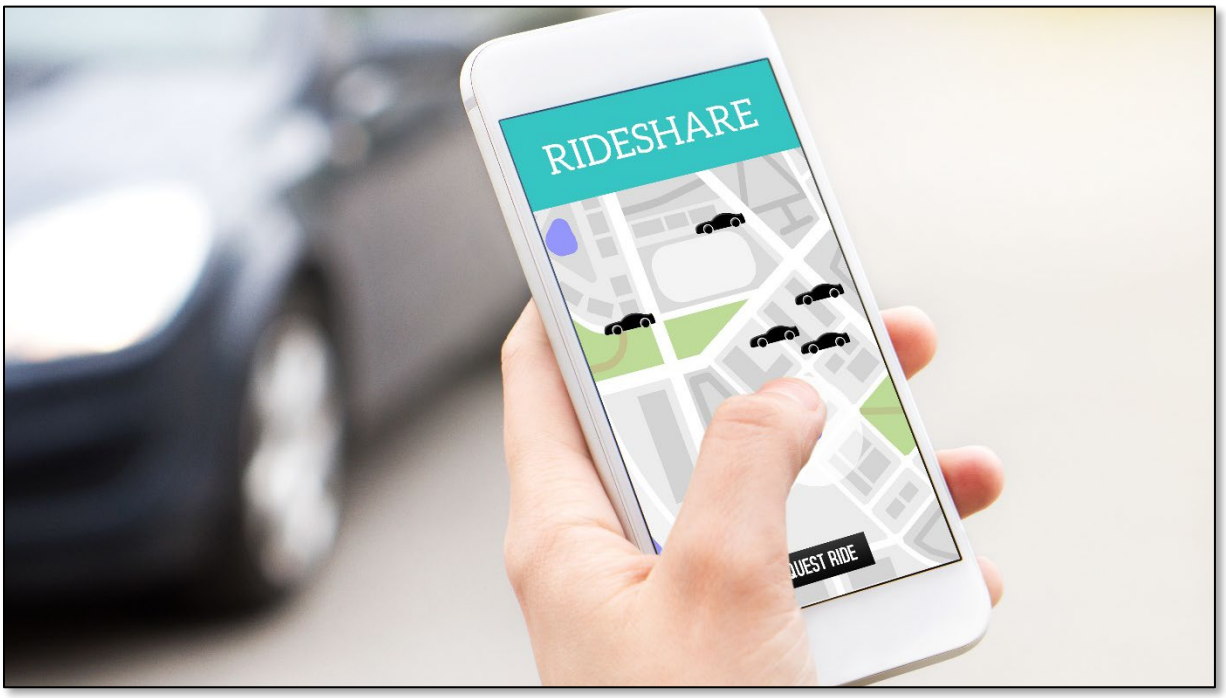
**SURTCOM 22-15**

# Interest of Shared Mobility and Emerging Vehicle Technologies in Rural America

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**December 2022**

## Acknowledgements

Funds for this study were provided by the Small Urban, Rural and Tribal Center on Mobility (SURTCOM), a partnership between the Western Transportation Institute at Montana State University and the Upper Great Plains Transportation Institute at North Dakota State University. The Center is funded through the U.S. Department of Transportation's Office of the Assistant Secretary of Research and Technology as a University Transportation Center. The Small Urban and Rural Center on Mobility within the Upper Great Plains Transportation Institute at North Dakota State University conducted the research.

## Disclaimer

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# 1. BACKGROUND AND STUDY OBJECTIVES

Vehicle technologies and technology-enabled mobility services have significantly transformed transportation ecosystems in urban communities. Ownership of vehicles with advanced features, such as adaptive cruise control, emergency braking, autopilot etc., have increased among individuals as vehicle manufacturers increase the number of automation functionalities in the latest vehicles for the public. Ride-sourcing services, such as Uber, Lyft, and other services, have already become an integral part of the transportation framework in most urban and suburban communities. The combination of market-ready vehicle technologies, smartphone ownership, and use of smartphone applications, and the presence of technology-enabled shared-use mobility services present a great opportunity to provide flexible and additional transportation choices in metro areas.

While technology-enabled shared mobility services offer more mobility options in urban areas, they have the potential to be just as useful in rural and small-urban communities, and they could become the only available mobility service in some rural communities; these services could also lead to better, more effective transportation by working with local transit/transportation providers for improved resource distribution. Shared-use mobility services such as ridesourcing, bikesharing, and carsharing have also been introduced in a few rural communities and a fair number of small-urban communities. Input about the interest and potential willingness to use these services, and adoption of various emerging vehicle technologies, could help improve understanding and planning for appropriate shared mobility services to meet the transportation needs in rural and small-urban communities. Since the implementation of these services are in their initial stages through pilot studies in few communities, analyzing the interest and willingness to adopt various technologies and innovative transportation services by different demographic groups is important. Further, transit/transportation providers may offer unique insights about the potential for public private partnerships for innovative services and technologies to meet the mobility needs of rural and small-urban residents.

The study objectives included to address the identified research needs include:

1) Conduct comprehensive literature review of shared mobility implementations in rural and small-urban communities, summarize service impacts, and compile best practices for implementing shared mobility services in rural and small-urban communities.
2) Analyze the interest and adoption patterns for shared mobility and emerging vehicle technologies in rural and small-urban communities.
3) Analyze data from the National Household Travel Survey to identify characteristics of shared mobility users in rural America.

# 2. LITERATURE REVIEW

## 2.1 Recent Public Transit Ridership Trends

Public transit ridership and passenger miles traveled on transit vehicles increased in the United States through 2014, but then started to decline continuously until 2018. Figures 2.1 and 2.2 show the trends of public transit ridership over the years, and the decline despite an ever-increasing population (APTA Fact Book, 2020). An APTA study conducted research to identify the reasons for decline in public transit ridership after the modern-day record ridership observed in 2014. The study researched available literature and media reports and conducted confidential focus group interviews with public transportation officials representative of various system sizes, and with wide U.S. geographic representation. The factors identified as contributing toward ridership decline were categorized into four main areas: 1) Erosion of time competitiveness – decrease of speeds on shared ROW transit services caused by increased congestion in cities, increased delivery services, TNCs, etc.; 2) Reduced affinity – changing population trends among those less willing to purchase monthly passes, as they prefer to use multiple modes or telework; 3) Erosion of cost competitiveness – low cost of auto ownership and availability of inexpensive TNC fares; 4) External factors such as an increase in parking availability and movement of transit rider destinations away from the transit service areas (APTA, 2018).

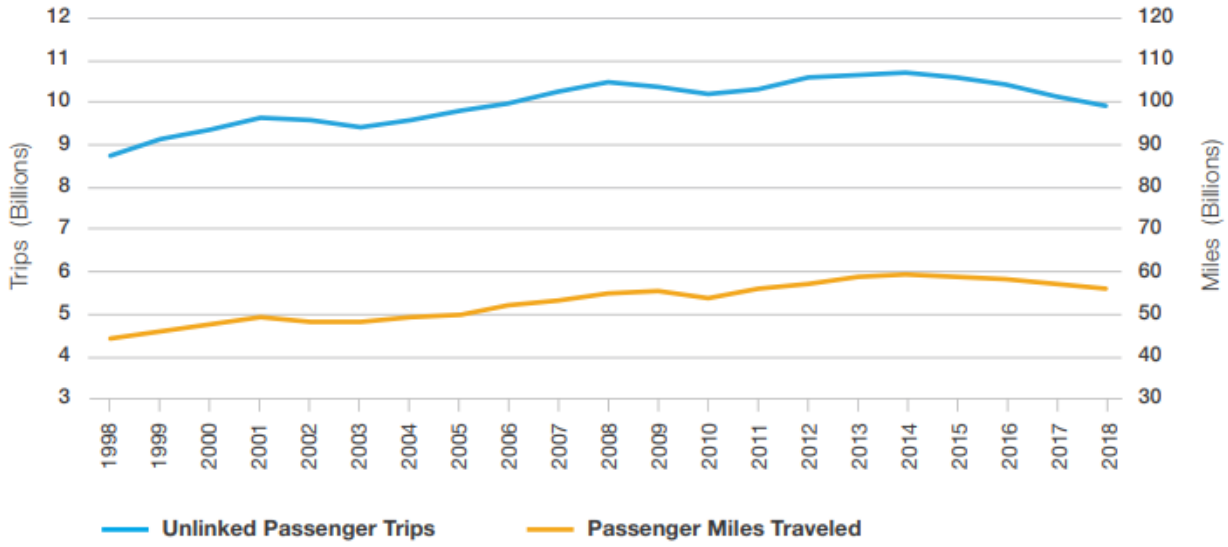


**Figure 2.1** Ridership and Distance Traveled on Public Transit Since 1998
Source: (APTA Fact Book, 2020)

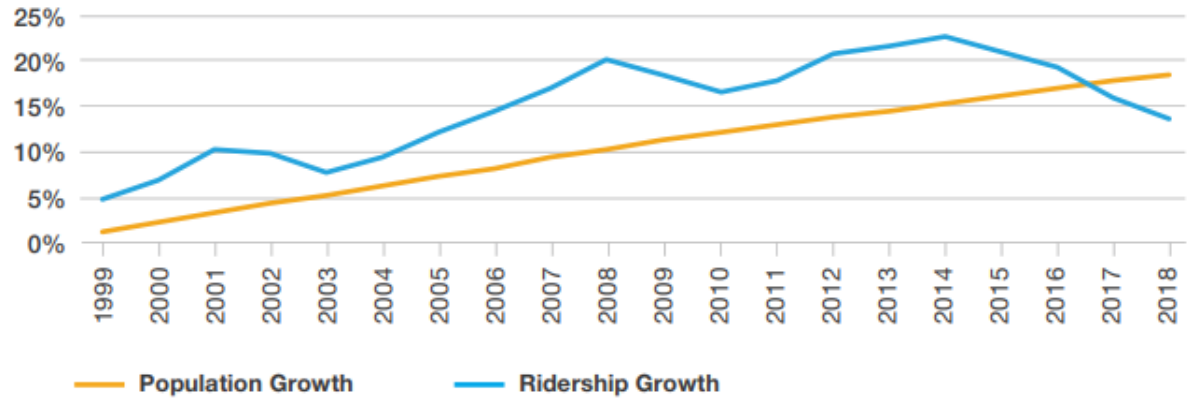


**Figure 2.2** Population and Ridership Growth Since 1998
Source: (APTA Fact Book, 2020)

The 2020 TCRP Report 209 examined the public transit ridership trends over the past several years in U.S. urban and suburban areas and have found that, when compared with other transit services, bus ridership declined the most following 2015 (Watkins, Berrebi, Diffee, Kiriazes, & Ederer, 2020). Rail ridership has also declined except for commuter rail, which remained flat. As population increased over the years, the study found that increasing transit service in dense transit-oriented regions (including midsize and large metro areas) can increase transit ridership much more than car-oriented regions. Further, the study determined that small to mid-sized regions that did not increase transit service levels between 2012 and 2016 could expect an 8% to 10% loss in transit ridership. One of the strategies that the study suggested to improve transit ridership was adding more emerging mobility options and opportunities for transit agencies to partner with these providers (Watkins, Berrebi, Diffee, Kiriazes, & Ederer, 2020).

Looking at the rural side of transit ridership, an increase of 7.8% in rural ridership was observed between 2007 and 2015 when only a 2.3% increase was observed in urban public transit. Rural transit ridership has significantly increased during the years despite the decline in the population in rural communities; it must be noted that the number of transit agencies have increased in rural and small towns over the years (Litman, et al., 2017). However, rural transit ridership stopped increasing since 2015 and is following a downward trend. According to the 2020 Rural Transit Fact Book, which was produced based on 2018 transit ridership data, total annual ridership for rural transit systems decreased by 2% between 2017 and 2018 while service levels (i.e., the total vehicle miles and vehicle hours) remained steady (Mistry & Mattson, 2020). Similarly, according to the 2021 Rural Transit Fact Book, which was produced based on 2019 transit ridership data, total annual ridership for rural transit systems decreased by 0.4% between 2018 and 2019; during this period, service levels (i.e., total vehicle miles and vehicle hours) decreased 3.6% and 3.4%, respectively (Mattson & Mistry, 2021).

## 2.2 Emerging Mobility Options

Technology-enabled shared-use mobility (SUM) services started in large metropolitan areas and gradually spread to more urban communities, small-urban communities, and a few rural communities. While most categories of SUM services, such as ride-sourcing, carsharing, micro-transit, bike- and scooter-sharing, etc., exist in larger urban communities, the array of service offerings tends to decrease with community size. Ridesourcing services such as Uber and/or Lyft are typically available in urban and small urban settings, but less prevalent in rural communities where demand is low, trip distances are large, and fewer contract drivers work for the platforms (Godavarthy, Hough, Libberton, & Koff, 2019) (Villwock-Witte, New Mobility Opportunities in a Rural Context, 2019). SUM services have generally proven to be effective at meeting customer mobility needs by providing convenient and flexible services; these services could greatly help rural communities provide mobility services in communities where transportation services are scarce.

While rural communities are commonly served by traditional transportation services, such as ADA paratransit, demand-response transit, and fixed-route transit, it is important to assess the willingness to use emerging SUM services in these areas in order to estimate the feasibility, success, and sustainability of emerging SUM services in rural communities. Spurlock et al. (2019) conducted a study where the researchers surveyed over 1,000 residents in the San Francisco Bay Area to study travel choice patterns, preferences, and decision-making processes with regard to new mobility services (ride-hailing, pooled ride-hailing, carsharing, etc.) and emerging vehicle technologies (adaptive cruise control, automated vehicles, electric vehicles, etc.) (Spurlock, et al., 2019). The study found that ride-hailing services and adaptive cruise control technologies have penetrated the market more extensively than electrified vehicles and carsharing services. The study also found that higher-income earners are disproportionately represented (or over-represented) among the current adopters of emerging services and technologies (Spurlock, et al., 2019). Other studies have also observed a similar pattern where adopters of ride-hailing and car-sharing services were disproportionately high-income earners, younger, and college educated (Alemi, Circella, Handy, & Mokhtarian, 2018) (Clewlow & Mishra, 2017). Spurlock et al. (2019), however, also observed in their study that low- to middle-income earners are just as likely to have adapted to pooled ride-hailing services when compared with high-income earners (Spurlock, et al., 2019). It is important to note, however, that these adoption patterns may not be generalizable to other urban, small urban, or rural U.S. communities. Nevertheless, the present research team find the survey instrument developed and deployed by Spurlock et al. (2019) to be promising. As a result, the present research team will use it as a model from which to develop a simplified survey to gauge rural community adoption patterns in this study.

A study conducted by the Western Transportation Institute included surveys with communities that have a TNC operating within their jurisdiction, and analyzed the challenges and benefits of the new shared-use mobility options in the rural context (Villwock-Witte, New Mobility Opportunities in a Rural Context, 2019). Some of the challenges observed for rural communities include low population density, competition with other modes, and safety while some of the benefits include increased mobility options, reduced transportation costs, and convenience.

An NCHRP Task 76 comprehensive study of rural SUM services in the U. S. found that while Uber and Lyft primarily use contracted drivers to provide trips, a different business model could be much more feasible to provide ridesourcing in a rural setup by using existing volunteer drivers in the rural community. The study highlighted the examples of Feonix Mobility Rising and RubyRide agencies using both volunteer and employed drivers to provide successful on-demand ridesourcing service in rural communities (Godavarthy, Hough, Libberton, & Koff, 2019). Similarly, while carsharing services are rare in rural communities, a subsidized small-scale carshare program could be a solution where a rural community has specific transportation needs that could be fulfilled only by a carshare program. The study

conducted interviews and case studies with emerging SUM service providers and found a willingness to explore future operations in rural communities; however, there is hesitation in the near-term due to lack of familiarity with specific rural mobility needs and uncertain profitability. The NCHRP Task 76 research produced a five-step rural SUM toolkit (Figure 2.3) that is designed to inform state DOTs, regional transportation agencies, rural transit agencies, local governments, human service agencies, and other state and local agencies about the various steps and tasks involved in strategically planning for piloting and implementing emerging SUM practices in rural communities. This toolkit is applicable for various categories of rural SUM services, such as ridesourcing, carsharing, bikesharing, microtransit, as well as mobility-as-a-service (MaaS) platforms (Godavarthy, Hough, Libberton, & Koff, 2019).

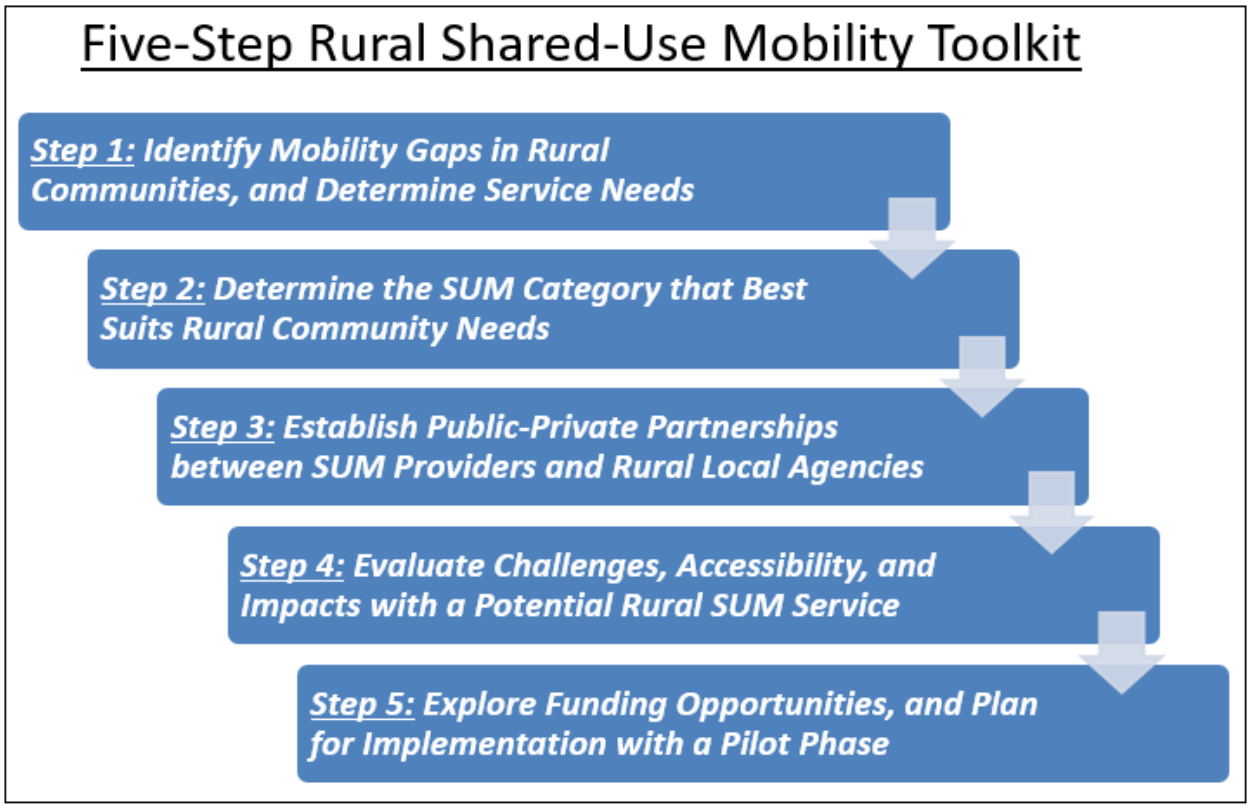


**Figure 2.3** Summary of Five-Step Rural SUM Toolkit
Source: (Godavarthy, Hough, Libberton, & Koff, 2019)

## 2.3 Vehicle Technologies

Automobiles and transit vehicles are experiencing rapid technological changes in terms of driver-assist and automation features, onboard software, and vehicle propelling technologies. Full vehicle automation is one of the software and technological breakthroughs all legacy automakers and big technological companies have been trying to achieve in the last few years by investing billions of dollars. While a fully automated vehicle is not yet on the consumer market, different kinds of automation features are currently available for various vehicles. The National Highway Traffic Safety Administration (NHTSA) published a report, "Automated Driving Systems 2.0: A Vision for Safety," to educate the public (Figure 2.4) about the various levels of driving automation for consumers (U.S.DOT, 2017). Categories of vehicle automation range from Society of Automotive Engineers (SAE) level zero (no automation) to SAE level five (full automation).

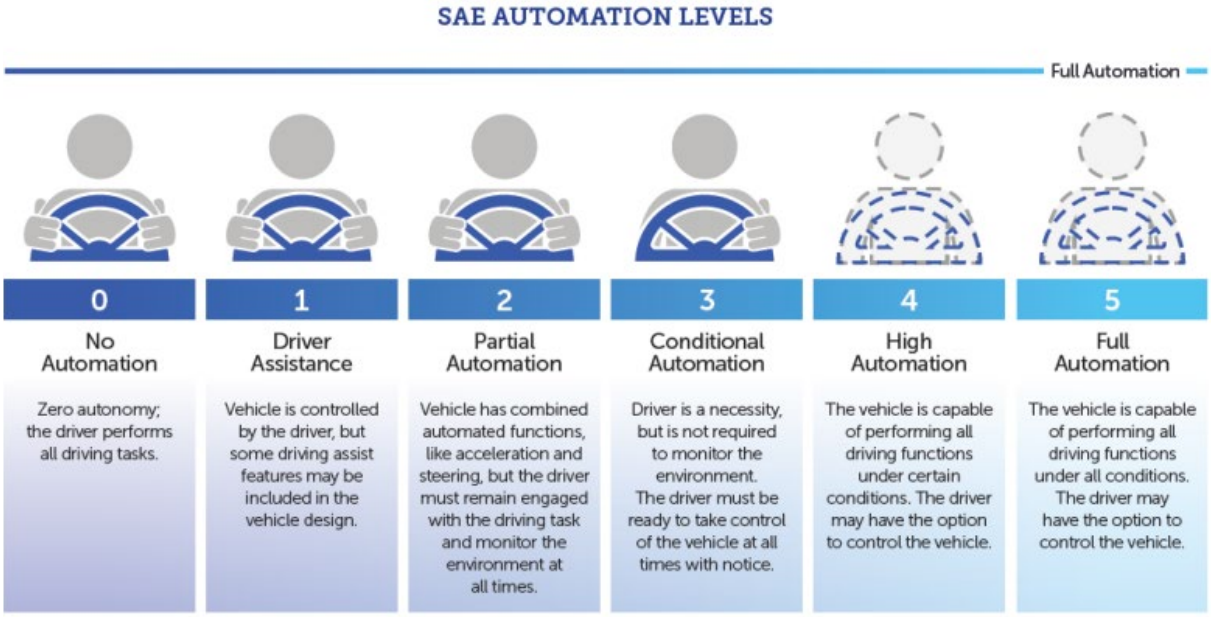


**Figure 2.4** SAE Levels of Automation from Automated Driving Systems 2.0
Source: (U.S.DOT, 2017)

It has become standard for new passenger cars and trucks sold in the U. S. to come with driver assist features such as adaptive cruise control, lane-keep assist features, and back-up sensors. Further, as the automobile industry plan to moving toward higher levels of automation, many vehicle providers plan or already have next generation vehicles on market. These have sophisticated automation features to drive hands-free on the road, at least on some road segments like freeways; examples include Tesla's autopilot and GM's Super Cruise. More advanced autonomous driving technologies, such as Google's Waymo program and Chevy's Cruise automation, are also currently available and being road tested.

Along with automation, the automobile industry is also pursuing vehicle electrification. Many car makers plan to completely shift their vehicle models to all-electric.

Despite high levels of investment by the auto industry and rapid technological advances, there is still considerable uncertainty with regard to how rapidly and fully the adoption of these new vehicle technologies will occur, especially in rural communities.

Recent surveys have shown that Americans are divided on their willingness to use self-driving cars (Naughton, 2019) (Favre, 2019). An HNTB study found that 57% of the respondents who are familiar with the vehicles are willing to ride them, and 51% find them safer than people-driven cars (Favre, 2019). In the future, AVs could lead toward self-driving pooled ridesharing services. Lavieri and Bhat have studied consumer disposition toward shared rides in automated vehicles (Lavieri & Bhat, 2019). The study found that users would be less sensitive to the presence of strangers in a commute trip compared with a leisure trip in a shared autonomous vehicle. However, one barrier that was observed with shared autonomous vehicles is that passengers may not be willing to wait longer times to serve other passengers (Lavieri & Bhat, 2019).

Vehicle automation could have numerous and promising applications in the transit industry, as transit vehicles are in service for most of the day and operating along identical or similar routes, making transit vehicles a logical application for automation. A SURCOM study (2019) surveyed U.S. transit agencies to gauge interest in automation technologies for operations (Godavarthy, Transit Automation Technologies: A Review of Transit Agency Perspective, 2019), and found that 30% of rural agencies, 54% of small urban agencies, and 89% of urban agencies believe transit vehicles with automated functions would be beneficial. The study also found that transit agencies believed that transit vehicles in levels 1 to 3 could improve safety, while vehicles in levels 4 and 5 could be cost-efficient by reducing operator expenses and have the potential to operate throughout the day if needed for increased service levels (Godavarthy, Transit Automation Technologies: A Review of Transit Agency Perspective, 2019).

To lead the U.S. transit industry toward automation, the FTA's Office of Research, Demonstration and Innovation developed a five-year (2017-2022) Strategic Transit Automation Research (STAR) plan (Figure 2.5), which was built based on extensive stakeholder consultation and use case analysis, and informed by a rigorous literature review (FTA, 2018). The scope of the STAR plan for bus transit automation ranges from collision-avoidance technologies for human-operated buses to full vehicle automation. The STAR plan identified five areas of use cases, including advanced driver assistance systems (ADAS), automated shuttles, automated maintenance and yard operations, automated mobility-on-demand service, and automated bus rapid transit (FTA, 2018).

FTA also produced a recent transit bus automation market assessment report, which summarized the status of automated transit bus technology in terms of its availability, capabilities, and limitations (FTA, 2019). The report described confusion among stakeholders about the difference between conceptual ideas, prototype systems, and available products, and found that automation deployment in buses is difficult due to low market volume and high customization, as well as a lack of interest from transit agency customers. The study concluded that federal funding is important for automation demonstrations and pilot programs to support further understanding regarding technological and financial p feasibility of automation systems for transit buses (FTA, 2019).

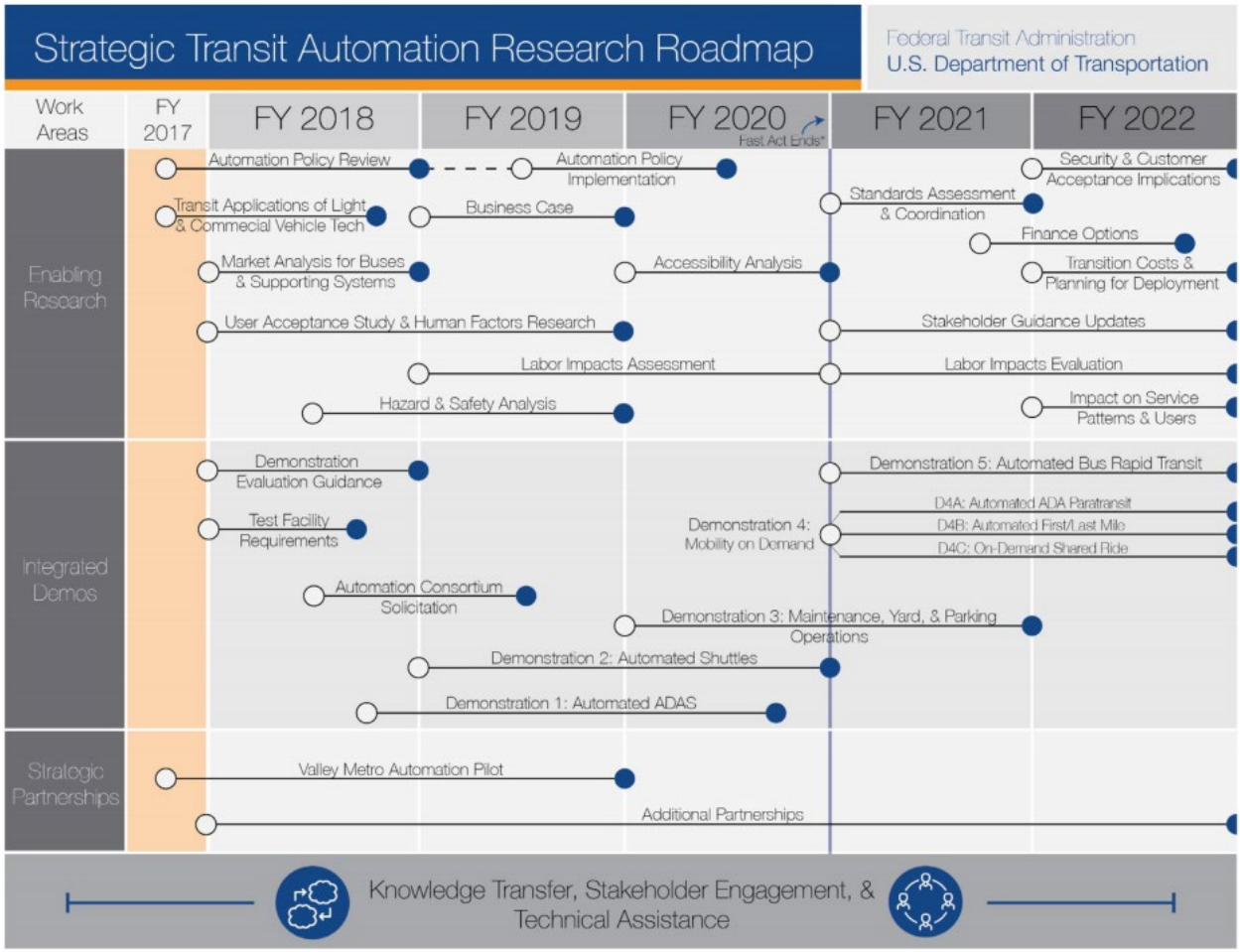


**Figure 2.5** FTA's Strategic Transit Automation Research Roadmap Plan
Source: (FTA, 2018)

# 3. ANALYSIS OF NATIONAL HOUSEHOLD TRAVEL SURVEY

The 2017 National Household Travel Survey (NHTS) database was used in this study to analyze the usage of various shared-use mobility services among rural community residents across the US. The 2017 NHTS database collected attitudinal and travel behavior data for 129,969 households and 264,234 individuals between April 2016 and April 2017. Among the 264,234 individuals, 76.8% (202,907) are from urban areas and 23.2% (61,327 people responses) are from rural areas. The survey was designed to be demographically representative (and therefore suitable for disaggregation) at the national and census region levels.

By 2017, the majority of urban U.S. communities had operational shared-use mobility services, such as ridesharing, carsharing, and bikesharing, and a fair number of rural U.S. communities had some shared-use mobility services. The research team was able to leverage new questions about shared-use mobility in the 2017 NHTS database to better understand rideshare, bikeshare, and carshare use in rural communities. Further, the research team used the database to analyze online purchases for delivery in rural communities.

Findings from the analysis of the 2017 NHTS database are summarized in the following subsections, which are organized by service type.

## 3.1 Rideshare Usage in Rural Communities:

The 2017 NHTS questionnaire had a specific question: “In the past 30 days, how many times have you purchased a ride with a smartphone rideshare app (e.g., Uber, Lyft, Sidecar)?” Responses to this question combined with other relevant question responses are used to summarize key findings for rideshare usage in rural America.

The research team found that 8.1% of people in urban areas and 1.9% people of people in rural areas have used a rideshare app to purchase anywhere between one and 99 trips in the past 30 days they have taken the survey (Figure 3.1). Comparing rideshare app usage in rural and urban areas (Figure 3.1), people in rural areas are four times less likely to purchase rideshare trips. Some of the potential reasons for this lower likelihood could be lack of availability of rideshare services in rural areas, lack of broadband coverage, and lack of access to smartphones. Among the 1.9% of people in rural areas who used rideshare services at least once, most (1.8%) purchased 1-10 rideshare trips in the prior 30 days (Figure 3.2).

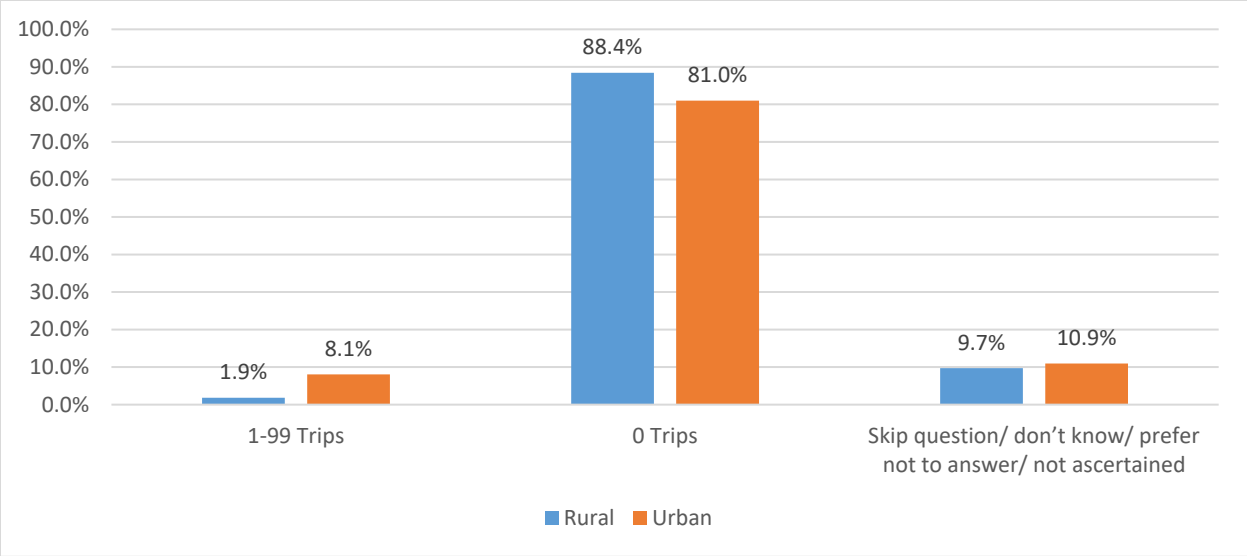


**Figure 3.1** Rideshare trip frequency in the past 30 days - urban vs. rural

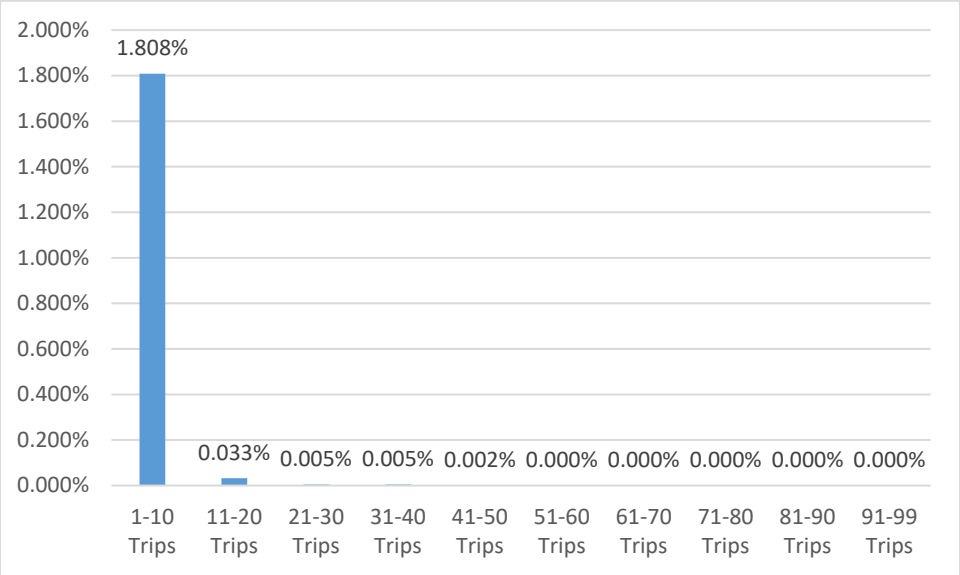


**Figure 3.2** Breakdown of rideshare user's trip frequency in the past 30 days for rural areas

While the majority of rural responses for the 2017 NHTS are women (51.5% women and 48.4% men), a higher share of rideshare users in rural areas are men (51.9%) (Figure 3.3). Older adults (65-or-older) and children (<18) are underrepresented among rural rideshare users[1].

Household income is positively associated with rideshare usage in rural areas (Figure 3.5). In fact, more than 60% of rural rideshare trips were taken by people who have a household income of $100,000 or more.

[1] Minimum age for users to purchase rides is 18. However, individuals <18 of age might take a ride with someone older or via a trip paid for by an adult.

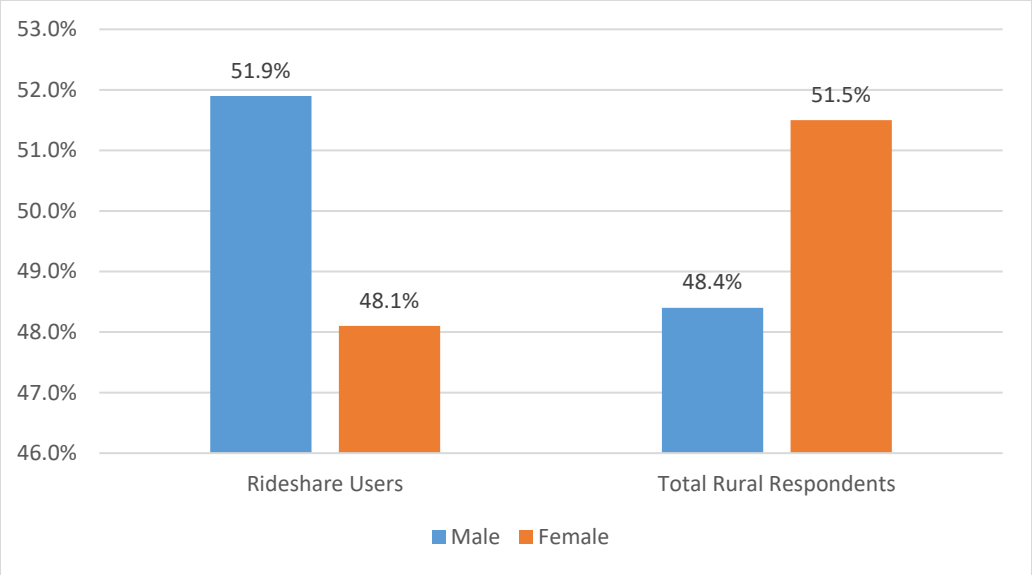


**Figure 3.3** Gender of rideshare users and all rural respondents

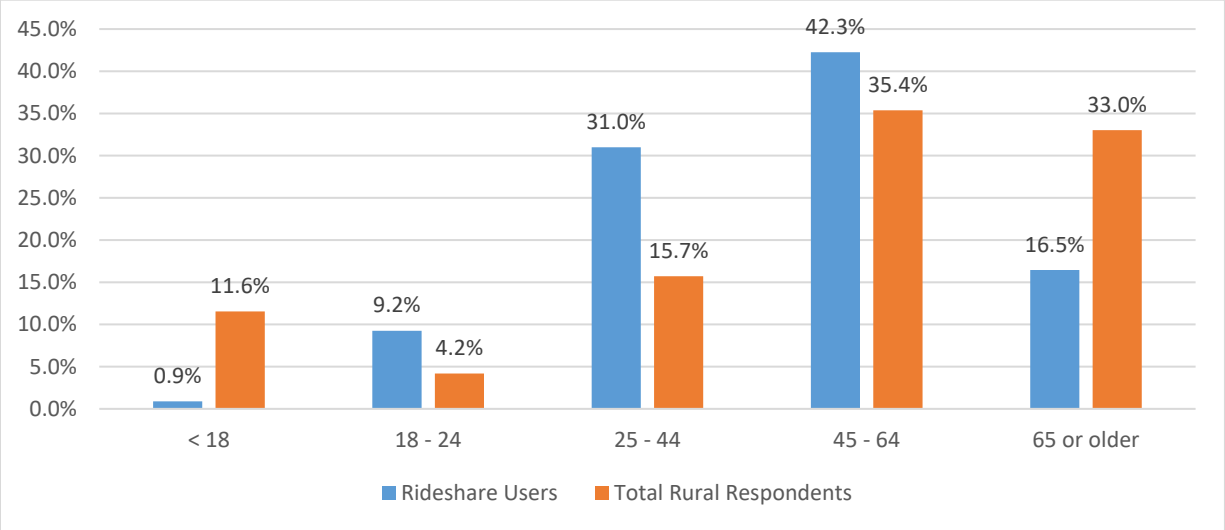


**Figure 3.4** Age of rideshare users and all rural respondents

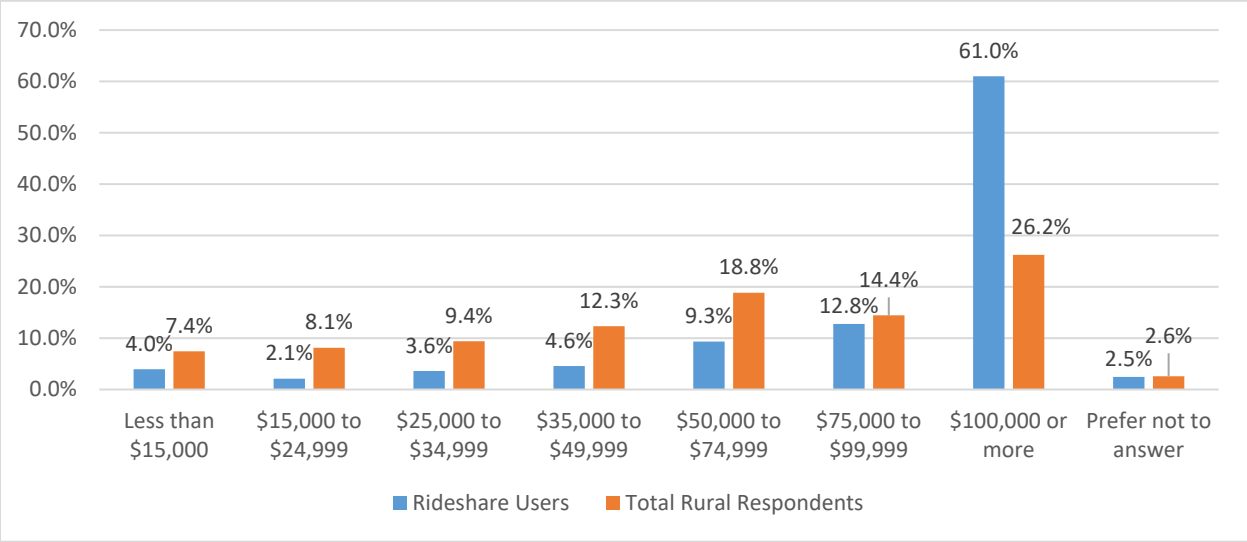


**Figure 3.5** Household income of rideshare users and all rural respondents

Beyond demographic categories, the research team also analyzed the association between smartphone usage and rideshare usage in rural areas, 65% of people use smartphones regularly, 22.1% of people never use smartphones, and the rest use smartphones occasionally (Figure 3.6). Meanwhile, as expected, more than 90% of rideshare users in rural areas are daily smartphone users[2]. Nevertheless, not all regular smartphone users are rideshare users. This could be due to a lack of need for the services (i.e., convenient regular access to a private vehicle), but also due to a lack of availability of ride services in some rural communities. We also assessed the association between frequency of internet usage and rideshare usage (Figure 3.7), and found that 97.4% of rideshare users access the internet daily compared to 85.5% of all rural respondents.

[2] Smartphones are the most common and convenient way to use ridesharing services.

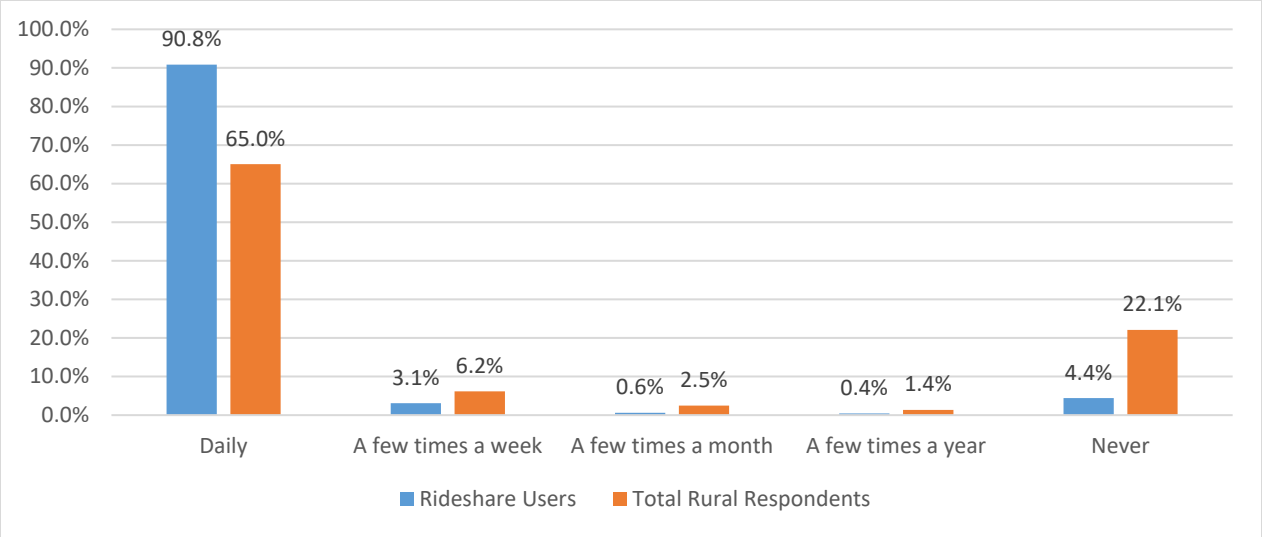


**Figure 3.6** Smartphone usage for rideshare users and all rural respondents

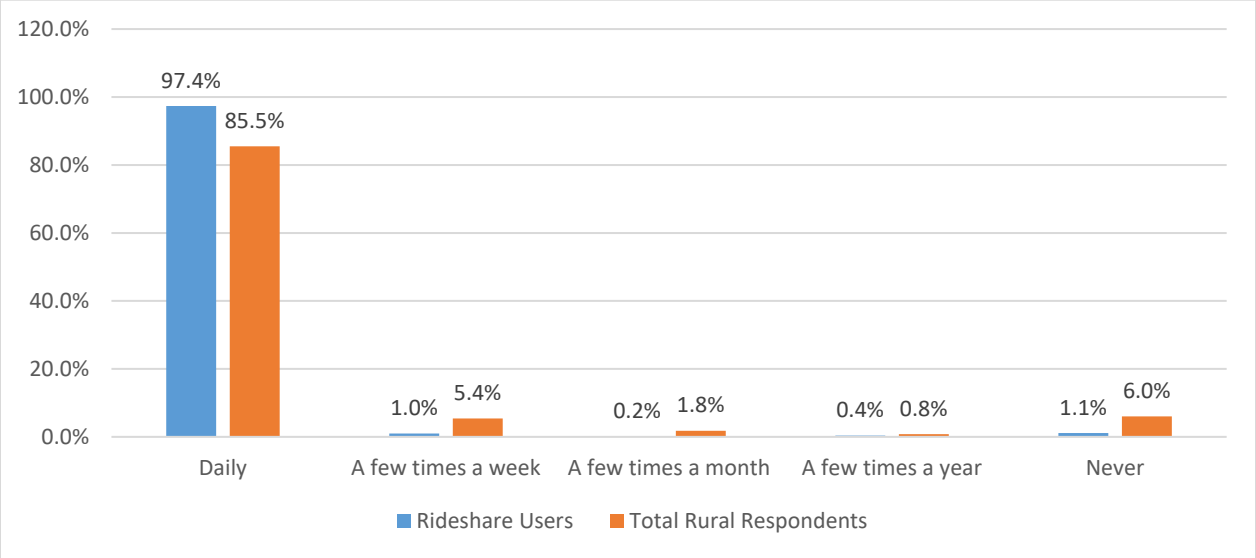


**Figure 3.7** Internet usage for rideshare users and all rural respondents

Rural rideshare users report having used public transit in the past 30 days at a much higher rate (29.9%) than rural respondents in general (5.6%) (Figure 3.8). A number of factors could explain this correlation. It is possible that the availability of public transit and rideshare services covary (i.e., rural rideshare services are more common in places with rural transit service), and it could again relate to convenient, regular access to a private vehicle – those who cannot drive easily may be more likely to seek out both public transit and ridesharing services.

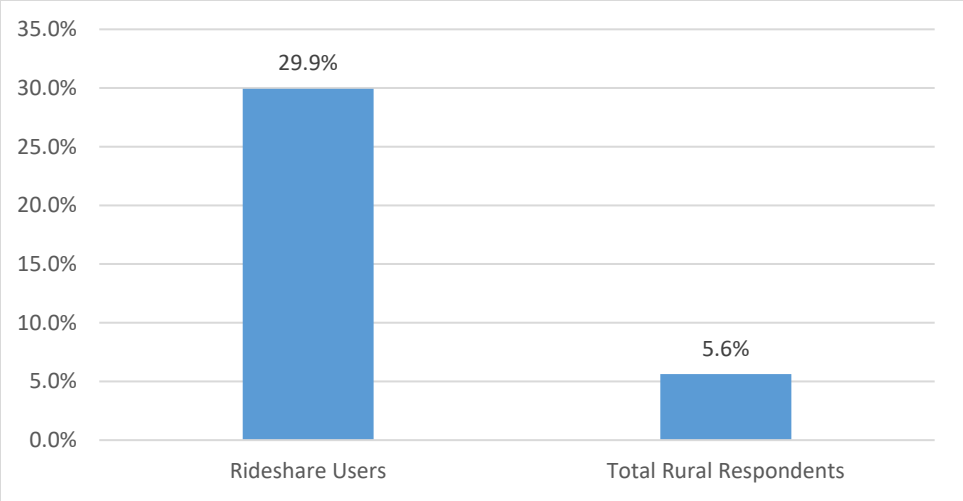


**Figure 3.8** Public transit usage among rideshare users and all rural respondents

## 3.2 Carshare Usage in Rural America

Another 2017 NHTS question was: "In the past 30 days, how many times did you use a car sharing service where a car can be rented by the hour (e.g., Zipcar or Car2Go)?" Responses for this question combined with other relevant question responses are used to summarize some key findings for carshare usage in rural America.

Carsharing (1-99 trips in the past 30 days) is relatively rare in both urban (0.658% of people) and rural areas (0.238% of people) (Figure 3.9), and much rarer than rideshare usage in both urban and rural areas (see Figure 3.1). This low level of carsharing in rural areas is likely explained by the relative scarcity of rural carsharing service availability. About 94% of rural carshare users made 1-10 carshare trips in their past 30 days (Figure 3.10).

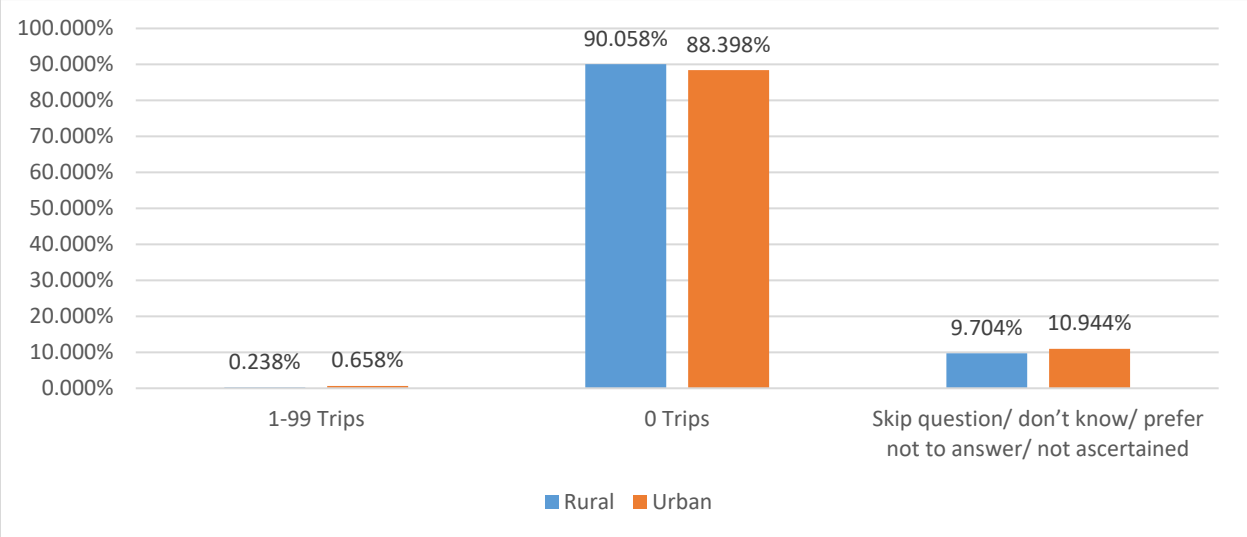


**Figure 3.9** Carshare trip frequency in the past 30 days - urban vs. rural

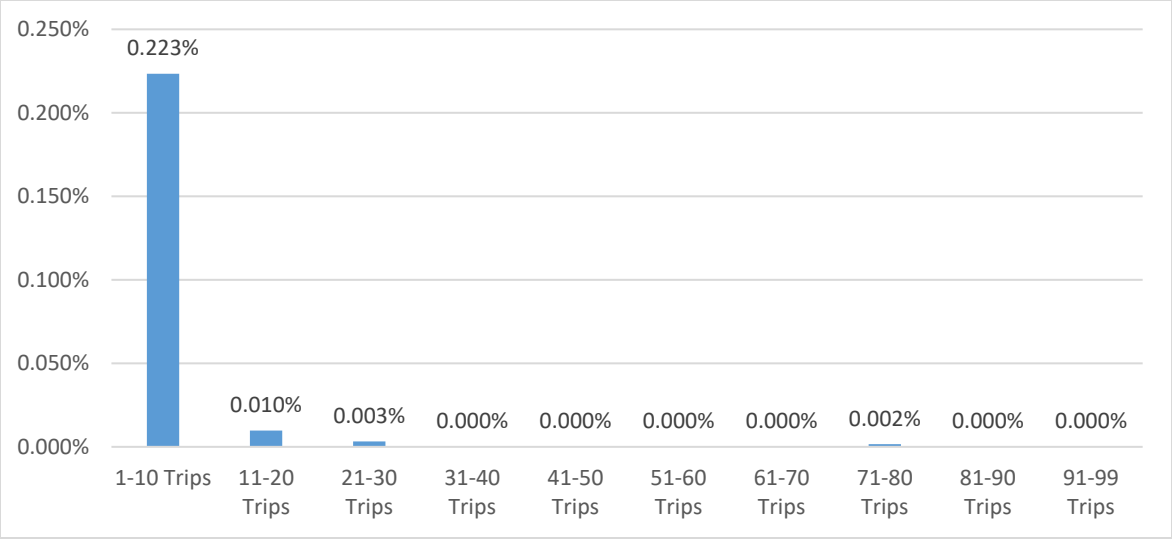


**Figure 3.10** Breakdown of carshare user's trip frequency in the past 30 days for rural areas

The majority of carshare users in rural areas are observed as women (Figure 3.11). Carshare users predominantly belonged to age groups 45-64, 25-44, and 65-or-older (Figure 3.12. Older adults (65-or-older) and children (<18)[3] are underrepresented among rural carshare users (Figure 3.12).

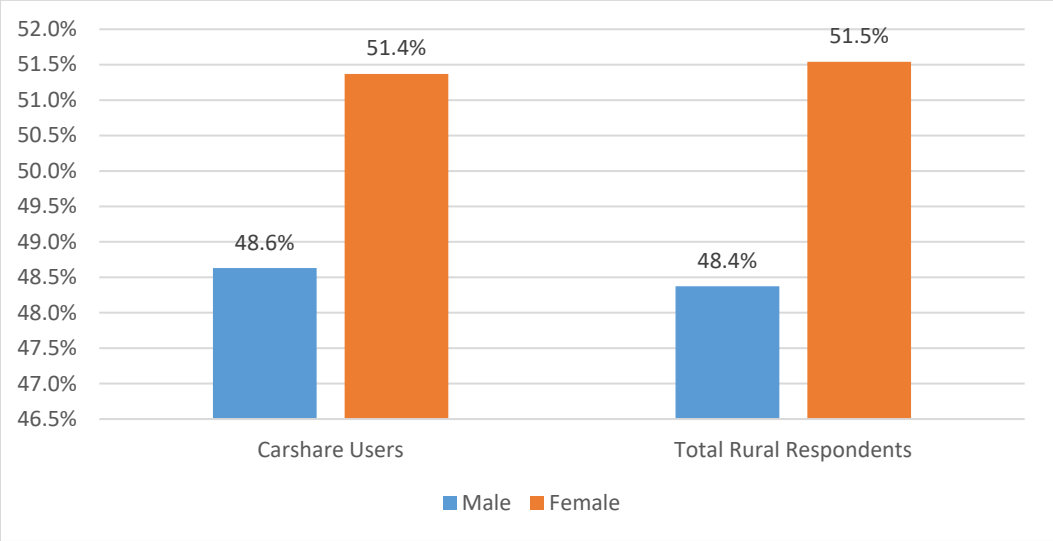


**Figure 3.11** Gender of carshare users and all rural respondents

[3] Carshare usage among the <18 age group is observed to be very minimal, as 18 (and sometimes 21) is the minimum age for users to participate in the program.

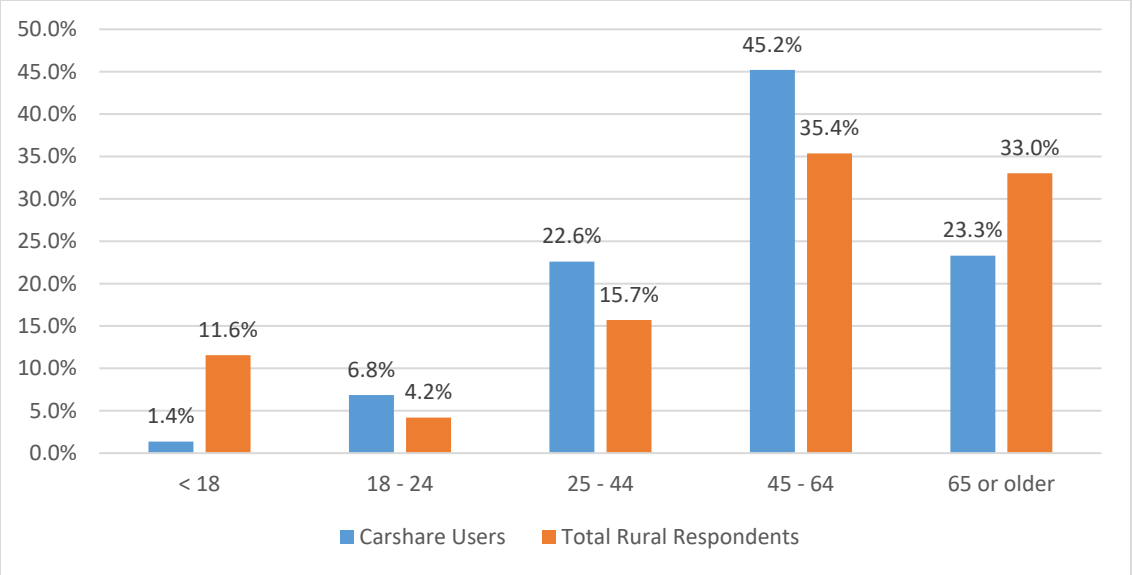


**Figure 3.12** Age of carshare users and all rural respondents

Carshare usage is overrepresented in households with lower (less than $15,000, and $15,000 to $24,999) and higher ($100,000 or more) income groups (Figure 3.13). Higher carshare usage from low-income households could be explained by the fact that low-income households live in poverty and do not own a personal vehicle, and carshare programs offers opportunity to rent a car for a short period of time. Carshare programs in rural areas, which are typically subsidized in some way, provide affordable access to a car for individuals who do not own one. Higher carshare usage among individuals with household income of $100,000 or more follows a similar trend that is observed among rideshare users - people in this group have the luxury to afford such services to have better accessibility when needed.

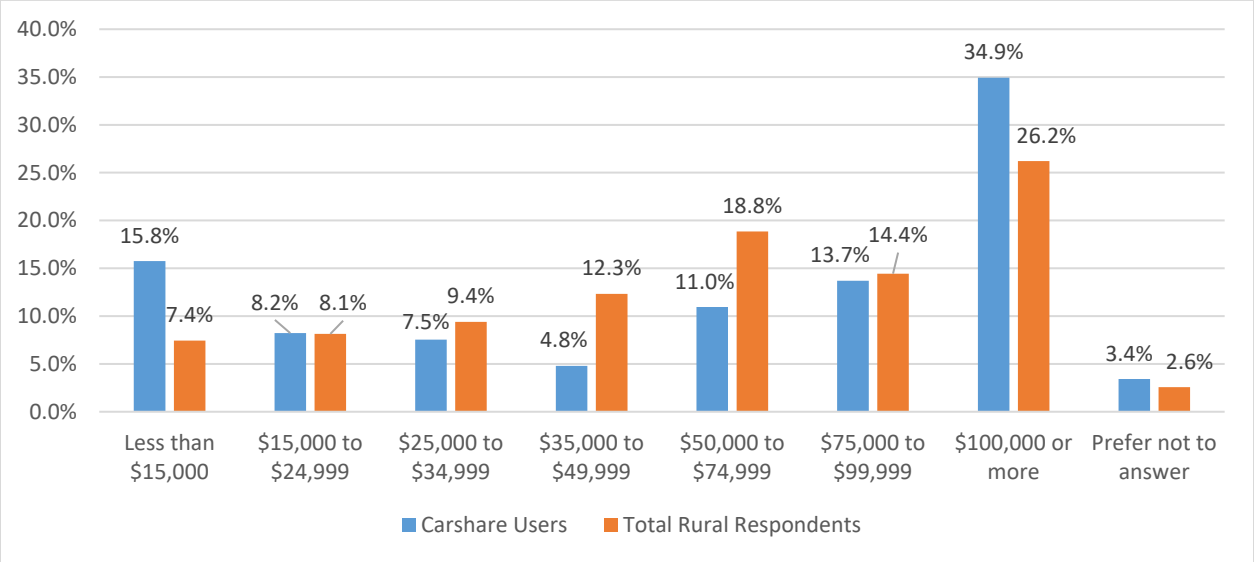


**Figure 3.13** Household income of carshare users and all rural respondents

Household vehicle count for carshare users and all rural responders are compared, and the findings are summarized in Figure 3.14. While the breakdown of household vehicle ownership trends seems similar between carshare users and all rural respondents, carshare users are overrepresented among the groups with lower (0 or 1) or higher (6) vehicles in their household.

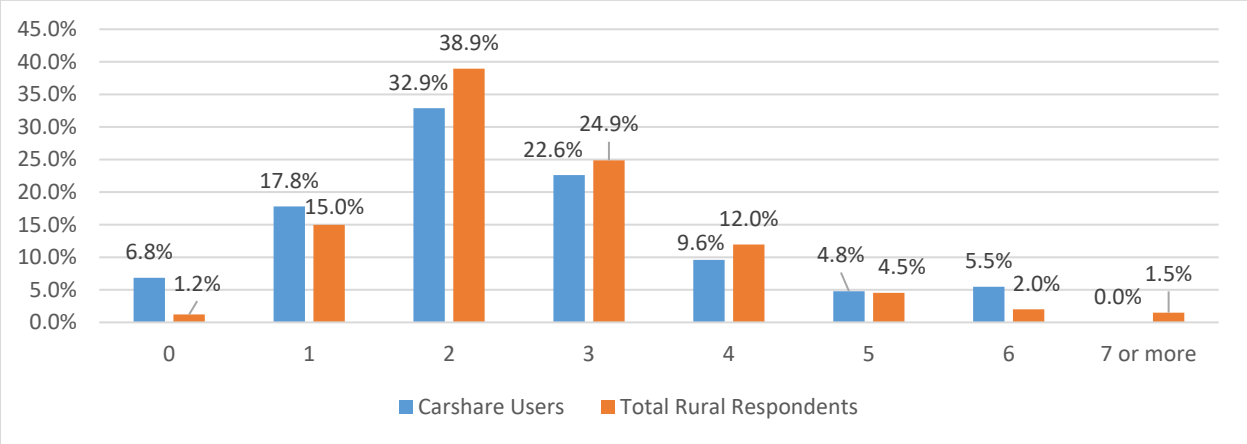


**Figure 3.14** Household vehicle count of carshare users and all rural respondents

Smartphone usage and internet usage among carshare users was found higher than that of all rural respondents[4]. While 65% of people in rural areas are smartphone users, more than 74% of carshare users in rural areas are daily smartphone users (Figure 3.15). Similarly, internet usage is slightly higher among carshare users (89.7%) when compared to rural areas (85.5%) in general (Figure 3.16). It must also be noted that internet use and/or smartphone use is sometimes not mandatory to use carshare programs, especially in rural areas. In certain settings, carshare programs are typically set up in innovative ways to make them accessible for people who do not use the internet, have a smartphone, or have a bank account.

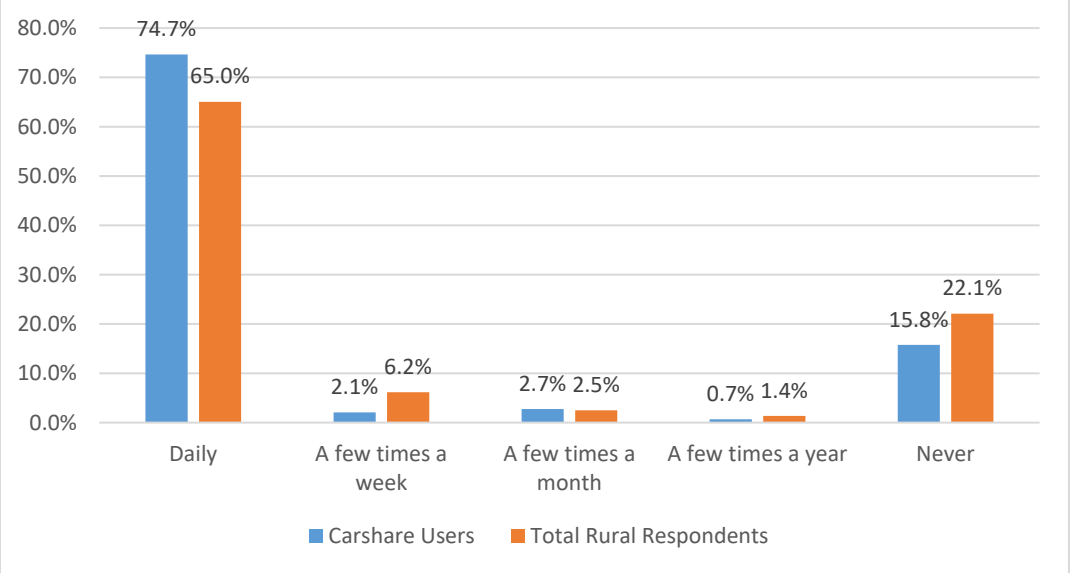


**Figure 3.15** Smartphone usage for carshare users and all rural respondents

[4] Carshare programs are facilitated through internet and smartphone apps, and therefore it is important for potential carshare customers to use the internet and smartphones.

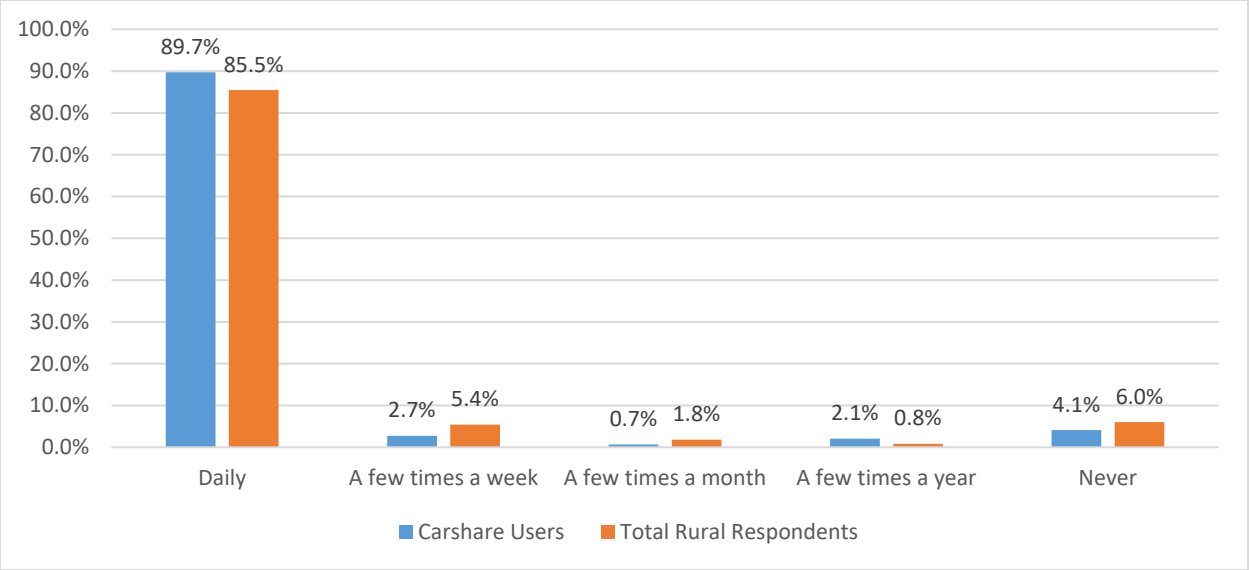


**Figure 3.16** Internet usage for carshare users and all rural respondents

Rural carshare users report having used public transit in the past 30 days at a much higher rate (28.8%) than rural respondents in general (5.6%) (Figure 3.17). An explanation for this correlation is that it is possible that the availability of public transit and carshare services covary (i.e., rural carshare services are more common in places with rural transit service), and it could relate to access to a private vehicle – those who do not have access to a personal vehicle may be more likely to seek out both public transit and carsharing services.

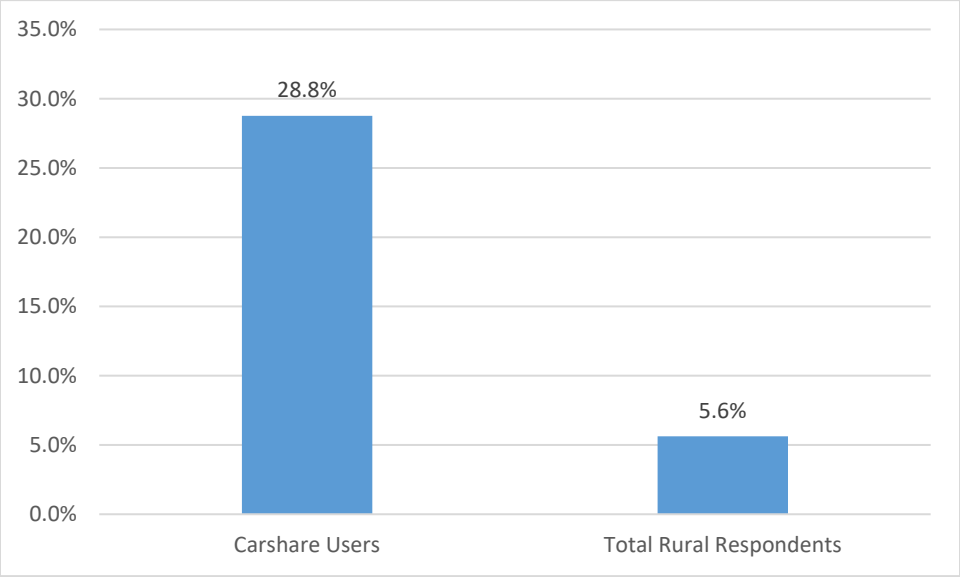


**Figure 3.17** Public transit usage among carshare users and all rural respondents

## 3.3 Bikeshare Usage in Rural America

Another 2017 NHTS question reads: "In the past 30 days, how many times did you use a bike share program (e.g., Bikeshare, Zagster, or CycleHop)?" Responses for this question combined with other relevant question responses are used to summarize some key findings for bikeshare usage in rural America.

Bikesharing (1-99 trips in the past 30 days) is relatively rare in both urban (0.536% of people) and rural areas (0.308% of people) (Figure 3.18) and much rarer than rideshare usage in both urban and rural areas (see Figure 3.1). This low level of bikesharing in rural areas is likely explained by the relative scarcity of rural bikesharing service availability. Bikeshare usage (0.308% of people) is closer to carshare (0.238% of people) usage in rural areas. Among the 0.308% of people in rural areas who used bikeshare services at various frequencies, most (0.220% of the people) purchased one to10 bikeshare trips in the past 30 days (Figure 3.19).

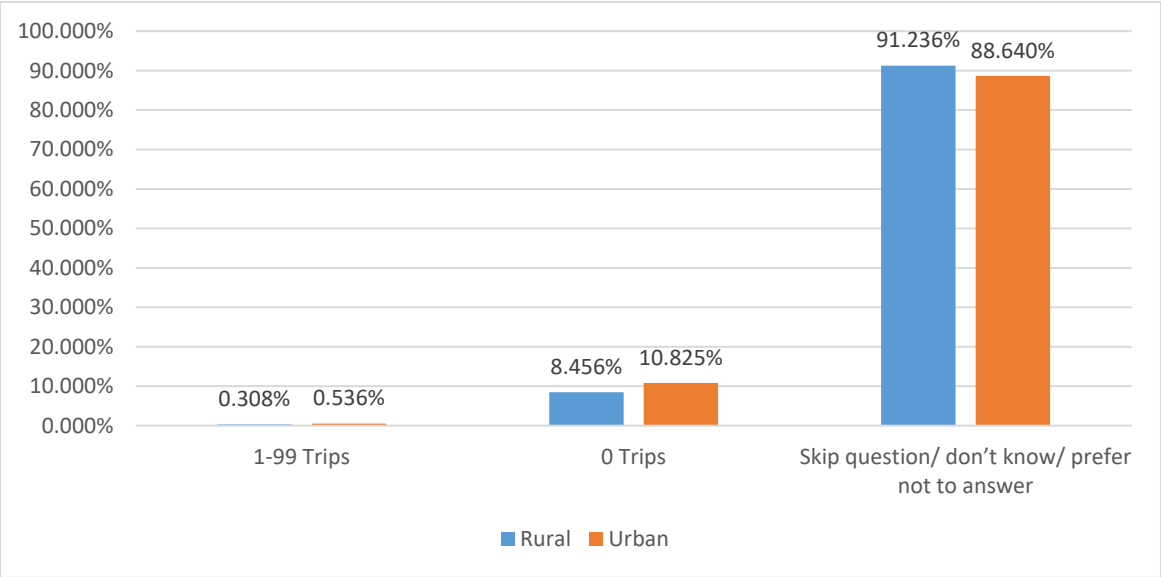


**Figure 3.18** Bikeshare trip frequency in the past 30 days - urban vs. rural

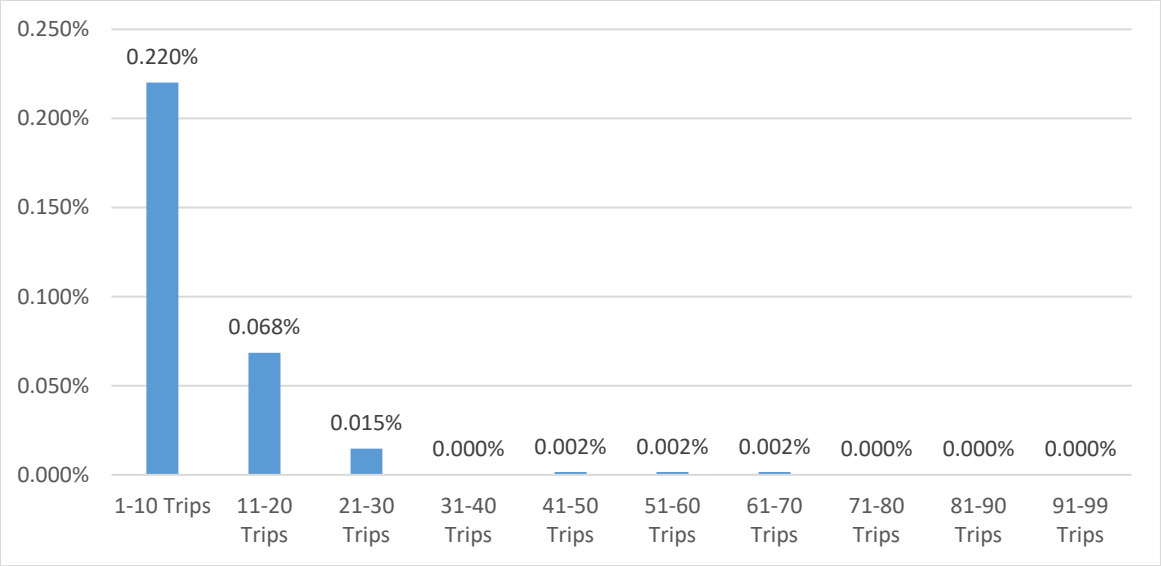


**Figure 3.19** Breakdown of bikeshare user's trip frequency in the past 30 days for rural areas

Bikeshare users in rural areas are observed to be more men (55.6%) than women (43.9%) (Figure 3.20). When compared with age groups of total rural respondents, bikeshare users in rural areas are overrepresented for the <18 age group (16 is the minimum age to use bikeshare programs for many systems, unlike the rideshare and carshare program) and the 25-44 age group (Figure 3.21).

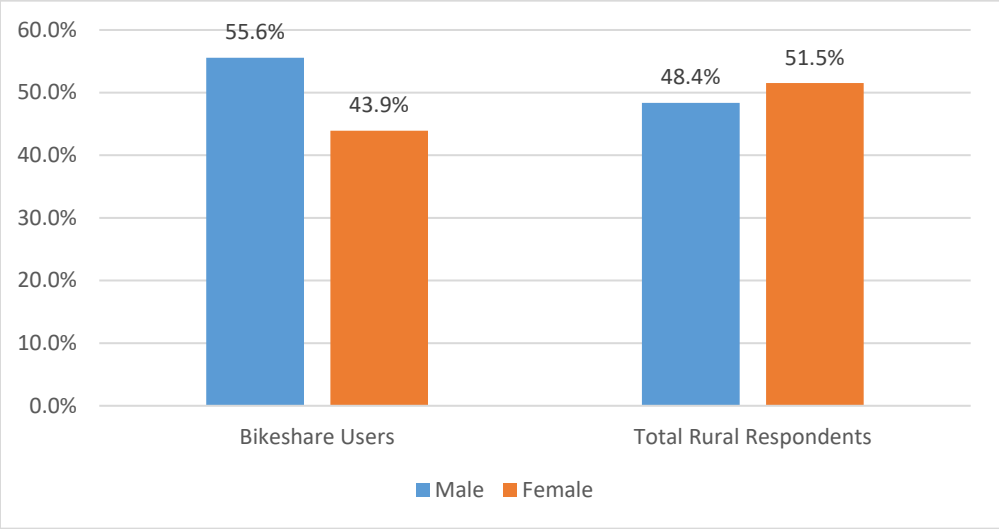


**Figure 3.20** Gender of bikeshare users and all rural respondents

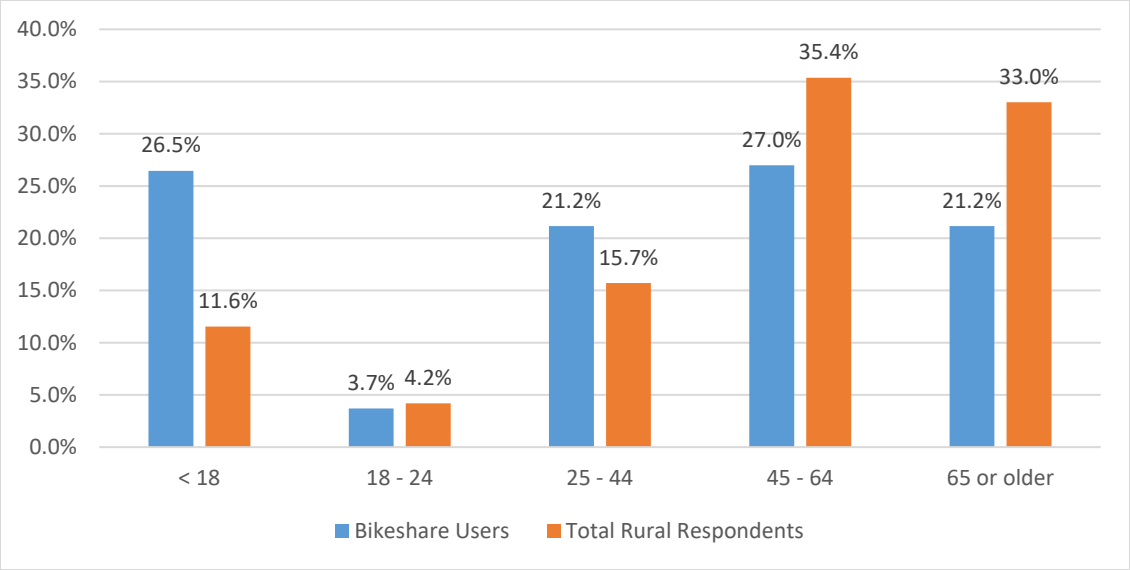


**Figure 3.21** Age of bikeshare users and all rural respondents

Bikeshare usage is overrepresented in the lower (less than $15,000, $15,000 to $24,999) and higher ($75,000 to $99,999) household income groups (Figure 3.22). Overrepresentation of bikeshare usage among lower household income groups in rural areas could be explained by the fact that a significant percentage of the low-income households live in poverty and they rely on affordable transportation options to get from point A to point B. Bikeshare programs are affordable transportation services among all the shared-use mobility services available. Bikeshare programs in some rural areas are further subsidized to make them even more affordable, or sometimes free.

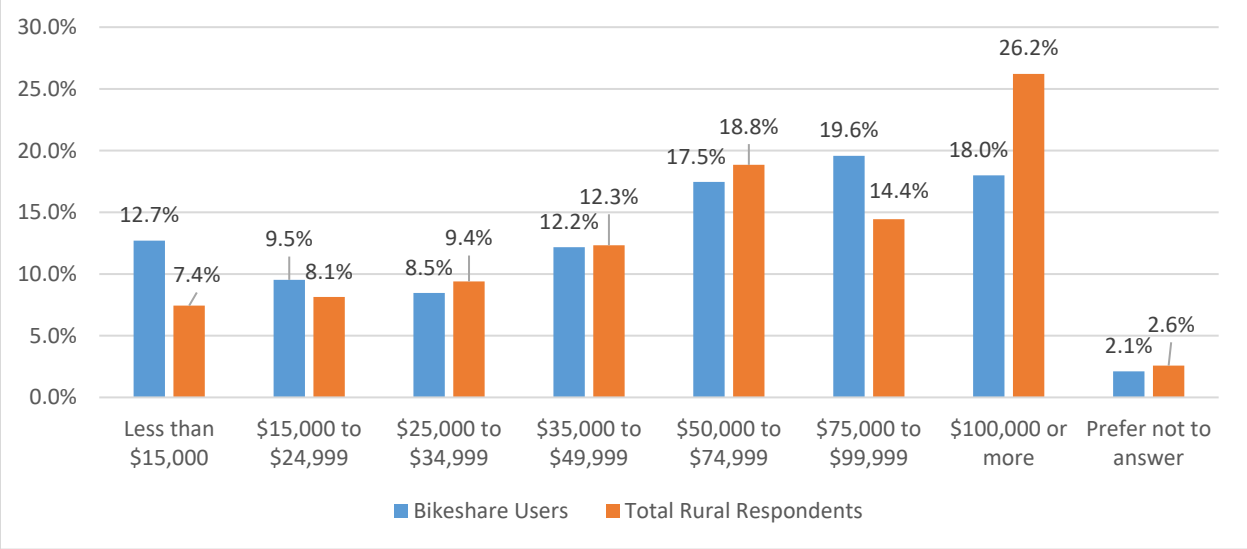


**Figure 3.22** Age of bikeshare users and all rural respondents

Smartphone usage and internet usage among bikeshare users was found higher than that of all rural respondents[5]. While 65% of people in rural areas are smartphone users, more than 79% of bikeshare users in rural areas are daily smartphone users (Figure 3.23). Similarly, internet usage is slightly higher among carshare users (90.5%) when compared to rural areas (85.5%) in general (Figure 3.24). Internet use and/or smartphone use is sometimes not mandatory to use bikeshare programs, especially in rural areas. In some rural communities, bikeshare programs check out bikes after verifying identity.

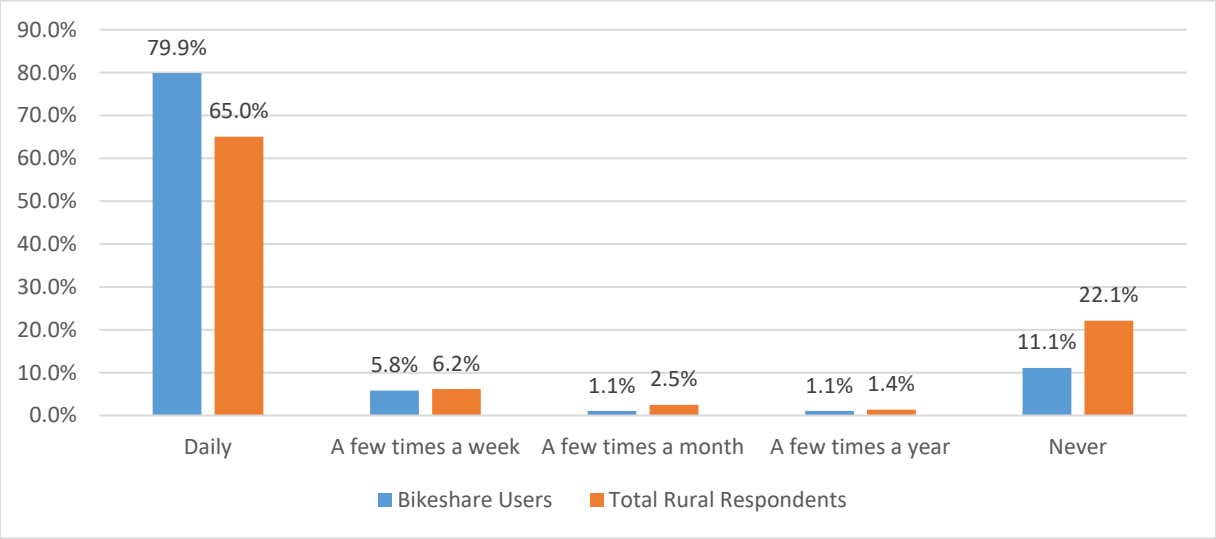


**Figure 3.23** Smartphone usage for bikeshare users and all rural respondents

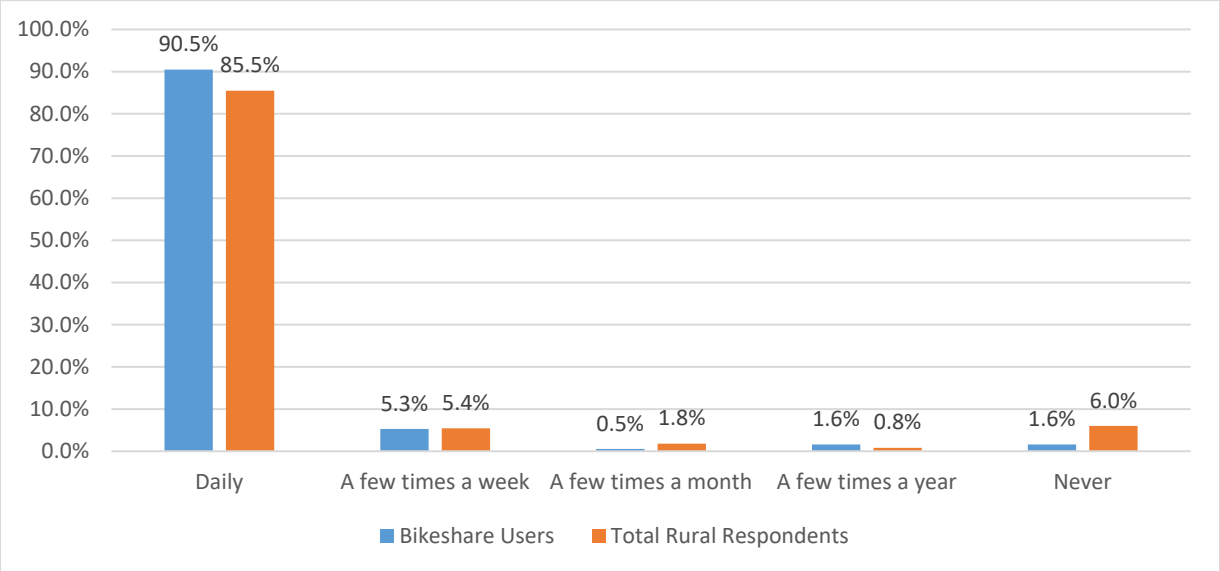


**Figure 3.24** Internet usage for bikeshare users and all rural respondents

[5] Bikeshare programs are facilitated through the internet and smartphone apps. Therefore, it is important for potential bikeshare customers to use the internet and smartphones.

Rural bikeshare users report having used public transit in the past 30 days at a much higher rate (20.1%) than rural respondents in general (5.6%) (Figure 3.25). An explanation for this correlation is that it is possible that the availability of public transit and bikeshare services covary (i.e., rural bikeshare services are more common in places with rural transit service), and it could relate to access to a private vehicle – those who do not have access to a personal vehicle may be more likely to seek out both public transit and bikesharing services.

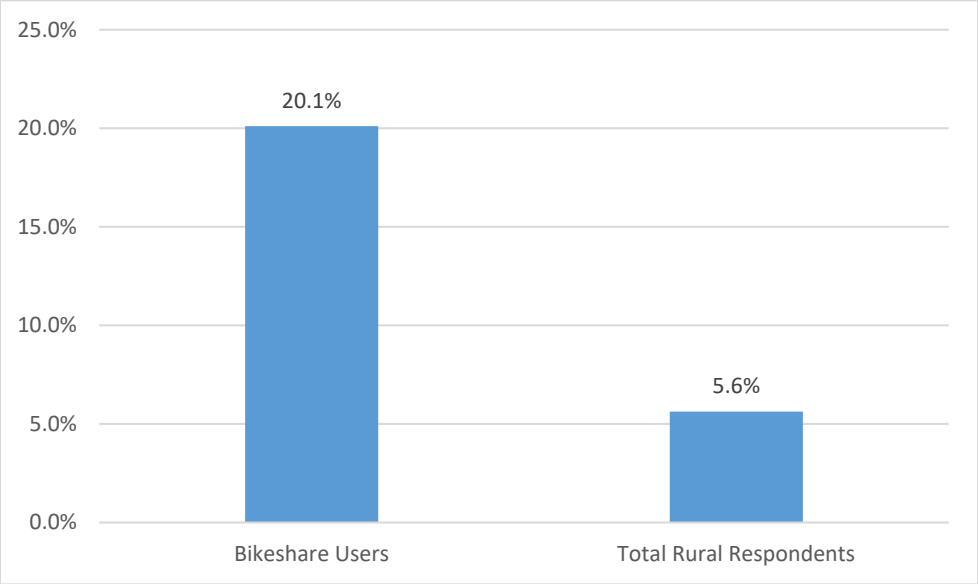


**Figure 3.25** Public transit usage among bikeshare users and all rural respondents

## 3.4 Online Shopping for Delivery in Rural America

Another 2017 NHTS question reads: "In the past 30 days, how many times did you purchase something online and have it delivered?" Responses for this question combined with other relevant question responses are used to summarize some key findings for online shopping for delivery in rural America.

Online shopping behavior is almost the same for respondents from urban and rural areas (Figure 3.26). About half of the respondents in urban (51.9% ) and rural (48.1% ) areas purchased something (1-99 times in the past 30 days) online and had it delivered (Figure 3.26). It is interesting to note that internet shopping to have things delivered is much more prominent among rural residents than using the internet to purchase transportation services (rideshare, carshare, and bikeshare services). Among the 48.1% of people in rural areas who used online shopping for delivery, most (44.7%) of the people made online purchases anywhere between one and 10 times in the past 30 days (Figure 3.27). It must also be noted that there are a notable percentage of rural residents who made online purchases more than 10 times in the past 30 days.

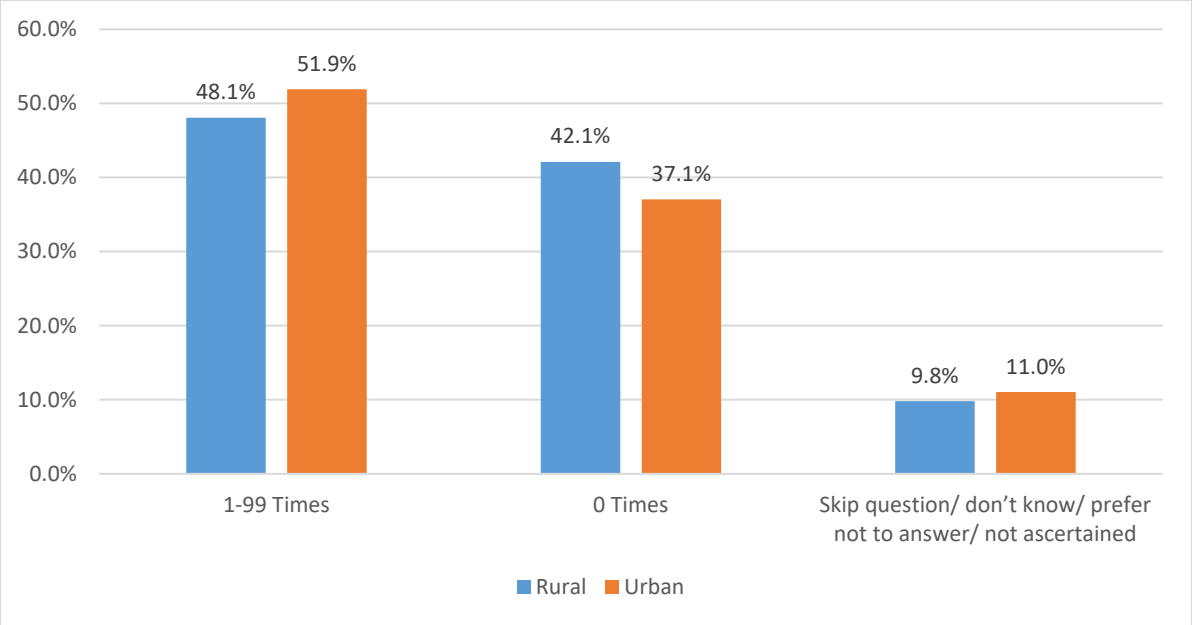


**Figure 3.26** Online shopping frequency in the past 30 days - urban vs. rural

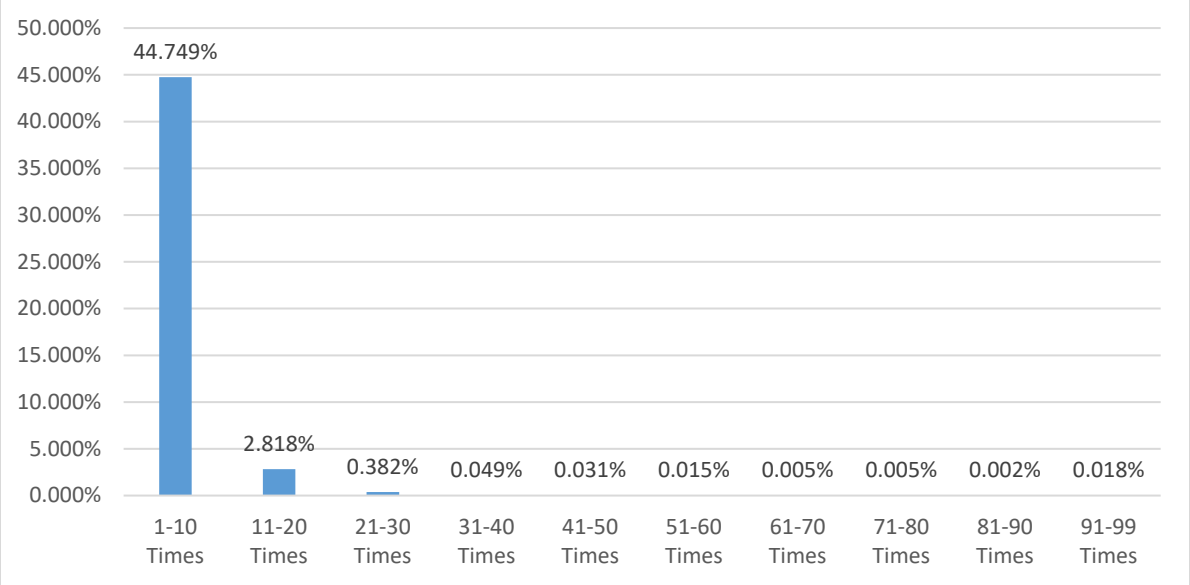


**Figure 3.27** Breakdown of online shopping frequency in the past 30 days for rural areas

Most online shoppers are observed to be women (refer Figure 3.28), just as women were the majority among total rural respondents. Age groups that are overrepresented as online shoppers in rural areas are 45-64 and 25-44, which means rural respondents among these age groups are inclined toward shopping online when compared with other age groups. Online shoppers among the <18 age group are observed to be very minimal, as there would be an age limit on platforms that allow for online shopping or for bank accounts that facilitate the payment process for online shopping.

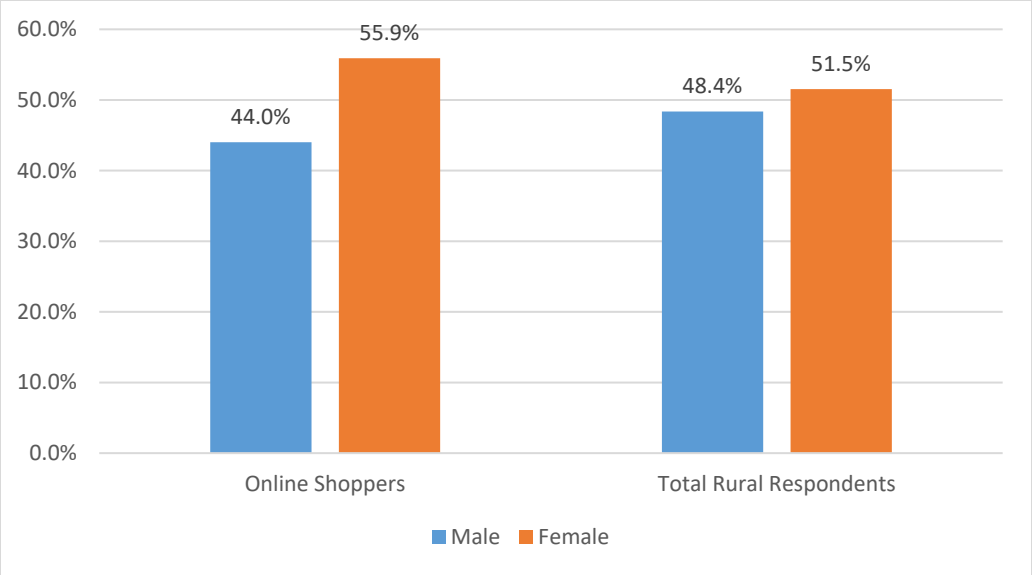


**Figure 3.28** Gender of rural online shoppers and all rural respondents

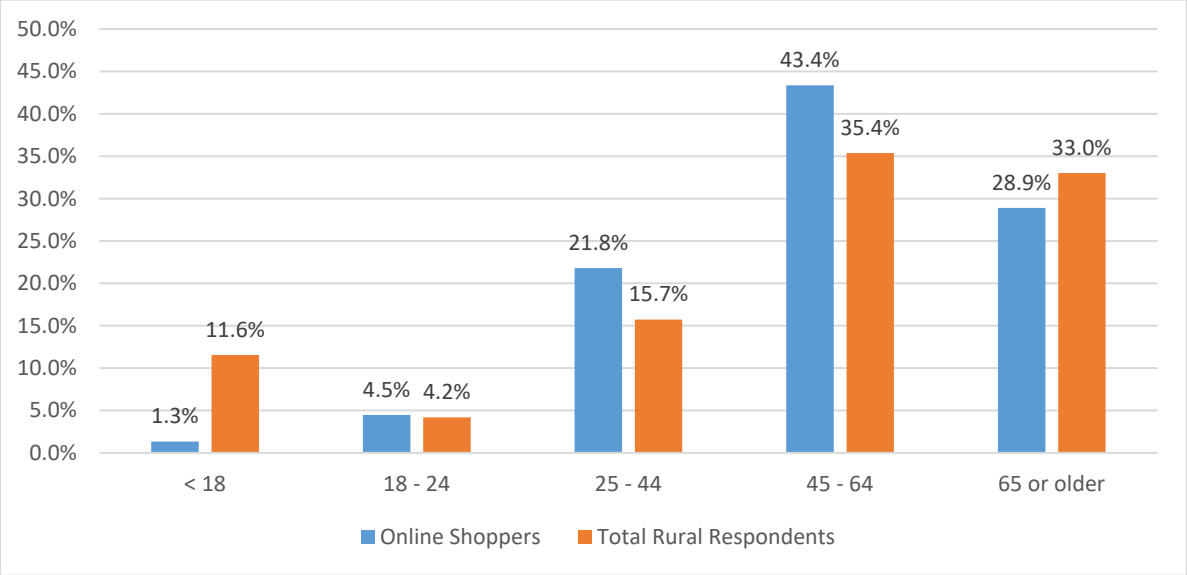


**Figure 3.29** Age of rural online shoppers and all rural respondents

Household income has an impact on online shopping behavior in rural areas. As the household income increased, online shopping behavior increased (Figure 3.30). Therefore, it can be concluded that lower income groups tend to shop less online and higher income groups are inclined toward more online shopping.

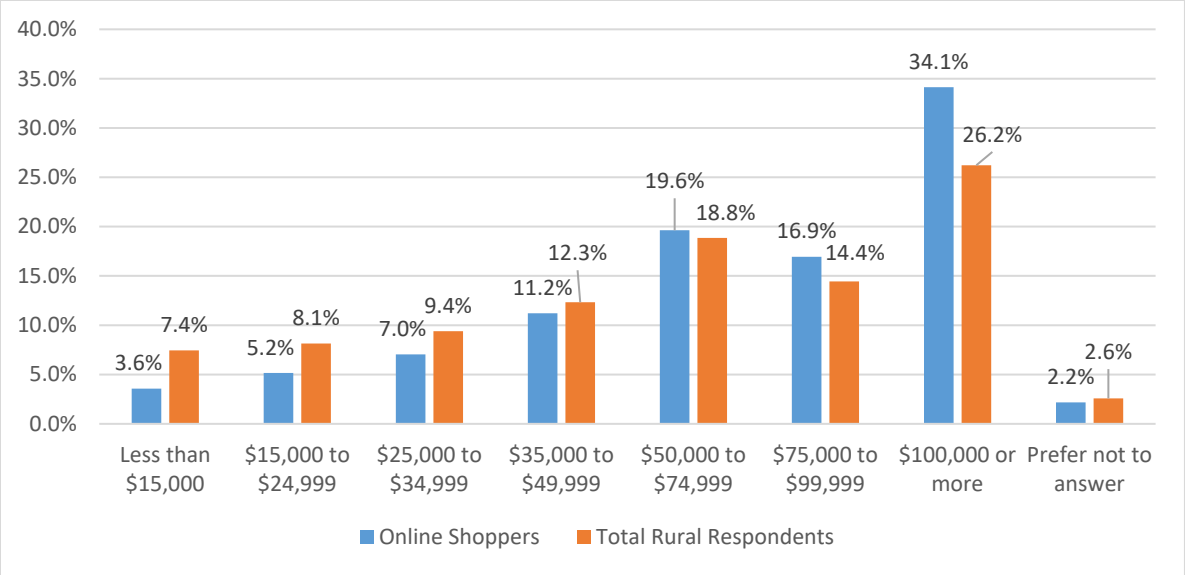


**Figure 3.30** Household income of rural online shoppers and all rural respondents

Smartphone and internet usage among online shoppers was found higher than that of all rural respondents - primarily because internet or smartphones are facilitators to make online shopping possible. While 65% of people in rural areas are smartphone users, more than 73% of online shoppers in rural areas are daily smartphone users (Figure 3.31). Similarly, internet usage is slightly higher among online shoppers (94.9%) when compared to rural areas (85.5%) in general (Figure 3.32).

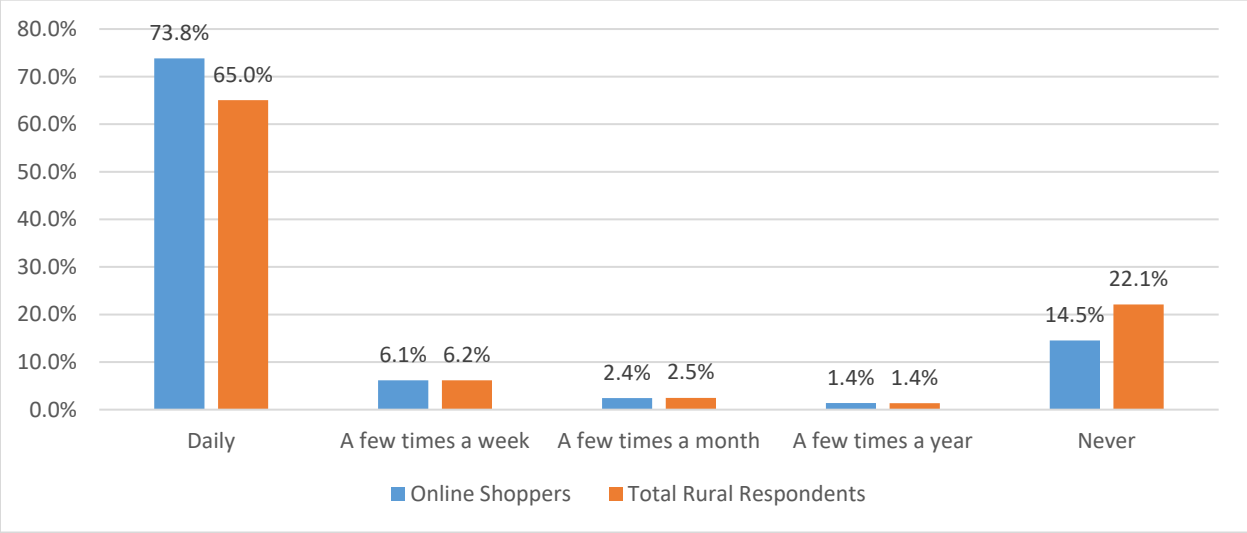


**Figure 3.31** Smartphone usage for rural online shoppers and all rural respondents

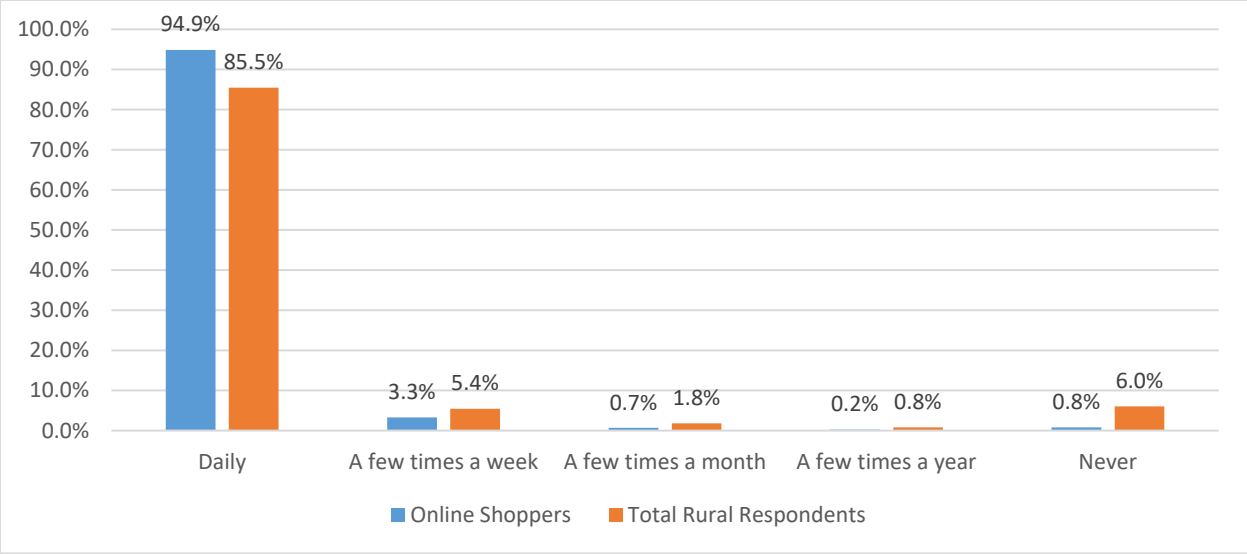


**Figure 3.32** Internet usage for rural online shoppers and all rural respondents

## 3.5 Data Correlation Analysis

This section presents results from the modelling conducted with 2017 National Transit Household Survey (NHTS) data to predict how various factors observed in the NHTS data could help predict the usage of rideshare services and online shopping for delivery in rural areas. For this process, the initial step adopted was to develop models to predict the likelihood of rideshare usage and online shopping for delivery service usage in rural areas in the United States. Later steps involve developing simulation models to predict optimal circumstances that can result in the desired outcome for rideshare usage and online shopping for delivery service usage. Specifics about models chosen, analysis procedure, and simulations conducted are presented in Appendix A.

*Results from Analysis of Rideshare Users:*

Household family income and education levels correlate significantly with ridershare service usage. A unit increase in education correlates with a 37.8% increase in the odds of using rideshare service. A unit increase in household income correlates with a 31.6% increase in the odds of using rideshare service. Note that at a lower level of significance, the models suggest that being male, increased use of shopping delivery service, and increases in the number of walk trips all increase the odds of using rideshare service.

*Results from Analysis of Shopping for Delivery Service:*

Household family income, the frequency of smartphone use, and the logarithm of the level of education correlate significantly with shopping for delivery service. A unit decrease in the level of household family income decreases the odds of delivery service use by 16.3%. Similarly, a unit decrease in the logarithm of education reduces the odds of delivery service use by 99.3%. A unit increase in the frequency of smartphone use increases the odds of delivery service use by 26.1%.

# 4. RURAL COMMUNITY SHARED USE MOBILITY STUDY

## 4.1 Description of Survey

In 2019, a survey was developed to administer to residents in two North Dakota communities: Fargo, a small urban[6] city on the eastern border of the state with a population of 121,881 residents, and Dickinson, a rural community on the western side of the state with a population of 22,882. The intent of the survey was to learn about the types of transportation options each community uses, how the options have changed because of the COVID-19 pandemic, public opinion about and interest in transportation-related technologies like electric vehicles, and factors associated with transportation choices, opinions, and interests. Several questions were patterned after aspects of the *Whole Traveler Transportation Behavior* study from the Lawrence Berkeley National Laboratory, Berkeley, California, and administered in San Francisco to learn about the adoption of interests in shared, electrified, and automated transportation.

To participate in the survey, respondents had to be 18 years old. If they were not 18, they could not proceed with the questionnaire. The first section of the survey contained questions about the primary trip destination of the respondent and aspects related to the primary destination, e.g., work or school, distance, frequency traveled to the destination pre- and post-COVID, mode of travel, and thoughts about transportation options that included online deliveries. Respondents were also asked about what they liked most and least about making purchases online. The second section contained questions about advanced transportation-related technologies, such as hybrid vehicles and smartphones, to understand if the respondents would be early adopters of the advanced transportation-related technologies. The third section contained questions about basic demographics and household information to better understand attributes of the respondents.

## 4.2 Methodology

The survey was conducted online from December 9 to 22, 2020 via Facebook and distribution onboard buses. A separate website link was available for each city's questionnaire. The links were placed on Facebook. Radio and television stations within each city were contacted and asked to help promote the surveys. Bus drivers for the Dickinson Public Transit system had paper surveys available for riders who did not have computer access to complete the survey online. To help recruit survey respondents, two random drawings for $50 Amazon gift cards within each community were held and distributed on December 23.

In Fargo, 91 respondents over age 18 completed the survey, while 38 respondents over 18 from Dickinson completed the survey. Respondents from both cities were asked the same questions. Responses from Fargo are first presented and then responses from Dickinson are presented followed by a comparison of the two cities identifying the similarities and differences.

[6] Urban being a population greater than 50,000 residents and rural being a population less than 50,000 residents.

The survey results presented consist of descriptive statistics for each city. Simple frequencies are explained with some crosstabs using age and gender. We entertained fitting a regression model to identify the independent variables that may help identify those who may be more likely to adopt or be interested in adopting the new transportation technologies, but the preliminary assessment of the data suggested it would not be productive. A larger sample size from each city would be needed to move forward with this type of analysis.

## 4.3 Fargo

The demographics of the Fargo respondents are shown in Table 4.1. When examining the demographics, 42 males, 27 females, and one person that preferred not to answer the question responded. “Other” was also included as a gender option, but no respondents selected that category, so it is not included in this analysis. Most respondents were in the age groups 25-44 (36%) and 45-64 (43%).

When asking about race, the survey options included: White; Hispanic, Latino, or Spanish origin; Black or African American; Asian; Middle Eastern or North African; American Indian or Alaska Native; Native Hawaiian or Pacific Islander; Some other race or origin; and Prefer not to answer. Most respondents were White (91%), with Asian (1%), other race or origin (1.4%) and prefer not to answer (6%) selected (Table 1).

As seen in Table 4.1, about 73% of the respondents hold a bachelor’s or advanced degree. Likewise, about 73% of respondents are employed for wages, 16% are retired, 6% are self-employed, 6% are students, and 3% reported as homemaker. Although 16% preferred not to answer the household income question, 63% earn incomes greater than $45,000. According to the U.S. Census Bureau, American Community Survey (ACS), the median household income in Fargo was $55,551 in 2019, so some of the residents are below the average household income but many respondents are above the mean in household income.

**Table 4.1** Characteristics of Fargo Respondents, N=70

| | Total | Male | Female | Prefer not to answer |
|---|---|---|---|---|
| Total Count (All) | 70.0 | 42.0 | 27.0 | 1.0 |
| **Race** | | | | |
| White | 91.4% | 95.2% | 88.9% | 0.0% |
| Hispanic, Latino, or Spanish origin | 0.0% | 0.0% | 0.0% | 0.0% |
| Black or African American | 0.0% | 0.0% | 0.0% | 0.0% |
| Asian | 1.4% | 0.0% | 3.7% | 0.0% |
| Some other race or origin | 1.4% | 0.0% | 3.7% | 0.0% |
| Prefer not to answer | 5.7% | 4.8% | 3.7% | 100.0% |
| **Highest Education Level Completed** | | | | |
| 12th grade or less, no diploma | 0.0% | 0.0% | 0.0% | 0.0% |
| High school diploma/GED | 5.7% | 7.1% | 3.7% | 0.0% |
| Some college | 12.9% | 9.5% | 18.5% | 0.0% |
| Associate degree | 7.1% | 9.5% | 3.7% | 0.0% |
| Bachelor's degree | 52.9% | 54.8% | 51.9% | 0.0% |
| Master's degree | 12.9% | 11.9% | 14.8% | 0.0% |
| Professional degree (for example: MD, DDS, JD) | 7.1% | 7.1% | 7.4% | 0.0% |
| Prefer not to answer | 1.4% | 0.0% | 0.0% | 100.0% |
| **Annual Household Income before Taxes** | | | | |
| Less than $20,000 | 5.7% | 7.1% | 3.7% | 0.0% |
| $20,000 - $44,999 | 15.7% | 9.5% | 25.9% | 0.0% |
| $45,000 - $99,999 | 18.6% | 19.0% | 18.5% | 0.0% |
| $100,000 - $149,999 | 22.9% | 26.2% | 18.5% | 0.0% |
| $150,000 or more | 21.4% | 23.8% | 18.5% | 0.0% |
| Prefer not to answer | 15.7% | 14.3% | 14.8% | 100.0% |
| **Employment Status** | | | | |
| Employed for wages | 72.9% | 71.4% | 77.8% | 0.0% |
| Self-employed | 5.7% | 7.1% | 3.7% | 0.0% |
| Out of work and looking for work | 0.0% | 0.0% | 0.0% | 0.0% |
| Out of work but not currently looking for work | 0.0% | 0.0% | 0.0% | 0.0% |
| A homemaker | 2.9% | 0.0% | 7.4% | 0.0% |
| A student | 5.7% | 9.5% | 0.0% | 0.0% |
| Military | 0.0% | 0.0% | 0.0% | 0.0% |
| Retired | 15.7% | 16.7% | 14.8% | 0.0% |
| Unable to work | 2.9% | 4.8% | 0.0% | 0.0% |
| Prefer not to answer | 1.4% | 0.0% | 0.0% | 100.0% |

Most respondents (73%) identified work as their primary destination (Figure 4.1). About 2% of respondents' primary trip was to school while 4% was for the work or school of a household member. About 21% of respondents reported other as their primary trip destination and provided the description of medical appointments, grocery store, daycare, volunteering, and fun times.

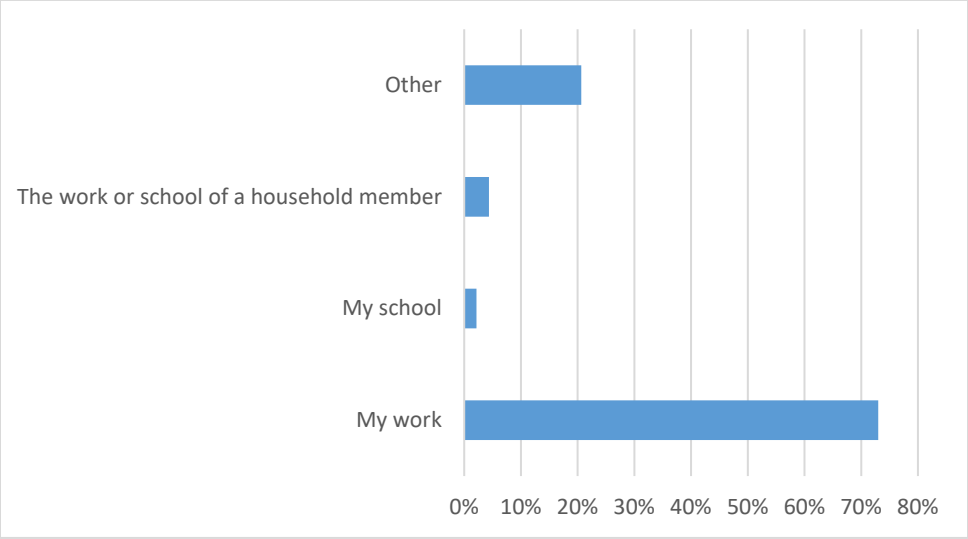


**Figure 4.1** Primary Destination, N=92

One-fourth of the respondents (25%) travel 1-3 miles to reach their primary destination, while 32% travel 3-5 miles, and another 25% travel 5-10 miles (Table 4.2).

**Table 4.2** Miles to Primary Destination

| **Miles** | **%** | **Count** |
|---|---|---|
| Less than 1/2 mile | 4.8 | 4 |
| 1/2 mile to 1 mile | 3.6 | 3 |
| 1 mile to 3 miles | 25.3 | 21 |
| 3 - 5 miles | 32.5 | 27 |
| 5 - 10 miles | 25.3 | 21 |
| 10 - 15 miles | 4.8 | 4 |
| 15 - 25 miles | 0.0 | 0 |
| More than 25 miles | 3.6 | 3 |
| Total | 99.9* | 83 |

*Does not total 100% due to rounding

### 4.3.1 Number of days per week to primary destination before COVID-10 / After COVID-19

Respondents were asked how many days per week they traveled to their primary destination before COVID-19 and how many days after COVID-19. Before COVID-19, 77% of respondents traveled five days per week to their primary destination; this was reduced to 47% after COVID-19 (Figure 4.2). Whereas only 1% of respondents indicated they traveled one day per week to their primary destination before COVID-19, this number increased to 12% after COVID-19. Two percent of respondents did not travel to their primary destination much during the week; this number increased to 17% of those who no longer traveled to their primary destination. In summary, some respondents who traveled regularly to their primary destinations have instead been traveling less frequently (0 days a week, 1 day a week, 2 days a week, 3 days a week, etc.,) after COVID-19.

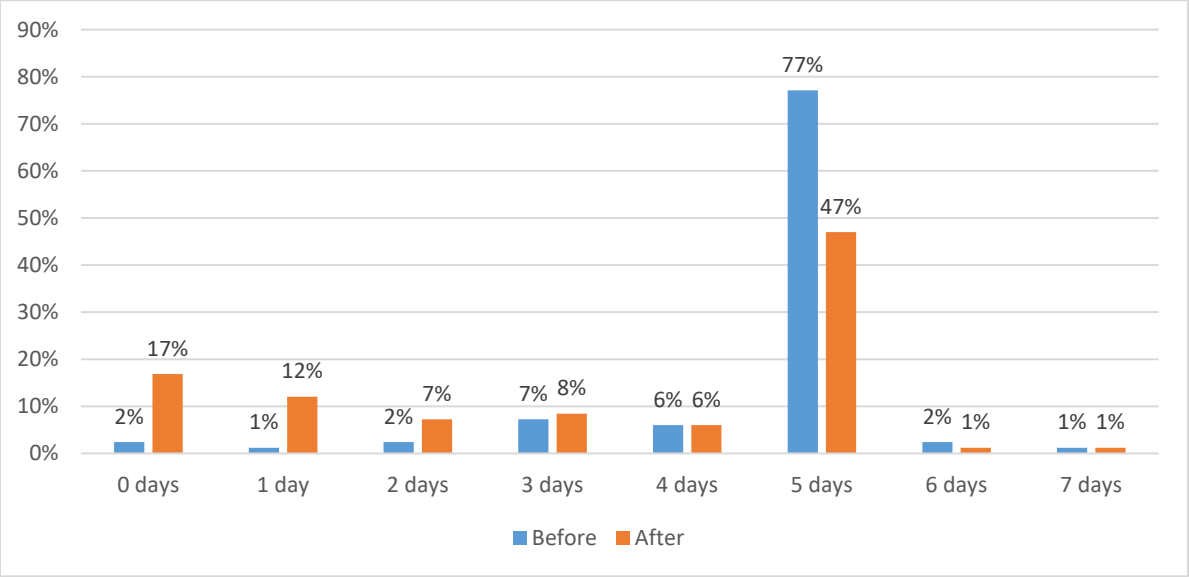


**Figure 4.2** Number of days travel to primary destination before and after COVID-19, N=83

Respondents were asked about the type of transportation mode they took to their primary destination per week before and after COVID-19. The transportation mode options provided for the respondents to select included:

- Your own vehicle (single occupant)
- Carpool with a friend, family member, colleague, or through casual carpool
- Public transit
- Uber, Lyft, or similar app-based rideshare service
- Motorcycle, moped, or scooter
- Your own bicycle/scooter
- Bike/scooter sharing programs
- Walking

Eighty respondents answered this question, and 73% indicated they used their own vehicle as a single occupant four or more times per week prior to COVID-19 (Figure 4.3). Next to using their own vehicle, the most frequently used mode four or more times per week included public transit (10%), walk (7.5%), carpool with friend (6.25%), and using personal bicycle/scooter (2.47%). Figure 4.3 summarizes the various modes respondents used to travel to their primary destination and their frequency of usage.

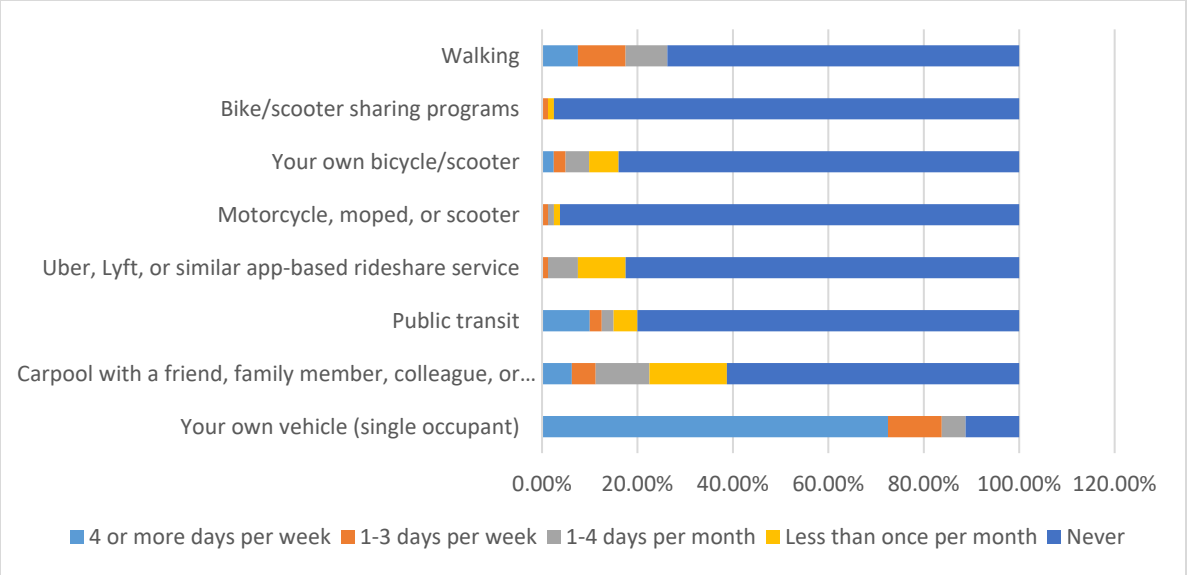


**Figure 4.3** Transportation mode taken to primary destination, prior to COVID

Ninety-six percent (78) of the respondents reported that they had a driver's license, yet 17% (14) reported they preferred not to drive. Two respondents indicated they could not drive because of a disability, illness, or other limitation.

We wanted to better understand if respondents considered two travel factors (ability to interact with others and environmental factors) as positive, negative, or indifferent, which would impact their decision regarding their travel mode. Among respondents, 42% viewed their ability to interact with other people as positive, whereas only 11% viewed this as negative and 47% were indifferent to traveling with other people (Table 4.3). Nearly 60% of respondents viewed minimizing environmental impacts as positive, whereas only 5% viewed this as negative and 36% were indifferent.

**Table 4.3** Characteristics Viewed as Positive and Negative, N=81

| Characteristic | Positive | Negative | Indifferent |
|---|---|---|---|
| | ----------Percent---------- | | |
| Ability to interact with people (other than close friends or family members) | 42 | 11 | 47 |
| Minimize environmental impacts | 59 | 5 | 36 |

Predictability and safety were important to respondents when selecting a travel mode. More specifically, predictable arrival time (69.3%), safety (65.3%), shelter from bad weather (64%), and low hassle (62.7%) were the factors identified as very important to respondents as shown in Table 4.4. More than half did not view it as important nor think about the ability to transport a child under 8 years of age safely and conveniently, nor did they think it was important to have the ability to engage in activities while traveling. Fifty percent of respondents had not thought about maximizing the environmental impact as an important travel aspect, yet 31% and 37.8% thought it was very important and somewhat important, respectively, to minimize their environmental impact (Table 4.4).

**Table 4.4** Importance of Identified Characteristics for Decision of Transportation Options

| Characteristic | Very Important | Moderately important | Slightly important | Not at all important | I never thought about it before |
|---|---|---|---|---|---|
| Short travel time | 46.0% | 35.1% | 13.5% | 2.7% | 2.7% |
| Shelter from bad weather | 64.0% | 24.0% | 8.0% | 1.3% | 2.7% |
| Low Cost | 32.0% | 28.0% | 20.0% | 14.7% | 5.3% |
| Predictable arrival time | 69.3% | 26.7% | 1.3% | 1.3% | 1.3% |
| Ability to engage in activities while traveling | 12.0% | 14.7% | 25.3% | 41.3% | 6.7% |
| Ability to easily make more than one stop | 41.3% | 38.7% | 10.7% | 5.3% | 4.0% |
| Ability to safely and conveniently transport a child under 8 years of age | 18.9% | 5.4% | 9.5% | 46.0% | 20.3% |
| Low hassle | 62.7% | 28.0% | 5.3% | 1.3% | 2.7% |
| Safety | 65.3% | 20.0% | 9.3% | 4.0% | 1.3% |
| Predictable cost | 30.7% | 40.0% | 17.3% | 9.3% | 2.7% |
| Not having to interact with people (other than close friends or family members) | 37.5% | 50.0% | 12.5% | 0.0% | 0.0% |
| Maximize environmental impacts | 25.0% | 0.0% | 25.0% | 0.0% | 50.0% |
| Ability to interact with people (other than close friends or family members) | 16.1% | 25.8% | 32.3% | 22.6% | 3.2% |
| Minimize environmental impacts | 31.1% | 37.8% | 24.4% | 6.7% | 0.0% |

### 4.3.2 Deliveries and Trips During a Typical Month Pre- and Post-COVID

Respondents were asked how many times during a typical month someone in their household received delivery from an online/phone order, took a vehicle (such as personal vehicle, taxi, Uber, or Lyft) to a store or restaurant, or walked, biked or used public transit to get to the store or restaurant to purchase one or more of these options: groceries; clothing, shoes or accessories; household items; or prepared meals, which include eating at a restaurant or getting takeout. Since travel behavior has changed greatly with the COVID-19 pandemic, this question was asked for a pre-COVID and post-COVID condition. A summary of the survey findings for these two questions is synthesized in Table 4.5.

Online/phone grocery purchase orders for a delivery were not prominent before COVID, as only 10% of the respondents used them at various frequencies in a typical month. However, after COVID, more than one-third of the respondents started purchasing groceries using online/phone orders for a home delivery. The frequency of grocery purchase among the respondents in a typical month is summarized in Table 4.5. A breakdown of these observations based on gender and age group is summarized in Table 4.6, 4.7, and 4.8. Purchasing groceries by taking a vehicle, walking, bicycling, or taking public transit did not change drastically; this can be observed in Table 4.5. While there are some small fluctuations in the frequency of grocery purchases, the trend toward higher or lower vehicle usage, walking, biking, and public transit was not found.

Online/phone clothing, shoes, and accessories purchases for a delivery option were prominent among respondents before COVID with 68% of the respondents receiving various delivery frequencies; after COVID, the purchase of clothing, shoes, and accessories slightly increased overall to 75% of respondents receiving various frequency of deliveries. Purchasing clothing, shoes, and accessories by taking a vehicle, walking, bicycling, or taking public transit decreased slightly; this can be observed in Table 4.5. A 29.69% share of respondents mentioned taking zero trips using a vehicle to purchase clothing, shoes, and accessories before COVID, and this percentage increased to 48.44% after COVID. Similarly, 82.54% of respondents mentioned taking zero trips via walking, biking, or public transit to purchase clothing, shoes, and accessories before COVID, and this percentage increased to 93.65% after COVID. A breakdown of these observations based on gender and age group is summarized in Table 4.6, 4.7, and 4.8.

Online/phone household item purchases for a delivery option were also fairly prominent among respondents before COVID, with 56% of the respondents receiving various delivery frequencies; after COVID, purchases of household items slightly increased overall to 76% of respondents receiving various frequency of deliveries. Purchasing household items by taking a vehicle, walking, bicycling, or taking public transit did not change drastically, but respondents traveled less frequently to shop for household items; this can be observed in Table 4.5. A breakdown of these observations based on gender and age group is summarized in Table 4.6, 4.7, and 4.8.

Online/phone prepared meal purchases for a delivery option were also observed as prominent among respondents before COVID, with about 61% of the respondents receiving deliveries for various frequencies; after COVID, purchases of prepared meals for delivery slightly increased to 71.65% of respondents receiving deliveries of various frequencies. The increase in the online/phone prepared meal purchases for delivery after COVID was seen specifically for higher frequency delivery categories, meaning respondents have specifically started ordering prepared meals multiple times in a typical month (4-10 deliveries, and more than 10 deliveries per month). Purchasing prepared meals to eat at a restaurant or through takeout orders by taking a vehicle, walking, bicycling, or taking public transit decreased after COVID, and respondents traveled less frequently to eat outside or pick up a takeout order. A breakdown of these observations based on gender and age group is summarized in Table 4.6, 4.7 and 4.8.

**Table 4.5** Shopping Habits of Respondents for Pre-COVID and Post-COVID Scenario

| | Received a delivery from an online/phone order of… | | Took a vehicle (e.g., personal vehicle, taxi, Uber, Lyft) to a store or restaurant to buy… | | Walked, biked or used public transit to get to a store or restaurant to buy... | |
|---|---|---|---|---|---|---|
| **Pre-COVID** | | | | | | |
| Groceries | 0 Deliveries | 89.55% | 0 Trips | 16.18% | 0 Trips | 70.15% |
| | 1-3 Deliveries | 7.46% | 1-3 Trips | 11.76% | 1-3 Trips | 14.93% |
| | 4-6 Deliveries | 1.49% | 4-6 Trips | 41.18% | 4-6 Trips | 7.46% |
| | 7-9 Deliveries | 0.00% | 7-9 Trips | 14.71% | 7-9 Trips | 2.99% |
| | ≥10 deliveries | 1.49% | ≥10 Trips | 16.18% | ≥10 Trips | 4.48% |
| Clothing, shoes or accessories | 0 Deliveries | 31.82% | 0 Trips | 29.69% | 0 Trips | 82.54% |
| | 1-3 Deliveries | 59.09% | 1-3 Trips | 51.56% | 1-3 Trips | 11.11% |
| | 4-6 Deliveries | 7.58% | 4-6 Trips | 12.50% | 4-6 Trips | 4.76% |
| | 7-9 Deliveries | 1.52% | 7-9 Trips | 3.13% | 7-9 Trips | 1.59% |
| | ≥10 deliveries | 0.00% | ≥10 Trips | 3.13% | ≥10 Trips | 0.00% |
| Household items | 0 Deliveries | 43.94% | 0 Trips | 21.21% | 0 Trips | 79.69% |
| | 1-3 Deliveries | 46.97% | 1-3 Trips | 30.30% | 1-3 Trips | 10.94% |
| | 4-6 Deliveries | 9.09% | 4-6 Trips | 40.91% | 4-6 Trips | 6.25% |
| | 7-9 Deliveries | 0.00% | 7-9 Trips | 3.03% | 7-9 Trips | 1.56% |
| | ≥10 deliveries | 0.00% | ≥10 Trips | 4.55% | ≥10 Trips | 1.56% |
| Prepared meal (eating at a restaurant or getting takeout) | 0 Deliveries | 38.81% | 0 Trips | 22.39% | 0 Trips | 77.27% |
| | 1-3 Deliveries | 44.78% | 1-3 Trips | 28.36% | 1-3 Trips | 15.15% |
| | 4-6 Deliveries | 10.45% | 4-6 Trips | 28.36% | 4-6 Trips | 6.06% |
| | 7-9 Deliveries | 2.99% | 7-9 Trips | 10.45% | 7-9 Trips | 1.52% |
| | ≥10 deliveries | 2.99% | ≥10 Trips | 10.45% | ≥10 Trips | 0.00% |
| **Post-COVID** | | | | | | |
| Groceries | 0 Deliveries | 63.24% | 0 Trips | 17.91% | 0 Trips | 76.92% |
| | 1-3 Deliveries | 27.94% | 1-3 Trips | 22.39% | 1-3 Trips | 13.85% |
| | 4-6 Deliveries | 5.88% | 4-6 Trips | 37.31% | 4-6 Trips | 7.69% |
| | 7-9 Deliveries | 1.47% | 7-9 Trips | 13.43% | 7-9 Trips | 0.00% |
| | ≥10 deliveries | 1.47% | ≥10 Trips | 8.96% | ≥10 Trips | 1.54% |
| Clothing, shoes or accessories | 0 Deliveries | 25.37% | 0 Trips | 48.44% | 0 Trips | 93.65% |
| | 1-3 Deliveries | 53.73% | 1-3 Trips | 45.31% | 1-3 Trips | 4.76% |
| | 4-6 Deliveries | 16.42% | 4-6 Trips | 6.25% | 4-6 Trips | 1.59% |
| | 7-9 Deliveries | 1.49% | 7-9 Trips | 0.00% | 7-9 Trips | 0.00% |
| | ≥10 deliveries | 2.99% | ≥10 Trips | 0.00% | ≥10 Trips | 0.00% |
| Household items | 0 Deliveries | 23.88% | 0 Trips | 23.88% | 0 Trips | 84.38% |
| | 1-3 Deliveries | 53.73% | 1-3 Trips | 59.70% | 1-3 Trips | 10.94% |
| | 4-6 Deliveries | 14.93% | 4-6 Trips | 13.43% | 4-6 Trips | 4.69% |
| | 7-9 Deliveries | 5.97% | 7-9 Trips | 2.99% | 7-9 Trips | 0.00% |
| | ≥10 deliveries | 1.49% | ≥10 Trips | 0.00% | ≥10 Trips | 0.00% |
| Prepared meal (eating at a restaurant or getting takeout) | 0 Deliveries | 28.36% | 0 Trips | 31.34% | 0 Trips | 85.94% |
| | 1-3 Deliveries | 44.78% | 1-3 Trips | 40.30% | 1-3 Trips | 9.38% |
| | 4-6 Deliveries | 16.42% | 4-6 Trips | 20.90% | 4-6 Trips | 1.56% |
| | 7-9 Deliveries | 4.48% | 7-9 Trips | 1.49% | 7-9 Trips | 3.13% |
| | ≥10 deliveries | 5.97% | ≥10 Trips | 5.97% | ≥10 Trips | 0.00% |

**Table 4.6** Online/Phone Order Shopping Habits for Delivery - Pre-COVID and Post-COVID Scenario

| Received a delivery from an online/phone order of… | | Total | Gender | | Age Group | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Male | Female | 18-24 | 25-44 | 45-64 | 65 or older |
| | | **Pre-COVID** | | | | | | |
| Groceries | 0 Deliveries | 89.6% | 60.0% | 38.3% | 100.0% | 88.0% | 73.3% | 100.0% |
| | 1-3 Deliveries | 7.5% | 60.0% | 40.0% | 0.0% | 8.0% | 10.0% | 0.0% |
| | 4-6 Deliveries | 1.5% | 0.0% | 100.0% | 0.0% | 0.0% | 3.3% | 0.0% |
| | 7-9 Deliveries | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| | ≥10 deliveries | 1.5% | 100.0% | 0.0% | 0.0% | 0.0% | 3.3% | 0.0% |
| Clothing, shoes or accessories | 0 Deliveries | 31.8% | 71.4% | 28.6% | 33.3% | 20.0% | 20.0% | 75.0% |
| | 1-3 Deliveries | 59.1% | 48.7% | 48.7% | 66.7% | 52.0% | 70.0% | 16.7% |
| | 4-6 Deliveries | 7.6% | 100.0% | 0.0% | 0.0% | 12.0% | 3.3% | 8.3% |
| | 7-9 Deliveries | 1.5% | 100.0% | 0.0% | 0.0% | 4.0% | 0.0% | 0.0% |
| | ≥10 deliveries | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Household items | 0 Deliveries | 43.9% | 51.7% | 48.3% | 33.3% | 28.0% | 40.0% | 75.0% |
| | 1-3 Deliveries | 47.0% | 71.0% | 25.8% | 66.7% | 48.0% | 46.7% | 16.7% |
| | 4-6 Deliveries | 9.1% | 50.0% | 50.0% | 0.0% | 12.0% | 6.7% | 8.3% |
| | 7-9 Deliveries | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| | ≥10 deliveries | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Prepared meal (eating at a restaurant or getting takeout) | 0 Deliveries | 38.8% | 53.8% | 46.2% | 0.0% | 36.0% | 33.3% | 58.3% |
| | 1-3 Deliveries | 44.8% | 63.3% | 36.7% | 100.0% | 40.0% | 46.7% | 25.0% |
| | 4-6 Deliveries | 10.4% | 85.7% | 14.3% | 0.0% | 16.0% | 6.7% | 8.3% |
| | 7-9 Deliveries | 3.0% | 0.0% | 50.0% | 0.0% | 0.0% | 3.3% | 0.0% |
| | ≥10 deliveries | 3.0% | 100.0% | 0.0% | 0.0% | 0.0% | 3.3% | 8.3% |
| | | **Post-COVID** | | | | | | |
| Groceries | 0 Deliveries | 63.2% | 67.4% | 30.2% | 66.7% | 60.0% | 46.7% | 91.7% |
| | 1-3 Deliveries | 27.9% | 47.4% | 52.6% | 33.3% | 32.0% | 30.0% | 8.3% |
| | 4-6 Deliveries | 5.9% | 0.0% | 75.0% | 0.0% | 4.0% | 10.0% | 0.0% |
| | 7-9 Deliveries | 1.5% | 100.0% | 0.0% | 0.0% | 0.0% | 3.3% | 0.0% |
| | ≥10 deliveries | 1.5% | 100.0% | 0.0% | 0.0% | 0.0% | 3.3% | 0.0% |
| Clothing, shoes or accessories | 0 Deliveries | 25.4% | 70.6% | 29.4% | 0.0% | 20.0% | 16.7% | 58.3% |
| | 1-3 Deliveries | 53.7% | 47.2% | 50.0% | 100.0% | 48.0% | 63.3% | 8.3% |
| | 4-6 Deliveries | 16.4% | 72.7% | 27.3% | 0.0% | 12.0% | 16.7% | 25.0% |
| | 7-9 Deliveries | 1.5% | 100.0% | 0.0% | 0.0% | 0.0% | 0.0% | 8.3% |
| | ≥10 deliveries | 3.0% | 100.0% | 0.0% | 0.0% | 8.0% | 0.0% | 0.0% |
| Household items | 0 Deliveries | 23.9% | 43.8% | 56.3% | 0.0% | 24.0% | 16.7% | 41.7% |
| | 1-3 Deliveries | 53.7% | 63.9% | 36.1% | 66.7% | 40.0% | 63.3% | 41.7% |
| | 4-6 Deliveries | 14.9% | 60.0% | 30.0% | 33.3% | 16.0% | 6.7% | 16.7% |
| | 7-9 Deliveries | 6.0% | 75.0% | 25.0% | 0.0% | 8.0% | 6.7% | 0.0% |
| | ≥10 deliveries | 1.5% | 100.0% | 0.0% | 0.0% | 4.0% | 0.0% | 0.0% |
| Prepared meal (eating at a restaurant or getting takeout) | 0 Deliveries | 28.4% | 52.6% | 47.4% | 33.3% | 28.0% | 10.0% | 66.7% |
| | 1-3 Deliveries | 44.8% | 66.7% | 33.3% | 66.7% | 44.0% | 53.3% | 8.3% |
| | 4-6 Deliveries | 16.4% | 72.7% | 27.3% | 0.0% | 12.0% | 16.7% | 25.0% |
| | 7-9 Deliveries | 4.5% | 0.0% | 66.7% | 0.0% | 0.0% | 6.7% | 0.0% |
| | ≥10 deliveries | 6.0% | 50.0% | 50.0% | 0.0% | 8.0% | 6.7% | 0.0% |

**Table 4.7** Shopping by Taking a Vehicle to Store or Restaurant - Pre-COVID and Post-COVID Scenario

| Took a vehicle (personal vehicle, taxi, Uber, Lyft) to a store or restaurant to buy primarily… | | Total | Gender | | Age Group | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Male | Female | 18-24 | 25-44 | 45-64 | 65 or older |
| | | **Pre-COVID** | | | | | | |
| Groceries | 0 Trips | 16.2% | 54.5% | 45.5% | 0.0% | 12.0% | 23.3% | 8.3% |
| | 1-3 Trips | 11.8% | 50.0% | 50.0% | 66.7% | 12.0% | 6.7% | 8.3% |
| | 4-6 Trips | 41.2% | 57.1% | 42.9% | 0.0% | 48.0% | 36.7% | 41.7% |
| | 7-9 Trips | 14.7% | 80.0% | 10.0% | 33.3% | 8.0% | 10.0% | 25.0% |
| | ≥10 Trips | 16.2% | 63.6% | 36.4% | 0.0% | 12.0% | 20.0% | 16.7% |
| Clothing, shoes or accessories | 0 Trips | 29.7% | 47.4% | 52.6% | 0.0% | 20.0% | 36.7% | 25.0% |
| | 1-3 Trips | 51.6% | 66.7% | 33.3% | 100.0% | 52.0% | 43.3% | 33.3% |
| | 4-6 Trips | 12.5% | 62.5% | 37.5% | 0.0% | 8.0% | 13.3% | 16.7% |
| | 7-9 Trips | 3.1% | 50.0% | 0.0% | 0.0% | 4.0% | 0.0% | 0.0% |
| | ≥10 Trips | 3.1% | 100.0% | 0.0% | 0.0% | 0.0% | 0.0% | 16.7% |
| Household items | 0 Trips | 21.2% | 50.0% | 50.0% | 0.0% | 12.0% | 30.0% | 16.7% |
| | 1-3 Trips | 30.3% | 65.0% | 35.0% | 66.7% | 44.0% | 16.7% | 16.7% |
| | 4-6 Trips | 40.9% | 59.3% | 40.7% | 33.3% | 24.0% | 50.0% | 41.7% |
| | 7-9 Trips | 3.0% | 50.0% | 0.0% | 0.0% | 0.0% | 0.0% | 8.3% |
| | ≥10 Trips | 4.5% | 100.0% | 0.0% | 0.0% | 4.0% | 0.0% | 16.7% |
| Prepared meal (eating at a restaurant or getting takeout) | 0 Trips | 22.4% | 53.3% | 46.7% | 0.0% | 20.0% | 26.7% | 16.7% |
| | 1-3 Trips | 28.4% | 63.2% | 36.8% | 66.7% | 24.0% | 20.0% | 41.7% |
| | 4-6 Trips | 28.4% | 57.9% | 42.1% | 0.0% | 32.0% | 26.7% | 25.0% |
| | 7-9 Trips | 10.4% | 57.1% | 28.6% | 33.3% | 4.0% | 13.3% | 0.0% |
| | ≥10 Trips | 10.4% | 85.7% | 14.3% | 0.0% | 8.0% | 10.0% | 16.7% |
| | | **Post-COVID** | | | | | | |
| Groceries | 0 Trips | 17.9% | 50.0% | 50.0% | 33.3% | 12.0% | 23.3% | 8.3% |
| | 1-3 Trips | 22.4% | 53.3% | 46.7% | 33.3% | 24.0% | 23.3% | 8.3% |
| | 4-6 Trips | 37.3% | 60.0% | 40.0% | 0.0% | 44.0% | 30.0% | 41.7% |
| | 7-9 Trips | 13.4% | 77.8% | 22.2% | 33.3% | 4.0% | 13.3% | 25.0% |
| | ≥10 Trips | 9.0% | 83.3% | 16.7% | 0.0% | 8.0% | 6.7% | 16.7% |
| Clothing, shoes or accessories | 0 Trips | 48.4% | 51.6% | 48.4% | 100.0% | 44.0% | 46.7% | 25.0% |
| | 1-3 Trips | 45.3% | 72.4% | 27.6% | 0.0% | 36.0% | 43.3% | 58.3% |
| | 4-6 Trips | 6.3% | 75.0% | 0.0% | 0.0% | 0.0% | 3.3% | 16.7% |
| | 7-9 Trips | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| | ≥10 Trips | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Household items | 0 Trips | 23.9% | 56.3% | 43.8% | 66.7% | 16.0% | 30.0% | 8.3% |
| | 1-3 Trips | 59.7% | 57.5% | 42.5% | 0.0% | 68.0% | 56.7% | 50.0% |
| | 4-6 Trips | 13.4% | 66.7% | 22.2% | 0.0% | 4.0% | 10.0% | 33.3% |
| | 7-9 Trips | 3.0% | 100.0% | 0.0% | 33.3% | 0.0% | 0.0% | 8.3% |
| | ≥10 Trips | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Prepared meal (eating at a restaurant or getting takeout) | 0 Trips | 31.3% | 52.4% | 47.6% | 66.7% | 32.0% | 30.0% | 16.7% |
| | 1-3 Trips | 40.3% | 55.6% | 40.7% | 0.0% | 44.0% | 33.3% | 41.7% |
| | 4-6 Trips | 20.9% | 64.3% | 35.7% | 33.3% | 12.0% | 16.7% | 41.7% |
| | 7-9 Trips | 1.5% | 100.0% | 0.0% | 0.0% | 0.0% | 3.3% | 0.0% |
| | ≥10 Trips | 6.0% | 100.0% | 0.0% | 0.0% | 0.0% | 13.3% | 0.0% |

**Table 4.8** Shopping by Walking, Biking or Using Public Transit- Pre-COVID and Post-COVID Scenario

| Walked, biked or used public transit to get to a store or restaurant to buy primarily… | | Total | Gender | | Age Group | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Male | Female | 18-24 | 25-44 | 45-64 | 65 or older |
| | | **Pre-COVID** | | | | | | |
| Groceries | 0 Trips | 70.1% | 63.8% | 34.0% | 66.7% | 68.0% | 66.7% | 58.3% |
| | 1-3 Trips | 14.9% | 60.0% | 40.0% | 0.0% | 12.0% | 16.7% | 16.7% |
| | 4-6 Trips | 7.5% | 60.0% | 40.0% | 33.3% | 4.0% | 6.7% | 8.3% |
| | 7-9 Trips | 3.0% | 0.0% | 100.0% | 0.0% | 4.0% | 0.0% | 8.3% |
| | ≥10 Trips | 4.5% | 66.7% | 33.3% | 0.0% | 4.0% | 3.3% | 8.3% |
| Clothing, shoes or accessories | 0 Trips | 82.5% | 63.5% | 34.6% | 33.3% | 60.0% | 86.7% | 75.0% |
| | 1-3 Trips | 11.1% | 57.1% | 42.9% | 66.7% | 16.0% | 3.3% | 0.0% |
| | 4-6 Trips | 4.8% | 33.3% | 66.7% | 0.0% | 4.0% | 3.3% | 8.3% |
| | 7-9 Trips | 1.6% | 100.0% | 0.0% | 0.0% | 0.0% | 0.0% | 8.3% |
| | ≥10 Trips | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Household items | 0 Trips | 79.7% | 64.7% | 33.3% | 66.7% | 60.0% | 83.3% | 66.7% |
| | 1-3 Trips | 10.9% | 57.1% | 42.9% | 33.3% | 20.0% | 3.3% | 0.0% |
| | 4-6 Trips | 6.3% | 25.0% | 75.0% | 0.0% | 0.0% | 6.7% | 16.7% |
| | 7-9 Trips | 1.6% | 100.0% | 0.0% | 0.0% | 0.0% | 0.0% | 8.3% |
| | ≥10 Trips | 1.6% | 0.0% | 100.0% | 0.0% | 4.0% | 0.0% | 0.0% |
| Prepared meal (eating at a restaurant or getting takeout) | 0 Trips | 77.3% | 64.7% | 33.3% | 33.3% | 76.0% | 70.0% | 75.0% |
| | 1-3 Trips | 15.2% | 60.0% | 40.0% | 66.7% | 8.0% | 13.3% | 16.7% |
| | 4-6 Trips | 6.1% | 25.0% | 75.0% | 0.0% | 4.0% | 6.7% | 8.3% |
| | 7-9 Trips | 1.5% | 100.0% | 0.0% | 0.0% | 0.0% | 3.3% | 0.0% |
| | ≥10 Trips | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| | | **Post-COVID** | | | | | | |
| Groceries | 0 Trips | 76.9% | 62.0% | 36.0% | 66.7% | 68.0% | 70.0% | 75.0% |
| | 1-3 Trips | 13.8% | 55.6% | 44.4% | 0.0% | 8.0% | 20.0% | 8.3% |
| | 4-6 Trips | 7.7% | 60.0% | 40.0% | 33.3% | 12.0% | 0.0% | 8.3% |
| | 7-9 Trips | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| | ≥10 Trips | 1.5% | 100.0% | 0.0% | 0.0% | 0.0% | 0.0% | 8.3% |
| Clothing, shoes or accessories | 0 Trips | 93.7% | 64.4% | 33.9% | 100.0% | 72.0% | 86.7% | 91.7% |
| | 1-3 Trips | 4.8% | 33.3% | 66.7% | 0.0% | 8.0% | 3.3% | 0.0% |
| | 4-6 Trips | 1.6% | 0.0% | 100.0% | 0.0% | 0.0% | 0.0% | 8.3% |
| | 7-9 Trips | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| | ≥10 Trips | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Household items | 0 Trips | 84.4% | 64.8% | 33.3% | 66.7% | 64.0% | 86.7% | 75.0% |
| | 1-3 Trips | 10.9% | 42.9% | 57.1% | 33.3% | 16.0% | 3.3% | 8.3% |
| | 4-6 Trips | 4.7% | 33.3% | 66.7% | 0.0% | 4.0% | 0.0% | 8.3% |
| | 7-9 Trips | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| | ≥10 Trips | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Prepared meal (eating at a restaurant or getting takeout) | 0 Trips | 85.9% | 61.8% | 36.4% | 66.7% | 72.0% | 80.0% | 83.3% |
| | 1-3 Trips | 9.4% | 66.7% | 33.3% | 0.0% | 12.0% | 3.3% | 16.7% |
| | 4-6 Trips | 1.6% | 0.0% | 100.0% | 33.3% | 0.0% | 0.0% | 0.0% |
| | 7-9 Trips | 3.1% | 50.0% | 50.0% | 0.0% | 0.0% | 6.7% | 0.0% |
| | ≥10 Trips | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |

### 4.3.3 Familiarity, Interest in Owning and/or Utilizing Various Mobility or Delivery-Related Technologies

The respondents were asked to identify their familiarity as well as their interest in owning various types of vehicle-related technologies, including:

- hybrid vehicles
- plug-in vehicle
- smartphones
- rooftop solar panels
- adaptive cruise controls
- partially automated
- fully automated

Similarly, questions were also asked about familiarity and usage of rideshare and web applications that may help with improving trips or take the place of a trip through a delivery. These technologies include:

- Rideshare services
- Navigation or trip-planning apps, e.g., Google maps
- Amazon Prime services

When looking at respondents' adoption of and interest in the advanced technologies, it helps to understand the technology penetration in our sample and their receptiveness to adoption in the future. In Figures 4.4 and 4.5, we see the respondents' answers to their use and interest in the advanced technologies. After which, we look at the adoption and interest breakdown by gender followed by age groups presented in the order with the most to the least used technologies.

Four of the advanced technologies have high adoption rates, smart phone (96%), trip planning apps (88%), Amazon Prime (77%), and rideshare (60%). Further, technologies such as rideshare services (68%), adaptive cruise control (41%), partially automated vehicles (22%), and hybrid vehicles (20%) have moderate adoption rates.

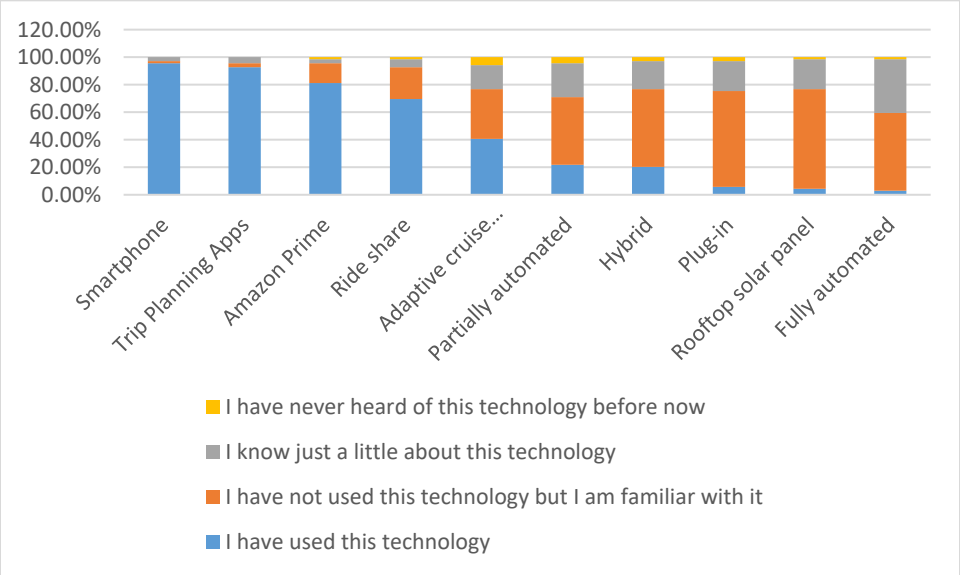


**Figure 4.4** Familiarity with select advanced transportation related technologies, N=69

Figure 4.5 shows that there is quite a bit of interest in hybrid, plug-in, rooftop solar panels, and partially and fully automated vehicles. Yet, several respondents indicated they were not interested in owning fully automated or even partially automated vehicles.

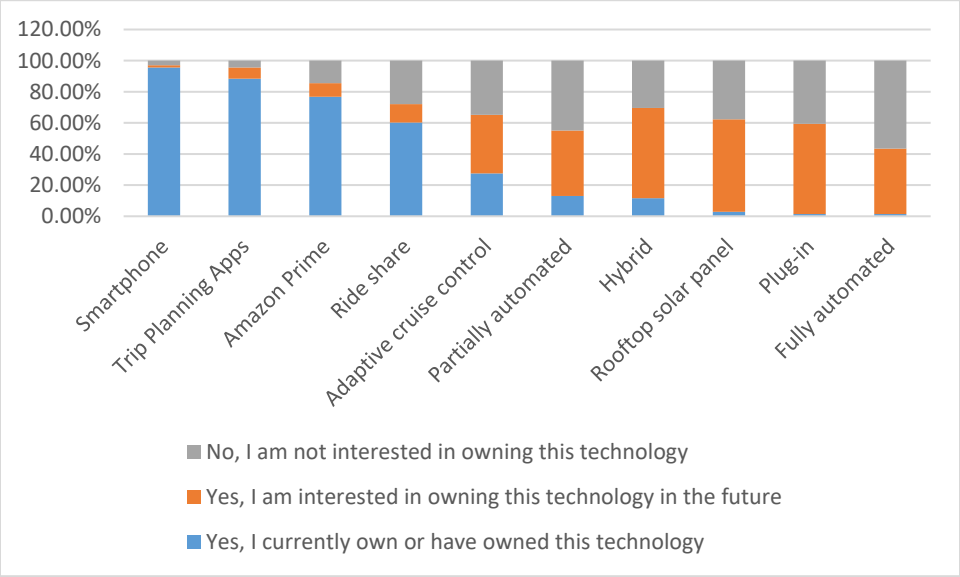


**Figure 4.5** Interest in owning select advanced transportation related technologies

**Smartphone**

The smartphone technology is essentially saturated among the respondents by gender and age. About 17% of respondents over the age of 65 are not interested in owning a smartphone (Table 4.9).

**Table 4.9** Smartphone Usage and Interest, by Gender

| **What do you think about Smartphone technology?** | **Total** | Male | Female |
|---|---|---|---|
| I have used this technology | 95.7% | 95.2% | 96.3% |
| I have not used this technology, but I am familiar with it | 1.4% | 2.4% | 0.0% |
| I know just a little about this technology | 2.9% | 2.4% | 3.7% |
| I have never heard of this technology before now | 0.0% | 0.0% | 0.0% |
| | | | |
| **Are you interested in owning a Smartphone?** | **Total** | Male | Female |
| Yes, I currently own or have owned this technology | 95.7% | 95.2% | 96.3% |
| Yes, I am interested in owning this technology in the future | 1.4% | 2.4% | 0.0% |
| No, I am not interested in owning this technology | 2.9% | 2.4% | 3.7% |

**Table 4.10** Smartphone Usage and Interest, by Age Group

| **What do you think about Smartphone technology?** | **Total** | 18-24 | 25-44 | 45-64 | 65 or older |
|---|---|---|---|---|---|
| I have used this technology | 95.7% | 100.0% | 100.0% | 96.6% | 83.3% |
| I have not used this technology, but I am familiar with it | 1.4% | 0.0% | 0.0% | 0.0% | 8.3% |
| I know just a little about this technology | 2.9% | 0.0% | 0.0% | 3.4% | 8.3% |
| I have never heard of this technology before now | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| | | | | | |
| **Are you interested in owning a Smartphone?** | **Total** | 18-24 | 25-44 | 45-64 | 65 or older |
| Yes, I currently own or have owned this technology | 95.7% | 100.0% | 100.0% | 96.6% | 83.3% |
| Yes, I am interested in owning this technology in the future | 1.4% | 0.0% | 0.0% | 3.4% | 0.0% |
| No, I am not interested in owning this technology | 2.9% | 0.0% | 0.0% | 0.0% | 16.7% |

**Navigation or trip-planning apps, e.g., Google maps**

Most respondents, 95% of males and 89% of females, have used trip planning apps, and no respondents reported never hearing of the technology (Table 4.11). Very few respondents reported no interest in the technology. Trip planning apps appears to be widely adopted among the survey respondents. About 17% of the respondents 65 and older reported having no interest in using the technology (Table 4.12).

**Table 4.11** Trip-planning Apps Usage and Interest, by Gender

| **What do you think about navigation or trip-planning apps (e.g., Google Maps, Apple Maps, WAZE) technology?** | **Total** | Male | Female |
|---|---|---|---|
| I have used this technology | 92.8% | 95.2% | 88.9% |
| I have not used this technology, but I am familiar with it | 2.9% | 0.0% | 7.4% |
| I know just a little about this technology | 4.3% | 4.8% | 3.7% |
| I have never heard of this technology before now | 0.0% | 0.0% | 0.0% |
| | | | |
| **Are you interested in using navigation or trip-planning apps?** | **Total** | Male | Female |
| Yes, I currently use or have used this technology | 88.4% | 88.1% | 88.9% |
| Yes, I am interested in using this technology in the future | 7.2% | 9.5% | 3.7% |
| No, I am not interested in using this technology | 4.3% | 2.4% | 7.4% |

**Table 4.12** Trip-planning Apps Usage and Interest, by Age Group

| **What do you think about navigation or trip-planning apps (e.g., Google Maps, Apple Maps, WAZE) technology?** | **Total** | 18-24 | 25-44 | 45-64 | 65 or older |
|---|---|---|---|---|---|
| I have used this technology | 92.8% | 100.0% | 100.0% | 93.1% | 75.0% |
| I have not used this technology, but I am familiar with it | 2.9% | 0.0% | 0.0% | 3.4% | 8.3% |
| I know just a little about this technology | 4.3% | 0.0% | 0.0% | 3.4% | 16.7% |
| I have never heard of this technology before now | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| | | | | | |
| **Are you interested in using navigation or trip-planning apps?** | **Total** | 18-24 | 25-44 | 45-64 | 65 or older |
| Yes, I currently use or have used this technology | 88.4% | 100.0% | 100.0% | 93.1% | 50.0% |
| Yes, I am interested in using this technology in the future | 7.2% | 0.0% | 0.0% | 3.4% | 33.3% |
| No, I am not interested in using this technology | 4.3% | 0.0% | 0.0% | 3.4% | 16.7% |

**Amazon Prime services**

As shown in Table 4.13, Amazon Prime services have been used by 83% of males and 78% of females responding to this survey. Currently using the service are 79% males and 74% females. There were very few respondents that have not heard of the service. About 12% of males and 19% of females have no interest in using the service.

**Table 4.13** Amazon Prime Service Usage and Interest, by Gender

| **What do you think about Amazon Prime Service?** | **Total** | Male | Female |
|---|---|---|---|
| I have used this service | 81.2% | 83.3% | 77.8% |
| I have not used this service, but I am familiar with it | 14.5% | 11.9% | 18.5% |
| I know just a little about this service | 2.9% | 2.4% | 3.7% |
| I have never heard of this service before now | 1.4% | 2.4% | 0.0% |
| **Are you interested in using Amazon Prime Service?** | **Total** | Male | Female |
| Yes, I currently use or have used this service | 76.8% | 78.6% | 74.1% |
| Yes, I am interested in using this service in the future | 8.7% | 9.5% | 7.4% |
| No, I am not interested in using this service | 14.5% | 11.9% | 18.5% |

All the age groups reported using Amazon Prime. About 42% of those 65 and older have no interest in using this service (Table 4.14).

**Table 4.14** Amazon Prime Service Usage and Interest, by Age Group

| **What do you think about Amazon Prime Service?** | **Total** | 18-24 | 25-44 | 45-64 | 65 or older |
|---|---|---|---|---|---|
| I have used this service | 81.2% | 100.0% | 96.0% | 82.8% | 41.7% |
| I have not used this service, but I am familiar with it | 14.5% | 0.0% | 4.0% | 17.2% | 33.3% |
| I know just a little about this service | 2.9% | 0.0% | 0.0% | 0.0% | 16.7% |
| I have never heard of this service before now | 1.4% | 0.0% | 0.0% | 0.0% | 8.3% |
| **Are you interested in using Amazon Prime Service?** | | | | | |
| Yes, I currently use or have used this service | 76.8% | 100.0% | 92.0% | 75.9% | 41.7% |
| Yes, I am interested in using this service in the future | 8.7% | 0.0% | 4.0% | 10.3% | 16.7% |
| No, I am not interested in using this service | 14.5% | 0.0% | 4.0% | 13.8% | 41.7% |

**Rideshare services**

Males and females, 71% and 67%, respectively, reported using rideshare services, as shown in Table 4.15. Very few, 3.7% of female respondents, reported not hearing of this technology. There were 26% males and 31% females who were not interested in using this service (Table 4.15). Some respondents who may be interested in rideshare are those who view travel time and predictable travel time as important, as seen in Table 4.4. Further, some of the characteristics that a few respondents viewed as important, such as low cost and sharing a ride with others, can contribute to them staying away from rideshare, as shown in Table 4.4.

**Table 4.15** Rideshare or App-based Ride Share Service Usage and Interest, by Gender

| **What do you think about Uber, Lyft, or similar app-based ride share services?** | **Total** | Male | Female |
|---|---|---|---|
| I have used this service | 69.6% | 71.4% | 66.7% |
| I have not used this service, but I am familiar with it | 23.2% | 26.2% | 18.5% |
| I know just a little about this service | 5.8% | 2.4% | 11.1% |
| I have never heard of this service before now | 1.4% | 0.0% | 3.7% |
| | | | |
| **Are you interested in using Uber, Lyft, or similar app-based ride share services?** | **Total** | Male | Female |
| Yes, I currently use or have used this service | 60.3% | 66.7% | 50.0% |
| Yes, I am interested in using this service in the future | 11.8% | 7.1% | 19.2% |
| No, I am not interested in using this service | 27.9% | 26.2% | 30.8% |

All age groups reported using this service with the 65-and-older group reporting the lowest percentage of users (Table 4.16). Fifty percent of the 65-and-older group have no interest in using this service.

**Table 4.16** Rideshare or App-based Ride Share Service Usage and Interest, by Age Group

| **What do you think about Uber, Lyft, or similar app-based ride share services?** | **Total** | 18-24 | 25-44 | 45-64 | 65 or older |
|---|---|---|---|---|---|
| I have used this service | 69.6% | 100.0% | 92.0% | 65.5% | 25.0% |
| I have not used this service, but I am familiar with it | 23.2% | 0.0% | 8.0% | 20.7% | 66.7% |
| I know just a little about this service | 5.8% | 0.0% | 0.0% | 10.3% | 8.3% |
| I have never heard of this service before now | 1.4% | 0.0% | 0.0% | 3.4% | 0.0% |
| | | | | | |
| **Are you interested in using Uber, Lyft, or similar app-based ride share services?** | **Total** | 18-24 | 25-44 | 45-64 | 65 or older |
| Yes, I currently use or have used this service | 60.3% | 100.0% | 76.0% | 57.1% | 25.0% |
| Yes, I am interested in using this service in the future | 11.8% | 0.0% | 8.0% | 10.7% | 25.0% |
| No, I am not interested in using this service | 27.9% | 0.0% | 16.0% | 32.1% | 50.0% |

**Adaptive Cruise Control**

When asking respondents about adaptive cruise control, we provided the explanation that the "technology brakes and accelerates to match the speed of the vehicle in front of it while traveling only on highways, but also requires the driver to steer the vehicle." Of the males completing the survey, 52.4% have used the technology, while 22.2% of females responding have used the technology. Many of the respondents were at least aware of the technology. Nearly half of the males responding are interested in owning the technology in the future, while 22.2% of females are interested in owning it. About 20% of males responding are not interested in owning it, whereas almost 60% of females are not interested in the technology.

**Table 4.17** Adaptive Cruise Control Usage and Interest, by Gender

| **What do you think about adaptive cruise control technology?** | **Total** | Male | Female |
|---|---|---|---|
| I have used this technology | 40.6% | 52.4% | 22.2% |
| I have not used this technology, but I am familiar with it | 36.2% | 31.0% | 44.4% |
| I know just a little about this technology | 17.4% | 14.3% | 22.2% |
| I have never heard of this technology before now | 5.8% | 2.4% | 11.1% |
| **Are you interested in owning adaptive cruise control technology?** | | | |
| Yes, I currently own or have owned this technology | 27.5% | 33.3% | 18.5% |
| Yes, I am interested in owning this technology in the future | 37.7% | 47.6% | 22.2% |
| No, I am not interested in owning this technology | 34.8% | 19.0% | 59.3% |

**Table 4.18** Adaptive Cruise Control Usage and Interest, by Age Group

| **What do you think about adaptive cruise control technology?** | **Total** | 18-24 | 25-44 | 45-64 | 65 or older |
|---|---|---|---|---|---|
| I have used this technology | 40.6% | 0.0% | 52.0% | 34.5% | 41.7% |
| I have not used this technology, but I am familiar with it | 36.2% | 100.0% | 32.0% | 37.9% | 25.0% |
| I know just a little about this technology | 17.4% | 0.0% | 8.0% | 24.1% | 25.0% |
| I have never heard of this technology before now | 5.8% | 0.0% | 8.0% | 3.4% | 8.3% |
| **Are you interested in owning an adaptive cruise control technology?** | **Total** | 18-24 | 25-44 | 45-64 | 65 or older |
| Yes, I currently own or have owned this technology | 27.5% | 0.0% | 32.0% | 27.6% | 25.0% |
| Yes, I am interested in owning this technology in the future | 37.7% | 100.0% | 32.0% | 41.4% | 25.0% |
| No, I am not interested in owning this technology | 34.8% | 0.0% | 36.0% | 31.0% | 50.0% |

**Partially Automated**

When asking respondents about partially automated vehicles, we provided the description that "a vehicle with this technology automatically brakes and accelerates, and steers sufficiently to stay in a lane (only on highways), but requires the driver to be paying attention, to change lanes and be available to override (e.g., Tesla Autopilot)." About 24% of males and 19% of females have used the technology. While 14% of males and 11% of females own or have owned this technology, 52% of males and 26% of females are interested in owning it in the future. Surprisingly, 63% of females indicated they are not interested in owning this technology, while 33% of males reported no interest (Table 4.19).

**Table 4.19** Partially Automated Usage and Interest, by Gender

| **What do you think about partially automated technology?** | **Total** | Male | Female |
|---|---|---|---|
| I have used this technology | 21.7% | 23.8% | 18.5% |
| I have not used this technology, but I am familiar with it | 49.3% | 52.4% | 44.4% |
| I know just a little about this technology | 24.6% | 21.4% | 29.6% |
| I have never heard of this technology before now | 4.3% | 2.4% | 7.4% |
| **Are you interested in owning a partially automated technology?** | **Total** | Male | Female |
| Yes, I currently own or have owned this technology | 13.0% | 14.3% | 11.1% |
| Yes, I am interested in owning this technology in the future | 42.0% | 52.4% | 25.9% |
| No, I am not interested in owning this technology | 44.9% | 33.3% | 63.0% |

The 25-44 group (32%) was most likely to use partially automated technology. Well over half of the respondents in each category are at least familiar with the technology (Table 4.20). The 18-24 group (67%) has the greatest interest in owning this technology in the future, and the 25-44 (40%) and 45-64 (48.3%) groups are interested as well.

**Table 4.20** Partially Automated Usage and Interest, by Age Group

| **What do you think about partially automated technology?** | **Total** | 18-24 | 25-44 | 45-64 | 65 or older |
|---|---|---|---|---|---|
| I have used this technology | 21.7% | 0.0% | 32.0% | 17.2% | 16.7% |
| I have not used this technology, but I am familiar with it | 49.3% | 66.7% | 44.0% | 51.7% | 50.0% |
| I know just a little about this technology | 24.6% | 33.3% | 20.0% | 27.6% | 25.0% |
| I have never heard of this technology before now | 4.3% | 0.0% | 4.0% | 3.4% | 8.3% |
| **Are you interested in owning a partially automated technology?** | **Total** | 18-24 | 25-44 | 45-64 | 65 or older |
| Yes, I currently own or have owned this technology | 13.0% | 0.0% | 16.0% | 10.3% | 16.7% |
| Yes, I am interested in owning this technology in the future | 42.0% | 66.7% | 40.0% | 48.3% | 25.0% |
| No, I am not interested in owning this technology | 44.9% | 33.3% | 44.0% | 41.4% | 58.3% |

**Hybrid**

When looking more specifically at hybrid vehicles, we find that in general more males (69%) than females (37%) have not used the technology but are familiar with it. Likewise, more males (69%) are interested in owning this technology in the future, whereas, about 41% of females are interested in owning it in the future. Interestingly, 41% of females are not interested in owning it in the future (Table 4.21). When considering age, at least 50% or more of all age groups are interested in owning it in the future; 32% of the respondents in the 25-44 age group and 41% of the respondents 65 and older are not interested in owning this technology (Table 4.22).

**Table 4.21** Hybrid Usage and Interest, by Gender

| **What is your familiarity with a hybrid vehicle?** | **Total** | Male | Female |
|---|---|---|---|
| I have used this technology | 20.3% | 21.4% | 18.5% |
| I have not used this technology, but I am familiar with it | 56.5% | 69.0% | 37.0% |
| I know just a little about this technology | 20.3% | 9.5% | 37.0% |
| I have never heard of this technology before now | 2.9% | 0.0% | 7.4% |
| **Are you Interested in owning a hybrid vehicle?** | **Total** | Male | Female |
| Yes, I currently own or have owned this technology | 11.6% | 7.1% | 18.5% |
| Yes, I am interested in owning this technology in the future | 58.0% | 69.0% | 40.7% |
| No, I am not interested in owning this technology | 30.4% | 23.8% | 40.7% |

**Table 4.22** Hybrid Usage and Interest, by Age Group

| **What is your familiarity with a hybrid vehicle?** | **Total** | 18-24 | 25-44 | 45-64 | 65 or older |
|---|---|---|---|---|---|
| I have used this technology | 20.3% | 0.0% | 16.0% | 24.1% | 25.0% |
| I have not used this technology, but I am familiar with it | 56.5% | 33.3% | 60.0% | 55.2% | 58.3% |
| I know just a little about this technology | 20.3% | 66.7% | 24.0% | 17.2% | 8.3% |
| I have never heard of this technology before now | 2.9% | 0.0% | 0.0% | 3.4% | 8.3% |
| **Are you Interested in owning a hybrid vehicle?** | | | | | |
| Yes, I currently own or have owned this technology | 11.6% | 0.0% | 16.0% | 10.3% | 8.3% |
| Yes, I am interested in owning this technology in the future | 58.0% | 100.0% | 52.0% | 62.1% | 50.0% |
| No, I am not interested in owning this technology | 30.4% | 0.0% | 32.0% | 27.6% | 41.7% |

**Plug-in Vehicle**

There were very few respondents that had not at least heard of plug-in vehicles, including 7.4% of females. The 1.4% of respondents that own the technology are male. About 74% of males indicated they are interested in owning a plug-in vehicle in the future, whereas 67% of females are not interested in owning this technology (Table 4.23).

**Table 4.23** Plug-in Vehicle Usage and Interest, by Gender

| **What is your familiarity with Plug-in Vehicle technology?** | **Total** | Male | Female |
|---|---|---|---|
| I have used this technology | 5.8% | 7.1% | 3.7% |
| I have not used this technology, but I am familiar with it | 69.6% | 78.6% | 55.6% |
| I know just a little about this technology | 21.7% | 14.3% | 33.3% |
| I have never heard of this technology before now | 2.9% | 0.0% | 7.4% |
| | | | |
| **Are you interested in owning a Plug-in Vehicle?** | **Total** | Male | Female |
| Yes, I currently own or have owned this technology | 1.4% | 2.4% | 0.0% |
| Yes, I am interested in owning this technology in the future | 58.0% | 73.8% | 33.3% |
| No, I am not interested in owning this technology | 40.6% | 23.8% | 66.7% |

When considering the age of the respondents, very few had never heard of the plug-in vehicle and 50% or more of each age group is at least interested in owning this technology in the future (Table 4.24).

**Table 4.24** Plug-in Vehicle Usage and Interest, by Age Group

| **What is your familiarity with Plug-in Vehicle technology?** | **Total** | 18-24 | 25-44 | 45-64 | 65 or older |
|---|---|---|---|---|---|
| I have used this technology | 5.8% | 0.0% | 4.0% | 6.9% | 8.3% |
| I have not used this technology, but I am familiar with it | 69.6% | 66.7% | 84.0% | 58.6% | 66.7% |
| I know just a little about this technology | 21.7% | 0.0% | 12.0% | 31.0% | 25.0% |
| I have never heard of this technology before now | 2.9% | 33.3% | 0.0% | 3.4% | 0.0% |
| | | | | | |
| **Are you interested in owning a Plug-in Vehicle?** | **Total** | 18-24 | 25-44 | 45-64 | 65 or older |
| Yes, I currently own or have owned this technology | 1.4% | 0.0% | 4.0% | 0.0% | 0.0% |
| Yes, I am interested in owning this technology in the future | 58.0% | 66.7% | 60.0% | 58.6% | 50.0% |
| No, I am not interested in owning this technology | 40.6% | 33.3% | 36.0% | 41.4% | 50.0% |

**Rooftop Solar Panel**

Although not many of the respondents reported using or owning rooftop solar panels, nearly 80% of males and 63% of females were familiar with them. Likewise, 71% of males and 41% of females are interested in owning them in the future (Table 4.25).

**Table 4.25** Rooftop Solar Panel Usage and Interest, by Gender

| What do you think about rooftop solar panel technology? | **Total** | Male | Female |
|---|---|---|---|
| I have used this technology | 4.3% | 2.4% | 7.4% |
| I have not used this technology, but I am familiar with it | 72.5% | 78.6% | 63.0% |
| I know just a little about this technology | 21.7% | 19.0% | 25.9% |
| I have never heard of this technology before now | 1.4% | 0.0% | 3.7% |
| **Are you interested in owning a rooftop solar panel?** | | | |
| Yes, I currently own or have owned this technology | 2.9% | 2.4% | 3.7% |
| Yes, I am interested in owning this technology in the future | 59.4% | 71.4% | 40.7% |
| No, I am not interested in owning this technology | 37.7% | 26.2% | 55.6% |

The results show that 33.3% of those who have used the technology are between 18 and 24. However, nearly 70% of all age groups were familiar with the technology. Further, well over 50% of all age groups reported interest in owning this technology in the future (Table 4.26).

**Table 4.26:** Rooftop Solar Panel Usage and Interest, by Age Group

| What do you think about rooftop solar panel technology? | **Total** | 18-24 | 25-44 | 45-64 | 65 or older |
|---|---|---|---|---|---|
| I have used this technology | 4.3% | 33.3% | 4.0% | 3.4% | 0.0% |
| I have not used this technology, but I am familiar with it | 72.5% | 66.7% | 68.0% | 72.4% | 83.3% |
| I know just a little about this technology | 21.7% | 0.0% | 28.0% | 20.7% | 16.7% |
| I have never heard of this technology before now | 1.4% | 0.0% | 0.0% | 3.4% | 0.0% |
| **Are you interested in owning a rooftop solar panel?** | **Total** | 18-24 | 25-44 | 45-64 | 65 or older |
| Yes, I currently own or have owned this technology | 2.9% | 0.0% | 4.0% | 3.4% | 0.0% |
| Yes, I am interested in owning this technology in the future | 59.4% | 100.0% | 56.0% | 65.5% | 41.7% |
| No, I am not interested in owning this technology | 37.7% | 0.0% | 40.0% | 31.0% | 58.3% |

**Fully Automated**

Fully automated was described as "vehicle technology in which the vehicle drives itself and does not require a driver to be paying attention (e.g., rider could sleep, read, work, or otherwise not pay attention to the road)." When examining the results by gender and age group, we found that about 5% of responding males had used the technology while no females had used it (Table 4.27). Well over half (64%) of the males completing the survey were familiar with the technology. More than half of the males were interested in owning this technology in the future, whereas about 26% of females have this interest (Table 4.27).

**Table 4.27** Fully Automated Usage and Interest, by Gender

| What do you think about fully automated vehicle technology? | **Total** | Male | Female |
|---|---|---|---|
| I have used this technology | 2.9% | 4.8% | 0.0% |
| I have not used this technology, but I am familiar with it | 56.5% | 64.3% | 44.4% |
| I know just a little about this technology | 39.1% | 28.6% | 55.6% |
| I have never heard of this technology before now | 1.4% | 2.4% | 0.0% |
| **Are you interested in owning a fully automated vehicle technology?** | | | |
| Yes, I currently own or have owned this technology | 1.4% | 2.4% | 0.0% |
| Yes, I am interested in owning this technology in the future | 42.0% | 52.4% | 25.9% |
| No, I am not interested in owning this technology | 56.5% | 45.2% | 74.1% |

When looking at the interest in owning fully automated vehicles by age group, all age groups have some familiarity with the technology (Table 4.28). The 18–24-year-olds have the most interest (67%) in owning this technology in the future; whereas, the other age groups have interest, but 83% of those 65 and older have no interest in this advanced technology. While most of the respondents in the 65 years and older category are not interested, fully automated vehicles, once they are commercially available and tested as a safe alternative, could be beneficial to this age group as they do not need to drive. However, apart from Google's Waymo service, which is still in its pilot stage, fully automated vehicles are commercially not available, and it may take years for an SAE Level 4 or Level 5 vehicle to become available to the public.

**Table 4.28** Fully Automated Usage and Interest, by Age Group

| **What do you think about fully automated vehicle technology?** | **Total** | 18-24 | 25-44 | 45-64 | 65 or older |
|---|---|---|---|---|---|
| I have used this technology | 2.9% | 0.0% | 4.0% | 3.4% | 0.0% |
| I have not used this technology, but I am familiar with it | 56.5% | 66.7% | 48.0% | 55.2% | 75.0% |
| I know just a little about this technology | 39.1% | 33.3% | 44.0% | 41.4% | 25.0% |
| I have never heard of this technology before now | 1.4% | 0.0% | 4.0% | 0.0% | 0.0% |
| **Are you interested in owning a fully automated vehicle technology?** | **Total** | 18-24 | 25-44 | 45-64 | 65 or older |
| Yes, I currently own or have owned this technology | 1.4% | 0.0% | 4.0% | 0.0% | 0.0% |
| Yes, I am interested in owning this technology in the future | 42.0% | 66.7% | 44.0% | 48.3% | 16.7% |
| No, I am not interested in owning this technology | 56.5% | 33.3% | 52.0% | 51.7% | 83.3% |

## 4.4 Dickinson

A total of 38 responses were collected form the city of Dickinson. Of these 38 responses, 30 are observed to be complete responses, and the rest were partially completed. All the 38 responses were considered for analysis. The demographics of the respondents in Dickinson are shown in Table 4.29. When examining the demographics, 17 males, 13 females, and eight no responses were recorded. “Prefer not to answer” and “Other” were also included as a gender option, but no respondents selected these options for the gender question. Respondents primarily belonged to the age groups 45-64 (43.3%), 25-44 (30.0%), and 65 or older (26.7%).

When asking about race, the survey options identified included White; Hispanic, Latino, or Spanish origin; Black or African American; Asian; Middle Eastern or North African; American Indian or Alaska Native; Native Hawaiian or Pacific Islander; some other race or origin; and prefer not to answer. Most respondents were White (93.3%), with black or African American (3.3%) and prefer not to answer/no response (3.3%) selected (Table 4.29).

As seen in Table 4.29, about 56.7% of the respondents hold a bachelor’s or an advanced degree. Likewise, about 80.0% of respondents are employed for wages, 6.7% are self-employed, and 6.7% are retired. Although 10.0% preferred not to answer the household income question, 73.6% earn incomes greater than $45,000 and 53.3% earn more than $100,000. According to the U.S. Census Bureau, American Community Survey (ACS), the median household income in Dickinson was $68,719 in 2019, so some residents are below the average household income, but many respondents are above the mean in household income.

**Table 4.29** Characteristics of Dickinson Respondents, N= 30

| | Total | Male | Female | Prefer not to answer/ Other |
|---|---|---|---|---|
| Total Count (All) | 30 | 17 | 13 | 0 |
| **Race** | | | | |
| White | 93.33% | 94.12% | 92.31% | 0.00% |
| Hispanic, Latino, or Spanish origin | 0.00% | 0.00% | 0.00% | 0.00% |
| Black or African American | 3.33% | 5.88% | 0.00% | 0.00% |
| Asian | 0.00% | 0.00% | 0.00% | 0.00% |
| Some other race or origin | 0.00% | 0.00% | 0.00% | 0.00% |
| Prefer not to answer | 3.33% | 0.00% | 7.69% | 0.00% |
| **Highest Education Level Completed** | | | | |
| 12th grade or less, no diploma | 3.33% | 5.88% | 0.00% | 0.00% |
| High school diploma/GED | 3.33% | 5.88% | 0.00% | 0.00% |
| Some college | 16.67% | 17.65% | 15.38% | 0.00% |
| Associate degree | 20.00% | 11.76% | 30.77% | 0.00% |
| Bachelor's degree | 40.00% | 41.18% | 38.46% | 0.00% |
| Master's degree | 16.67% | 17.65% | 15.38% | 0.00% |
| Professional degree (for example: MD, DDS, JD) | 0.00% | 0.00% | 0.00% | 0.00% |
| Prefer not to answer | 0.00% | 0.00% | 0.00% | 0.00% |
| **Annual Household Income before Taxes** | | | | |
| Less than $20,000 | 3.33% | 5.88% | 0.00% | 0.00% |
| $20,000 - $44,999 | 10.00% | 0.00% | 23.08% | 0.00% |
| $45,000 - $99,999 | 23.33% | 23.53% | 23.08% | 0.00% |
| $100,000 - $149,999 | 40.00% | 52.94% | 23.08% | 0.00% |
| $150,000 or more | 13.33% | 11.76% | 15.38% | 0.00% |
| Prefer not to answer | 10.00% | 5.88% | 15.38% | 0.00% |
| **Employment Status** | | | | |
| Employed for wages | 80.00% | 76.47% | 84.62% | 0.00% |
| Self-employed | 6.67% | 0.00% | 15.38% | 0.00% |
| Out of work and looking for work | 0.00% | 0.00% | 0.00% | 0.00% |
| Out of work but not currently looking for work | 0.00% | 0.00% | 0.00% | 0.00% |
| A homemaker | 0.00% | 0.00% | 0.00% | 0.00% |
| A student | 0.00% | 0.00% | 0.00% | 0.00% |
| Military | 0.00% | 0.00% | 0.00% | 0.00% |
| Retired | 6.67% | 11.76% | 0.00% | 0.00% |
| Unable to work | 0.00% | 0.00% | 0.00% | 0.00% |
| Prefer not to answer | 3.33% | 5.88% | 0.00% | 0.00% |

Most respondents (88.2%) identified work as their primary destination (Figure 4.6). About 11.8% of respondent's primary trip was for the work or school of a household member. About 2.9% of respondents reported other as their primary trip destination and provided the description as volunteer-related work.

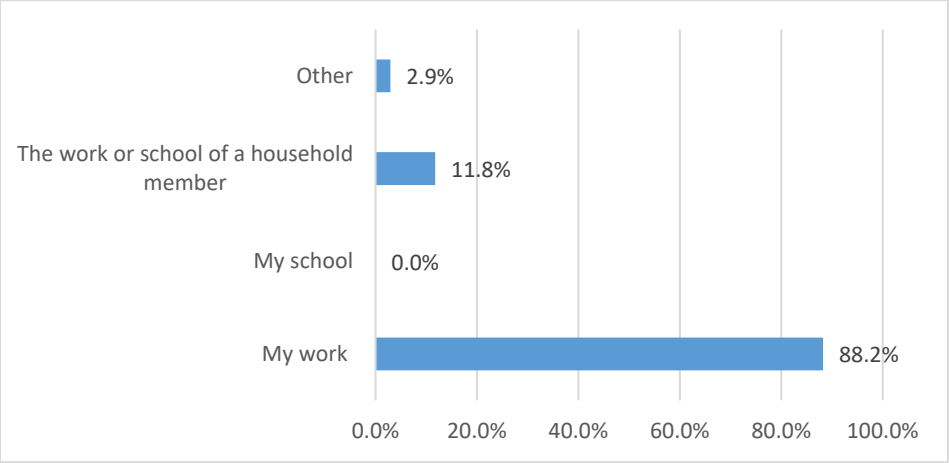


**Figure 4.6** Primary destination, N=34

*Note: Sum of percentages is more than 100 because more than one option can be selected by respondents.*

About one-third of the respondents (32.4%) travel 1-3 miles to reach their primary destination, while a little over one-third (35.3%) travel 3-5 miles (Table 4.30).

**Table 4.30** Miles to Primary Destination

| Miles | % | Count |
|---|---|---|
| Less than 1/2 mile | 8.8% | 3 |
| 1/2 mile to 1 mile | 0.0% | 0 |
| 1 mile to 3 miles | 32.4% | 11 |
| 3 - 5 miles | 35.3% | 12 |
| 5 - 10 miles | 8.8% | 3 |
| 10 - 15 miles | 0.0% | 0 |
| 15 - 25 miles | 2.9% | 1 |
| More than 25 miles | 11.8% | 4 |
| Total | 100% | 34 |

### 4.4.1 Number of days per week to primary destination before COVID-10 and after COVID-19

Respondents were asked how many days per week they traveled to their primary destination before COVID-19 and how many days after COVID-19. Before COVID-19, 70.6% of respondents traveled five days per week to their primary destination; after COVID-19, this percentage was reduced to 44.1% (Figure 4.7). While there are no respondents who traveled 0 or 1 day per week to work before COVID-19, 11.8% and 8.8% of respondents traveled 0 or 1 day after COVID-19, respectively. Overall, the trend moved toward respondents going to work less frequently after COVID-19.

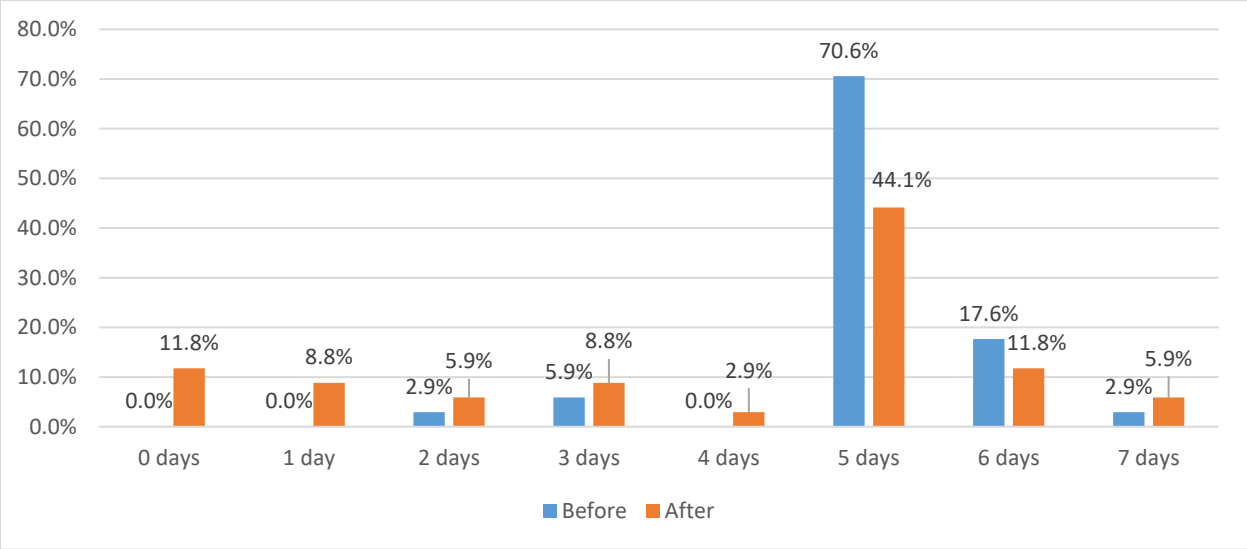


**Figure 4.7** Number of days travel to primary destination before and after COVID-19, N=34

Respondents were asked about the type of transportation mode they took to their primary destination per week before and after COVID-19. The transportation mode options provided for the respondents to select included:

- Your own vehicle (single occupant)
- Carpool with a friend, family member, colleague, or through casual carpool
- Public transit
- Uber, Lyft, or similar app-based rideshare service
- Motorcycle, moped, or scooter
- Your own bicycle/scooter
- Bike/scooter sharing programs
- Walking

Thirty-four respondents answered this question and 82.4% indicated they used their own vehicle as a single occupant four or more times per week prior to COVID-19 (Figure 4.8). Figure 4.8 summarizes the various modes respondents used to travel to their primary destination and their frequency of usage.

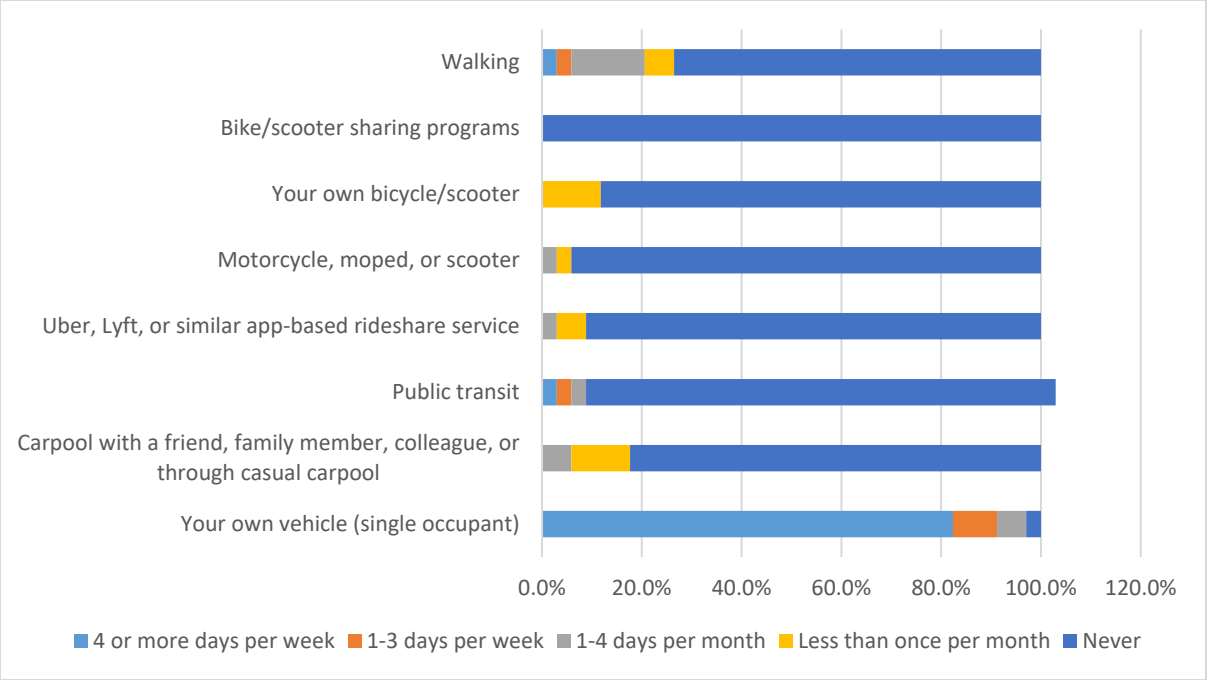


**Figure 4.8** Transportation mode taken to primary destination, prior to COVID

All (100%) of the respondents reported that they had a driver's license, yet four (12.1%) reported they preferred not to drive; one among the four indicated they could not drive because of a disability, illness, or other limitation.

Among respondents, 57.6% viewed their ability to interact with other people as positive, whereas only 12.1% viewed this as negative and 30.3% were indifferent to traveling with other people (Table 4.31). Nearly 39.4% of respondents viewed minimizing environmental impacts as positive, whereas only 6.1% viewed this as negative and a majority of the respondents (54.5%) were indifferent.

**Table 4.31** Characteristics Viewed as Positive and Negative, N=33

| Characteristic | Positive | Negative | Indifferent |
|---|---|---|---|
| Ability to interact with people (other than close friends or family members) | 57.6% | 12.1% | 30.3% |
| Minimize environmental impacts | 39.4% | 6.1% | 54.5% |

Safety and predictability were important to respondents when selecting a travel mode. More specifically, safety (75.8%), predictable arrival time (72.7%), shelter from bad weather (63.6%), and low hassle (63.6%) were the factors identified as very important to respondents as shown in Table 4.32. These were the same factors identified as important from the Fargo residents' survey.

**Table 4.32** Importance of Identified Characteristics for Decision of Transportation Options

| Characteristic | Very important | Moderately important | Slightly important | Not at all important | I never thought about it before |
|---|---|---|---|---|---|
| Short travel time | 54.5% | 30.3% | 15.2% | 0.0% | 0.0% |
| Shelter from bad weather | 63.6% | 24.2% | 9.1% | 3.0% | 0.0% |
| Low Cost | 30.3% | 30.3% | 24.2% | 9.1% | 3.0% |
| Predictable arrival time | 72.7% | 18.2% | 6.1% | 0.0% | 3.0% |
| Ability to engage in activities while traveling | 18.2% | 9.1% | 27.3% | 36.4% | 6.1% |
| Ability to easily make more than one stop | 51.5% | 15.2% | 21.2% | 3.0% | 9.1% |
| Ability to safely and conveniently transport a child under 8 years of age | 36.4% | 12.1% | 6.1% | 30.3% | 15.2% |
| Low hassle | 63.6% | 30.3% | 6.1% | 0.0% | 0.0% |
| Safety | 75.8% | 21.2% | 3.0% | 0.0% | 0.0% |
| Predictable cost | 45.5% | 18.2% | 15.2% | 12.1% | 9.1% |
| Not having to interact with people (other than close friends or family | 3.0% | 0.0% | 0.0% | 3.0% | 0.0% |
| Maximize environmental impacts | 3.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Ability to interact with people (other than close friends or family | 3.0% | 9.1% | 15.2% | 9.1% | 12.1% |
| Minimize environmental impacts | 12.1% | 15.2% | 6.1% | 0.0% | 0.0% |

### 4.4.2 Section Deliveries and Trips During a Typical Month Pre- and Post-COVID

Respondents were asked how many times during a typical month someone in their household received delivery from an online/phone order, took a vehicle (such as personal vehicle, taxi, Uber, or Lyft) to a store or restaurant, or walked, biked, or used public transit to get to the store or restaurant to purchase one or more of these options: groceries; clothing, shoes, or accessories; household items; and prepared meals, which include eating at a restaurant or getting takeout. Since travel behavior has changed greatly with the COVID-19 pandemic, this question was asked for a pre-COVID and post-COVID condition. A summary of the survey findings for these two questions is synthesized in Table 4.33.

Online/phone grocery purchase orders for a delivery were used by approximately one-third (34.62%) of the respondents before COVID, and close to two-thirds (65.38%) did not use it. After COVID, there was only a slight change and very few people started placing online/phone orders more frequently; the frequency of grocery purchases among the respondents in a typical month is summarized in Table 4.33. A breakdown of these observations based on gender and age group is summarized in Table 4.34, 4.35, and 4.36. Purchasing groceries by taking a vehicle, walking, bicycling, or taking public transit did not change drastically; this can be observed in Table 4.33. While there are some small fluctuations in the frequency

of grocery purchases, the trend toward higher or lower vehicle usage, walking, biking, and public transit was not found.

Online/phone clothing, shoes, and accessories purchases for a delivery option was prominent among respondents before COVID with 73.1% receiving various delivery frequencies after COVID, purchases of clothing, shoes, and accessories slightly decreased overall to 66.7% of respondents receiving various delivery frequencies. Purchasing clothing, shoes, and accessories by taking a vehicle, walking, bicycling, or taking public transit also decreased; this can be observed in Table 4.33. Among respondents, 14.8% mentioned taking zero trips using a vehicle to purchase clothing, shoes, and accessories before COVID, and this percentage increased to 32.1% after COVID. A breakdown of these observations based on gender and age group is summarized in Table 4.34, 4.35, and 4.36.

Online/phone household item purchases for a delivery option were also fairly prominent among respondents before COVID with 59.3% of respondents receiving various delivery frequencies; after COVID, purchases of household items stayed the same with 59.3% of respondents receiving various delivery frequencies; however, it is worth noting that respondents purchased household items more frequently using the online/phone option. Purchasing household items by taking a vehicle, walking, bicycling, or taking public transit did not change drastically, but respondents traveled less frequently to shop for household items; this can be observed in Table 4.33. A breakdown of these observations based on gender and age group is summarized in Table 4.34, 4.35, and 4.36.

Online/phone prepared meal purchases for a delivery option increased slightly after COVID; purchases of prepared meals for delivery slightly increased overall from 65.4% to 70.4% of respondents receiving various delivery frequencies. After COVID, purchasing prepared meals to eat at a restaurant or getting a takeout order by taking a vehicle slightly increased, and it slightly decreased for walking, bicycling, or taking public transit. A breakdown of these observations based on gender and age group is summarized in Table 4.34, 4.35, and 4.36.

**Table 4.33** Shopping Habits of Respondents for Pre-COVID and Post-COVID Scenario

| | Received a delivery from an online/phone order of… | | Took a vehicle (e.g., personal vehicle, taxi, Uber, Lyft) to a store or restaurant to buy… | | Walked, biked or used public transit to get to a store or restaurant to buy... | |
|---|---|---|---|---|---|---|
| **Pre-COVID** | | | | | | |
| Groceries | 0 Deliveries | 65.38% | 0 Trips | 3.45% | 0 Trips | 80.77% |
| | 1-3 Deliveries | 34.62% | 1-3 Trips | 27.59% | 1-3 Trips | 19.23% |
| | 4-6 Deliveries | 0.00% | 4-6 Trips | 27.59% | 4-6 Trips | 0.00% |
| | 7-9 Deliveries | 0.00% | 7-9 Trips | 27.59% | 7-9 Trips | 0.00% |
| | ≥10 deliveries | 0.00% | ≥10 Trips | 13.79% | ≥10 Trips | 0.00% |
| Clothing, shoes or accessories | 0 Deliveries | 26.92% | 0 Trips | 14.81% | 0 Trips | 100.00% |
| | 1-3 Deliveries | 69.23% | 1-3 Trips | 66.67% | 1-3 Trips | 0.00% |
| | 4-6 Deliveries | 3.85% | 4-6 Trips | 11.11% | 4-6 Trips | 0.00% |
| | 7-9 Deliveries | 0.00% | 7-9 Trips | 0.00% | 7-9 Trips | 0.00% |
| | ≥10 deliveries | 0.00% | ≥10 Trips | 7.41% | ≥10 Trips | 0.00% |
| Household items | 0 Deliveries | 40.74% | 0 Trips | 0.44% | 0 Trips | 96.15% |
| | 1-3 Deliveries | 51.85% | 1-3 Trips | 6.99% | 1-3 Trips | 3.85% |
| | 4-6 Deliveries | 7.41% | 4-6 Trips | 3.93% | 4-6 Trips | 0.00% |
| | 7-9 Deliveries | 0.00% | 7-9 Trips | 0.00% | 7-9 Trips | 0.00% |
| | ≥10 deliveries | 0.00% | ≥10 Trips | 1.31% | ≥10 Trips | 0.00% |
| Prepared meal (eating at a restaurant or getting takeout) | 0 Deliveries | 34.62% | 0 Trips | 3.45% | 0 Trips | 70.37% |
| | 1-3 Deliveries | 30.77% | 1-3 Trips | 41.38% | 1-3 Trips | 29.63% |
| | 4-6 Deliveries | 23.08% | 4-6 Trips | 13.79% | 4-6 Trips | 0.00% |
| | 7-9 Deliveries | 11.54% | 7-9 Trips | 27.59% | 7-9 Trips | 0.00% |
| | ≥10 deliveries | 0.00% | ≥10 Trips | 13.79% | ≥10 Trips | 0.00% |
| **Post-COVID** | | | | | | |
| Groceries | 0 Deliveries | 57.69% | 0 Trips | 6.90% | 0 Trips | 88.46% |
| | 1-3 Deliveries | 34.62% | 1-3 Trips | 31.03% | 1-3 Trips | 11.54% |
| | 4-6 Deliveries | 7.69% | 4-6 Trips | 31.03% | 4-6 Trips | 0.00% |
| | 7-9 Deliveries | 0.00% | 7-9 Trips | 20.69% | 7-9 Trips | 0.00% |
| | ≥10 deliveries | 0.00% | ≥10 Trips | 10.34% | ≥10 Trips | 0.00% |
| Clothing, shoes or accessories | 0 Deliveries | 33.33% | 0 Trips | 32.14% | 0 Trips | 100.00% |
| | 1-3 Deliveries | 55.56% | 1-3 Trips | 46.43% | 1-3 Trips | 0.00% |
| | 4-6 Deliveries | 11.11% | 4-6 Trips | 10.71% | 4-6 Trips | 0.00% |
| | 7-9 Deliveries | 0.00% | 7-9 Trips | 3.57% | 7-9 Trips | 0.00% |
| | ≥10 deliveries | 0.00% | ≥10 Trips | 7.14% | ≥10 Trips | 0.00% |
| Household items | 0 Deliveries | 40.74% | 0 Trips | 6.90% | 0 Trips | 92.31% |
| | 1-3 Deliveries | 44.44% | 1-3 Trips | 68.97% | 1-3 Trips | 7.69% |
| | 4-6 Deliveries | 11.11% | 4-6 Trips | 13.79% | 4-6 Trips | 0.00% |
| | 7-9 Deliveries | 3.70% | 7-9 Trips | 0.00% | 7-9 Trips | 0.00% |
| | ≥10 deliveries | 0.00% | ≥10 Trips | 10.34% | ≥10 Trips | 0.00% |
| Prepared meal (eating at a restaurant or getting takeout) | 0 Deliveries | 29.63% | 0 Trips | 0.00% | 0 Trips | 92.31% |
| | 1-3 Deliveries | 40.74% | 1-3 Trips | 51.72% | 1-3 Trips | 7.69% |
| | 4-6 Deliveries | 14.81% | 4-6 Trips | 17.24% | 4-6 Trips | 0.00% |
| | 7-9 Deliveries | 7.41% | 7-9 Trips | 17.24% | 7-9 Trips | 0.00% |
| | ≥10 deliveries | 7.41% | ≥10 Trips | 13.79% | ≥10 Trips | 0.00% |

**Table 4.34** Online/Phone Order Shopping Habits for Delivery - Pre-COVID and Post-COVID Scenario

| Received a delivery from an online/phone order of… | | Total | Gender | | Age Group | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Male | Female | 18-24 | 25-44 | 45-64 | 65 or older |
| | | **Pre-COVID** | | | | | | |
| Groceries | 0 Deliveries | 65.4% | 58.8% | 41.2% | 0.0% | 75.0% | 36.4% | 100.0% |
| | 1-3 Deliveries | 34.6% | 44.4% | 55.6% | 0.0% | 25.0% | 63.6% | 0.0% |
| | 4-6 Deliveries | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| | 7-9 Deliveries | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| | ≥10 deliveries | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Clothing, shoes or accessories | 0 Deliveries | 26.9% | 57.1% | 42.9% | 0.0% | 12.5% | 27.3% | 42.9% |
| | 1-3 Deliveries | 69.2% | 50.0% | 50.0% | 0.0% | 87.5% | 63.6% | 57.1% |
| | 4-6 Deliveries | 3.8% | 100.0% | 0.0% | 0.0% | 0.0% | 9.1% | 0.0% |
| | 7-9 Deliveries | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| | ≥10 deliveries | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Household items | 0 Deliveries | 40.7% | 72.7% | 27.3% | 0.0% | 12.5% | 54.5% | 57.1% |
| | 1-3 Deliveries | 51.9% | 42.9% | 57.1% | 0.0% | 75.0% | 45.5% | 42.9% |
| | 4-6 Deliveries | 7.4% | 50.0% | 50.0% | 0.0% | 12.5% | 9.1% | 0.0% |
| | 7-9 Deliveries | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| | ≥10 deliveries | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Prepared meal (eating at a restaurant or getting takeout) | 0 Deliveries | 34.6% | 44.4% | 55.6% | 0.0% | 62.5% | 18.2% | 28.6% |
| | 1-3 Deliveries | 30.8% | 37.5% | 62.5% | 0.0% | 25.0% | 36.4% | 28.6% |
| | 4-6 Deliveries | 23.1% | 83.3% | 16.7% | 0.0% | 12.5% | 45.5% | 0.0% |
| | 7-9 Deliveries | 11.5% | 66.7% | 33.3% | 0.0% | 0.0% | 0.0% | 42.9% |
| | ≥10 deliveries | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| | | **Post-COVID** | | | | | | |
| Groceries | 0 Deliveries | 57.7% | 66.7% | 33.3% | 0.0% | 50.0% | 45.5% | 85.7% |
| | 1-3 Deliveries | 34.6% | 44.4% | 55.6% | 0.0% | 37.5% | 45.5% | 14.3% |
| | 4-6 Deliveries | 7.7% | 0.0% | 100.0% | 0.0% | 12.5% | 9.1% | 0.0% |
| | 7-9 Deliveries | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| | ≥10 deliveries | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Clothing, shoes or accessories | 0 Deliveries | 33.3% | 66.7% | 33.3% | 0.0% | 12.5% | 33.3% | 57.1% |
| | 1-3 Deliveries | 55.6% | 46.7% | 53.3% | 0.0% | 62.5% | 58.3% | 42.9% |
| | 4-6 Deliveries | 11.1% | 66.7% | 33.3% | 0.0% | 25.0% | 8.3% | 0.0% |
| | 7-9 Deliveries | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| | ≥10 deliveries | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Household items | 0 Deliveries | 40.7% | 54.5% | 45.5% | 0.0% | 12.5% | 33.3% | 85.7% |
| | 1-3 Deliveries | 44.4% | 58.3% | 41.7% | 0.0% | 50.0% | 58.3% | 14.3% |
| | 4-6 Deliveries | 11.1% | 33.3% | 66.7% | 0.0% | 25.0% | 8.3% | 0.0% |
| | 7-9 Deliveries | 3.7% | 100.0% | 0.0% | 0.0% | 12.5% | 0.0% | 0.0% |
| | ≥10 deliveries | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Prepared meal (eating at a restaurant or getting takeout) | 0 Deliveries | 29.6% | 62.5% | 37.5% | 0.0% | 37.5% | 16.7% | 42.9% |
| | 1-3 Deliveries | 40.7% | 54.5% | 45.5% | 0.0% | 37.5% | 58.3% | 14.3% |
| | 4-6 Deliveries | 14.8% | 25.0% | 75.0% | 0.0% | 12.5% | 25.0% | 0.0% |
| | 7-9 Deliveries | 7.4% | 100.0% | 0.0% | 0.0% | 12.5% | 0.0% | 14.3% |
| | ≥10 deliveries | 7.4% | 50.0% | 50.0% | 0.0% | 0.0% | 0.0% | 28.6% |

**Table 4.35** Shopping by Taking a Vehicle to Store or Restaurant - Pre-COVID and Post-COVID Scenario

| Took a vehicle (personal vehicle, taxi, Uber, Lyft) to a store or restaurant to buy primarily… | | Total | Gender | | Age Group | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Male | Female | 18-24 | 25-44 | 45-64 | 65 or older |
| | | **Pre-COVID** | | | | | | |
| Groceries | 0 Trips | 3.4% | 0.0% | 100.0% | 0.0% | 0.0% | 0.0% | 12.5% |
| | 1-3 Trips | 27.6% | 50.0% | 50.0% | 0.0% | 44.4% | 25.0% | 12.5% |
| | 4-6 Trips | 27.6% | 37.5% | 62.5% | 0.0% | 33.3% | 33.3% | 12.5% |
| | 7-9 Trips | 27.6% | 75.0% | 25.0% | 0.0% | 11.1% | 33.3% | 37.5% |
| | ≥10 Trips | 13.8% | 75.0% | 25.0% | 0.0% | 11.1% | 8.3% | 25.0% |
| Clothing, shoes or accessories | 0 Trips | 14.8% | 0.0% | 100.0% | 0.0% | 22.2% | 9.1% | 14.3% |
| | 1-3 Trips | 66.7% | 55.6% | 44.4% | 0.0% | 77.8% | 63.6% | 57.1% |
| | 4-6 Trips | 11.1% | 100.0% | 0.0% | 0.0% | 0.0% | 18.2% | 14.3% |
| | 7-9 Trips | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| | ≥10 Trips | 7.4% | 50.0% | 50.0% | 0.0% | 0.0% | 9.1% | 14.3% |
| Household items | 0 Trips | 3.4% | 0.0% | 100.0% | 0.0% | 0.0% | 0.0% | 12.5% |
| | 1-3 Trips | 55.2% | 37.5% | 62.5% | 0.0% | 77.8% | 33.3% | 62.5% |
| | 4-6 Trips | 31.0% | 88.9% | 11.1% | 0.0% | 22.2% | 58.3% | 0.0% |
| | 7-9 Trips | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| | ≥10 Trips | 10.3% | 66.7% | 33.3% | 0.0% | 0.0% | 8.3% | 25.0% |
| Prepared meal (eating at a restaurant or getting takeout) | 0 Trips | 3.4% | 100.0% | 0.0% | 0.0% | 0.0% | 8.3% | 0.0% |
| | 1-3 Trips | 41.4% | 33.3% | 66.7% | 0.0% | 66.7% | 25.0% | 37.5% |
| | 4-6 Trips | 13.8% | 75.0% | 25.0% | 0.0% | 0.0% | 0.0% | 25.0% |
| | 7-9 Trips | 27.6% | 75.0% | 25.0% | 0.0% | 11.1% | 50.0% | 12.5% |
| | ≥10 Trips | 13.8% | 50.0% | 50.0% | 0.0% | 11.1% | 8.3% | 25.0% |
| | | **Post-COVID** | | | | | | |
| Groceries | 0 Trips | 6.9% | 0.0% | 100.0% | 0.0% | 11.1% | 0.0% | 12.5% |
| | 1-3 Trips | 31.0% | 44.4% | 55.6% | 0.0% | 44.4% | 33.3% | 12.5% |
| | 4-6 Trips | 31.0% | 44.4% | 55.6% | 0.0% | 33.3% | 33.3% | 25.0% |
| | 7-9 Trips | 20.7% | 83.3% | 16.7% | 0.0% | 0.0% | 33.3% | 25.0% |
| | ≥10 Trips | 10.3% | 100.0% | 0.0% | 0.0% | 11.1% | 0.0% | 25.0% |
| Clothing, shoes or accessories | 0 Trips | 32.1% | 44.4% | 55.6% | 0.0% | 33.3% | 25.0% | 37.5% |
| | 1-3 Trips | 46.4% | 46.2% | 53.8% | 0.0% | 66.7% | 33.3% | 37.5% |
| | 4-6 Trips | 10.7% | 100.0% | 0.0% | 0.0% | 0.0% | 16.7% | 12.5% |
| | 7-9 Trips | 3.6% | 0.0% | 0.0% | 0.0% | 0.0% | 8.3% | 0.0% |
| | ≥10 Trips | 7.1% | 0.0% | 0.0% | 0.0% | 0.0% | 8.3% | 12.5% |
| Household items | 0 Trips | 6.9% | 0.0% | 100.0% | 0.0% | 11.1% | 0.0% | 12.5% |
| | 1-3 Trips | 69.0% | 55.0% | 45.0% | 0.0% | 88.9% | 58.3% | 62.5% |
| | 4-6 Trips | 13.8% | 75.0% | 25.0% | 0.0% | 0.0% | 33.3% | 0.0% |
| | 7-9 Trips | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| | ≥10 Trips | 10.3% | 0.0% | 0.0% | 0.0% | 0.0% | 8.3% | 25.0% |
| Prepared meal (eating at a restaurant or getting takeout) | 0 Trips | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| | 1-3 Trips | 51.7% | 40.0% | 60.0% | 0.0% | 77.8% | 33.3% | 50.0% |
| | 4-6 Trips | 17.2% | 60.0% | 40.0% | 0.0% | 11.1% | 33.3% | 0.0% |
| | 7-9 Trips | 17.2% | 100.0% | 0.0% | 0.0% | 0.0% | 25.0% | 25.0% |
| | ≥10 Trips | 13.8% | 50.0% | 50.0% | 0.0% | 11.1% | 8.3% | 25.0% |

**Table 4.36** Shopping by Walking, Biking or Using Public Transit - Pre-COVID and Post-COVID Scenario

| Walked, biked or used public transit to get to a store or restaurant to buy primarily… | | Total | Gender | | Age Group | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Male | Female | 18-24 | 25-44 | 45-64 | 65 or older |
| | | **Pre-COVID** | | | | | | |
| Groceries | 0 Trips | 31.3% | 57.1% | 42.9% | 0.0% | 32.0% | 20.0% | 58.3% |
| | 1-3 Trips | 7.5% | 40.0% | 60.0% | 0.0% | 0.0% | 16.7% | 0.0% |
| | 4-6 Trips | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| | 7-9 Trips | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| | ≥10 Trips | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Clothing, shoes or accessories | 0 Trips | 38.1% | 50.0% | 50.0% | 0.0% | 100.0% | 100.0% | 100.0% |
| | 1-3 Trips | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| | 4-6 Trips | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| | 7-9 Trips | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| | ≥10 Trips | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Household items | 0 Trips | 96.2% | 56.0% | 44.0% | 0.0% | 100.0% | 90.9% | 100.0% |
| | 1-3 Trips | 3.8% | 0.0% | 100.0% | 0.0% | 0.0% | 9.1% | 0.0% |
| | 4-6 Trips | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| | 7-9 Trips | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| | ≥10 Trips | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Prepared meal (eating at a restaurant or getting takeout) | 0 Trips | 70.4% | 57.9% | 42.1% | 0.0% | 75.0% | 50.0% | 100.0% |
| | 1-3 Trips | 29.6% | 50.0% | 50.0% | 0.0% | 25.0% | 50.0% | 0.0% |
| | 4-6 Trips | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| | 7-9 Trips | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| | ≥10 Trips | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| | | **Post-COVID** | | | | | | |
| Groceries | 0 Trips | 88.5% | 56.5% | 43.5% | 0.0% | 100.0% | 72.7% | 100.0% |
| | 1-3 Trips | 11.5% | 33.3% | 66.7% | 0.0% | 0.0% | 27.3% | 0.0% |
| | 4-6 Trips | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| | 7-9 Trips | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| | ≥10 Trips | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Clothing, shoes or accessories | 0 Trips | 100.0% | 53.8% | 46.2% | 0.0% | 100.0% | 100.0% | 100.0% |
| | 1-3 Trips | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| | 4-6 Trips | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| | 7-9 Trips | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| | ≥10 Trips | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Household items | 0 Trips | 92.3% | 54.2% | 45.8% | 0.0% | 100.0% | 81.8% | 100.0% |
| | 1-3 Trips | 7.7% | 50.0% | 50.0% | 0.0% | 0.0% | 18.2% | 0.0% |
| | 4-6 Trips | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| | 7-9 Trips | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| | ≥10 Trips | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| Prepared meal (eating at a restaurant or getting takeout) | 0 Trips | 92.3% | 58.3% | 41.7% | 0.0% | 87.5% | 90.9% | 100.0% |
| | 1-3 Trips | 7.7% | 0.0% | 100.0% | 0.0% | 12.5% | 9.1% | 0.0% |
| | 4-6 Trips | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| | 7-9 Trips | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |
| | ≥10 Trips | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |

### 4.4.3 Familiarity, Interest in Owning, and/or Utilizing Various Mobility or Delivery Related Technologies

The respondents were asked to identify their familiarity as well as their interest in owning various types of vehicle-related technologies, including:

- hybrid vehicles
- plug-in vehicle
- smartphone
- rooftop solar panel
- adaptive cruise control
- partially automated
- fully automated

Similarly, questions were also asked about familiarity and usage of rideshare and web applications that may help with improving trips or take the place of a trip through a delivery. These technologies include:

- Rideshare services
- Navigation or trip-planning apps, e.g., Google maps
- Amazon Prime services

In Figures 4.9 and 4.10, we see the respondents' answers to their use and interest in the advanced technologies. Three of the advanced technologies have high adoption rates, smartphones (97%), trip planning apps (90%), and Amazon Prime (70%). Further, technologies such as rideshare services (47%), adaptive cruise control (43%), and partially automated vehicles (23%) have moderate adoption rates.

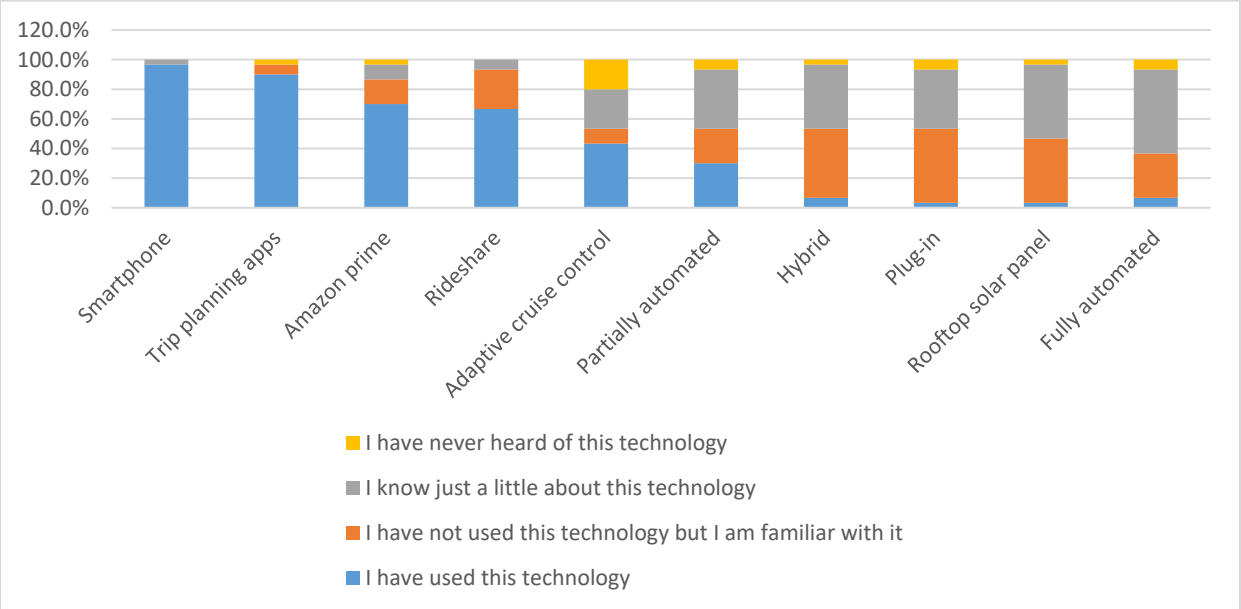


**Figure 4.9** Familiarity with select advanced transportation related technologies, N=30

Figure 4.10 shows there is quite a bit of interest in hybrid, plug-in, as well as fully automated vehicles. Several respondents indicated they were not interested in owning hybrid vehicles, plug-in vehicles, fully automated vehicles, rooftop solar, adaptive cruise control, rideshare, or Amazon Prime.

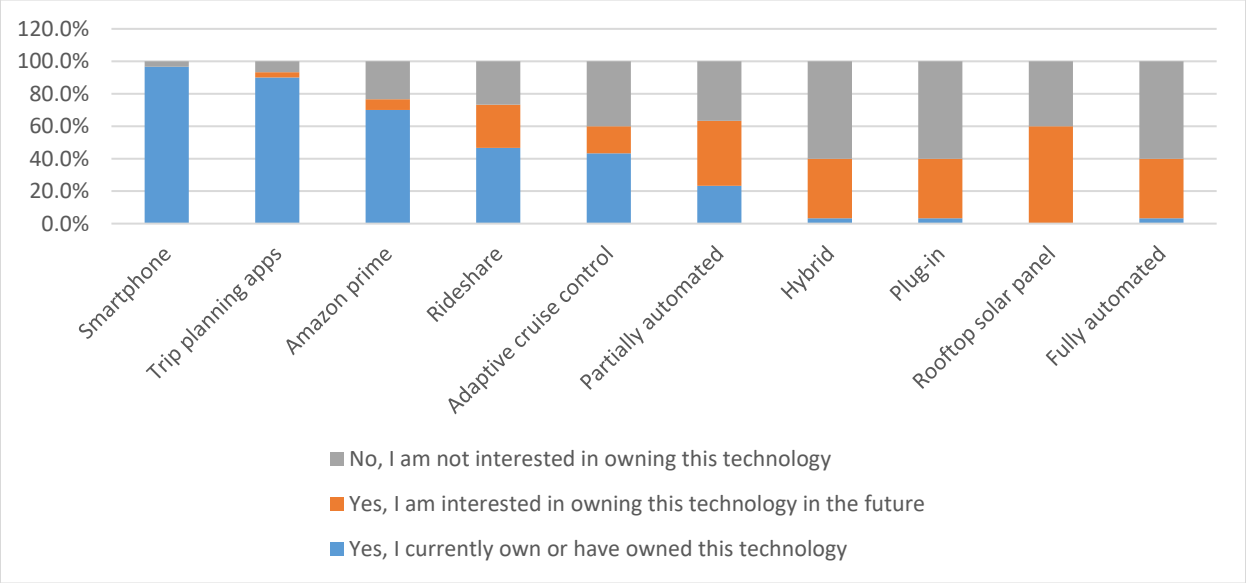


**Figure 4.10** Interest in owning select advanced transportation related technologies

## 4.5 Comparison of Survey Results for Fargo, ND, and Dickinson, ND

This section presents the comparison of survey results between the cities of Fargo and Dickinson. This comparison focuses on identifying the similarities and differences among some of the major observations from the survey responses for the urban city of Fargo and rural city of Dickinson in North Dakota.

A total of 91 survey responses were received from Fargo, and 38 survey responses from Dickinson. More than 90% of responders in both cities are white, and most respondents identified work as their primary destination in Fargo (73%) and Dickinson (88.2%). Over 70% of respondents in both Fargo and Dickinson traveled five days per week to their primary destination before COVID-19, and this percentage was reduced to the mid-40% range for both cities after COVID-19.

Among various characteristics available for deciding on transportation mode, safety and predictability were observed as the two important characteristics for both Fargo and Dickinson when selecting a travel mode. Most of the residents in both communities (73% in Fargo and 82.4% in Dickinson) chose using their own vehicle as a transportation mode to travel to their primary destination.

Respondents in both communities were asked how many times someone in their household used various methods (online/phone order, drove, walked, biked, or used public transit) to purchase groceries, clothing, shoes or accessories, household items, and prepared meals. When compared with Fargo respondents, a larger percentage of respondents in Dickinson used online/phone order methods even before COVID-19 to purchase groceries (34.6% of respondents in Dickinson vs. 10% of respondents in Fargo); clothing, shoes, or accessories (73.1% of respondents in Dickinson vs. 68% of respondents in Fargo); household items (59% of respondents in Dickinson vs. 56% of respondents in Fargo); and prepared meals, which include eating at a restaurant or getting takeout (65.4% of respondents in Dickinson vs. 61% of respondents in Fargo). After COVID-19, one consistent observation in Fargo and Dickinson survey responses is that there was an increase in the percentage of respondents using online/phone order methods to purchase groceries, clothing, shoes or accessories, household items, and prepared meals.

Regarding the adaptation of advanced technologies, both Fargo and Dickinson were observed to have high adaptation rates for advanced technologies such as smartphones, trip planning apps, and Amazon Prime. Rideshare service has a high adaptation rate in Fargo but moderate adaptation rate in Dickinson. Adaptive cruise control and partially automated vehicles have moderate adaptation rates in both Fargo and Dickinson. Fargo respondents also had moderate adoption rates for hybrid vehicles.

# 5. SUMMARY AND CONCLUSION

## 5.1 Summary of Findings from 2017 National Household Travel Survey Analysis

The 2017 National Household Travel Survey (NHTS) database was used in this study to analyze various characteristics of rideshare users, carshare users, bikeshare users, and online shoppers in rural America. Data from 61,327 people within rural U.S. households were used to conduct the analysis. By 2017, various kinds of shared-use mobility services became prominent in urban areas and available in some rural areas. With the availability of shared-use mobility services in rural areas, and the 2017 NHTS having specific questions to measure the usage of rideshare, carshare, bikeshare, and online shopping, the study results helped to better understand the demographics characteristics of people who use this various technology enabled services.

Among all rural respondents, about 1.8% use rideshare services, about 0.2% use carshare services, and about 0.3% use bikeshare services (Figure 5.1). Close to half (48.1%) of all rural respondents use online shopping for a delivery; this online shopping behavior among rural respondents is almost same for urban residents where 51.9% of urban respondents purchase online for a delivery. This high percentage of online shopping could be anecdotally attributed to the fact that there are logistic providers who can deliver a good almost anywhere across the United States. Availability of quality internet service is hard for people living in sparsely populated rural areas. Therefore, availability of quality internet service is critical for attracting shared-use mobility services to rural areas as well as having people use them.

Among the three shared-use mobility options, rideshare service usage seems to be comparatively more prominent among rural respondents; the reason could be ridesharing service is the most available shared-use mobility service in rural areas among other services. While the percentage of rural respondents using rideshare services is very small (1.8%), the percentage of all rural respondents using public transit in rural areas is 5.6%, which is also small (Figure 5.2). It also should be noted that some form of public transit is available in most rural communities, but, as of 2017, only a few rural communities have rideshare services available. Therefore, considering public transit availability within rural areas and its usage among the rural population, it can be understood that 1.8% of rural respondents using rideshare service is a decent usage amount, particularly considering that most rural areas do not have operational rideshare services. Therefore, it can be inferred that there is a demand for rideshare services and other shared-use mobility services in rural areas, and if these services are operational in many rural communities, the percentage of rural respondents using shared-use mobility services could increase. About 71% of rural respondents use a smartphone daily or a few times a week, about 91% of rural respondents use the internet daily or a few times a week, and about 48% of rural respondents shop online for a delivery. Considering that shared-use mobility services require a smartphone, the internet, and ability to make purchases online, most rural residents have the equipment and consumer behavior needed to use these services. The only missing element is the shared-use mobility services themselves in rural areas.

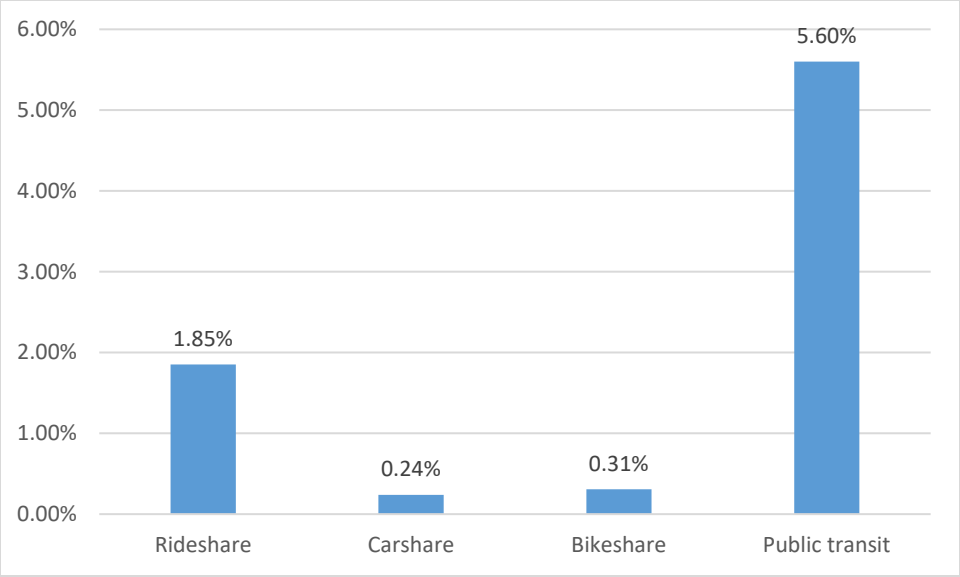


**Figure 5.1** Percentage of rural respondents who use rideshare, carshare, bikeshare, and public transit

Another important finding from the study is that a significant portion of rideshare users (29.9%), carshare users (28.8%), and bikeshare (20.1%) users are also public transit users. For perspective, only 5.6% of respondents among all rural respondents are public transit users. Therefore, it could be understood that public transit users tend to use shared-use mobility services such as rideshare, carshare, and bikeshare services. This covarying tendency could likely be due to the overlapping of geographical availability of these services. With this synergy between shared-use mobility services and public transit services within rural areas, the authors believe that collaboration efforts between public transit providers and private mobility providers offering rideshare, carshare, and bikeshare services on top of traditional public transit services could primarily benefit rural residents. The benefit would be improved mobility options by building a better transportation network, therefore improving the ridership for all the parties involved in a potential collaborative effort.

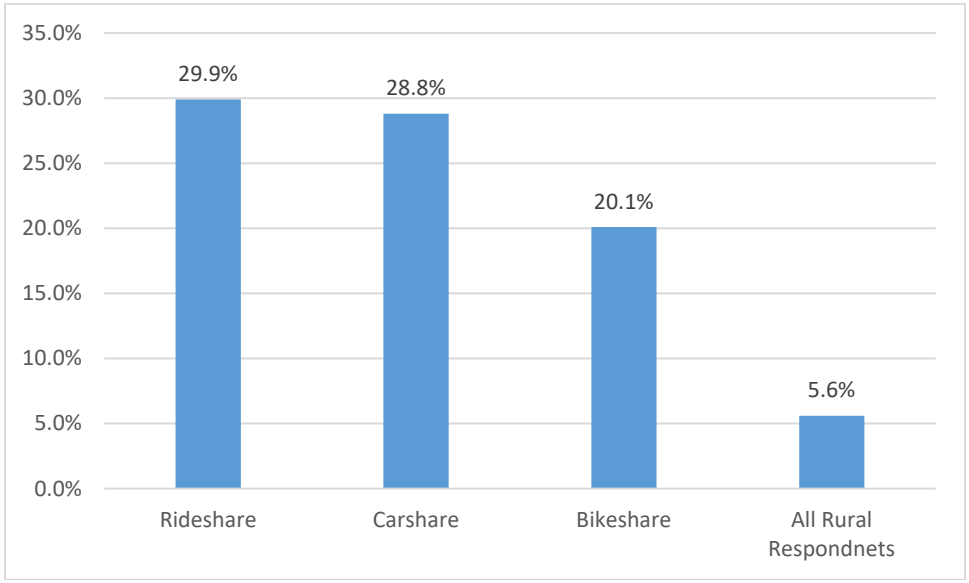


**Figure 5.2** Transit usage among rideshare users, carshare users, bikeshare users, and all rural respondents

## 5.2 Shared Use Mobility Survey Results

A survey was conducted in two North Dakota communities, Fargo and Dickinson, during December 2020 to learn about the types of transportation options each community uses and how the options may have changed because of the COVID-19 pandemic. The survey also intended to learn their opinions and interests in transportation related technologies like electric vehicles, and to understand their background and how it may influence some of their transportation choices. A total of 91 Fargo respondents over age 18 completed the survey and 38 Dickinson respondents over 18 completed the survey.

More than 90% of responders in both cities are white, and most respondents identified work as their primary destination in Fargo (73%) and Dickinson (88.2%). Over 70% of respondents in both cities traveled five days per week to their primary destination before COVID-19, and this percentage was reduced to the mid-40% range for both cities.

Among various characteristics available for deciding on transportation mode, safety, and predictability were seen as the two important characteristics for both Fargo and Dickinson when selecting a travel mode. Most of the residents in both the communities (73% in Fargo and 82.4% in Dickinson) chose using their own vehicle as a transportation mode to travel to their primary destination.

Regarding the adoption of advanced technologies, both Fargo and Dickinson were observed to have high adoption rates for advanced technologies such as smartphones, trip planning apps, and Amazon Prime. Rideshare service has a high adoption rate in Fargo but moderate adoption rate in Dickinson. Adaptive cruise control and partially automated vehicles have moderate adoption rates in both Fargo and Dickinson. Fargo respondents also had moderate adoption rates for hybrid vehicles.

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# 7. APPENDIX A

The 2017 National Transit Household Survey (NHTS) results were analyzed in this section to:

1. Develop models to predict the likelihood of rideshare and delivery service use in rural areas in the United States and to identify correlations between NHTS features with delivery and rideshare. This is done by developing predictive models and using them on NHTS data.
2. Develop simulation models to predict optimal conditions that result in the desired outcome for rideshare and delivery services. This is done by developing optimization models to understand desired setups that yield the desired output for rideshare and online shopping for delivery use.

The study runs through the analytic processes using the extraction, transformation, and load (ETL) process. Within the ETL process, the analysis runs the NHTS data through a rigorous sub-process (See Figure A.1) to improve the performance of the predictive and prescriptive models. Figure A.1 demonstrates six steps with sub-components for developing logistic regression and simulation models.

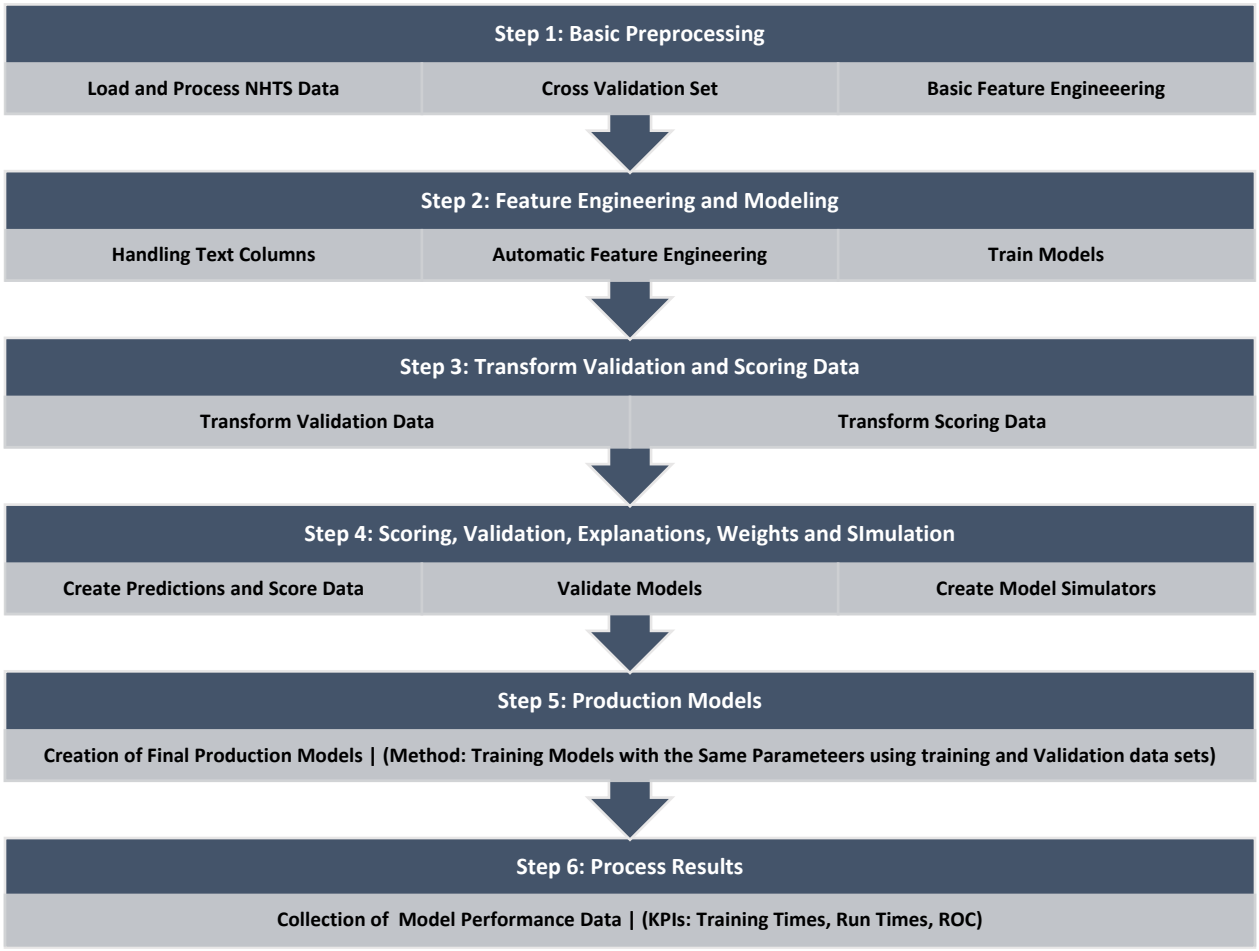


**Figure A.1** Process for Predictive (Logistics Regression) and Prescriptive (Optimization) Analysis.

The authors developed two logistic regression models during this six-step process, one logit model for rideshare services and another for delivery services. The rideshare service logit model had the following variables:

1. Sex of respondents (male/female)
2. Respondents use delivery service (yes/no)
3. Respondents level of education (between 1 and 5)
    a. 1 for less than a high school graduate
    b. 2 for high school graduate or GED
    c. 3 for some college or associate's degree
    d. 4 for bachelor's degree
    e. 5 for a graduate degree or professional degree
4. Household family income (between 1 and 11)
    a. 1 for less than $10,000
    b. 2 for $10,000 to $14,999
    c. 3 for $15,000 to $24,999
    d. 4 for $25,000 to $34,999
    e. 5 for $35,000 to $49,999
    f. 6 for $50,000 to $74,999
    g. 7 for $75,000 to $99,999
    h. 8 for $100,000 to $124,999
    i. 9 for $125,000 to $149,999
    j. 10 for $150,000 to $199,999
    k. 11 for $200,000 or more
5. Number of bike-share trips (between 1 and 20)
6. Number of walk trips (between 1 and 80)
7. Smart phone use frequency (between 1 and 5)
8. Number of walks for exercise (between 0 and 40)

The delivery service logit model had the same variables/features, excluding the second feature (respondents use delivery service) and including the logarithm of the third variable/features (respondents' level of education).

## RESULTS

The ridership service logistic regression model has a 95% prediction accuracy. The household family income and education level correlate significantly with ridership service use. A unit increase in education correlates with a 37.8% increase in the odds of using rideshare. A unit increase in household income correlates with a 31.6% increase in the odds of using rideshare. Note that at a lower level of significance, the models suggest that being male, increase use of delivery service, and increased number of walks all increase the odds of rideshare use. On the other hand, an increase in bike-share trips, walks for exercise, and smartphone use all decrease the odds of using rideshare.

The authors ran a simulation-based optimization on the rideshare model. The results suggest that non-users of the rideshare service is at a minimum when the input variables are as follows:

- When the sex is male
- 1 for the use of delivery service use
- 5 for the level of education (graduate degree or professional degree)
- 11 for household income is ($200,000 or more)
- 1 for number of bike-share trips
- 25 for the number of walks

- 1 for smartphone use

These simulation results suggest that those who contribute the most to the odds of rideshare use are males who have used a delivery service at least once, are educated, earn a high income, have used the bike-share once, take frequent walks, and rarely use their smartphones.

The delivery service logistic regression model has a 74.3% prediction accuracy. The household family income, the frequency of smartphone use, and the logarithm of the level of education correlate significantly with delivery service use. A unit decrease in the level of household family income decreases the odds of delivery service used by 16.3%. Similarly, a unit decrease in the logarithm of education reduces the odds of delivery service by 99.3%. A unit increase in the frequency of smartphone use increases the odds of delivery service by 26.1%.

Note that at a lower level of significance (less than 95% confidence interval), the models suggest that an increase in the level of education and the respondent's age increase the odds of delivery use. On the other hand, an increase in bike-share trips decreases the odds of delivery service use. The authors ran a simulation-based optimization on the delivery model, and the results suggest that the number of non-users of the delivery service is at a minimum when the input variables are:

- AA value of 1 for the logarithm of education level.
- 84 years old (age 84)
- 5 for the level of education (graduate degree or professional degree)
- 2 for household income is ($10,000 to $14,999)
- 1 for number of bike-share trips
- 25 for the number of walks
- 5 for smartphone use

These findings suggest that more educated, low-income earners, who are older, use their smartphones frequently, and frequent walks contribute the most to the odds of delivering service use.