Delft University of Technology

Document Version
Proof

Licence
CC BY

Citation (APA)
Willberg, E., Tenkanen, H., van Wee, B., & Toivonen, T. (in press). Accessibility: Can less be better? *Transportation Research Interdisciplinary Perspectives*, Article 102160. https://doi.org/10.1016/j.trip.2026.102160

Important note
To cite this publication, please use the final published version (if applicable).
Please check the document version above.

Copyright
In case the licence states "Dutch Copyright Act (Article 25fa)", this publication was made available Green Open Access via the TU Delft Institutional Repository pursuant to Dutch Copyright Act (Article 25fa, the Taverne amendment). This provision does not affect copyright ownership.
Unless copyright is transferred by contract or statute, it remains with the copyright holder.

Sharing and reuse
Other than for strictly personal use, it is not permitted to download, forward or distribute the text or part of it, without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license such as Creative Commons.

Takedown policy
Please contact us and provide details if you believe this document breaches copyrights.
We will remove access to the work immediately and investigate your claim.

This work is downloaded from Delft University of Technology.

ARTICLE IN PRESS

Transportation Research Interdisciplinary Perspectives xxx (xxxx) xxx

Contents lists available at ScienceDirect

Transportation Research Interdisciplinary Perspectives

journal homepage: www.sciencedirect.com/journal/transportation-research-interdisciplinary-perspectives

Accessibility: Can less be better?

A R T I C L E I N F O

Keywords:
Accessibility
Land use
Transport
Sustainable mobility
Sufficiency
Planetary boundaries

A B S T R A C T

In recent decades, spatial accessibility provision has gradually become a core objective of urban and transport policies due to its many benefits for individuals and societies. While the minimum levels of accessibility have received significant attention in research recently, the upper end of the spectrum has rarely been addressed. Almost always, higher levels of accessibility are implicitly assumed to be better. In this perspective, we ask whether this view is justified. Or can more accessibility in some cases and contexts, be negative, or even excessive, especially given the deep unsustainability of our current transport systems? Can less be better? We begin by distinguishing between the main approaches to providing accessibility – by speed and by proximity – and examining evidence on when higher levels of accessibility may become negative. We then consider some reasons for these avenues not having been pursued this far. We conclude our perspective by suggesting that to support sustainability, transport research and planning should place greater emphasis on balancing societal benefits and trade-offs of accessibility, rather than only increasing individual choice. To this end, we have suggested some directions for further research.

The need for accessibility

Spatial accessibility stands as a central conceptual idea and empirical tool for driving sustainable development in transport. Defined as the potential of opportunities for interaction (Hansen, 1959). accessibility reflects the integration between land use and transport. Accessibility measures are quantitative indicators of how easily various opportunities are available, given their spatial distribution, characteristics of transport system, temporal constrains, and individual characteristics (Geurs and van Wee, 2004). Conceptually, accessibility differs from mobility by describing the potential to reach opportunities rather than their realisation. Accessibility-oriented planning, referring to the planning approach focused on improving people's ability to reach activities, rather than simply increasing their movement, has resonated with many social and economic goals and promised environmental co-benefits through shorter travel distances and modal shift, thus becoming a key part of the sustainable mobility paradigm (Banister, 2008). Among transport researchers, accessibility, rather than mobility, is now gradually seen as the core of what transport systems should facilitate, while its adoption in transport planning and policy has continued to grow slowly but steadily (Handy, 2020).

The shift toward accessibility-oriented planning has been grounded in large volumes of empirical evidence on its benefits. For individuals, higher accessibility to destinations has been consistently associated with higher employment and social inclusion, higher quality of life, better nutrition, and greater freedom of choice (Cass et al., 2005; Farrington and Farrington, 2005; Grengs, 2015; Lucas, 2012; Oviedo and Sabogal, 2020). For societies, higher levels of accessibility have been shown to promote social equity, economic productivity, innovation, higher land value, and improved population health in addition to the aggregate effects of benefits on individuals (Brown et al., 2019; Cervero, 2001; Mazumdar et al., 2018; Melo et al., 2017). Mounting evidence has also revealed critical shortages in accessibility provision. In many parts of the world, cities and regions fail to provide access to essential amenities for significant parts of their populations while suffering from profoundly unequal accessibility distribution (e.g., Boisjoly et al., 2020; Wu et al., 2021).

Taking the current research together, there is little doubt that higher levels of accessibility very often lead to substantial social, economic, and environmental benefits, and that improvements are also very often needed. Yet, when it comes to accessibility, there has been plenty of attention to its scarcity, but very little debate over whether more accessibility is *always* better. Given the overwhelming evidence of its benefits, accessibility has come to be approached almost exclusively through a framing in which more equals better. Note that while most accessibility studies do not make explicit that 'more accessibility is always better', they implicitly seem to assume this because they do not discuss any disadvantages of high(er) accessibility levels. However, this might not always be fully justified. Especially if higher levels of accessibility result in increases in motorized travel (which is often the case when accessibility improves by providing more or 'faster' infrastructure for cars, aircraft or trains).

The current orientation stands in growing contrast with broader societal and academic debates concerning the tenability of unlimited growth and consumption in a finite planet (Meadows et al., 1972; Raworth, 2017; Ripple et al., 2024; Robeyns, 2024; Steffen et al., 2015). Increasingly, similar themes have surfaced elsewhere in transport research in debates on excess commuting (Ma and Banister, 2006),

https://doi.org/10.1016/j.trip.2026.102160
Received 23 January 2026; Received in revised form 31 May 2026; Accepted 21 July 2026
2590-1982/© 2026 The Author(s). Published by Elsevier Ltd. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).

Please cite this article as: Elias Willberg et al., *Transportation Research Interdisciplinary Perspectives,* https://doi.org/10.1016/j.trip.2026.102160

political economy of car dependence (Mattioli et al., 2020), sustainable consumption corridors (Dillman et al., 2021), and alternative mobility narratives (Brömmelstroet et al., 2022). Yet, critical perspectives on the continued expansion, and potential excess, of accessibility have remained largely absent thus far.

In this perspective, we address this rarely addressed area by discussing why higher levels of accessibility can sometimes be negative. We do not seek to present a thorough review but aim at bringing together scattered evidence on potential disadvantages and trade-offs between accessibility and other societally relevant effects. We do so by using a systemic lens and suggest some directions for expanding research in this area. With this, we hope to advance the linking of accessibility research with current discourses on excess resources and planetary limits, and spark further discussion on how to align transport systems with strong sustainability.

What kind of provisioning?

In thinking about the potential negative sides of higher accessibility, we need to first distinguish between the different approaches to providing it: through speed versus through proximity. Over the last century, higher speeds have enabled great strides in access to employment, services, and leisure facilities. This way of provisioning has been a characterisation of the *accessibility by speed* approach, in which the improvements to available opportunities are primarily provided through the transport system by speeding up traffic and facilitating ease of moving. By prioritising rapid movement, the approach has largely meant focus on private cars through road and highway construction at the urban and regional scales, (high-speed) rail at the urban, regional, national and international scales, and on air travel through the expansion of flight connections and airport infrastructure at the continental and global scales.

In contrast, *accessibility by proximity* (see Silva et al., 2025 for related terminology) has provided an alternative provisioning approach with a greater focus on the land use system. With concepts such as transit-oriented development, the compact city, and the 15-minute city gaining prominence, in recent decades transport research and planning have strongly shifted toward the proximity-based model to the extent that the term "accessibility" has nearly become synonymous with urbanism (Levine, 2020). Compared to the speed-based approach, the proximity-based approach has primarily focused on cities, aiming to reduce reliance on cars as the source of urban mobility. Key strategies for this have included higher densities and mixed land use to enhance local access via land use planning, and transport planning focusing on active modes and public transport to expand travel mode options (Handy, 2020).

Despite the growing prominence of the proximity-based approach, both provisioning models remain common in transport planning and policy, to cater for the growing levels of mobility. In most developed economies, road construction and congestion relief continue to dominate transport infrastructure spending (OECD/ITF, 2023). Globally, the trend is even clearer. Passenger kilometres are expected to more than double by 2050 compared to 2015 levels, including major increases in urban and regional travel in all world regions, and especially in Asia (OECD/ITF, 2021). Given the continuing growth of both models, we now turn into considering potential disadvantages and trade-offs in providing more accessibility with them.

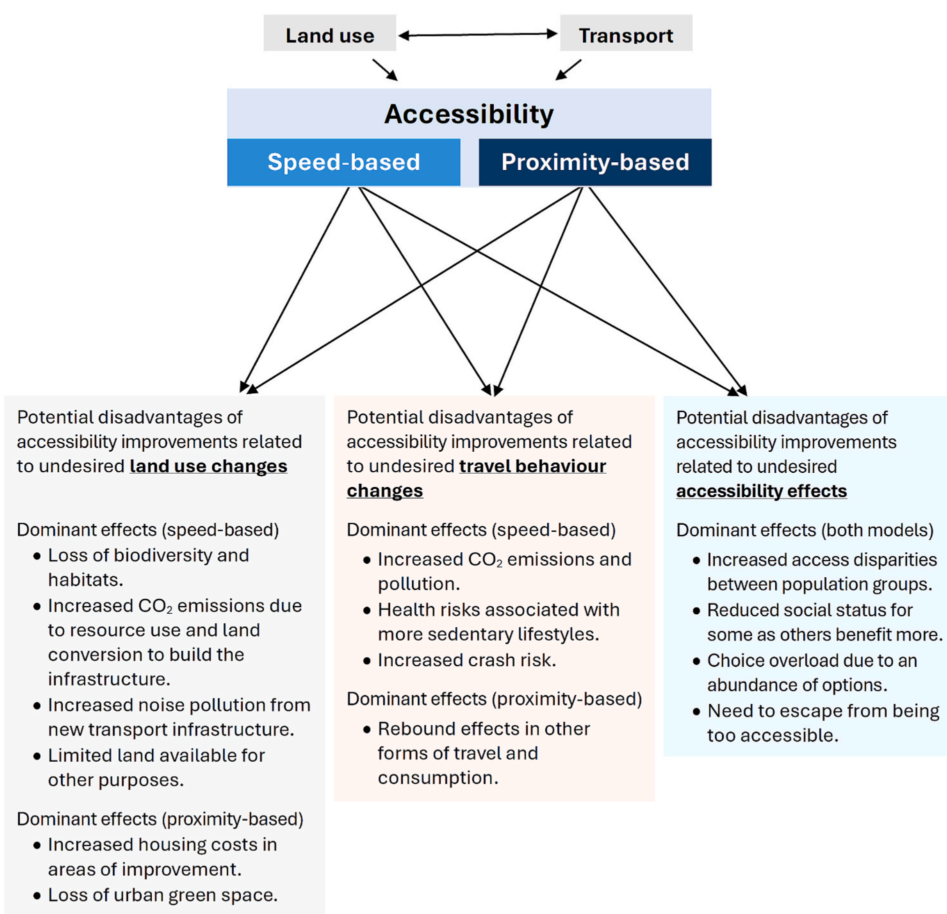

Fig. 1. Potential disadvantages of higher accessibility can be divided into three categories based on whether they are related to undesired land use changes, undesired travel behavior changes, or undesired accessibility effects.

When more accessibility may become negative

We can categorize potential disadvantages to accessibility into three groups: 1) disadvantages related to undesired land use changes; 2) disadvantages related to undesired travel behaviour changes; and 3) disadvantages related to undesired accessibility effects (Fig. 1). We can also distinguish whether the disadvantages concern the speed-based model, the proximity-based model, or both, as we will do next.

Potential disadvantages of accessibility by speed

The most obvious disadvantages with the speed-based provision of accessibility relate to its environmental costs. As with any human system, transport systems are constrained by the environment (Bertolini, 2017; Willberg et al., 2024b). Rapid and unsustainable growth of transport-related emissions and environmental harm has followed fossil-fuel dependent leaps for higher access. This has created potential disadvantages related to both land use and travel behaviour changes. High car dependence in urban and regional accessibility and the strong growth of national and international air travel are the dominant sources of carbon emissions in the transport sector (Banister et al., 2011; IPCC, 2022). When accounting for the whole lifecycle, the picture is even bleaker. The building of new transport infrastructure, including roads, railways, high-speed rail, airports, and fuelling stations which enable speed-based accessibility, is highly carbon-intensive, generates pollution of the air, land, and water, increases noise levels, and requires heavy natural resource extraction and use (Dillman et al., 2021; Miner et al., 2024). The speed-based model also involves other major environmental costs, especially through land use conversion and consumption of space. In natural areas, regional accessibility – particularly through roads – is one of the strongest predictors of forest loss and environmental degradation (Kaczan, 2020; Laurance et al., 2014). In cities and surrounding areas, urban expansion and sprawl enabled by higher travel speeds, pose a major threat to local ecosystems, species, and biodiversity, due to habitat loss, deforestation and increased human pressure (Nielsen et al., 2014; Seto et al., 2012).

Another well-documented disadvantage of the speed-based model are its negative effects on human health representing impacts related to travel behaviour changes. With higher accessibility, especially when provided by private car, the risk of sedentary lifestyles and reduced physical activity increases, as many short trips by active modes are replaced by car or public transport trips (Scheepers et al., 2016; Vafeiadis and Elldér, 2024). Sedentary lifestyles in turn can lead to various health risks including higher all-cause mortality through a range of pathways (Kim et al., 2013; Warren et al., 2010). Providing accessibility through speed and by private car, is also associated with other negative health effects through increased crash risk (Merlin et al., 2020; Xiao et al., 2024) and higher air pollution levels (da Schio et al., 2019).

Economically, providing and maintaining speed-based accessibility represents a significant expenditure for local and national governments with diminishing returns. After a decent level of access to jobs and amenities is reached, the ability of new transport infrastructure and improved accessibility to provide economic value, well-being, and satisfaction of needs gradually diminishes (Martens and Di Ciommo, 2017; Virág et al., 2022). However, potential disadvantages related to land use and travel behaviour changes may grow. Road and highway expansion to relieve congestion has long illustrated the dilemma. The projected gains of faster travel flows have often failed to materialise, and simply led to induced travel demand and further congestion, reproducing the original problem (Hymel, 2019). In addition, transport infrastructure such as roads, rails, parking places, and related buffer zones require large amounts of land, which limits land available for other uses, such as agriculture or nature, and contributes to higher housing costs (Lehe, 2018; Shoup, 2021).

Finally, while accessibility can promote social cohesion both locally and regionally (Mazumdar et al., 2018; Monzon et al., 2019), the one may come at other's expense. Land use related changes resulting from investments in regional and national transport connections, such as highways or high-speed rail, may lead to reduced local opportunities and increased social disparities in by-passed places and regions that do not benefit from the improvements and cannot compete with them (Baum-Snow et al., 2020; Huang and Zong, 2021). In these and other instances, higher levels of accessibility by speed can clash with policy goals related to social equity and integration.

Potential disadvantages of accessibility by proximity

Much less academic focus has been directed into thinking about the potential downsides of having a higher level of accessibility by proximity. This is not surprising, given the ample evidence on the various benefits of the proximity-based model (Brand et al., 2021; Saunders et al., 2013). However, even with the proximity-based provisioning model, there are some potential trade-offs.

As for environmental impacts, it is widely accepted that the proximity-based accessibility model and compact city designs typically lead to lower vehicle kilometres and transport emissions in urban areas (Czepkiewicz et al., 2024; Ewing and Cervero, 2010; Manaugh and El-Geneidy, 2012). However, research also suggests that the time and effort saved from necessary travel due to urban proximity often trigger rebound effects, leading to travel behaviour changes, such as increased travel at local, regional, and international scales, as well as higher overall consumption of goods and services (Czepkiewicz et al., 2018; Eliasson, 2022; Zhang et al., 2025). This means that the environmental benefits of reducing transport emissions can easily be offset by higher emissions from increased travel, and higher emissions due to changes in consumption, but the effects on total emissions remain uncertain (Heinonen et al., 2013; Ottelin et al., 2019). Diminishing returns in environmental benefits might also be applicable to proximity-based accessibility, as even in cities with high levels, only a minority of the population relies on sustainable modes, potentially suggesting that accessibility investments have limited effectiveness in promoting sustainable modal shift when distances are already relatively short (Maciejewska et al., 2025).

As for social effects, proximity-based models typically increase neighborhood attractiveness driving up land value and housing prices (Deboosere et al., 2018; He, 2020; Higgins et al., 2024). While these effects can be regarded as positive for urban economies, through them the proximity-based model may inadvertently contribute to land use related disadvantages, such as displacement of lower-income populations (Casarin et al., 2023; Tammaru et al., 2023). Empirical studies have in some cases confirmed this notion, but relevant evidence remains mixed and uncertain (Padeiro et al., 2019). Another understudied, but potential trade-off with local accessibility is its contribution to socio-spatial segregation. It may reduce cross-neighbourhood mobility and limit interactions between social groups living in different neighbourhoods, especially among low-income residents, as was found from 420 urban areas in the U.S. (Abbiasov et al., 2024).

Finally, in the warming climate, dense built environment required to provide high proximity-based accessibility creates a land use trade-off with the provision of sufficient urban green spaces that provide essential ecosystem services, such as shelter from urban heat islands (McDonald et al., 2023). A recent study of 43 European cities found a consistent negative relationship between higher walking accessibility and lower route vegetation (Willberg et al., 2024a). Green spaces also illustrate complex trade-offs related to sustainability. While the proximity-based model can preserve more green space in total than dispersed development with benefits to biodiversity, it can simultaneously reduce local green space for urban residents with possible negative effects on their health and wellbeing, and quality of living (Talen and Wileden, 2025).

Potential disadvantages of both provision models

In most cases, it seems reasonable to assume that if only direct accessibility effects are considered, increases typically appear positive because they expand freedom of choice. However, there can be cases in which accessibility effects themselves are negative, which concern both provision models. For example, expensive investments to provide greater accessibility (e.g., through high-speed rail or air travel), could lead to negative effects alongside positive effects. From an egalitarian perspective, which emphasizes the equal distribution of resources, such investments may be problematic if they increase accessibility disparities in society. Higher accessibility levels could also be subject to positionality, meaning that their value partly depends on the levels others have, because they are linked to social status (see van Wee, 2021). Following this reasoning, accessibility improvements can create situations where improving accessibility for some people comes at a lower positional value of existing accessibility level for others.

Another potential disadvantage is the so-called *choice overload*, in which the abundance of opportunities can overwhelm an individual's decision-making, causing anxiety and stress (Chernev et al., 2015; Scheibehenne et al., 2010). Finally, people may also travel (only or partially) to escape from family, work, or neighbourhood. For many, having a relaxed holiday or even an opportunity to have concentrated working time now requires getting out of access and connectedness (see van Wee and Mokhtarian, 2023). These effects could mean that a lower level of accessibility is valued.

What hinders us from measuring excess?

As we have shown, there are arguments suggesting that we should focus more on disadvantages and trade-offs to accessibility. However, remarkably little examination of these topics has been done so far, so let us now examine why this may be.

One clear reason relates to the concept of accessibility, which describes the potential to reach opportunities rather than their realisation as mobility. From this viewpoint, the source of negative impacts is not higher levels of accessibility but higher levels of mobility resulting from higher levels of accessibility. But what is often not considered, is that many potential disadvantages of accessibility stem not from undesired changes in travel behaviour but from undesired changes in land use. As we have seen, many disadvantages relate to resource use required to build infrastructure for higher levels of accessibility, land consumption that converts and restricts existing or potential uses, and indirect social impacts arising from land-use changes.

However, it is often unclear whether accessibility acts as a causal factor behind disadvantages, a mediator, or is merely correlated with them. Many of the potential disadvantages arise from complex interactions between land use and transport systems. For example, while speed-based accessibility may be associated with negative health effects, this relationship likely reflects underlying land use dynamics, including urban dispersion and regional growth, rather than accessibility investments alone. For other disadvantages, the causal relationship is more firmly established, such as the impact of regional accessibility on forest loss in pristine areas (Kaczan, 2020; Laurance et al., 2014). Despite this, causal study designs and longitudinal data remain underutilized in quantitative transport research (see Brathwaite and Walker, 2018; Næss, 2025).

Another reason for the research gap could relate to the difficulty of defining excess in accessibility, which is dependent on the applied normative criteria, spatial scale (regional or supra-regional vs local), the type of opportunity (employment, service, etc.), the travel mode, the population group, and the characteristics of an area or place. Some scholars have voiced concerns that normative accessibility thresholds easily became perceived negatively, because they can appear paternalistic or restrictive to meeting individual needs (Silva and Larsson, 2018; Vanoutrive and Cooper, 2019). Consequently, many accessibility studies operationalise their analyses using assumed travel time thresholds (e.g., 15 or 30 min) and amenity categories that residents are likely to require, without explicitly clarifying whether these limits represent minimums, maximums, or both. Given the little attention on excessive accessibility, the theoretical basis of thresholds is limited, and there is a lack of shared practices, standards, and guidance to support empirical implementations.

Thirdly, accessibility planning often lags behind academic practice. Although the adoption of accessibility measures in urban and regional planning has increased, it continues to face barriers related to their operationalisation, institutionalisation, and limited data and expertise (Boisjoly and El-Geneidy, 2017; Handy, 2020; Silva et al., 2017). In this context, where even the use of simpler accessibility measures is not fully established in planning practice, introducing upper limits could further complicate the measures and reduce their applicability. It is also important to note that some disadvantages may be evaluated, at least partly, through separate processes such as Environmental Impact Assessments (EIA), in which potential negative impacts are assessed independently of accessibility indicators.

Finally, accessibility planning and research do not occur in a vacuum; they are embedded in existing societal structures and systems, reflecting current values and norms. The mainstream framing of mobility and transport continues to revolve around urban growth, speed, and efficiency (Brömmelstroet et al., 2022; Gössling and Cohen, 2014). In this respect, it is important to recognise that the neoliberal ethos has remained among important drivers of speed-based and proximity-based accessibility planning and policy with two fundamental assumptions. First, profit and capital accumulation are generated through, and dependent on, travel time savings, whether realised by growing nearby opportunities, or by providing faster access to more distant opportunities. Second, more choice is better as it can lead to higher consumer demand and, ultimately, economic growth. Essentially, any ideas of excessive or less accessibility are easily at odds with these assumptions in transport planning and policy, where mobility increases due to improved accessibility are consistently evaluated positively.

Finding the balance

In this short perspective, we have asked if less accessibility can sometimes be better. Our intention was not to deny the many benefits that accessibility provides to individuals and societies, nor to question the value of common approaches to accessibility, such as sufficiency and capabilities approaches, that focus on advancing its equitable distribution and identifying existing gaps in current levels (see Martens et al., 2022; Vecchio and Martens, 2021). Nor did we wanted to prescribe, which accessibility measures (e.g., cumulative opportunities, utility-based, etc.) should be used to define upper limits, as various types of measures are likely to be useful in this endeavour. Rather, our aim has been to emphasise the need for more careful consideration of what type and level of accessibility is needed in various contexts and scales to enable sustainable outcomes. We close this perspective with a few directions that we believe would be fruitful to advance.

Clearly, most of the disadvantages and trade-offs of higher accessibility concern the speed-based model primarily. The proximity-based model can alleviate many of the disadvantages, including reducing carbon emissions, biodiversity loss, and negative health effects from transport. Even so, trade-offs seem common to both models, especially due to impacts arising not only from changes in travel behaviour, but also changes in land use, which remain less recognised in current research. There is surprisingly little evidence currently available on the diminishing social, environmental and economic returns to accessibility improvements, which are a recurrent feature of these trade-offs. Similarly, establishing a firmer causality between accessibility and its impacts requires further investigation, as many potential disadvantages are also linked to broader societal dynamics, including economic growth, urban expansion, and other land-use changes.

There are obviously costs and benefits, and difficult trade-offs involved with any planning policies. However, what requires better understanding and evidence is when the negative impacts of accessibility begin to outweigh its positive effects. Greater attention should be given to balancing accessibility provisioning rather than simply focusing on increasing individual choice. To this end, recent studies have applied socially and ecologically integrative theories to accessibility by proposing conceptual frameworks between the sufficient and excessive levels (Burgsteden, 2026; Czepkiewicz et al., 2026; Willberg et al., 2024b), and tested methodologies for setting limits to accessibility provisioning based on environmental budgets and social equity principles (Kinigadner et al., 2021; Krajzewicz et al., 2024). These studies show that accounting for disadvantages in accessibility can substantially shift the perceived competitiveness of travel modes. They also illustrate wide gaps between current and sustainable levels and raise important social considerations regarding who would benefit or lose from accessibility limits.

Much more theoretical and empirical work is still required on what it would mean for social prosperity, justice, and economic stability, to limit accessibility and related mobility impacts to truly sustainable levels that are compatible with planetary budgets. Here, it is necessary to emphasize that understanding when less might be better in case of accessibility should be more than a technical exercise. Without systemic and interdisciplinary perspectives that extend beyond transport to consider broader societal impacts, we are prone to think too simplistically about accessibility. Contributions are required from geography (e.g., spatial, demographic, and modal disparities in access), sustainability science (e.g., planetary boundaries), public policy (e.g., policy evaluation), engineering and planning (e.g., the use of accessibility indicators in transportation investments), economics (e.g., utility theory) and ethics (e.g., theories of justice), among other disciplines. Specifically, distributive justice theories like *limitarianism* (Robeyns, 2024; Timmer, 2024) and *planetary justice* (Biermann et al., 2020), which consider absolute environmental limits alongside fairness and equity, can prove useful in guiding the efforts for conceptual and empirical advances.

Further research is also needed on the positive value of lower rather than higher levels of accessibility to identify at which point accessibility no longer enhances well-being. Distinguishing more carefully between human needs and wants is central to this line of research, but also more broadly for accessibility studies. Once a higher level of accessibility is established, over time it can be transformed from a luxury to necessity, as demonstrated by the social institutionalisation of long-distance accessibility by air travel (Mattioli, 2016; Schmidt et al., 2025). Finally, future research should explore whether the value of accessibility is positional, and depends on the levels others have, especially given the ubiquitous presence of comparison in social media today (van Wee, 2021). By this logic, improvements in accessibility can lead to perverse outcomes, such as fostering status competition, and thereby resulting in more emission-intensive travel and consumption.

To conclude, we invite transport and urban researchers to remain open to the idea that in some situations and contexts, there can be too much accessibility. In our view, exploring and addressing these options could add significant value to the already rich body of accessibility research and has the potential to support more sustainable societies at large.

Funding:

This study is part of the GREENTRAVEL project (2023–2027) funded by the European Union (ERC, project 101044906). Views and opinions expressed are however those of the authors only and do not necessarily reflect those of the European Union or the European Research Council Executive Agency. Neither the European Union nor the granting authority can be held responsible for them. This work has been also supported by the University of Helsinki and the Flagship Program of Advanced Mathematics for Sensing, Imaging, and Modelling (FAME) funded by Research Council of Finland (grant number 359182).

CRediT authorship contribution statement

Elias Willberg: Writing – review & editing, Writing – original draft, Funding acquisition, Conceptualization. **Henrikki Tenkanen:** Writing – review & editing, Conceptualization. **Bert van Wee:** Writing – review & editing, Conceptualization. **Tuuli Toivonen:** Writing – review & editing, Funding acquisition, Conceptualization.

Declaration of competing interest

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.

Data availability

No data was used for the research described in the article.

References

Abbiasov, T., Heine, C., Sabouri, S., Salazar-Miranda, A., Santi, P., Glaeser, E., Ratti, C., 2024. The 15-minute city quantified using human mobility data. Nat. Hum. Behav. 8, 445–455. https://doi.org/10.1038/s41562-023-01770-y.

Banister, D., 2008. The sustainable mobility paradigm. Transp. Policy 15, 73–80. https://doi.org/10.1016/j.tranpol.2007.10.005.

Banister, D., Anderton, K., Bonilla, D., Givoni, M., Schwanen, T., 2011. Transportation and the environment. Annu. Rev. Env. Resour. 36, 247–270. https://doi.org/10.1146/annurev-environ-032310-112100.

Baum-Snow, N., Henderson, J.V., Turner, M.A., Zhang, Q., Brandt, L., 2020. Does investment in national highways help or hurt hinterland city growth? J. Urban Econ., Cities China 115, 103124. https://doi.org/10.1016/j.jue.2018.05.001.

Bertolini, L., 2017. Planning the Mobile Metropolis, 1st ed, Planning, Environment, Cities. Bloomsbury Publishing.

Boisjoly, G., El-Geneidy, A.M., 2017. The insider: A planners' perspective on accessibility. J. Transp. Geogr. 64, 33–43. https://doi.org/10.1016/j.jtrangeo.2017.08.006.

Boisjoly, G., Serra, B., Oliveira, G.T., El-Geneidy, A., 2020. Accessibility measurements in São Paulo, Rio de Janeiro, Curitiba and Recife, Brazil. J. Transport Geography 82, 102551. https://doi.org/10.1016/j.jtrangeo.2019.102551.

Brand, C., Dons, E., Anaya-Boig, E., Avila-Palencia, I., Clark, A., de Nazelle, A., Gascon, M., Gaupp-Berghausen, M., Gerike, R., Götschi, T., Iacorossi, F., Kahlmeier, S., Laeremans, M., Nieuwenhuijsen, M.J., Pablo Orjuela, J., Racioppi, F., Raser, E., Rojas-Rueda, D., Standaert, A., Stigell, E., Sulikova, S., Wegener, S., Int Panis, L., 2021. The climate change mitigation effects of daily active travel in cities. Transp. Res. Part D: Transp. Environ. 93, 102764. https://doi.org/10.1016/j.trd.2021.102764.

Brathwaite, T., Walker, J.L., 2018. Causal inference in travel demand modeling (and the lack thereof). J. Choice Model. 26, 1–18. https://doi.org/10.1016/j.jocm.2017.12.001.

Brown, V., Barr, A., Scheurer, J., Magnus, A., Zapata-Diomedi, B., Bentley, R., 2019. Better transport accessibility, better health: a health economic impact assessment study for Melbourne, Australia. Int. J. Behav. Nutr. Phys. Activity 16. https://doi.org/10.1186/s12966-019-0853-y.

Casarin, G., MacLeavy, J., Manley, D., 2023. Rethinking urban utopianism: the fallacy of social mix in the 15-minute city. Urban Stud. 60, 3167–3186. https://doi.org/10.1177/00420980231169174.

Cass, N., Shove, E., Urry, J., 2005. Social exclusion, mobility and access. Sociol. Rev. 53, 539–555. https://doi.org/10.1111/j.1467-954X.2005.00565.x.

Cervero, R., 2001. Efficient urbanisation: economic performance and the shape of the metropolis. Urban Stud. 38, 1651–1671.

Chernev, A., Böckenholt, U., Goodman, J., 2015. Choice overload: a conceptual review and meta-analysis. J. Consum. Psychol. 25, 333–358. https://doi.org/10.1016/j.jcps.2014.08.002.

Czepkiewicz, M., Heinonen, J., Ottelin, J., 2018. Why do urbanites travel more than do others? A review of associations between urban form and long-distance leisure travel. Environ. Res. Lett. 13, 073001. https://doi.org/10.1088/1748-9326/aac9d2.

Czepkiewicz, M., Schmidt, F., Krysiński, D., Brudka, C., 2024. Satisfying transport needs with low carbon emissions: exploring individual, social, and built environmental factors. Comput. Environ. Urban Syst. 114, 102196. https://doi.org/10.1016/j.compenvurbsys.2024.102196.

Czepkiewicz, M., Mattioli, G., Schmidt, F., Willberg, E., Kilian, L., Tenkanen, H., Timmer, D., Gosztonyi, Á., Raudsepp, J., Ala-Mantila, S., Jacobson, L., Guillen-Royo, M., Krysiński, D., Dillman, K., Heinonen, J., Næss, P., 2026. Sufficient mobility and access within limits: research agenda for bringing together corridor frameworks and transportation research. Transp. Res. Interdiscip. Perspect. 37, 102029. https://doi.org/10.1016/j.trip.2026.102029.

da Schio, N., Boussauw, K., Sansen, J., 2019. Accessibility versus air pollution: a geography of externalities in the Brussels agglomeration. Cities 84, 178–189. https://doi.org/10.1016/j.cities.2018.08.006.

Deboosere, R., El-Geneidy, A.M., Levinson, D., 2018. Accessibility-oriented development. J. Transp. Geogr. 70, 11–20. https://doi.org/10.1016/j.jtrangeo.2018.05.015.

Dillman, K.J., Czepkiewicz, M., Heinonen, J., Davíðsdóttir, B., 2021. A safe and just space for urban mobility: a framework for sector-based sustainable consumption corridor development. Global Sustain. 4, e28.
Eliasson, J., 2022. Will we travel less after the pandemic? Transp. Res. Interdiscip. Perspect. 13, 100509. https://doi.org/10.1016/j.trip.2021.100509.
Ewing, R., Cervero, R., 2010. Travel and the built environment. J. Am. Plann. Assoc. 76, 265–294. https://doi.org/10.1080/01944361003766766.
Farrington, J., Farrington, C., 2005. Rural accessibility, social inclusion and social justice: towards conceptualisation. J. Transport Geography, Sustain. Interaction Between External Effects of Transport (Part Special Issue, pp. 23-99) 13, 1–12. https://doi.org/10.1016/j.jtrangeo.2004.10.002.
Geurs, K.T., van Wee, B., 2004. Accessibility evaluation of land-use and transport strategies: review and research directions. J. Transp. Geogr. 12, 127–140. https://doi.org/10.1016/j.jtrangeo.2003.10.005.
Gössling, S., Cohen, S., 2014. Why sustainable transport policies will fail: EU climate policy in the light of transport taboos. J. Transp. Geogr. 39, 197–207. https://doi.org/10.1016/j.jtrangeo.2014.07.010.
Grengs, J., 2015. Nonwork accessibility as a social equity indicator. Int. J. Sustain. Transp. 9, 1–14. https://doi.org/10.1080/15568318.2012.719582.
Handy, S., 2020. Is accessibility an idea whose time has finally come? Transp. Res. Part D: Transp. Environ. 83, 102319. https://doi.org/10.1016/j.trd.2020.102319.
Hansen, W.G., 1959. How accessibility shapes land use. J. Am. Inst. Plann. 25, 73–76. https://doi.org/10.1080/01944365908978307.
He, S.Y., 2020. Regional impact of rail network accessibility on residential property price: modelling spatial heterogeneous capitalisation effects in Hong Kong. Transp. Res. A Policy Pract. 135, 244–263. https://doi.org/10.1016/j.tra.2020.01.025.
Heinonen, J., Jalas, M., Juntunen, J.K., Ala-Mantila, S., Junnila, S., 2013. Situated lifestyles: I. How lifestyles change along with the level of urbanization and what the greenhouse gas implications are—a study of Finland. Environ. Res. Lett. 8, 025003. https://doi.org/10.1088/1748-9326/8/2/025003.
Higgins, C.D., Arku, R.N., Farber, S., Miller, E.J., 2024. Modelling changes in accessibility and property values associated with the King Street Transit Priority Corridor project in Toronto. Transp. Res. A Policy Pract. 190, 104256. https://doi.org/10.1016/j.tra.2024.104256.
Huang, Y., Zong, H., 2021. Has high-speed railway promoted spatial equity at different levels? A case study of inland mountainous area of China. Cities 110, 103076. https://doi.org/10.1016/j.cities.2020.103076.
Hymel, K., 2019. If you build it, they will drive: measuring induced demand for vehicle travel in urban areas. Transp. Policy 76, 57–66. https://doi.org/10.1016/j.tranpol.2018.12.006.
IPCC (Ed.), 2022. Mitigation Pathways Compatible with 1.5°C in the Context of Sustainable Development, in: Global Warming of 1.5°C: IPCC Special Report on Impacts of Global Warming of 1.5°C above Pre-Industrial Levels in Context of Strengthening Response to Climate Change, Sustainable Development, and Efforts to Eradicate Poverty. Cambridge University Press, Cambridge, pp. 93–174. https://doi.org/10.1017/9781009157940.004.
Kaczan, D.J., 2020. Can roads contribute to forest transitions? World Dev. 129, 104898. https://doi.org/10.1016/j.worlddev.2020.104898.
Kim, Y., Wilkens, L.R., Park, S.-Y., Goodman, M.T., Monroe, K.R., Kolonel, L.N., 2013. Association between various sedentary behaviours and all-cause, cardiovascular disease and cancer mortality: the multiethnic cohort study. Int. J. Epidemiol. 42, 1040–1056. https://doi.org/10.1093/ije/dyt108.
Kinigadner, J., Büttner, B., Vale, D., Wulfhorst, G., 2021. Shifting perspectives: a comparison of travel-time-based and carbon-based accessibility landscapes. J. Transp. Land Use 14, 345–365. https://doi.org/10.5198/jtlu.2021.1741.
Krajzewicz, D., Rudloff, C., Straub, M., Millonig, A., 2024. Measuring and visualising 15-min-areas for fair CO2 budget distribution. Eur. Transp. Res. Rev. 16, 16. https://doi.org/10.1186/s12544-024-00638-0.
Laurance, W.F., Clements, G.R., Sloan, S., O'Connell, C.S., Mueller, N.D., Goosem, M., Venter, O., Edwards, D.P., Phalan, B., Balmford, A., Van Der Ree, R., Arrea, I.B., 2014. A global strategy for road building. Nature 513, 229–232. https://doi.org/10.1038/nature13717.
Lehe, L., 2018. How minimum parking requirements make housing more expensive. J. Transp. Land Use 11. https://doi.org/10.5198/jtlu.2018.1340.
Levine, J., 2020. A century of evolution of the accessibility concept. Transp. Res. Part D: Transp. Environ. 83, 102309. https://doi.org/10.1016/j.trd.2020.102309.
Lucas, K., 2012. Transport and social exclusion: where are we now? Transport Policy, Urban Transport Initiatives 20, 105–113. https://doi.org/10.1016/j.tranpol.2012.01.013.
Ma, K., Banister, D., 2006. Excess commuting: a critical review. Transp. Rev. 26, 749–767. https://doi.org/10.1080/01441640600782609.
Maciejewska, M., Cubells, J., Marquet, O., 2025. When proximity is not enough. A sociodemographic analysis of 15-minute city lifestyles. J. Urban Mobility 7, 100119. https://doi.org/10.1016/j.urbmob.2025.100119.
Manaugh, K., El-Geneidy, A., 2012. What makes travel "local": Defining and understanding local travel behaviour. J. Transp. Land Use 5. https://doi.org/10.5198/jtlu.v5i3.300.
Martens, K., Di Ciommo, F., 2017. Travel time savings, accessibility gains and equity effects in cost–benefit analysis. Transp. Rev. 37, 152–169. https://doi.org/10.1080/01441647.2016.1276642.
Martens, K., Singer, M.E., Cohen-Zada, A.L., 2022. Equity in accessibility. J. Am. Plann. Assoc. 1–16. https://doi.org/10.1080/01944363.2021.2016476.
Mattioli, G., 2016. Transport needs in a climate-constrained world. A novel framework to reconcile social and environmental sustainability in transport. Energy Research & Social Science, Energy Demand for Mobility and Domestic Life: New Insights from Energy Justice 18, 118–128. https://doi.org/10.1016/j.erss.2016.03.025.
Mattioli, G., Roberts, C., Steinberger, J.K., Brown, A., 2020. The political economy of car dependence: a systems of provision approach. Energy Res. Soc. Sci. 66, 101486. https://doi.org/10.1016/j.erss.2020.101486.
Mazumdar, S., Learnihan, V., Cochrane, T., Davey, R., 2018. The built environment and social capital: a systematic review. Environ. Behav. 50, 119–158. https://doi.org/10.1177/0013916516687343.
McDonald, R.I., Aronson, M.F.J., Beatley, T., Beller, E., Bazo, M., Grossinger, R., Jessup, K., Mansur, A.V., Puppim de Oliveira, J.A., Panlasigui, S., Burg, J., Pevzner, N., Shanahan, D., Stoneburner, L., Rudd, A., Spotswood, E., 2023. Denser and greener cities: Green interventions to achieve both urban density and nature. People Nat. 5, 84–102. https://doi.org/10.1002/pan3.10423.
Meadows, D.H., Meadows, D.L., Randers, J., Behrens, W.W., 1972. The Limits to Growth. Universe Books, New York.
Melo, P.C., Graham, D.J., Levinson, D., Aarabi, S., 2017. Agglomeration, accessibility and productivity: evidence for large metropolitan areas in the US. Urban Stud. 54, 179–195.
Merlin, L.A., Cherry, C.R., Mohamadi-Hezaveh, A., Dumbaugh, E., 2020. Residential accessibility's relationships with crash rates per capita. J. Transp. Land Use 13, 113–128. https://doi.org/10.5198/jtlu.2020.1626.
Miner, P., Smith, B.M., Jani, A., McNeill, G., Gathorne-Hardy, A., 2024. Car harm: a global review of automobility's harm to people and the environment. J. Transp. Geogr. 115, 103817. https://doi.org/10.1016/j.jtrangeo.2024.103817.
Monzon, A., Lopez, E., Ortega, E., 2019. Has HSR improved territorial cohesion in Spain? An accessibility analysis of the first 25 years: 1990–2015. Eur. Plan. Stud. 27, 513–532. https://doi.org/10.1080/09654313.2018.1562656.
Næss, P., 2025. Four common misconceptions in quantitative studies of the built environment and travel. Transp. Res. Part D: Transp. Environ. 139, 104597. https://doi.org/10.1016/j.trd.2025.104597.
Nielsen, A.B., van den Bosch, M., Maruthaveeran, S., van den Bosch, C.K., 2014. Species richness in urban parks and its drivers: a review of empirical evidence. Urban Ecosyst. 17, 305–327. https://doi.org/10.1007/s11252-013-0316-1.
OECD/ITF, 2021. ITF Transport Outlook 2021. OECD, Paris.
OECD/ITF, 2023. Comparing transport infrastructure investment policies around the globe [WWW Document]. URL https://www.itf-oecd.org/modal-shift-cleaner-transport-fails-materialise (accessed 7.30.25).
Ottelin, J., Ala-Mantila, S., Heinonen, J., Wiedmann, T., Clarke, J., Junnila, S., 2019. What can we learn from consumption-based carbon footprints at different spatial scales? Review of policy implications. Environ. Res. Lett. 14, 093001. https://doi.org/10.1088/1748-9326/ab2212.
Oviedo, D., Sabogal, O., 2020. Unpacking the connections between transport and well-being in socially disadvantaged communities: structural equations approach to low-income neighbourhoods in Nigeria. J. Transp. Health 19, 100966. https://doi.org/10.1016/j.jth.2020.100966.
Padeiro, M., Louro, A., da Costa, N.M., 2019. Transit-oriented development and gentrification: a systematic review. Transp. Rev. 39, 733–754. https://doi.org/10.1080/01441647.2019.1649316.
Raworth, K., 2017. Doughnut economics : seven ways to think like a 21st-century economist. Random House, London.
Ripple, W.J., Wolf, C., Gregg, J.W., Rockström, J., Mann, M.E., Oreskes, N., Lenton, T.M., Rahmstorf, S., Newsome, T.M., Xu, C., Svenning, J.-C., Pereira, C.C., Law, B.E., Crowther, T.W., 2024. The 2024 state of the climate report: Perilous times on planet Earth. Bioscience. https://doi.org/10.1093/biosci/biae087.
Robeyns, I., 2024. Limitarianism: The Case Against Extreme Wealth. Astra House.
Saunders, L.E., Green, J.M., Petticrew, M.P., Steinbach, R., Roberts, H., 2013. What are the health benefits of active travel? A systematic review of trials and cohort studies. PLoS One 8, e69912. https://doi.org/10.1371/journal.pone.0069912.
Scheepers, C.E., Wendel-Vos, G.C.W., van Kempen, E.E.M.M., de Hollander, E.L., van Wijnen, H.J., Maas, J., den Hertog, F.R.J., Staatsen, B.A.M., Stipdonk, H.L., Int Panis, L.L.R., van Wesemael, P.J.V., Schuit, A.J., 2016. Perceived accessibility is an important factor in transport choice — results from the AVENUE project. J. Transp. Health 3, 96–106. https://doi.org/10.1016/j.jth.2016.01.003.
Scheibehenne, B., Greifeneder, R., Todd, P.M., 2010. Can there ever be too many options? A meta-analytic review of choice overload. J. Consum. Res. 37, 409–425. https://doi.org/10.1086/651235.
Schmidt, F., Czepkiewicz, M., Mattioli, G., Kostecka, M., Krysiński, D., 2025. Flight Dependence in the Making. Social Institutionalisation of Air Travel Across Generations. https://doi.org/10.2139/ssrn.5248848.
Seto, K.C., Güneralp, B., Hutyra, L.R., 2012. Global forecasts of urban expansion to 2030 and direct impacts on biodiversity and carbon pools. Proc. Natl. Acad. Sci. 109, 16083–16088. https://doi.org/10.1073/pnas.1211658109.
Shoup, D., 2021. High Cost of Free Parking. Routledge, New York. https://doi.org/10.4324/9781351179539.
Silva, C., Larsson, A., 2018. Challenges for Accessibility Planning and Research in the Context of Sustainable Mobility. OECD/ITF.
Silva, C., Bertolini, L., te Brömmelstroet, M., Milakis, D., Papa, E., 2017. Accessibility instruments in planning practice: bridging the implementation gap. Transp. Policy 53, 135–145. https://doi.org/10.1016/j.tranpol.2016.09.006.
Silva, C., Büttner, B., Seisenberger, S., Teixeira, J.F., Baquero-Larriva, M.T., Beyazit, E., Hachette, M., Hernandez, D., Kariuki, W., Lamíquiz-Daudén, P.J., Levine, J., L'Hostis, A., Li, C., Martens, K., Martin, J.C., Martinazzo, L., Mella-Lira, B., Merlin, L. A., Moinse, D., Palacio, F., Patuelli, R., Pereira, R.H.M., Radics, M., Radzimski, A., Rodrigue, L., Rossetti, R., Singer, M.E., Toivonen, T., van Burgsteden, M., Willberg, E., Bittencourt, T., Chai, Y., Reggiani, A., Visvardis, D., 2025. Proximity-centred accessibility – a conceptual debate involving planning practitioners worldwide. Cities 167, 106376. https://doi.org/10.1016/j.cities.2025.106376.

Steffen, W., Richardson, K., Rockström, J., Cornell, S.E., Fetzer, I., Bennett, E.M., Biggs, R., Carpenter, S.R., de Vries, W., de Wit, C.A., Folke, C., Gerten, D., Heinke, J., Mace, G.M., Persson, L.M., Ramanathan, V., Reyers, B., Sörlin, S., 2015. Planetary boundaries: guiding human development on a changing planet. Science 347, 1259855. https://doi.org/10.1126/science.1259855.

Talen, E., Wileden, L., 2025. The density puzzle: what is known, what is disputed, and where to go from here. J. Plan. Lit. 40, 375–390. https://doi.org/10.1177/08854122241262750.

Tammaru, T., Sevtsuk, A., Witlox, F., 2023. Towards an equity-centred model of sustainable mobility: integrating inequality and segregation challenges in the green mobility transition. J. Transp. Geogr. 112, 103686. https://doi.org/10.1016/j.jtrangeo.2023.103686.

te Brömmelstroet, M., Mladenović, M.N., Nikolaeva, A., Gaziulusoy, İ., Ferreira, A., Schmidt-Thomé, K., Ritvos, R., Sousa, S., Bergsma, B., 2022. Identifying, nurturing and empowering alternative mobility narratives. J. Urban Mobility 2, 100031. https://doi.org/10.1016/j.urbmob.2022.100031.

Timmer, D., 2024. Limitarianism, upper limits, and minimal thresholds. Res. Publica. https://doi.org/10.1007/s11158-024-09662-2.

Vafeiadis, E., Elldér, E., 2024. Correlates of perceived accessibility across transport modes and trip purposes: insights from a Swedish survey. Transp. Res. A Policy Pract. 186, 104147. https://doi.org/10.1016/j.tra.2024.104147.

van Burgsteden, M., 2026. The outside edge of the doughnut: sustainable mobility and accessibility inequalities in Dutch transport policy. Transp. Res. Interdiscip. Perspect. 37, 101978. https://doi.org/10.1016/j.trip.2026.101978.

Vanoutrive, T., Cooper, E., 2019. How just is transportation justice theory? The issues of paternalism and production. Transp. Res. A Policy Pract. 122, 112–119. https://doi.org/10.1016/j.tra.2019.02.009.

van Wee, B., 2021. Accessibility and mobility: positional goods? A discussion paper. J. Transp. Geogr. 92, 103033. https://doi.org/10.1016/j.jtrangeo.2021.103033.

van Wee, B., Mokhtarian, P., 2023. Escape theory: explaining a negative motivation to travel. Transp. Res. A Policy Pract. 169, 103603. https://doi.org/10.1016/j.tra.2023.103603.

Vecchio, G., Martens, K., 2021. Accessibility and the capabilities approach: a review of the literature and proposal for conceptual advancements. Transp. Rev. 41, 833–854. https://doi.org/10.1080/01441647.2021.1931551.

Virág, D., Wiedenhofer, D., Baumgart, A., Matej, S., Krausmann, F., Min, J., Rao, N.D., Haberl, H., 2022. How much infrastructure is required to support decent mobility for all? An exploratory assessment. Ecol. Econ. 200, 107511. https://doi.org/10.1016/j.ecolecon.2022.107511.

Warren, T.Y., Barry, V., Hooker, S.P., Sui, X., Church, T.S., Blair, S.N., 2010. Sedentary behaviors increase risk of cardiovascular disease mortality in men. Med. Sci. Sports Exerc. 42, 879–885. https://doi.org/10.1249/MSS.0b013e3181c3aa7e.

Willberg, E., Fink, C., Klein, R., Heinonen, R., Toivonen, T., 2024. 'Green or short: choose one' - a comparison of walking accessibility and greenery in 43 European cities. Comput. Environ. Urban Syst. 113, 102168. https://doi.org/10.1016/j.compenvurbsys.2024.102168.

Willberg, E., Tenkanen, H., Miller, H.J., Pereira, R.H.M., Toivonen, T., 2024. Measuring just accessibility within planetary boundaries. Transp. Rev. 44, 140–166. https://doi.org/10.1080/01441647.2023.2240958.

Wu, H., Avner, P., Boisjoly, G., Braga, C.K.V., El-Geneidy, A., Huang, J., Kerzhner, T., Murphy, B., Niedzielski, M.A., Pereira, R.H.M., Pritchard, J.P., Stewart, A., Wang, J., Levinson, D., 2021. Urban access across the globe: an international comparison of different transport modes. npj Urban Sustain 1, 1–9. https://doi.org/10.1038/s42949-021-00020-2.

Xiao, D., Ding, H., Sze, N.N., Zheng, N., 2024. Investigating built environment and traffic flow impact on crash frequency in urban road networks. Accid. Anal. Prev. 201, 107561. https://doi.org/10.1016/j.aap.2024.107561.

Zhang, X., Poliakov, A., Tenkanen, H., Arcaute, E., 2025. Recurrent visitations expose the paradox of human mobility in the 15-Minute City vision. https://doi.org/https://doi.org/10.48550/arXiv.2509.00919.

Elias Willberg[a,*], Henrikki Tenkanen[b], Bert van Wee[c], Tuuli Toivonen[a]

[a] *Digital Geography Lab, Faculty of Science, University of Helsinki, Finland*

[b] *GIST Lab, Department of Built Environment, School of Engineering, Aalto University, Finland*

[c] *Transport and Logistics Group, Faculty of Technology, Policy and Management, Delft University of Technology, the Netherlands*

[*] Corresponding author at: Gustaf Hällströmin katu 2 A (Physicum) PL 64, 00014 Helsingin yliopisto, Finland.

E-mail address: elias.willberg@helsinki.fi (E. Willberg).