

Impacts of the Built Environment on Transit Accessibility Among People with Disabilities

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Transportation has a direct impact on one's ability to participate in society as it determines individuals' access to employment, education, health care, and other social settings (Bezyak et al., 2017). Despite this evident importance, not all individuals have equal access to transportation, and the lack of adequate access to transportation has disproportionate impacts on certain groups, such as people with disabilities (Bezyak et al., 2017). According to recent findings from the 2022 Canadian Survey on Disability (CSD), 27% of Canadians aged 15 years and older, or eight million individuals, live with one or more disabilities that limit their capacity in their daily activities (Statistics Canada, 2023). Still, findings from the 2017 CSD showed that people with disabilities encounter various transportation-related barriers in different aspects of their daily lives (Statistics Canada, 2021). For example, approximately 18% of Canadians with disabilities aged 15 years and older considered themselves housebound because they lack access to specialized transportation (Statistics Canada, 2021). 'Specialized transportation,' or paratransit services, were introduced to provide on-demand transportation services for people who are unable to utilize conventional public transit independently (Bezyak et al., 2017). For example, HandyDART (Metro Vancouver), Wheel-Trans (City of Toronto), and Para Transpo (City of Ottawa) are only a few examples of such services operating in Canada (OC Transpo, n.d.; Toronto Transit Commission, n.d.; TransLink, n.d.). Although paratransit services are useful for filling in some of the accessibility gaps, their operational costs and limited availability prevent them from being an ultimate alternative to public transit services for people with disabilities (Grisé et al., 2019).

Further research in North America indicates that people with disabilities rely more heavily on public transportation than the general population, and a smaller proportion of working-age persons with disabilities have a driving license (60.5%) than others (91.7%)

(Bezyak et al., 2017; Henly & Brucker, 2019; Liu et al., 2023). However, due to accessibility concerns, people with disabilities tend to be more selective with their travel times and destinations, as their overall independence, wellbeing, and quality of life are disproportionately impacted by the inaccessibility of the transportation network (Liu et al., 2023; Sitter & Mitchell, 2020). These impacts are particularly pronounced among people with mobility disabilities (PwMD), as they encounter higher rates of barriers to public transportation compared to those with other disabilities (Bezyak et al., 2017). Accessibility of public transportation is, in part, determined by the accessibility of vehicles, but the impact of the local built environment on transportation barriers is as significant as vehicle accessibility and should not be overlooked (Henly & Brucker, 2019). Therefore, it is important to understand the extent to which the built environment impacts transit and paratransit accessibility among people with disabilities and ensure that this population group has access to adequate public transportation that is necessary for their full participation in communities.

Methodology

Databases searched include Academic Search Premier and Google Scholar. The search strategy comprised a combination of search terms that capture published journal articles on public transportation and people with disabilities in a geographical location applicable to the Metro Vancouver setting. Search terms used include public transportation, public transit, mass transit, people with disabilities, disabilities, impairment, Metro Vancouver, Canada, and North America. Further, backward and forward reference searching were utilized to find other articles that were not captured through database searching. The primary inclusion criteria involved: (1) studies published after 2015, (2) empirical studies, (3) studies conducted in North America, and (4) explicit reference to people with disabilities and public transportation and/or paratransit

services. After a brief review of titles and abstracts, the final inclusion criteria involved selecting studies with explicit or implicit reference to the built environment with the aim of having a combination of complementary study designs (quantitative and qualitative).

Research Summary

Accessibility of Public Transportation

There are various methods for quantifying the accessibility of public transportation in a region, one of which involves measuring the potential opportunities that individuals with and without disabilities can access within a given time frame (Grisé et al., 2019). Grisé et al (2019) utilized this methodology to evaluate the performance of public transportation systems in Montreal and Toronto. The study reveals stark disparities experienced by wheelchair users in terms of accessing jobs using public transportation compared to the general population. These disparities are further highlighted in a study by Liu et al (2023), where both accessibility and usage of fixed-route transit services were compared between people with and without mobility disabilities in Columbus, Ohio, USA. This study also found the disparities to be substantial, with accessible stops and areas being significantly less for PwMD.

Sidewalk Availability and Quality

One of the main aspects of the built environment that impacts the accessibility of public transportation is the structure of sidewalks and routes to stops/stations. Liu et al (2023) analyzed the impact of sidewalk infrastructure on accessibility and found that poor sidewalk quality compromises PwMD's transit accessibility, with these individuals being more prone to experience physical difficulties and injuries due to low sidewalk connectivity (missing sidewalks) and uneven surfaces. These findings are consistent with another study that aimed to assess ramp-related incidents experienced by wheelchair users who rely on transit bus ramps to

access public transportation across the US (Frost et al., 2020). In this study, Frost and colleagues found that aspects of the built environment contributed to the majority of ramp incidents. For example, when there is a surface elevation or depression because of sidewalk deterioration, the corner of the exterior ramp threshold will be off the ground, or when the sidewalks are not cleared of snow or ice, ramps cannot be deployed in a safe position (Frost et al., 2020). Similarly, in a study by Bezyk et al (2017), the inaccessibility of routes to stops/stations, along with inaccessible stops/stations themselves were highlighted by people with disabilities as the built environment barriers to public transportation across USA. Although sidewalks are not an explicit part of the public transportation system, the findings from all these studies suggested that sidewalk availability and quality have a substantial impact on individuals' ability to access public transportation, particularly among PwMD (Bezyak et al., 2017; Frost et al., 2020; Liu et al., 2023).

Paratransit Accessibility

While the studies discussed above focus on public transit, the accessibility of sidewalks and walkways is also relevant to paratransit accessibility. In a photovoice study, Sitter and Mitchell (2020) explore the paratransit experiences of people with disabilities in Eastern Canada. This study also identifies the physical environment, particularly the walkways, as a major barrier to paratransit accessibility during the winter. Participants of this study expressed that they cannot even access door-to-door paratransit services and they become isolated in their homes when the walkways and sidewalks are not clear and safe. Therefore, without snow-clearing services, access to any form of public or paratransit is deemed to be impossible for this population group (Sitter & Mitchell, 2020). To bring it all together, Henly and Brucker (2019) suggested that since working-age adults with a travel-limiting condition utilize a wide range of travel support devices

(such as canes, walkers, and manual wheelchairs), the entire travel chain must be accessible for the overall transit accessibility to be improved.

One major controversy in this field is related to the role of paratransit services. While some studies suggest that paratransit services were meant to temporarily provide transportation for people with disabilities until transit systems become more accessible (Bezyak et al., 2017), others suggest a complementary relationship between the conventional transport network and paratransit services (Liu et al., 2023). Differences also emerge among studies regarding the relative use of paratransit services; some indicate that many individuals use paratransit as their primary mode of transportation (Bezyak et al., 2017), while others argue that the reported paratransit use is low (Henly & Brucker, 2019). Such variations may stem from differences in the accessibility of public transportation systems across the regions where these measurements were conducted.

Transportation Improvements and Equitable Access

One question that remains unanswered is the extent to which improvements in the built environment can contribute to more *equitable* access to public transportation. In terms of the sidewalk infrastructure, Liu et al (2023) found that while more complete sidewalks benefit both people with and without mobility disabilities, people without disabilities will benefit more, which results in higher disparities. According to Liu and colleagues, this is because PwMD travel at lower speeds and shorter distances and cannot fully utilize a more complete sidewalk network, unlike people without disabilities. These findings suggest that the relationship between accessibility disparities and sidewalk networks is not linear, and PwMD can only benefit more than people without disabilities if sidewalk connectivity is significantly improved (Liu et al., 2023).

Critique

Strengths

The main strength of evidence in this area is the availability and utilization of different data sources, including administrative databases, survey data, and focus-group data, which allow for observing broader patterns, as well as individual-level experiences. Using administrative databases by Liu et al (2023), Grisé et al (2019), and Henly and Brucker (2019) allows for measuring the experiences of people with disabilities and performance of the system at the macro level while eliminating potential biases. Using cross-sectional study design, as observed in studies like Bezyak et al (2017) and Frost et al (2020), allows for designing surveys that can address specific research questions outlined by the research team, which also enables the researchers to study associations between multiple variables simultaneously. Using some form of a focus group with a small sample size, like the study conducted by Sitter and Mitchell (2020), facilitates strong connections within the group and with the research team, which can result in developing a deeper understanding of the perceptions and experiences of people with disabilities at an individual level.

Limitations

These study designs are not without limitations. In studies that use administrative databases, the heterogeneity within the population of people with disabilities in terms of their physical conditions and sociodemographic characteristics is not considered, and these studies are limited to reflecting the average trends (Liu et al., 2023). The cross-sectional surveys utilized by Bezyak et al (2017) and Frost et al (2020) were online and based on voluntary participation, which can affect the generalizability of results as there could be a self-selection bias towards those who have access to electronic means and might have higher socio-economic status. Also,

these studies only surveyed people with disabilities, so their results are insufficient to differentiate limitations inherent to public transit systems from challenges only faced by people with disabilities. The main limitation of the study by Sitter and Mitchell (2020) is the recall bias inherent to many photovoice studies as participants are not able to comment on their images for weeks after capturing them. Finally, one limitation of the datasets used in all these studies is their descriptive nature and inability to establish causal or predictive relationships.

Applicability to Metro Vancouver

As repeatedly noted in the literature, weather conditions, particularly snow and ice, impede the accessibility of individuals with disabilities to public transportation (Frost et al., 2020; Liu et al., 2023; Sitter & Mitchell, 2020). This is, at least in part, driven by how the built environment is maintained during winter. Across Metro Vancouver, residents of properties are responsible for removing snow and ice from their sidewalks within 24 hours (Brierley, 2017). This has two important implications: First, many residents do not clear their sidewalks, or only partially clear their sidewalks. As a result, the cleared path is not wide enough for mobility aids to pass through, which prevents people with disabilities from accessing public transportation (Brierley, 2017). This emphasizes the need for clearer regulatory mechanisms that ensure the maintenance of sidewalks that fall outside of cities' responsibility. Second, many people with disabilities are unable to clear their walkways/sidewalks or rely on others to do their snow clearing (Sitter & Mitchell, 2020). This not only prevents them from accessing public transportation but also from utilizing paratransit, which highlights the need for a snow-clearing program for people with disabilities in BC. While the province offers the 'Better at Home' program to support older adults with a range of non-medical home services, including snow

shovelling (Government of British Columbia, 2013), it leaves a gap for younger individuals with disabilities who are not eligible for this program.

In terms of the impact of sidewalk infrastructure on accessibility, sidewalk connectivity was highlighted as the most important factor in reducing disparities experienced by PwMD (Liu et al., 2023). While Vancouver ranks the highest among Metro Vancouver municipalities in terms of the completeness of the sidewalk network, the city is still missing 450 km of sidewalks (City of Vancouver, n.d.). This highlights the need for improving the sidewalk infrastructure, particularly sidewalk connectivity in Metro Vancouver to meet the needs of PwMD.

Finally, it is important to acknowledge the positive step taken by TransLink with their paratransit service, HandyDART, which contributes to enhancing transportation accessibility for people with disabilities (TransLink, n.d.). Existing literature suggests that providing accessible services within the conventional transit system is not only more beneficial for individuals but also more cost-effective for transit agencies (Grisé et al., 2019). Therefore, a viable recommendation would be for TransLink to work more closely with cities and people with disabilities to ensure that the entire public transit network, from door to door, is accessible for this particular population group.

Conclusion

While adequate access to transportation is essential for activities of daily living, it is evident that people with disabilities, particularly those with mobility disabilities, are disproportionately affected by the inaccessibility of transportation systems in North America. This inaccessibility is partly due to aspects of the built environment, such as the low connectivity and poor quality of sidewalks, which hinder individuals' ability to reach public transit stops and stations. Although paratransit services are designed to address some of these challenges, they are

viewed as complementary to the conventional public transit system rather than an alternative. In applying the existing evidence to the local context of Metro Vancouver, the primary recommendation is for stakeholders to work together closely to ensure that the entire public transit network is accessible and meets the transportation needs of this population.

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