

# Assessing the Unmet Transportation Needs of Americans with Disabilities

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## EXECUTIVE SUMMARY<sup>1</sup>

Americans with disabilities are currently underserved by transportation options. Autonomous Vehicles (“AVs”) have the potential to significantly improve the mobility of Americans with disabilities by partially or fully automating the driving process. However, these improvements are only possible if automobile manufacturers consider people with disabilities and others with travel-limiting conditions when constructing these vehicles and include universal accessibility principles in their designs. For future ride sharing fleets, especially, accessible autonomous vehicles are crucial to providing consistent supply to travel-limited passengers.

The current travel-limited population of the U.S. constitutes a large and growing market, however, no automobile manufacturers currently mass-produce an accessible vehicle for this market. As a result, many people with disabilities are required to pay for expensive aftermarket modifications in order to own a private vehicle, or otherwise be dependent on under-developed public transportation options which are funded by taxpayers. Many transportation-as-a-service (“TaaS”) providers do not yet provide widespread availability of accessible vehicles for hire, although this is beginning to change. Manufacturers, public transit agencies, and ridesharing services should each consider their obligations to enhance service to these consumers.

The introduction of AVs provides an opportunity to improve the mobility of Americans reliant on wheelchairs, scooters, and other mobility devices. AVs also set the stage to expand independence for other underserved groups such as those with visual or intellectual and developmental disabilities. In this white paper, we estimate the total population of individuals in the U.S. with travel-limiting disabilities as well as two sub-groups: those using any type of wheelchair and those specifically using a motorized wheelchair. We also demonstrate that these populations are underserved by current accessible transportation options.

We find that:

- The travel-limited, wheelchair-using, and motorized wheelchair-using populations that currently reside in a vehicle-owning household are 11.2 to 15.4 million, 3.6 to 5.0 million, and 0.9 to 1.3 million, respectively. These individuals may purchase accessible vehicles if they were available directly from manufacturers, as this would likely reduce the price of such vehicles.
- Since the growth of ridesharing may reduce private vehicle ownership in the future, the large population of travel-limited Americans suggests that TaaS providers could grow services to this market. In particular, we find that the transit needs of the travel-limited population could support a ridesharing fleet of over 2 million accessible vehicles.
- The travel-limited, wheelchair-using, and motorized wheelchair-using populations currently travel less than the non-travel-limited population even when accounting for vehicle ownership, employment status, age, and household income. This suggests that a lack of accessible transportation options for these groups is suppressing travel.
- The number of wheelchair users grew by over 50% between 2010 and 2014. If such trends continue, wheelchair users in the U.S. could number over 12 million within five years, with more than 3 million motorized wheelchair users among them.

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<sup>1</sup> The authors would like to thank the following groups for their assistance in gathering the data presented in this report: the We Will Ride Coalition, United Spinal Association, San Francisco Municipal Transportation Agency, Uber Technologies, Inc., and New York City Taxi & Limousine Commission.

## **I. Background on the Transit Issues Facing Americans with Disabilities**

The Americans with Disabilities Act (“ADA”), passed in 1990, has improved accessibility and provided greater opportunities for those living with a disability. However, significant transportation gaps still exist for individuals with a disability in the U.S. A number of factors drive these gaps, including the cost associated with aftermarket conversions of standard-production vehicles to render them fully accessible,<sup>2</sup> the ability of individuals with certain disabilities to obtain a driver’s license, the limited availability of accessible taxis and rideshare services, and the extensive time and planning required for a traveler with a disability to utilize current paratransit options.

Autonomous Vehicles (“AVs”) have the potential to create extensive changes in how individuals in the U.S. travel. AVs also have the potential to significantly alter traditional automobile manufacturers’ business models as they transition from selling vehicles to individual consumers towards selling and maintaining fleets of vehicles for rideshare operators and transit firms. In particular, AVs have the ability to allow individuals with a disability access to private transportation that has until now been too costly or impractical to use.

This study estimates the current unmet needs for transportation among individuals with a disability in the U.S. To do so, we first estimate the current travel-limited, wheelchair-using, and motorized wheelchair populations and then adjust for those who would have the means to purchase a vehicle or pay for a ridesharing service.<sup>3</sup> We use U.S. Department of Transportation (“DOT”) data to analyze the travel patterns of these populations, compared to those that are not travel-limited, to measure the difference in trips that is attributable to disability. We then assess the current supply of accessible transit services to demonstrate that this current supply is insufficient to satisfy current demand.<sup>4</sup> In doing so, we estimate the size of a ridesharing fleet capable of satisfying the transit needs of all U.S. residents with travel limitations.

## **II. Estimating the Travel-Limited and Wheelchair-Using U.S. Populations**

There are a large number of individuals in the U.S. who are travel-limited. Specifically, we estimate that there are 18.5 million travel-limited individuals in the U.S., of which 5.7 million are wheelchair-using, and, of those, 1.4 million use a motorized wheelchair.

To arrive at these estimates, we analyzed U.S. Census data, which provide estimates of the number of individuals in the U.S. with disabilities from 2010 and 2014, and then adjusted for both population increases

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<sup>2</sup> See <https://www.aeromobility.com/convert-your-vehicle-in-anaheim-ca>; <https://mobilityexpress.com/blog/how-much-does-a-wheelchair-van-conversion-cost/>.

<sup>3</sup> We define “motorized wheelchair-using” as those identified as using an electric or motorized wheelchair as identified by the Department of Transportation. We define “wheelchair using” to those identified by the U.S. Census and the Department of Transportation are regularly using a wheelchair or motorized wheelchair. We define “travel limited” as the wheelchair-using population as well as those with the following disabilities: blindness or vision restrictions, cerebral palsy, epilepsy, paralysis, and those who used a cane/crutches/walker for more than six months (as identified by the U.S. Census). We use the terms “TaaS,” “ridesharing,” and “transportation network company” interchangeably in this report to refer to app-based transportation options such as Uber and Lyft.

<sup>4</sup> Throughout this report, we use current vehicle ownership as a proxy for future vehicle ownership and the use of TaaS providers. While we do not forecast the growth of ridesharing relative to private ownership, we assume that both services meet the same basic transportation need.

and for changes in the share of individuals with disabilities, using data from the American Community Survey (“ACS”).<sup>5</sup> We discuss our methodology for each of these estimates in more detail below.

### **a. Estimation of the Travel-Limited Population**

In 2010, the travel-limited U.S. population was 17.3 million.<sup>6</sup> Using U.S. Census yearly population estimates, we assume that the travel-limited population has increased at a similar rate since 2010 as the U.S. population overall.<sup>7</sup> To account for any potential changes in the travel-limited population not associated with general population increases, we use data from the ACS that show the proportion of the U.S. population with a disability has increased by 0.8% since 2010.<sup>8</sup> Using these estimates, we arrive at the current travel-limited population of 18.5 million.

In estimating a potential market for accessible vehicles, it is important to note that not all of the travel-limited population would be of age to purchase or regularly use a vehicle, have the means of purchasing a vehicle, or be interested in using a ride sharing service. We therefore adjust the travel-limited population estimate. In particular, using ACS data on the age distribution of Americans with disabilities, we find that 93% are over the age of 18.<sup>9</sup> To adjust for economic means, we use vehicle ownership rates from the 2017 National Household Travel Survey (“NHTS”) and income data from the U.S. Census specific to the disability population. Using these adjustments, we estimate the range of the travel-limited population that has the means of purchasing private vehicles or using a ride sharing service to be between 11.2 to 15.4 million.

### **b. Estimation of the Wheelchair-Using Population**

In 2014, the wheelchair-using U.S. population was 5.5 million.<sup>10</sup> Using U.S. Census yearly population estimates, we assume that the wheelchair-using population has increased at a similar rate since 2014 as the U.S. population overall.<sup>11</sup> To account for any potential changes in the wheelchair-using population not associated with general population increases, we apply data from the ACS that shows the proportion of the U.S. population with an ambulatory disability has increased by 0.3% since 2014.<sup>12</sup> Using these estimates, we arrive at the current wheelchair-using population of 5.7 million.

To determine the number of wheelchair-using individuals who are likely to purchase a vehicle or use ridesharing, we adjust our wheelchair-using population estimate. In particular, using ACS data on the age

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<sup>5</sup> U.S. Census Bureau (2012), “Americans with Disabilities: 2010”; U.S. Census Bureau (2018), “Americans with Disabilities: 2014”; U.S. Census Bureau (2010), “American Community Survey”; U.S. Census Bureau (2017), “American Community Survey.”

<sup>6</sup> U.S. Census Bureau (2012), “Americans with Disabilities: 2010”; U.S. Census Bureau (2010), Survey of Income and Program Participation, 2008 Panel, Wave 6 Topical Module.

<sup>7</sup> Please note this is a conservative rate. From the 2010 and 2014 Americans with Disabilities reports, we have seen the wheelchair-using population grow at a higher rate. From 2010 through 2018 the U.S. population increased by 6.07%.

<sup>8</sup> U.S. Census Bureau (2010), “American Community Survey”; U.S. Census Bureau (2017), “American Community Survey.”

<sup>9</sup> U.S. Census Bureau (2017), “American Community Survey.” Since travel-limitedness can encompass different types of disabilities (ambulatory, vision, etc.), we use this as the best estimate for the age ranges of the travel-limited population.

<sup>10</sup> U.S. Census Bureau (2018), “Americans with Disabilities: 2014.”

<sup>11</sup> From 2014-2018, the U.S. population increased by 2.98%.

<sup>12</sup> U.S. Census Bureau (2014), “American Community Survey”; U.S. Census Bureau (2017), “American Community Survey.”

breakdown of Americans with disabilities, we find that 98% of Americans with an ambulatory disability are over the age of 18.<sup>13</sup> To adjust for economic means, we use vehicle ownership rates from the 2017 NHTS and income data from the U.S. Census specific to the disability population. Using these adjustments, we estimate the range of the wheelchair-using population that has the means of purchasing private vehicles or using a ride sharing service to be between 3.6 and 5.0 million.

### **c. Estimation of the Motorized Wheelchair-Using Population**

To focus specifically on the motorized wheelchair population, we first use the most recent estimates for the general wheelchair-using population; in 2014, the U.S. wheelchair-using population was 5.5 million.<sup>14</sup> Relying on data from the 2017 NHTS, we estimate that motorized wheelchairs comprise approximately 26% of the greater wheelchair-using population.<sup>15</sup> These values allow us to estimate the motorized wheelchair population in 2014 to be 1.4 million. Using U.S. Census yearly population estimates, we assume that the motorized wheelchair-using population has increased at a similar rate since 2014 as the U.S. population overall.<sup>16</sup> To account for any potential changes in the wheelchair-using population not associated with general population increases, we apply data from the ACS that shows the proportion of the U.S. population with an ambulatory disability has increased by 0.3% since 2014.<sup>17</sup> Using these estimates, we arrive at the current motorized wheelchair-using population of 1.5 million.

To determine the number of motorized wheelchair-using individuals who are likely to purchase a vehicle or use ridesharing, we adjust our motorized wheelchair-using population estimate. In particular, using ACS data on the age breakdown of Americans with disabilities, we find that 98% of Americans with an ambulatory disability are over the age of 18.<sup>18</sup> To adjust for economic means, we use vehicle ownership rates from the 2017 NHTS and income data from the U.S. Census specific to the disability population. Applying these adjustments, we estimate the range of the motorized wheelchair-using population that has the means of purchasing private vehicles or using a rideshare service to be between 0.9 and 1.3 million.

## **III. Projections of Growth in the Disability Population**

While we use a conservative estimate for the growth of the wheelchair-using population based on broader population growth, it is notable that the U.S. Census estimate for the wheelchair-using population increased by 50.4%, from 3.6 million to 5.5 million, between 2010 and 2014.<sup>19</sup> Equivalent to an annual growth rate of 10.75%, this increase is especially notable given that the U.S. population grew at an annual rate of only 0.74% during that same period. If we apply these growth rates to the 2014 estimate in order to project the wheelchair-using population in 2022, the wheelchair-using population could reach up to 12.4 million. Similar growth rates in the motorized wheelchair-using population would suggest a group of 3.2 million people by 2022.

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<sup>13</sup> U.S. Census Bureau (2017), “American Community Survey.”

<sup>14</sup> U.S. Census Bureau (2018), “Americans with Disabilities: 2014.”

<sup>15</sup> U.S. Department of Transportation (2018), “2017 National Household Travel Survey.”

<sup>16</sup> From 2014-2018 the U.S. population increased by 2.98%.

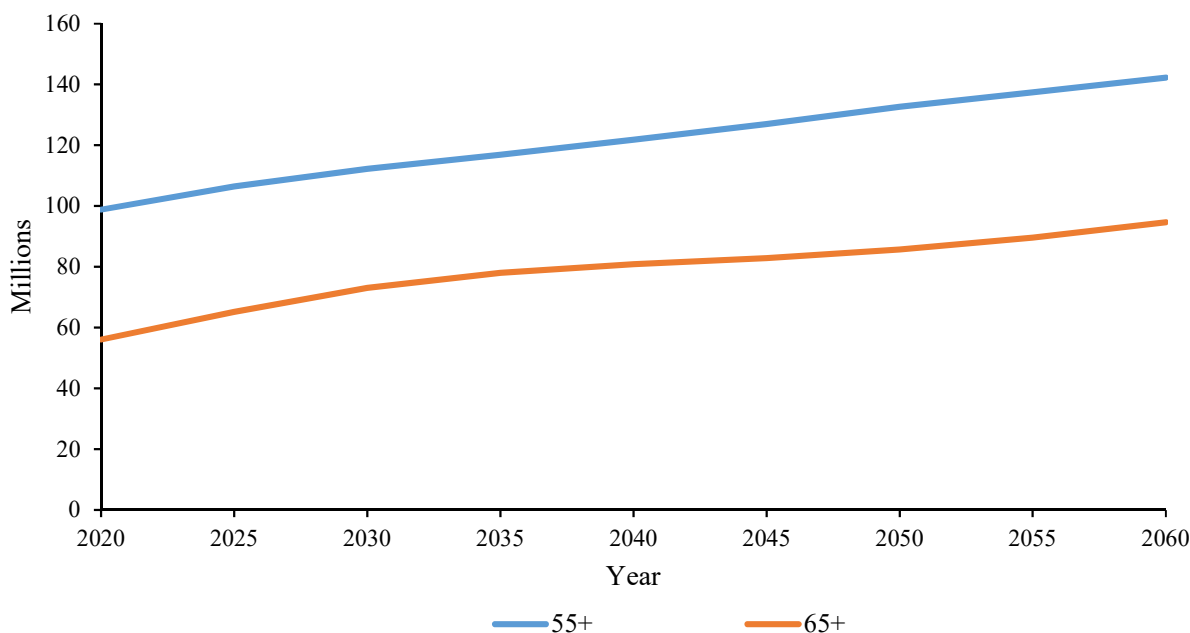
<sup>17</sup> U.S. Census Bureau (2014), “American Community Survey”; U.S. Census Bureau (2017), “American Community Survey.”

<sup>18</sup> U.S. Census Bureau (2017), “American Community Survey.”

<sup>19</sup> U.S. Census Bureau (2012), “Americans With Disabilities: 2010.” U.S. Census Bureau (2018), “Americans With Disabilities: 2014.”

We also highlight that many individuals with functional limitations to their physical movement may not self-identify as “disabled,” but would also benefit from more accessible transportation. There is likely to be continuing growth in this group of individuals due to the aging of the country. Specifically, by 2030, the U.S. Census Bureau estimates that there will be an additional 21.5 million Americans over the age of 55.<sup>20</sup> Currently, those over the age of 55 comprise 28% of the U.S. population, while those over 65 make up 15%. However, it is estimated these groups will account for 32% and 21%, respectively, by 2030.<sup>21</sup> Additionally, the Census Bureau estimates that in 2035 there will be more people in the U.S. aged 65 and over than children under the age of 18.<sup>22</sup> **Figure 1** shows the projected population increase for those 55 years and older and 65 years and older from 2016 to 2060.

**Figure 1**  
**U.S. Population Projections for 55+ and 65+ Age Groups**  
**2020 to 2060**



Source: U.S. Census Bureau (2017), "2017 National Population Projections Tables."

Resources available to the elderly population include both public and private sources. While we focus on public spending, it is useful to note that collectively, Baby Boomers account for nearly half of the invested assets in the U.S., some fraction of which will be available for meeting transportation needs.<sup>23</sup> As the elderly population increases, mandatory government spending on Medicare will also increase (beneficiaries can qualify for Medicare at the age of 65). A majority of the growth in the Congressional Budget Office’s (“CBO”) projections for Medicare is due to the aging of the baby boomer population (those born between 1946 and 1964) coupled with the rise in life expectancy.<sup>24</sup> In 2018, Medicare spending accounted for 3.5%

<sup>20</sup> U.S. Census Bureau (2017), “2017 National Population Projections Tables.”

<sup>21</sup> U.S. Census Bureau (2017), “2017 National Population Projections Tables.”

<sup>22</sup> Vespa, Jonathan (2018), “The U.S. Joins Other Countries with Large Aging Populations,” *U.S. Census Bureau*.

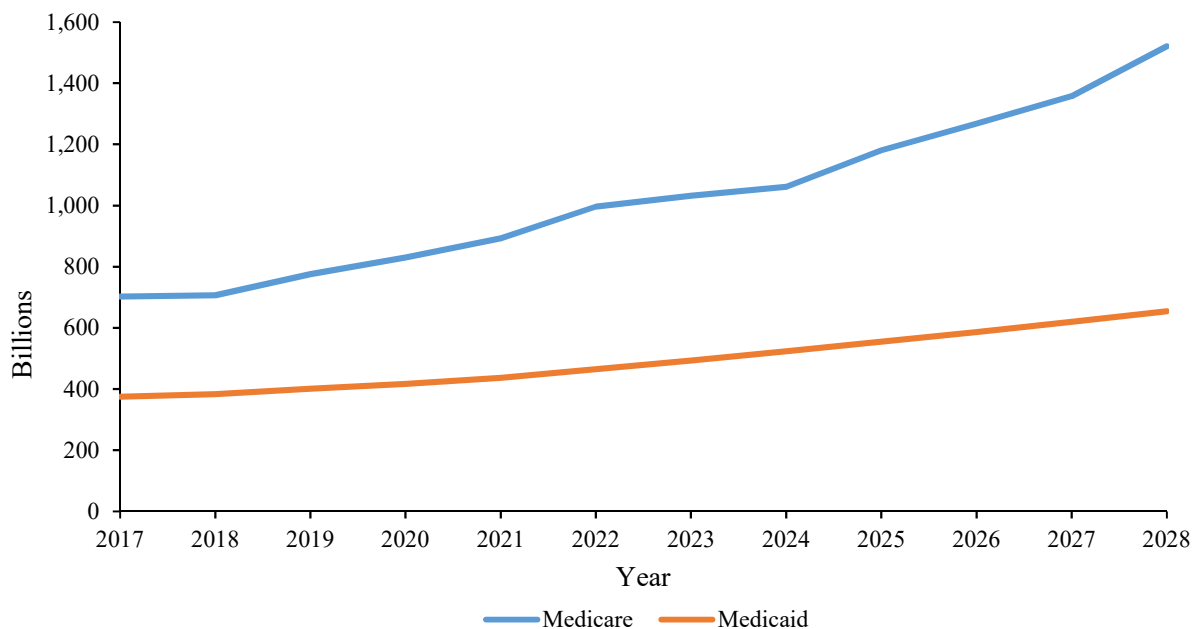
<sup>23</sup> See <https://insight.equifax.com/baby-boomer-wallets-high-average-assets-household/>.

<sup>24</sup> Congressional Budget Office (2018), “The 2018 Long-Term Budget Outlook,” p. 2-3.

of U.S. GDP.<sup>25</sup> As a share of GDP, Medicare spending is projected to grow significantly over the coming decades, reaching 6.8% of GDP by the 2040s.<sup>26</sup>

**Figure 2** shows the increase in mandatory spending projected by the CBO for Medicare and other healthcare programs.<sup>27</sup> Some studies have highlighted the substantial spending made by Medicare towards transportation stemming from the needs of the travel-limited population for healthcare appointments. For example, the Government Accountability Office (“GAO”) estimated that Nonemergency Medical Transport, largely used by travel-limited populations, totaled \$2.7 billion in 2013 across both Medicare and Medicaid.<sup>28</sup> As the size of this population increases, such demand will also rise and contribute to greater taxpayer-funded healthcare spending.

**Figure 2**  
**Mandatory Spending Projected in the CBO’s Baseline for the Medicare Program**  
**2017 to 2028**



Source: Congressional Budget Office (2018), "The Budget and Economic Outlook: 2018 to 2028."

#### IV. The Disparity of Transit Use

In this section, we review the available data on transportation use by individuals in the U.S. as a function of their disability status, household income, age, employment status, and whether or not they live in a

<sup>25</sup> Congressional Budget Office (2018), "The 2018 Long-Term Budget Outlook," p. 2.

<sup>26</sup> Congressional Budget Office (2018), "The 2018 Long-Term Budget Outlook," p. 2.

<sup>27</sup> It is notable that a number of benefits exist from the federal government, particularly the Department of Veterans Affairs (VA), to help subsidize the cost of accessible vehicles for private ownership and these benefits would be likely to apply to mass-produced accessible vehicles as well which would further support demand. In the case of military veterans, many with substantial service injuries are eligible for grants of up to \$21,000 towards the purchase of such vehicles. Department of Veterans Affairs, "Automobile Allowance Benefit." [https://www.benefits.va.gov/compensation/special\\_Benefit\\_Allowances\\_2018.asp](https://www.benefits.va.gov/compensation/special_Benefit_Allowances_2018.asp).

<sup>28</sup> U.S. Government Accountability Office, "Nonemergency Medical Transportation." February 2016. Available at: <https://www.gao.gov/assets/680/674934.pdf>.



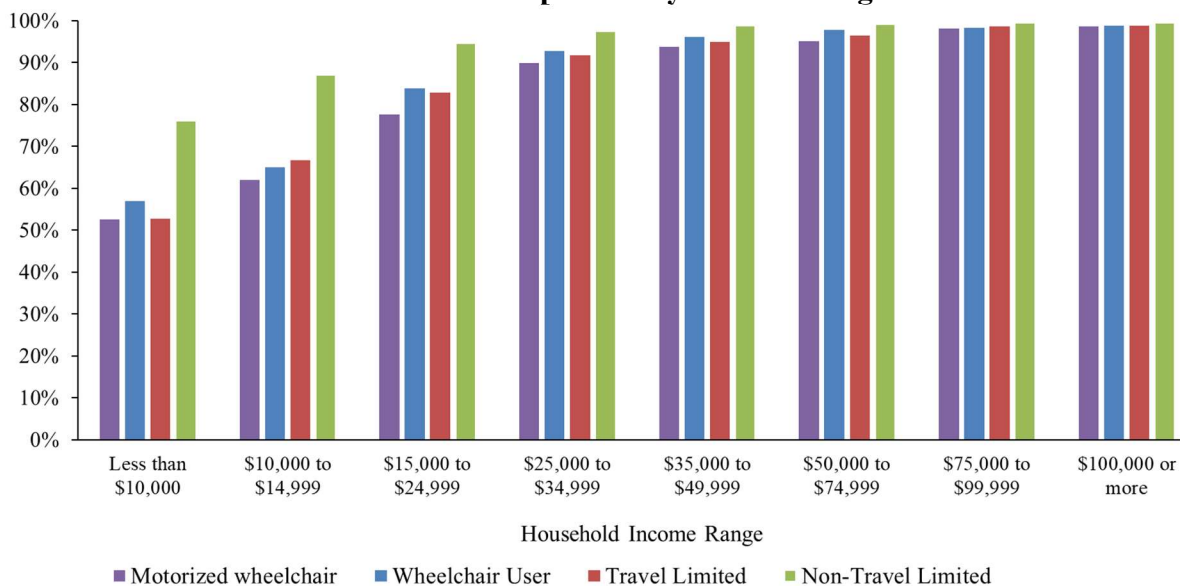
household that owns a private vehicle. We find that across all subgroups, those with travel-limiting disabilities travel less than their peers. However, wider availability of accessible vehicles from all industry participants (manufacturers, ridesharing firms, and public transit authorities) could help to bridge this gap and provide services more broadly.

To undertake this analysis, we rely on data from the 2017 NHTS, which provides detailed travel data from a random sample of 129,696 households and 264,234 individuals across 50 U.S. states and Washington D.C.<sup>29</sup> The NHTS provides household, personal, and vehicle characteristics along with detailed trip information for each respondent over the age of five during a “typical” day.<sup>30</sup> We use these data to analyze the socio-economic and travel frequency differences between the wheelchair-using and the travel-limited population compared to the non-travel limited population. These data illustrate that transportation use by individuals with disabilities is not a factor of more advanced age, lower rates of employment, lower incomes, or lack of vehicle ownership.

### a. Transit Patterns

**Figure 3** shows vehicle ownership rates for the motorized wheelchair-using, wheelchair-using, travel-limited, and non-travel-limited populations across various income ranges.<sup>31</sup> In all income groups, vehicle ownership rates are higher for non-travel-limited populations compared to all other groups studied. In fact, compared to the non-travel limited population, the wheelchair-using and the travel-limited populations are six times more likely to live in zero vehicle households and the motorized wheelchair-using population is eight times more likely. This underscores the need for ridesharing services and paratransit services to be affordable, convenient, and accessible in order to help alleviate the disparities seen in private ownership.

**Figure 3**  
**Vehicle Ownership Rates by Income Range**



Source: U.S. Department of Transportation, “National Household Travel Survey,” 2017.

<sup>29</sup> U.S. Department of Transportation (2018), “2017 NHTS Data User Guide.”

<sup>30</sup> U.S. Department of Transportation (2018), “2017 NHTS Data User Guide.”

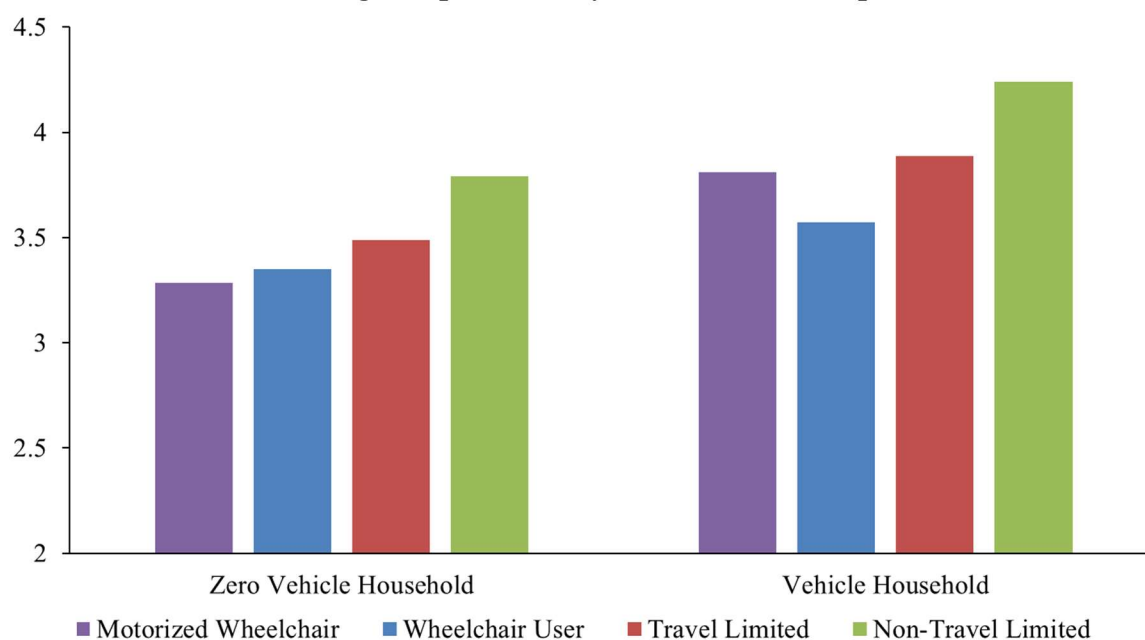
<sup>31</sup> The data do not indicate if the vehicle is accessible to wheelchair-users, but if accessible vehicles were available at comparable cost to other mass-market vehicles, we feel it reasonable to propose that many of these homes would own accessible vehicles that accommodate all family members.



The differences in vehicle ownership generally decrease as household earnings increase. For example, households earning more than \$35,000 per year have nearly 100% vehicle ownership rates regardless of disability status. Vehicle ownership rates among the motorized wheelchair-using, wheelchair-using, and travel-limited populations are relatively similar across all income groups.

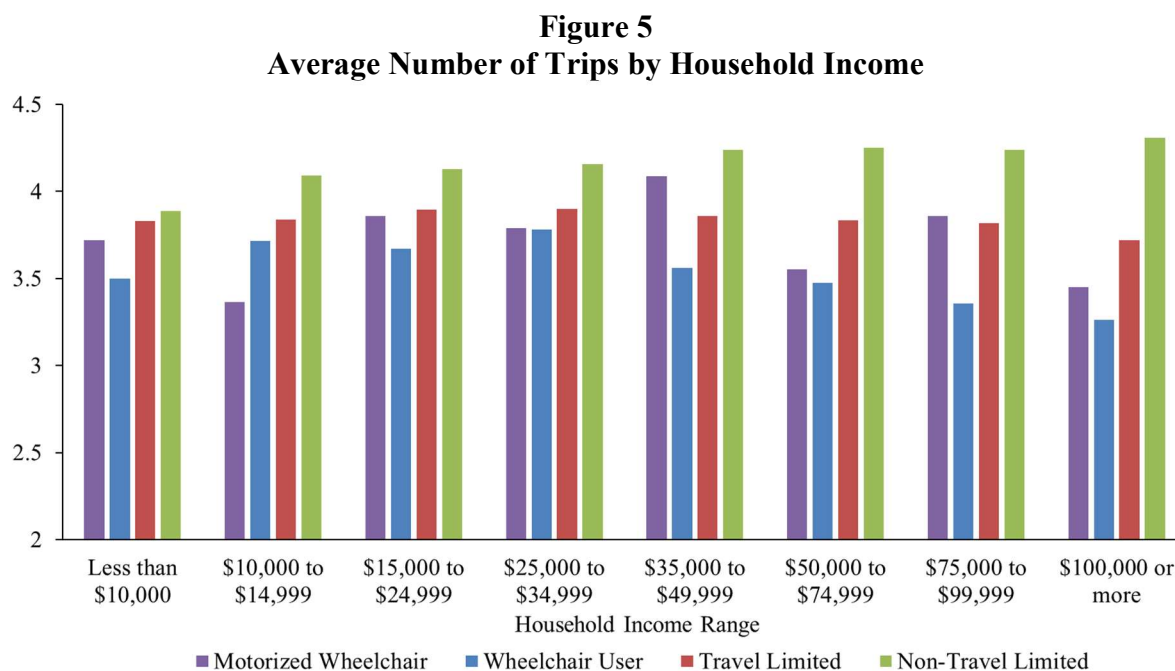
**Figure 4** shows the average number of trips taken on a “typical” day by the motorized wheelchair-using, wheelchair-using, travel-limited, and non-travel-limited populations based on whether a household owns a vehicle. While more trips are taken by households with vehicles, wheelchair users and those who are travel-limited travel less frequently than those who are not travel-limited, even when comparing within vehicle ownership groups. While a non-travel-limited person takes on average 0.5 more daily trips when they own a vehicle, a vehicle-owning wheelchair user on average travels less frequently than a non-vehicle owner who is not travel-limited. These data also suggest that public transit, paratransit, and ridesharing services are not fully meeting the needs of travel-limited Americans without private vehicles.

**Figure 4**  
**Average Trips Taken by Vehicle Ownership**



Source: U.S. Department of Transportation, "National Household Travel Survey," 2017.

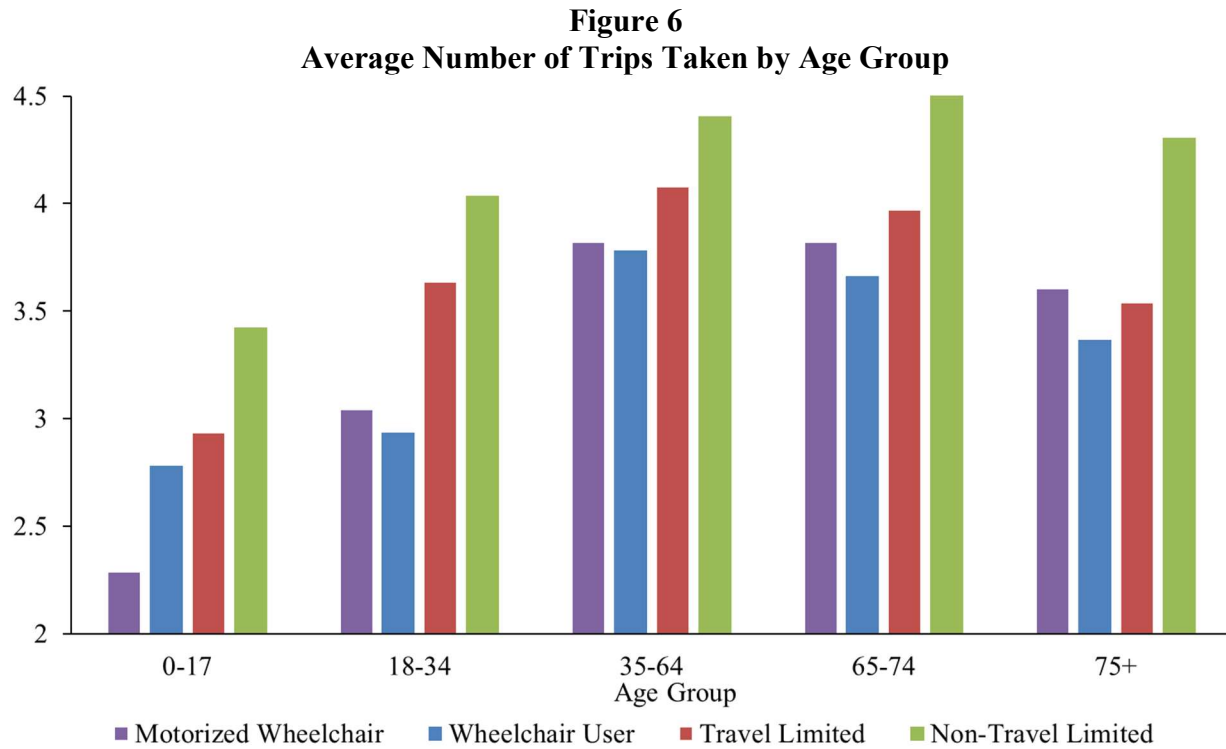
**Figure 5** displays the average number of trips taken on a “typical” day for the motorized wheelchair-using, wheelchair-using, travel-limited, and non-travel-limited populations by household income ranges.<sup>32</sup> Individuals in any of these groups are, on average, less likely to travel than the non-travel-limited population at all income levels. While there are large differences between the travel-limited population and the non-travel-limited population, those who are travel-limited average a larger number of trips than those who are specifically wheelchair users.



Source: U.S. Department of Transportation, "National Household Travel Survey," 2017.

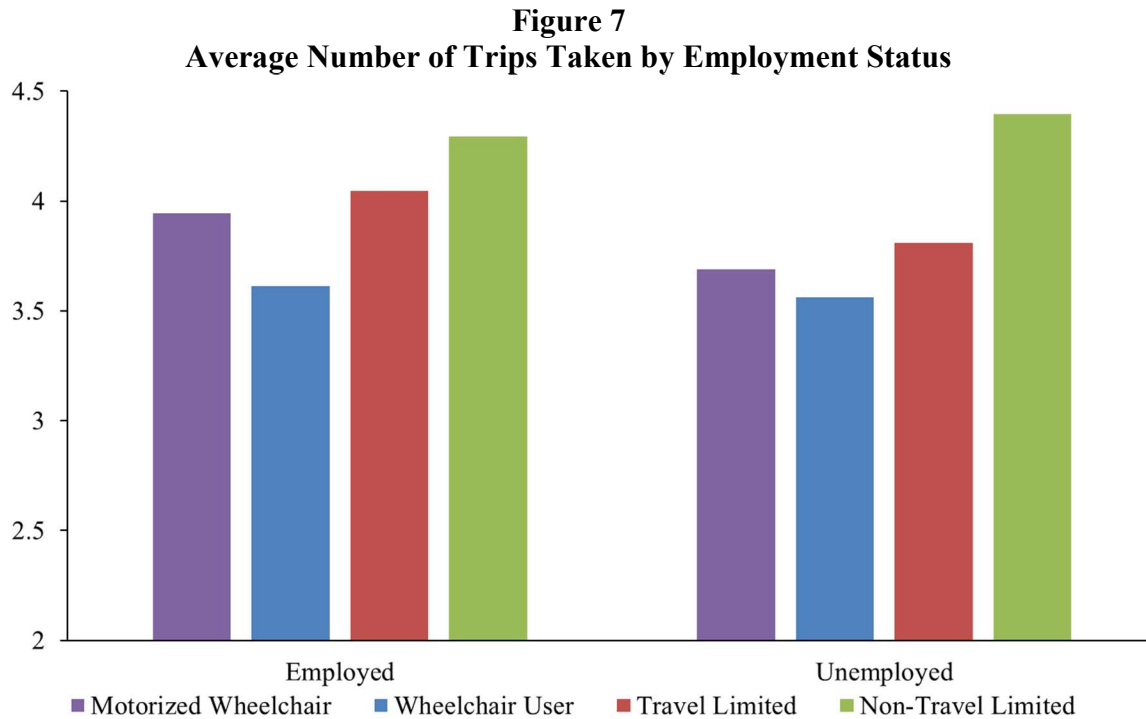
<sup>32</sup> The DOT survey attempted to capture a typical day for each respondent.

**Figure 6** shows the average number of trips taken on a “typical” day for motorized wheelchair-using, wheelchair-using, travel-limited, and non-travel-limited populations by age group. Within all age cohorts, motorized wheelchair users, wheelchair users, and those that are travel-limited complete fewer trips when compared to those that are not travel-limited. However, we observe similar patterns in all four groups, regardless of travel limitations, as respondents between the ages of 35 and 74 reported completing the highest number of trips relative to younger and older cohorts.



Source: U.S. Department of Transportation, "National Household Travel Survey," 2017.

**Figure 7** provides the average number of trips taken on a “typical” day for motorized wheelchair-using, wheelchair-using, travel-limited, and non-travel-limited populations by employment status. Motorized wheelchair users, wheelchair users, and those who are travel-limited travel substantially less than those who are not travel-limited, even when comparing within employment status. While employment status is associated with a modest increase in the number of trips taken by non-travel-limited individuals, there is a more significant increase in the averages between unemployed and employed members of the other groups studied. Employment is associated with a greater increase in the average number of trips taken for the travel-limited population and motorized wheelchair users compared to the wheelchair-using and non-travel limited populations.



Source: U.S. Department of Transportation, "National Household Travel Survey," 2017.

Considering the results presented above in combination, and given that there is no reason (on the basis of income, age, employment, or vehicle ownership) for inherently lower transit needs by the travel-limited, wheelchair-using, or motorized wheelchair-using populations, it is likely that the reduced level of trips and vehicle ownership in these groups is due to lack of available or affordable vehicles and services. We explore the existing services for these populations further below.

## V. Current Services and Transit Solutions Are Not Sufficient

Here, we assess the existing transportation services available to individuals with disabilities. These primarily are (1) public transit and paratransit services, and (2) car hire and ride sharing services, including taxis, Uber, Lyft, and other TNCs. We find that, while these services have improved accessibility for those with disabilities over the past few decades, existing services do not yet provide convenient, reliable, and affordable transportation to the extent that the general population enjoys.

### a. Public Transit and Paratransit Services

We have reviewed the twenty largest regional (non-train) transit authorities in the U.S., 12 of which had available data on paratransit vehicle availability. Based on these metropolitan areas, the average number of paratransit vehicles<sup>33</sup> in operation per capita is approximately 10 per 100,000. This compares to more than 155 vehicles per 100,000 for taxis and nearly 800 per 100,000 cars-for-hire in New York City, including Uber, Lyft, and other Transportation Network Companies (“TNCs”).<sup>34</sup> The results are shown in **Table 1**.

**Table 1**  
**Paratransit Vehicles Available in Major U.S. Metro Areas**

Metro Area	Vehicles per 100,000
	Metro Population
New York City <sup>A</sup>	11.92
Chicago <sup>B</sup>	12.91
Los Angeles <sup>C</sup>	18.05
Washington, D.C. <sup>D</sup>	11.69
Philadelphia <sup>E</sup>	3.87
Atlanta <sup>F</sup>	5.98
Seattle <sup>G</sup>	9.16
Miami <sup>H</sup>	6.31
Denver <sup>I</sup>	12.81
Portland, OR <sup>J</sup>	11.03
San Diego <sup>K</sup>	5.21
San Francisco <sup>L</sup>	17.11
Minneapolis <sup>M</sup>	9.72

**Sources:**

[A] MTA New York City Transit.

[B] Chicago Transit Authority.

[C] Los Angeles County Metropolitan Transit Authority.

[D] Washington Metropolitan Area Transit Authority.

[E] Southeastern Pennsylvania Transit Authority.

[F] Metropolitan Atlanta Rapid Transit Authority.

[G] King County Department of Transportation.

[H] Miami-Dade Transit.

[I] Denver Regional Transportation District

[J] Tri-County Metropolitan Transportation District of Oregon.

[K] San Diego Metropolitan Transit System.

[L] San Francisco Municipal Transportation Agency, using city population only.

[M] Metro Transit.

<sup>33</sup> For our purposes, paratransit vehicles are those operated solely for use by passengers with disabilities and their companions such as shuttles and modified vans. We do not include buses, although the vast majority of these are handicap-accessible.

<sup>34</sup> Based on 13,500 yellow cab medallions in the five boroughs of New York City, a city population of 8.6 million and a ratio of TaaS vehicles-to-taxis of 4 to 1.

These data suggest that in large metropolitan areas, the number of available paratransit vehicles is too low to provide reliable, on-demand, transportation to the travel-limited and wheelchair-using populations. Further, while public paratransit services are generally affordable, they sometimes must be reserved up to 24 hours in advance and arrive within a wide window of time. They do not, by themselves, offer a timely and reliable transportation service for Americans with disabilities. (Data regarding overall trends in public transit use are not conclusive at the national level, making it difficult to estimate what future share of trips might be made using public transit.)

## **b. Taxi and Transportation Network Companies**

While some cities, such as New York, have put in place plans to make a substantial portion of their taxi fleets accessible, most taxi fleets across the country only offer limited services for individuals with a disability. For example, San Francisco’s Municipal Transportation Agency (“SFMTA”) reports that there are currently 40 taxis equipped with wheelchair-accessible ramps out of 1,500 in-service taxi medallions.<sup>35</sup>

Research into the accessibility services provided by rideshare companies, such as Uber and Lyft, indicates that these companies have recently begun to provide transit solutions for the disability community, but at levels that do not yet meet demand across the country. For example, Uber has expanded wheelchair accessible vehicle (“UberWAV”) services by working with MV Transportation, a national third-party transportation provider, in five U.S. markets.<sup>36</sup>

Early usage data for UberWAV suggest that ridesharing is an effective way to provide accessible transport, mirroring its popularity among the broader population. Further, Uber’s experience suggests a substantial unmet demand being satisfied by new programs. From January 2018 to January 2019, the number of monthly UberWAV trips more than doubled in those five markets.<sup>37</sup> The number of repeat UberWAV users (completing more than one trip in a given week) also increased by 133% in those markets. Uber reports that it has invested tens of millions of dollars into expanding its UberWAV program to ensure that accessible vehicles (contracted by Uber) are reliably available on the platform and that prices for WAV service are equivalent to those on the UberX platform.<sup>38</sup> Uber provides an average response time of 15 minutes or less for wheelchair-accessible vehicles in these five U.S. markets: New York City, Philadelphia, Chicago, Washington, D.C., and Boston (with similar improvements being made in Los Angeles and San Francisco). In addition to these markets, UberWAV also operates in other regions.

The increased demand for accessible vehicles from taxis and TNCs is likely to be a large factor driving the growth in demand for accessible AVs as these platforms further develop to meet the requirements of the ADA and extend to additional areas.

Providing some of the financial support for the growth of these programs in some metropolitan areas are “Wheelchair Accessibility Funds.” In Seattle, for example, TNCs must pay \$0.10 per ride originated within

<sup>35</sup> Communications with SFMTA.

<sup>36</sup> See <https://www.uber.com/ride/uberwav/>, <https://help.lyft.com/hc/en-us/articles/115013081668-Accessible-vehicle-dispatch#co>, <https://techcrunch.com/2018/11/20/uber-aims-to-offer-more-wheelchair-accessible-rides-through-partnership-with-mv-transportation/>, and <https://www.mbta.com/accessibility/the-ride/on-demand-pilot>.

<sup>37</sup> Uber reports an increase of 115% in UberWAV trip requests from January 2018 to January 2019 across these five U.S. cities and Toronto, Canada.

<sup>38</sup> UberX is the “basic,” and most popular, service level available on Uber’s platform.

the city toward the Wheelchair Accessible Services Fund.<sup>39</sup> Chicago, similarly, charges non-accessible vehicles a fee of \$0.10 per ride to the city's accessibility fund.<sup>40</sup> These fees are collected from non-accessible vehicles and then used to further the investment in accessible infrastructure, including more accessible taxicabs, public transit and other services for those with travel limitations.

Markets where AV services are being piloted therefore create a unique opportunity. With the coming convergence of ridesharing, associated WAV funds, accessible taxis, and accessible vehicles operated by public transit agencies, there may soon be sufficient supply of WAV to meet the demand of riders interested in using TaaS. If vehicle manufacturers were to begin building vehicles that require fewer aftermarket modifications in response to this demand (also driven by the need for AV services to comply with the ADA), it will reduce the overall cost of vehicles.

### c. Aggregate Accessible Vehicle Demand

While trends in private vehicle ownership may be changing in favor of fleet-based ridesharing or increased use of public transit, it is useful to consider the aggregate transit demands of people with travel-limiting disabilities across any and all available travel modes. This aggregate demand can be approximated, very generally, using the data previously presented in this report. For illustrative purposes, we offer an estimate of transit demands in a number of select cities as well as for the nation as a whole. **Table 2** shows the potential demand for transit among those with travel-limiting disabilities.

**Table 2**  
**Demand for Accessible Transit - Ridesharing Fleets**

Metropolitan Area	Population	Travel-Limited Population	Daily Trips	Accessible Vehicles Supported
Washington, D.C.	6,200,000	290,301	1,248,294	39,009
Boston, MA	4,790,000	224,281	964,408	30,138
San Francisco/Oakland, CA	4,700,000	220,067	946,288	29,571
Phoenix, AZ	4,660,000	218,194	938,234	29,320
Nashville, TN	1,900,000	88,963	382,542	11,954
<b>United States</b>	<b>328,900,000</b>	<b>15,400,000</b>	<b>66,220,000</b>	<b>2,069,375</b>

#### Notes:

- [1] Assumes approximately 4.7% American average rate of travel-limitation applies equally to each metropolitan area's general population.
- [2] Assumes 4.3 trips per person per day.
- [3] Assumes each WAV vehicle can support 32 trips per day (4 trips per hour over 8 hours per day).

#### Sources:

- [A] U.S. Census Bureau.
- [B] Discussions with ridesharing companies.
- [C] DOT Survey Analysis.

<sup>39</sup> See Seattle.gov, "Transportation Network Companies." Accessed on January 14, 2019. <https://www.seattle.gov/business-regulations/taxis-for-hires-and-tncs/transportation-network-companies/tnc-companies>.

<sup>40</sup> Chicago, Illinois Municipal Code, Chapter 9-115. Accessed on January 18, 2019. <http://www.goutcc.org/wp-content/uploads/2015/04/municipal-code-TNP.pdf>.



## **VI. Conclusion**

AVs have a substantial role to play in the fulfillment of transportation equality for the disability population in the U.S. Our analysis suggests that those with disabilities are currently underserved by available transit options. Despite decades of investment and improvement under the ADA, the disability community completes fewer daily trips per capita than those without disabilities, even after accounting for employment, income, age, and vehicle ownership.

Including as many as 18.5 million people in the U.S., the disability community is eager to adopt new modes of transportation, as revealed by initial data from the launch of UberWAV. Driving demand for more accessible vehicles, both autonomous and conventional, are factors including the projected growth of the disability population, “wheelchair accessibility funds,” and legal obligations arising from the ADA applying to new transit programs such as ridesharing firms.

From automobile manufacturers and fleet operators to ridesharing firms, the responsibilities of stakeholders throughout the transportation economy to the disability community requires that careful consideration be paid to the design and development of AVs and fleet service offerings. This will ensure that future transportation systems can provide equal access in greater measure than is currently available.

## Appendices

### Appendix 1

#### Summary of Wheelchair-Using Population from the NHTS

U.S. Census Region	Survey Respondents that Use a Wheelchair		Wheelchair Users that Own a Vehicle		Wheelchair Users with a Household Income Greater than \$35,000	
	Sample Size	Percentage	Sample Size	Percentage	Sample Size	Percentage
East North Central	330	1.1%	289	87.6%	147	44.5%
East South Central	46	1.7%	38	82.6%	20	43.5%
Middle Atlantic	426	1.1%	330	77.4%	197	46.3%
Mountain	132	1.3%	116	87.9%	61	46.2%
New England	40	1.1%	31	76.4%	20	50.0%
Pacific	748	1.3%	656	87.7%	400	53.5%
South Atlantic	837	1.5%	745	89.0%	350	41.8%
West North Central	115	1.1%	96	83.5%	45	39.1%
West South Central	700	1.3%	608	86.9%	316	45.1%
<b>Total</b>	<b>3,374</b>	<b>1.3%</b>	<b>2,909</b>	<b>86.2%</b>	<b>1,556</b>	<b>46.1%</b>

**Source:**

[A] U.S. Department of Transportation (2018), “2017 National Household Travel Survey.”

## Appendix 2

### Summary of Wheelchair-Using Population from the National Household Travel Survey

State	Survey Respondents that Use a Wheelchair		Wheelchair Users that Own a Vehicle		Wheelchair Users with a Household Income Greater than \$35,000	
	Sample Size	Percentage	Sample Size	Percentage	Sample Size	Percentage
AK	3	0.6%	3	100.0%	1	33.3%
AL	16	2.4%	15	93.8%	9	56.3%
AR	8	2.0%	4	50.0%	2	25.0%
AZ	89	1.5%	80	89.9%	40	44.9%
CA	708	1.3%	626	88.4%	378	53.4%
CO	9	1.0%	8	88.9%	3	33.3%
CT	6	1.2%	4	66.7%	2	33.3%
DC	6	1.1%	1	16.7%	2	33.3%
DE	7	1.4%	6	85.7%	4	57.1%
FL	31	1.1%	26	83.9%	14	45.2%
GA	273	1.5%	239	87.5%	111	40.7%
HI	13	2.3%	11	84.6%	13	100.0%
IA	56	1.0%	49	87.5%	21	37.5%
ID	6	0.8%	5	83.3%	1	16.7%
IL	27	1.3%	24	88.9%	12	44.4%
IN	13	1.3%	13	100.0%	5	38.5%
KS	4	0.7%	3	75.0%	2	50.0%
KY	9	1.4%	8	88.9%	3	33.3%
LA	12	2.6%	11	91.7%	5	41.7%
MA	4	0.4%	3	75.0%	1	25.0%
MD	36	1.2%	27	75.0%	18	50.0%
ME	10	1.5%	7	70.0%	5	50.0%
MI	20	1.3%	17	85.0%	10	50.0%
MN	17	1.3%	11	64.7%	6	35.3%
MO	23	2.4%	19	82.6%	10	43.5%
MS	9	2.1%	7	77.8%	4	44.4%
MT	2	0.3%	2	100.0%	1	50.0%
NC	250	1.4%	226	90.4%	91	36.4%
ND	6	1.1%	5	83.3%	3	50.0%
NE	2	0.3%	2	100.0%	2	100.0%
NH	9	1.5%	8	88.9%	6	66.7%
NJ	10	0.9%	7	70.0%	5	50.0%
NM	10	2.2%	9	90.0%	7	70.0%
NV	5	1.2%	4	80.0%	3	60.0%
NY	387	1.1%	302	78.0%	177	45.7%
OH	20	1.0%	16	80.0%	6	30.0%

State	Survey Respondents that Use a Wheelchair		Wheelchair Users that Own a Vehicle		Wheelchair Users with a Household Income Greater than \$35,000	
OK	32	1.2%	29	90.6%	16	50.0%
OR	10	1.2%	4	40.0%	3	30.0%
PA	29	1.4%	21	72.4%	15	51.7%
RI	4	0.9%	3	75.0%	2	50.0%
SC	248	1.8%	229	92.3%	120	48.4%
SD	7	1.1%	7	100.0%	1	14.3%
TN	12	1.3%	8	66.7%	4	33.3%
TX	648	1.3%	564	87.0%	293	45.2%
UT	6	0.8%	5	83.3%	4	66.7%
VA	14	1.0%	11	78.6%	7	50.0%
VT	7	0.9%	6	85.7%	4	57.1%
WA	14	1.1%	12	85.7%	5	35.7%
WI	250	1.1%	219	87.6%	114	45.6%
WV	8	1.7%	7	87.5%	1	12.5%
WY	5	0.9%	3	60.0%	2	40.0%
<b>Total</b>	<b>3,410</b>	<b>1.3%</b>	<b>2,936</b>	<b>86.1%</b>	<b>1,574</b>	<b>46.2%</b>

**Source:**

[A] U.S. Department of Transportation (2018), “2017 National Household Travel Survey.”

### Appendix 3

#### Summary of Travel-Limited Population from the National Household Travel Survey

State	Survey Respondents that Are Travel Limited		Travel Limited Respondents that Own a Vehicle		Travel Limited Respondents with a Household Income Greater than \$35,000	
	Sample Size	Percentage	Sample Size	Percentage	Sample Size	Percentage
AK	26	5.5%	22	84.6%	17	65.4%
AL	61	9.3%	54	88.5%	24	39.3%
AR	35	8.8%	29	82.9%	12	34.3%
AZ	448	7.7%	408	91.1%	193	43.1%
CA	3,558	6.6%	3,037	85.4%	1,753	49.3%
CO	53	5.6%	47	88.7%	28	52.8%
CT	26	5.4%	21	80.8%	8	30.8%
DC	34	6.5%	17	50.0%	11	32.4%
DE	39	7.6%	32	82.1%	20	51.3%
FL	176	6.3%	156	88.6%	75	42.6%
GA	1,138	6.4%	959	84.3%	428	37.6%
HI	36	6.3%	24	66.7%	23	63.9%
IA	317	5.8%	266	83.9%	116	36.6%
ID	31	4.1%	26	83.9%	11	35.5%
IL	108	5.3%	89	82.4%	52	48.1%
IN	56	5.6%	52	92.9%	22	39.3%
KS	28	5.0%	26	92.9%	14	50.0%
KY	44	6.9%	37	84.1%	13	29.5%
LA	38	8.2%	35	92.1%	19	50.0%
MA	41	4.1%	26	63.4%	19	46.3%
MD	203	6.8%	166	81.8%	101	49.8%
ME	41	6.3%	31	75.6%	17	41.5%
MI	103	6.5%	82	79.6%	40	38.8%
MN	65	5.0%	48	73.8%	29	44.6%
MO	76	7.9%	70	92.1%	35	46.1%
MS	39	9.2%	33	84.6%	9	23.1%
MT	28	4.3%	28	100.0%	16	57.1%
NC	1,192	6.8%	1,041	87.3%	460	38.6%
ND	29	5.1%	24	82.8%	13	44.8%
NE	36	6.2%	30	83.3%	15	41.7%
NH	35	6.0%	30	85.7%	10	28.6%
NJ	53	4.5%	40	75.5%	23	43.4%
NM	31	6.9%	26	83.9%	18	58.1%
NV	34	8.3%	31	91.2%	14	41.2%
NY	2,187	6.3%	1,693	77.4%	912	41.7%
OH	134	6.6%	112	83.6%	56	41.8%
OK	173	6.7%	144	83.2%	79	45.7%

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**Summary of Travel-Limited Population from the National Household Travel Survey**


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State	Survey Respondents that Are Travel Limited		Travel Limited Respondents that Own a Vehicle		Travel Limited Respondents with a Household Income Greater than \$35,000	
OR	47	5.8%	38	80.9%	22	46.8%
PA	131	6.2%	100	76.3%	53	40.5%
RI	27	5.9%	22	81.5%	12	44.4%
SC	990	7.1%	883	89.2%	393	39.7%
SD	31	5.0%	30	96.8%	6	19.4%
TN	74	7.9%	60	81.1%	28	37.8%
TX	2,993	5.8%	2,619	87.5%	1,356	45.3%
UT	24	3.1%	21	87.5%	13	54.2%
VA	91	6.4%	84	92.3%	47	51.6%
VT	42	5.5%	34	81.0%	18	42.9%
WA	70	5.3%	59	84.3%	40	57.1%
WI	1,278	5.5%	1,086	85.0%	534	41.8%
WV	40	8.7%	31	77.5%	12	30.0%
WY	28	5.2%	22	78.6%	11	39.3%
<b>Total</b>	<b>16,618</b>	<b>6.3%</b>	<b>14,081</b>	<b>84.7%</b>	<b>7,250</b>	<b>43.6%</b>

**Source:**

[A] U.S. Department of Transportation (2018), “2017 National Household Travel Survey.”

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