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Evaluating public transportation through a caregivers' lens

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ABSTRACT

Caregivers, particularly those with young children, face unique challenges when using public transportation systems designed primarily for solo adult travelers. This study examines 14 U.S. transit systems across various modes, including rail, bus, and trolley, in diverse urban and regional settings. The research assesses policies, infrastructure, and environmental conditions, focusing on the specific needs of caregivers. Key findings highlight that transit stations often lack child-friendly design, making it difficult for caregivers to navigate busy or unsafe environments. Moreover, public transportation frequently fails to provide essential amenities, such as bathrooms and drinking water, which exacerbates challenges during delays or long wait times. Additionally, many transit systems inadequately support the use of assistive devices like strollers, complicating boarding and the management of children. The study calls for a reevaluation of transit design and policies to better accommodate caregivers, ultimately benefiting all passengers with similar needs, including seniors and people with disabilities.

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Introduction

Accessibility of transit networks is essential for creating navigable cities without reliance on automobiles. A robust and reliable public transportation system complements walkable infrastructure, ensuring seamless access within cities and regions at both micro and macro levels. However, like pedestrian spaces, transit networks often overlook the needs of populations beyond able-bodied adults (Unsworth *et al.* 2021). Yet, these groups – such as caregivers, seniors, and individuals with disabilities – are among the most reliant on public transportation for accessing urban and regional areas (Rosenbloom 2003, Clark 2004, Walker 2012a, Lid and Koren Solvang 2016).

Caregivers face unique challenges when using public transportation, as they must manage both their own travel needs and those of their dependents. Traveling with children <7 years old is particularly demanding, requiring physical, cognitive, and emotional support throughout the journey. The themes identified as findings in this study are unique to the caregivers who are managing or taking on these demands. Policies and infrastructure that focus primarily on able-bodied solo adults, without providing support for this demographic, makes essential tasks such as waiting, boarding, paying, and riding unnecessarily difficult.

Despite growing recognition of diverse travel needs, transit policies and infrastructure often assume

passengers are able-bodied individuals traveling independently. This assumption is evident in station design, boarding processes, and fare systems. For example, narrow turnstiles, steep steps, and limited space within vehicles create barriers for those managing strollers, bags, or multiple children (Rosenbloom 2003). These design choices can make public transit inaccessible for caregivers, particularly those traveling with infants or toddlers. Addressing these inequities is essential for mobility justice, ensuring that marginalized communities are equitably served through transit policy and infrastructure that integrates with walkable networks (Sheller 2018).

Designing public transit systems to meet the transportation needs of a diverse population is challenging but aligns with the principles of Universal Design, which seeks to enhance accessibility for all users (Bezyak *et al.* 2020, Heitplatz 2020, Lanteigne *et al.* 2022). Effective transit planning must accommodate a variety of travel needs, particularly those of caregivers traveling with young children. By considering this demographic, transit systems can improve conditions for all riders, reinforcing the Universal Design model (Steinfeld and Maisel 2012).

Addressing the experiences of caregivers when using public transit contributes to the broader discourse on mobility justice by including a population often overlooked. Addressing these issues within

a Universal Design framework would benefit not only caregivers but also seniors, people with disabilities, and other transit-dependent populations (Li 2022, Park *et al.* 2023). Improved public transportation would further support walkability scholars' efforts to integrate micro- and macro-mobility networks into a more inclusive vision of urban accessibility.

This study presents a representative analysis of U.S. public transportation systems based on first-hand researcher observations of 14 transit networks, spanning rail, bus, and trolley services in urban, suburban, and regional settings. The research follows the seven-step framework for transit trips outlined by Walker (2012b), systematically assessing user experience from trip planning to arrival to investigate three questions: (1) How accessible are public transit systems for caregivers traveling with young children? (2) What specific infrastructure, policy, and environmental barriers impact their mobility? (3) How can transit design and policies be modified to better support caregivers and enhance accessibility for all users? Additionally, the study examines policies regarding travel with young children, evaluates transit-supporting infrastructure, and considers environmental factors such as air quality. This approach provides a nuanced understanding of accessibility challenges and opportunities in public transportation systems, with a focus on caregivers and their dependents. Ultimately, three key themes emerged from this analysis.

Literature

Public transportation systems play a critical role in promoting urban mobility and equity, yet their design and policies have historically prioritized the needs of able-bodied, solo adult commuters, often overlooking marginalized populations such as seniors, people with disabilities, and caregivers traveling with young children (Lid and Koren Solvang 2016, Loukaitou-Sideris and Fink 2009, Sheller 2018). Universal Design principles offer a theoretical framework aimed at improving accessibility for all users, emphasizing environments that require no adaptation (Goldsmith 2000, Steinfeld and Maisel 2012). However, in practice, the application of Universal Design in public transportation has been uneven and frequently limited to compliance with disability legislation (Bezyak *et al.* 2020). Though new discussions of Universal Design highlight its role in emerging transport innovations, stressing the need to incorporate flexibility and inclusivity in rapidly changing mobility environments (Aarhaug 2023, Michopoulou *et al.* 2016), these

discussions have not yet sought to include the experiences of caregivers with young children particularly in public transit. This gap highlights the need for more inclusive and adaptable transit solutions regarding design of public services that go beyond compliance with disability laws to ensure broader accessibility.

Transit policies are increasingly expected to address the needs of diverse populations (Tirachini and Cats 2020). Walker (2012b) conceptualized a transit trip as seven steps: understanding the system, accessing the origin, waiting, paying, riding, connecting, and reaching the destination. While useful for modeling efficiency, this framework overlooks accessibility at each stage. Cardoso *et al.* (2021), drawing from Max-Neef (1992), proposed a human needs-based model focused on subsistence (basic bodily needs), protection (safety), and participation (engagement with the system). This study supports that framework, emphasizing human needs as key drivers of behavior and service quality. However, it challenges Cardoso *et al.* (2021)'s claim of universality, arguing that needs differ significantly across population subgroups.

Gendered mobility studies further reveal how caregiving responsibilities shape distinct travel patterns and create specific accessibility needs. Women, who are more likely to be primary caregivers, often engage in complex, multimodal trips involving trip chaining, off-peak travel, and accompaniment of dependents (Law 1999, Blumenberg 2004, Loukaitou-Sideris and Wachs 2018). Public transportation systems typically fail to account for these travel behaviors, offering limited physical space, inadequate stroller policies, and unsafe waiting environments (Fischer 1998, Loukaitou-Sideris and Fink 2009, Lubitow *et al.* 2017). For example, narrow walkways, steep steps, and poorly designed boarding areas, creates significant obstacles for caregivers, especially those using strollers or carrying multiple children. Despite growing recognition of gendered mobility needs, there remains a lack of empirical research specifically addressing the mobility experiences of caregivers with young children. This gap underscores the importance of integrating caregiving needs into transportation planning and policy, aligning with broader calls for mobility justice (Sheller 2018).

Around the turn of the century, medical scholars began examining the accessibility of travel with young children – primarily in air travel but also in land-based transit contexts. They found both significant accessibility obstacles and increased exposure to infectious diseases (Foster *et al.* 1997, Fischer 1998, Konop and Kamat 2001). Fischer and Konop, focusing on land travel, highlighted the lack of child-friendly facilities

such as changing stations, bathrooms, and accessible seating – barriers that made public transit particularly challenging for caregivers. Despite these early insights, the accessibility of land-based transit for this demographic remains deeply understudied. This study addresses that gap by exploring how current transit systems either support or hinder caregivers with young children. Reflecting on existing best practices in infrastructure and policy can help ensure that transit environments fulfill essential human needs – subsistence, protection, and participation – and provide a more inclusive experience for families.

There are many reasons why a transit agency may struggle to meet the needs of all demographics (Malekzadeh and Chung 2020). For example, infrastructure built before contemporary expectations for accessibility may not reflect these aspirations. Older infrastructure may have also lacked technology and techniques supporting accessibility developed after its construction (Yannis and Chaziris 2022, Makkonen and Inkinen 2024). Funding for improvements is often lacking, particularly as transit agencies aim to operate with low fees for their ridership. Additionally, the typical climate of an area may drive challenges for transit design, such as frequent snowfall, extreme heat, flooding (Dzyuban *et al.* 2022, Ahmed *et al.* 2016). Finally, transit agencies seeking to make improvements with limited resources must balance the broad range of accessibility needs across their ridership – choosing between different aspects of accessibility like system accessibility and access to more destinations Dzyuban *et al.* 2022).

Studies have identified practices that transit agencies could implement to improve accessibility for caregivers. Loukaitou-Sideris and Fink (2009) suggest designing transit stops with designated child-friendly areas and clear safety measures, while Malekzadeh and Chung (2020) review transit accessibility models and propose integrating caregiver needs into these frameworks to make them more comprehensive. The San Francisco Salesforce Station, explored in this study, serves as a model reflective of this approach due to its child-friendly design, showcasing how public-private partnerships can lead to enhanced transit environments that align with Universal Design principles.

Mobility justice scholarship underscores the need to prioritize equity and inclusivity in transportation planning. Despite a growing body of literature advocating for mobility justice and inclusive transit design, significant gaps remain in addressing the specific needs of caregivers traveling with young children. Most studies have focused on broader categories

such as people with disabilities, seniors, or low-income individuals (Jamal and Bruce Newbold 2020, Li 2020, 2022, Cardoso *et al.* 2021), with limited attention to caregivers as a distinct group with unique mobility challenges. Existing accessibility models often fail to reflect the complex realities of caregiving trips, including the need for flexible and safe spaces for waiting, boarding, and navigating transit systems. This study seeks to fill that gap by examining how transit infrastructure and policy can better support caregivers with young children, while also offering broader insights into the implementation of universal design principles across diverse transit contexts.

Methodology

This study employed a multi-method approach to evaluate the accessibility of U.S. public transit systems for caregivers traveling with young children. The research focused on assessing how transit infrastructure, policies, and environmental conditions either support or hinder mobility for this demographic.

Case selection

Fourteen public transit systems were selected across the United States, representing a diversity of geographic locations, urban scales, and transit modes. These systems include major metropolitan networks (e.g. New York City's MTA, Boston's MBTA), regional commuter lines (e.g. Amtrak Northeast Regional), and smaller-scale systems serving suburban or rural areas (e.g. AppalCart in Boone, NC). Selection was based on proximity and logistical feasibility, with an effort to capture a range of operating conditions. Routes within each agency were intentionally chosen to reflect different transit modes and urban contexts. The U.S. was chosen as the case study due to its varied transit landscape and the absence of prior studies specifically addressing caregivers' transit experiences within this context. While the study focused primarily on U.S. cities, one Canadian system (Toronto) was included for comparative context.

This research examined a diverse range of services across 14 transit agencies, selected to represent different regions, jurisdiction sizes, and transit types (Table 1). The goal was to assess how the infrastructure and policies of these systems either support or marginalize riders traveling with young children. A research team specializing in Planning and Urban Studies collected qualitative data for each route, complemented by quantitative air quality analysis. Additionally, three interviews with transit agency

Table 1. Transit systems studied, with specific routes indicated.

Transit System	Modes Assessed:	City (Region)/Routes
SEPTA	Rail, Trolley	Philadelphia (5, 11, 15, Market-Frankfort, Broad St, Norristown, Media-Elwyn)
AMTRAK	Rail	Northeast Regional (New York City to D.C., Portland ME to Boston) Texas Eagle (San Marcos to Benson)
VIA	Bus	San Antonio (14, 8, 88, 5, 51, 82, 100, 30, 90, 17, Airport Express)
Sunway	Bus	North Carolina (Boone to Charlotte)
Appalcart	Bus	Boone, NC (Red, POP 105, Green, Night Owl)
MTA	Rail	New York City (A,B,5)
Vista Transit	Bus, BRT	Sierra Vista, AZ (Pink, Blue, Gray)
MetroLinx	Rail	Toronto, Canada Union Pearson Express (Pearson to Union)
MVTA	Rail, Bus	Minneapolis (Blue, Green, 54)
Metro	Rail, Bus	Seattle (8, 2, 124)
MTS	Trolley, Rail	San Diego (Green, 30, 43)
SFMTA	Trolley, Rail, Bus	San Francisco (N, F, 15, 12, 30, 8, 45, T, 55, 15)
MBTA	Bus, Rail, Trolley	Boston (Orange, Red, Blue Mattapan)
RIPTA	Bus	Providence (57)

directors were conducted to provide context and deepen understanding of the qualitative findings.

The transit modes studied in this research include rail (20), trolley (7), and bus services (25). Within the rail category, systems comprised light rail, regional rail, and subway lines. However, it was often difficult to draw clear distinctions between these subcategories, as individual lines frequently encompassed multiple characteristics. For example, SEPTA's Media-Elwyn Line transitions from a subway in Center City Philadelphia to light rail and eventually to regional rail as it moves outward into Delaware County. Many rail lines studied similarly transition including the Toronto Union-Pearson Express and Amtrak. Bus trips include some BRT and express routes as noted.

Data collection

An interdisciplinary Planning and Urban Studies research team carried out fieldwork across various regions of the United States and Toronto, Canada. They conducted over 400 unique trips along 55 routes between September 2022 and July 2024, with all routes traveled at least twice to ensure consistency, with most systems observed for about a week. The most

frequently studied systems – SEPTA, VIA, and AppalCART – were observed daily over several weeks and during different months to capture a wider range of conditions and user experiences.

Researchers conducted first-hand, participatory observations to assess the factors outlined in Table 2. To strengthen the participatory design, researchers traveled with children under age seven on 76.5% of routes, providing firsthand insight into the challenges caregivers face. This approach added depth to the qualitative data, allowing researchers to document experiences that might otherwise go unnoticed in more traditional forms of observation.

Within the selected case cities, there was limited functional or infrastructural distinction between rail and bus systems. In many cases, rail lines run within the cartway and follow routes similar to those of bus lines, sometimes even sharing stops. A single rail line may include both above-grade and below-grade segments, often shifting to a subway format in dense downtown areas. Moreover, both bus and rail services generally operate on comparable schedules and face similar challenges in terms of reliability and service frequency.

For each of these transit modes, researchers assessed the quality of access with respect to traveling

Table 2. Aspects of policy and infrastructure considered.

Infrastructure:	
Ticketing	Ex: Ticket infrastructure accommodates purchasing multiple tickets/passes
Stops/Stations	Ex: Seating available that allows for multiple individuals to sit together
Boarding	Ex: Ability to use assistive technology (strollers, etc.) to board
Seating	Ex: Seating is designed for small children to sit on their parents lap or be secured
Storage	Ex: Space available for storage of assistive technology (strollers, etc.)
Safety	Ex: Design, location of stops/stations, cleanliness and repair, etc.
Policies:	
Fares	Ex: children ride free or discounted
Use of Assistive Technology	Ex: strollers, carseats etc. are considered assistive devices and able to be used for boarding or riding
Seating	Ex: children are allowed to sit on parents lap or with parents
Noise	Ex: spaces available that are not "silent ride"
Frequency	Ex: length of time between transit service
Reliability	Ex: rides are on time, etc.

with young children. The specific elements evaluated are outlined in Table 2. Each trip was analyzed for both positive and negative aspects related to these criteria, ensuring a consistent and comprehensive evaluation of the rider experience across different systems and service types.

Researchers closely monitored the travel experiences as they related to the items described in Table 2. They observed all transit stops along the route studied, noting how aspects of infrastructure design and policy shaped the travel experience for caregivers and young children. They assessed safety perceptions based on location (lighting, street classification, etc.), informing the human needs satisfaction approach to evaluating transit accessibility.

Additionally, researchers took photographs of transit system infrastructure (stops, signage, seating, etc.), vehicles, and surrounding conditions

whenever it felt safe to do so while travelling. This allowed documentation of transit system experiences and later discussion among the research team regarding the positive and negative aspects for the population of interest.

For each metric (Table 2), the researcher(s) considered the following questions (Figure 1):

- (1) How accessible are public transit systems for caregivers traveling with young children?
 - a. Does the design of this aspect (ticketing, stops, boarding, etc.) allow caregivers to travel with ease (positive design) or
 - b. Does the design of this aspect (ticketing, stops, boarding, etc.) inconvenience or create barriers to travel for this population (negative design)?

If positive, then:

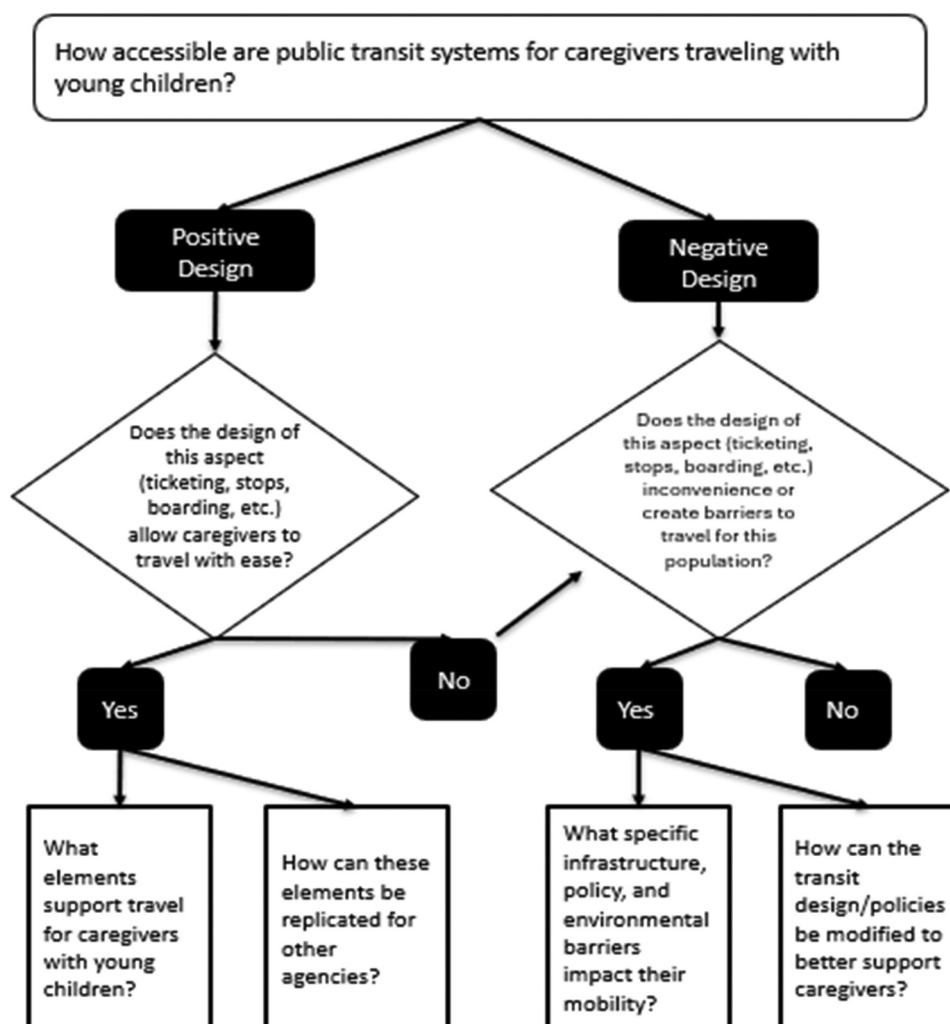


Figure 1. Framework for transit asset analysis (2025. Credit: Author).

- (2a) What elements support travel for caregivers with young children? and
- (3b) How can these elements be replicated for other agencies?

If negative, then:

- (2b) What specific infrastructure, policy, and environmental barriers impact their mobility? and,
- (3b) How can the transit design/policies be modified to better support caregivers?

Across stops, stations, routes, and systems these aspects demonstrated both positive and negative aspects. Responses to these questions varied even among similar locations or routes by trip. Researchers often found each location or route provided some negative and some positive characteristics.

Air quality testing

Environmental conditions were further evaluated through microclimate analysis. Researchers used Temtop M2000 hand-held air quality monitors to collect readings of PM2.5, PM10, CO2, NO2, temperature, and humidity at transit stops. This method enabled nuanced understanding of microclimates, nothing changes within a few feet. Thus, the understanding of the experiences of these travelers included assessment of the air quality, and its subsequent impacts on health-related conditions impacting caregivers and children while waiting at transit stop locations along the routes surveyed.

Interviews with transit agencies

To complement field observations, informal interviews were conducted with transit directors in three cities: San Antonio, TX; Boone, NC; and Sierra Vista, AZ. The interviews followed observation of their respective transit systems, discussing the findings and operational considerations. The inclusion of both field observations and professional insights allowed for a more comprehensive understanding of how transit systems accommodate or exclude families traveling with young children.

Limitations

The complexities of researching the intersections of caregiver needs, accessible design, and transit generates several limitations. Most prominent of these is the difficulty to quantify information at this intersection.

Assessing the quality of design and services for a specific subgroup of the population is inherently subjective. Further, the changing qualities of transit services each day and across space reinforces the challenge of quantifying the quality of those services. Even factors like cleanliness and reliability varied along single routes or from trip to trip. Assessing the quality of a sub-group's experience while travelling is also a subjective measure that will vary by person and trip. Thus, quantifying by routes, trips, stations, or agencies is not feasible because the elements studied changed dynamically across each individual observation. Additionally, the selection of the cases studied (while robustly representative) was limited by the ability of researchers to access the service areas. Therefore case selection was largely limited to particular localities across the United States for predetermined lengths of time.

Findings

The analysis identified three primary themes related to the accessibility of public transportation infrastructure and policies for caregivers with young children: (1) physical ability, (2) safety and environmental conditions, and (3) provision for basic human needs. Each theme revealed notable barriers as well as occasional examples of best practices. The study found that the design of public transit infrastructure and policies can negatively impact the health, safety, and welfare of this specific subpopulation, highlighting the potential harm caused by systems not adequately considering the needs of these caregivers.

Physical ability

The study found that caregivers often need above-average physical ability to navigate the public transportation systems studied. Physical accessibility was a critical factor, particularly in how transit policies and infrastructure either supported or hindered the use of assistive devices like strollers. These limitations affected caregivers' ability to wait, board, and disembark safely and efficiently, especially while managing both their mobility, the care of young children, and any baggage (Figure 2). This creates a particularly burdensome experience for those with limited physical capacity, including individuals recovering postpartum, for whom these demands can be impractical or unsafe.

Most systems did not adequately account for the needs of passengers traveling with children. As a result, even those with typical mobility faced challenges when handling strollers, bags, and children.



Figure 2. A father traveling with an infant and preschooler folds a stroller in preparation for boarding outside a daycare (Boone (NC), 2025. Credit: Author).

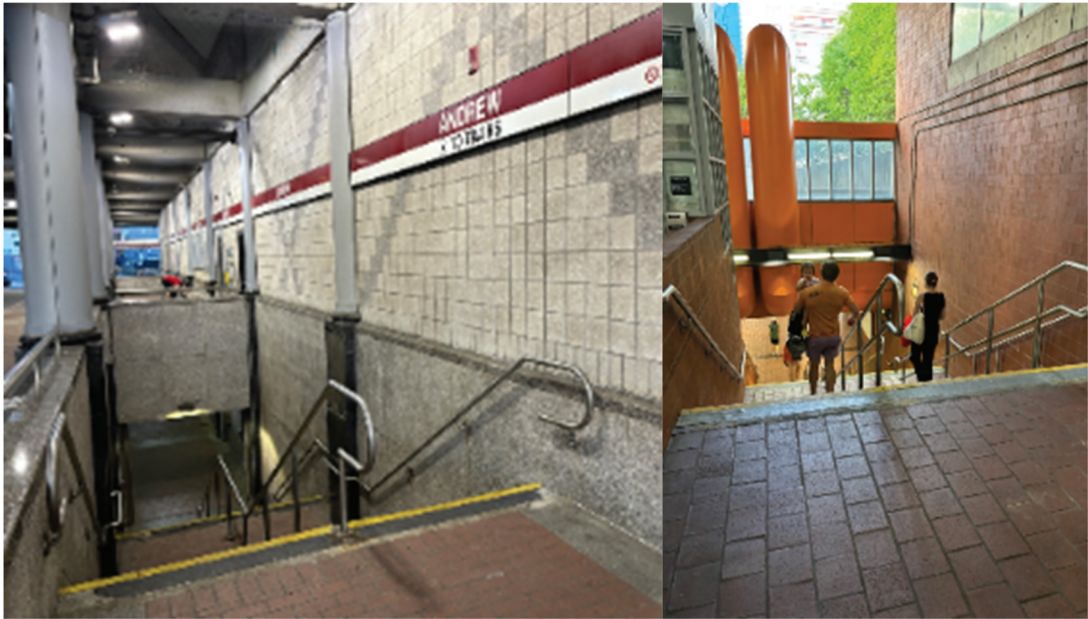


Figure 3. Stairs to access transit platf-orms, without elevator alternatives (Boston (MA), 2024. Credit: Author).

This demand for physical exertion was especially pronounced in cities with older transit systems – such as Philadelphia, Boston, and San Diego – where platform access often required climbing stairs (Figure 3).

Ramps and elevators were generally limited to major stations, central urban areas, and rail lines, and when available, elevators were frequently out of service or unsanitary.

Access to assistive technology significantly influenced physical accessibility. In 10 of the 14 transit systems, strollers were restricted or prohibited, forcing caregivers to carry children and belongings while boarding, disembarking, or using stairs. Unlike wheelchair users, who may receive staff assistance via ramps or other accommodations, caregivers with children typically received no such support.

All three transit directors discussed the difficulty of updating infrastructure to better accommodate mobility challenges of ridership. Fares and grant funding is sufficient to maintain status-quo services with occasional upgrades, but significant changes require more funding than allowed (Antos 2007). They also expressed concern about the logistical challenges of pausing service to completely renovate stations. Regarding stroller limitation policies, one director expressed concern about allowing strollers on buses since they are in the process of switching to smaller buses that do not require commercial licensure as a response to staffing challenges.

Safety and environmental conditions

Safety emerged as an inconsistent and often inadequate feature across the transit systems and stops examined. While some settings implemented effective measures, many posed substantial risks – particularly for caregivers traveling with young children. Notably, safety concerns were more acute at stations and stops than during transit itself, highlighting the importance of secure, sanitary, and navigable waiting environments (Lubitow *et al.* 2017). Caregivers often had to manage these risks while simultaneously attending to one or more children.

Sanitation and station infrastructure were among the most pressing issues. In at least seven transit systems, human excrement was observed within stations; used hypodermic needles were present in two. Elevators – essential for those unable to use stairs with children and equipment – were frequently in disrepair or repurposed as makeshift toilets, often lacking routine cleaning. Trash and debris were common, with few stops providing trash receptacles, particularly outside major hubs. These unsanitary conditions pose significant risks for young children, who are likely to touch contaminated surfaces or debris. Moreover, policies prohibiting strollers, intended to manage space and efficiency, often forced caregivers to remove children from protective enclosures, increasing their exposure to unsafe and unhygienic environments.

Physical layout and infrastructure further compromised safety. Stand-alone stops along busy corridors, particularly for bus and rail, often lacked protective barriers or sufficient distance from traffic. Seating, when present, was frequently placed dangerously close to roadways. Many stops, especially those along bus routes, consisted only of signage without sidewalks, seating, or buffers, increasing the risk of children wandering into traffic and exposure to pollutants such as particulate matter and nitrogen dioxide (Figure 4). Transit directors shared the challenges of situating stops on major corridors when so many newer commercial areas are built without pedestrian infrastructure. Limited Right-of-Way and the need to partner with private landowners adds to the difficulty of developing safe stops locations.

Wayfinding and signage added to these challenges. Fonts were often too small to be legible from a distance, and route information was unclear or incomplete. For caregivers managing children, strollers, and bags, navigating poor signage heightened stress and risk.

Shelter varied greatly from stop to stop without regard for agency, transit type, street classification, or consistency along routes. Even major stops, such as one of only two Amtrak stops in Arizona (Figure 5) lacked substantial shelter infrastructure. Shelters



Figure 4. Bus stop for primary route with limited seating in unsafe proximity to major corridor (San Antonio (TX), 2024. Credit: Author).



Figure 5. Stop infrastructure for one of two Arizona Amtrak stops (Benson (AZ), 2024. Credit: Author).

provided varied from none at all (6a), traditional D-type shelters (6b), custom designed shelters highlighting landmarks (6c), and buildings (6d). Sometimes, roofs of shelters were mesh or other porous material (4b) (Figure 6). Other stops relied on existing structures for shelter, such as shopping malls or grocery stores. One transit director described recent partnerships with nonprofits or businesses to ‘sponsor’ a stop by building a custom shelter highlighting their enterprises. Adequate shelter protects travelers from both sun and precipitation, and lacking this critical amenity when exposed to either is very detrimental.

Lighting was another significant concern. While some routes ran through well-lit commercial areas, many stops – especially those servicing rail – were in dim or unlit zones behind businesses or in residential areas. Bus stops, often marked only by signs, were the least equipped. Poor lighting elevated risks of injury, crime, and general unease, particularly for those traveling after dark. In one case, an Amtrak station expected to receive a train at 7:30 p.m. experienced delays until after 10:30 p.m., leaving travelers – including caregivers – in an unlit, unsheltered area with no staff or facilities. Across all U.S. case sites, transit

infrastructure often served as overnight shelter for unhoused individuals, which sometimes escalated safety concerns and prompted law enforcement involvement.

Air quality testing revealed broad ranges of all metrics assessed. Readings varied by stop location, time of day, day of reading, and even season of the year. However, there was some consistency for increased air pollution (CO₂ and total particulate matter) for stops located along busy roads particularly with less setbacks.

Three times, the air quality monitor issued a warning for poor air quality during testing for a particular stop. These stops were the corner of S. St. Mary’s St. and S. Alamo in San Antonio, located just outside an auto repair facility; the stop at San Diego Children’s Park located nearby an industrialized area; and the corner of Pearl St. and Bunker Hill St. just south of the industrial harbor of Boston. These outliers presented with distinctly poor air quality different from surrounding areas, and their similarities regarding land use suggest that surrounding environmental conditions formed by land uses may play a role in air quality exposure of riders while waiting at stops.

These findings underscore the essential role transit agencies play in ensuring clean, well-lit, and secure environments at all stops. Achieving this will require targeted investment in underserved and historically marginalized communities, where infrastructure is frequently insufficient. For caregivers with young children, such improvements are not enhancements – they are prerequisites for equitable, accessible transit.

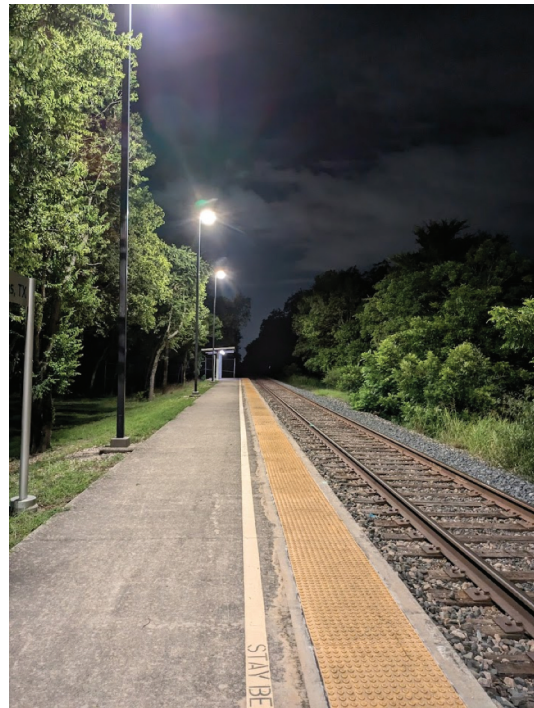
Basic human needs and amenities

Across transit systems, the study found that access to basic human needs – such as food, water, restrooms, and adequate seating – was frequently insufficient, particularly outside of major hubs. These gaps directly impacted the comfort, health, and well-being of caregivers and their children, for whom access to these amenities is not a convenience but a necessity.

Transit travel requires caregivers to plan around a variety of essential needs, including food, water, and hygiene supplies such as diapers/wipes. This burden is intensified by the unpredictability of transit systems. Many caregivers use transit for commuting, often traveling with limited supplies, and extended trip times due to transfers, wait times, and walking distances exacerbate these challenges. Service disruptions can leave caregivers without access to necessities like water, restrooms, or additional supplies for longer



(a; Providence, RI)



(b; San Marcos, TX)



(c; Minneapolis, MN)



(d; Sierra Vista, AZ)

Figure 6. Shelter types at transit stops, ((a) Providence, RI; (b) San Marcos, TX; (c) Minneapolis, MN; (d) Sierra Vista, AZ. Credit: Author).

than expected, complicating the travel experience for families (Pereira 2019).

Current infrastructure and policies largely fail to address these specialized needs. For instance, during the observation period, Amtrak services experienced multiple delays ranging from two to eight hours.

Stations and trains lacked essential items such as formula, breast milk storage, clean water, or replacement diapers, leaving caregivers without options during extended waits. Facilities were neither equipped to provide these items nor to accommodate emergency needs.

Restroom availability was notably inadequate. In local transit systems, public restrooms were entirely unavailable or limited to central stations. Changing tables were confined to major hubs. Notably, 12 of the 14 transit systems explicitly prohibited diaper changes on vehicles. Amtrak trains lacked changing tables entirely, though this may change with the proposed ‘Baby Changing on Board Act’. This limits the ability to attend to diapered infants or potty-training toddlers during travel. For families in transit, particularly those facing wait times exceeding an hour from either the need to transfer, infrequent service, or a service delay, these shortcomings could create highly stressful or unmanageable situations.

Other basic amenities such as drinking fountains, sinks, and seating were also inadequate. Even major stations lacked drinking fountains. Available seating was often sparse or poorly maintained, and design choices – such as anti-homeless infrastructure – reflected design for solo able-bodied adults (Figure 2). Seating at stops and on vehicles was not conducive to breastfeeding, despite the frequent and time-sensitive nature of this need.

The spatial placement of transit stops further complicated access to basic needs. Rail stations in particular were often located behind commercial corridors or in isolated areas, limiting proximity to nearby services such as cafes, convenience stores, or public restrooms. This poor integration with surrounding amenities made it difficult for caregivers to manage delays or long wait times, especially in systems with infrequent service.

These findings underscore how the lack of provisions for basic human needs – particularly outside major transit hubs – poses significant barriers for caregivers. Transit systems often prioritize the needs of solo adult travelers and are designed under the assumption that riders will use the service for short, point-to-point trips with access to amenities at either end. However, this assumption fails to align with the lived experiences of many transit users, particularly caregivers traveling with young children. Field observations revealed that what might appear to be a short local trip often required between two to four hours of one-way travel. This extended duration included walking to and from transit stops, waiting for service, frequent in-vehicle stops, transfers between lines, and navigating pedestrian infrastructure to reach the final destination. For caregivers managing children, strollers, and supplies, these long, unpredictable trips amplify the urgency of access to food, water, restrooms, and seating throughout the journey – not just at origin and destination points. As such, transit infrastructure and policy must evolve to reflect these

conditions, prioritizing the needs of families and vulnerable travelers to create more equitable, inclusive, and realistic public transportation systems.

Compounding policies

Researchers observed that transit policies often perpetuate challenges for certain ridership demographics, particularly when enforced by operators and drivers in ways that further isolate these groups. One illustrative example involved a parent with a child in an umbrella stroller – presumably boarding after picking up the child from a nearby preschool – who did not speak English. Unaware of the policy requiring children to be removed from strollers before boarding, and unable to communicate with a driver who did not speak Spanish, the parent became involved in an escalating altercation. Other passengers attempted to translate, but tensions rose due to limited space: the bus had only one designated stroller storage area, which was already occupied. Although other items such as shopping carts, walkers, and wheelchairs were being stored alongside other passengers’ seats, the driver insisted that additional strollers could not be accommodated elsewhere. The parent, visibly frustrated and needing to return to work, was eventually assisted when another caregiver chose to leave the bus early to free up stroller space. Such instances were not isolated. Across the 14 transit systems studied, caregivers frequently expressed frustration when faced with policies that posed challenges related to physical ability, safety, and basic human needs.

Ticketing policies in public transit often overlooked the needs of travelers with young children. In a review of 14 transit agencies, 9 did not require tickets for child passengers, while the remaining five required tickets for all riders, regardless of age, even when free. Age limits for free child fares varied widely, ranging from 10 to 17 years. Notably, two agencies operated fare-free systems for all riders supported by grants and local funding. The increasing reliance on mobile apps and ridership cards complicated access as two platforms allowed only one ticket per device, with each ticket tied to a unique device identifier, excluding children without mobile devices and forcing caregivers to use kiosks that were not always available or functional. These challenges underscore how software design choices can unintentionally exclude users and highlight the need for digital systems that follow Universal Design principles to ensure broader accessibility.

Positive examples of infrastructure and policies

While the study identified numerous challenges for caregivers travelling with young children, several examples demonstrated promising practices that effectively support this demographic. These examples illustrate how thoughtful infrastructure design, integration with community amenities, and inclusive policies can significantly improve accessibility for caregivers, and other groups with similar needs by extension.

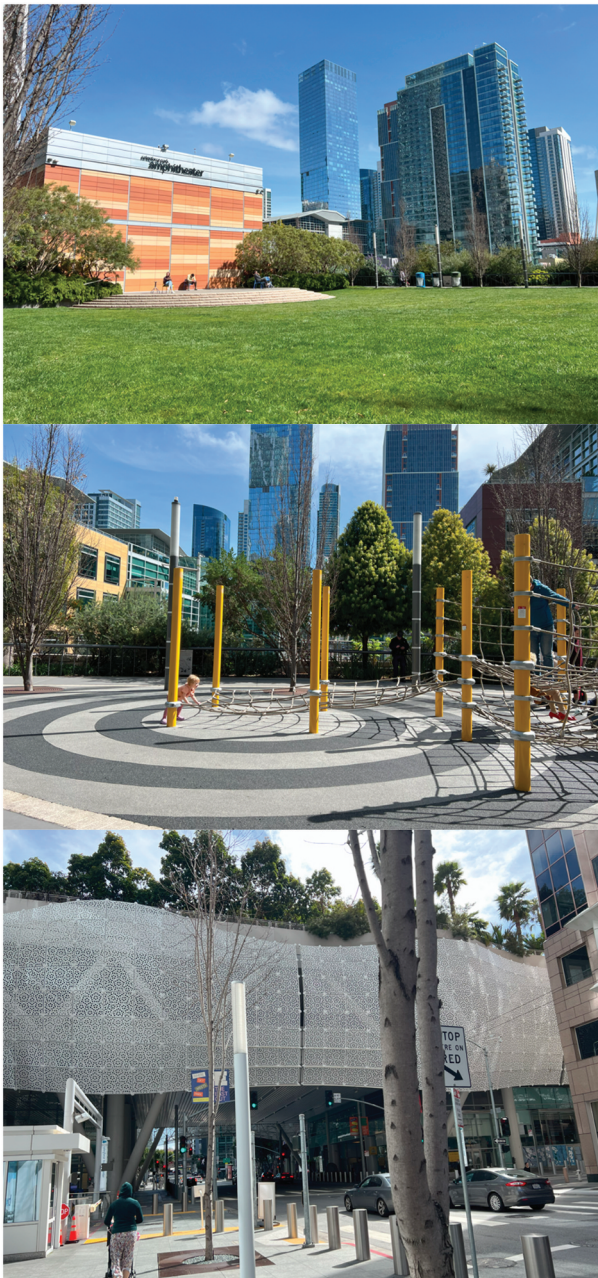


Figure 7. Newly constructed Salesforce transit station with many important amenities for caregivers at midday (San Francisco (CA), 2024. Credit: Author).

Among all sites observed, San Francisco's Salesforce Transit Center (Figure 7) emerged as a standout example of best practices. Developed as a public-private partnership, the station illustrates how collaborative models can produce high-quality public infrastructure. The elevated transit center includes two fully accessible restrooms, drinking fountains, a playground, walking trail, and lawn space. It is accessible via four elevators from street level and, as of March 2024, was soliciting food vendors through a request for proposals process. The facility comprehensively supports the three central themes identified in this study – physical ability, safety and environmental conditions, and basic human needs – in one unified space. Additionally, the elevation of the platform and incorporation of greenery significantly improved air quality. For example, particulate matter readings showed levels of 5,232 PM_{10} and 3,785 $PM_{2.5}$ at street level, compared to only 11 PM_{10} and 26 $PM_{2.5}$ on the platform.

This highly accessible transit station with significant amenities was possible because of the partnership between surrounding businesses who wished to support their employee base and public support enabling flexibility in development procedures. This example highlights the importance of collaboration among stakeholders to achieve success. Municipalities may struggle to identify land and financing for projects of this scale. Meanwhile, private companies may struggle to combat zoning or design regulations that restrict innovative development. Public-private partnerships can balance these hurdles to achieve success.

While large-scale amenities like the Salesforce Transit Center may not be feasible at every transit location, smaller interventions also demonstrated meaningful impacts. Enhanced bus stops – featuring shaded areas, seating, setbacks from traffic, and trash collection – helped mitigate common challenges for caregivers waiting for delayed or infrequent service (see Figure 8). These design features also support broader rider comfort, particularly in adverse weather conditions such as heat, rain, or snow (Miao *et al.* 2018).

The location of transit stops also plays a critical role in improving accessibility. In San Diego (Figure 9), for instance, the Green Line runs in proximity to public playgrounds with nearby restroom facilities. These adjacent amenities offer a functional waiting area for caregivers between trips. While some drawbacks were noted – including poor air quality in the playground area and limited access to restrooms (available only through secure, monitored entry) – this arrangement nonetheless provided a safer and more accommodating alternative than waiting on the platform itself.



Figure 8. Transit stops with shading, seating, protected shelters setback from the road, and trash service (San Antonio (TX); San Francisco (CA), 2022-2024. Credit: Author).



Figure 9. Park with an accessible bathroom, a short walk away from rail transit. Bathroom is accessible with permission from guards behind bullet-proof glass (San Diego (CA), 2024. Credit: Author).

Minneapolis offers another compelling example through the integration of its transit system with existing urban infrastructure. In the downtown area, the Skyway system allows riders to move between routes while accessing a range of amenities (e.g. food, restrooms, seating) in a comfortable, walkable environment. Although the transit stops themselves offer minimal infrastructure, their strategic placement within reach of indoor pedestrian networks helps fulfill basic human needs for families in transit.

Fare policy also proved to be an area with generally inclusive practices. Most systems allow young children to ride free with an accompanying adult, usually without a ticket for the child. Systems that did not require

smartphone purchases for young children were especially supportive.

These positive examples and policies demonstrate the potential for transit systems to meaningfully enhance accessibility and inclusion for caregivers with young children. While large-scale interventions provide inspiration, even modest infrastructure adjustments, policy refinements, and thoughtful placement of stops can substantially improve the rider experience for this often-overlooked demographic.

Discussion

Being a caregiver presents unique challenges for using public transportation. Caregivers are responsible not only for their own journeys but also for facilitating the trips of their children, which requires physical, cognitive, and sometimes emotional support. Many transit systems, however, are structured to support solo travel, assuming that passengers are able-bodied adults responsible only for themselves. This oversight in design and policy creates barriers for caregivers traveling with young children, as transit spaces are not adequately designed to accommodate their needs when waiting, boarding, paying, and riding.

In examining the accessibility of public transportation for caregivers with young children, three major themes emerged: physical ability, safety and environmental conditions, and the provision of basic human needs.

- (1) **Physical Ability:** The ability of caregivers to navigate public transportation with children is heavily influenced by whether the system supports or hinders the use of assistive devices, such as strollers. Many transit systems either

prohibit strollers or provide inadequate space for them, complicating the process of boarding, unloading, and managing children and their supplies. This lack of accommodation can force caregivers to carry children, bags, and other items, leading to physical strain and increased risk of accidents.

- (2) **Safety and environmental hazards:** While the safety of the transit ride itself is often considered, the safety of transit stations and stops is a greater concern for caregivers. Stations may lack appropriate child-friendly features, such as secure waiting areas, ramps, or elevators, making it difficult for caregivers to manage children in busy or hazardous environments. Sanitation is a particular concern for this demographic who are less likely than other demographics to avoid unsanitary conditions. The design of these spaces frequently overlooks the need for clear sightlines, sufficient lighting, and secure areas where children can wait safely while caregivers manage tickets or navigate crowds. Proximity to either rail lines or auto traffic is a major safety concern with stops or stations having limited setbacks between designated waiting areas and hazards. In addition to physical hazards, environmental exposures such as extreme heat, lack of shelter at stops, and high concentrations of particulate matter and vehicle emissions further compromised the safety of these spaces. Caregivers cannot simply avoid these environments, and their need to manage children while navigating physical and environmental hazards significantly compounds the burden of transit use.
- (3) **Basic Human Needs:** Caregiving inherently involves planning for basic human needs, such as feeding, changing diapers, and managing children's comfort. Public transportation systems often fail to account for these needs, with long wait times, unreliable service, and a lack of access to essential amenities like bathrooms and drinking water exacerbating the challenges faced by caregivers. When transit services are delayed, provide infrequent service, or when connections are missed, caregivers can find themselves stranded without the necessary supplies, leading to stressful and potentially unsafe situations for both the caregiver and the children.

These three themes of specific challenges for caregivers with young children are exacerbated by service

frequency and reliability. That is, how quickly caregivers can expect to complete their trip and the predictability of those trips for planning purposes.

Addressing these challenges requires a comprehensive reevaluation of public transportation systems to ensure they accommodate the needs of caregivers and their children. This involves not only redesigning physical spaces and policies to be more inclusive but also recognizing the diverse needs of all passengers, particularly those who provide care to others. Improving transit accessibility will improve pedestrian mobility justice across a diverse set of needs.

Existing literature on universal design, mobility justice, and transit accessibility rarely mentions the experiences of travel with young children. However, the findings in this study illustrated that this demographic faces similar challenges regarding physical mobility, safety, and human needs as other demographics advocated for in these sub-fields. While the experiences and solutions are sometimes unique, shared characteristics among this demographic as those identified among disabled, women, and senior populations broadens the discussions regarding mobility justice, transit accessibility, and universal design.

Methods for improving transit accessibility to overcome the challenges found in this study include implementing some of the best practices found among the case examples. First, prioritizing safe and accessible stop placement, avoiding unlit or isolated locations. Second, ensuring access to basic human needs that will require attention during trips. For larger stations, it may be practical to provide spaces for feeding and changing diapers on-site. For smaller stops, it may be difficult. Therefore, consideration of stop placement in better proximity to existing community amenities – such as in Minneapolis or San Diego – would help support ridership. Overall, this requires considering the experiences of caregivers with young children waiting for 20-40 minutes (or longer for regional transit) at stop/stations, particularly in combination with duration of trip length. This includes assessment of potential hazards and supporting potential needs.

Third, allowing strollers on board, treating them as essential assistive device and extending boarding time is perhaps one of the most important changes that could be made across systems for this demographic. While ADA requires wheelchair accessibility for passengers with disabilities, this does not extend to caregivers traveling with young children. Many caregivers may have limited mobility themselves (being postpartum, seniors, or having other physical challenges) and may struggle with the

burden of carrying children, supplies, strollers, and their own belongings through their transit experience. Policies prohibiting use of strollers to board and dismounting while riding ultimately generate more challenges for this group. Treating strollers as assistive technology devices, similar to wheelchairs, would allow caregivers to keep young children safe while waiting, boarding, and riding. This is especially important if traveling with multiple children. Additionally, needing to disassemble assistive devices when boarding and riding limits the supplies caregivers can carry with them on rides.

Conclusion

This study highlights the accessibility challenge with the U.S. public transit system for caregivers traveling with children under 7. Despite the important role public transit plays in supporting mobility, many transit systems remain designed primarily for single, able-bodied adult travelers, neglecting the needs of caregivers who manage mobility of both themselves and dependents. Our analysis across 14 transit agencies reveals three major themes affecting accessibility: physical ability, safety and environmental conditions, and the provisions for basic human needs.

Overall, the findings highlight both the structural inequities and practical challenges caregivers face when using public transportation with young children. While several systems demonstrated promising practices, the majority of infrastructure and policies do not adequately consider this population's specific needs. Addressing these gaps will require coordinated efforts across planning, policy, and design to ensure that transit systems are truly inclusive, accessible, and family-friendly.

Caregivers frequently encounter physical barriers, such as inadequate accommodations for strollers, limited accessibility features like elevators and ramps, and unsafe environments at transit stops. Additionally, the lack of essential amenities, such as bathrooms and drinking water, further complicates the transit experience for caregivers, especially during delays or long wait times. These findings emphasize that transit policies and infrastructure often fail to account for the needs of this demographic.

By addressing these barriers, transit agencies can enhance not only the accessibility for caregivers but also improve the overall inclusivity and functionality of transit systems for other vulnerable groups, including seniors and individuals with disabilities. Embracing Universal Design principles, which aim to create environments accessible to all, is a critical step

in achieving mobility justice and making public transportation a viable and equitable option for all users. Future efforts should focus on policy reforms and infrastructure improvements that prioritize the unique needs of caregivers, fostering a more supportive and inclusive public transit system.

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