



健康领域常用的环境暴露观测工具的发展

健康地理学青年学者论坛2024 珠海 5.26

戴劭劼

荷兰特温特大学地理信息与对地观测学院 (ITC)

武汉大学空间全生命周期健康国际研究中心 (ISLE)

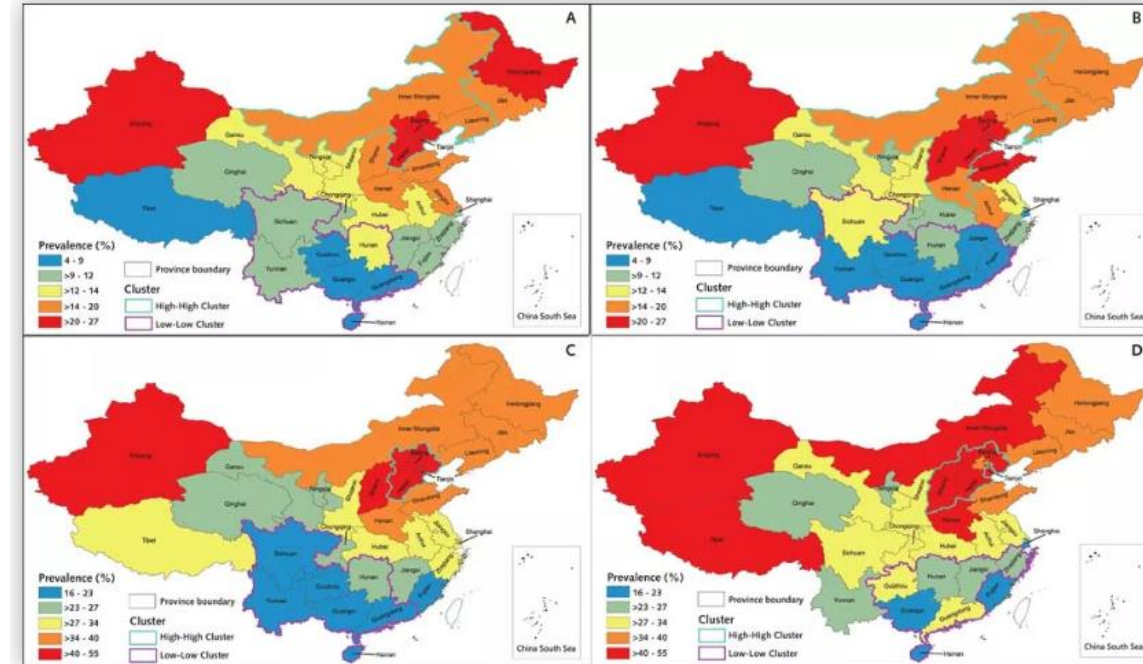
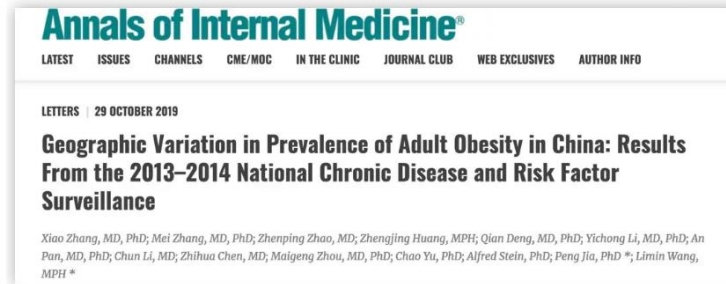
目录

- 环境暴露与肥胖的关联研究
- 循证医学式的系统综述框架
- 地理大数据赋能城市暴露观测
- 小结与展望

环境暴露与肥胖的关联研究

近日，一则关于“中国成年人肥胖地图”的研究刷爆了朋友圈。

在这篇发表于 *Annals of Internal Medicine* 杂志上的文章中，来自国家疾病预防控制中心的王丽敏教授团队分析了2013年-2014年间我国各省份的肥胖人群比例及流行趋势，进而为我国的肥胖现状及其带来的公共健康问题敲响了警钟¹。

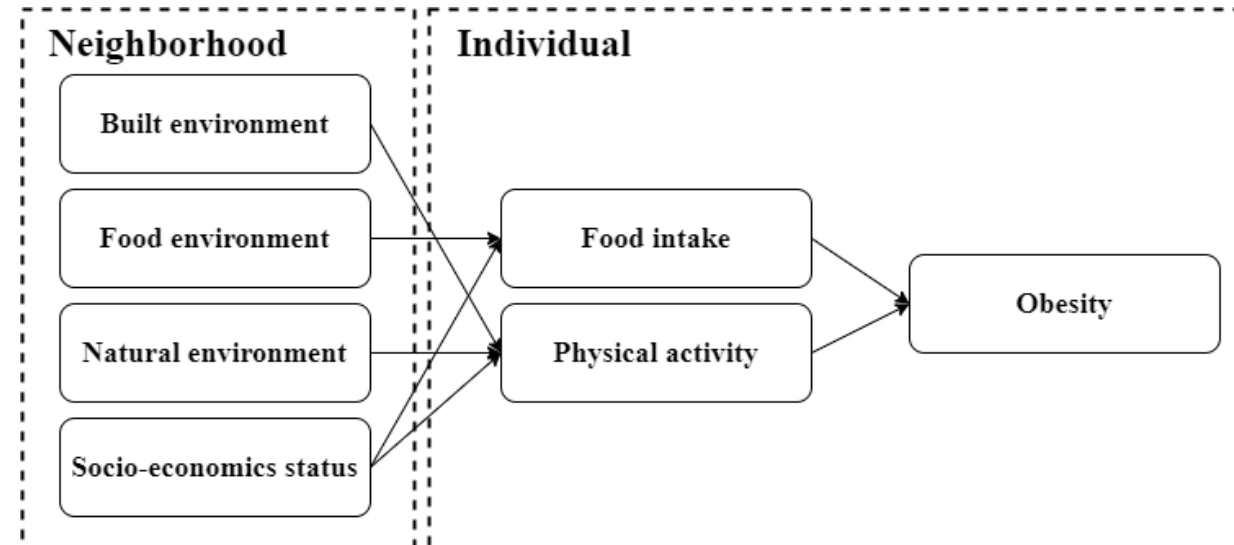
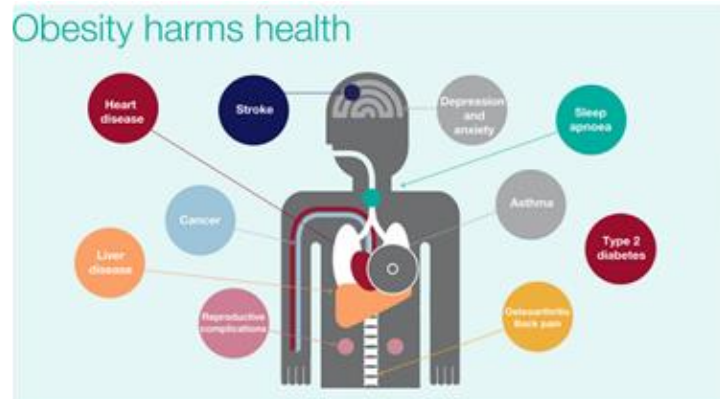


(各省份肥胖分布图。A. 男性普通肥胖；B. 女性普通肥胖；C. 男性腹部肥胖；D. 女性腹部肥胖。

颜色由蓝到红指征肥胖率由低到高。图片来源: Zhang X, 2019)

Zhang X. et al. (2019). *Annals of Internal Medicine*

环境暴露与肥胖的关联研究



Dai, S., Qiu, G., Li, Y., Yang, S., Yang, S., & Jia, P. (2024) State of the Art of Lifecourse Cohort Establishment. *China CDC Weekly*, 6(14), 300-304. (IF=4.7)

环境暴露与肥胖的关联研究



Volume 22, Issue S1
Special Issue: Obesogenic Environment and Childhood Obesity
 February 2021
 Issue Edited by: Peng Jia

[< Previous Issue](#) | [Next Issue >](#)

[Export Citation\(s\)](#) | [Download PDF\(s\)](#)

Obesogenic Environment and Childhood Obesity

ISSUE INFORMATION

[Free Access](#)

Issue Information

e13206 | First Published: 08 March 2021

[Abstract](#) | [PDF](#) | [Request permissions](#)

SUPPLEMENT ARTICLES

[Free Access](#)

Obesogenic environment and childhood obesity

Peng Jia

e13158 | First Published: 30 November 2020

[Abstract](#) | [Full text](#) | [PDF](#) | [References](#) | [Request permissions](#)

[Open Access](#)

Association between access to convenience stores and childhood obesity: A systematic review

Junguo Xin, Li Zhao, Tong Wu, Longhao Zhang, Yan Li, Hong Xue, Qian Xiao, Ruiou Wang, Peiyao Xu, Tommy Visscher, Xiao Ma, Peng Jia

e12908 | First Published: 05 July 2019

[Abstract](#) | [Full text](#) | [PDF](#) | [References](#) | [Request permissions](#)

Access to public transport and childhood obesity: A systematic review

Fei Xu, Lingling Jin, Zhenzhen Qin, Xiang Chen, Zhen Xu, Jing He, Zhiyong Wang, Wen Ji, Fu Ren, Qingyun Du, Yaqing Xiong, Peng Jia

e12987 | First Published: 30 January 2020

[Abstract](#) | [Full text](#) | [PDF](#) | [References](#) | [Request permissions](#)

[Open Access](#)

Neighborhood sidewalk access and childhood obesity

Junxiang Wei, Yang Wu, Jing Zheng, Peng Nie, Peng Jia, Youfa Wang

e13057 | First Published: 07 July 2020

[Abstract](#) | [Full text](#) | [PDF](#) | [References](#) | [Request permissions](#)

[Open Access](#)

Access to bike lanes and childhood obesity: A systematic review and meta-analysis

Xiongfen Pan, Li Zhao, Jiayou Luo, Yin hao Li, Lin Zhang, Tong Wu, Melody Smith, Shaoqing Dai, Peng Jia

e13042 | First Published: 18 May 2020

[Abstract](#) | [Full text](#) | [PDF](#) | [References](#) | [Request permissions](#)

[Open Access](#)

Street connectivity, physical activity, and childhood obesity: A systematic review and meta-analysis

Peng Jia, Yuxuan Zou, Zhifeng Wu, Dong Zhang, Tong Wu, Melody Smith, Qian Xiao

e12943 | First Published: 10 September 2019

[Abstract](#) | [Full text](#) | [PDF](#) | [References](#) | [Request permissions](#)

[Open Access](#)

Neighbourhood residential density and childhood obesity

Yuxuan Zou, Yanan Ma, Zhifeng Wu, Yang Liu, Min Xu, Ge Qiu, Heleen Vos, Peng Jia, Limin Wang

e13037 | First Published: 14 May 2020

[Abstract](#) | [Full text](#) | [PDF](#) | [References](#) | [Request permissions](#)

[Open Access](#)

Neighbourhood speed limit and childhood obesity

Miyang Luo, Hanqi Li, Xiongfen Pan, Teng Fei, Shaoqing Dai, Ge Qiu, Yuxuan Zou, Heleen Vos, Jiayou Luo, Peng Jia

e13052 | First Published: 12 July 2020

[Abstract](#) | [Full text](#) | [PDF](#) | [References](#) | [Request permissions](#)

Green space access in the neighbourhood and childhood obesity

Peng Jia, Xinxi Cao, Hongxi Yang, Shaoqing Dai, Pan He, Ganlin Huang, Tong Wu, Yaogang Wang

e13100 | First Published: 14 July 2020

[Abstract](#) | [Full text](#) | [PDF](#) | [References](#) | [Request permissions](#)

[Open Access](#)

Association between neighborhood aesthetics and childhood obesity

Pengfei Qu, Miyang Luo, Yang Wu, Fan Zhang, Heleen Vos, Xinqian Gu, Yang Mi, Xiaoqin Luo, Peng Jia

e13079 | First Published: 28 July 2020

[Abstract](#) | [Full text](#) | [PDF](#) | [References](#) | [Request permissions](#)

[Open Access](#)

Land use mix in the neighbourhood and childhood obesity

Peng Jia, Xiongfen Pan, Fangchao Liu, Pan He, Weiwei Zhang, Li Liu, Yuxuan Zou, Liding Chen

e13098 | First Published: 02 August 2020

[Abstract](#) | [Full text](#) | [PDF](#) | [References](#) | [Request permissions](#)

[Open Access](#)

Urban sprawl and childhood obesity

Tong Wu, Shujuan Yang, Meijing Liu, Ge Qiu, Hanqi Li, Miyang Luo, Peng Jia

e13091 | First Published: 17 August 2020

[Abstract](#) | [Full text](#) | [PDF](#) | [References](#) | [Request permissions](#)

[Open Access](#)

Traffic-related environmental factors and childhood obesity: A systematic review and meta-analysis

Zhuo Wang, Li Zhao, Qin Huang, Andy Hong, Chao Yu, Qian Xiao, Bin Zou, Shuming Ji, Longhao Zhang, Kun Zou, Yi Ning, Junfeng Zhang, Peng Jia

e12995 | First Published: 30 January 2020

[Abstract](#) | [Full text](#) | [PDF](#) | [References](#) | [Request permissions](#)

[Open Access](#)

Natural environment and childhood obesity: A systematic review

Peng Jia, Shaoqing Dai, Kristen E. Rohli, Robert V. Rohli, Yanan Ma, Chao Yu, Xiongfen Pan, Weiqi Zhou

e13097 | First Published: 01 September 2020

[Abstract](#) | [Full text](#) | [PDF](#) | [References](#) | [Request permissions](#)

Obesogenic Environment and Childhood Obesity. (2021) *Obesity Reviews*. (IF=8.9)

环境暴露与肥胖的关联研究

- 16种环境因子(10种建成环境因子, 6种食品环境)
- 3种复合环境因子(可步行性, 自然环境, 交通环境)
- 24,155初始检索文献→ 纳入457篇研究(PRISMA)



Jia, P., Shi, Y., Jiang, Q., **Dai, S.**, Yu, B., Yang, S., ... & Yang, S. (2023) Environmental determinants of childhood obesity: a meta-analysis. *The Lancet Global Health*, 11, S7. (IF=34.3)

环境暴露与肥胖的关联研究

Environment	Factors	Weight-related behaviors	Weight-related outcomes
Built environment	Street connectivity	+	*
	Residential density	+	*
	Speed limit	-	X
	Land use mix	+	X
	Urban sprawl	X	X
	Green space access	+	X
	Public transport access	+	X
	Bike lanes access	*	X
	Sidewalk access	+	-
	Aesthetics	X	X
Food environment	Convenience stores	-	X
	Fruit and vegetable markets	X	X
	Grocery stores	X	X
	Full-service restaurants	X	X
	Fast-food restaurants	X	X
	Supermarkets	X	X
Composite environment	Natural environment	X	X
	Walkability	X	X
	Traffic-related environment	X	+

[+] positive associations, [-] negative associations, [*] mixed associations, [x] unclear associations.

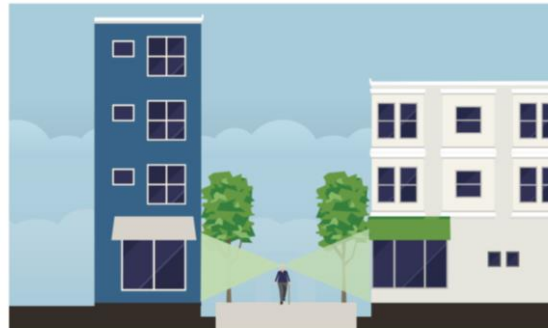
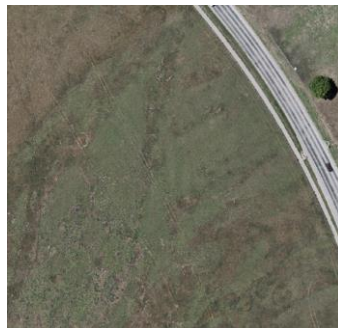
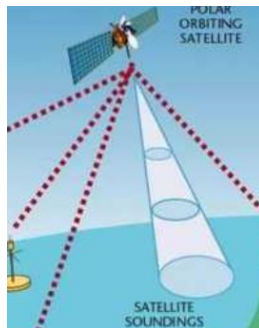
Jia, P., Shi, Y., Jiang, Q., **Dai, S.**, Yu, B., Yang, S., ... & Yang, S. (2023) Environmental determinants of childhood obesity: a meta-analysis. *The Lancet Global Health*, 11, S7. (IF=34.3)

环境暴露与肥胖的关联研究

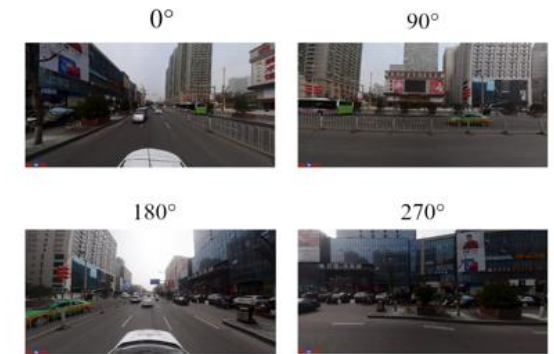
- 环境暴露测度工具：对地观测 → 人本观测

The performance of GIS-based and self-reported environment measures in explaining weight status outcomes was more complex. The most obvious finding was that almost all self-reported environment variables were significantly related to weight status, compared with very few significant associations for GIS-measured environment variables. The only common finding was that multi-component index variables were significant for the relation of both GIS-based and self-reported environment variables with overweight/obesity, reinforcing the importance of multivariable conceptualization and measurement of environments. The limited findings with GIS-based variables were partly explained by the sex-specific associations with weight status reported in the original paper (22).

Sallis, J. F., et al. (2020). *Annual reviews of Public Health*



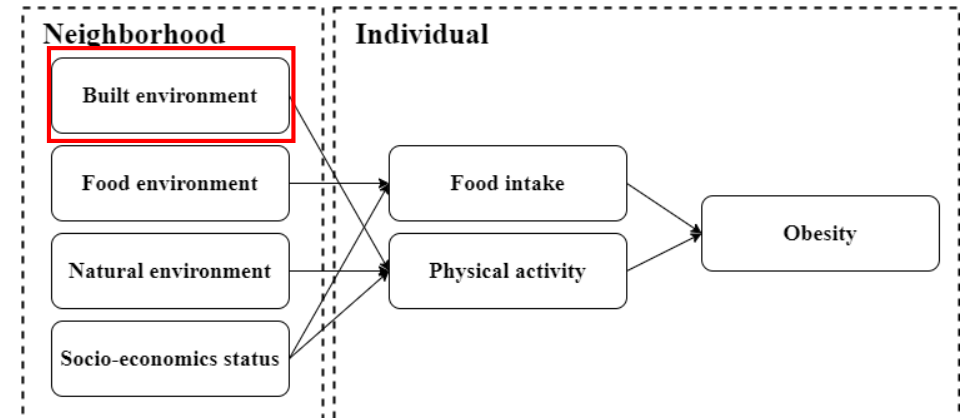
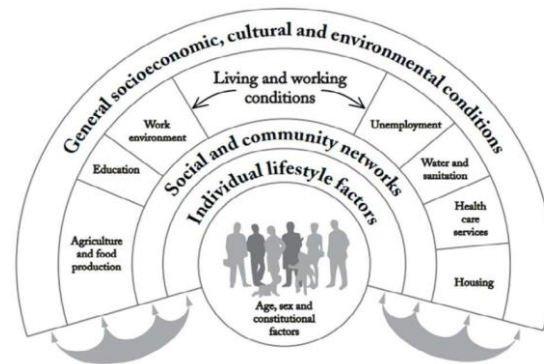
GIS客观测度与感知的差异
可达性 ≠ 实际行为



Dai, S., Li, Y., Stein, A., Yang, S., & Jia, P. (2024) Street view imagery-based built environment auditing tools: a systematic review. *International Journal of Geographical Information Science*, 1-22. (IF=5.7)

环境暴露与肥胖的关联研究


- 主动随访队列 (Biobank, CKB, HELIX, FHS, Nurse)
- 基于注册数据的队列建设 (Nordic countries, England, Australia, China)
- 基于先进技术的数据收集方式 (Satellite, Wearable device, **Street view images**)
- 未来全生命周期人群队列建设的思考



Dai, S., Qiu, G., Li, Y., Yang, S., Yang, S., & Jia, P. (2024) State of the Art of Lifecourse Cohort Establishment. *China CDC Weekly*, 6(14), 300-304. (IF=4.7)

环境暴露与肥胖的关联研究

- 环境暴露测度工具的一种典型表现：建成环境审计，建成环境有什么？怎么样？



If you do not see a pedestrian, cycle, motorcycle, scooter, car, or bus please click NEXT. Note that vehicles can be moving or parked.

Else, specify the number of pedestrians, cyclists, parked cycles, and motor vehicles you see in the image. If you are unsure please put the closest answer without spending too long.

	0	1-3	4-6	more than 6
Number of pedestrians	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Number of cyclists	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Number of parked cycles	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Number of cars	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Number of buses	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Number of motorcycles/scooters	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Number of vans/trucks	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Flag an issue with the image

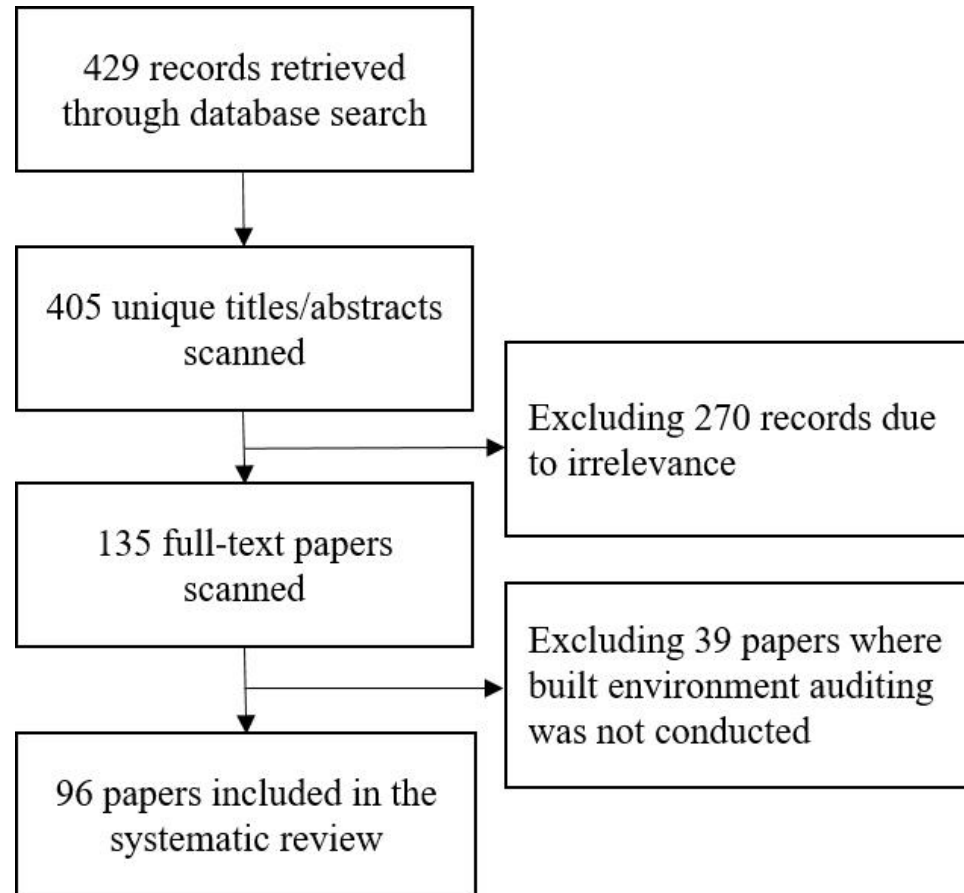
Dai, S., Li, Y., Stein, A., Yang, S., & Jia, P. (2024) Street view imagery-based built environment auditing tools: a systematic review. *International Journal of Geographical Information Science*, 1-22. (IF=5.7)

循证医学式的系统综述框架

- 以PubMed 与Web of Science两个数据库进行文献检索
- 时间截止至2023年10月
- 关键词包含：
 - ‘built environment* audit’, ‘auditing’, and ‘virtual audit*’
 - ‘streetview*’, ‘street view*’, ‘street-view*’, and ‘street view image*’
- 筛选标准：完整的建成环境要素审计

Dai, S., Li, Y., Stein, A., Yang, S., & Jia, P. (2024) Street view imagery-based built environment auditing tools: a systematic review. *International Journal of Geographical Information Science*, 1-22. (**IF=5.7**)

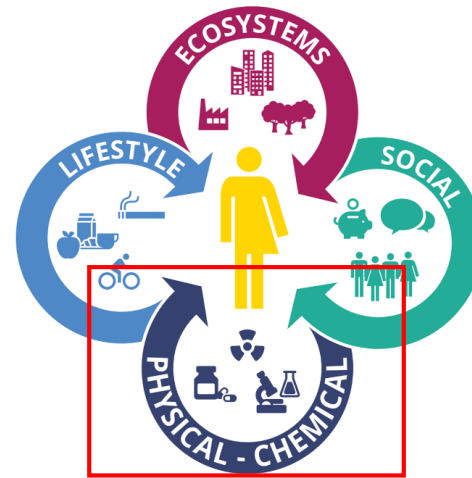
循证医学式的系统综述框架



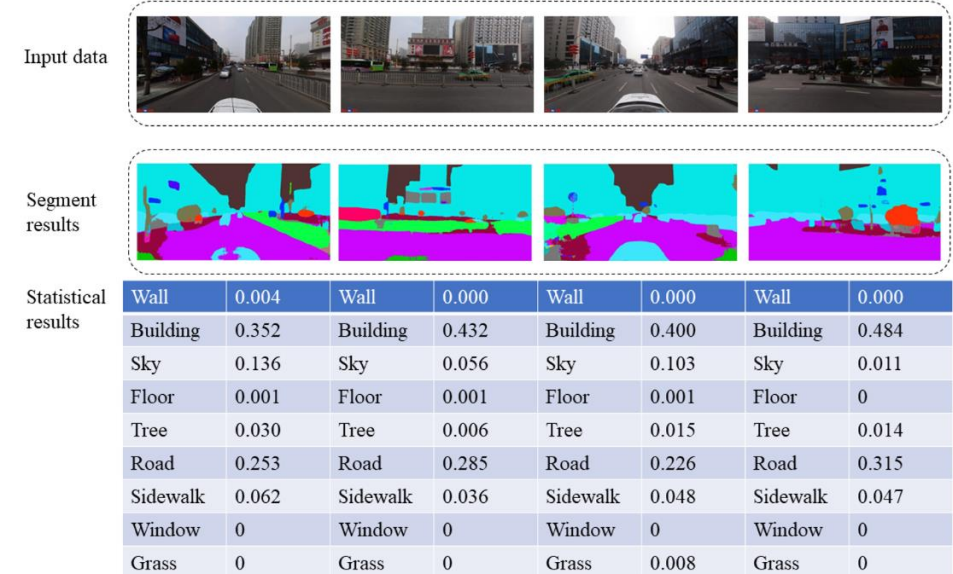
Dai, S., Li, Y., Stein, A., Yang, S., & Jia, P. (2024) Street view imagery-based built environment auditing tools: a systematic review. *International Journal of Geographical Information Science*, 1-22. (IF=5.7)

地理大数据赋能城市暴露观测

- Exposome (暴露组学): 从出生开始的环境暴露总量
- Bridging the BEA and urban exposome observation through SVI



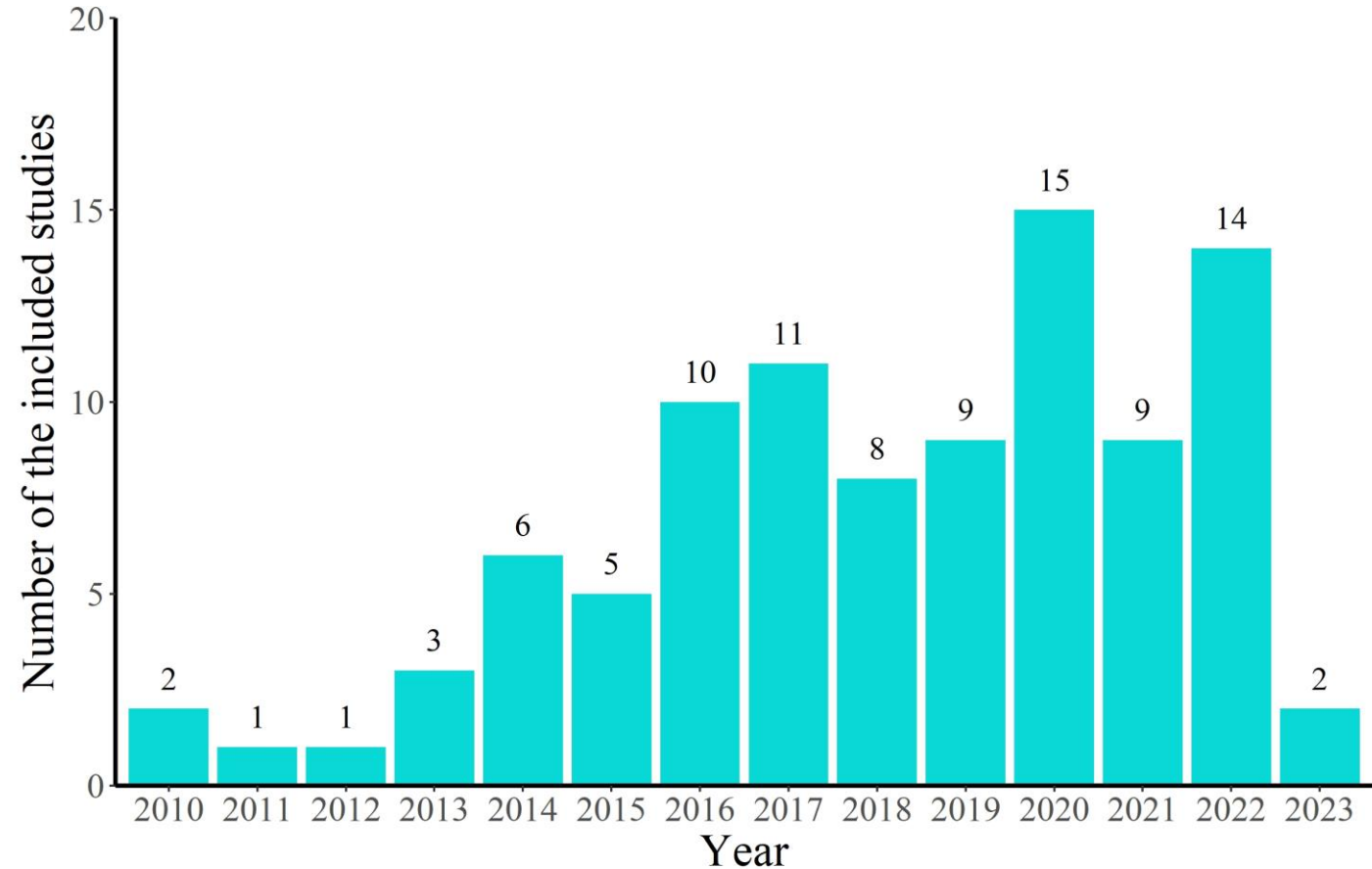
Vermeulen R., et al. (2020). *Science*



Dai, S., Li, Y., Stein, A., Yang, S., & Jia, P. (2024) Street view imagery-based built environment auditing tools: a systematic review. *International Journal of Geographical Information Science*, 1-22. (IF=5.7)

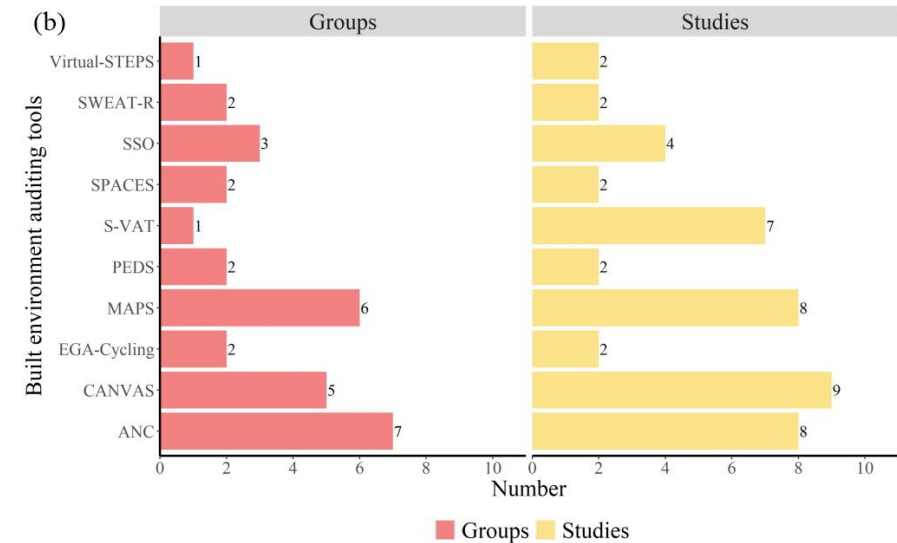
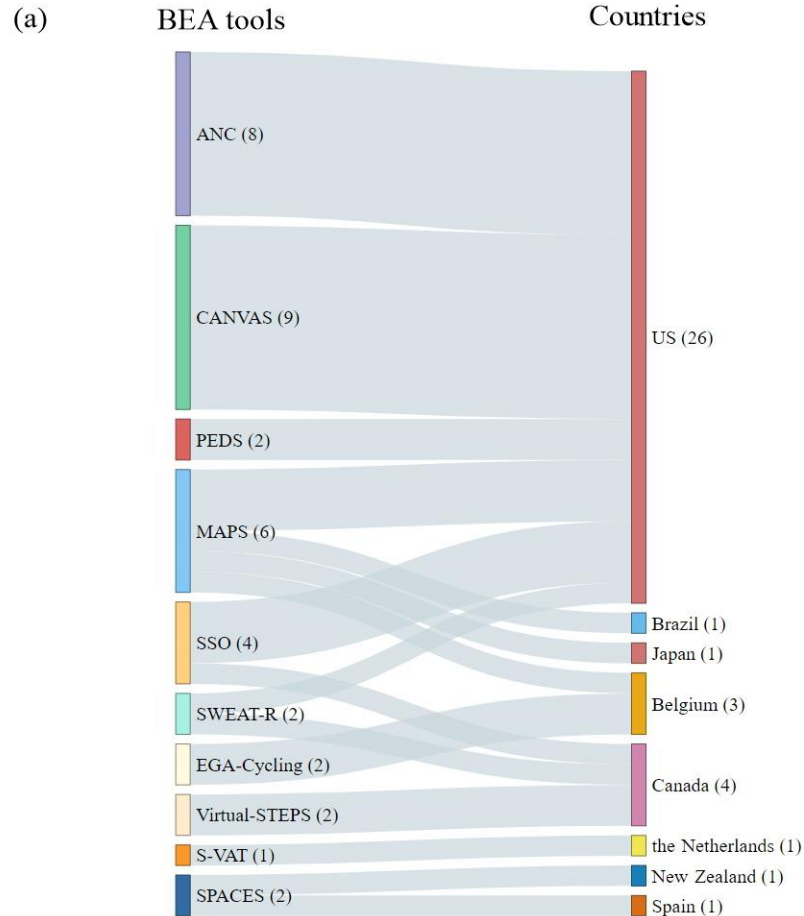
地理大数据赋能城市暴露观测

- 92.7% 基于谷歌街景
- 81.3% 基于人工审计
- 深度学习的兴起



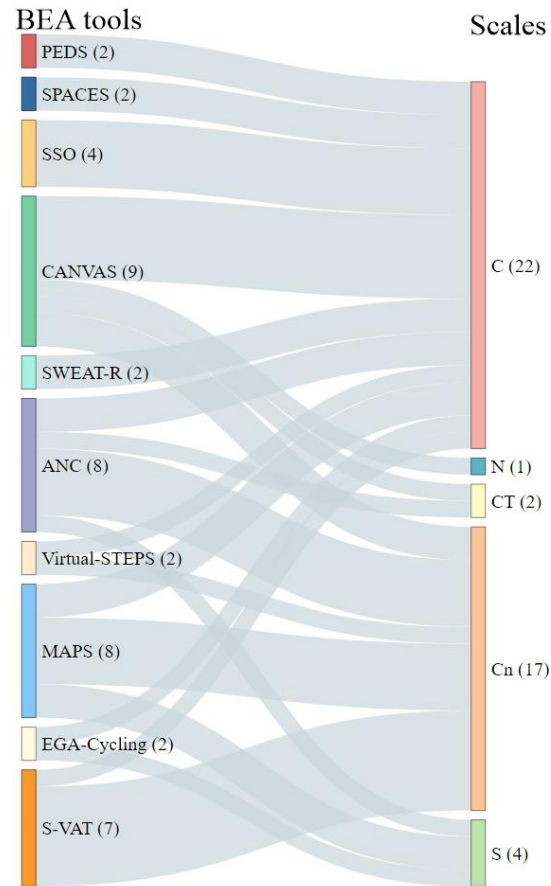
Dai, S., Li, Y., Stein, A., Yang, S., & Jia, P. (2024) Street view imagery-based built environment auditing tools: a systematic review. *International Journal of Geographical Information Science*, 1-22. (IF=5.7)

地理大数据赋能城市暴露观测



Dai, S., Li, Y., Stein, A., Yang, S., & Jia, P. (2024) Street view imagery-based built environment auditing tools: a systematic review. *International Journal of Geographical Information Science*, 1-22. (IF=5.7)

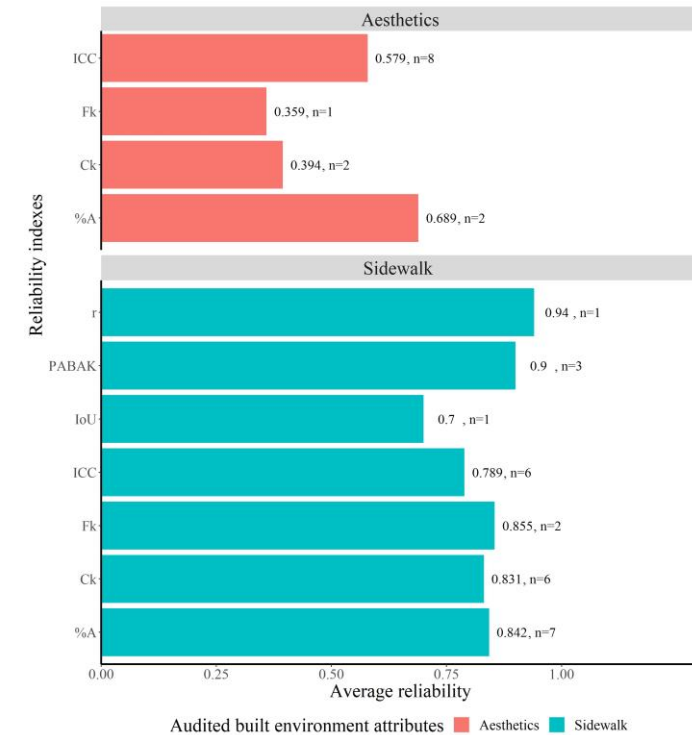
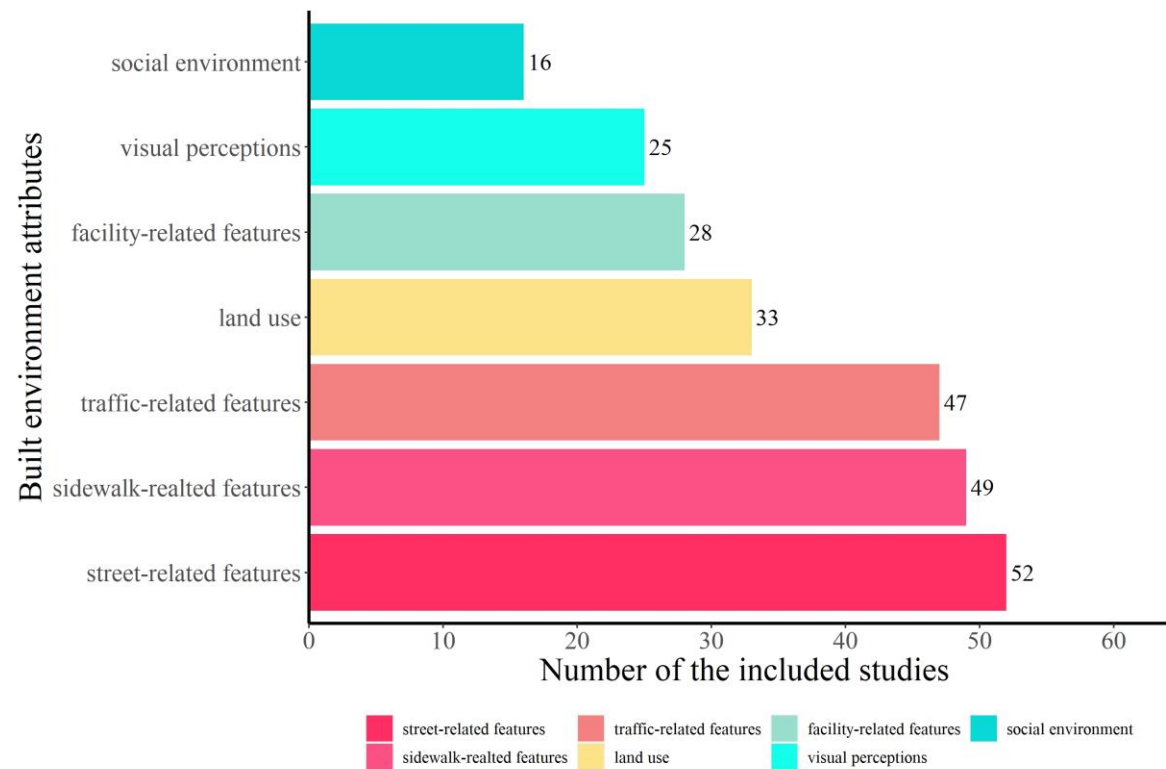
地理大数据赋能城市暴露观测



Auditing tools	Purpose	Applied scenes	Audited attributes
ANC	Assessing key street-level features related to physical activity	Physical activity-related studies	<ul style="list-style-type: none"> - Land use types - Sidewalks - Shoulders and bike lanes - Street characteristics - Quality of the environment for pedestrians
CANVAS	Measuring built environmental exposures of interest and environmental effect modifiers	Built environmental exposures and environmental effect-related studies	<ul style="list-style-type: none"> - Aesthetics - Physical disorder - Pedestrian safety - Motorized traffic and parking - Infrastructure for active travel - Sidewalk amenities - Human presence and social interactions
EGA-Cycling	Assessing the physical environmental characteristics of cycling routes to school	Cycling-related studies	<ul style="list-style-type: none"> - Land use types - Characteristics of street segment - Cycling facilities - Pedestrian facilities - Aesthetics
MAPS	Examining the associations between microscale environmental attributes and macro-level neighborhood walkability	Walkability-related studies	<ul style="list-style-type: none"> - Routes - Street segments - Crossings - Cul-de-sac
PEDS	Assessing the walking environment	Walkability-related studies	<ul style="list-style-type: none"> - Environment - Pedestrian facilities - Road attributes - Walking/Cycling environment
S-VAT	Identifying and comparing environmental characteristics to assess the obesogenicity of neighborhoods	Obesity-related studies	<ul style="list-style-type: none"> - Walking - Cycling - Public transport - Aesthetics - Land use mix - Grocery stores - Food outlets - Recreational facility-related items
SPACES	Assessing the walking and cycling environment	Active transport behaviors-related studies	<ul style="list-style-type: none"> - Walking/Cycling function - Walking/Cycling safety - Walking/Cycling aesthetics - Walking/Cycling destinations
SSO	Examining some phenomenon or aspect of behavior	Social-related studies	No uniform audited attributes
SWEAT-R	Understanding the influence of the physical environment on physical activity of older adults	Physical activity-related studies in elders	<ul style="list-style-type: none"> - Functionality - Safety - Aesthetics - Destinations and facilities
Virtual-STEPS	Auditing instruments that can be used for widespread surveillance at local, provincial, and national levels	Auditing infrastructure	<ul style="list-style-type: none"> - Pedestrian infrastructure - Traffic calming and streets - Building characteristics - Bicycling infrastructure - Transit - Aesthetics/disorder

Dai, S., Li, Y., Stein, A., Yang, S., & Jia, P. (2024) Street view imagery-based built environment auditing tools: a systematic review. *International Journal of Geographical Information Science*, 1-22. (IF=5.7)

地理大数据赋能城市暴露观测



Dai, S., Li, Y., Stein, A., Yang, S., & Jia, P. (2024) Street view imagery-based built environment auditing tools: a systematic review. *International Journal of Geographical Information Science*, 1-22. (IF=5.7)

地理大数据赋能城市暴露观测

- **Urban exposome observation: earth observation→human-center observation**
- **街道**是最常审核的对象（54.2%），其次是**人行道**（51%）、交通（49%）和土地使用（34.4%）
- 与主观属性（例如邻里环境感知）相比，客观属性有更高的可靠性
- **Active Neighborhood Checklist**与**Microscale Audit of Pedestrian Streetscapes**是两种应用最广泛的环境暴露观测工具

Dai, S., Li, Y., Stein, A., Yang, S., & Jia, P. (2024) Street view imagery-based built environment auditing tools: a systematic review. *International Journal of Geographical Information Science*, 1-22. (IF=5.7)

地理大数据赋能城市暴露观测

- 街景图像在**捕获建成环境**的某些属性方面表现良好，能够有效地提高**环境暴露观测**的准确性
- 街景图像在促进环境健康中**城市暴露观测**方面具有巨大潜力。与遥感或实地观测等替代观测方法相比，**街景图像**提供了一种可以在**人的视线水平**捕获**城市物理环境**的高效方法

Dai, S., Li, Y., Stein, A., Yang, S., & Jia, P. (2024) Street view imagery-based built environment auditing tools: a systematic review. *International Journal of Geographical Information Science*, 1-22. (**IF=5.7**)

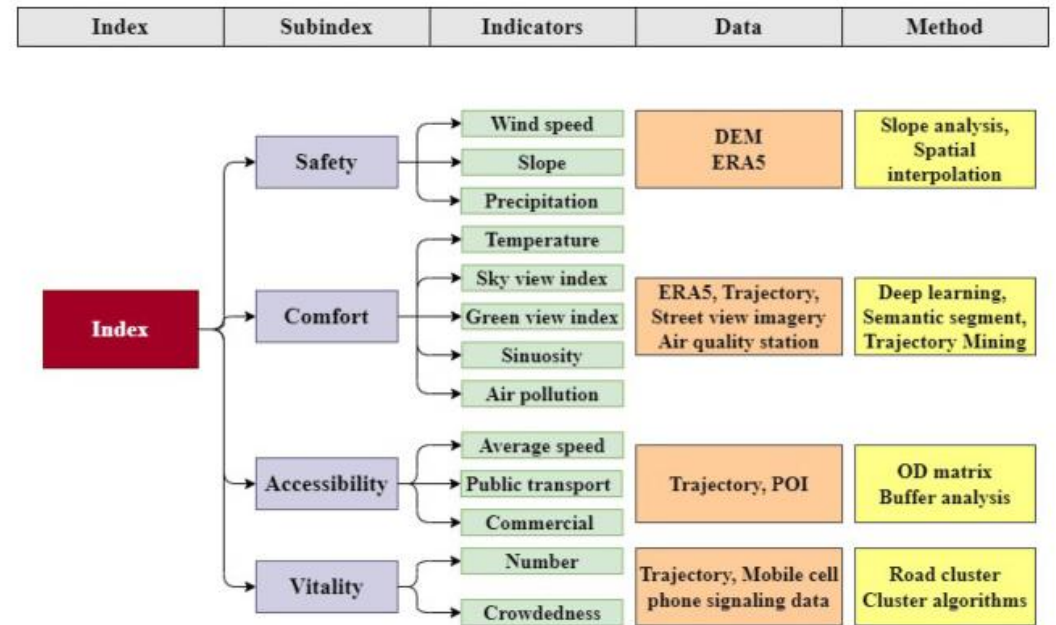
小结与展望

- 亟需将**人工智能**的力量与街景图像相结合，建立具有不变或稳定几何信息的通用**观测城市环境暴露**的**标准数据集**
- 亟需探索使用**多源街景图像**与其他**遥感影像数据**的**融合**，以促进创建空间完整且时间一致的**城市场景**
- 重点关注针对**发展中国家**独特情况定制和验证环境暴露观测工具至关重要。

Dai, S., Li, Y., Stein, A., Yang, S., & Jia, P. (2024) Street view imagery-based built environment auditing tools: a systematic review. *International Journal of Geographical Information Science*, 1-22. (**IF=5.7**)

小结与展望

- 一些探索（环境暴露与体力活动的关联）
- 环境暴露与骑行行为
 - 传统可骑行性评估的指标
 - 以人为本的环境感知指标
 - 过去忽视的自然环境指标
 - 实际骑行行为的轨迹指标



Dai, S., Zhao, W., Wang, Y., Huang, X., Chen, Z., Lei, J., ... & Jia, P. (2023) Assessing spatiotemporal bikeability using multi-source geospatial big data: A case study of Xiamen, China. *International Journal of Applied Earth Observation and Geoinformation*, 125, 103539. **(IF=7.5)**

小结与展望

■ 一些探索 (环境暴露与体力活动的关联)

方法

数据

- 共享单车轨迹 (赛事提供)
- 街景数据 (百度地图)
- 手机信令数据 (联通)
- POI (百度地图)
- 空气质量数据 (网络开源大数据)
- 气象再分析数据 (欧洲哥白尼气候数据平台)
- 数字高程模型 (地理空间数据云)

序号	名称	主要字段	提供数据	数据来源
1	30 m DEM 数据	高程值	1 米	地理空间数据云
2	共享单车轨迹数据	车辆编号, 经纬度, 定位时间	约 979 万	官网提供
3	路网数据	道路名称	约 4 万条	OpenStreetMap
4	街景图片数据	图片 3008 张	1700 张	百度地图
5	POI 数据	名称, 类型	约 5 万条	百度地图
6	手机信令数据	手机号码, 人流量	约 1 亿条	联通
7	厦门行政区划数据	省份, 城市	1 条	网络开源大数据
8	空气质量数据	PM2.5, PM10 每 24 小时平均值	100 条	网络开源大数据
9	ERA-5 逐小时气象再分析资料	30 m 分辨率垂直分量, 10 m 分辨率水平分量, 2 m 高度度, 总降水量		欧洲哥白尼气候数据平台

方法

数据清洗 workflow (属性与空间)
机器学习与深度学习
轨迹挖掘算法
时空冷热点分析
主成分分析法

```

import pandas as pd
import numpy as np
import geopandas as gpd
import os

# 数据清洗与空间处理
def clean_data(filepath):
    df = pd.read_csv(filepath)
    df.drop_duplicates(inplace=True)
    df['geometry'] = gpd.points_from_xy(df['lon'], df['lat'])
    return df

# 机器学习与深度学习
def train_model(features, target):
    # 模型训练逻辑
    pass

# 轨迹挖掘算法
def extract_tracks(tracks):
    # 轨迹提取逻辑
    pass

# 时空冷热点分析
def hotspots_analysis(data):
    # 时空冷热点分析逻辑
    pass

# 主成分分析法
def pca_analysis(features):
    # PCA 分析逻辑
    pass
    
```

平台

Python 3.8
R 4.0.3
ArcGIS Pro 2.7.2
百度地图API

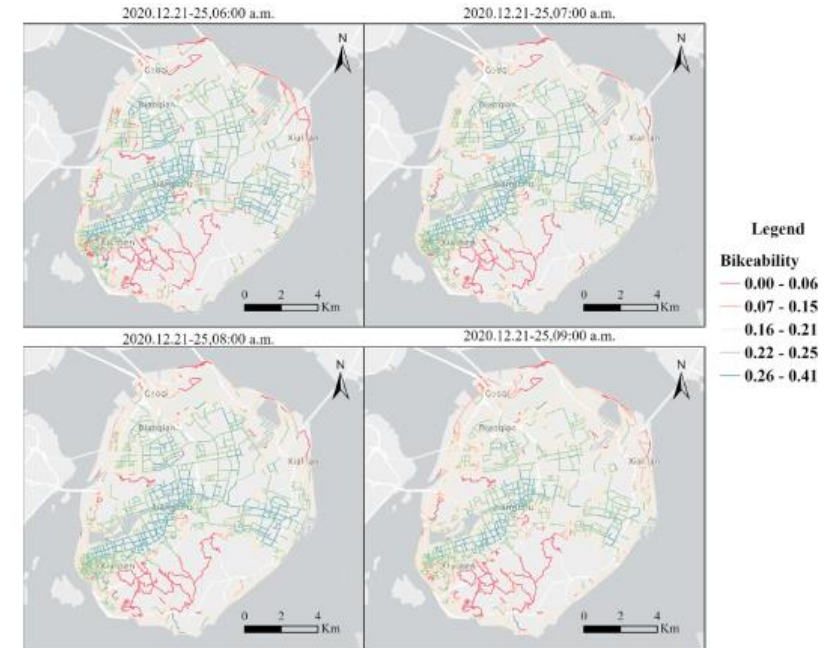
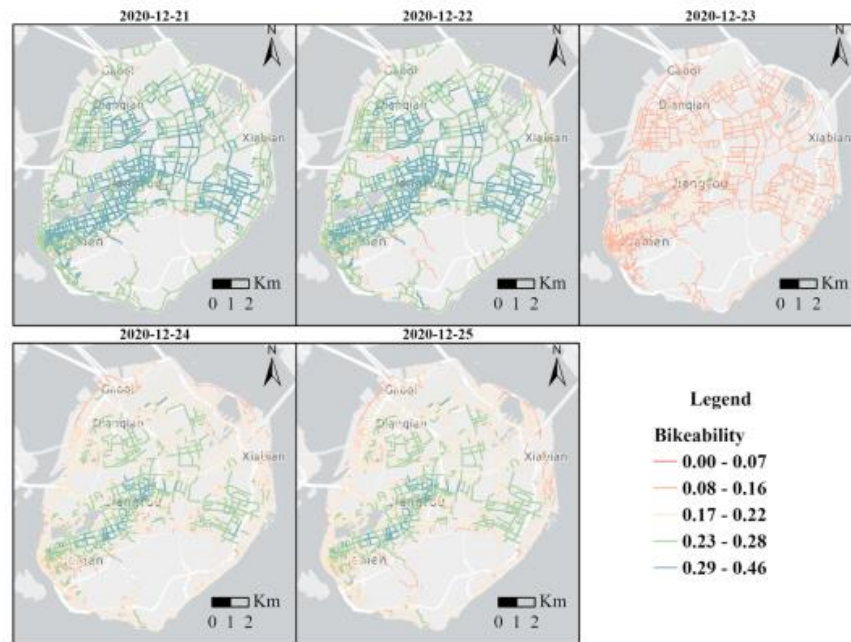




Dai, S., Zhao, W., Wang, Y., Huang, X., Chen, Z., Lei, J., ... & Jia, P. (2023) Assessing spatiotemporal bikeability using multi-source geospatial big data: A case study of Xiamen, China. *International Journal of Applied Earth Observation and Geoinformation*, 125, 103539. (IF=7.5)

小结与展望

- 一些探索 (环境暴露与体力活动的关联)



Dai, S., Zhao, W., Wang, Y., Huang, X., Chen, Z., Lei, J., ... & Jia, P. (2023) Assessing spatiotemporal bikeability using multi-source geospatial big data: A case study of Xiamen, China. *International Journal of Applied Earth Observation and Geoinformation*, 125, 103539. (IF=7.5)

小结与展望

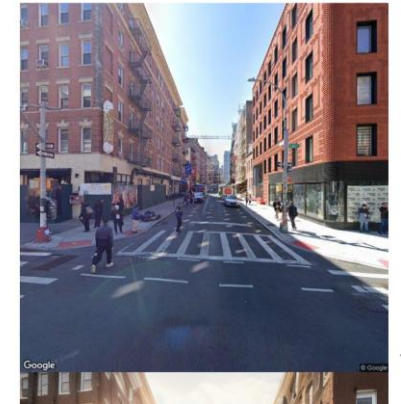
■ ChatGPT与AIGC下的思考



NL Netherlands

Bring your imagination,
we'll do the same

Add a touch of
Dutch to your
street



Dai, S., Zhao, W., Wang, Y., Huang, X., Chen, Z., Lei, J., ... & Jia, P. (2023) Assessing spatiotemporal bikeability using multi-source geospatial big data: A case study of Xiamen, China. *International Journal of Applied Earth Observation and Geoinformation*, 125, 103539. **(IF=7.5)**



International Journal of Geographical Information Science >
Volume 38, 2024 - Issue 6

Enter keywords, authors, DOI, etc

Submit an article | Journal homepage

253 Views
0 CrossRef citations to date
4 Altmetric

Review Article
Street view imagery-based built environment auditing tools: a systematic review
Shaoqing Dai , Yuchen Li , Alfred Stein , Shujuan Yang & Peng Jia
Pages 1136-1157 | Received 11 Oct 2022, Accepted 25 Mar 2024, Published online: 11 Apr 2024
[Cite this article](https://doi.org/10.1080/13658816.2024.2336034) | <https://doi.org/10.1080/13658816.2024.2336034> |

第四届空间全生命周期健康国际研讨会通知 (第二轮)

会议时间: 7月27-28日
会议地点: 湖北武汉



国际空间健康研究中心

Thanks for your attention!

Shaoqing Dai (戴劭劭)
PhD Candidate, Department of Earth Observation Science,
Faculty of Geoinformation Science and Earth Observation,
University of Twente

s.dai@utwente.nl

