# Searching for standards of fairness in the transportation literature

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**Abstract**

This work provides a synthesis of how transportation fairness, justice and equity literature has operationalized standards. We first outline a flexible framework for engaging fairness questions and then apply it to collate the literature review's results. We find most articles were published within the last half decade and center urban areas, with 40% exploring Global South case studies. Income groups, followed by specific age groups (i.e., older adults) and people with disabilities, are most commonly the subjects of justice. Transit and pedestrian modes are the most frequently studied mobility tools; with many analyses being multimodal and comparative in nature. The benefits and burdens, the "What" of mobility, focuses on movement (i.e., quality of trips taken) or the potential for movement (i.e., accessibility). How the reviewed works conceptualize fairness is varied (e.g., Vertical Equity, Wellbeing, Rights-Based); but is often delineated with a supporting opportunity standard (37%) (i.e., number of parks within a 30-minute travel time) or population standard (36%) (i.e., bottom income quartile), though

Infrastructure (i.e., level of service) and Environmental+ (i.e., air pollution) standards are also prominent. While the reviewed literature is extensive, we conclude with calls to action for researchers, practitioners, and transportation advocates to drive meaningful change. These include developing standards based on rigorous conceptualizations, advancing systems-thinking approaches to fairness, ensuring data accessibility as a matter of justice, strengthening the connection between standards and lived experiences, and rigorously evaluating interventions and policies.

**Keywords:** transportation; equity; justice; fairness; standards; transportation planning; literature review

# Introduction

Transportation systems are technologies essential for social inclusion and activity participation, and therefore important from an equity perspective (Karel Martens 2016; Karner, Pereira, and Farber 2024; Vecchio, Tiznado-Aitken, and Hurtubia 2020). Beyond ethical motivations, tracking objective and perceived inequalities is of interest for governing bodies to respond to popular and needed demands for fairness. However, this has proven to be a challenging task: transportation systems are notoriously complex, with benefits and burdens that are diffuse over space and time. To compound matters, emerging technologies and service models can swiftly change the balance of benefits and burdens among a population (Guo et al. 2020). Transportation systems that are engineered to offer higher mobility for people *somewhere* can simultaneously cut others off from essential opportunities *elsewhere* (Raje 2004). The shades of policies cast long shadows, as shown by the legacy of U.S. urban highways (Archer 2020) and impacts of transportation-related climate change (Markolf et al. 2019).

Responding to this topic, a plethora of academic literature has emerged in recent decades. For instance, much research has been devoted to the issues of *measuring* equity in transportation (e.g., A. Delbosc and Currie 2011a; Karel Martens, Bastiaanssen, and Lucas 2019; Pritchard, Zanchetta, and Martens 2022). Further, there are multiple works that discuss the conceptual and philosophical foundations of equity and fairness in transportation (e.g., Karel Martens 2016; R. H. M. Pereira, Schwanen, and Banister 2017; Vanoutrive and Cooper 2019). Previous reviews of equity in planning documents have been tightly scoped to cover accessibility (e.g., Boisjoly and El-Geneidy 2017-04) or a particular mode of transportation (e.g., cycling in Doran, El-Geneidy, and Manaugh 2021). While these efforts are valuable, there remains a gap in terms of understanding *how* standards for equity are developed and implemented for transportation systems.

The objective of this work is to broadly scan the state of this knowledge. Through a distributive justice lens (R. H. M. Pereira, Schwanen, and Banister 2017; R. H. M. Pereira and Karner 2021), our work seeks to make two contributions. First, it outlines

a conceptual and flexible framework for engaging and analysing transportation fairness questions, based on the questions "Why?", "Where?", "When?", "Who?", "What?", and "How?" (5WH). Second, it applies the framework to collate the existing knowledge about fairness standards. To achieve this, we scan the state of academic knowledge in defining standards of fairness in transportation. In contrast to previous reviews on measuring inequality in transportation systems, this work is concerned with the implicit or explicit standards used to judge whether inequalities are fundamentally "fair" or unacceptable.

# Background

## Definitions

Fairness, equity and justice are closely related and often colloquially used interchangeably. In this section, we clarify these concepts' definitions to facilitate their precise use throughout the manuscript.

**Fairness** is a subjective and moral assessment of a treatment, outcome, or both, in relation to a given state of affairs. Within the transportation domain, the fairness of the distribution of transportation "goods" and "burdens" (e.g., access to opportunities, transportation-related externalities) for individuals, groups and society is often at issue (R. H. M. Pereira and Karner 2021). For example, congestion pricing schemes could be unfair if they disproportionately disadvantage lower income groups (Eliasson 2016), systems designed to service "mandatory" destinations like employment or commercial retail that are not as relevant to all populations like those entangled in caring -work (Ravensbergen, Fournier, and El-Geneidy 2023; Hail and McQuaid 2021), or even the application of justice such as Title VI of the U.S. Civil Rights Act of 1964 for the purpose of accessibility planning as discussed in Karel Martens and Golub (2021). Individuals may feel certain situations are unfair, processes can be seen as unfair, or even outcomes of these processes and situations can be unfair.

There are a multitude of aspects to **fairness** in transportation (Hail and McQuaid 2021), namely because the distribution of transportation "goods" and "burdens" are often ambiguous. Individuals' ability to access and benefit from transportation-related outcomes varies continuously, often in ways that are unrecognized (implicitly or explicitly) or inadequately considered by transportation planners and other influential actors in the system. To put it briefly, when it comes to the distribution of "goods," fairness can be understood as a *moral* appraisal concerning the amount and strength of moral claims to those goods (Wintein 2024). Hence, in this manuscript, we define **fairness** as the moral evaluation of the rightness or wrongness of a given state of affairs (e.g., the impartiality and consistency of treatment or associated outcomes). In other words, fairness serves as a yardstick for justice.

Relatedly, **justice** can be viewed as the formalized goal of fairness, an analytically reasoned *fair* state of affairs. Justice is attained when people "give and receive whatever they are due" (Jaggar 2009, 1–2), and it ceases to exist when there are persons or groups that are denied "access to the opportunities they need to lead a meaningful

and dignified life" (Karner et al. 2020, 440). Different scopes and approaches to justice have been developed, as formalizing fairness depends on the desirability of different states of affairs, which depend on populations, places, times, and different scopes. For instance, several forms of justice can be distinguished (Jaggar 2009; R. H. M. Pereira, Schwanen, and Banister 2017; Karner et al. 2020):

- **Retributive justice** is concerned with the proportional retribution of wrongdoers relative to legitimate punishers and the innocent (Walen 2023).
- **Reparative (or restorative) justice** focuses on the reparation of caused harm; it centers the needs and voices of victims to restore wrongdoers and the community according to moral values (Tyler 2006; Braithwaite et al. 2003). In planning and policy contexts, reparative justice involves accountability mechanisms (material, powers, rights, processes) to compensate victims (Safransky 2022; Williams and Steil 2023).
- **Procedural justice** strives to ensure that the views and preferences of all stakeholders are fairly accounted for in the decision-making and inter-personal procedures affecting their lives and communities (Tyler 2006).
- **Distributive justice** is perhaps the most studied form of justice in transportation (R. H. M. Pereira, Schwanen, and Banister 2017) and elsewhere (see Jaggar 2009, 2). Its main concern is the collection of benefits and burdens of the tangible and intangible products of society by different segments of a population. The just distributive aspects of transportation systems is also of focus in this work.

While justice (i.e., formalized fairness) is a broad moral concept, **equity** and **standards** can be understood as the 'instruments' of justice- the tools through which society moves towards a just state of affairs.

**Equity**, as conceptualized alongside distributive justice, tends to encompass tools to understand the distribution of benefits and burdens of things among a population (e.g., disparities), emphasizing those with the least advantage or most disadvantage. In the transportation domain, equity analysis often flows from the top: stemming from the authority of the state and meant to assist with decisions about regulating and financing spending (Karner et al. 2020). As in Karner et al. (2020), equity and disparity analysis should not be seen as an end in and of itself, but rather as a means to gather information about actual, observed, and perceived inequities.

And lastly, in this work's context, a **standard** is a concrete statement about fairness; it is a formalized threshold in understanding disparities (i.e., related to equity) as part of the goal of formalized fairness (i.e., justice). A standard establishes criteria for how benefits or burdens should be distributed or allocated in a way that aligns with moral or formalized principles. For example, a weak standard might be a Pareto improvement, where benefits may be concentrated in certain groups (even those already advantaged), as long as no group is made worse off compared to the existing situation (Tan et al. 2016; S.-X. Xu et al. 2018). As another example, a more strict standard could be based on egalitarian principles (e.g., proportional equity)

where the benefits or burdens are weighted by population; in the consistent application of this standard, each group would give or receive in proportion to their relevant 'size' (Bills and Walker 2017; K. Martens, Golub, and Robinson 2012). In contrast, an affirmative action standard (i.e., those related to restorative justice) could be an even stricter standard, requiring the benefits to be distributed in a non-egalitarian way to favour people still harmed by past or present discriminatory practices (Bierbaum, Karner, and Barajas 2021).

To summarise, in this work we use **justice** to describe a moral target, **fairness** as an evaluation or yardstick of justice, **equity** as a set of related disparity measurement tools, and **standards** as concrete statements of fairness.

## A framework to analyze questions of justice: 5WH

Having defined justice, fairness, equity and standards, we approach the literature with an analytical apparatus inspired by the framing of Jaggar (2009) for philosophical questions of justice.[1]. According to Jaggar (2009), Western philosophy has approached the issue of justice by asking "Why?", "Where?", "When?", "Who?", "What?", and "How?" (5WH), applying them to a particular domain or sphere of life relevant to justice.

In the case of transportation, the question of **"Where?"** is paramount as transportation by its very nature concentrates the benefits (e.g., access points to the system are not ubiquitous). The burdens, in contrast, are often diffuse: they are incrementally paid, for example, by a distributed population in the form of taxes, or by a (possibly different) population in the form of poor health. As such, the answer to "Where?" is the definition of the spatial boundaries.

Conventionally, the question of **"When?"** refers to the temporal circumstances within which the demands of justice apply. When it comes to transportation, questions regarding temporarily are important in different domains: *when* did the analysis take place and under what historical policy context; when is *the right time* to invest in infrastructure and as a result when to generate a spatial inequality (Rabello Quadros and Nassi 2015); for *how long* the burdens and benefits can be associated to a specific intervention; or even the *timeline* of reparative justice to reconcile the shadows of past transport-related injustices.

When asking **"Who?"**, we think about the entities that should be regarded as subjects/arbiters of justice. For tractability, this question is often approached through the filter of population groups, which may include several concurrent traits, including gender identity, ableness, ethnicity, age, caste, and income. Often, it is appropriate to consider the intersections between traits, given differences in a person's lived experiences. A complication in the case of transportation is that disentangling the "Who" from their mobility tools is not always straightforward. Although a person is not their

[1]Similar questions are found peppered throughout the literature. This is done either explicitly, as for example in Karner et al. (2020), who ask "of what", "for whom," and "how much" in reference to equity; or implicitly, as in Gössling (2016), who asks of the outputs ("what?") of transportation (exposure, space, access) and "for whom?" (gender, age, ethnicity).

mode of transportation, there are large segments of the population who cannot extricate themselves from the mobility tools they use, either because they have driven themselves out of choices (Lavery, Paez, and Kanaroglou 2013), or have been driven out of choices by factors beyond their control (Jacques, Manaugh, and El-Geneidy 2012). While it is important to avoid conflating the "Who" with the "What", we need to be mindful of the connection between a person and their mobility tools for analytical purposes.

**"What?"** refers to which entities should be regarded as objects of inequities, meaning which categories of things should be distributed in a just manner. To understand the distributional implications of transportation systems, it is essential to understand what they *produce*. Transportation systems rely on technologies to improve the rate at which space is traded for time by increasing the speed of movement. But as the adage goes, travel is derived demand (Mokhtarian, Salomon, and Redmond 2001). For this reason, we cannot stop at considering only mobility but must consider its ulterior goal–reaching destinations. Coupled with land use, mobility creates accessibility to opportunities as well as varied burdens. For instance, some are direct and paid by the traveler (e.g., travel time, out-of-pocket costs), but many others are indirect and related to network externalities (e.g., exposure to pollution). Transportation justice, thus, involves proximate (mobility tools and mobility) and ulterior (accessibility and activity opportunities) objectives.

The next question is **"How?"**, and it relates to the allocation of various objects of justice ("what") to various subjects of justice ("who") in various circumstances ("when" and "where"). Fairness standards are an equity tool for answering this distributive question. The thresholds can be quantitative (e.g., square meters of green space per capita), qualitative descriptions (e.g., do not knowingly discriminate) or a mix of the two. Some examples include: maximum travel distance/cost/time to or from key destinations, levels of maximum exposure to externalities (i.e., noise or air pollution), un/fulfilled needs, and dis/satisfaction with travel. To support us when approaching this question, we draw from concepts in transport-related social exclusion, transport disadvantage, and transport poverty, which are typically based on utilitarian or sufficientarian philosophies. The "How?" is supported by fairness conceptualisations along with standards.

Above all, convincing answers to the above questions require a supporting rationale: a **"Why?"** (Jaggar 2009). This is perhaps the most slippery of 5WH. Justice is inherently a social construct. Asking **Why?** amounts to asking what sort of social contracts regulate human interactions, that is, the self-imposed rules that result from our collective will to believe. These contracts can be defined by constitution, but there are often unwritten and possibly contested variants. In this way, analyzing the "Why?" in the corpus is not the focus of this review, partly because answers to "Why?" are seldom explicitly stated. Instead, our focus is on the standards of fairness that, combined with the use of analysis, can help us understand how better to move towards just transportation systems and better formulate answers to "Why?".

## Review methods

This work examines the academic literature on transportation to identify the extent to which standards for equity are defined and employed. In this task, we follow the Joanna Briggs Institute (JBI) approach to the conduct of scoping reviews, an approach that builds upon the Arksey and O'Malley (2005) framework (Peters et al. 2020). The review is also guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses, particularly the extension for scoping reviews (PRISMA-ScR) which is consistent with the JBI approach (Tricco et al. 2018).

The primary research question and the protocol were initially defined by the authors, a group of experts in the field of transportation. The initial draft of the protocol was refined from preliminary searches of related reviews (e.g., Zhang and Zhao 2021; R. H. M. Pereira, Schwanen, and Banister 2017; Vecchio and Martens 2021) and in consultation with research services librarians. The final protocol was released on OSF [redacted for double-blind review] , and the methods are summarised as follows.

The search strategy was developed iteratively using **inclusion** and **exclusion** criteria (Peters et al. 2020). For the inclusion criteria, the mnemonic PCC (population, concept, and context) was adopted. The search strategy was refined by adding search terms. The terms were bundled by means of Boolean operators. These stages are summarised as follows (see Appendix Section **??** for details):

1. An initial limited search of Web of Science (WoS) Core Collection (containing journals, conference proceedings, and books published all over the world) was undertaken to identify key documents. Separate searches using the terms 'transportation' and 'equity' were generated. From these searches, we examined the text contained in the titles and abstracts, the index terms, and subject heading searches when available. As we developed a clearer outline of the literature, we refined the terms used for the search. This took the form: ("Transport" OR "Transit" OR "Car*" OR "Walk" OR "Bike"…**1**) AND ("Equity" OR "Justice" OR "Fair"…**2**), where **1** and **2** signify additional terms relating to 'transportation' and 'equity', respectively.
2. Upon inspection of the preliminary search results and after achieving a consensus among the authors, the set of search terms related to 'equity' was expanded into three sets of terms. The first describes theories and concepts of equity, the second describes the object of justice (i.e., the "what" in our analytical framework), and the third describes terms referring to standards (i.e., the "how"). These sets of terms were augmented iteratively. The final search query took the following general form: ("Transport" OR "Transit" OR "Car*" OR "Walk" OR "Bike"…**1**) AND ("Equity" OR "Justice" OR "Equity" OR "Fair"…**2**) AND ("Accessibility" OR "Mobility" OR …**3**) AND ("Standard" OR "Threshold" OR …**4**) where **1**,**2**,**3**, and **4** signify additional terms included in the sets combined with "OR" operators.

After testing the search strategy on WoS Core Collection, we applied it to an augmented list of databases. The databases used were: WoS General Collection-Science Citation Index Expanded, WoS Social Sciences Citation Index, and Transportation Research International Documentation (TRID). The definitive version of the search

was completed and exported by the lead author on March 21st, 2021. The number of documents identified in this was was 6,382.

The semi-automated nature of the search strategy was overly inclusive, thereby reducing the risk of omitting relevant material. The next stage was to trim the corpus; the authors worked with a group of previously trained undergraduate research assistants to scan the documents and assess their relevance based on titles and abstracts. Two research assistants voted on each document, and a third vote from the authorship team broke ties. After this step, 1,710 documents were assessed based on full-text, again with each being voted on by two research assistants and an authorship team member tie-breaker. Next, using a data extraction template and workflow that was pilot-tested with a subset of papers, the authorship team extracted data from the eligible documents using *Covidence* (Covidence 2023), an online application for literature screening. The evidence selection workflow, flow diagram, data extraction template, and some sample data extractions can be consulted in Appendix Figure **??**. The end result of this scan was a corpus of 165 documents retained for data extraction.

# Synthesis of findings

This section threads together the trends identified from the reviewed transportation literature. Specifically, a thematic overview of "When?" and "Where?" transportation fairness is considered, "Who?" are the subjects of justice, "What?" could be considered the objects of justice, and lastly "How?" is fairness measured. As an overview, Figure **??** illustrates the prominence of each thematic category for "When?", "Where?", "Who?", and "What?", while Figure **??** presents an overview of the types of fairness conceptualizations and thresholds, addressing the "How?".

## "When" and "Where" is transportation fairness considered

Within our corpus, most papers (60%) focus on studies in the Global North, with many studies from North America (particularly U.S. and Canada), Europe (France, Spain and Northern Europe), Oceania (Australia and New Zealand), and Asia (Japan and Israel). Though their subject matter is varied, their spatial context mainly pertains to North America and Europe, and thus more often than not deals with more developed and formal government transport planning apparatuses and technologies e.g., planning for equitable high-speed rail (Monzon, Ortega, and Lopez 2013), autonomous vehicle technology (Eppenberger and Richter 2021), or on the public consultation processes (Reddy, Chennadu, and Lu 2010).

Of note, work included in the reviewed literature does not often explore the historical or temporal aspects of transportation fairness in depth. Therefore, in this section we provide a thematic overview of the temporal and spatial contexts associated with the studied case studies and the publication location.

40% of studies from the Global South are predominately from Asia, notably China, but also India, Thailand, Iran, Philippines, and Indonesia. The next most common focus within the literature from the Global South is from South America. Many of

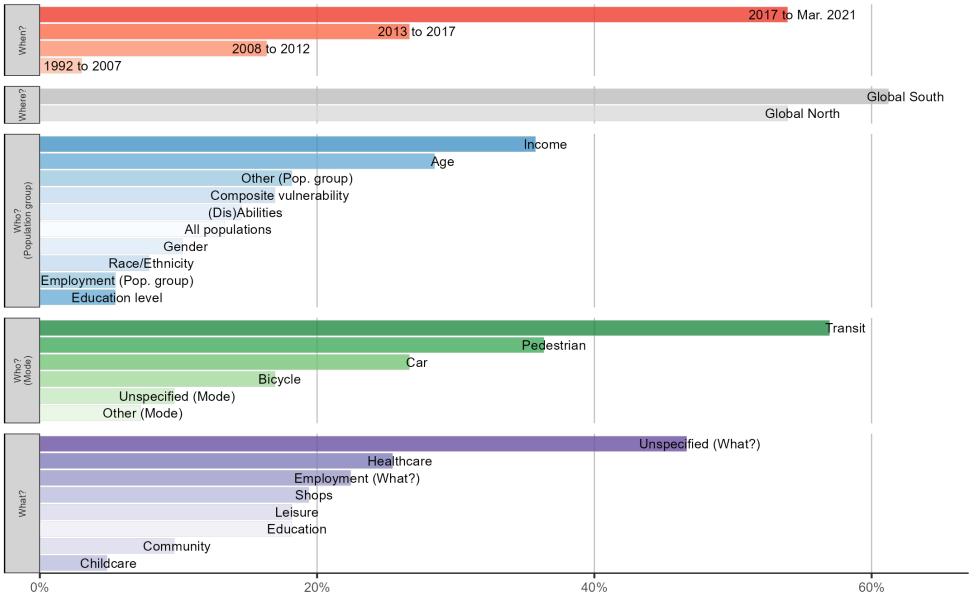



**Figure 1**: The proportion of papers in each When, Where, Who, and What by topics in each category. Topic categories were generated by the authors based on the reviewed literature.

these studies mention a systemic absence of evidence relevant to the region (Vecchio, Tiznado-Aitken, and Hurtubia 2020). Despite a growing recognition of the interconnections between transport development, social exclusion, and poverty (Benevenuto and Caulfield 2020), a number of studies underscore ongoing neglect of the social dimension of transport during the planning stage (Benevenuto and Caulfield 2020; Boisjoly et al. 2020). Many studies also point at affordability as one of the main mobility barriers in the region (Falavigna and Hernandez 2016; Rivas, Serebrisky, and Suárez-Alemán 2018), while some highlight multi-dimensional concerns such as public transport accessibility and quality of walking environments that contribute to mobility inequalities (Tiznado-Aitken, Munoz, and Hurtubia 2018). Studies pertaining to Africa are even less numerous.

A shared characteristic among studies from Africa and South America is a scarcity of official transport data (Fried et al. 2020). These studies also incorporate the use of informal transportation options and tensions in developing road network infrastructure (which tends to support car dependency) over meeting the mobility/accessibility needs of citizens more equitably and sustainably (Thondoo et al. 2020). To address these challenges, researchers compile databases based on open and geo-referenced data, calculate objective and/or subjective measures (Berhe, Martinez, and Verplanke 2014), and focus on advancing transport justice for low to medium income countries by aligning their goals with external policy guidelines such as the Sustainability Development Goals (SDG), particularly those related to universal accessibility (Fried et al. 2020).

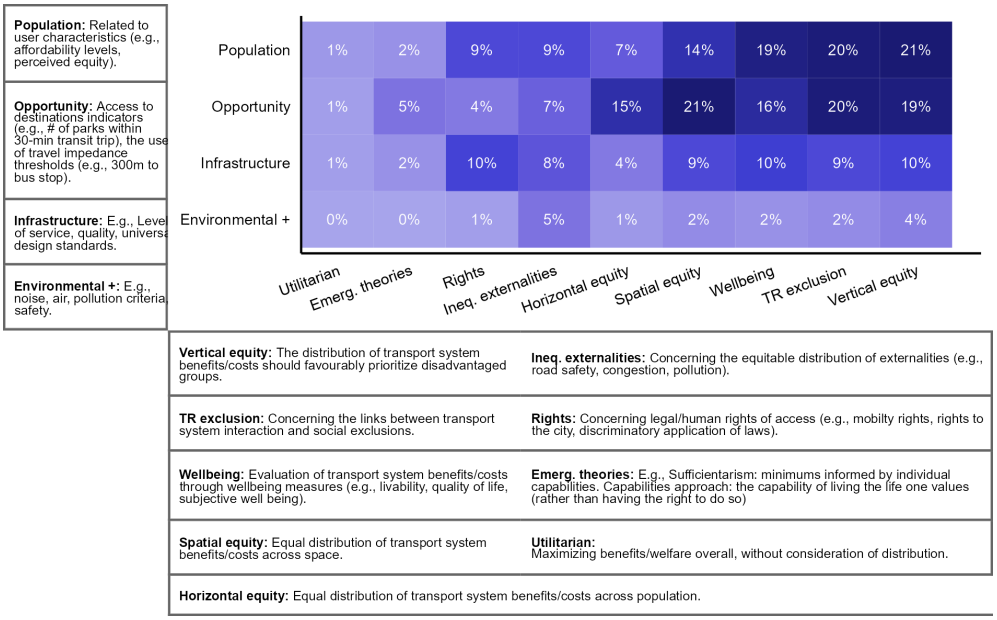



**Figure 2**: The proportion of papers by topics in the How categories. How is split into two categories: topics related to fairness conceptualisation (horizontal axis) and topics related to standards (vertical axis). Topic categories were generated by the authors based on the reviewed literature.

Of all the studies reviewed, 85% focus on urban and suburban settings and are highly varied in their research aims. To give an example, Cox and Bartle (2020) qualitatively examine cycling as a mode of travel for people with disabilities in a typical mid-size town in the U.K. Ampe et al. (2020), on the other hand, work to identify the lateral clearance that motorists should maintain when passing cyclists with children seats. The remainder of the studies focus on rural regions (14%), or remote regions, such as those that rely on inter-island ferry trips in the Philippines (Cao and Stanley 2017). Similarly, Parry et al. (2018) studied remote communities in the Amazonian region, and suggest that "increasing accessibility through road building would be maladaptive, exposing marginalized people to further harm and exacerbating climatic change by driving deforestation" (pp. 125).

Overall, studies from the Global South often have some key differences in focus compared to the Global North:

- affordability as a barrier at the user- or policy maker- level is more often the motivation in work from the Global South;
- the expression of greater tensions in investing in new transportation infrastructure, such as roads in rural/under-developed areas, compared to prioritization of non-car modes. Studies centered in the Global North often focus on the later; and

- more significant data availability limitations and reliance on 'informally' collected data.

These differences center on the direct economic outcomes tied to transport infrastructure. Often, work from the Global South does not engage as intimately with emerging mobility technologies. As well, the informal aspects of transport planning are more overbearing. Clearly, countries in the Global South still struggle with the consequences of past colonialism, which has left them more reliant on primary sector exports (lower efficiency, lower national GDP) under growing global financial markets, and with more fragile democracies. Due to lower data availability, reliance on crowd-sourced or 'informally' collected data, and more extreme needs for 'sufficient' transport, analysis of transportation inequities is often cast along economic lines in the Global South.

We gather that the literature on the Global North and South tend to focus on different aspects of transport inequities, related to the level of their transportation infrastructure. Formal planning processes in the South operate under greater financial precariety, they rely on more informal processes to address unmet needs. This turns out to be a significant source of equity concerns, e.g, informal transit (Fried et al. 2020), and populations living in informal settlements (Sharma and Patil 2021). International standards are more highly relevant in literature from the Global South, such as the WHO noise and air pollution standard (Apparicio et al. 2021), while not as frequently featured in the Global North literature. For example, in Carrier et al. (2014), disadvantaged populations are disproportionately impacted by higher $NO_2$ pollution near roadways in Montreal, but these levels are still consistently below the WHO standard. This difference in focus presents interesting opportunities for the Global South, to adopt potentially successful enhancements from Global North formal equity planning processes (e.g., indicator creation for disadvantaged groups (Cui et al. 2020)) and to avoid past and ongoing mistakes (e.g., from entrenched car-centric development (Warren et al. 2015) to the disproportionate contribution to carbon-intense mobility (Chancel and Piketty 2015)). For the Global North, there is an opportunity to reckon with its own contributions to uneven development globally and environmental impacts as well as adopt relevant aspects from informal planning processes.

## "Who" are the subjects of transportation justice and their mobility tools

### Population groups

Turning to the question of "Who?" in Figure **??**, the focus of the literature tends to be on "Income", especially the lowest-income groups who simultaneously face lower mobility and accessibility *and* higher costs and exposure (Peungnumsai et al. 2020; PJ Zhao, Li, and Liu 2020; Falavigna and Hernandez 2016). Evidence suggests that low household income is a significant determinant of transport-related inequities e.g., urban access to public transport (Peungnumsai et al. 2020), access to urban employment opportunities (Boisjoly et al. 2020), and unfavorable rates of environmental noise, air pollution, and green space (Kruize et al. 2007). Yet, low-income is not universally associated with lower transport-related benefits for every object of justice.

For instance, in Sheffield, U.K., Mears et al. (2019) demonstrate that historically working-class (lower-income) neighbourhoods have *more* access to green space than other neighbourhoods, but of lower quality, likely due to historic urban planning approaches. Similarly, Bertrand, Therien, and Cloutier (2008) find that the granularity of the analysis matters, and lower income groups do not always have lower accessibility, something echoed in other spatial and temporal contexts (Foth, Manaugh, and El-Geneidy 2013; Allen and Farber 2019)

"Age" is the second most common "Who?" focus. In this regard, Martinez-Jimenez and Salinas-Perez (2019) and Arranz-Lopez, Soria-Lara, and Pueyo-Campos (2019) investigate travel distances/times to various opportunities, demonstrating how age is associated with differences in opportunity access. School-aged children and older populations are a common focus. For children, analysis of wellbeing (Laszkiewicz and Sikorska 2020), safety and access to schools (Sharma and Patil 2022; Corazza et al. 2020), and promoting active travel (Mackie 2009; Mehdizadeh, Mamdoohi, and Nordfjaern 2017) are common-place. Papers that focus on older adults similarly investigate transport-related wellbeing (Y. Chen et al. 2020), access to age-specific destinations (Cheng et al. 2019), and options to reduce unmet travel needs (Nordbakke and Schwanen 2015).

Many papers focus on intersecting characteristics. As an exception, we classify some studies as focusing on "(Dis)abilities" or "All Populations". Studies with a "(Dis)abilities" focus assess travel capabilities, namely through physical accessibility and universal design guidelines (J. Park et al. 2017; Chiscano 2021; Orellana et al. 2020). "All Populations" papers make no distinction in population. This is done, for instance, by Kita et al. (2020), who investigates disparities in accessibility to food stores and self-reported capability/frequency of going outdoors. Often, the implicit or explicit motivation of these papers is access (to necessities and desired destinations) for all.

A large proportion of papers apply composite vulnerability indices that combine several individual traits like low income, unemployment, and/or immigrant status. These indices are generated from government sources or author-informed census data creation methods. As an example, the Neighbourhood Equity Index is a measure of vulnerability created by the City of Toronto and used in Awuor and Melles (2019) to examine disparities in premature death. Other works use national census indicators such as the social and housing deprivation index (Pucci et al. 2019) or explore transport disadvantage, equity in policy implementation, or transport-related mortality burden by means of census measures (e.g., household poverty) and transport-related accessibility indicators (Aldred et al. 2021; Iungman et al. 2021; Sun and Thakuriah 2021; Scheurer, Curtis, and McLeod 2017). Similarly, Environmental Justice (EJ) indicators have been used in the U.S. literature to identify neighbourhoods that have a higher than average proportion of low-income and non-white populations and evaluate the equity impacts of transportation projects (D. Rowangould, Karner, and London 2016; K. Park et al. 2021; Reddy, Chennadu, and Lu 2010).

Multi-dimensional considerations are so prevalent in the reviewed literature that "Gender", "Race/ethnicity", "Education", or "Employment" are infrequently studied in isolation. Only a few papers focus exclusively on gendered differences in active transportation (Adlakha and Parra 2020; Xie and Spinney 2018), race/ethnicity's relationship to green space proximity (Silva et al. 2018), and culturally-appropriate opportunities (Wang and Roisman 2011). Papers that focus *solely* on "Employment" status or "Education" level are completely absent in the corpus. Furthermore, "Other" population groups are also frequently considered: this is a catch-all category that includes populations less commonly targeted by research e.g., veterans and access to specific-healthcare needs (Mooney et al. 2000), pregnant people and access to maternity services (Vadrevu and Kanjilal 2016), and youth who live in foster care (Batsche and Reader 2012). Overall, the diversity of population groups considered in the corpus demonstrates the variety of transportation-equity concerns addressed.

## Modes (mobility tools)

Travel mode, though modifiable, is intertwined with individual identity, presenting challenges for the analysis of disparities. In this subsection, we choose to view the mode of travel primarily as those who use the mode, hence as subjects of justice (i.e., the "Who?"). However, at times, travel mode will also be considered as an object of justice (i.e., a "What?", such as disparities in rural transit service).

To begin, transit characterises the majority of the reviewed literature (Figure **??**), reflecting some intuitive sense. Despite transit being perceived unfavourably by some (e.g., Mella Lira and Paez (2021)), it is often viewed as the only or primary mobility option mode for many (Jacques, Manaugh, and El-Geneidy 2012). Overall, we can infer that transit is largely considered a public good and, therefore, a natural object of justice. As such, public transportation is especially amendable to being modified to meet the demands of justice by ensuring adequate funding to provide barrier-free transport for most, despite challenges such as low densities, fiscal constraints, and political will (Markard et al. 2023). As such, papers that focus on transit assess a variety of related topics, including food deserts (McKey, Kim, and Seo 2020) and barrier-free transportation for people who face disabilities (Jiménez-Espada and González-Escobar 2021; Liu et al. 2019; Lim et al. 2021; Feeley 2019).

Transit also plays a central role in multimodal comparisons in transport disparities, especially comparing "Walk", "Car", or some other category in Figure **??**. For instance, Brussel et al. (2019) compares transit, pedestrian and road network accessibility measurements in the context of SDG 11.2. Renne and Mayorga (2018) reviews natural disaster evacuation plans, focusing on carless households and emphasizing transit and pedestrian networks. A few papers also frame transit as a direct competitor of car travel or use it as a benchmark (Golub and Martens 2014; K. Martens, Golub, and Robinson 2012). For instance, Warren et al. (2015) proposes car ownership standards while acknowledging the tension between mobility needs in transit under-served areas and emission reduction goals. However, this framing is not universal, and transit is sometimes seen as a mode to fulfill individual capabilities. As an example, Smith, Hirsch, and Davis (2012) explores perspectives about transport needs and costs to

achieve perceived sufficient living standards for those living in rural areas. Notably, papers vary in the importance they place on climate urgency, with some focusing more on satisfying *all* sufficient individual needs while planning for less car-dependent cities in the future.

After transit, pedestrian travel ("Walk") is the second most studied object of justice. Pedestrians represent a unique convergence of "what" and "who," utilizing their own bodies for mobility. Papers focusing primarily on walking often use walkability scores to assess neighbourhood quality (Evans 2015), mobility by different demographics (Towne et al. 2016; H. Kim et al. 2016), or urban peripheral regions (Blecic et al. 2021). Some use walkability to gauge public health and urban vitality (Sung and Lee 2015; McCormack et al. 2012). Papers with a pedestrian focus also often see walking as a bridge to connect multiple modes: they discuss 'walkability' as part of active transportation, which focuses on both walking, bicycle and/or transit. Concepts discussed include how active transport contributes to children's physical activity levels (Mammen et al. 2014), walkability as an alternative to car predominance (Bertrand, Therien, and Cloutier 2008) or tension that exists between modes, creating unsafe conditions for walking (Siu 2019; Ferenchak and Marshall 2019).

The third most studied mode in the reviewed literature is "Car". Unlike transit and walking, these studies rarely feature car as the mode of primary focus. Car is often assessed against transit and active modes (e.g., low traffic neighbourhoods Aldred et al. 2021) or in areas with inadequate transit service (Kimmel et al. 2018; Aljoufie 2016). Under our appraisal, transit and walk modes are of most interest because they represent a reckoning with automobility's legacy and ongoing demands for space, public subsidies and government supports that underestimate their true cost (Gössling et al. 2019; Timperley 2021). Upon the rise of the automobile, pedestrian spaces were distinguished, non-car modes came to be seen as a hindrance to full automobility, and transit seen as a social service. We ascertain that for these reasons, "Car" is often compared against non-car modes and never put forward as the only mode that should be expanded. Furthermore, some papers reflect on "Other" forms of mobility (Figure **??**), including wheelchair-accessible taxi and/or paratransit services (Marquez, Poveda, and Vega 2019; Wilkinson-Meyers et al. 2015), travel on waterways (Vadrevu and Kanjilal 2016; Cao and Stanley 2017; Parry et al. 2018), motorcycle or other micro-mobility (Berry et al. 2016; Schmitz et al. 2019; Tiwari and Phillip 2021), or emergency vehicles (Pedigo and Odoi 2010; Patel, Waters, and Ghali 2007).

Papers that pay no particular attention to any mode are "Unspecified": as examples, a focus on road infrastructure or road network distances (Wismadi et al. 2014; Mishra et al. 2014), travel needs generally (Titheridge, Solomon, and Accessibility and User Needs in Transport for Sustainable Urban Environments Consortium (AUNT-SUE) 2008; Benevenuto and Caulfield 2020), realized travel (Abasolo, Manning, and Jones 2001), or externalities of realized travel (Iungman et al. 2021).

## "What" could be the objects of transportation justice

The objects of fairness assessment, the "What", are often motivated by concepts encompassed by either mobility or accessibility. A fundamental benefit of transportation systems is mobility (enabling or impeding movement). This benefit is sometimes valued by itself but is often seen by the literature as instrumental to achieve an ulterior goal (e.g., activity participation and associated benefits). For example, although vehicle kilometers traveled (VKT) is sometimes seen as a useful policy instrument (Pengjun Zhao and Li 2021), travelling more is not necessarily a sign of advantage when accessibility is low, and short trips may actually be a sign of advantage (K. Park et al. 2021). For this reason, although the right to the road (and transportation systems more generally) is important, the literature leans heavily on the ulterior object, namely accessibility to (the ease of reaching) destinations. In tandem, themes of existing transportation system burdens associated with mobility and accessibility can be interpreted: for instance, these could be environmental (e.g., potential for GHG emissions reductions relative to the status quo (Bocarejo and Urrego 2022)), or human-health and traffic-related externalities (e.g., decreased wellbeing due to transport poverty (Churchill and Smyth 2019) or reduction in potential road-related fatalities (Bocarejo and Urrego 2022))

### Mobility

Most papers in the reviewed literature take a broad approach, with 47% focusing on "Unspecified" destinations (Figure **??**), examining various equity dimensions across different transportation modes. Many of these papers are 'mobility' focused and examine the impact of the trip itself on the individuals, groups or the environment. These benefits and burdens include safety (Zhe et al. 2008), infrastructure quality and service levels (Prasertsubpakij and Nitivattananon 2012; Fürst and Vogelauer 2013; Lattman, Friman, and Olsson 2016) or air and pollution levels (Apparicio et al. 2021). Others analyze trips taken by specific groups like women or people with disabilities (Russell et al. 2021; Wilkinson-Meyers et al. 2015), often with a consideration of what constitutes 'sufficient' quality of life (Churchill and Smyth 2019). In sum, these papers reveal the multifaceted nature of transportation systems: they serve utilitarian purposes related to travel while also shaping user experiences, expressing some aspects that can be summarized as societal and/or planetary benefits and burdens.

### Access to opportunities

Generally, papers that focus on a particular destination can be construed to interpret "accessibility" as the "What?" as the object of fairness, with access *to* opportunities being the benefit. When analyzing access to particular destinations, "Healthcare" services (18%) and "Employment" (25%) are the most common in the reviewed literature (Figure **??**). Papers on healthcare often highlight disparities in services, like Wang and Roisman (2011), who assess access to Mandarin speaking family physicians for Mainland Chinese immigrants in Toronto. Similarly, papers focusing on employment are often aimed at identifying transportation-poor neighbourhoods (Allen and Farber

2019; Churchill and Smyth 2019). Employment is frequently used as a proxy for overall accessibility since it is the most common trip purpose and employment is usually co-located with destinations like shops, recreation, and other services. These studies typically use travel surveys, census data, and point-of-interest databases, and benefit from well-developed institutional data. This especially holds in the Global North where these data are more readily available.

Other destinations have received less attention despite serving essential needs. "Shopping" destinations (19%) often aim to identify food deserts (Choi and Suzuki 2013; Jiao et al. 2012; McKey, Kim, and Seo 2020; D. Kim and Park 2020). "Education"-related papers (18%) explore children's active transportation to school (Larkins, Dunning, and Ridout 2011) or universal design (Larkins, Dunning, and Ridout 2011). Places of "Leisure" (18%) prompt questions about their spatial distribution (M. Xu et al. 2017) and accessibility (Mavoa et al. 2015). Fewer papers cover "Community" destinations (e.g., public service centres, places of community support or worship) (10%) or "Childcare" (5%), but they are integral to holistically study activity participation (Alberts, Pfeffer, and Baud 2016; Smith, Hirsch, and Davis 2012). The lack of information about community destinations in the reviewed literature, especially for children, is noticeable (Desjardins et al. 2022). In sum, these works that focus on 'accessibility' can be seen to frame access and its related externalities as benefits, while the lack of access (or associated externalities) as burdens.

## Standards: "How" fairness is measured

### Conceptualisations of fairness

The conceptual foundations of fairness are often not made explicit within the reviewed literature, they have to be inferred. Though not exhaustive, the following categories emerged from our review and in broad terms are (Figure **??** details definitions):

- Vertical equity (27%)
- Transport-related social exclusion (27%)
- Well-being (27%)
- Spatial equity (26%)
- Horizontal equity (17%)
- Inequitable externalities (17%)
- Rights (14%)
- Emerging theories (5%)
- Utilitarian (1%)

A slice of the reviewed literature is supported by broader "Rights" conceptualisations of fairness: these papers often focus on equity for people with disabilities or non-car users and associated challenges accessing transport infrastructure (Jiménez-Espada and González-Escobar 2021; Daamen, de Boer, and de Kloe 2008; Bharathy and D'Souza 2018). While many papers are underpinned with the right to the city (the *right* to participate in the production of urban space (Lefebvre 1967; Adli and Donovan 2018)), others emphasize legal *Rights* like regulations aligned with The Americans

with Disabilities Act (ADA) (Bharathy and D'Souza 2018) or the goal of *access for all* in land-use transportation master plans (Lim et al. 2021).

In another subset of the reviewed literature, distributions are examined through concepts of "Horizontal" and "Spatial equity", often using quantitative methods to assess distributional disparities without explicit justice rationales. Examples include setting travel impedance thresholds (Shen et al. 2020) and mapping accessibility indices spatially across populations (Monzon, Ortega, and Lopez 2013) or population-groups (Sharma and Patil 2021). These papers may also address burdens such as traffic-related air and noise pollution or urban temperatures. In these papers, equity is theoretically achieved if similar levels are attained for all populations (horizontal equity) or spatial areas (spatial equity). This egalitarian perspective rarely delves into minimum or maximum levels associated with harm or need satisfaction.

Papers that center "Well-being" assess what constitutes a satisfactory life in relation to transportation; mixed-methods are often used and, in contrast to the last set, the objects of injustice are often identified. Some papers use physical activity guidelines and surveys to understand the effect of active transportation infrastructure (Adlakha and Parra 2020; Auchincloss et al. 2020; McCormack et al. 2012). Mixed or qualitative methods combined with health-related outcome standards lead to more concrete statements of fairness e.g., travel times for emergency treatment (Schmitz et al. 2019) or premature mortality (Awuor and Melles 2019).

Another research branch, often quantitative with some qualitative or mixed-methods studies, focuses on "Transport-related social exclusion", "Vertical equity", and/or "Sufficientarian/capabilities". Here, the objects of justice are often clearly identified and link standards to tangible welfare-informed outcomes. They focus on groups from perspectives of disadvantage such as: social exclusion and transport poverty (Allen and Farber 2019; A. Delbosc and Currie 2011b; Churchill and Smyth 2019), food deserts (McKey, Kim, and Seo 2020), and energy poverty (Robinson and Mattioli 2020; Berry et al. 2016; Berry 2019).

## Standards and methods of measuring fairness

We identify several categories of standards that overlap with at least one of the conceptualisations of fairness discussed above (see Figure **??** for definitions):

- Opportunity standards (66%)
- Population standards (64%)
- Infrastructure standards (41%)
- Environment+ standards (7%)

Papers with "Opportunity" standards often employ quantitative methods to analyze disparities and assess distributional fairness. Many deal with travel impedance thresholds based on speed, distance, or cost (Z. Chen and Haynes 2017; Yenisetty and Bahadure 2020; Shen et al. 2020). Inequality measures like the Gini coefficient and poverty measures are used to empirically define travel impedance thresholds

(van der Veen et al. 2020; Tiznado-Aitken, Munoz, and Hurtubia 2018). Further, methods tangential to travel impedance, like limiting transport expenditure to 10% of monthly income (Rivas, Serebrisky, and Suárez-Alemán 2018), addressing spatial mismatch (Mulley et al. 2015), or pinpointing areas of relative regional inequities are also used. Notably, many papers with "Opportunity" standards consider multiple dimensions, employing similar methods but tailored to different focal points. For instance, Peungnumsai et al. (2020) suggest service benchmarks of equal supply and demand of transit, revealing horizontal inequities as well. Others conceive the externalities of transportation system as trade-offs and aim to maximize transport-related benefits (i.e., time savings, emissions reductions, congestion reductions, user fares) through optimization/location-allocation methodologies (Fakhrmoosavi, Zockaie, and Abdelghany 2021; Zheng and Geroliminis 2020; Wismadi et al. 2014).

"Population" standards are often founded on "Well-being" conceptualisations from a variety of socio-demographic and spatial angles. Methods include: establishing thresholds based on questionnaires and comparisons to recommended physical activity levels (Auchincloss et al. 2020; McCormack et al. 2012; H. Kim et al. 2016; Timperio, Veitch, and Carver 2015), region-relative comparisons in health outcomes in a spatial unit such as premature mortality rates (Awuor and Melles 2019), spatial access benchmarks based on population-related characteristics like supermarket access (Murphy et al. 2017) and hospital access (R. Pereira et al. 2021), summative per capita benchmarks such as decent living energy consumption levels (Rao and Baer 2012), and community-informed spatial boundaries like EJ defined communities (D. Rowangould, Karner, and London 2016). While most of these papers use quantitative or mixed-methods approaches, some employ exclusively qualitative methods (Berhe, Martinez, and Verplanke 2014).

Papers that feature both "Population" and "Opportunity" standards are often founded on "Vertical equity", "Well-being", and/or "Transport-related social exclusion" conceptualisations. They feature mixed-methods, with questionnaires and qualitative approaches for "population" standards and quantitative methods like accessibility indices for "opportunity" standards. Census data and household estimates within specific travel distances or times to key destinations identify social exclusionary situations (W.-H. Chen 2010; Daniels and Mulley 2011; Sun and Thakuriah 2021; Sharma and Patil 2021), linkages between transport disadvantages (A. Delbosc and Currie 2011b), areas experiencing transport poverty (Allen and Farber 2019; Churchill and Smyth 2019), food deserts (McKey, Kim, and Seo 2020), or transport-related energy poverty (Robinson and Mattioli 2020; Berry et al. 2016; Berry 2019). They employ various methods, such as clustering techniques (Mohri, Mortazavi, and Nassir 2021). Some exclusively use qualitative methods to analyze survey data on travel willingness/barriers or conduct interviews on unmet activity needs (W.-H. Chen 2010; Mehdizadeh, Mamdoohi, and Nordfjaern 2017; Nordbakke and Schwanen 2015).

"Infrastructure" standards offer another perspective on fairness, commonly grounded in "Rights" conceptualisations, which are twice as frequent in this segment of the corpus compared to other conceptualisations. These papers most frequently address the rights of non-car users and populations with disabilities. Though various methods

are applied, infrastructure and environmental audits as well as qualitative approaches are most prominent. Infrastructure audits compare existing infrastructure against universal design best practices (Odeck, Hagen, and Fearnley 2010; Larkins, Dunning, and Ridout 2011; Jiménez-Espada and González-Escobar 2021; Perez-delHoyo et al. 2021) or investigate elements correlating with mode use by specific population groups (Moniruzzaman and Paez 2016). Qualitative methods include interviews/surveys on perceived access (Marquez, Poveda, and Vega 2019; Iderlina Mateo-Babiano, Kumar, and Mejia 2017; Fürst and Vogelauer 2013; Velho et al. 2016; J. Park et al. 2017; Lim et al. 2021; Stjernborg 2019; Desjardins et al. 2021) and assessment of standards under best-practice criteria (Daamen, de Boer, and de Kloe 2008; Velho et al. 2016; Bharathy and D'Souza 2018).

Additionally, "Infrastructure" standards papers sometimes encompass multiple dimensions, moving beyond rights (to the infrastructure) to provide "Opportunity" and/or "Population" standards. These papers often employ "Vertical", "Horizontal", and "Spatial equity" lenses. These papers often refer to guidelines and propose composite indices. For example, (Rachele et al. 2017) integrate various transport network properties to define an indicator supporting walkability and public transport access. Others evaluate infrastructure quality (M. Xu et al. 2017), accident severity (Benevenuto and Caulfield 2020; Appleyard, Ferrell, and Taecker 2017), and user-groups, especially disadvantaged ones with respect to vertical equity of multi-criteria indicators (Prasertsubpakij and Nitivattananon 2012). Some focus explicitly on affordability and barriers, proposing infrastructure enhancements for better inclusivity, especially for the most disadvantaged (Basu and Alves 2019; Song, Kirschen, and Taylor 2019; Welch 2013), grounded in transport-related social exclusion (Kent and Karner 2019) or capabilities approaches (Smith, Hirsch, and Davis 2012).

"Environmental+" standards are featured less prominently in the reviewed literature, possibly because the environmental burdens of transportation are addressed more broadly in other literature (e.g., environmental justice). However, the papers included in our corpus present some interesting insights. They often use traffic-related air and noise pollution, green space, urban design, urban air temperature, health outcomes, and physical activity guidelines to assess transport-related "inequitable externalities". Methods employed are primarily quantitative or mixed-methods, identifying inequalities through Gini coefficients (Feng and Timmermans 2014) or composite indices (Agost-Felip, Rua, and Kouidmi 2021; Miranda and da Silva 2012; Corazza et al. 2020), occasionally incorporating spatial analysis (Jephcote and Chen 2013; Carrier et al. 2014). Many use established thresholds or health guidelines e.g., WHO guidelines for Active Aging and targets included in the United Nations' SDG (Agost-Felip, Rua, and Kouidmi 2021) and OECD or WHO standards for traffic noise level, $NO_2$ levels, available green space and $PM_{2.5}$ levels (Kruize et al. 2007; Iungman et al. 2021; Apparicio et al. 2021; Khomenko et al. 2020; Mueller et al. 2018). These metrics are sometimes criticized for their general applicability. Nonetheless, their use provides interpretable values for tracking progress, offering comparability across communities, unlike accessibility measures, which vary in methods and assumptions.

Appendix Section **??** presents detailed examples of various standards, outlined within the 5WH framework, as derived from the examined corpus.

# Moving forward: discussion and calls for action

As previously noted, this work makes two contributions to the literature. First, it outlines a conceptual and flexible "Why", Where", "When", "Who", "What" and "How" (5WH) framework with supporting definitions for approaching questions about transportation justice. Second, it applies the framework in synthesizing and appraising of 165 academic articles drawn from the transportation justice literature; these studies use equity analysis as instruments to gauge proximity to their context's just situation. Based on the preceding sections of what is in the literature, and what is lacking from our perspective, we conclude with the following five calls to action. Based on the preceding sections of what is in the literature, and what is lacking from our perspective, we conclude with the following five calls to action.

## Call 1: Underpin tailored standards based on rigorous concepts of justice

The conceptual grounding for standards is often left implicit within the literature. For example, Mueller et al. (2018) suggests the relative risk of mortality from transport-related air pollution should not be higher in deprived groups than the general population. While the conceptual justice foundations are not explicitly declared, we infer an egalitarian focus. But, what level of relative risk is acceptable for the general population? What purpose does mortality risk serve and who benefits from it? To move equity analysis outputs towards just transport futures, explicit inclusion of justice rationales (the "Why?") should become more common place. We must be clear with our terms–what is equity and for whom?

Standards are statements of fairness, yet some standards are seemingly arbitrary in the reviewed literature–in other words, set arbitrary justice goals. For example, Cao and Stanley (2017) proposes 20 ferries per day to avoid social exclusion for inter-island transport planning, though acknowledging the standard should be politically determined. It is unclear if selecting a different benchmark such as 10 or 30 ferries would make a difference in any specific object of justice (e.g., accessibility to particular destinations) or if that number is tied to funding or resource constraints. Another example is the conceptual underpinnings of the 15-minute city, where 15 minutes is the standard for travel times. Is this sufficientarism? Or egalitarianism? The standard can be interpreted in a multitude of ways. We argue that conceptualization of justice must guide the selection of the standard. As Karel Martens and Golub (2021) demonstrate, being explicit about "Why" is important. Recent work by Karner, Pereira, and Farber (2024) provides several concrete examples for developing standards that follow directly from different justice conceptualizations.

Additionally, there is a need to go beyond the focus on low-income transit riders, as clear "Who?"-specific standards are lacking. Positioning intersectional considerations within the creation of community-based equity definitions and tailored standards are

critical, as the act of delineating equity-deserving communities impacts results (e.g., Dana Rowangould, Karner, and London (2015)). Standards should be sensitive to evolving community-based definitions of inequities. Are issues of economic inequity at the root of transport inequities for a particular community? Are inequities in access provided by certain modes emphasized because access offered by other modes are *relatively* better? Access to what types of opportunities are driving transport inequities? How do populations, travel modes, and opportunities sought intersect to define the "who" of inequities? A community-informed understanding of inequities and tracking how they change are needed.

For decision-makers, setting standards, measuring inequities, and developing flexible guidelines for standards that are also compatible with community-informed calls for justice, are the next steps for transportation equity planning. If we assume that one function of the academic literature is to recommend standards, researchers must connect compatible conceptualisations and standards to justice frameworks. Currently, these fundamental connections are mostly missing.

## Call 2: Develop creative methods for systems-thinking approaches to fairness

On the methodological side, transportation justice research would benefit from a wider use of mixed-methods. Concepts and standards are often discussed from purely qualitative or quantitative approaches. This is a missed opportunity to combine the strengths of both approaches, whether by diving deeper into some particular experiences or perceptions through qualitative methods or tailoring more meaningful quantitative analysis after qualitative explorations. As mixed-method examples, Xie and Spinney (2018) find through interviews and go-alongs with women cyclists that the standard Cycling Level of Service tools used by engineers to plan cycling infrastructure misses a critical gendered perspective. Further, Somenahalli and Taylor (2007) survey older adults to understand their mobility issues, revealing factors that are unseen in standard daily travel surveys.

While disparity analysis is frequently used, the resulting standards do not often align with practical applications. For example, metrics of accessibility (usually measured with travel impedance cut-offs of between 15 to 60 minutes depending on the destination, population group and mode) are used to show descriptive differences among areas and groups but with scarce implications as to the experience of travelers. How low must an accessibility index be before it is too low? Relatedly, once sufficient accessibility levels are reached, excessively high accessibility values can result in high inequalities. Are inequalities of a certain level an issue? A lack of discussion poses a challenge to translating results from these analyses into policy and practice. Creative methods and discussions of quantitative accessibility metrics should be paired with results; they should yield interpretable results. The explicit discussion of minimum *and* maximum values in the distribution of the object of justice (the "What?"), as applicable, is critical.

Other times, when analysis engages with metrics that may be tied to particular concepts of equity (like the Gini coefficient or Theil index), they fall short in assessing whether the results are good or bad (Mijares, Suzuki, and Yai 2013). For example, a Gini coefficient of 0 would mean that all people have the same access to public transport stops. But is this level of access good enough or lacking? And what does it mean if the result is 0.2, 0.3, or 0.4? Is this good or bad news? How should a decision-maker interpret this? Are new policies needed to reduce that number to a certain threshold, orienting future interventions? These questions usually remain unanswered in the literature despite their importance. These measurements can also bring some challenges and pitfalls as summarised by Karner, Pereira, and Farber (2024) but are necessary for more effective equity analyses.

## Call 3: Making data available is a matter of justice

In our review of the literature, we were left wondering specifically– what are the motivations for the inclusion of some destinations and the choice to not include others? For instance, leisure (e.g., green space, parks, recreation) and certain care destinations (e.g., community organizations, government services, banking locations, daycares) are infrequently studied or missing altogether. We suspect that since the methods used in the reviewed literature are predominately quantitative, the reliance on commonly used point of interest databases is also high. These databases typically include education, health, and occasionally include aggregated categories for leisure and community destinations, but are less generous for points of interest that are more often associated with understudied mobility patterns.

However, through the reviewed literature, we know that transport systems are more than just facilitators to work or as a source of economic development (though in underdeveloped regions, transport systems as a force of economic development is pronounced, e.g., high-speed rail (Z. Chen and Haynes 2017; Monzon, Ortega, and Lopez 2013; H. Kim and Sultana 2015)). As such, data availability matters. In the context of the Global South and rural geographies fewer official data sources and public research resources exist relative to urban communities and areas in the Global North. The operationalization of emerging conceptual theories in equity analysis, such as sufficientariansm (van der Veen et al. 2020), might be impacted if relevant data is not available.

The calls for and relevant issues of data availability are not new, but they have at least three pieces. What and who is the subject of justice? When/Where/How is it measured? And, who gets to consult and use the data? Deciding who is the subject of justice frames the data collection activity; if it is the mobility of those who do domestic work, the classification of who does this work and how it changes over time/space is fundamental. How we classify mobility and access has implications for our understanding of just who is a subject of justice, as illustrated by the history of racial classifications in the U.S. (Lee 1993). The methods we use, the spatio-temporal boundaries for data collection, and who has (and does not have) access to the collected data, can all impact how we think about justice. In the case of transportation, the issue of data collection/availability as a matter of justice is gaining traction as digitization of

data casts a starker light on these questions (Sourbati and Behrendt 2021; Behrendt and Sheller 2023).

## Call 4: Develop more direct and explicit links between standards and lived experiences

Robust assessments of the implications of standards on lived experiences are still lacking in the literature, but are essential for equity analysis that translates into just practice. While the estimation of the benefits of increased mobility or accessibility, or reducing burdens is commonplace in the literature, there is a need to associate them with outcomes, including life and neighbourhood satisfaction, subjective well-being, mental and physical health, and social capital. The literature must move beyond describing inequities and their contributing factors. Instead, it should incorporate causal methods that establish clear cause-and-effect relationships, enabling policymakers to quantify the impact of various policies and infrastructure decisions on advancing justice.

Composite measures such as the transport-land-use index proposed by Appleyard, Ferrell, and Taecker (2017) is an example of systems-thinking approach that links findings to quality-of-life proxies; they ground their measure in the principle of *livability* along corridors of varying levels of estimated transport-land-use integration. However, the methods could go further: they could be tied to absolute goals of integration or livability. Relatably, Higgs et al. (2019) develops an urban livability index and demonstrates the relationship between the population's use of a certain mode in a neighbourhood and a one unit increase in the index. However, are there absolute minimums or maximums for the index or the mode-choice goals that should not be crossed?

More explicit discussion of the boundaries in the distribution of the object of justice (the "What?") alongside these creative methods are needed. These links may be used to track progress towards justice across time and space, a critical point for practitioners.

## Call 5: Rigorously evaluate interventions and policies

There is a need to evaluate equity interventions and policies: track their before, during, and after. In this review, a small proportion of studies assess specific transport-related policy interventions through an equity lens. Examples include mode-shift from driving to active school travel (Mammen et al. 2014), transit fare restructures (Hickey, Lu, and Reddy 2010) and spatial analysis of Low Traffic neighbourhoods (Aldred et al. 2021). The assessment of interventions and tracking associated outcomes can be thought of as a key step towards transport justice. Similarly, for how long the burdens and benefits can still be associated to a specific transportation intervention remains a critical avenue to explore.

Outcomes of interventions can be compared within and between communities, and cross community comparisons can be created that may expedite the adoption of effective policies that move towards just outcomes; the presence of these synthesis and comparative studies could support brave decision-makers in the application of research

into practice. Again, causal methods and mixed methods approaches might serve as valuable approaches to reach this in practice.

# References


Abasolo, Ignacio, Rob Manning, and Andrew M. Jones. 2001. "Equity in Utilization of and Access to Public-Sector GPs in Spain." *Applied Economics* 33 (3): 349–64. https://doi.org/10.1080/00036840122511.

Adlakha, D, and DC Parra. 2020. "Mind the Gap: Gender Differences in Walkability, Transportation and Physical Activity in Urban India." *Journal of Transport & Health* 18. https://doi.org/10.1016/j.jth.2020.100875.

Adli, SN, and S Donovan. 2018. "Right to the City: Applying Justice Tests to Public Transport Investments." *Transport Policy* 66: 56–65. https://doi.org/10.1016/j.tranpol.2018.03.005.

Agost-Felip, R, MJ Rua, and F Kouidmi. 2021. "An Inclusive Model for Assessing Age-Friendly Urban Environments in Vulnerable Areas." *Sustainability* 13 (15). https://doi.org/10.3390/su13158352.

Alberts, A, K Pfeffer, and I Baud. 2016. "Rebuilding Women's Livelihoods Strategies at the City Fringe: Agency, Spatial Practices, and Access to Transportation from Semmencherry, Chennai." *Journal of Transport Geography* 55: 142–51. https://doi.org/10.1016/j.jtrangeo.2015.11.004.

Alderton, A, M Davern, K Nitvimol, I Butterworth, C Higgs, E Ryan, and H Badland. 2019. "What Is the Meaning of Urban Liveability for a City in a Low-to-Middle-Income Country? Contextualising Liveability for Bangkok, Thailand." *Globalization and Health* 15. https://doi.org/10.1186/s12992-019-0484-8.

Aldred, R, E Verlinghieri, M Sharkey, I Itova, and A Goodman. 2021. "Equity in New Active Travel Infrastructure: A Spatial Analysis of London's New Low Traffic Neighbourhoods." *Journal of Transport Geography* 96. https://doi.org/10.1016/j.jtrangeo.2021.103194.

Aljoufie, M. 2016. "URBAN PLANNING AND ARCHITECTURAL DESIGN FOR SUSTAINABLE DEVELOPMENT (UPADSD)." In, edited by F Naselli, F Pollice, and MS Amer, 216:535–44. https://doi.org/10.1016/j.sbspro.2015.12.013.

Allen, J, and S Farber. 2019. "Sizing up Transport Poverty: A National Scale Accounting of Low-Income Households Suffering from Inaccessibility in Canada, and What to Do about It." *Transport Policy* 74: 214–23. https://doi.org/10.1016/j.tranpol.2018.11.018.

Ampe, T, B de Geus, I Walker, B Serrien, B Truyen, H Durlet, and R Meeusen. 2020. "The Impact of a Child Bike Seat and Trailer on the Objective Overtaking Behaviour of Motorized Vehicles Passing Cyclists." *TRANSPORTATION RESEARCH PART F-TRAFFIC PSYCHOLOGY AND BEHAVIOUR* 75: 55–65. https://doi.org/10.1016/j.trf.2020.09.014.

Apparicio, P, J Gelb, V Jarry, and E Lesage-Mann. 2021. "Cycling in One of the Most Polluted Cities in the World: Exposure to Noise and Air Pollution and Potential Adverse Health Impacts in Delhi." *International Journal of Health Geographics* 20 (1). https://doi.org/10.1186/s12942-021-00272-2.

Appleyard, B, CE Ferrell, and M Taecker. 2017. "Transit Corridor Livability Realizing the Potential of Transportation and Land Use Integration." *Transportation Research Record*, no. 2671: 20–30. https://doi.org/10.3141/2671-03.

Archer, Deborah N. 2020. ""White Men's Roads Through Black Men's Homes": Advancing Racial Equity Through Highway Reconstruction." *Vand. L. Rev.* 73: 1259.

Arranz-Lopez, A, JA Soria-Lara, and A Pueyo-Campos. 2019. "Social and Spatial Equity Effects of Non-Motorised Accessibility to Retail." *CITIES* 86: 71–82. https://doi.org/10.1016/j.cities.2018.12.012.

Auchincloss, AH, YL Michael, D Fuller, SY Li, S Niamatullah, CE Fillmore, C Setubal, and C Bettigole. 2020. "Design and Baseline Description of a Cohort of Bikeshare Users in the City of Philadelphia." *Journal of Transport & Health* 16. https://doi.org/10.1016/j.jth.2020.100836.

Awuor, L, and S Melles. 2019. "The Influence of Environmental and Health Indicators on Premature Mortality: An Empirical Analysis of the City of Toronto's 140 Neighborhoods." *Health & Place* 58. https://doi.org/10.1016/j.healthplace.2019.102155.

Basu, R, and BB Alves. 2019. "Practical Framework for Benchmarking and Impact Evaluation of Public Transportation Infrastructure: Case of Belo Horizonte, Brazil." *Transportation Research Record* 2673 (3): 711–21. https://doi.org/10.1177/0361198119835528.

Batsche, CJ, and S Reader. 2012. "Using GIS to Enhance Programs Serving Emancipated Youth Leaving Foster Care." *EVALUATION AND PROGRAM PLANNING* 35 (1): 25–33. https://doi.org/10.1016/j.evalprogplan.2011.06.003.

Behrendt, Frauke, and Mimi Sheller. 2023. "Mobility Data Justice." Journal Article. *Mobilities*, 1–19. https://doi.org/10.1080/17450101.2023.2200148.

Benevenuto, R, and B Caulfield. 2020. "Examining Transport Needs in the Global South Using a Screening Framework." *Journal of Transport Geography* 88. https://doi.org/10.1016/j.jtrangeo.2020.102845.

Berhe, RT, J Martinez, and J Verplanke. 2014. "Adaptation and Dissonance in Quality of Life: A Case Study in Mekelle, Ethiopia." *Social Indicators Research* 118 (2): 535–54. https://doi.org/10.1007/s11205-013-0448-y.

Berry, A. 2019. "The Distributional Effects of a Carbon Tax and Its Impact on Fuel Poverty: A Microsimulation Study in the French Context." *Energy Policy* 124: 81–94. https://doi.org/10.1016/j.enpol.2018.09.021.

Berry, A, Y Jouffe, N Coulombel, and C Guivarch. 2016. "Investigating Fuel Poverty in the Transport Sector: Toward a Composite Indicator of Vulnerability." *Energy Research & Social Science* 18: 7–20. https://doi.org/10.1016/j.erss.2016.02.001.

Bertrand, L, F Therien, and MS Cloutier. 2008. "Measuring and Mapping Disparities in Access to Fresh Fruits and Vegetables in Montreal." *CANADIAN JOURNAL OF PUBLIC HEALTH-REVUE CANADIENNE DE SANTE PUBLIQUE* 99 (1): 6–11. https://doi.org/10.1007/BF03403732.

Bharathy, A, and C D'Souza. 2018. "Revisiting Clear Floor Area Requirements for Wheeled Mobility Device Users in Public Transportation." *Transportation Research*

*Record: Journal of the Transportation Research Board* 2672 (8): 675–85. https://doi.org/10.1177/0361198118787082.

Bierbaum, Ariel H., Alex Karner, and Jesus M. Barajas. 2021. "Toward Mobility Justice: Linking Transportation and Education Equity in the Context of School Choice." *Journal of the American Planning Association* 87 (2): 197–210. https://doi.org/10.1080/01944363.2020.1803104.

Bills, Tierra S., and Joan L. Walker. 2017. "Looking Beyond the Mean for Equity Analysis: Examining Distributional Impacts of Transportation Improvements." *Transport Policy* 54: 61–69. https://doi.org/10.1016/j.tranpol.2016.08.003.

Blecic, I, A Cecchini, T Congiu, G Fancello, V Talu, and GA Trunfio. 2021. "Capability-Wise Walkability Evaluation as an Indicator of Urban Peripherality." *ENVIRONMENT AND PLANNING B-URBAN ANALYTICS AND CITY SCIENCE* 48 (4): 895–911. https://doi.org/10.1177/2399808320908294.

Bocarejo, Juan Pablo, and Luis Felipe Urrego. 2022. "The Impacts of Formalization and Integration of Public Transport in Social Equity: The Case of Bogota." *Research in Transportation Business & Management* 42. https://doi.org/10.1016/j.rtbm.2020.100560.

Boisjoly, Geneviève, and Ahmed M. El-Geneidy. 2017-04. "How to Get There? A Critical Assessment of Accessibility Objectives and Indicators in Metropolitan Transportation Plans." *Transport Policy* 55 (2017-04): 38–50. https://doi.org/10.1016/j.tranpol.2016.12.011.

Boisjoly, Geneviève, Bernardo Serra, Gabriel T Oliveira, and Ahmed El-Geneidy. 2020. "Accessibility Measurements in Sao Paulo, Rio de Janeiro, Curitiba and Recife, Brazil." *Journal of Transport Geography* 82. https://doi.org/10.1016/j.jtrangeo.2019.102551.

Braithwaite, John et al. 2003. "Principles of Restorative Justice." *Restorative Justice and Criminal Justice: Competing or Reconcilable Paradigms*, 1–20.

Brussel, M, A Zuidgeest, K Pfeffer, and M van Maarseveen. 2019. "Access or Accessibility? A Critique of the Urban Transport SDG Indicator." *ISPRS International Journal of Geo-Information* 8 (2). https://doi.org/10.3390/ijgi8020067.

Cao, D, and J Stanley. 2017. "Indicators of Socio-Spatial Transport Disadvantage for Inter-Island Transport Planning in Rural Philippine Communities." *Social Inclusion* 5 (4): 116–31. https://doi.org/10.17645/si.v5i4.1098.

Carrier, M, P Apparicio, AM Seguin, and D Crouse. 2014. "The Application of Three Methods to Measure the Statistical Association Between Different Social Groups and the Concentration of Air Pollutants in Montreal: A Case of Environmental Equity." *Transportation Research Part D: Transport and Environment* 30: 38–52. https://doi.org/10.1016/j.trd.2014.05.001.

Chancel, Lucas, and Thomas Piketty. 2015. "Carbon and Inequality: From Kyoto to Paris."

Chen, Wan-Hui. 2010. "Exploring Travel Characteristics and Factors Affecting the Degree of Willingness of Seniors in Taiwan to Use an Alternative Service Bus." *TRANSPORTATION RESEARCH RECORD*, no. 2182: 71–78. https://doi.org/10.3141/2182-10.

Chen, Y, A Bouferguene, M Shirgaokar, and M Al-Hussein. 2020. "Spatial Analysis Framework for Age-Restricted Communities Integrating Spatial Distribution and Accessibility Evaluation." *JOURNAL OF URBAN PLANNING AND DEVELOPMENT* 146 (1). https://doi.org/10.1061/(ASCE)UP.1943-5444.0000537.

Chen, ZH, and KE Haynes. 2017. "Impact of High-Speed Rail on Regional Economic Disparity in China." *Journal of Transport Geography* 65: 80–91. https://doi.org/10.1016/j.jtrangeo.2017.08.003.

Cheng, L, F Caset, J De Vos, B Derudder, and F Witlox. 2019. "Investigating Walking Accessibility to Recreational Amenities for Elderly People in Nanjing, China." *Transportation Research Part D: Transport and Environment* 76: 85–99. https://doi.org/10.1016/j.trd.2019.09.019.

Chiscano, MC. 2021. "Improving the Design of Urban Transport Experience with People with Disabilities." *Research in Transportation Business and Management* 41. https://doi.org/10.1016/j.rtbm.2020.100596.

Choi, Y, and T Suzuki. 2013. "Food Deserts, Activity Patterns, & Social Exclusion: The Case of Tokyo, Japan." *Applied Geography* 43: 87–98. https://doi.org/10.1016/j.apgeog.2013.05.009.

Churchill, SA, and R Smyth. 2019. "Transport Poverty and Subjective Wellbeing." *Transportation Research Part A: Policy and Practice* 124: 40–54. https://doi.org/10.1016/j.tra.2019.03.004.

Corazza, Maria Vittoria, Daniela D'Alessandro, Paola Di Mascio, and Laura Moretti. 2020. "Methodology and Evidence from a Case Study in Rome to Increase Pedestrian Safety Along Home-to-School Routes." *Journal of Traffic and Transportation Engineering (English Edition)* 7 (5): pp 715–727. https://doi.org/10.1016/j.jtte.2020.03.003.

Covidence. 2023. "Covidence." https://www.covidence.org/.

Cox, B, and C Bartle. 2020. "A Qualitative Study of the Accessibility of a Typical UK Town Cycle Network to Disabled Cyclists." *Journal of Transport & Health* 19. https://doi.org/10.1016/j.jth.2020.100954.

Cui, B, G Boisjoly, R Wasfi, H Orpana, K Manaugh, R Buliung, Y Kestens, and A El-Geneidy. 2020. "Spatial Access by Public Transport and Likelihood of Healthcare Consultations at Hospitals." *Transportation Research Record: Journal of the Transportation Research Board* 2674 (12): 188–98. https://doi.org/10.1177/0361198120952793.

Daamen, W, E de Boer, and R de Kloe. 2008. "Assessing the Gap Between Public Transport Vehicles and Platforms as a Barrier for the Disabled Use of Laboratory Experiments." *Transportation Research Record: Journal of the Transportation Research Board*, no. 2072: 131–38. https://doi.org/10.3141/2072-14.

Daniels, R, and C Mulley. 2011. "A Proposal for Accessibility Planning in NSW: Research and Policy Issues." In, 16p. https://trid.trb.org/view/1105622.

Delbosc, A., and G. Currie. 2011a. "Using Lorenz Curves to Assess Public Transport Equity." Journal Article. *Journal of Transport Geography* 19 (6): 1252–59. https://doi.org/10.1016/j.jtrangeo.2011.02.008.

Delbosc, A, and G Currie. 2011b. "Transport Problems That Matter - Social and Psychological Links to Transport Disadvantage." *Journal of Transport Geography* 19 (1): 170–78. https://doi.org/10.1016/j.jtrangeo.2010.01.003.

Desjardins, Elise, Emma Apatu, S. Donya Razavi, Christopher D. Higgins, Darren M. Scott, and Antonio Páez. 2021. "'Going Through a Little Bit of Growing Pains': A Qualitative Study of the Factors That Influence the Route Choice of Regular Bicyclists in a Developing Cycling City." Journal Article. *Transportation Research Part F: Traffic Psychology and Behaviour* 81: 431–44. https://doi.org/https://doi.org/10.1016/j.trf.2021.06.005.

Desjardins, Elise, Zahra Tavakoli, Antonio Páez, and Edward O. Waygood. 2022. "Children's Access to Non-School Destinations by Active or Independent Travel: A Scoping Review." Electronic Article. https://doi.org/10.3390/ijerph191912345.

Doran, Alexandra, Ahmed El-Geneidy, and Kevin Manaugh. 2021. "The Pursuit of Cycling Equity: A Review of Canadian Transport Plans." *Journal of Transport Geography* 90: 102927. https://doi.org/10.1016/j.jtrangeo.2020.102927.

Eliasson, Jonas. 2016. "Is Congestion Pricing Fair? Consumer and Citizen Perspectives on Equity Effects." *Transport Policy* 52: 1–15. https://doi.org/10.1016/j.tranpol.2016.06.009.

Eppenberger, N, and MA Richter. 2021. "The Opportunity of Shared Autonomous Vehicles to Improve Spatial Equity in Accessibility and Socio-Economic Developments in European Urban Areas." *European Transport Research Review* 13 (1). https://doi.org/10.1186/s12544-021-00484-4.

Evans, G. 2015. "Accessibility and User Needs: Pedestrian Mobility and Urban Design in the UK." *PROCEEDINGS OF THE INSTITUTION OF CIVIL ENGINEERS-MUNICIPAL ENGINEER* 168 (1): 32–44. https://doi.org/10.1680/muen.14.00012.

Fakhrmoosavi, F, A Zockaie, and K Abdelghany. 2021. "Incorporating Travel Time Reliability in Equitable Congestion Pricing Schemes for Heterogeneous Users and Bimodal Networks." *Transportation Research Record: Journal of the Transportation Research Board* 2675 (11): 754–68. https://doi.org/10.1177/03611981211019737.

Falavigna, C., and D. Hernandez. 2016. "Assessing Inequalities on Public Transport Affordability in Two Latin American Cities: Montevideo (Uruguay) and Cordoba (Argentina)." *Transport Policy* 45: 145–55. https://doi.org/10.1016/j.tranpol.2015.09.011.

Feeley, C. 2019. "Validation of the Paratransit Skills Assessment for Paratransit Travel and Mobility of Adults on the Autism Spectrum." *Transportation Research Record: Journal of the Transportation Research Board* 2673 (5): 759–69. https://doi.org/10.1177/0361198119839342.

Feng, Tao, and Harry J P Timmermans. 2014. "Trade-Offs Between Mobility and Equity Maximization Under Environmental Capacity Constraints: A Case Study of an Integrated Multi-Objective Model." *Transportation Research Part C: Emerging Technologies* 43, Part 3: pp 267–279. https://doi.org/10.1016/j.trc.2014.03.012.

Ferenchak, NN, and WE Marshall. 2019. "Equity Analysis of Proactively- Vs. Reactively-Identified Traffic Safety Issues." *Transportation Research Record: Journal of the Transportation Research Board* 2673 (7): 596–606. https://doi.org/10.1177/0361198119841296.

Foth, N, K Manaugh, and AM El-Geneidy. 2013. "Towards Equitable Transit: Examining Transit Accessibility and Social Need in Toronto, Canada, 1996-2006." *Journal of Transport Geography* 29: 1–10. https://doi.org/10.1016/j.jtrangeo.2012.12.008.

Fried, T, TH Tun, JM Klopp, and B Welle. 2020. "Measuring the Sustainable Development Goal (SDG) Transport Target and Accessibility of Nairobi's Matatus." *Transportation Research Record: Journal of the Transportation Research Board* 2674 (5): 196–207. https://doi.org/10.1177/0361198120914620.

Fürst, Elmar, and Christian Vogelauer. 2013. "Best and Bad Practices in Public Transport: Approaches to a Barrier-Free Design for the Visually and Hearing Impaired." In, 29p. https://aetransport.org/past-etc-papers/conference-papers-2013https://trid.trb.org/view/1330058.

Golub, A, and K Martens. 2014. "Using Principles of Justice to Assess the Modal Equity of Regional Transportation Plans." *Journal of Transport Geography* 41: 10–20. https://doi.org/10.1016/j.jtrangeo.2014.07.014.

Gössling, Stefan. 2016. "Urban Transport Justice." Journal Article. *Journal of Transport Geography* 54: 1–9. https://doi.org/https://doi.org/10.1016/j.jtrangeo.2016.05.002.

Gössling, Stefan, Andy Choi, Kaely Dekker, and Daniel Metzler. 2019. "The Social Cost of Automobility, Cycling and Walking in the European Union." Journal Article. *Ecological Economics* 158: 65–74. https://doi.org/https://doi.org/10.1016/j.ecolecon.2018.12.016.

Guo, Yujie, Zhiwei Chen, Amy Stuart, Xiaopeng Li, and Yu Zhang. 2020. "A Systematic Overview of Transportation Equity in Terms of Accessibility, Traffic Emissions, and Safety Outcomes: From Conventional to Emerging Technologies." *Transportation Research Interdisciplinary Perspectives* 4: 100091. https://doi.org/10.1016/j.trip.2020.100091.

Hail, Yvonne, and Ronald McQuaid. 2021. "The Concept of Fairness in Relation to Women Transport Users." *Sustainability* 13 (5): 2919. https://doi.org/10.3390/su13052919.

Hickey, RL, A Lu, and A Reddy. 2010. "Using Quantitative Methods in Equity and Demographic Analysis to Inform Transit Fare Restructuring Decisions." *Transportation Research Record: Journal of the Transportation Research Board*, no. 2144: 80–92. https://doi.org/10.3141/2144-10.

Higgs, C, H Badland, K Simons, LD Knibbs, and B Giles-Corti. 2019. "The Urban Liveability Index: Developing a Policy-Relevant Urban Liveability Composite Measure and Evaluating Associations with Transport Mode Choice." *International Journal of Health Geographics* 18. https://doi.org/10.1186/s12942-019-0178-8.

Iungman, T, S Khomenko, M Nieuwenhuijsen, EP Barboza, A Ambros, C Padilla, and N Mueller. 2021. "The Impact of Urban and Transport Planning on Health: Assessment of the Attributable Mortality Burden in Madrid and Barcelona and

Its Distribution by Socioeconomic Status." *ENVIRONMENTAL RESEARCH* 196. https://doi.org/10.1016/j.envres.2021.110988.

Jacques, Cynthia, Kevin Manaugh, and AhmedM El-Geneidy. 2012. "Rescuing the Captive [Mode] User: An Alternative Approach to Transport Market Segmentation." Journal Article. *Transportation*, 1–21. https://doi.org/10.1007/s11116-012-9437-2.

Jaggar, Alison M. 2009. "The Philosophical Challenges of Global Gender Justice." *Philosophical Topics*, Gale Academic OneFile, 37 (2): 1+. link.gale.com/apps/doc/A284016231/AONE?u=ocul_mcmaster&sid=bookmark-AONE&xid=390bfcb0.

Jephcote, C, and HB Chen. 2013. "Geospatial Analysis of Naturally Occurring Boundaries in Road-Transport Emissions and Children's Respiratory Health Across a Demographically Diverse Cityscape." *SOCIAL SCIENCE & MEDICINE* 82: 87–99. https://doi.org/10.1016/j.socscimed.2013.01.030.

Jiao, JF, AV Moudon, J Ulmer, PM Hurvitz, and A Drewnowski. 2012. "How to Identify Food Deserts: Measuring Physical and Economic Access to Supermarkets in King County, Washington." *AMERICAN JOURNAL OF PUBLIC HEALTH* 102 (10): E32–39. https://doi.org/10.2105/AJPH.2012.300675.

Jiménez-Espada, Montaña, and Rafael González-Escobar. 2021. "Research on the Problem of Universal Accessibility in Urban Public Transport. Case Study: The City of Cáceres." In, 58:pp 21–28. Elsevier. https://doi.org/10.1016/j.trpro.2021.11.004.

Karner, Alex, Jonathan London, Dana Rowangould, and Kevin Manaugh. 2020. "From Transportation Equity to Transportation Justice: Within, Through, and Beyond the State." *Journal of Planning Literature* 35 (4): 440–59. https://doi.org/10.1177/0885412220927691.

Karner, Alex, Rafael H. M. Pereira, and Steven Farber. 2024. "Advances and Pitfalls in Measuring Transportation Equity." *Transportation*. https://doi.org/10.1007/s11116-023-10460-7.

Kent, M, and A Karner. 2019. "Prioritizing Low-Stress and Equitable Bicycle Networks Using Neighborhood-Based Accessibility Measures." *International Journal of Sustainable Transportation* 13 (2): 100–110. https://doi.org/10.1080/15568318.2018.1443177.

Khisty, C. Jotin. 1996. "Operationalizing Concepts of Equity for Public Project Investments." *Transportation Research Record: Journal of the Transportation Research Board* 1559 (1): 94–99. https://doi.org/10.1177/0361198196155900112.

Khomenko, S, M Nieuwenhuijsen, A Ambros, S Wegener, and N Mueller. 2020. "Is a Liveable City a Healthy City? Health Impacts of Urban and Transport Planning in Vienna, Austria." *ENVIRONMENTAL RESEARCH* 183. https://doi.org/10.1016/j.envres.2020.109238.

Kim, D, and J Park. 2020. "Assessing Social and Spatial Equity of Neighborhood Retail and Service Access in Seoul, South Korea." *Sustainability* 12 (20). https://doi.org/10.3390/su12208537.

Kim, H, Y Choi, J Ma, K Hyung, M Miyashita, and S Lee. 2016. "The Neighborhood Environment Walkability Scale for the Republic of Korea: Reliability and Relationship with Walking." *Iranian Journal of Public Health* 45 (11): 1427–35.

Kim, H, and S Sultana. 2015. "The Impacts of High-Speed Rail Extensions on Accessibility and Spatial Equity Changes in South Korea from 2004 to 2018." *Journal of Transport Geography* 45: 48–61. https://doi.org/10.1016/j.jtrangeo.2015.04.007.

Kimmel, AD, SP Masiano, RS Bono, EG Martin, FZ Belgrave, AA Adimora, B Dahman, H Galadima, and LM Sabik. 2018. "Structural Barriers to Comprehensive, Coordinated HIV Care: Geographic Accessibility in the US South." *AIDS Care* 30 (11): 1459–68. https://doi.org/10.1080/09540121.2018.1476656.

Kita, Hideyuki, Hirofumi Yotsutsuji, Satoshi Komoda, and Kohei Yasunaga. 2020. "Does the Level of Transportation Service Affect the Disparity of Activity Opportunities Between Localities?" In, 48:pp 2527–2536. Elsevier. https://doi.org/10.1016/j.trpro.2020.08.257.

Kruize, H, PPJ Driessen, P Glasbergen, and K van Egmond. 2007. "Environmental Equity and the Role of Public Policy: Experiences in the Rijnmond Region." *ENVIRONMENTAL MANAGEMENT* 40 (4): 578–95. https://doi.org/10.1007/s00267-005-0378-9.

Larkins, KE, AE Dunning, and JS Ridout. 2011. "Accessible Transportation and the Built Environment on College Campuses." *Transportation Research Record: Journal of the Transportation Research Board*, no. 2218: 88–97. https://doi.org/10.3141/2218-10.

Laszkiewicz, E, and D Sikorska. 2020. "Children's Green Walk to School: An Evaluation of Welfare-Related Disparities in the Visibility of Greenery Among Children." *ENVIRONMENTAL SCIENCE & POLICY* 110: 1–13. https://doi.org/10.1016/j.envsci.2020.05.009.

Lattman, K, M Friman, and LE Olsson. 2016. "Perceived Accessibility of Public Transport as a Potential Indicator of Social Inclusion." *Social Inclusion* 4 (3): 36–45. https://doi.org/10.17645/si.v4i3.481.

Lavery, T. A., A. Paez, and P. S. Kanaroglou. 2013. "Driving Out of Choices: An Investigation of Transport Modality in a University Sample." Journal Article. *Transportation Research Part A-Policy and Practice* 57: 37–46. https://doi.org/10.1016/j.tra.2013.09.010.

Lee, Sharon M. 1993. "Racial Classifications in the US Census: 1890–1990." Journal Article. *Ethnic and Racial Studies* 16 (1): 75–94. https://doi.org/10.1080/01419870.1993.9993773.

Lefebvre, Henri. 1967. "Le droit à la ville." *L Homme et la société* 6 (1): 29–35. https://doi.org/10.3406/homso.1967.1063.

Lim, PY, P Kong, H Cornet, and F Frenkler. 2021. "Facilitating Independent Commuting Among Individuals with Autism-A Design Study in Singapore." *Journal of Transport & Health* 21. https://doi.org/10.1016/j.jth.2021.101022.

Liu, Xiaofei, Xumei Chen, Chang Gao, and American Society of Civil Engineers. 2019. "The Status Quo, Challenges, and Policy Recommendation of Transport Barrier-Free Environment Development in China." In, pp 5351–5363. https://doi.org/10.1061/9780784482292.461.

Mackie, H. 2009. "Overcoming Barriers to Cycling to School: A Key to Improving Transport System Performance." In, 32:11p (session Thurs 2A). http://atrf.info/papers/2009/2009_Mackie.pdfhttps://trid.trb.org/view/1149648.

Mammen, G, MR Stone, R Buliung, and G Faulkner. 2014. "School Travel Planning in Canada: Identifying Child, Family, and School-Level Characteristics Associated with Travel Mode Shift from Driving to Active School Travel." *Journal of Transport & Health* 1 (4): 288–94. https://doi.org/10.1016/j.jth.2014.09.004.

Markard, Jochen, Peter Wells, Xiao-Shan Yap, and Harro van Lente. 2023. "Unsustainabilities: A Study on SUVs and Space Tourism and a Research Agenda for Transition Studies." Journal Article. *Energy Research & Social Science* 106: 103302. https://doi.org/https://doi.org/10.1016/j.erss.2023.103302.

Markolf, Samuel A., Christopher Hoehne, Andrew Fraser, Mikhail V. Chester, and B. Shane Underwood. 2019. "Transportation Resilience to Climate Change and Extreme Weather Events – Beyond Risk and Robustness." Journal Article. *Transport Policy* 74: 174–86. https://doi.org/https://doi.org/10.1016/j.tranpol.2018.11.003.

Marquez, L, JC Poveda, and LA Vega. 2019. "Factors Affecting Personal Autonomy and Perceived Accessibility of People with Mobility Impairments in an Urban Transportation Choice Context." *Journal of Transport & Health* 14. https://doi.org/10.1016/j.jth.2019.100583.

Martens, Karel. 2016. *Transport Justice: Designing Fair Transportation Systems*. Routledge.

Martens, Karel, Jeroen Bastiaanssen, and Karen Lucas. 2019. "Measuring Transport Equity: Key Components, Framings and Metrics." Book Section. In *Measuring Transport Equity*, edited by Karen Lucas, Karel Martens, Floridea Di Ciommo, and Ariane Dupont-Kieffer, 13–36. Elsevier. https://doi.org/https://doi.org/10.1016/B978-0-12-814818-1.00002-0.

Martens, Karel, and Aaron Golub. 2021. "A Fair Distribution of Accessibility: Interpreting Civil Rights Regulations for Regional Transportation Plans." Journal Article. *Journal of Planning Education and Research* 41 (4): 425–44. https://doi.org/10.1177/0739456x18791014.

Martens, K, A Golub, and G Robinson. 2012. "A Justice-Theoretic Approach to the Distribution of Transportation Benefits: Implications for Transportation Planning Practice in the United States." *Transportation Research Part A: Policy and Practice* 46 (4): 684–95. https://doi.org/10.1016/j.tra.2012.01.004.

Martinez-Jimenez, E, and JA Salinas-Perez. 2019. "Accessibility to Culture and Education. Educative City of Cordoba (Spain)." *Journal of Maps* 15 (1): 39–45. https://doi.org/10.1080/17445647.2019.1575776.

Mateo-Babiano, I. 2016. "Pedestrian's Needs Matter: Examining Manila's Walking Environment." *Transport Policy* 45: 107–15. https://doi.org/10.1016/j.tranpol.2015.09.008.

Mateo-Babiano, Iderlina, Sameera Kumar, and Alvin Mejia. 2017. "Bicycle Sharing in Asia: A Stakeholder Perception and Possible Futures." In, 25:pp 4970–4982. Elsevier. https://doi.org/10.1016/j.trpro.2017.05.375.

Mavoa, S, MJ Koohsari, HM Badland, M Davern, XQ Feng, T Astell-Burt, and B Giles-Corti. 2015. "Area-Level Disparities of Public Open Space: A Geographic Information Systems Analysis in Metropolitan Melbourne." *Urban Policy and Research* 33 (3): 306–23. https://doi.org/10.1080/08111146.2014.974747.

McCormack, GR, C Friedenreich, BA Sandalack, B Giles-Corti, PK Doyle-Baker, and A Shiell. 2012. "The Relationship Between Cluster-Analysis Derived Walkability and Local Recreational and Transportation Walking Among Canadian Adults." *Health & Place* 18 (5): 1079–87. https://doi.org/10.1016/j.healthplace.2012.04.014.

McKey, T, D Kim, and S Seo. 2020. "Crowdsourced Mapping for Healthy Food Accessibility in Dallas, Texas: A Feasibility Study." *FRONTIERS IN PUBLIC HEALTH* 8. https://doi.org/10.3389/fpubh.2020.00071.

Mears, M, P Brindley, R Maheswaran, and A Jorgensen. 2019. "Understanding the Socioeconomic Equity of Publicly Accessible Greenspace Distribution: The Example of Sheffield, UK." *GEOFORUM* 103: 126–37. https://doi.org/10.1016/j.geoforum.2019.04.016.

Mehdizadeh, M, A Mamdoohi, and T Nordfjaern. 2017. "Walking Time to School, Children's Active School Travel and Their Related Factors." *Journal of Transport & Health* 6: 313–26. https://doi.org/10.1016/j.jth.2017.01.012.

Mella Lira, Beatriz, and Antonio Paez. 2021. "Do Drivers Dream of Walking? An Investigation of Travel Mode Dissonance from the Perspective of Affective Values." Journal Article. *Journal of Transport & Health* 20: 101015. https://doi.org/https://doi.org/10.1016/j.jth.2021.101015.

Mijares, Andra Charis, Mio Suzuki, and Tetsuo Yai. 2013. "Equity Analysis of Urban Rail Fare Policy and Passenger Overload Delay: An International Comparison and the Case of Metro Manila MRT-3." *Journal of the Eastern Asia Society for Transportation Studies* 10: pp 45–65. https://doi.org/10.11175/easts.10.45.

Miranda, HD, and ANR da Silva. 2012. "Benchmarking Sustainable Urban Mobility: The Case of Curitiba, Brazil." *Transport Policy* 21: 141–51. https://doi.org/10.1016/j.tranpol.2012.03.009.

Mishra, Rajeev Kumar, Ankita Shukla, Manoranjan Parida, and Santosh Rangnekar. 2014. "EIA Based Comparative Urban Traffic Noise Analysis Between Operational and Under Construction Phase Public Transport Corridor." *International Journal for Traffic and Transport Engineering* 4 (3): pp 352–362. https://doi.org/10.7708/ijtte.2014.4(3).08.

Mohri, SS, S Mortazavi, and N Nassir. 2021. "A Clustering Method for Measuring Accessibility and Equity in Public Transportation Service: Case Study of Melbourne." *Sustainable Cities and Society* 74. https://doi.org/10.1016/j.scs.2021.103241.

Mokhtarian, P. L., I. Salomon, and L. S. Redmond. 2001. "Understanding the Demand for Travel: It's Not Purely 'Derived'." Journal Article. *Innovation* 14 (4).

Moniruzzaman, M., and A. Paez. 2016. "An Investigation of the Attributes of Walkable Environments from the Perspective of Seniors in Montreal." Journal Article. *Journal of Transport Geography* 51: 85–96. https://doi.org/10.1016/j.jtrangeo.2015.12.001.

Monzon, A, E Ortega, and E Lopez. 2013. "Efficiency and Spatial Equity Impacts of High-Speed Rail Extensions in Urban Areas." *CITIES* 30: 18–30. https://doi.org/10.1016/j.cities.2011.11.002.

Mooney, C, J Zwanziger, CS Phibbs, and S Schmitt. 2000. "Is Travel Distance a Barrier to Veterans' Use of VA Hospitals for Medical Surgical Care?" *SOCIAL SCIENCE & MEDICINE* 50 (12): 1743–55. https://doi.org/10.1016/S0277-9536(99)00414-1.

Mueller, N, D Rojas-Rueda, H Khreis, M Cirach, C Mila, A Espinosa, M Foraster, et al. 2018. "Socioeconomic Inequalities in Urban and Transport Planning Related Exposures and Mortality: A Health Impact Assessment Study for Bradford, UK." *ENVIRONMENT INTERNATIONAL* 121: 931–41. https://doi.org/10.1016/j.envint.2018.10.017.

Mulley, C, L Ma, G T Clifton, and M Tanner. 2015. "Are Network Planning Guidelines Based on Equal Access Equitable?" In, 18p. http://atrf.info/papers/2015/index.aspxhttps://trid.trb.org/view/1395093.

Murphy, M, MJ Koohsari, H Badland, and B Giles-Corti. 2017. "Supermarket Access, Transport Mode and BMI: The Potential for Urban Design and Planning Policy Across Socio-Economic Areas." *PUBLIC HEALTH NUTRITION* 20 (18): 3304–15. https://doi.org/10.1017/S1368980017002336.

Nordbakke, S, and T Schwanen. 2015. "Transport, Unmet Activity Needs and Well-being in Later Life: Exploring the Links." *TRANSPORTATION* 42 (6): 1129–51. https://doi.org/10.1007/s11116-014-9558-x.

Odeck, James, Trine Hagen, and Nils Fearnley. 2010. "Economic Appraisal of Universal Design in Transport: Experiences From Norway." *Research in Transportation Economics* 29 (1): pp 304–311. http://www.sciencedirect.com/science/article/B8JHM-5119FS6-2/2/3212b0f3260bbd5899dbf18cc4b3cf0ehttps://trid.trb.org/view/981277.

Orellana, D, ME Bustos, M Marin-Palacios, N Cabrera-Jara, and MA Hermida. 2020. "Walk'n'roll: Mapping Street-Level Accessibility for Different Mobility Conditions in Cuenca, Ecuador." *Journal of Transport & Health* 16. https://doi.org/10.1016/j.jth.2020.100821.

Page, Matthew J, Joanne E McKenzie, Patrick M Bossuyt, Isabelle Boutron, Tammy C Hoffmann, Cynthia D Mulrow, Larissa Shamseer, et al. 2021. "The PRISMA 2020 Statement: An Updated Guideline for Reporting Systematic Reviews." *BMJ*, n71. https://doi.org/10.1136/bmj.n71.

Park, J, J BAMFORD, H Byun, and S Chowdhury. 2017. "Journey by Visually Impaired Public Transport Users: Barriers and Consequences." In, 6p. https://atrf.info/papers/2017/index.aspxhttps://trid.trb.org/view/1596698.

Park, K, A Rigolon, DA Choi, T Lyons, and S Brewer. 2021. "Transit to Parks: An Environmental Justice Study of Transit Access to Large Parks in the US West." *Urban Forestry & Urban Greening* 60. https://doi.org/10.1016/j.ufug.2021.127055.

Parry, L, G Davies, O Almeida, G Frausin, A de Moraes, S Rivero, N Filizola, and P Torres. 2018. "Social Vulnerability to Climatic Shocks Is Shaped by Urban Accessibility." *Annals of the American Association of Geographers* 108 (1): 125–43. https://doi.org/10.1080/24694452.2017.1325726.

Patel, AB, NM Waters, and WA Ghali. 2007. "Determining Geographic Areas and Populations with Timely Access to Cardiac Catheterization Facilities for Acute Myocardial Infarction Care in Alberta, Canada." *International Journal of Health Geographics* 6. https://doi.org/10.1186/1476-072X-6-47.

Pedigo, AS, and A Odoi. 2010. "Investigation of Disparities in Geographic Accessibility to Emergency Stroke and Myocardial Infarction Care in East Tennessee Using Geographic Information Systems and Network Analysis." *ANNALS OF EPIDEMIOLOGY* 20 (12): 924–30. https://doi.org/10.1016/j.annepidem.2010.06.013.

Pereira, Rafael H. M., and Alex Karner. 2021. "Transportation Equity." In *International Encyclopedia of Transportation*, 271–77. Elsevier. https://doi.org/10.1016/B978-0-08-102671-7.10053-3.

Pereira, Rafael H. M., Tim Schwanen, and David Banister. 2017. "Distributive Justice and Equity in Transportation." *Transport Reviews* 37 (2): 170–91. https://doi.org/10.1080/01441647.2016.1257660.

Pereira, RHM, CKV Braga, LM Servo, B Serra, P Amaral, N Gouveia, and A Paez. 2021. "Geographic Access to COVID-19 Healthcare in Brazil Using a Balanced Float Catchment Area Approach." *SOCIAL SCIENCE & MEDICINE* 273. https://doi.org/10.1016/j.socscimed.2021.113773.

Perez-delHoyo, R, MD Andujar-Montoya, H Mora, V Gilart-Iglesias, and RA Molla-Sirvent. 2021. "Participatory Management to Improve Accessibility in Consolidated Urban Environments." *Sustainability* 13 (15). https://doi.org/10.3390/su13158323.

Peters, Micah D. J., Casey Marnie, Andrea C. Tricco, Danielle Pollock, Zachary Munn, Lyndsay Alexander, Patricia McInerney, Christina M. Godfrey, and Hanan Khalil. 2020. "Updated Methodological Guidance for the Conduct of Scoping Reviews." *JBI Evidence Synthesis* 18 (10): 2119–26. https://doi.org/10.11124/JBIES-20-00167.

Peungnumsai, A, H Miyazaki, A Witayangkurn, and SM Kim. 2020. "A Grid-Based Spatial Analysis for Detecting Supply-Demand Gaps of Public Transports: A Case Study of the Bangkok Metropolitan Region." *Sustainability* 12 (24). https://doi.org/10.3390/su122410382.

Prasertsubpakij, Duangporn, and Vilas Nitivattananon. 2012. "Evaluating Accessibility to Bangkok Metro Systems Using Multi-Dimensional Criteria Across User Groups." *IATSS Research* 36 (1): pp 56–65. http://www.sciencedirect.com/science/article/pii/S0386111212000040https://trid.trb.org/view/1148211.

Pritchard, John P., Anna Zanchetta, and Karel Martens. 2022. "A New Index to Assess the Situation of Subgroups, with an Application to Public Transport Disadvantage in US Metropolitan Areas." Journal Article. *Transportation Research Part A: Policy and Practice* 166: 86–100. https://doi.org/https://doi.org/10.1016/j.tra.2022.10.002.

Pucci, P, G Vecchio, L Bocchimuzzi, and G Lanza. 2019. "Inequalities in Job-Related Accessibility: Testing an Evaluative Approach and Its Policy Relevance in Buenos Aires." *Applied Geography* 107: 1–11. https://doi.org/10.1016/j.apgeog.2019.04.002.

Rabello Quadros, Saul Germano, and Carlos David Nassi. 2015. “An Evaluation on the Criteria to Prioritize Transportation Infrastructure Investments in Brazil.” Journal Article. *Transport Policy* 40: 8–16. https://doi.org/https://doi.org/10.1016/j.tranpol.2015.02.002.

Rachele, JN, V Learnihan, HM Badland, S Mavoa, G Turrell, and B Giles-Corti. 2017. “Neighbourhood Socioeconomic and Transport Disadvantage: The Potential to Reduce Social Inequities in Health Through Transport.” *Journal of Transport & Health* 7: 256–63. https://doi.org/10.1016/j.jth.2017.09.002.

Raje, F. 2004. “Engineering Social Exclusion? Poor Transport Links and Severance.” Journal Article. *Proceedings of the Institution of Civil Engineers-Municipal Engineer* 157 (4): 267–73.

Rao, ND, and P Baer. 2012. “”Decent Living” Emissions: A Conceptual Framework.” *Sustainability* 4 (4): 656–81. https://doi.org/10.3390/su4040656.

Ravensbergen, Léa, Juliette Fournier, and Ahmed El-Geneidy. 2023. “Exploratory Analysis of Mobility of Care in Montreal, Canada.” *Transportation Research Record* 2677 (1): 1499–509. https://doi.org/10.1177/03611981221105070.

Reddy, A, T Chennadu, and A Lu. 2010. “Safeguarding Minority Civil Rights and Environmental Justice in Service Delivery and Reductions Case Study of New York City Transit Authority Title VI Program.” *Transportation Research Record: Journal of the Transportation Research Board*, no. 2163: 45–56. https://doi.org/10.3141/2163-05.

Renne, John L, and Estefania Mayorga. 2018. “What Has America Learned Since Hurricane Katrina? Evaluating Evacuation Plans for Carless and Vulnerable Populations in 50 Large Cities Across the United States.” In, 13p. https://trid.trb.org/view/1495593.

Rivas, Maria Eugenia, Tomás Serebrisky, and Ancor Suárez-Alemán. 2018. “How Affordable Is Transportation in Latin America and the Caribbean?” In, 15p. https://annualmeeting.mytrb.org/OnlineProgram/Details/15652https://trid.trb.org/view/1759304.

Robinson, C, and G Mattioli. 2020. “Double Energy Vulnerability: Spatial Intersections of Domestic and Transport Energy Poverty in England.” *Energy Research & Social Science* 70. https://doi.org/10.1016/j.erss.2020.101699.

Rowangould, Dana, Alex Karner, and Jonathan London. 2015. “Identifying Environmental Justice Communities for Transportation Analysis.” In, 11p. https://trid.trb.org/view/1339508.

Rowangould, D, A Karner, and J London. 2016. “Identifying Environmental Justice Communities for Transportation Analysis.” *Transportation Research Part A: Policy and Practice* 88: 151–62. https://doi.org/10.1016/j.tra.2016.04.002.

Russell, Marie, Cheryl Davies, Kirsty Wild, and Caroline Shaw. 2021. “Pedalling Towards Equity: Exploring Women’s Cycling in a New Zealand City.” *Journal of Transport Geography* 91. https://doi.org/10.1016/j.jtrangeo.2021.102987.

Ryan, Jean, and Rafael .H. M. Pereira. 2021. “What Are We Missing When We Measure Accessibility? Comparing Calculated and Self-Reported Accounts Among Older People.” *Journal of Transport Geography* 93. https://doi.org/10.1016/j.jtrangeo.2021.103086.

Safransky, Sara. 2022. "Grammars of Reckoning: Redressing Racial Regimes of Property." *Environment and Planning D: Society and Space* 40 (2): 292–305.

Scheurer, J, C Curtis, and S McLeod. 2017. "Spatial Accessibility of Public Transport in Australian Cities: Does It Relieve or Entrench Social and Economic Inequality?" *Journal of Transport and Land Use* 10 (1): 911–30. https://doi.org/10.5198/jtlu.2017.1097.

Schmitz, Michelle M., Florina Serbanescu, Vincent Kamara, Joan Marie Kraft, Marc Cunningham, Gregory Opio, Patrick Komakech, Claudia Morrissey Conlon, and Mary M. Goodwin. 2019. "Did Saving Mothers, Giving Life Expand Timely Access to Lifesaving Care in Uganda? A Spatial District-Level Analysis of Travel Time to Emergency Obstetric and Newborn Care." *Global Health: Science and Practice* 7: S151–67. https://doi.org/10.9745/GHSP-D-18-00366.

Sharma, G, and GR Patil. 2021. "Public Transit Accessibility Approach to Understand the Equity for Public Healthcare Services: A Case Study of Greater Mumbai." *Journal of Transport Geography* 94. https://doi.org/10.1016/j.jtrangeo.2021.103123.

———. 2022. "Spatial and Social Inequities for Educational Services Accessibility - A Case Study for Schools in Greater Mumbai." *CITIES* 122. https://doi.org/10.1016/j.cities.2021.103543.

Shen, C, ZL Zhou, S Lai, L Lu, WY Dong, M Su, J Zhang, et al. 2020. "Measuring Spatial Accessibility and Within-Province Disparities in Accessibility to County Hospitals in Shaanxi Province of Western China Based on Web Mapping Navigation Data." *International Journal for Equity in Health* 19 (1). https://doi.org/10.1186/s12939-020-01217-0.

Silva, CD, I Viegas, T Panagopoulos, and S Bell. 2018. "Environmental Justice in Accessibility to Green Infrastructure in Two European Cities." *Land* 7 (4). https://doi.org/10.3390/land7040134.

Siu, BWY. 2019. "Assessment of Physical Environment Factors for Mobility of Older Adults: A Case Study in Hong Kong." *Research in Transportation Business and Management* 30. https://doi.org/10.1016/j.rtbm.2019.100370.

Smith, N, D Hirsch, and A Davis. 2012. "Accessibility and Capability: The Minimum Transport Needs and Costs of Rural Households." *Journal of Transport Geography* 21: 93–101. https://doi.org/10.1016/j.jtrangeo.2012.01.004.

Somenahalli, S V, and M A Taylor. 2007. "Aging and Transport: Mobility Issues: A Case Study for Adelaide." *STATE OF AUSTRALIAN CITIES NATIONAL CONFERENCE, 2007, ADELAIDE, SOUTH AUSTRALIA*, 11P. https://trid.trb.org/view/868838.

Song, L, M Kirschen, and J Taylor. 2019. "Women on Wheels: Gender and Cycling in Solo, Indonesia." *SINGAPORE JOURNAL OF TROPICAL GEOGRAPHY* 40 (1): 140–57. https://doi.org/10.1111/sjtg.12257.

Sourbati, Maria, and Frauke Behrendt. 2021. "Smart Mobility, Age and Data Justice." Journal Article. *New Media & Society* 23 (6): 1398–1414. https://doi.org/10.1177/1461444820902682.

Stjernborg, V. 2019. "Accessibility for All in Public Transport and the Overlooked (Social) Dimension-A Case Study of Stockholm." *Sustainability* 11 (18). https://doi.org/10.3390/su11184902.

Sun, YR, and P Thakuriah. 2021. "Public Transport Availability Inequalities and Transport Poverty Risk Across England." *ENVIRONMENT AND PLANNING B-URBAN ANALYTICS AND CITY SCIENCE* 48 (9): 2775–89. https://doi.org/10.1177/2399808321991536.

Sung, H, and S Lee. 2015. "Residential Built Environment and Walking Activity: Empirical Evidence of Jane Jacobs' Urban Vitality." *Transportation Research Part D: Transport and Environment* 41: 318–29. https://doi.org/10.1016/j.trd.2015.09.009.

Tan, Zhijia, Hai Yang, Wei Tan, and Zhichun Li. 2016. "Pareto-Improving Transportation Network Design and Ownership Regimes." *Transportation Research Part B: Methodological* 91: 292–309.

Thondoo, M, O Marquet, S Marquez, and MJ Nieuwenhuijsen. 2020. "Small Cities, Big Needs: Urban Transport Planning in Cities of Developing Countries." *Journal of Transport & Health* 19. https://doi.org/10.1016/j.jth.2020.100944.

Timperio, A, J Veitch, and A Carver. 2015. "Safety in Numbers: Does Perceived Safety Mediate Associations Between the Neighborhood Social Environment and Physical Activity Among Women Living in Disadvantaged Neighborhoods?" *PREVENTIVE MEDICINE* 74: 49–54. https://doi.org/10.1016/j.ypmed.2015.02.012.

Timperley, Jocelyn. 2021. "The Fight to End Fossil-Fuel Subsidies." Journal Article. *Nature* 598: 403–5.

Titheridge, H, J Solomon, and Accessibility and User Needs in Transport for Sustainable Urban Environments Consortium (AUNT-SUE). 2008. "Social Exclusion, Accessibility and Lone Parents." In, 14p. http://www.sortclearinghouse.info/cgi/viewcontent.cgi?article=1232&context=researchhttps://trid.trb.org/view/1153041.

Tiwari, Geetam, and Caleb Phillip. 2021. "Development of Public Transport Systems in Small Cities: A Roadmap for Achieving Sustainable Development Goal Indicator 11.2." *IATSS Research* 45 (1): pp 31–38. https://doi.org/10.1016/j.iatssr.2021.02.002.

Tiznado-Aitken, I, JC Munoz, and R Hurtubia. 2018. "The Role of Accessibility to Public Transport and Quality of Walking Environment on Urban Equity: The Case of Santiago de Chile." *Transportation Research Record* 2672 (35): 129–38. https://doi.org/10.1177/0361198118782036.

Towne, SD, J Won, S Lee, MG Ory, SN Forjuoh, SJ Wang, and C Lee. 2016. "Using Walk Score (TM) and Neighborhood Perceptions to Assess Walking Among Middle-Aged and Older Adults." *JOURNAL OF COMMUNITY HEALTH* 41 (5): 977–88. https://doi.org/10.1007/s10900-016-0180-z.

Tricco, Andrea C., Erin Lillie, Wasifa Zarin, Kelly K. O'Brien, Heather Colquhoun, Danielle Levac, David Moher, et al. 2018. "PRISMA Extension for Scoping Reviews (PRISMA-ScR): Checklist and Explanation." *Annals of Internal Medicine* 169 (7): 467–73. https://doi.org/10.7326/M18-0850.

Tyler, Tom R. 2006. “Restorative Justice and Procedural Justice: Dealing with Rule Breaking.” *Journal of Social Issues* 62 (2): 307–26. https://doi.org/10.1111/j.1540-4560.2006.00452.x.

Vadrevu, L, and B Kanjilal. 2016. “Measuring Spatial Equity and Access to Maternal Health Services Using Enhanced Two Step Floating Catchment Area Method (E2SFCA) - a Case Study of the Indian Sundarbans.” *International Journal for Equity in Health* 15. https://doi.org/10.1186/s12939-016-0376-y.

Vanoutrive, Thomas, and Erin Cooper. 2019. “How Just Is Transportation Justice Theory? The Issues of Paternalism and Production.” Journal Article. *Transportation Research Part A: Policy and Practice* 122: 112–19. https://doi.org/https://doi.org/10.1016/j.tra.2019.02.009.

Vecchio, Giovanni, and Karel Martens. 2021. “Accessibility and the Capabilities Approach: A Review of the Literature and Proposal for Conceptual Advancements.” *Transport Reviews*, 1–22. https://doi.org/10.1080/01441647.2021.1931551.

Vecchio, Giovanni, Ignacio Tiznado-Aitken, and Ricardo Hurtubia. 2020. “Transport and Equity in Latin America: A Critical Review of Socially Oriented Accessibility Assessments.” *Transport Reviews* 40 (3): 354–81. https://doi.org/10.1080/01441647.2020.1711828.

Veen, Anne S van der, Jan Anne Annema, Karel Martens, Bart van Arem, and Gonçalo Homem de Almeida Correia. 2020. “Operationalizing an Indicator of Sufficient Accessibility - a Case Study for The City of Rotterdam.” *Case Studies on Transport Policy* 8 (4): pp 1360–1370. https://doi.org/10.1016/j.cstp.2020.09.007.

Velho, R, C Holloway, A Symonds, and B Balmer. 2016. “The Effect of Transport Accessibility on the Social Inclusion of Wheelchair Users: A Mixed Method Analysis.” *Social Inclusion* 4 (3): 24–35. https://doi.org/10.17645/si.v4i3.484.

Walen, Alec. 2023. “Retributive Justice.” In *The Stanford Encyclopedia of Philosophy*, edited by Edward N. Zalta and Uri Nodelman, Fall 2023. https://plato.stanford.edu/archives/fall2023/entries/justice-retributive/; Metaphysics Research Lab, Stanford University.

Wang, L, and D Roisman. 2011. “Modeling Spatial Accessibility of Immigrants to Culturally Diverse Family Physicians.” *PROFESSIONAL GEOGRAPHER* 63 (1): 73–91. https://doi.org/10.1080/00330124.2010.510087.

Warren, J, E Morris, M Enoch, IP Magdaleno, ZP Arias, and J Guanche. 2015. “Developing an Equitable and Sustainable Mobility Strategy for Havana.” *CITIES* 45: 133–41. https://doi.org/10.1016/j.cities.2015.02.007.

Welch, Timothy F. 2013. “Equity in Transport: The Distribution of Transit Access and Connectivity Among Affordable Housing Units.” *Transport Policy* 30: 283–93. https://doi.org/10.1016/j.tranpol.2013.09.020.

Wilkinson-Meyers, L, PM Brown, R McNeill, J Reeve, P Patston, and R Baker. 2015. “To Live an Ordinary Life: Resource Needs and Additional Costs for People with a Physical Impairment.” *Disability & Society* 30 (7): 976–90. https://doi.org/10.1080/09687599.2015.1061479.

Williams, Rashad, and Justin Steil. 2023. “‘The Past We Step into and How We Repair It’: A Normative Framework for Reparative Planning.” *Journal of the American Planning Association* 89 (4): 580–91. https://doi.org/10.1080/01944363.2022.2154247.

Wintein, Stefan. 2024. "To Be Fair: Claims Have Amounts and Strengths." *Social Choice and Welfare* 62 (3): 443–64. https://doi.org/10.1007/s00355-023-01494-y.

Wismadi, A, M Zuidgeest, M Brussel, and M van Maarseveen. 2014. "Spatial Preference Modelling for Equitable Infrastructure Provision: An Application of Sen's Capability Approach." *Journal of Geographical Systems* 16 (1): 19–48. https://doi.org/10.1007/s10109-013-0185-4.

Xie, LJ, and J Spinney. 2018. ""I Won't Cycle on a Route Like This; I Don't Think I Fully Understood What Isolation Meant": A Critical Evaluation of the Safety Principles in Cycling Level of Service (CLoS) Tools from a Gender Perspective." *Travel Behaviour and Society* 13: 197–213. https://doi.org/10.1016/j.tbs.2018.07.002.

Xu, MY, J Xin, SL Su, M Weng, and ZL Cai. 2017. "Social Inequalities of Park Accessibility in Shenzhen, China: The Role of Park Quality, Transport Modes, and Hierarchical Socioeconomic Characteristics." *Journal of Transport Geography* 62: 38–50. https://doi.org/10.1016/j.jtrangeo.2017.05.010.

Xu, Shu-Xian, Ronghui Liu, Tian-Liang Liu, and Hai-Jun Huang. 2018. "Pareto-Improving Policies for an Idealized Two-Zone City Served by Two Congestible Modes." *Transportation Research Part B: Methodological* 117: 876–91. https://doi.org/10.1016/j.trb.2017.08.010.

Yenisetty, PT, and P Bahadure. 2020. "Measuring Accessibility to Various ASFs from Public Transit Using Spatial Distance Measures in Indian Cities." *ISPRS International Journal of Geo-Information* 9 (7). https://doi.org/10.3390/ijgi9070446.

Zhang, Mengzhu, and Pengjun Zhao. 2021. "Literature Review on Urban Transport Equity in Transitional China: From Empirical Studies to Universal Knowledge." Journal Article. *Journal of Transport Geography* 96: 103177. https://doi.org/https://doi.org/10.1016/j.jtrangeo.2021.103177.

Zhao, Pengjun, and Peilin Li. 2021. "Rethinking the Determinants of Vehicle Kilometers Traveled (VKT) in an Auto-Dependent City: Transport Policies, Socioeconomic Factors and the Built Environment." Journal Article. *Transportation Planning and Technology* 44 (3): 273–302. https://doi.org/10.1080/03081060.2021.1883228.

Zhao, PJ, SX Li, and D Liu. 2020. "Unequable Spatial Accessibility to Hospitals in Developing Megacities: New Evidence from Beijing." *Health & Place* 65. https://doi.org/10.1016/j.healthplace.2020.102406.

Zhe, P, H Yamanaka, K Kakihara, and WIT Press. 2008. "Evaluation of Shared Use of Bicycles and Pedestrians in Japan." In, pp 47–56. https://trid.trb.org/view/873583.

Zheng, N, and N Geroliminis. 2020. "Area-Based Equitable Pricing Strategies for Multimodal Urban Networks with Heterogeneous Users." *Transportation Research Part A: Policy and Practice* 136: 357–74. https://doi.org/10.1016/j.tra.2020.04.009.

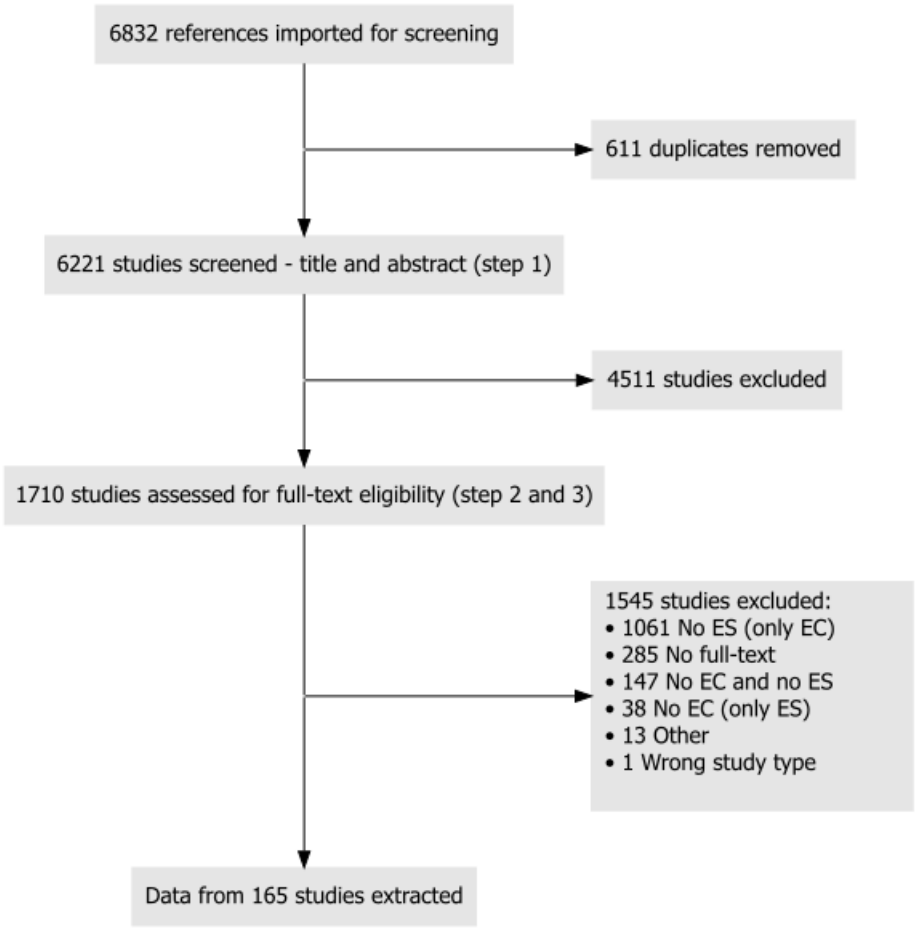



**Figure 3**: PRISMA flow diagram for the evidence selection process. ES signifies standards and EC signifies conceptualisations.

# Appendix

## Evidence search strategy

The evidence selection process is also represented using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram (Page et al. 2021) in Figure **??**. Notably, two rounds of exclusion occurred during the assessment for full-text eligibility. 1710 studies entered step 2, 1223 were excluded and the remaining 487 papers entered step 3. The data extraction template used by the reviewers (authorship team) in step 3 revealed that, as expected, inclusion was initially too generous, and some papers were not sufficiently relevant, because of a lack of content on standards and/or conceptual/theoretical elements. In this fashion, 322 papers were further excluded and data extraction was completed to give a final corpus of 165 papers. A

summary of the reasons for exclusion of the 1545 papers (between steps 2 and 3) are included in Figure **??**.

| **Database/Index** (Platform) | Search | Hits |
|---|---|---|
| **Web of Science General Collection -Science Citation Index Expanded; Social Sciences Citation Index** (Web of Science) | (TS= (( "transport*" OR "travel" or "paratransit" or "microtransit" or "micro-transit" or "transit" OR "bus" OR "buses" OR "e-bus" or "e-buses" OR "busing" OR "streetcar*" OR "subway*" OR "tram" or "trams" or "tramway" or "public transport*" OR "rail*" OR "train" or "trains" or "bik*" Or "biking" OR "bike-shar*" OR "bike shar*" OR "cycling" OR "bicyclist*" OR "bicycling" OR "*scooter*" or "pedestrian*" OR "walk*" OR "active transport*" OR "active travel" or "ride-shar*" OR "ride shar*" OR "ride-hail*" OR "car" OR "cars" OR "car-shar*" Or "car shar*" OR "taxi*" or "*motori*ed" ))) AND (TS=(( "MCA" or "CBA" or "wider impact*" or "mobility" or "accessibility" or "access" or "affordab*" or "user fees" or "user-fees" or "poverty" or "activity participation" or "quality of service" or "level of service" or "service frequency" or "congestion" or "crowding" or "safety" or "collisions" or "accidents" or "crashes" or "vulnerable road user*" or "*policing" or "*policed" or "externalit*" or "pollution" or "air quality" or "emissions" or "energy consumption" or "fuel consumption" ))) AND (TS=(( "justice*" or "fairness" or "fair" or "ethic*" or "equit*" OR "inequit*" OR "equalit*" OR "inequalit*" OR "equal" OR "unequal" OR "disparit*" OR "relian*" or "*dependent" OR "social inclusion" OR "social exclusion" or "capabilit*" or "marginali*" or "barrier*" OR "disadvantage*" or "needs-based" or "dissonance" OR "wellbeing" or "well*being" or "transport poverty" or "social assessment" or "equity assessment" or "universal design" or "captive" or "deprived" ))) AND ( TS = (( "standard*" OR "threshold*" or "indicator*" or "criteria" or "criterion" or "guideline*" or "guidance*" or "score*" or "equ* ind*" or "pricing strateg*" or "priorit*"))) and (TASCA == (Transportation or Public Environmental Occupational Health or Environmental Sciences or Transportation Science Technology or Economics or Engineering Civil or Environmental Studies or Geography or Green Sustainable Science Technology or Energy Fuels or Engineering Environmental or Geography Physical or Social Sciences Interdisciplinary or Social Issues or Social Sciences Mathematical Methods or Social Sciences Biomedical or Social Work or Sociology or Philosophy or Urban Studies or Engineering Multidisciplinary or Regional Urban Planning))<br><br>1992 to 2022; English; Doc type: Articles, Early Access, Book Chapters | 4187 |
| **Transportation Research International Documentation** - (TRID) | Keywords =<br>( "MCA" or "CBA" or "wider impact*" or "mobility" or "accessibility" or "access" or "affordab*" or "user fees" or "user-fees" or "poverty" or "activity participation" or "quality of service" or "level of service" or "service frequency" or "congestion" or "crowding" or "safety" or "collisions" or "accidents" or "crashes" or "vulnerable road user*" or "*policing" or "*policed" or "externalit*" or "pollution" or "air quality" or "emissions" or "energy consumption" or "fuel consumption" )<br>AND ("justice*" or "fairness" or "fair" or "ethic*" or "equit*" OR "inequit*" OR "equalit*" OR "inequalit*" OR "equal" OR "unequal" OR "disparit*" OR "relian*" or "*dependent" OR "social inclusion" OR "social exclusion" or "capabilit*" or "marginali*" or "barrier*" OR "disadvantage*" or "needs-based" or "dissonance" OR "wellbeing" or "well*being" or "transport poverty" or "social assessment" or "equity assessment" or "universal design" or "captive" or "deprived" )<br>AND ("standard*" OR "threshold*" or "indicator*" or "criteria" or "criterion" or "guideline*" or "guidance*" or "score*" or "pricing strateg*" or "priorit*" or "equ* ind*" )<br><br>Subject Areas: Passenger Transportation OR Pedestrians and Bicyclists OR Policy OR Public Transportation OR Transportation (General) OR Railroads<br>- (the use of subject areas replaces the Transport concept)<br><br>Language: English<br>Document type: Articles and papers<br>Published: 1992 to 2014 then another search for 2015 to 2025 | 2645 |

**Figure 4**: The search query. TS = topic search (keywords, abstract, title). TASCA = subject categories. Green text area transportation system related terms, blue text are equity dimension related terms, purple text are equity/justice conceptualization related terms, and orange text are standards related terms. Hits corresponds the number of papers that the search yielded and was retained into the evidence selection process.

Definitions of the population-concept context (PCC) used in the creation of the inclusion and exclusion criteria for the search strategy.

- **Population**: the focus of the included studies should be on individuals, groups, communities, or entire regional areas that are impacted by passenger transportation infrastructure and systems (i.e., all modes and flows) from the perspective of equity (i.e., fair distribution, production, and re-production of burdens and benefits). This criteria is reflected in the creation of the first set of topic search terms that relate to transportation modes (e.g., "walking" OR "cycling" OR "transit" - see green text in Figure **??** for the full list).
- **Concept**: the included studies should also include equity dimensions and conceptualizes equity as discussed in the previous section. This inclusion criteria is reflected in the second and third set of topic search terms developed in the search strategy. These terms relate to types of equity dimensions (e.g., "accessibility" OR "mobility" or "transport-related air pollution" - see blue text in the Figure **??** for the full list) and fairness conceptualizations (e.g., "Justice" OR "equity" - see purple text in Figure **??** for the full list).

- **Context**: the included studies should also be limited to publications that include types of standards. Context can be more difficult to explicitly search for with key terms so synonyms for 'standards' were added to the query as a four set of topic search terms (e.g., threshold, indicator, criteria - see orange text in Figure **??** for full list). Additionally, journal article and conference papers, English-language literature from any country, any study design (e.g., quantitative, qualitative, or mixed-method studies, or conceptual frameworks), and any record published within the past 30 years are included (January 1992 to March 2022). The time period is selected as the first (to the authors knowledge) peer-reviewed article which operationalized standards and fairness conceptualization was published in 1996 (Khisty 1996); we are broadening the search by a few years for completeness. English is selected as it is the common language spoken across the authorship team. Furthermore, papers that explicitly fall within the Transportation or related topic/category is included in the query (e.g., "Transportation", "Social Sciences", "Geography", "Civil Engineering", "Philosophy" - see the Figure **??** for full query).

The **exclusion criteria** for the search are papers that are not within the inclusion criteria. Specifically:

- Literature published before January 1992.
- Papers which do not include transportation equity dimensions.
- Grey literature, as concepts contained within are frequently published in a more developed form in journals.

## Evidence selection and data extraction

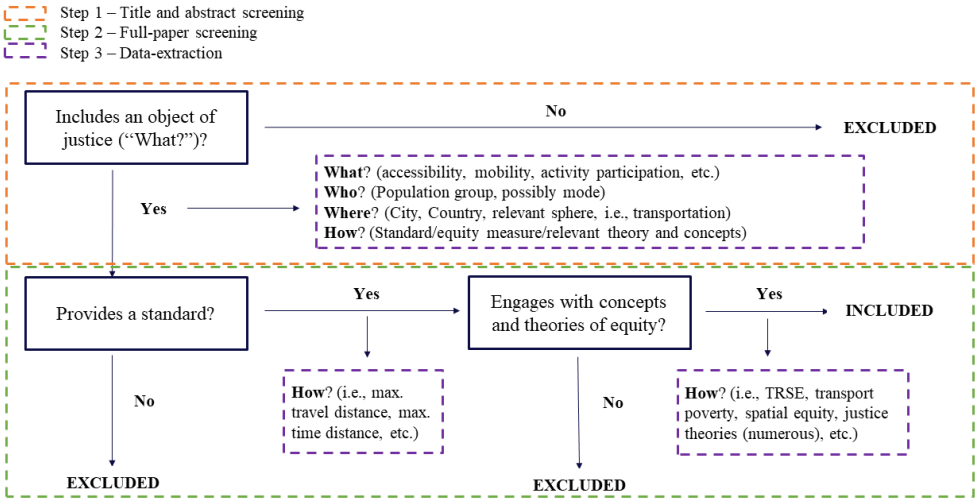
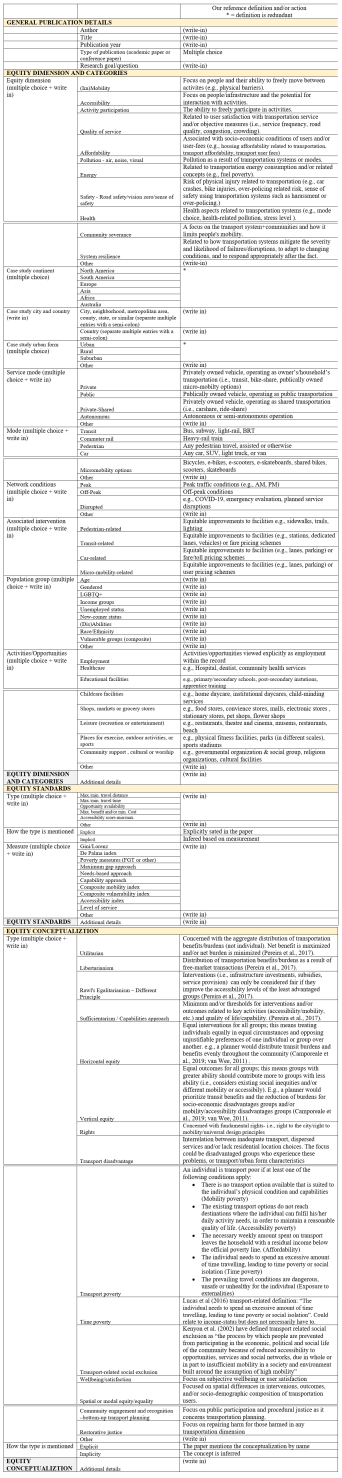



**Figure 5**: Evidence selection workflow. Step 1 (orange) is title and abstract screening, step 2 (green) is full-text review, and step 3 (purple) is data extraction.

The following steps summarise the evidence selection process:

1. The first step (orange box in Figure **??**) included screening all titles and abstracts of papers on whether they included transportation equity as defined by the PCC. Each paper was screened by two independent reviewers who then voted for inclusion, exclusion, or uncertain inclusion. All uncertain papers, conflicting papers, and papers missing abstracts were reviewed by a third person for inclusion or exclusion.
2. The second step (green box in Figure **??**) included scanning all full-text papers which passed step 1. These papers were reviewed to determine if they included a relevant "how", i.e., an standard and/or relevant theoretical or conceptual discussion. At this stage, papers were evaluated again by two independent reviewers who voted for inclusion or exclusion. If an article was voted to be excluded, it was tagged with one of five possible reasons for exclusion, namely (1) no standards included; (2) no relevant conceptual elements included; (3) no standard and no conceptual elements included; (4) send back – QA issue; or (5) other. Discrepancies were resolved by a third reviewer.
3. In the last step, a data extraction template for each record was filled by one reviewer (purple box in Figure **??**). The data extraction template was created with the aim of striking a balance between the complexity of categories and the simplicity of summary; information related to "Where?" (the geographical context and sphere of life), "When?" (temporal circumstances for the application of justice), "Who?" (the subject of justice), "What?" (the object of justice), and "How?" ( standards and conceptualisations) was filled out for each study. The following table contains the template that was input into *Covidence* and used throughout.

Data extraction for each document that passed through all three steps was then extracted using this template:



| | | Our reference definition and/or action<br>* = definition is redundant |
|---|---|---|
| **GENERAL PUBLICATION DETAILS** | | |
| | Author | (write-in) |
| | Title | (write-in) |
| | Publication year | (write-in) |
| | Type of publication (academic paper or conference paper) | Multiple choice |
| | Research goal/question | (write-in) |
| **EQUITY DIMENSION AND CATEGORIES** | | |
| Equity dimension (multiple choice + write in) | (Im)Mobility | Focus on people and their ability to freely move between activities (e.g., physical barriers). |
| | Accessibility | Focus on people/infrastructure and the potential for interaction with activities. |
| | Activity participation | The ability to freely participate in activities. |
| | Quality of service | Related to user satisfaction with transportation service and/or objective measures (i.e., service frequency, road quality, congestion, crowding). |
| | Affordability | Associated with socio-economic conditions of users and/or user-fees (e.g., housing affordability related to transportation, transport affordability, transport user fees) |
| | Pollution - air, noise, visual | Pollution as a result of transportation systems or modes. |
| | Energy | Related to transportation energy consumption and/or related concepts (e.g., fuel poverty). |
| | Safety - Road safety/vision zero/sense of safety | Risk of physical injury related to transportation (e.g., car crashes, bike injuries, over-policing related risk, sense of safety using transportation systems such as harassment or over-policing.) |
| | Health | Health aspects related to transportation systems (e.g., mode choice, health-related pollution, stress level ). |
| | Community severance | A focus on the transport system+communities and how it limits people's mobility. |
| | System resilience | Related to how transportation systems mitigate the severity and likelihood of failures/disruptions, to adapt to changing conditions, and to respond appropriately after the fact. |
| | Other | (write-in) |
| Case study contianent (multiple choice) | North America | * |
| | South America | |
| | Europe | |
| | Asia | |
| | Africa | |
| | Australia | |
| Case study city and country (write in) | City, neighborhood, metropolitan area, county, state, or similar (separate multiple entries with a semi-colon) | (write in) |
| | County (separate multiple entries with a semi-colon) | (write in) |
| Case study urban/ form (multiple choice) | Urban | * |
| | Rural | |
| | Suburban | |
| | Other | (write in) |
| Service mode (multiple choice + write in) | Private | Privately owned vehicle, operating as owner's/household's transportation (i.e., transit, bike-share, publically owned micro-mobility options) |
| | Public | Publically owned vehicle, operating as public transportation |
| | Private-Shared | Privately owned vehicle, operating as shared transportation (i.e., carshare, ride-share) |
| | Autonomous | Autonomous or semi-autonomous operation |
| | Other | (write in) |
| Mode (multiple choice + write in) | Transit | Bus, subway, light-rail, BRT |
| | Commuter rail | Heavy-rail train |
| | Pedestrian | Any pedestrian travel, assisted or otherwise |
| | Car | Any car, SUV, light truck, or van |
| | Micromobility options | Bicycles, e-bikes, e-scooters, e-skateboards, shared bikes, scooters, skateboards |
| | Other | (write in) |
| Network conditions (multiple choice + write in) | Peak | Peak traffic conditions (e.g., AM, PM) |
| | Off-Peak | Off-peak conditions |
| | Disrupted | e.g., COVID-19, emergency evaluation, planned service disruptions |
| | Other | (write in) |
| Associated intervention (multiple choice + write in) | Pedestrian-related | Equitable improvements to facilities e.g., sidewalks, trails, lighting |
| | Transit-related | Equitable improvements to facilities (e.g., stations, dedicated lanes, vehicles) or fare pricing schemes |
| | Car-related | Equitable improvements to facilities (e.g., lanes, parking) or fare/toll pricing schemes |
| | Micro-mobility-related | Equitable improvements to facilities (e.g., lanes, parking) or user pricing schemes |
| Population group (multiple choice + write in) | Age | (write in) |
| | Gendered | (write in) |
| | LGBTQ+ | (write in) |
| | Income groups | (write in) |
| | Unemployed status | (write in) |
| | Non-owner status | (write in) |
| | (Dis)Abilities | (write in) |
| | Race/Ethnicity | (write in) |
| | Vulnerable groups (composite) | (write in) |
| | Other | (write in) |
| Activities/Opportunities (multiple choice + write in) | Employment | Activities/opportunities viewed explicitly as employment within the record |
| | Healthcare | e.g., Hospital, dentist, community health services |
| | Educational facilities | e.g., primary/secondary schools, post-secondary institutes, apprentice training |
| | Childcare facilities | e.g., home daycare, institutional daycares, child-minding services |
| | Shops, markets or grocery stores | e.g., food stores, convience stores, malls, electronic stores , stationary stores, pet shops, flower shops |
| | Leisure (recreation or entertainment) | e.g., restaurants, theatre and cinema, museums, restaurnats, beach |
| | Places for exercise, outdoor activities, or sports | e.g., physical fitness facilities, parks (in different scales), sports stadiums |
| | Community support , cultural or worship | e.g., governmental organization & social group, religious organizations, cultural facilities |
| | Other | (write in) |
| **EQUITY DIMENSION AND CATEGORIES** | Additional details | (write in) |
| **EQUITY STANDARDS** | | |
| Type (multiple choice + write in) | Min./max. travel distance | (write in) |
| | Min./max. travel time | |
| | Opportunity availability | |
| | Min./max benefit/cost ratio, Cost | |
| | Accessibility score maximum | |
| | Other | (write in) |
| How the type is mentioned | Explicit | Explicitly saied in the paper |
| | Implicit | Inferred based on context/content |
| Measure (multiple choice + write in) | Gini/Lorenz | (write in) |
| | De Palma index | |
| | Poverty measures (FGT or other) | |
| | Absolutes gap approach | |
| | Needs-based approach | |
| | Capability approach | |
| | Composite mobility index | |
| | Composite vulnerability index | |
| | Accessibility index | |
| | Level of service | |
| | Other | (write in) |
| **EQUITY STANDARDS** | Additional details | (write in) |
| **EQUITY CONCEPTUALIZTION** | | |
| Type (multiple choice + write in) | Utilitarian | Concerned with the aggregate distribution of transportation benefits/burdens (not individual). Net benefit is maximized and/or net burden is minimized (Pereira et al., 2017). |
| | Libertarianism | Distribution of transportation benefits/burdens as a result of free-market transactions (Pereira et al., 2017). |
| | Rawl's Egalitarianism – Different Principle | Interventions (i.e., infrastructure investments, subsidies, service provision) can only be considered fair if they improve the accessibility levels of the least advantaged groups (Pereira et al., 2017). |
| | Sufficientarism / Capabilities approach | Minimum and/or thresholds for interventions and/or outcomes related to key activities (accessibility/mobility, etc.) and quality of life/capability. (Pereira et al., 2017). |
| | Horizontal equity | Equal interventions for all groups; this means treating individuals equally in equal circumstances and opposing unjustifiable preferences of one individual or group over another. e.g., a planner would distribute transit burdens and benefits evenly throughout the community (Camporeale et al., 2019; van Wee, 2011). |
| | Vertical equity | Equal outcomes for all groups; this means groups with greater ability should contribute more to groups with less ability (i.e., considers existing social inequities and/or different mobility or accessibily). E.g., a planner would prioritize transit benefits and the reduction of burdens for socio-economic disadvantages groups and/or mobility/accessibility disadvantages groups (Camporeale et al., 2019; van Wee, 2011). |
| | Rights | Concerned with fundamental rights- i.e., right to the city/right to mobility/universal design principles |
| | Transport disadvantage | Interrelation between inadequate transport, dispersed services and/or lack residential location choices. The focus could be disadvantaged groups who experience these problems, or transport/urban form characteristics |
| | Transport poverty | An individual is transport poor if at least one of the following conditions apply:<br>• There is no transport option available that is suited to the individual's physical condition and capabilities (Mobility poverty)<br>• The existing transport options do not reach destinations where the individual can fulfil his/her daily activity needs, in order to maintain a reasonable quality of life. (Accessibility poverty)<br>• The necessary weekly amount spent on transport leaves the household with a residual income below the official poverty line. (Affordability)<br>• The individual needs to spend an excessive amount of time travelling, leading to time poverty or social isolation (Time poverty)<br>• The prevailing travel conditions are dangerous, unsafe or unhealthy for the individual (Exposure to externalities) |
| | Time poverty | Lucas et al (2016) transport-related definition: "The individual needs to spend an excessive amount of time travelling, leading to time poverty or social isolation". Could relate to income status but does not necessarily have to. |
| | Transport-related social exclusion | Kenyon et al. (2002) have defined transport related social exclusion as "the process by which people are prevented from participating in the economic, political and social life of the community because of reduced accessibility to opportunities, services and social networks, due in whole or in part to insufficient mobility in a society and environment built around the assumption of high mobility" |
| | Wellbeing/satisfaction | Focus on subjective wellbeing or user satisfaction |
| | Spatial or modal equity/equality | Focused on spatial differences in interventions, outcomes, and/or socio-demographic composition of transportation users. |
| | Community engagement and recognition - bottom-up transport planning | Focus on public participation and procedural justice as it concerns transportation planning. |
| | Restorative justice | Focus on repairing harm for those harmed in any transportation dimension |
| | Other | (write in) |
| How the type is mentioned | Explicit | The paper mentions the conceptualization by name |
| | Implicity | The concept is inferred |
| **EQUITY CONCEPTUALIZTION** | Additional details | (write in) |

**Figure 6**: The data extraction template with associated defintions.