



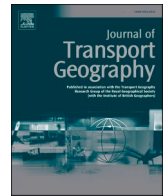
Volume 132, April 2026

ISSN 0966-6923

Journal of Transport Geography

**Published in association with the Transport Geography
Research Group of the Royal Geographical Society
(with the Institute of British Geographers)**





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

Ying'ao Peng^a, Yisheng Peng^a, Yuxin Cao^{a,b}, Linchuan Yang^{a,*}

^a Department of Urban and Rural Planning, School of Architecture, Southwest Jiaotong University, Chengdu, China

^b Department of Geography, Oklahoma State University, Stillwater, Oklahoma, USA

ARTICLE INFO

Keywords:

Built environment
Physical environment
Green corridor
Cycling activity
Interpretable machine learning

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

* Corresponding author.

E-mail addresses: pya0420@my.swjtu.edu.cn (Y. Peng), yisheng.peng@my.swjtu.edu.cn (Y. Peng), yuxin.cao@okstate.edu (Y. Cao), yanglc0125@swjtu.edu.cn (L. Yang).

<https://doi.org/10.1016/j.jtrangeo.2026.104637>

Received 16 September 2025; Received in revised form 22 January 2026; Accepted 15 March 2026

0966-6923/© 2026 Elsevier Ltd. All rights are reserved, including those for text and data mining, AI training, and similar technologies.

序号	标题	作者	计划栏目	稿号	学科	投稿时间↓	当前阶段	立即处理	申请撤稿
☐ 1	面向女性友好的步行环境影响因素及优化策略研究 	彭迎澳  杨林川 	NS2026[已截止]	2026.01.1006		2026/1/15	编辑部处理中 [录用]		申请

女性步行行为的建成环境影响因素及优化策略

Built environment factors influencing women's walking behavior and optimization strategies

彭迎澳¹, 杨林川^{1*}

PENG Ying' ao¹, YANG Linchuan^{1*}

1. 西南交通大学建筑学院, 成都

* 通信作者, E-mail: yanglc0125@swjtu.edu.cn

2026-01-15 收稿, 2026-03-24 修回, 2026-04-22 录用, 2026-XX-XX 网络版发表

国家自然科学基金面上项目 (52278080): 多尺度建成环境与老年人体力活动动态关联模型构建及适老环境优化研究

四川省杰出青年科学基金项目 (2025NSFJQ0016): 支持绿色出行的城市复杂建成环境优化机制与整合规划研究

摘要: 步行的健康效益受到日益关注。虽然已有研究聚焦于建成环境对步行行为的作用机制, 但从女性友好视角进行的相关研究仍较有限。本文基于成都市综合交通调查数据, 测算男女居民的日步行时长, 并采用极端梯度提升 (XGBoost) 模型分析社区建成环境与男女步行时长之间的非线性关系。研究发现: (1) 女性平均步行时长略高于男性; (2) 社区建成环境对女性步行时长的贡献为 75.11%, 明显高于社会经济属性 (24.89%), 其中天空率为最重要的影响因素; (3) 道路密度、绿视率、购物设施数量及公交站点数量等社区建成环境要素与步行时长存在复杂的非线性关系和阈值效应。基于实证结果, 本文提出女性友好步行环境规划策略, 为城市规划与政策制定提供科学依据。

Abstract: The health benefits of walking have gained growing attention. While previous studies have focused on uncovering the mechanisms through which the built environment affects walking behavior, research examining this issue from a women-friendly perspective is still limited. This study utilizes comprehensive travel survey data in Chengdu to measure the daily walking time across genders, and employs the XGBoost model to analyze the nonlinear associations between community-level built environment characteristics and walking time for both genders. The key findings are as follows: (1) The average walking time of women is slightly higher than that of men. (2) Built-environment variables account for 75.11% of the total feature importance in the female model, higher than socioeconomic attributes (24.89%). The sky view index is the most important factor. (3) Complex nonlinear and threshold effects are observed between walking time and built environment factors such as road density, green view index, the number of shopping facilities, and the number of bus stops. Based on the empirical findings, this study proposes planning strategies for a women-friendly walking environment, providing an evidence-based reference for urban planning and policy making.

关键词: 女性友好规划, 建成环境, 步行行为, 空间规划, 机器学习, 非线性关系

Keywords: women-friendly planning, built environment, walking behavior, spatial planning, machine learning, nonlinear relationships

科研项目工作量认定说明

彭迎澳同学（学号：2024310468），系我院 2024 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	40%
中国老年学和老年医学学会《中国老龄工作发展研究报告》专项课题	中国适老化交通的政策价值重构与全龄友好导向研究	CG0225ZX055	60%
四川省哲学社会科学规划项目“四川统计发展专项（重点项目）”	四川城乡消费基础设施均等化测度研究	SC25TJ004	30%

特此说明

项目负责人：杨林川
2026 年 9 月 7 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

中国老年学和老年医学学会

结题证明

杨林川：

您负责的课题已完成预定研究任务，现准予结题。特此证明！

课题编号：CAGG2025ZX055

课题名称：中国适老化交通的政策价值重构与全龄友好
导向研究

课题成员：陈杰、姜宇逍、彭迎澳、刘卓玥、杨梓源、
范文韬、严琪胜

中国老年学和老年医学学会

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。

省社科规划项目一经批准，其申请书即成为有约束力的协议。课题组必须严格遵守《四川省哲学社会科学规划项目管理办法(试行)》等有关规定，认真开展研究工作，加强学风建设，强化学术规范，合理使用资助经费，确保课题按时结题验收，取得高质量的研究成果。对不能完成或没有通过鉴定结项的成果，规划办将作出终止或撤销项目的决定，并按有关规定追回项目经费，项目负责人 3 年或 5 年内不得申请或者参与申请省社科规划项目。

四川省哲学社会科学规划办公室

2025 年 8 月 29 日

