



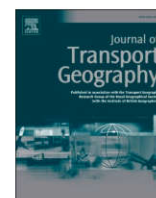
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Nonlinear and interaction effects of multiscale greenway environment factors on cycling behavior: Evidence from on-site photography and crowdsourced data

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ABSTRACT

Urban greenways provide a continuous and safe environment for cycling. However, studies focusing on cycling within greenways remain limited, and even fewer have examined the associations between multiscale greenway environment (GE) factors and cycling behavior. Using the Chengdu Ring Ecological Zone Greenway as a case study, this study uses on-site photography to assess microscale GE factors and crowdsourced Strava data to measure cycling volume, and develops eXtreme Gradient Boosting (XGBoost) and SHapley Additive Explanations (SHAP) models to examine the nonlinear and interaction effects of multiscale GE factors on cycling volume. The results demonstrate that: (1) distance to the central business district (CBD) is the most important GE factor, suggesting that the exclusion of regional destination accessibility metrics in many built environment-travel studies constitutes a significant oversight; (2) at the microscale, the visual diversity index and sky view index are the most important factors; (3) the influence of GE factors on cycling volume is similar across weekdays and weekends, but access-related factors matter more for discretionary leisure cycling on weekends; (4) nonlinear and threshold effects are observed in the relationships between GE factors and cycling volume; and (5) significant interaction effects are observed across multiscale combinations of GE factors. We suggest that policymakers and urban planners should integrate both microscale and macroscale GE factors into the design and development of cycling-friendly urban greenways.

1. Introduction

Physical activity has significant benefits for health. Maintaining appropriate levels of physical activity can decrease the risk of chronic diseases and enhance both physical and mental health (Götschi et al., 2016; Lee et al., 2012). The World Health Organization recommends that adults engage in at least 150–300 min of moderate-intensity or 75–150 min of vigorous-intensity physical activity per week. Consequently, promoting physical activity has emerged as a crucial strategy for improving public health. Among various forms of physical activity, cycling is a simple, low-impact aerobic exercise that places minimal stress on the joints and muscles. Regular cycling effectively improves cardiorespiratory fitness and physical endurance, contributing to the maintenance of optimal health (Götschi et al., 2016; Oja et al., 2011). Beyond its health benefits, cycling is also a sustainable mode of

transportation that helps decrease air pollution and alleviate traffic congestion, offering notable environmental benefits (De Hartog et al., 2010). Therefore, cycling has become an attractive choice for urban residents seeking both physical activity and green travel options.

Urban greenways, as multifunctional linear green infrastructure within cities, enhance the urban ecological environment (Ahern, 1995) and provide ideal venues for outdoor exercise, such as cycling and walking, for residents (Keith et al., 2018; Xie et al., 2023; Yang et al., 2025). Recently, with the global advancement of sustainable development strategies and growing emphasis on green infrastructure, many countries have actively promoted greenway construction. In China, large-scale greenway construction has become a key focus of urban planning and development (Liu et al., 2019). As of the end of 2024, the total length of urban greenways in the country had reached nearly 100,000 km. As greenway networks expand, cycling on greenways has grown

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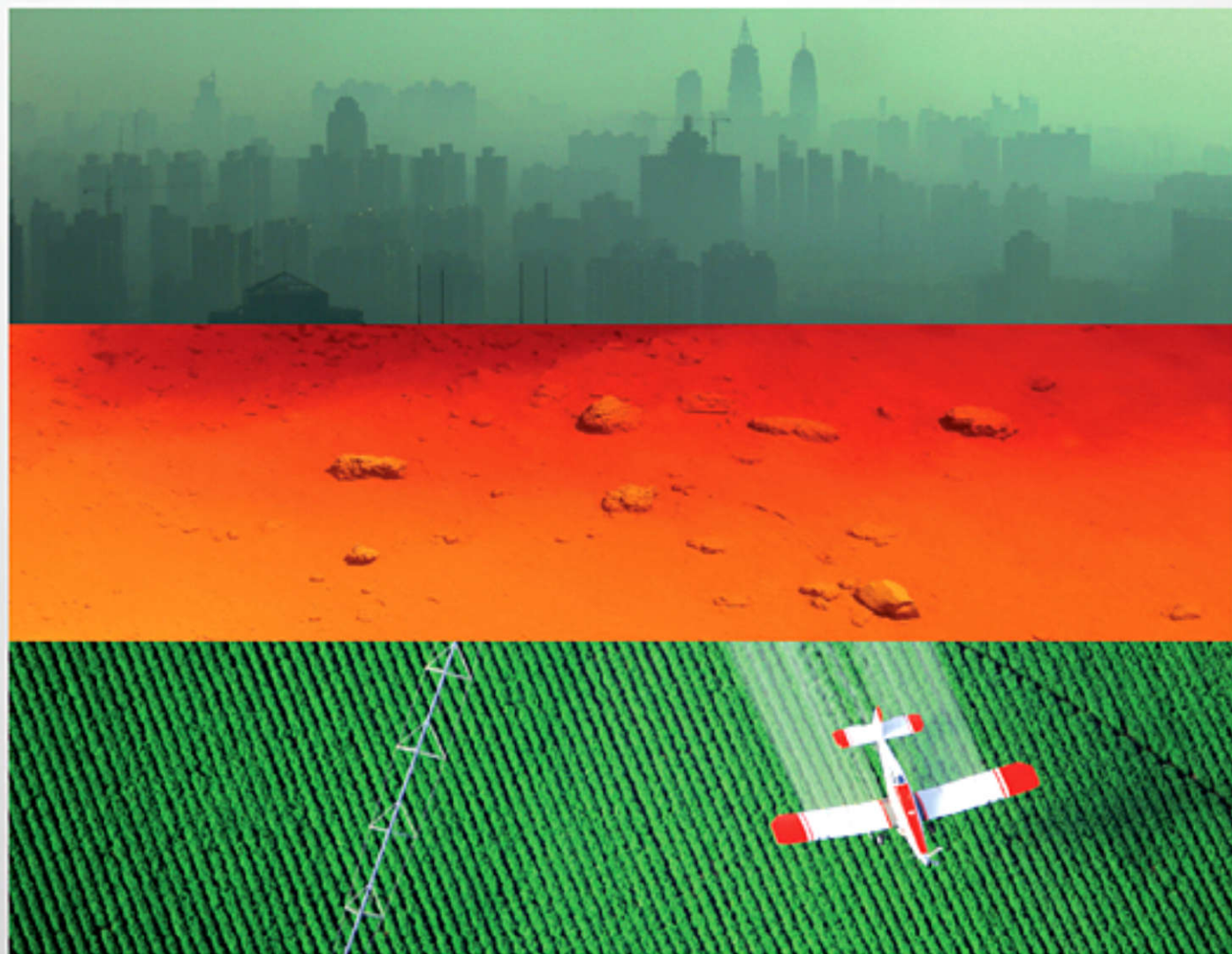
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environmental research





Beyond green availability: Socioeconomic deprivation and suicide mortality across multidimensional urban green space patterns in high-density Hong Kong

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ABSTRACT

Although urban green space (UGS) has been widely examined in relation to mental health, its association with suicide mortality remains insufficiently understood, particularly when moving beyond single indicators of green space. This cross-sectional ecological study examined the UGS pattern and its relationships with socioeconomic deprivation (SED) and suicide mortality (2019–2022) in Hong Kong using the large street block as the unit of spatial analysis. Latent profile analysis identified UGS patterns based on three complementary dimensions: availability, accessibility, and visibility. Multinomial logistic regression examined socioeconomic correlates of these patterns, and negative binomial regression assessed their associations with suicide mortality alongside SED, including interaction terms to examine variation in the SED-suicide mortality association across UGS patterns. Four UGS patterns were identified that reflected environmental inequalities. More socioeconomically advantaged areas were more likely to exhibit suburban neighborhoods with high availability and visibility. In contrast, more deprived areas were concentrated in dense urban cores with lower availability but relatively higher accessibility. Moreover, SED was positively associated with suicide mortality, and the positive association was weaker in neighborhoods characterized by relatively higher UGS accessibility, even where green space availability was relatively low. These findings highlight green space accessibility as a potentially important dimension for understanding spatial inequalities in suicide mortality in compact, high-density cities.

1. Introduction

Urban green space (UGS) is widely recognized as a public health promotion approach, especially for supporting mental health (Gong et al., 2024). A growing body of evidence has identified three main pathways linking UGS to mental health, including mitigation (reducing exposure to air and noise pollution), instoration (encouraging physical activity and social interaction), and restoration (facilitating psychological recovery and stress relief) (Markevych et al., 2017). However, empirical evidence regarding the association between UGS and suicide mortality remains limited and mixed (Feng et al., 2025; Helbich et al., 2020; B. Jiang et al., 2021; Mendoza et al., 2023). Some research has

found that greener environments are associated with lower suicide rates (Helbich et al., 2018; Kim and Sung, 2022), while other studies have identified no association between UGS and suicide mortality (Helbich et al., 2020; W. Jiang et al., 2021).

Such inconsistencies may be context-dependent and sensitive to how UGS is conceptualized and measured (Helbich et al., 2020). Availability, accessibility, and visibility represent distinct but complementary dimensions of UGS, and each may be linked to different pathways connecting UGS and mental health (Al-Kofahi and Al-Khlaief, 2025). Availability is more closely linked to the environmental functions of green space, such as mitigating air pollution, noise, and heat. Accessibility is more relevant to behaviorally mediated pathways, including

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轨道交通同城化对都市圈三级医院可达性及其空间公平性的影响

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摘要: 现有研究大多忽视都市圈层面轨道交通同城化对三级医院可达性及其空间公平性的影响。针对此问题, 引入两步移动搜索法和修正平均绝对偏差来分别评价可达性与空间公平性, 构建现状与轨道交通同城化两个场景, 以成都为例, 系统分析都市圈三级医院可达性及其空间公平性的演变。研究发现: 轨道交通同城化促进三级医院可达性的整体提升; 随着轨道交通同城化的推进, 可达性空间极化现象逐渐减弱, 同时无法获得优质医疗服务的区域也在减少, 但龙泉山脉东西两侧的可达性差异却愈发显著; 轨道交通同城化缩小可达性的空间差异, 促进空间公平。据此, 提出促进成都都市圈三级医院均衡化与高水平协同发展的优化策略。

关键词: 轨道交通同城化; 三级医院; 可达性; 空间公平; 成都都市圈

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Impact of Rail Transit Integration on Accessibility to Tertiary Hospitals and Its Spatial Equity in the Metropolitan Area

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Abstract: Most existing studies have overlooked the impact of rail transit integration at the metropolitan scale on accessibility to tertiary hospitals and its spatial equity. To address this gap, this study uses the two-step floating catchment area (2SFCA) model and the adjusted mean absolute deviation to measure accessibility to tertiary hospitals and its spatial equity, sets two scenarios (the status quo and the rail transit integration scenario), and evaluates the impact of rail transit integration on accessibility to tertiary hospitals and its spatial equity in the Chengdu Metropolitan Area. The results show that rail transit integration has substantially improved accessibility to tertiary hospitals. As rail transit integration progresses, spatial polarization in accessibility has gradually weakened, and the number of high-accessibility areas has declined. However, the accessibility gap between the eastern and western sides of the Longquan Mountains has become increasingly pronounced. Rail transit integration has reduced spatial disparities in accessibility to tertiary hospitals and fostered spatial equity. These findings provide valuable insights for the rational allocation of high-quality medical and rail transit resources.

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交互作用视角下蓝绿空间与建筑形态 对地表温度的影响研究*

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摘要: 快速城市化催生了极端气候频发和热岛效应加剧等一系列“城市病”,对城市可持续发展构成了挑战。尽管建筑形态和地表温度之间的关系被广泛分析,但蓝绿空间在二者中的调节机制尚未得到深入探讨。本文以广州市中心城区 2019 年夏、秋两季地表温度数据为基础,通过构建梯度提升回归树模型,定量评估蓝绿空间与建筑因子对地表温度的边际和交互作用。研究发现,建筑密度和近邻绿色空间面积分别是夏季、秋季地表温度的主导因子;各形态因子与地表温度呈非线性关系且存在阈值效应;交互视角下蓝绿空间对建筑形态与地表温度关系起到非线性调节作用,在特定条件下实现抑制升温或协调降温的效果。这些发现为制定系统性协同规划和针对性热岛效应缓解策略提供了新视角。

关键词: 城市热岛效应; 地表温度; 蓝绿空间因子; 建筑形态因子; 梯度提升回归树

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Effects of Blue-green Space and Building Morphology on Land Surface Temperature from the Perspective of Interaction

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Abstract: Rapid urbanization has led to a series of “urban diseases”, intensified frequent extreme weather events and urban heat island effect, posing significant challenges to urban sustainable development. While the relationship between building morphology and land surface temperature has been extensively studied, the regulatory mechanism of blue-green spaces in this interaction remains insufficiently explored. Based on summer and autumn LST data from central Guangzhou, this study employs a gradient boosting regression tree model to quantitatively evaluate the marginal and interactive effects of blue-green spaces and building factors on LST. The findings reveal seasonal variations in dominant influencing factors, non-linear relationships with threshold effects between morphological factors and LST, and non-linear regulatory effects of blue-green spaces on the building environment-LST relationship, which can inhibit temperature increase or facilitate cooling under specific conditions. These insights provide a novel perspective for developing targeted UHI mitigation strategies.

Keywords: Urban Heat Island (UHI) effect; land surface temperature; blue-green spatial features; building configuration features; gradient boosting regression trees

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科研项目工作量认定说明

彭一升同学（学号：2023300453），系我院 2023 级建筑学博士生，该生在 2025 年 9 月至 2026 年 8 月期间，曾深度参与了杨林川老师主持的多项科研项目，现对其工作量做如下认定：

项目来源	项目名称	项目编号	工作量认定
四川省第五次 全国经济普查 资料开发应用 课题	新质生产力赋能四川省国家 战略腹地建设：现实挑战 与实现路径	SCJP02	20%
四川省哲学社 会科学规划项 目四川统计发 展专项	四川城乡消费 基础设施均等 化测度研究	SC25TJ004	20%
成都市科技计 划项目	成都市低空经 济与城市空间 融合发展的路 径探索	2025-RK00-00042-ZF	30%

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项目负责人：杨林川

2026 年 9 月 10 日

四川省第五次全国经济普查资料开发应用课题 结项证书

立项编号：SCJP02

项目名称：新质生产力赋能四川省国家战略腹地建设：现实挑战
与实现路径

项目类别：重大

负责人：杨林川

主要参加人：王冰、彭迎澳、韩磊、彭一升、仇华龙、严琪胜

本项目经审核准予结项，等级**合格**，特发此证。

四川省第五次全国经济普查领导小组办公室

2025年12月25日

四川省哲学社会科学规划办公室

四川省哲学社会科学“十四五”规划 2025 年度 项目立项通知书

杨林川 同志：

经省社科联党组批准，您主持的四川省哲学社会科学研究“十四五”规划 2025 年度课题：四川城乡消费基础设施均等化测度研究(研究报告)，已获准立项。项目类别：四川统计发展专项(重点项目)，项目批准号：SC25TJ004，完成时间：2026 年 8 月。资助经费总额 5 万元，一次性拨付。

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四川省哲学社会科学规划办公室

2025 年 8 月 29 日



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西南交通大学:

贵单位牵头承担的成都市科技计划项目“成都市低空经济与城市空间融合发展的路径探索”已完成验收。

项目编号:2025-RK00-00042-ZF

验收评价结论:合格

2026年04月29日

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