

Data-Driven Zoning Reform and Health Equity in the United States: A Systematic Review of GIS-Enabled Planning Research Linking Housing Policy, Accessibility, and Community Health

Freda Frimpongmaa Botwe¹ and Eunice Amissah-Mensah²

¹School of Public Health, Knust.

²Iowa State University (ISU), Ames, IA.

Abstract: The patterns of housing, accessibility, and environmental exposure define health equity in American cities and are controlled by urban zoning and land-use policies. Even though mounting evidence uses Geographic Information Systems (GIS) to study spatial health disparity, evidence about the connection between zoning policy, GIS-enabled planning, and quantifiable health outcomes is still discrete. This paper is a systematic review of the current GIS-based research to explain how zoning is a structural determinant of health equity. The systematic literature review was performed according to PRISMA 2020. The search of the ScienceDirect database was structured into a Boolean search involving the identification of peer-reviewed articles published between 2020 and 2026. Articles were limited to those (1) that concern the United States, (2) that involve the use of GIS or spatial analytic techniques and (3) that discuss zoning, land-use policy, housing regulation, accessibility, or environmental exposure about health or health equity outcomes. Having screened 142 records, 100 studies were eligible. Information abstraction considered the context of the study, GIS practices, policy agenda, health outcomes, and equity. The quality of the studies was assessed with modified MMAT criteria with the focus on transparency, spatial rigor, and policy relevance. The review concludes that the effect of zoning on health is an upstream determinant of health because housing segregation, unequal access to necessary services and green space, and disproportionality of exposure to environmental hazards are found. Geographic disparities have been revealed through the application of GIS techniques and especially accessibility modeling, exposure mapping, spatial regression and composite equity indices. Nonetheless, most of the literature is based on cross-sectional designs, and few longitudinal or quasi-experimental analyses of zoning reform exist. The heterogeneity of methodology and the lack of unified incorporation of policy analysis restrict causal inference. It has been shown that zoning reform is to be considered a form of public health intervention that has quantifiable equity consequences. Moving towards the equity-based, data-driven zoning, it is necessary to incorporate health-related measurements into the land-use decision-making, enhance participatory GIS practice, and enhance longitudinal assessments of policy effects.

Keywords: Zoning policy, Health equity, Geographic Information Systems (GIS), Land-use planning, Accessibility.

INTRODUCTION

Urbanization has contributed to making cities the key spatial determinants of population health, which manipulates patterns of exposure, access, and opportunity, which turn into disproportionate health outcomes among populations. Urban environments have a direct impact on morbidity, mortality, and health generally by means of the spatial arrangement of residential settings, transport facilities, environment, and the availability of necessary facilities. These constructions in the built environment generate long-term and disproportionate health impacts on the populations (Seyedrezaei *et al.*, 2023; Giles-Corti *et al.*, 2022; Lowe *et al.*, 2022). Zoning and land-use regulation are now seen as structuring policy tools that actively form these spatial constructions and not objective technical tools and affect the localization of environmental burdens and health-promoting resources (Seraphim *et al.*, 2025; Kato-Huerta & Geneletti, 2023). Land-use patterns are also structurally related to health disparities with accessibility, environmental exposure, and infrastructure distribution

supporting the upstream determinants of health equity of zoning as an upstream factor (Zhou *et al.*, 2024; Haque & Sharifi, 2024).

Health inequities around zoning in the United States have deep historical and structural causes of exclusion, such as exclusionary zoning, redlining, segregation, and long-term disinvestment. Such policies institutionalized socioeconomic inequalities and racialized them by fomenting residential patterns and concentrating the environmental risks and reducing access to quality housing, healthcare, and green infrastructure in marginalized areas (Dennis *et al.*, 2025; Lee *et al.*, 2022; Alvarez *et al.*, 2022). Empirical studies prove that these spatial disparities are still present in modern American cities and they are reflected in having disproportional exposure to air pollution, urban heat, and infrastructural shortages, as well as high chances of chronic disease and heat-related death (Van Tran *et al.*, 2025; Dzwonczyk *et al.*, 2025; Friedman *et al.*, 2022). Such inequities are further enhanced by zoning housing affordability by contributing to residential instability and

displacement to environmentally hazardous locations and defining access to health-supportive infrastructure and long-term health outcomes (Chen *et al.*, 2025; Curtis *et al.*, 2024; Minaravesh, 2025).

Urban planning and public health have progressively embraced data-driven and Geographic Information System (GIS)-driven methods of facilitating evidence-based governance as a response to the increased awareness of spatial health inequities. GIS has become a vital instrument of accessibility modeling, exposure mapping, and equity diagnostics, which provides an opportunity to fine-grain the analysis of healthcare access, food environments, transportation systems, availability of green spaces, and environmental hazards (Spriggs *et al.*, 2024; Sadler *et al.*, 2025; Jiao *et al.*, 2025). The term accessibility modeling is used to measure how easily the individuals have access to the opportunities they desire, which may be services, jobs, or facilities, based on land-use allocation, transport system, time-related factors, and the attributes of the users (Malekzadeh & Chung, 2020). The U.S.-based research indicates that GIS-based analytics have the ability to provide distributive implications of zoning and land-use decisions, based on vulnerability mapping, composite indices, and scenario-based planning tools (Bucholz *et al.*, 2025; Yu *et al.*, 2025; Waqas *et al.*, 2024). Nevertheless, researchers warn that technocratic uses of GIS are prone to reproducing inequities when applied without defined equity prisms, interactions with communities, and policy responsibility (Mortaheb & Jankowski, 2023; Nizamani *et al.*, 2025). In line with this literature, research also shows the use of high-resolution spatial analysis in the context of urban vulnerability, resilience, and heat exposure in U.S. cities, which supports the necessity of equity-based GIS applications (Adu *et al.*, 2025; Lotsah *et al.*, 2025).

Regardless of these developments, the literature is still fragmented at the cross-section point of zoning policy, GIS-enabled analysis, and health equity outcomes. Spatial inequalities in health are regularly reported in health studies without necessarily involving zoning processes, whereas research in planning focuses on zoning reforms without necessarily considering the measurable health consequences (Seraphim *et al.*, 2025; Seyedrezaei *et al.*, 2023). The current reviews are more inclined to consider environmental justice or accessibility, or factors of the built environment

independently; they do not have the capacity to guide zoning reform as a unified intervention in the context of public health (Dennis & Sharifi, 2024; Anandhi, 2025). As a result, the systematic synthesis of the specific area of zoning reform in the United States, GIS-supported evidence, and health equity mechanisms is lacking. As a way to fill this gap, this study is a systematic literature review of GIS-enabled planning literature that explores the impact of zoning and land-use policies on health equity in the United States. Based on a conceptual model of the relationship between zoning and housing and accessibility, environmental exposure, and downstream community health outcomes, the review aims to establish the prevailing mechanisms, gaps in methodology, and possibilities of equity-based zoning reform (Seraphim *et al.*, 2025; Adu & Aliu, 2025; DOREEN *et al.*, 2025).

METHODOLOGY

The research used a Systematic Literature Review (SLR) to synthesize evidence rigorously on how zoning and land-use policies affect health equity using GIS-enabled planning studies in the United States. A narrative review was not taken since an SLR was chosen to guarantee transparency, reproducibility, and methodological rigor in covering an interdisciplinary and policy-relevant area of research. The review adhered to PRISMA 2020 rules, which offer the guidelines for documenting the process of research identification, screening, eligibility, and inclusion. The adherence to PRISMA was needed to help achieve a clear audit trail, minimize the selection bias, and ensure consistency of the evidence synthesis between planning, GIS, and public health literatures.

Search of the literature was done on 24/01/2026 with the help of ScienceDirect (Elsevier) as the single database, which was chosen due to its extensive representation of peer-reviewed publications in the field of urban planning, geography, GIS, and public health, environmental science, and policy studies. Articles published in 2020-2026 were searched with this search string ("zoning" OR "land use policy") AND (GIS OR "spatial analysis") AND ("health equity" OR "health disparities"), as this is the plateau of articles with GIS-enabled and data-driven urban health research that have been published in the past 6 years. Keywords that were related to zoning, GIS, health equity, and accessibility were used as Science Direct compatible Boolean search strings. Thematic search process was used in the iterative

mode and allowed refinement of search terms using preliminary screening to guarantee a comprehensive but narrow search of the relevant

studies. There were 142 records produced during this process.

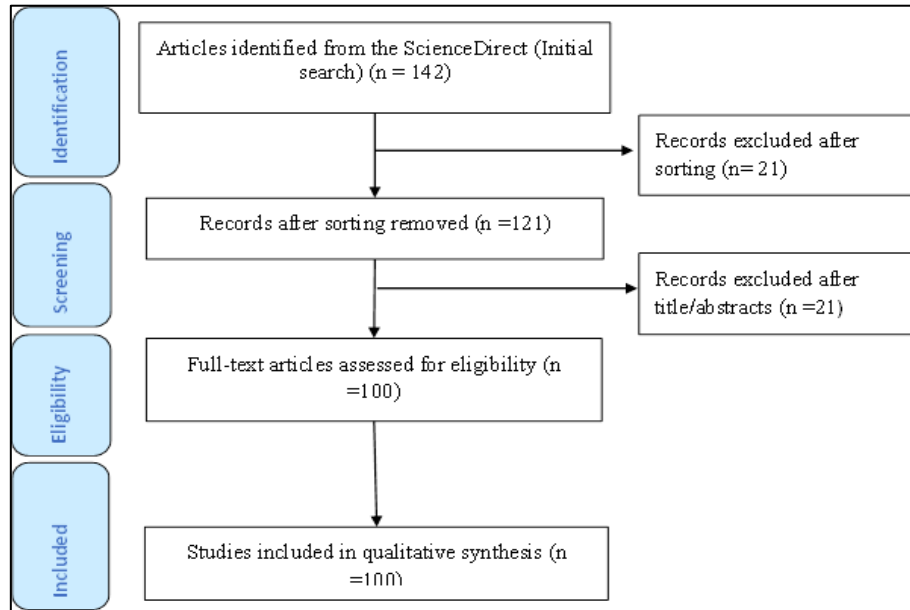


Figure 1: PRISMA Flow diagram showing the article selection process in the study.

Table 1: Search Strategy Summary

Component	Description
Database	ScienceDirect (Elsevier)
Years	2020–2026
Keywords	Zoning, GIS, health equity, accessibility
Article types	Research articles and review papers
Initial records	142

The included studies were those related to the United States, which used GIS or spatial analytical techniques and studied zoning, land-use policy, housing regulation, accessibility, or environmental exposure in the context of health or health equity outcomes. The criteria of inclusion were both empirical and review articles, but non-U.S. and

non-spatial analysis and pure clinical research were not included. After title and abstract screening, 121 records were left to go through the full text, and 100 studies were subject to all the rules of inclusion and were kept to be synthesized. Screening and the selection process were in line with PRISMA 2020 and presented in Figure 2.

Table 2: Inclusion and Exclusion Criteria

Criterion	Inclusion	Exclusion
Geography	United States	Non-U.S. studies
Methods	GIS / spatial analysis	Non-spatial methods
Study type	Empirical studies + reviews	Purely clinical/biomedical
Focus	Zoning, land-use, accessibility, exposure	No policy or spatial linkage

All data extraction frameworks were structured using an agreement to ensure consistency and comparability throughout the review. The variables that were extracted were author(s) and year of publication, city or regional study context, GIS or spatial analytical techniques, zoning or land-use policy focus, health outcomes investigated, and the equity dimension (e.g., race, income, vulnerability, or deprivation). This

framework facilitated the systematic mapping of the operationalization and association of zoning-related mechanisms with the health equity outcomes in a variety of urban contexts in the United States. To gauge the level of methodological robustness, the quality of the study was measured with the help of the Mixed Methods Appraisal Tool (MMAT) or similar criteria, given the specificity of the research to the study design,

with a particular focus on the transparency of data sources and methods, spatial rigor of GIS analyses, and applicability to zoning and health equity policy. The results of quality appraisal were

applied to contextualize the results and define the cross-cutting methodology strengths and limitations instead of disqualifying studies in the synthesis.

Table 3: Quality Criteria for Assessing Spatial Planning and Health Studies

Quality Dimension	Assessment Focus	Key Supporting References
Transparency	Clarity of data sources, methodological reporting, reproducibility, and documentation of assumptions	Seyedrezaei <i>et al.</i> (2023); Seraphim <i>et al.</i> (2025); Anandhi (2025)
Spatial rigor	Appropriateness of GIS methods, spatial scale, resolution, validation of models, and sensitivity to spatial heterogeneity	Spriggs <i>et al.</i> (2024); Sadler <i>et al.</i> (2025); Yu <i>et al.</i> (2025)
Policy relevance	Explicit linkage between zoning or land-use policy mechanisms and health or health equity outcomes	Dennis <i>et al.</i> (2025); Lee <i>et al.</i> (2022); Adu <i>et al.</i> (2025)

RESULTS

Characteristics and Methodological Profile of Included Studies

The 100 studies included in the sample were published in 2020-2026, and they represent a swift increase in GIS-enabled studies on the spatial determinants of equity and health in an urban setting. The steady increase in publication output since 2021 reached its peak in 2024-26 suggesting an overall trend of interdisciplinary convergence of the fields of urban planning, environmental science, geography, and public health. Out of the entire corpus, 78 articles were empirical research, and 22 were contributions based on reviews, such as systematic reviews, scoping reviews, and conceptual syntheses. Geographically, 46 of the studies were done in the United States and 54 studies were done in international settings, which include China, France, Malaysia, Ghana, Hong Kong, Australia, Canada, Iran and cross-national comparison. In the U.S.-based studies, cities like San Antonio, Dallas-Fort Worth, Kansas City, Los Angeles County and West Michigan were commonly represented.

Regarding the spatial scale, 39 of the studies existed at the neighbourhood level, 34 at the city level, 17 at the metropolitan or regional levels, and 10 at the national levels. Cross-sectional spatial analysis predominated the literature (72 studies) with only 8 studies using longitudinal or retrospective time designs and 20 relying mostly on modeling, simulation or index-construction designs. The corpus was dominated by GIS-based techniques. The most used methods were accessibility modeling (28%), exposure mapping (26%), and spatial regression methods such as geographically weighted regression (24%). In 22% of studies composite equity indices were developed or used and in 18% hot spot analysis was used. New approaches like machine learning and GeoAI were present in 9% and participatory GIS approaches in 7% of studies. All these findings indicate that there is a methodological consensus on diagnostic spatial analytics, with relatively restricted longitudinal and policy-evaluation designs.

Table 4: Descriptive Characteristics of Included Studies (n = 100)

Characteristic	Category	n	%
Study type	Empirical	78	78%
	Review	22	22%
Publication year	2020	6	6%
	2021	8	8%
	2022	14	14%
	2023	18	18%
	2024	23	23%
	2025	21	21%
Geographic focus	U.S.-based	46	46%
	International	54	54%

Spatial scale	Neighbourhood	39	39%
	City	34	34%
	Metro/Regional	17	17%
	National	10	10%
Study design	Cross-sectional	72	72%
	Longitudinal	8	8%
	Modeling/Simulation	20	20%

Table 5: GIS and Spatial Analytical Techniques Used

Geographic Information Systems Method	n	%	Common Application	Representative Studies
Accessibility modeling	28	28%	Access to healthcare services, food systems, and emergency medical services	Bucholz <i>et al.</i> (2025); Luan <i>et al.</i> (2025); Xu <i>et al.</i> (2026); Jiao <i>et al.</i> (2025)
Spatial regression analysis (including Geographically Weighted Regression)	24	24%	Linking environmental exposures to health outcomes	Yu <i>et al.</i> (2025); Waqas <i>et al.</i> (2024); Alvarez <i>et al.</i> (2022)
Hotspot analysis	18	18%	Identification of spatial clusters of hazards or disease	Hadi <i>et al.</i> (2026); Xiao <i>et al.</i> (2026)
Composite equity indices	22	22%	Measurement of deprivation, vulnerability, and distributive justice	Chen <i>et al.</i> (2024); Kato-Huerta & Geneletti (2023); Jiao <i>et al.</i> (2025)
Exposure mapping	26	26%	Mapping heat exposure, air pollution, and environmental risks	Van Tran <i>et al.</i> (2025); Dzwonczyk <i>et al.</i> (2025); Waqas <i>et al.</i> (2024); Alvarez <i>et al.</i> (2022)
Machine learning and Geographic Artificial Intelligence	9	9%	Predictive modeling and advanced spatial diagnostics	Mortaheb & Jankowski (2023); Xiao <i>et al.</i> (2026)
Participatory Geographic Information Systems	7	7%	Community-based spatial planning and governance engagement	Knox-Hayes <i>et al.</i> (2025); Kung & Zhu (2022)

Thematic Synthesis: Spatial Pathways Linking Urban Policy and Health

The most powerful thematic group among the 100 studies is about environmental exposure and environmental justice. Much of the literature records spatial inequalities in exposure to heat, air pollution, industrial toxics, and environmental hazards. Heat-related mortality and structural vulnerability were shown in San Antonio and Denver (Van Tran *et al.*, 2025; Dzwonczyk *et al.*, 2025), whereas exposure to industrial air toxins and nitrogen dioxide was racially patterned in U.S. metropolitan areas (Alvarez *et al.*, 2022; Waqas *et al.*, 2024). Geographically weighted regression was used to map localized differences in the exposure to lead (Yu *et al.*, 2025). Research constructing distributive environmental justice indices and analyzing the inequality in green infrastructure development also found systematic inequality in environmental amenities (Kato-Huerta & Geneletti, 2023). Historic redlining is associated with modern-day asthma burden, which

highlights the problem of structural spatial inequality (Friedman *et al.*, 2022; Lee *et al.*, 2022). Together, this cluster is the most empirically constructed way of the corpus.

The second thematic cluster is about accessibility and distribution of services as a means of spatial planning to health opportunity. Several studies used accessibility modeling to healthcare services, emergency medical system, food environment, and parks. Spatial accessibility measures were used to determine pediatric healthcare access and racial inequality (Bucholz *et al.*, 2025), whereas trade-off models were analyzed in terms of emergency medical service distribution. Inequality in access to transportation has been shown in the context of access to HIV prevention (Luan *et al.*, 2025) and the research of transport equity more generally. The inequity associated with food access was studied in the cases of a household level and index-based (Xu *et al.*, 2026; Jiao *et al.*, 2025; Odoms-Young *et al.*, 2024) and the inequity in the

access to recreational infrastructure has been observed in the context of parks. These studies place accessibility as an intermediate that can be measured between land-use structure and health outcomes.

The third cluster focuses on structural and governance determinants that bring about spatial health inequities. The conceptual frameworks of structural racism give a conceptual basis to the process of the institutional practices, which have been spatialized (Dennis *et al.*, 2025), and the political determinants like the unincorporation of counties explain the service differences based on

governance. Racial capitalism theoretical literature puts spatial violence in a larger economic system. The indicators of comparative planning policy (Lowe *et al.*, 2022), the model of resilience and environmental justice governance (Knox-Hayes *et al.*, 2025), and the new discourse of smart city governance and Geographic Artificial Intelligence (Mortaheb & Jankowski, 2023) show that the policy focus in the present research is increasingly shifting. This literature, though smaller than the exposure and accessibility clusters, points to upstream regulatory and institutional causes of spatial health inequality.

Table 6: Thematic Distribution of Studies Across Spatial Health Mechanisms

Thematic Domain	Subtopics	Number of Studies	Representative Studies
Environmental exposure and environmental justice	Heat, air toxics, nitrogen dioxide, lead, green disparities, redlining and asthma	38	Van Tran (2025); Alvarez (2022); Waqas (2024); Lee (2022)
Accessibility and service distribution	Healthcare access, emergency services, food systems, transport equity, park access	34	Xu (2026); Bucholz (2025); Jiao (2025)
Structural and governance determinants	Structural racism, political determinants, racial capitalism, planning policy, resilience governance	28	Dennis (2025); Lowe (2022); Knox-Hayes (2025)

Strength of Evidence and Policy Relevance

Across the 100 included studies, the literature is mainly cross-sectional studies based on Geographic Information Systems that establish a spatial inequity in environmental exposure, accessibility, and service distribution, but seldom provide a causal relationship between urban policy and health outcomes. The longitudinal and explicit zoning reform evaluations are minimal and limit evidence of the policy-initiated change throughout the time. Meanwhile, methodological progress

occurs in the field with growing application of composite equity and deprivation indices, greater integration of governance and structures, including structural racism and political determinants of health, and new uses of machine learning and Geographic Artificial Intelligence. Comprehensively, the corpus has a high diagnostic potential and increasing policy involvement, but a rather low causal assessment of land-use and zoning interventions.

Table 7: Evidence Strength and Policy Orientation

Evidence Dimension	Presence in Corpus	Implication	Representative Studies
Cross-sectional spatial analysis	High	Strong diagnostic capacity but limited causal inference	Van Tran <i>et al.</i> (2025); Waqas <i>et al.</i> (2024); Alvarez <i>et al.</i> (2022)
Longitudinal studies	Limited	Weak temporal evidence of policy impact	Chen & Li (2025); Curtis <i>et al.</i> (2024)
Explicit policy evaluation	Moderate	Often indirect or framework-based rather than intervention-based	Lowe <i>et al.</i> (2022); Knox-Hayes <i>et al.</i> (2025)
Index development	High	Robust tools for identifying deprivation and vulnerability	Chen <i>et al.</i> (2024); Davis <i>et al.</i> (2022); Kato-Huerta & Geneletti (2023); Jiao <i>et al.</i> (2025)
Participatory governance focus	Emerging	Increasing integration of procedural equity and	Knox-Hayes <i>et al.</i> (2025); Kung & Zhu (2022); Mortaheb & Jankowski

		planning governance	(2023)
Artificial intelligence / predictive modeling	Emerging	Expanding methodological sophistication	Mortaheb & Jankowski (2023); Xiao <i>et al.</i> (2026)

DISCUSSION

Interpretation of Key Findings

This systematic review highlights the conclusions in relation to zoning being an upstream health policy tool that determines population health via spatial mechanisms instead of a land-use tool. In the studies reviewed, zoning and housing policies invariably surfaced as the core to the organization of residential stability, availability of basic services, and exposure to environmental hazards. All these mechanisms affect subsequent health outcomes and support the argument that zoning decisions can be seen to act far beyond the margin of the urban design, and are more of a de facto intervention on the part of the general population health. The environmental load and service deficiency in historically marginalized neighborhoods pinpoint the role of zoning in embedding and reinforcing structural inequities over time, which is consistent with the larger body of literature on spatially generated health inequities.

The review also shows that GIS is an equity-revealing and not a neutral analytic tool used. GIS-enabled approaches caused the visualization of the spatial distribution of inequities that are inaccessible in aggregate or non-spatial analyses, especially in the context of accessibility, environmental exposure, and cumulative risk. Nonetheless, the data also indicates that GIS products are influenced by the assumptions in the background, the availability of data, and the choice of methods. In situations where GIS analyses are not applied with defined equity schemes, there is a danger of them recreating the discourses of power or efficiency over equity. Therefore, the evidence indicates that GIS does not necessarily promote

equity, but instead the equity effects of the tool are determined by the manner in which spatial evidence is packaged, interpreted and incorporated in the policy procedures.

Policy Implications

Evidence synthesis suggests several action implications for health-informed zoning reform. To start with, zoning codes ought to explicitly include health objectives by seeking to provide housing that is affordable, with density and mixed-use development in such a manner as to minimize displacement and enhance access to health-promoting infrastructure. Incorporating health measures of accessibility threshold, environmental exposure indicator, and vulnerability index into zoning and land-use decision-making can facilitate a more justifiable spatial result and give quantifiable standards of policy assessment.

Second, the results show the need for integrating GIS-based health measures directly into zoning codes and planning processes and not to confine it to advisory or post hoc analyses. GIS instruments based on scenarios may be utilized to assess the distributive effects of planned zoning modifications prior to the implementation, which allows policy makers to foresee the consequences of the changes and pre-empt the inequities. Lastly, participatory GIS is highlighted in the review as a very important tool because it brings the knowledge of the community and lived experience to the spatial analysis. Participatory strategies have the potential to offset the technocratic prejudices, augment procedural fairness, and make sure that the zoning reforms are more democratic and not a product of expert-only models.

Table 8: Policy Implications of GIS-Enabled Zoning Evidence

Policy Domain	Key Implication	Application
Zoning reform	Zoning should be treated as a public health tool	Health-informed density, mixed-use, and affordability provisions
Health metrics	Integrate spatial health indicators into zoning codes	Accessibility thresholds, exposure limits, equity indices
GIS governance	Use GIS for ex ante policy evaluation	Scenario testing of zoning changes
Community engagement	Expand participatory GIS practices	Co-produced maps and community-led spatial diagnostics

Theoretical Contributions

This review adds to the theory of spatial justice by showing empirically that zoning is a mechanism

that allows social power to become spatial and reproduce health inequity. The results support the idea that inequalities do not only emerge out of

personal agency or environmental factors but are constructed by the space regulation systems. The review introduces theoretical insights into the mechanism of how the spatial governance system is organized to shape health opportunity landscapes by the systematic association of zoning decisions with accessibility, exposure, and health outcomes.

The literature on structural determinants of health is also reinforced by the review since it places zoning in a multilevel causal model linking policy choices with embodied health results. By so doing, it fills the gap between planning and public health scholarship by making urban planning not a downstream factor, but a core determinant of health equity. This framing aligns with a paradigm that is increasingly gaining momentum, which frames planning as a public health intervention that should be critiqued and held accountable to the same ethical standards as traditional health policy.

Ethical and Governance Considerations

The results present significant ethical and governance issues of GIS application in zoning and health equity studies. There is also a problem of data bias that persists because most spatial datasets are biased against the marginalized groups, or use proxies that hide the lived experience. The inequity of data quality in different neighbourhoods may result in the wrong representation of need and support the formation of inequities in the distribution of resources.

Also, the review identifies risks linked to technocratic governance, in which complicated GIS models can concentrate the decision-making powers in the hands of the experts, but it does not consider the communities affected. In the absence of strong participatory processes, GIS-based zoning reforms will become black and white, as well as transparent and unresponsive. The practice of ethical zoning must thus be both technically rigorous and have meaningful community involvement, transparent model assumptions and structures of governance in which spatial evidence may be disputed, contextualized, and co-produced. To improve and not compromise health equity objectives, it is crucial to address these ethical aspects in case GIS-based zoning reforms are to proceed.

LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

There are some weaknesses of this review that should be considered when analyzing the results.

To begin with, the search strategy was based on one bibliographic database (ScienceDirect) and this could have led to the exclusion of any studies that were indexed in other databases or were published in other publications. Even though the coverage of urban planning, Geographic Information Systems, environmental science and research of public health has been well represented in ScienceDirect, the interdisciplinary scope of the synthesis could be limited due to the search being confined to a single database. Moreover, the use of peer-reviewed journal articles also presents the risk of publication bias because those studies that either produce statistically significant or policy-congruent results have high chances of publication. Omission of grey literature, government reports and planning practice documents can thus be biased against the implementation difficulties, politically constrained zoning reforms or null results in practice.

A second limitation relates to the predominant research approaches within the existing literature, which are largely oriented toward identifying and mapping spatial inequities, most specifically through accessibility assessments, exposure analyses, and spatial modeling techniques. Though these strategies are useful in establishing patterns of inequality, spatial scale differences, outcome measures, and forms of defining equity limit direct comparability of studies. Besides, causal inference is still restricted since most of the studies assess conditions at one point in time, under which the zoning and land-use policies are discussed more as contextual settings than policy interventions that are overtly assessed in terms of their health effects. Though this variety indicates the interdisciplinary and changing nature of GIS-enabling research in planning, it also indicates the need to have more coherence and more evaluative designs.

Future studies should focus more on longitudinal and quasi experimental studies on zoning and land-use reforms so that effects of health equity can be better evaluated over the course of time. Further expansion of the utilization of predictive modeling, machine learning, and Geographic Artificial Intelligence can help improve scenario testing and policy simulation compared to descriptive diagnostics. It is also vital to consider the general inclusion of participatory Geographic Information Systems and community-based spatial data, which could be used to supplement the administrative databases and improve procedural equity in zoning studies. Given such directions in methodology, the evidence base on equity-oriented zoning reform

will grow, and a more analytically rigorous and socially accountable planning practice will be supported.

CONCLUSION

This systematic review summarizes study-based research with GIS-enabled planning to show that zoning and land-use policies are an upstream determinant of health equity in the United States. The review enhances the current knowledge of the role of zoning choices in organizing health opportunities and burdens availed by urban space by synthesizing the existing body of research on housing regulation, accessibility, environmental exposure, and spatial risk. One of the key contributions of this paper is that it offers a disciplinary bridge between zoning and planning research and spatial health research: the conceptual framework of the article grounds GIS as a critical process of identifying, diagnosing, and judging health inequities. To this extent, the review streams in the literature gap related to synthetically connecting zoning policy, spatial evidence, and health equity results in one analytical synthesis.

The results are obviously applicable to the urban planners, policymakers, and practitioners in the various fields of urban health. To planners, the evidence suggests that zoning should be viewed not as a technical or economic tool but as a public health intervention with equity implications, with a long-term effect. To the policymakers, the review shows the importance of considering both the health and equity indicators in the zoning codes and land-use decision-making process, which should be backed by transparent and accountable GIS-based analysis. To professionals in the field of public health, the findings are used to support the necessity of involvement in land-use governance as an upstream intervention site. Together, the review is advocating a transition to equity-based, data-driven zoning, where spatial analytics are implemented to be used not as an apolitical optimization instrument but as a tool to promote spatial justice and structural health disparities and healthier, more equitable urban futures.

REFERENCES

1. Adu, S. A. G., Gyang, P. A. E. M., & Yakin, Z. "The role of GIS and spatial analysis in enhancing urban resilience and disaster response for vulnerable US communities." *World J Adv Res Rev* 27.1 (2025): 746-54.
2. Adu, S. A. G., Gyang, P. A. E. M., & Yakin, Z. "The role of GIS and spatial analysis in enhancing urban resilience and disaster response for vulnerable US communities." *World J Adv Res Rev* 27.1 (2025): 746-54.
3. Adu, S. A., & Aliu, A. "Community land trusts in Memphis: A blueprint for equitable and sustainable affordable housing." *World Journal of Advanced Engineering Technology and Sciences*, 17.2 (2025): 39–47.
4. Alvarez, C. H., Calasanti, A., Evans, C. R., & Ard, K. "Intersectional inequalities in industrial air toxics exposure in the United States." *Health & Place* 77 (2022): 102886.
5. Anandhi, A. "Literature review on environmental resilience: Frameworks, variables, scales, vulnerability, adaptation, perfect storms." *Environmental Development* 56 (2025): 101282.
6. Bai, X., Cao, K., & Tian, W. "How do community parks affect environmental justice for older adults: Insights from availability, accessibility, and attractiveness." *Urban Forestry & Urban Greening* (2025): 129017.
7. Bucholz, E. M., Day, R. T., Khazanchi, R., Alizadeh, F., Blossom, J., Bailey, D., & Moynihan, K. M. "Geospatial Accessibility of Pediatric Resources by Child Opportunity, Racial and Ethnic Composition and Urbanicity." *Academic Pediatrics* 25.5 (2025): 102817.
8. Chen, S., Wang, S., Sun, Y., & Liu, J. Y. W. "Development of a contextualized index of multiple deprivation for age-friendly cities: Evidence from Hong Kong." *Applied Geography* 167 (2024): 103285.
9. Chen, Y., & Li, Z. "Spatial heterogeneity and the dynamics of housing affordability in Hong Kong: A 22-year retrospective analysis." *Habitat International* 163 (2025): 103490.
10. Curtis, D. S., Kole, K., Brown, B. B., Smith, K. R., Meeks, H. D., & Kowaleski-Jones, L. "Social inequities in neighborhood health amenities over time in the Wasatch Front Region of Utah: Historical inequities, population selection, or differential investment?." *Cities* 145 (2024): 104687.
11. Dennis, A. C., Martinez, R. A. M., Chung, E. O., Lodge, E. K., & Wilbur, R. E. "The development, evolution, and maintenance of structural racism for the study of health inequities: An expanded framework for Asian, Black, Hispanic, Indigenous, and White Americans." *Social Science & Medicine* (2025): 118383.

12. DOREEN, U., ADETOLA, A. A., & FELIX, K. "Strategies to improve health equity through targeted public health initiatives." *INTERNATIONAL MEDICAL SCIENCE RESEARCH JOURNAL Ученители: Fair East Publishers* 5.2 (2025): 9-18.
13. Dzwonczyk, E. A., Anthamatten, P., & Crawford, B. R. "Heat and mortality in a semi-arid city: A multi-scalar analysis of the impacts of temperature in Denver, Colorado." *Urban Climate* 64 (2025): 102709.
14. Friedman, E., Lee, B., Kalman, C., & Wilson, N. "Historic racism in Kansas City affects today's pediatric asthma burden." *Health & place* 78 (2022): 102927.
15. Giles-Corti, B., Saghapour, T., Turrell, G., Gunn, L., Both, A., Lowe, M., & Higgs, C. "Spatial and socioeconomic inequities in liveability in Australia's 21 largest cities: Does city size matter?." *Health & place* 78 (2022): 102899.
16. Haque, M. N., & Sharifi, A. "Who are marginalized in accessing urban ecosystem services? A systematic literature review." *Land Use Policy* 144 (2024): 107266.
17. Jiao, J., Seong, K., Sammer, M., Lewis, R. H., Reese, A., Olvera, N., & Kakadiaris, I. "Developing a healthy food access index (HFAD): Web-based mapping and future directions for AI integrations." *Cities* 161 (2025): 105908.
18. Kato-Huerta, J., & Geneletti, D. "A distributive environmental justice index to support green space planning in cities." *Landscape and Urban Planning* 229 (2023): 104592.
19. Knox-Hayes, J., Agarwal, S., Arango-Quiroga, J., Ashford, N., Birge, D., Carolini, G., & Winer-Chan, R. "The equitable resilience framework: an environmental justice strategy for community-led resilience planning." *World Development Perspectives* 40 (2025): 100738.
20. Kodua, A. M., Olurunfemi, O. E., & Cudjoe-Mensah, y. M. "Advancing circular economy strategies for municipal solid waste management in the US: challenges and opportunities."
21. Kung, M., & Zhu, D. "What about my opposition!? The case of rural public hearing best practices during the COVID-19 pandemic." *Cities* 120 (2022): 103485.
22. Lee, E. K., Donley, G., Ciesielski, T. H., Yamoah, O., Roche, A., Martinez, R., & Freedman, D. A. "Health outcomes in redlined versus non-redlined neighborhoods: a systematic review and meta-analysis." *Social science & medicine* 294 (2022): 114696.
23. Lotsah, M., Gyang, P. A. E. M., Oluwabunmi, A., & Yakin, Z. "Evaluating the Impact of Urban Heat Island (UHI) mitigation strategies in southeastern US cities using high-resolution geospatial models." (2025).
24. Lowe, M., Adlakha, D., Sallis, J. F., Salvo, D., Cerin, E., Moudon, A. V., & Giles-Corti, B. "City planning policies to support health and sustainability: an international comparison of policy indicators for 25 cities." *The Lancet global health* 10.6 (2022): e882-e894.
25. Luan, H., Ransome, Y., Taggart, T., Chow, J., Mancuso, N., Grant, M., & Sullivan, P. "A comparison of HIV pre-exposure prophylaxis accessibility by public transit-and drive-time in Dallas-Fort Worth, Texas, 2024." *Health & Place* 96 (2025): 103550.
26. Malekzadeh, A., & Chung, E. "A review of transit accessibility models: Challenges in developing transit accessibility models." *International journal of sustainable transportation* 14.10 (2020): 733-748.
27. Minaravesh, B. "Identifying concentrations of overlapping environmental & economic insecurity in Los Angeles County." *Applied Geography* 178 (2025): 103575.
28. Mortaheb, R., & Jankowski, P. "Smart city re-imagined: City planning and GeoAI in the age of big data." *Journal of Urban Management* 12.1 (2023): 4-15.
29. Nizamani, M. M., Zhang, H. L., & Lai, Z. "Human-centered AI: advancing ethical, transparent, and context-aware systems for sustainable development." *Technology in Society* (2025): 103121.
30. Odoms-Young, A., Brown, A. G., Agurs-Collins, T., & Glanz, K. "Food insecurity, neighborhood food environment, and health disparities: state of the science, research gaps and opportunities." *The American journal of clinical nutrition* 119.3 (2024): 850-861.
31. Sadler, R. C., Gailey, S., & McNeely, E. R. "Physician and healthcare partner engagement in the creation of healthfulness indices for West Michigan." *Spatial and spatio-temporal epidemiology* 53 (2025): 100722.
32. Seraphim, A. P., Niu, H., Morgado, P., Miranda, B., & Silva, E. A. "Mapping urban health policies: A scoping review of environmental, behavioural and socioeconomic determinants of

- health." *Progress in Planning* 193 (2025): 100926.
33. Seyedrezaei, M., Becerik-Gerber, B., Awada, M., Contreras, S., & Boeing, G. "Equity in the built environment: A systematic review." *Building and Environment* 245 (2023): 110827.
34. Spriggs, A., Rotman, R., & Trauth, K. "Functional analysis of web-based GIS tools for environmental justice assessment of transportation projects." *Transportation Research Part D: Transport and Environment* 128 (2024): 104080
35. Van Tran, Q., Najafian, P., Hashemi, F., Morakinyo, T. E., & Ochoa, E. L. "Year-round heat exposure and structural spatial vulnerability: A case study of San Antonio, Texas." *Sustainable Cities and Society* (2025): 107021.
36. Waqas, M., Nazeer, M., Wong, M. S., Shaolin, W., Hon, L., & Heo, J. "Impact of urban spatial factors on NO₂ concentration based on different socio-economic restriction scenarios in US cities." *Atmospheric Environment* 316 (2024): 120191.
37. Xiao, D., Li, J., Liu, Y., Wang, T., Niu, C., Zhuang, R., & Zhang, L. "Emerging trends and hotspots evolution in cardiotoxicity: A bibliometric and knowledge-Map analysis From 2010 to 2022." *Frontiers in Cardiovascular Medicine* 10 (2023): 1089916.
38. Xu, M., de la Haye, K., MacDonald, B., & Wilson, J. P. "Rethinking food access at the household level under the 15-min city framework." *Cities* 170 (2026): 106657.
39. Yu, D., Fabolude, G., Knoble, C., & Vu, A. "Understanding lead exposure through data and domain expertise: Insights from New Jersey with a geographically weighted regression analysis." *Environmental Impact Assessment Review* 115 (2025): 108063.
40. Zhong, Z., Ma, Q., Fang, X., Kong, L., Cao, Q., Liu, L., & Du, S. "Who are marginalized? Unequal distribution of urban street shading in Shanghai." *Building and Environment* 283 (2025): 113361.
41. Zhou, S., Diao, H., Wang, M., Jia, W., Wang, Y., Liu, Z., & Zhao, Z. "Knowledge mapping and emerging trends of urban resilient infrastructure research in urban studies: Precedent work, current progress and future perspectives." *Journal of Cleaner Production* 452 (2024): 142087.

Source of support: Nil; Conflict of interest: Nil.

Cite this article as:

Botwe, F. F & Amissah-Mensah, E. "Data-Driven Zoning Reform and Health Equity in the United States: A Systematic Review of GIS-Enabled Planning Research Linking Housing Policy, Accessibility, and Community Health." *Sarcouncil Journal of Internal Medicine and Public Health* 5.3 (2026): pp 64-74.