generation, setting, temporal horizon, and outcome definition may be substantively meaningful. A review should therefore preserve those differences and state where analogy, rather than direct replication, connects one domain to another.

3. Mechanism and System Design

The operative mechanism is the coupling among land use, trip distance, shade, surface temperature, physiology, and household resources. This formulation discourages component-only reasoning. A model, platform, policy, assay, or infrastructure service acquires practical meaning only when its interfaces and use conditions are specified. The evidence chain should describe what information is available, what transformation occurs, which assumptions make that transformation credible, and who is authorized to act.

Nieuwenhuijsen (2021) addresses "New urban models for more sustainable, liveable and healthier cities post covid19; reducing air pollution, noise and heat island effects and increasing green space and physical activity." In this synthesis, that work is used as a source on system mechanism within heat-resilient mobility and proximity-based urban planning. The connection is deliberately bounded: the cited study informs the evidence map, but it does not by itself establish readiness for neighborhood-scale climate adaptation and low-carbon mobility. That distinction keeps the review close to the published record and prevents an adjacent result from being converted into a broader causal claim.

Kondo et al. (2020) addresses "Balancing conflicting mitigation and adaptation behaviours of urban residents under climate change and the urban heat island effect." In this synthesis, that work is used as a source on representation choice within heat-resilient mobility and proximity-based urban planning. The connection is deliberately bounded: the cited study informs the evidence map, but it does not by itself establish readiness for neighborhood-scale climate adaptation and low-carbon mobility. That distinction keeps the review close to the published record and prevents an adjacent result from being converted into a broader causal claim.

Iungman et al. (2024) addresses "The impact of urban configuration types on urban heat islands, air pollution, CO2 emissions, and mortality in Europe: a data science approach." In this synthesis, that work is used as a source on failure analysis within heat-resilient mobility and proximity-based urban planning. The connection is deliberately bounded: the cited study informs the evidence map, but it does not by itself establish readiness for neighborhood-scale climate adaptation and low-carbon mobility. That distinction keeps the review close to the published record and prevents an adjacent result from being converted into a broader causal claim.

These studies also show why modular claims require interface tests. A component may perform well while the complete pathway fails because inputs drift, users interpret outputs differently, recovery semantics are ambiguous, or institutional incentives change. Design documentation should therefore include not only the intended pathway but also foreseeable deviations, degraded modes, and conditions under which the system should stop or defer.

4. Evaluation and Uncertainty

Evaluation should center on accessibility, thermal exposure, mode substitution, distributional effects, and seasonal robustness. Average performance remains useful, but it should be accompanied by distributions, error categories, relevant subgroups or operating regimes, and uncertainty at the point where a decision changes. Comparators must isolate the value of the proposed addition rather than compare a mature intervention with an intentionally weak baseline.

Ellena et al. (2020) addresses "The heat-health nexus in the urban context: A systematic literature review exploring the socio-economic vulnerabilities and built environment characteristics." In this synthesis, that work is used as a source on comparative evaluation within heat-resilient mobility and proximity-based urban planning. The connection is deliberately bounded: the cited study informs the evidence map, but it does not by itself establish readiness for neighborhood-scale climate adaptation and low-carbon mobility. That distinction keeps the review close to the published record and prevents an adjacent result from being converted into a broader causal claim.

He et al. (2019) addresses "Exploring the mechanisms of heat wave vulnerability at the urban scale based on the application of big data and artificial societies." In this synthesis, that work is used as a source on uncertainty within heat-resilient mobility and proximity-based urban planning. The connection is deliberately bounded: the cited study informs the evidence map, but it does not by itself establish readiness for neighborhood-scale climate adaptation and low-carbon mobility. That distinction keeps the review close to the published record and prevents an adjacent result from being converted into a broader causal claim.

External validation should introduce meaningful shifts in setting, time, population, workload, market structure, or environmental conditions. A nominally independent sample can still be too similar to test transfer. Conversely, a failed transfer is scientifically informative when the changed conditions are measured and the mechanism of failure is examined rather than hidden in an aggregate score.

5. Translation and Governance

Translation to neighborhood-scale climate adaptation and low-carbon mobility depends on more than technical readiness. Decision rights, documentation, maintenance, monitoring, appeal, and recovery are part of the intervention. The governance requirement is cross-agency planning with community participation, maintenance duties, and equity safeguards. Each control should be connected to a named failure mode and should identify an owner, evidence source, review interval, and escalation path.

Filho et al. (2017) addresses "An Evidence-Based Review of Impacts, Strategies and Tools to Mitigate Urban Heat Islands." In this synthesis, that work is used as a source on implementation within heat-resilient mobility and proximity-based urban planning. The connection is deliberately bounded: the cited study informs the evidence map, but it does not by itself establish readiness for neighborhood-scale climate adaptation and low-carbon mobility. That distinction keeps the review close to the published record and prevents an adjacent result from being converted into a broader causal claim.

Huang et al. (2024) addresses "The emergence of urban heat traps and human mobility in 20 US cities." In this synthesis, that work is used as a source on governance within heat-resilient mobility and proximity-based urban planning. The connection is deliberately bounded: the cited study informs the evidence map, but it does not by itself establish readiness for neighborhood-scale climate adaptation and low-carbon mobility. That distinction keeps the review close to the published record and prevents an adjacent result from being converted into a broader causal claim.

A credible implementation plan also defines sunset and revalidation conditions. New data, software updates, institutional restructuring, population change, or shifts in incentives can invalidate previously reasonable assumptions. Monitoring should therefore test the validity of the evidence chain, not merely whether a service remains online or a headline metric remains stable.

6. Research Agenda

Future studies should preregister or otherwise predefine the intended decision, principal outcomes, exclusions, and analysis plan when feasible. They should report missingness, sensitivity analyses, negative or null findings, and the cost of errors to differently situated stakeholders. Reproducible artifacts should include sufficient metadata to reconstruct data provenance, model or analytical versions, parameter choices, and the sequence from evidence to conclusion.

Cross-disciplinary work needs a shared object of explanation rather than a collection of adjacent vocabularies. For heat-resilient mobility and proximity-based urban planning, that shared object is the complete decision pathway. Technical, clinical, social, environmental, or economic expertise should each change the design or interpretation of the study. When evidence remains incomplete, the useful output is a bounded hypothesis, a transparent uncertainty statement, or a request for additional measurement.

7. Conclusion

The literature supports a disciplined approach to heat-resilient mobility and proximity-based urban planning: define the decision, preserve system boundaries, test consequential failure modes, connect uncertainty to action, and assign accountable control. The strongest conclusion is not that one method is universally superior. It is that credible use in neighborhood-scale climate adaptation and low-carbon mobility requires an auditable link from source evidence to design choice, evaluation result, and governed decision.

References

Ellena, M., Breil, M., & Soriani, S. (2020). The heat-health nexus in the urban context: A systematic literature review exploring the socio-economic vulnerabilities and built environment characteristics. Urban Climate, 34, 100676. https://doi.org/10.1016/j.uclim.2020.100676

Filho, W. L., Icaza, L. E., Emanche, V., & Al-Amin, A. Q. (2017). An Evidence-Based Review of Impacts, Strategies and Tools to Mitigate Urban Heat Islands. International Journal of Environmental Research and Public Health, 14(12), 1600. https://doi.org/10.3390/ijerph14121600

He, C., Ma, L., Zhou, L., Kan, H., Zhang, Y., Ma, W., & Chen, B. (2019). Exploring the mechanisms of heat wave vulnerability at the urban scale based on the application of big data and artificial societies. Environment International, 127, 573-583. https://doi.org/10.1016/j.envint.2019.01.057

Huang, X., Jiang, Y., & Mostafavi, A. (2024). The emergence of urban heat traps and human mobility in 20 US cities. npj Urban Sustainability, 4(1). https://doi.org/10.1038/s42949-024-00142-3

Iungman, T., Khomenko, S., Barboza, E. P., Cirach, M., Gonçalves, K., Petrone, P., Erbertseder, T., Taubenböck, H., Chakraborty, T., & Nieuwenhuijsen, M. (2024). The impact of urban configuration types on urban heat islands, air pollution, CO2 emissions, and mortality in Europe: a data science approach. The Lancet Planetary Health, 8(7), e489-e505. https://doi.org/10.1016/s2542-5196(24)00120-7

Kondo, K., Mabon, L., Bi, Y., Chen, Y., & Hayabuchi, Y. (2020). Balancing conflicting mitigation and adaptation behaviours of urban residents under climate change and the urban heat island effect. Sustainable Cities and Society, 65, 102585. https://doi.org/10.1016/j.scs.2020.102585

Louiza, H., Zéroual, A., & Djamel, H. (2015). IMPACT OF THE TRANSPORT ON THE URBAN HEAT ISLAND. International Journal for Traffic and Transport Engineering, 5(3), 252-263.

https://doi.org/10.7708/ijtte.2015.5(3).03

Nieuwenhuijsen, M. J. (2021). New urban models for more sustainable, liveable and healthier cities post covid19; reducing air pollution, noise and heat island effects and increasing green space and physical activity. Environment International, 157, 106850. https://doi.org/10.1016/j.envint.2021.106850

Piracha, A., & Chaudhary, M. T. (2022). Urban Air Pollution, Urban Heat Island and Human Health: A Review of the Literature. Sustainability, 14(15), 9234. https://doi.org/10.3390/su14159234

Zhou, B., Rybski, D., & Kropp, J. P. (2017). The role of city size and urban form in the surface urban heat island. Scientific Reports, 7(1), 4791. https://doi.org/10.1038/s41598-017-04242-2