



Association between Built Environment attributes and Strava speeds and volumes in the Greater Manchester region

I. Itova^{a,*}, C. Staves^a, S.M. Labib^b, A. de Nazelle^c, A. Jafari^d, J. Woodcock^a, J. Panter^a, B. Zapata-Diomedí^d, T. Saghapour^d, L. Gunn^d, B. Giles-Corti^d, H. Khreis^a, D. Singh^d, O. Gudes^e

^a University of Cambridge, UK

^b Utrecht University, the Netherlands

^c Imperial College London, UK

^d RMIT University, Australia

^e Monash University, Australia

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ABSTRACT

The Built Environment (BE) along the travel network influences the likelihood of people making short or multimodal trips using active travel (AT) modes (i.e., cycling and walking). The literature shows that BE attributes are significant predictors of AT and are strongly correlated with high cycling volumes. Specifically, they have higher association with AT than socio-demographics, or proximity to central locations and green space. Moreover, their collective relationship with AT use is not additive but complex, since many of them are correlated.

Existing literature shows that BE attributes at the same time can contribute to delays, comfort and perceived safety levels. There is scarce evidence whether cycling and walking volumes increase if travel delays are reduced, while comfort level credited to high quality walking or cycling infrastructure is improved.

We examined the association between travel delays for cycling and walking, with the presence and type of intersections' traffic signals, street lighting, crime rates and pavement quality. We compared self-reported speeds and volumes from Strava users in Greater Manchester with the MATSim modelled free-flow speeds (function of the network gradient) and volumes. We observed travel delays on the network, with some attributes having positive, while others negative effect on speeds and volumes.

Video and Slide to this article can be found online at <https://doi.org/10.1016/j.sctalk.2023.100268>.

CRediT authorship contribution statement

Irena Itova: Conceptualization, Methodology, Investigation, Data curation, Formal analysis, Resources, Writing – original draft and Writing – review & editing. **Corin Staves:** Software, Conceptualization, Writing – review & editing. **S.M. Labib:** Conceptualization, Data Curation, Validation, Writing – review & editing. **Audrey de Nazelle:** Writing – review & editing. **Afshin Jafari:** Writing – review & editing. **James Woodcock:** Funding acquisition, Project administration, Writing – review & editing. **Jenna Panter:** Writing – review & editing. **Belen Zapata-Diomedí:** Funding Acquisition, Project administration, Writing – review & editing. **Tayebeh Saghapour:** Writing – review & editing. **Lucy Gunn:** Funding - Acquisition, Project administration, Writing – review & editing. **Billie Giles-Corti:** Funding Acquisition, Project administration, Writing – review

& editing. **Haneen Khreis:** Writing-review & editing. **Dhirendra Singh:** Writing – review & editing. **Ori Gudes:** Writing – review & editing.

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Data availability

The authors do not have permission to share data.

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* Corresponding author.

E-mail address: li256@medschl.cam.ac.uk (I. Itova).

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Declaration of interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Further reading

- [1] J. Broach, J. Dill, J. Gliebe, Where do cyclists ride? A route choice model developed with revealed preference GPS data, *Transp. Res. A Policy Pract.* 46 (2012) 1730–1740, <https://doi.org/10.1016/j.tra.2012.07.005>.
- [2] R. Certero, M. Duncan, Walking, bicycling, and urban landscapes: evidence from the San Francisco Bay Area, *Am. J. Public Health* 93 (9) (2003) 1478–1483, <https://doi.org/10.2105/ajph.93.9.1478> Sep. PMID: 12948966; PMCID: PMC1447996.
- [3] R. Ewing, R. Certero, Travel and the built environment, *J. Am. Plan. Assoc.* 76 (3) (2010) 265–294, <https://doi.org/10.1080/01944361003766766>.
- [4] R. Ewing, R. Certero, Does compact development make people drive less? The answer is yes, *J. Am. Plan. Assoc.* 83 (1) (2017) 19–25, <https://doi.org/10.1080/01944363.2016.1245112>.
- [5] J. Fox, M. Georges, Generalized collinearity diagnostics, *J. Am. Stat. Assoc.* 87 (417) (1992) 178–183, <https://doi.org/10.1080/01621459.1992.10475190>.
- [6] H.T. Le, R. Buehler, S. Hankey, Correlates of the built environment and active travel: evidence from 20 US metropolitan areas, *Environ. Health Perspect.* 126 (2018).
- [7] NOMIS Official Labour and Market Statistics, Office For National Statistics available at <https://www.nomisweb.co.uk/census/2011/wp703ew> and <https://www.nomisweb.co.uk/census/2011/wp7103ew>
- [8] Office For National Statistics available at <https://geoportal.statistics.gov.uk/datasets/ons:workplace-zones-december-2011-population-weighted-centroids-in-england-and-wales/explore?location=52.815247%2C-2.437578%2C7.42>
- [9] Strava Metro available at <https://metro.strava.com/>
- [10] T. Tao, X. Wu, J. Cao, Y. Fan, K. Das, A. Ramaswami, Exploring the nonlinear relationship between the built environment and active travel in the twin cities, *J. Plan. Educ. Res.* 0 (0) (2020), <https://doi.org/10.1177/0739456X20915765>.
- [11] W.N. Venables, B.D. Ripley, *Modern Applied Statistics with S*, Fourth edition Springer, 2002.



Irena Itova is a Research Associate at the Public Health Modelling Group, in the MRC Epidemiology Unit, University of Cambridge. She is holds a PhD from the University of Westminster with a research focus on complex networks, infrastructure integration, and systems' complexity.



Corin Staves is a PhD Student at the MRC Epidemiology Unit, University of Cambridge. His research interests are at the intersection of transport modelling and public health modelling, with a focus on microsimulation and agent-based methods.



S.M. Labib is Assistant Professor of Data Science & Health, at Utrecht University and a visiting research associate at the Public Health Modelling Group, in the MRC Epidemiology Unit, University of Cambridge. His research interests in spatial data science, GIS and their applications in environmental epidemiology, and urban health.



Audrey de Nazelle is a Senior Lecturer at the Centre of Environmental Policy. She is co-chair of the International Society for Environmental Epidemiology (ISEE) Policy Committee, and outgoing chair and founder of Imperial's Network of Excellence on Air Quality (NEXAir).



Afshin Jafari is a Postdoctoral Research Fellow in the Healthy Liveable Cities Lab. For his Ph.D., Afshin developed a large-scale agent-based simulation model for cycling in Melbourne and used it to explore the potential impact of different built-environment interventions on bicycle use and cycling travel behaviour.



James Woodcock is a Professor of Transport and Health Modelling at MRC Epidemiology Unit, University of Cambridge. He leads the Public Health Modelling group. His research focuses on cities and health in the transition to the zero-carbon society. He is an ERC Consolidator Grant holder.



Jenna Panter is a Senior Research Associate at the Population Health Interventions group, in the MRC Epidemiology Unit, the University of Cambridge. Her research focuses on understanding the effects of environmental changes on walking and cycling, the effects on physical activity.



Belen Zapata-Diomedí is an RMIT University Vice-Chancellors Research Fellow at the Center of Urban Research, RMIT University. Her research interests include modelling of health impacts related to transport behaviors and built environment interventions.



Tayebah Saghapour has finished her PhD in Transport Engineering at RMIT University. The outstanding results of her PhD research have been published as academic papers in very high quality international journals.



Haneen Khreis is a Senior Research Associate, at the Public Health Modelling Group, in the MRC Epidemiology Unit, University of Cambridge. She is also an Associate Research Scientist at Texas A&M Transportation Institute where she is a technical advisor on select projects. Her research interests are in exposure assessment, especially noise and air pollution, models' validation, and advancing health impact assessment methodologies.



Lucy Gunn is a Senior Research Fellow at the Center of Urban Research, RMIT University. Her research interests are in modelling relationships between the built environment, transport, and health in assessing built environment interventions.



Dharendra Singh is a CSIRO-funded Principal Research Fellow (Associate Professor) in the Artificial Intelligence Discipline of the School of Computing Technologies. He is an expert in agent-based modelling and simulation, cognitive modelling, and agent-oriented programming, and has several years of experience as Senior Software Engineer.



Billie Giles-Corti is an RMIT Vice-Chancellors Professorial Research Fellow and Director of the Healthy, Liveable Cities Lab at the Center of Urban Research, RMIT University. Her research interests are in measuring relationships between the built environment and health in support of the evidence-based policy.



Ori Gudes is a researcher with expertise in Geographic Information Systems (GIS), spatial analysis, and spatial science. His areas of research focus on GIS and Health, spatial analysis, decision support systems, city analytics, and usability evaluation.