

Exploring the Use of Public Transportation Among Older Adults During the COVID-19 Pandemic: A National Survey

Keertana Sureshbabu, BS
Egbe-Etu Etu, PhD

Susan Summerville, BS
Ankur Parmar, BS

Gaojian Huang, PhD



Mineta Transportation Institute

Founded in 1991, the Mineta Transportation Institute (MTI), an organized research and training unit in partnership with the Lucas College and Graduate School of Business at San José State University (SJSU), increases mobility for all by improving the safety, efficiency, accessibility, and convenience of our nation's transportation system. Through research, education, workforce development, and technology transfer, we help create a connected world. MTI leads the [Mineta Consortium for Transportation Mobility \(MCTM\)](#) funded by the U.S. Department of Transportation and the [California State University Transportation Consortium \(CSUTC\)](#) funded by the State of California through Senate Bill 1. MTI focuses on three primary responsibilities:

Research

MTI conducts multi-disciplinary research focused on surface transportation that contributes to effective decision making. Research areas include: active transportation; planning and policy; security and counterterrorism; sustainable transportation and land use; transit and passenger rail; transportation engineering; transportation finance; transportation technology; and workforce and labor. MTI research publications undergo expert peer review to ensure the quality of the research.

Education and Workforce

To ensure the efficient movement of people and products, we must prepare a new cohort of transportation professionals who are ready to lead a more diverse, inclusive, and equitable transportation industry. To help achieve this, MTI sponsors a suite of workforce development and education opportunities. The Institute supports educational programs offered by the

Lucas Graduate School of Business: a Master of Science in Transportation Management, plus graduate certificates that include High-Speed and Intercity Rail Management and Transportation Security Management. These flexible programs offer live online classes so that working transportation professionals can pursue an advanced degree regardless of their location.

Information and Technology Transfer

MTI utilizes a diverse array of dissemination methods and media to ensure research results reach those responsible for managing change. These methods include publication, seminars, workshops, websites, social media, webinars, and other technology transfer mechanisms. Additionally, MTI promotes the availability of completed research to professional organizations and works to integrate the research findings into the graduate education program. MTI's extensive collection of transportation-related publications is integrated into San José State University's world-class Martin Luther King, Jr. Library.

Disclaimer

The contents of this report reflect the views of the authors, who are responsible for the facts and accuracy of the information presented herein. This document is disseminated in the interest of information exchange. MTI's research is funded, partially or entirely, by grants from the California Department of Transportation, the California State University Office of the Chancellor, the U.S. Department of Homeland Security, and the U.S. Department of Transportation, who assume no liability for the contents or use thereof. This report does not constitute a standard specification, design standard, or regulation.

Report 22-51

Exploring the Use of Public Transportation Among Older Adults During the COVID-19 Pandemic: A National Survey

Keertana Sureshabu, BS

Egbe-Etu Etu, PhD

Susan Summerville, BS

Ankur Parmar, BS

Gaojian Huang, PhD

November 2022

A publication of the
Mineta Transportation Institute
Created by Congress in 1991

College of Business
San José State University
San José CA 95192-0219

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No. 22-51	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle Exploring the Use of Public Transportation Among Older Adults During the COVID-19 Pandemic: A National Survey		5. Report Date November 2022	
		6. Performing Organization Code	
7. Authors Keertana Sureshabu, BS Egbe-Etu Etu, PhD Susan Summerville, BS Ankur Parmar, BS Gaojian Huang, PhD		8. Performing Organization Report CA-MTI-2204	
9. Performing Organization Name and Address Mineta Transportation Institute College of Business San José State University San José, CA 95192-0219		10. Work Unit No.	
		11. Contract or Grant No. 69A3551747127	
12. Sponsoring Agency Name and Address U.S. Department of Transportation Research and Technology Office of the Assistant Secretary for University Transportation Centers Program 1200 New Jersey Avenue, SE Washington, DC 20590		13. Type of Report and Period Covered	
		14. Sponsoring Agency Code	
15. Supplemental Notes			
16. Abstract Public transportation is an essential part of many older adults' lives, but the pandemic presented new challenges for the vulnerable population. Adults aged 65 years and older experienced additional challenges, such as limited mobility options (e.g., lack of buses or trains in service due a combination of government lockdowns, fear of contracting or spreading the virus, and driver shortages in certain areas) because of the pandemic, which may have resulted in more age-related declines in perceptual, cognitive, and physical functioning. This study explores how older adults living in major metropolitan cities in the United States used and perceived public transportation during the COVID-19 pandemic. The research team conducted an online survey through the Amazon Mechanical Turk (MTurk) crowdsourcing marketplace, a platform that offers opportunities to recruit a larger number of participants from diverse geographic locations. 260 respondents completed the survey. Eligibility included: (1) residing in the United States, (2) being aged 55 years or older (the oldest age that can be selected on MTurk), and (3) having an approval rating of 90% or above (i.e., the percentage of the workers' submitted tasks approved by survey requesters, offered by the MTurk platform). Overall, older adults reported that they had changed travel patterns since the onset of the COVID-19 pandemic, experienced challenges in using public transportation, and expressed concerns about catching the SARS-CoV-2 virus while using public transportation. Mobile technology (e.g., a transportation navigation app) was perceived as a good option for finding public transportation information, but needs improved user experience and accessibility. These findings may help transit agencies develop effective strategies for improving transportation services and increasing policymakers' awareness of older adults' need for accessible public transportation.			
17. Key Words COVID-19, Aged, Public Transportation, Accessibility, Mobile Applications		18. Distribution Statement No restrictions. This document is available to the public through The National Technical Information Service, Springfield, VA 22161.	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 39	22. Price

Copyright © 2022

by **Mineta Transportation Institute**

All rights reserved.

DOI: 10.31979/mti.2022.2204

Mineta Transportation Institute
College of Business
San José State University
San José, CA 95192-0219

Tel: (408) 924-7560
Fax: (408) 924-7565
Email: mineta-institute@sjsu.edu

transweb.sjsu.edu/research/2204

ACKNOWLEDGMENTS

This work was supported by the U.S. Department of Transportation and Mineta Transportation Institute at San José State University (grant #69A3551747127).

CONTENTS

Acknowledgments	vi
List of Figures.....	viii
List of Tables.....	x
Executive Summary	1
1. Introduction.....	2
2. Methods	4
2.1 Survey Creation	4
2.2 Questionnaire	5
2.3 Participants.....	7
3. Results	9
3.1 COVID-19 Anxiety Scale	9
3.2 Public Transportation.....	9
3.3 Mobile Technology	17
3.4 Non-chronological Age-related Activities.....	19
4. Summary & Conclusions	23
Bibliography	25
About the Authors.....	28

LIST OF FIGURES

Figure 1. Major Components and Categories of this Study.....	4
Figure 2. How much does each item reflect your behavior in the last days?	9
Figure 3. In a typical month, about how often, if ever, do you use the following forms of transportation?.....	10
Figure 4. For what type of trips do you use public transportation for during the COVID-19 pandemic?.....	10
Figure 5. Which of the following public transit systems do you use? Please select all that apply.....	11
Figure 6. Do you ever have trouble finding transportation for trips you want or need to make?	11
Figure 7. For what types of trips do you need transportation but have trouble finding transportation during the COVID-19 pandemic? Please select all that apply.....	12
Figure 8. What times of day do you need transportation but have trouble finding transportation during the COVID-19 pandemic?.....	13
Figure 9. Please tell us how much of a problem, if at all during the COVID-19 pandemic (past 2 years), each of these barriers are for you.....	14
Figure 10. To what extent do you agree or disagree that each of the following are reasons you do not use paratransit services, during the COVID-19 pandemic (past 2 years)?	15
Figure 11. When answering the following questions please think of your transit or commuting activities over the COVID-19 pandemic (past 2 years).	15
Figure 12. How do you get your information about transportation services and programs?	16
Figure 13. If you use public transportation, how do you pay for your trip?.....	16
Figure 14. Please think of your smartphone usage while using public transportation over the COVID-19 pandemic (past 2 years).....	17

Figure 15. Over the past 2 years, how often did you use your smartphone to complete the following 18

Figure 16. What are some reasons that you do not use mobile payment apps for public transit services? Please select all that apply. 18

Figure 17. What kind of features do you expect to have on your public transportation mobile apps? 19

Figure 18. Thinking of your COVID-19 pandemic experience, please answer the following questions based on your cognitive and leisure activities over the past year..... 20

Figure 19. Please think of your activities over the COVID-19 pandemic (past 2 years). Below, you will find a series of statements. Read each statement and then select one of the six answers which best describes your present agreement or disagreement with the statement. 21

Figure 20. We would like to ask you a few more questions about your relationships with others during the COVID-19 pandemic (past 2 years). Remember, when the term “others” is used, it includes friends, neighbors, or family members..... 22

LIST OF TABLES

Table 1. Study Demographics 8

Executive Summary

Public transportation is an essential part of many older adults' lives, but the pandemic presented new challenges for the vulnerable population. Adults aged 65 years and older experienced additional challenges, such as limited mobility options (e.g., lack of buses or trains in service due a combination of government lockdowns, fear of contracting or spreading the virus, and driver shortages in certain areas) because of the pandemic, which may have resulted in more age-related declines in perceptual, cognitive, and physical functioning. This study explores how older adults living in major metropolitan cities in the United States used and perceived public transportation during the COVID-19 pandemic. The research team conducted an online survey through the Amazon Mechanical Turk (MTurk) crowdsourcing marketplace, a platform that offers opportunities to recruit a larger number of participants from diverse geographic locations. 260 respondents completed the survey. Eligibility included: (1) residing in the United States, (2) being aged 55 years or older (the oldest age that can be selected on MTurk), and (3) having an approval rating of 90% or above (i.e., the percentage of the workers' submitted tasks approved by survey requesters, offered by the MTurk platform). Overall, older adults reported that they had changed travel patterns since the onset of the COVID-19 pandemic, experienced challenges in using public transportation, and expressed concerns about catching the SARS-CoV-2 virus while using public transportation. Mobile technology (e.g., a transportation navigation app) was perceived as a good option for finding public transportation information, but needs improved user experience and accessibility. These findings may help transit agencies develop effective strategies for improving transportation services and increasing policymakers' awareness of older adults' need for accessible public transportation.

1. Introduction

As the fastest-growing demographic, older adults (i.e., individuals 65 years or older) make up 15% percent of the population in the United States, projected to reach 21% of the national population by 2030 (US Census Bureau, 2021). As people age, they may experience declines in perceptual, cognitive, and physical functioning, such as reduced vision, attention, or motor control (Erber, 2012). In recent years, research on factors or activities that may mitigate age-related declines has received more attention because it enhances the quality of lives for older adults, prolongs the time span in which the individuals can live independently, and reduces the costs of long-term care (Stieger and Lachman, 2021; Cunningham and Sullivan, 2020). For example, Huang & Pitts (2021) focused on one of the non-chronological age factors, physical exercise, on task performance in complex environments (i.e., automated vehicle takeover performance). The authors found that older adults who engaged in more aerobic exercise showed better task performance in complex environments than those who did not have regular physical exercise routines. It has also been found that other non-chronological age factors, including cognitive activities such as reading, or social activities such as visiting friends, may also be associated with better cognitive and physical functioning (Ballesteros et al., 2015). One such activity that contains cognitive, physical, and social elements, but has not been thoroughly studied, is mobility.

Mobility, especially in travel in and around one's community, is an essential element in older adults' lives. Mental and social engagement, as well as physical activity, is important for aging well (National Institute on Aging, 2022). For example, taking the bus to a pharmacy involves physical activities, engaging socially with those in the proximity, and exercising cognition in dealing with route schedules, which may help older adults practice cognitive and physical functioning. By maintaining mobility and independence, older adults could lower their risk of developing cognitive diseases such as depression, anxiety, and dementia (Schuch et al. 2020; Olivari et al. 2018; Callow et al. 2020). However, due to the COVID-19 pandemic, which brought concomitant policies such as government lockdowns and quarantining if infected, older adults' mobility has been affected (i.e., inability to travel around their communities' using buses or trains due to self-isolation or social distancing to avoid contracting the virus), resulting in potential declines in their emotional, physical, and social health (De Pue et al. 2021; Levasseur et al. 2015, 2020; Sepúlveda-Loyola et al. 2020; Cunningham and Sullivan, 2020).

The use of public transportation is one possible solution for maintaining mobility. This solution is essential for people who no longer drive due to age, or who cannot afford personal vehicles, or services such as taxis. In metropolitan areas, such as the cities of Boston, Chicago, New York, and San Francisco, public transportation takes a leading role in facilitating the mobility needs of older adults and connecting them to essential services within their communities. Despite this, travel within metropolitan areas can be confusing and overwhelming due to the wide range of transportation agencies, and the variety of modes of transportation available, including buses, trains, cable cars, and even ferries. Given that many public transportation routes were removed to prevent the spread of the virus and to preserve the funds of public transportation systems, public

transportation became increasingly complex (EBP US & American Public Transportation Association, 2021). However, it is unclear if older adults have been using public transportation systems and how they maintained mobility and engagement in cognitive, physical, and social activities during the COVID-19 pandemic.

Furthermore, despite the possibility of making public transportation more accessible by using mobile technology (e.g., Clipper mobile app, which allows transit users to purchase bus or train tickets and plan transit trips around the Bay Area, California), consumers were hesitant to adopt this technology (Duncan et al. 2021, Dal Fiore et al. 2014, Nandan et al. 2014). Mallat et al. (2006) suggested that a combination of factors, such as transaction complexity, lack of security, and poor design, led users to be reluctant to fully adopt mobile technology for public transportation. Older adults, who generally have a slower pace in adopting new technology (Fisk et al. 2004), may be further affected by the usability and accessibility of these mobile applications. . Lack of knowledge about how to use mobile technology or fear of financial scams when using phone applications may hinder mobility and access to real-time transit information (Shirgaokar, 2020). However, it is still unclear in the current literature whether these mobile technology applications were (1) used by older adults in general and/or used during the COVID-19 pandemic, and (2) accessible to older adults.

The purpose of this project is to extend our previous pilot study (Summerville et al. 2022), which investigated the use of public transportation among older adults during the COVID-19 pandemic in the San Francisco Bay area, to explore the impact COVID-19 had in the U.S. on (1) the mobility of older adults, primarily with respect to the use of public transportation, (2) older adults' daily cognitive, physical, and social activities, and (3) the current use of mobile apps by older adults to facilitate mobility within their communities.

2. Methods

2.1 Survey Creation

A survey was conducted using a questionnaire with a combination of 124 open-ended Likert scales and multiple-choice questions. This questionnaire was adapted from other validated studies and sources (see details in the Questionnaire section). The questionnaire was administered on Qualtrics (<https://www.qualtrics.com/>). The invitation to participate in the study described the length of the survey and the financial incentive offered to participants who complete the entire survey. Participants were recruited using Amazon Mechanical Turk (MTurk). MTurk leverages a variety of identity verification and user authentication systems to ensure that all users are verified, validated, and unique, in order to protect the integrity of survey study results. The study's eligibility criteria included: (1) residing in the United States, (2) being aged 55 years or older (the oldest age that can be selected on MTurk), and (3) having an approval rating of 90% or above (i.e., the percentage of the workers' submitted tasks that have been approved by the survey requesters, offered by the MTurk platform). Qualified participants were directed to Qualtrics to complete the questionnaire, where they gave consent to take the survey. On Qualtrics, additional screening questions were included: (1) Do you currently reside in a major city? and (2) Have you used public transportation at least once during the COVID-19 pandemic. . To ensure the quality of data, we screened the collected responses to remove respondents who exhibit suspicious behaviors, such as failing the attention check questions or finishing the survey in less than half the median survey completion time. The study was approved by the San José State University Institutional Review Board (IRB Protocol #21235).

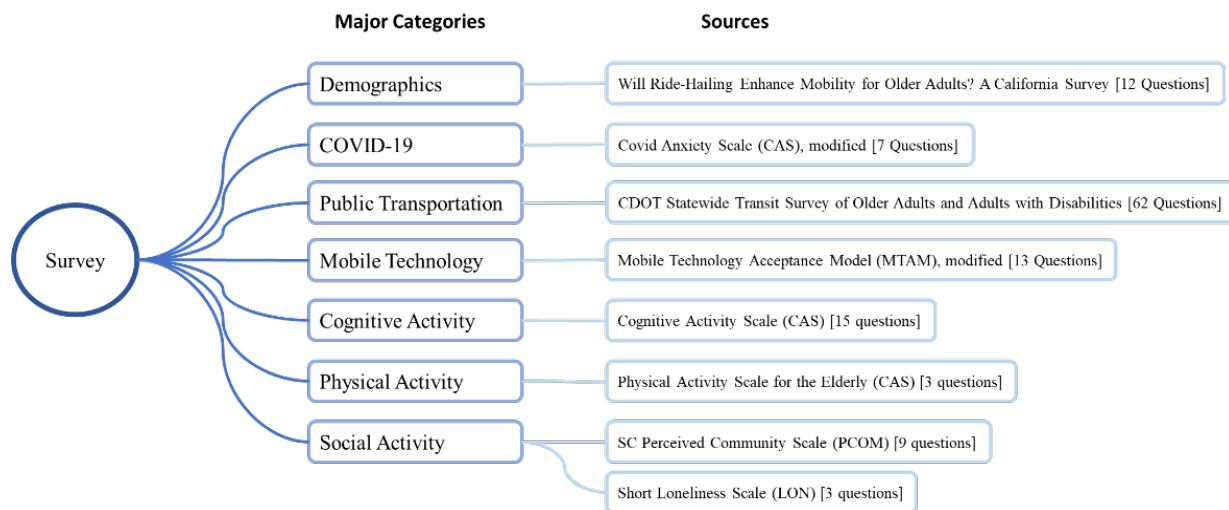


Figure 1. Major Components and Categories of this Study

2.2 Questionnaire

The questionnaire was organized into seven major categories: (1) demographic, (2) COVID-19, (3) public transportation, (4) mobile technology, (5) cognitive activity, (6) physical activity, and (7) social activity. The components of these major categories are visualized in Figure 1. The demographic section (12 questions) was adapted from a pre-pandemic public transportation survey conducted in the Bay Area (Agrawal et al. 2020). The purpose of these questions was to gain general information on the target population, similarly to previous transportation studies.

The COVID-19 section (seven questions) focused on the anxiety participants faced regarding COVID-19, which is characterized as a phobia. Literature shows various types of phobias (such as agoraphobia, social phobia), which is a result of anxiety or unrealistic fear of a person or situation. The fear or anxiety faced by individuals as result of COVID-19 is termed coronaphobia (Arora et al. 2020). Coronaphobia affects the behavior and psychological well-being of individuals causing excessive worry about one's health, increased levels of stress, depression, anxiety, loneliness, an increase in safety-seeking behaviors, and impaired resilience and functioning during daily life (Arora et al. 2020; Caycho-Rodriguez et al. 2022). For instance, Arora et al. 2020 has extensively discussed coronaphobia and developed a conceptual model that explains the risk factors and underlying mechanisms associated with this type of phobia. We used a modified 4-point Likert scale version of the COVID Anxiety Scale (Lee 2020) to understand how older adults' anxiety with respect to the COVID-19 pandemic was manifesting.

The public transportation section (62 questions) was adapted from a survey administered by the Colorado State Department of Transportation (2014). This section focused on understanding the respondents' use of public transportation and the issues they faced. More specifically, it measured the frequency of transportation in general including using public transportation, personal vehicles, and ridesharing. We used a combination of 4- and 3-point Likert scales, multiple-choice, and open-ended questions to ascertain travel habits and barriers faced by older adults. The section regarding the perceived barriers to using public transportation assessed whether respondents experienced barriers when using public transportation including fare price, service availability, route options, and seat availability. Respondents were asked to report if the barrier was a major problem, minor problem, or not a problem. COVID-19-specific questions were asked to measure how respondents felt about using public transportation during COVID-19 and what concerns they had, such as catching the SARS-CoV-2 virus while traveling, or someone coughing or sneezing near them.

For the mobile technology section, since there was little supporting data on mobile technology in public transportation use, these questions were adapted from a general mobile technology acceptance survey (Stal & Paliwoda-Pękosz 2019). The purpose of the mobile technology section is to confirm older adults' willingness to utilize mobile technology to facilitate their mobility. Respondents were asked how often they used their smartphones to help them acquire information about public transportation.

Cognitive, physical, and social activity levels were gathered to create a holistic view of older adults' daily activities during the COVID-19 pandemic. The Cognitive Activity Scale (CAS) was used in its original form, a 6-point Likert scale, which measured the types and frequency of cognitive activities they participated in, such as problem solving, decision making, or sense making that involves information processing. The Physical Activity Scale for the Elderly (PASE) was adapted to three open-scale questions and used to determine the weekly activity level of participants. Also, PASE questions measured the frequency and duration that the respondents engaged in physical activity. Finally, engagement in social activity was measured using the Perceived Community Scale (PCOM), including nine questions with a 6-point Likert scale (Heidrich & Ryff 1993). The PCOM scale measured respondents' engagement levels in social activities, such as whether they contribute to their neighborhood. Also, three attention check questions were used to improve the reliability of participants' responses.

Coronaphobia affects the behavior and psychological well-being of individuals causing excessive worry about one's health, increased levels of stress, depression, anxiety, loneliness, an increase in safety-seeking behaviors, and impaired resilience and functioning during daily life (Caycho-Rodriguez et al. 2022). A higher average score indicates that the respondents had greater anxiety about COVID-19. The public transportation section focused on understanding the respondents' use of public transportation and the issues they faced. More specifically, the mode of transportation section measured the frequency of transportation in general including using public transportation, personal vehicles, and ridesharing. A higher average score indicating respondents have a major problem with that barrier. COVID-19-specific questions were asked to measure how respondents felt about using public transportation during COVID-19 and what concerns they had, such as catching the SARS-CoV-2 virus while traveling or someone coughing or sneezing near them. Higher average scores on these questions indicate that respondents were more worried about certain concerns measured respondents' experience using public transportation apps such as those helping in finding accurate transportation information. A higher average score indicates that respondents perceived public transportation apps as more useful. Respondents were also asked how often they used their smartphone to help them use public transportation such as through getting transit information. A lower average score indicates more usage of smartphone apps for public transportation. The cognitive activity scale measured what types of cognitive activities they participated in and how often, such as playing board games such as problem solving, decision making, or sense making that involves information processing. A higher average score indicates a higher frequency of cognitive activities. The physical activity questions measured the frequency and duration that the respondents engaged in physical activity. Higher average scores indicate higher frequencies and longer durations of physical activity. Finally, the social activity scale measured respondents' engagement levels in social activities, such as whether they contribute to their neighborhood. Higher scores indicate that respondents were more socially connected with their community and valued social connections

2.3 Participants

In this study, we received a total of 260 completed surveys. Among the 260 respondents, 118 respondents identified as female, 141 identified as male, and one respondent preferred not to say (Table 1). The average age of respondents was 60 ± 6.06 years. 79.4% of the respondents fell within the 55–64 age range, and 20.6% of the respondents were within the 65–74 age range. Of the 260 respondents, 242 self-identified as White/Caucasian, 12 identified as Black/African American, two identified as American Indian or Alaskan Native, two identified as Asian, one responded other, and one respondent preferred not to say. Overall, 84.2% of the respondents worked for pay, and 10.38% of respondents were not working by choice. In terms of the annual income of respondents, 21.5% earned between \$0–\$50,000, 41.15% had an annual income of \$50,000–\$100,000, 19.23% had \$100,000–\$150,000, 8.84% had an annual income of \$150,000–\$200,000, 7.30% had an annual income \$200,000–\$400,000, and 1.92% earned more than \$400,000.

Table 1. Study Demographics

Characteristics	Number
Gender	
Female	118 (45.38%)
Male	141 (54.23%)
Prefer not to say	1 (0.38%)
Of Latino origin	
Yes	29 (11.15%)
No	227 (87.3%)
Prefer not to say	3 (1.15%)
Age	
55-64	201 (79.4%)
65-74	52 (20.6%)
Race	
White/Caucasian	242 (93.07%)
Black/African American	12 (4.61%)
American Indian or Alaskan native	2 (0.76%)
Asian	2 (0.76%)
Other	1 (0.38%)
Prefer not to say	1 (0.38%)
Employment status	
Working for pay	219 (84.2%)
Unemployed	3 (1.15%)
Volunteering	6 (2.30%)
Not working by choice (i.e., retired and not volunteering)	27 (10.38%)
Other	4 (1.53%)
Annual Income	
\$0-\$50,000	56 (21.5%)
\$50,000-\$100,000	107 (41.15%)
\$100,000-\$150,000	50 (19.23%)
\$150,000-\$200,000	23 (8.84%)
\$200,000-\$400,000	19 (7.30%)
\$400,000+	5 (1.92%)

3. Results

We administered the survey from April 25 through May 15, 2022. The survey respondents took a mean time of 15.97 minutes to complete the survey, with a median time of 13.43 minutes. A total of 260 adults responded with usable data.

3.1 COVID-19 Anxiety Scale

Overall, more than 50% of respondents selected "very applicable to me" and "sometimes applicable to me" for each of the items in the scale, such as "I feel anxious about COVID-19" or "I feel uneasy when reading news about COVID-19," indicating a possible negative effect of COVID-19 on older adults' behavior and psychological well-being (Figure 2).

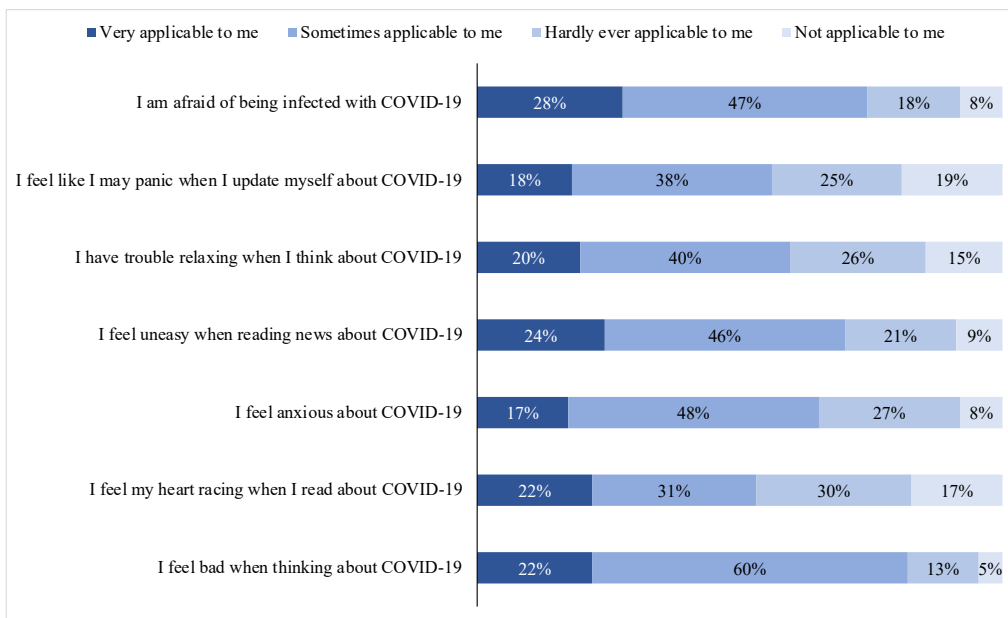


Figure 2. How much does each item reflect your behavior in the last days?

3.2 Public Transportation

In this section, we asked respondents (i.e., older adults) questions relating to their travel behaviors during the COVID-19 pandemic. Out of the 260 respondents, 76.69% (176 respondents) reported that their travel habits changed since the COVID-19 outbreak. As Figure 3 shows, 26% of respondents used public transit three or more times a week, 53% of respondents drove themselves in a personal vehicle one or two times a week, while 42% of respondents walked one or two times a week during the pandemic.

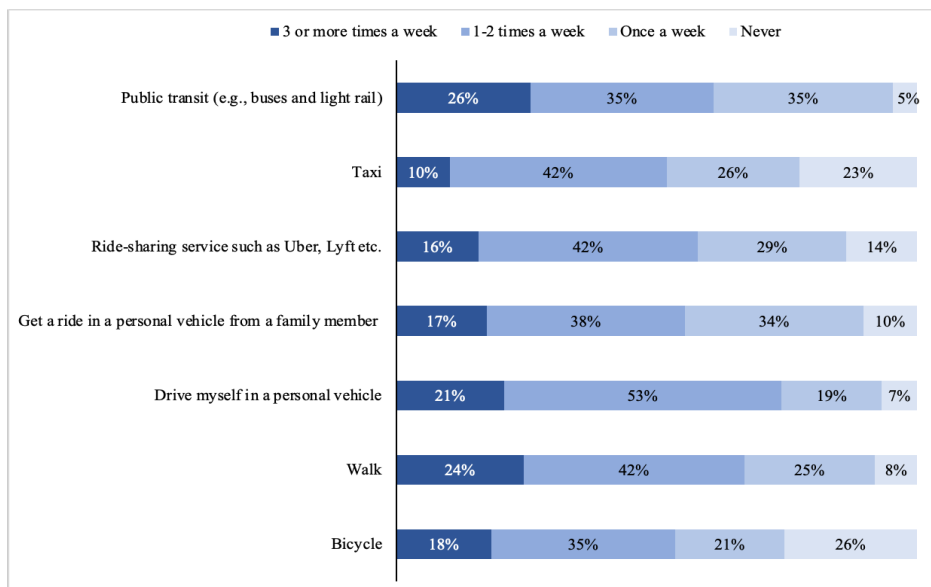


Figure 3. In a typical month, about how often, if ever, do you use the following forms of transportation?

Results from the survey indicated that the top three types of trip, for which older adults used public transportation, during the COVID-19 pandemic were medical appointments, work, and visiting family or friends (refer to Figure 4). As Figure 5 shows, 43% of all respondents used buses when using public transit and 35% used trains.

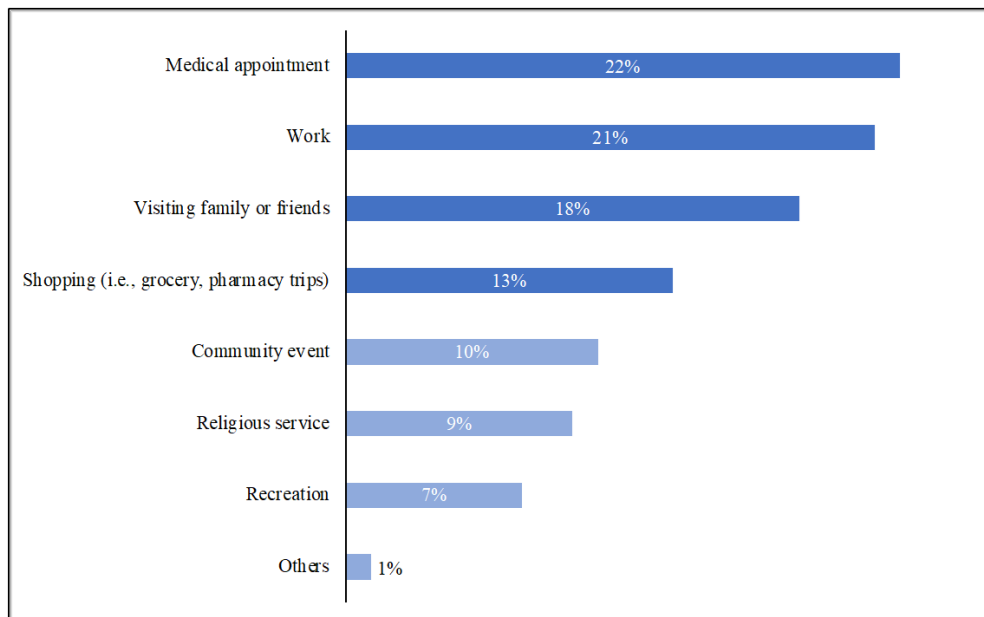


Figure 4. For what type of trips do you use public transportation for during the COVID-19 pandemic?

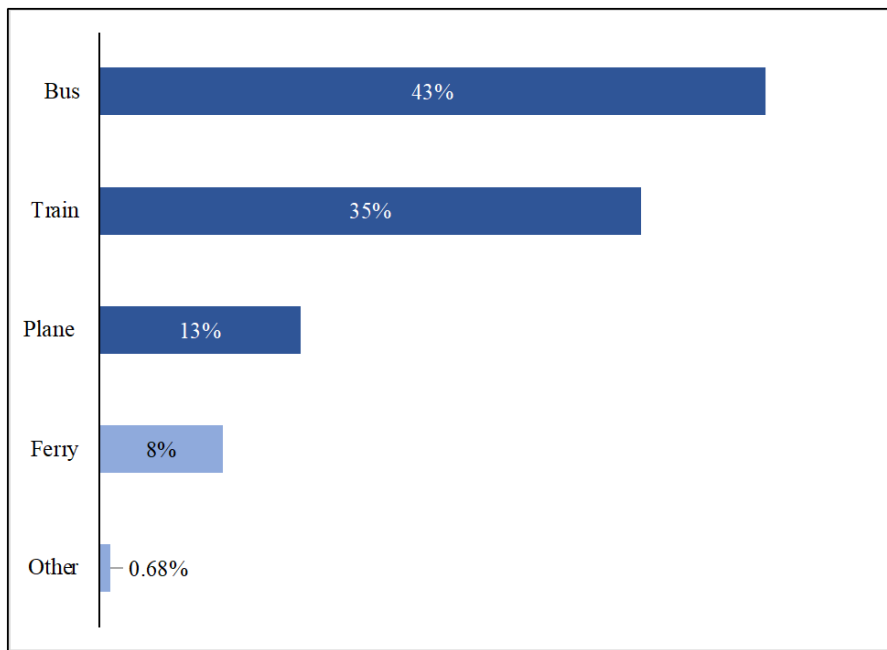


Figure 5. Which of the following public transit systems do you use? Please select all that apply.

We asked the survey respondents if they had issues finding transportation for their trips and 46% of the respondents stated that they sometimes face challenges finding transportation (Figure 6). With most respondents (i.e., those that stated, “sometimes”) experiencing challenges finding transportation, the top three types of trips for which they often find difficulty in getting transportation include work (18%), medical appointments (18%), and visiting family/friends (18%) (see Figure 7). The results in Figure 7 align with responses in Figure 4.

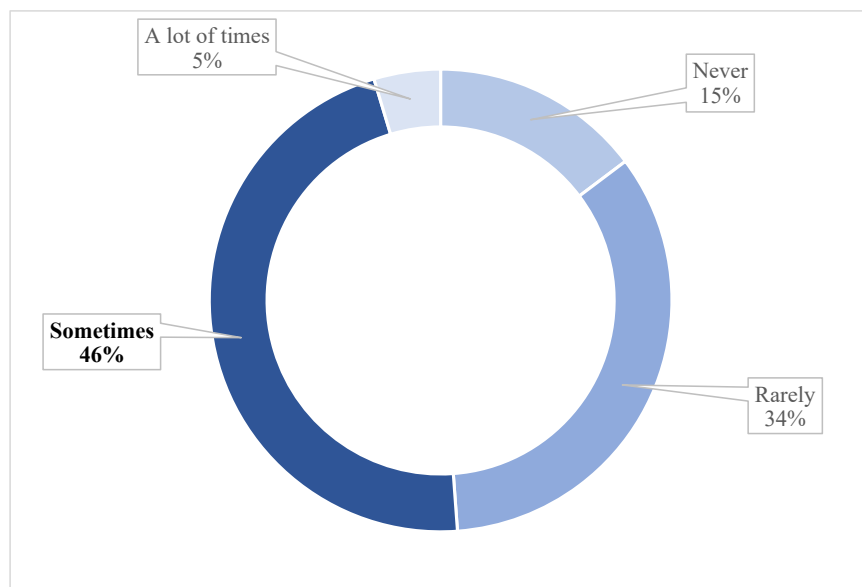


Figure 6. Do you ever have trouble finding transportation for trips you want or need to make?

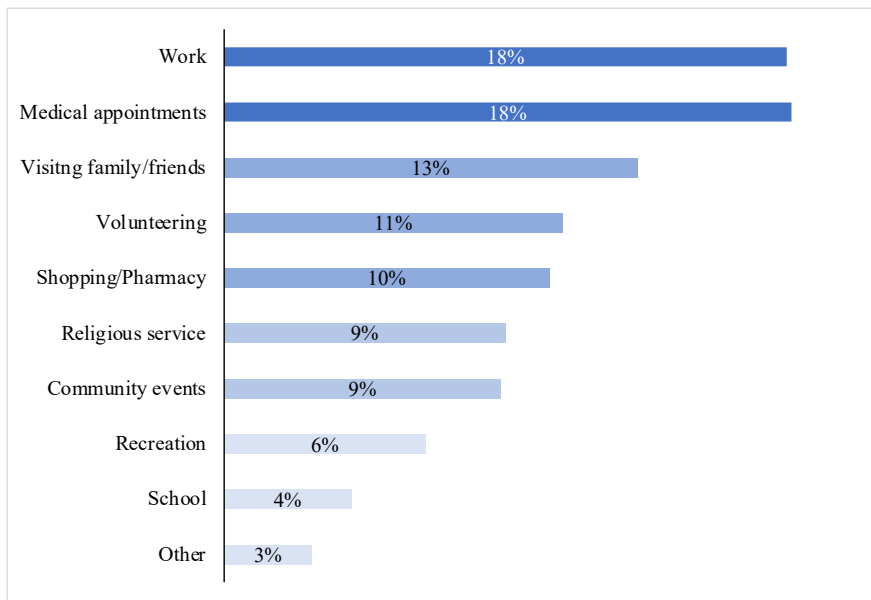


Figure 7. For what types of trips do you need transportation but have trouble finding transportation during the COVID-19 pandemic? Please select all that apply

Travel behaviors amongst individuals are significantly different depending on the day of the week and time. To properly grasp the challenges faced in finding public transport, we asked respondents about the time of the day they were unable to get public transportation. Figure 8 shows that 45% of the respondents faced significant challenges finding transportation during the daytime on weekdays while 19% had challenges finding transportation during the daytime on weekends.

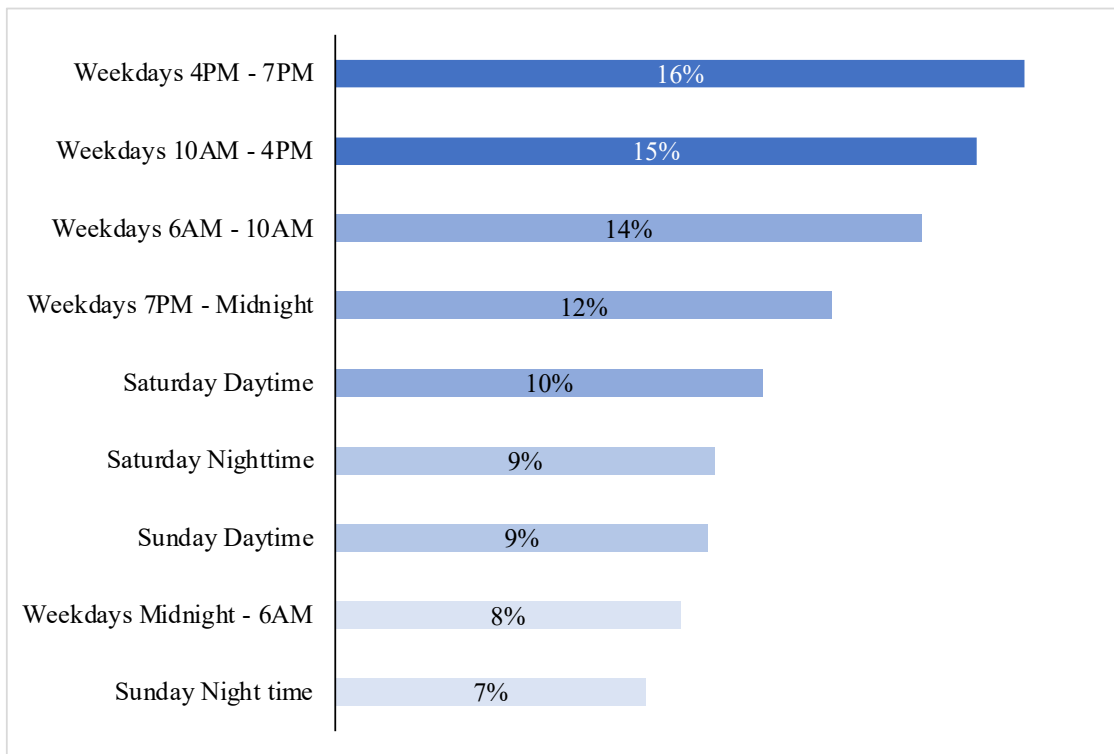


Figure 8. What times of day do you need transportation but have trouble finding transportation during the COVID-19 pandemic?

To understand the potential barriers older adults faced while using public transit systems during the pandemic, respondents were asked to indicate possible barriers they faced. The results in Figure 9 indicate that some of the major problems reported were: lack of information in languages other than English (44%), inability to cross roads safely (42%), not understanding how to make transfers (41%), and unclear information about fares, schedules, and routes (38%). Respondents found operation times unavailable when they needed the service (40%), difficulty boarding and exiting buses or light trains (53%), and difficulty reading transit information (46%), to be minor problems.

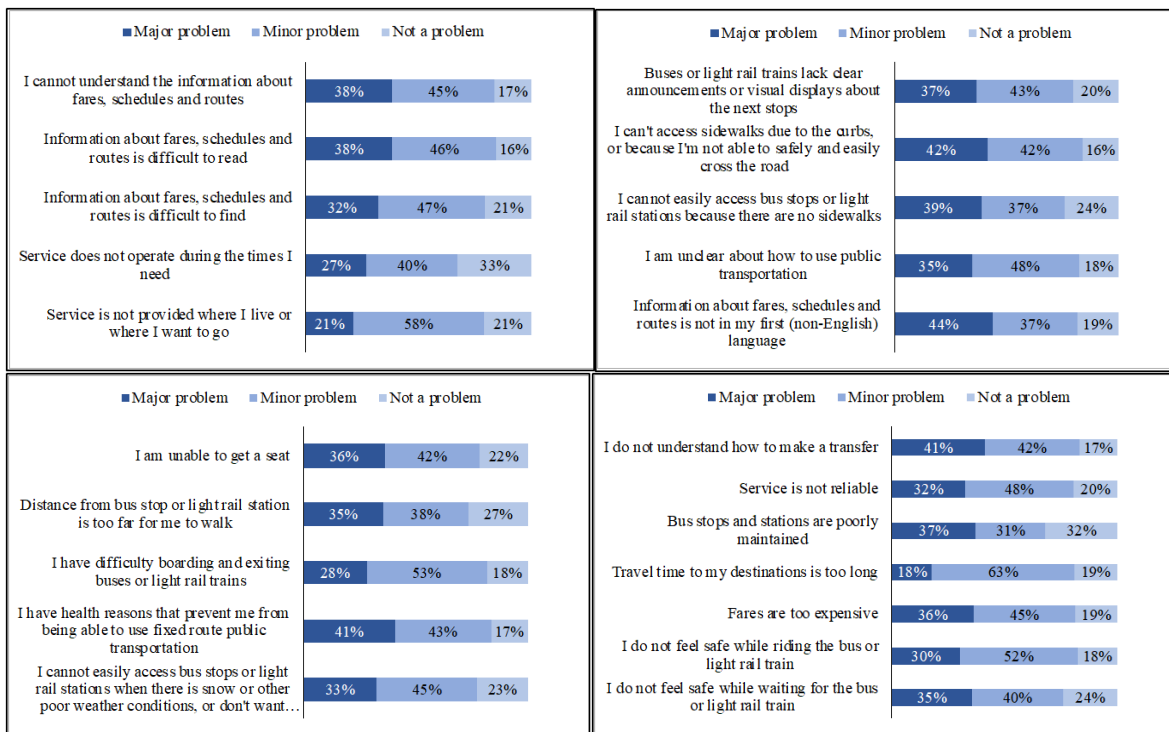


Figure 9. Please tell us how much of a problem, if at all during the COVID-19 pandemic (past 2 years), each of these barriers are for you.

People with disabilities often lack access to personal vehicles and therefore rely on public transportation services. In our survey, 29.23% of respondents had disabilities that required them to use paratransit services. These respondents were asked additional questions specific to their experiences using paratransit services and potential barriers they face during the pandemic. As shown in Figure 10, 25% of respondents felt that difficulty reading about services and costs was a major problem. Minor problems reported included: service not being provided to where they live or want to go (68%), information not presented in languages other than English (66%) and difficulty finding information about services and costs (55%).

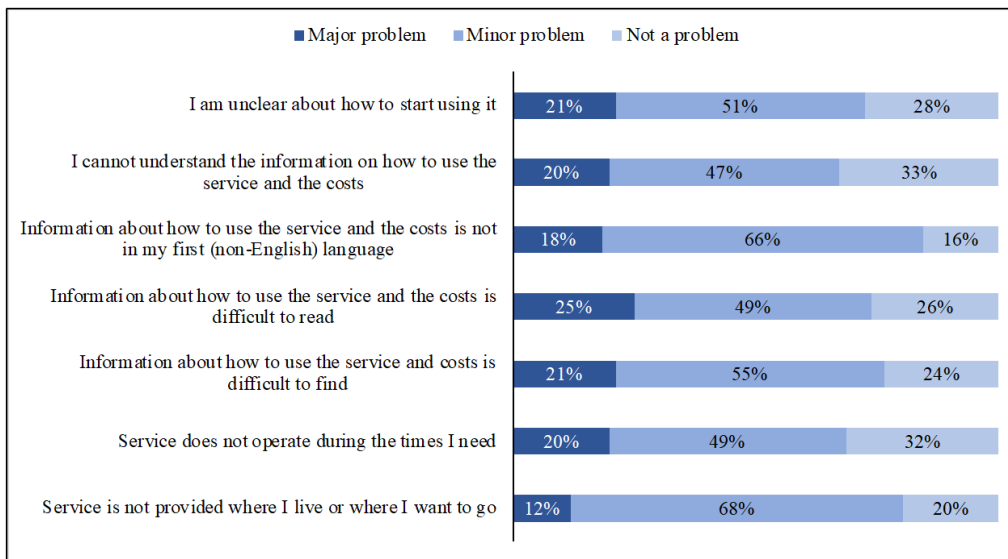


Figure 10. To what extent do you agree or disagree that each of the following are reasons you do not use paratransit services, during the COVID-19 pandemic (past 2 years)?

Most commuters were stressed and worried about contracting COVID-19 due to physical contact while on public transportation. In order to capture public transportation users' attitudes, a portion of our survey was used to determine their level of anxiety (as mentioned in the Methods section). Thirty-seven percent of the respondents were worried that people around them on public transit will infect them with COVID-19 while 35% were apprehensive about contracting SARS-CoV-2 from other passengers who sneeze or cough (see Figure 11).

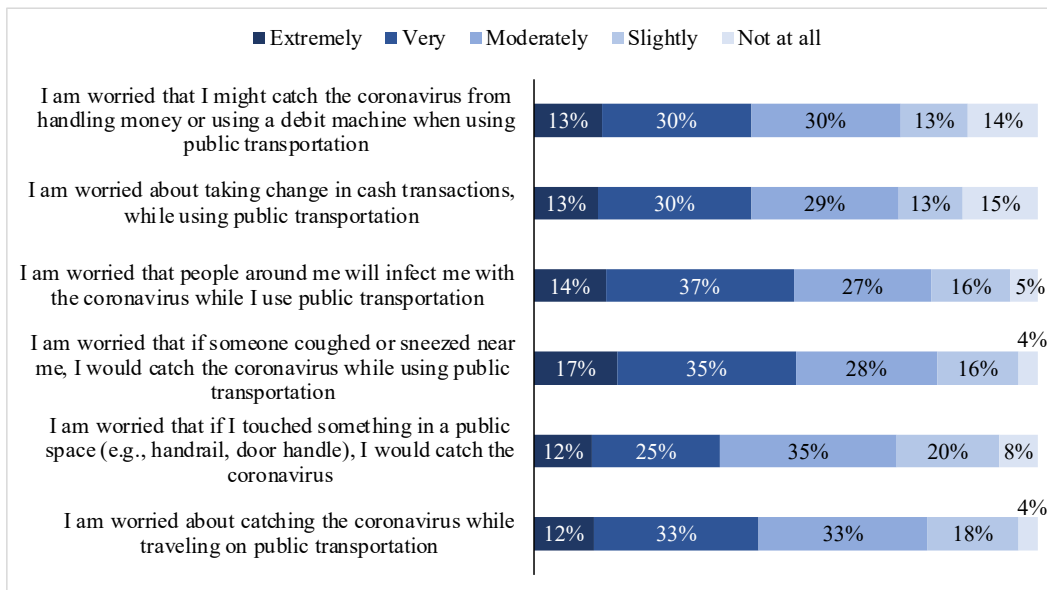


Figure 11. When answering the following questions please think of your transit or commuting activities over the COVID-19 pandemic (past 2 years).

We also asked respondents how they collected information about public transportation services and programs. As shown in Figure 12, 22% of the respondents indicated receiving information about transportation services from friends or family members, and 20% obtained information from online platforms (e.g., websites, email, and social media).

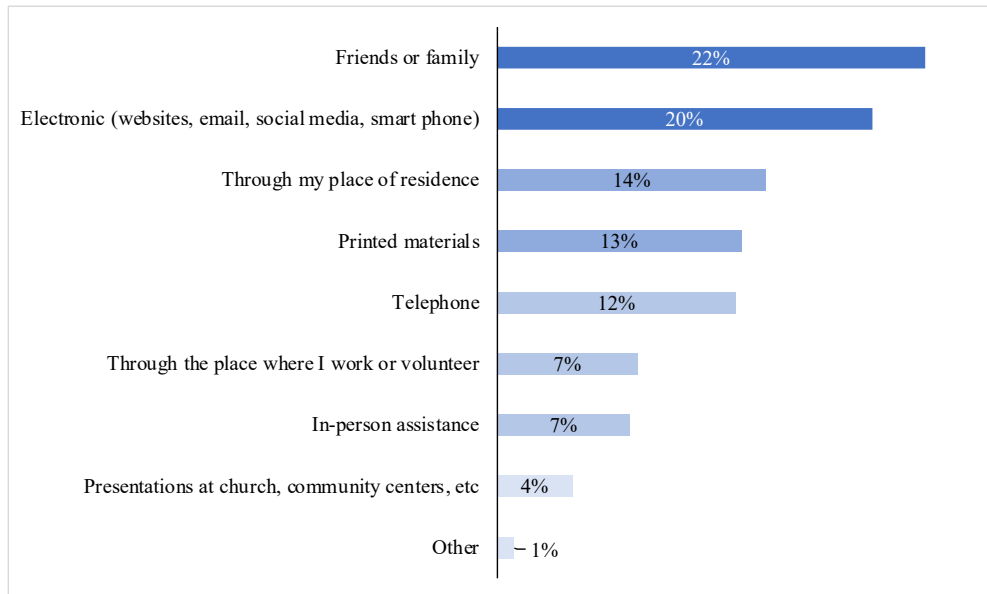


Figure 12. How do you get your information about transportation services and programs?

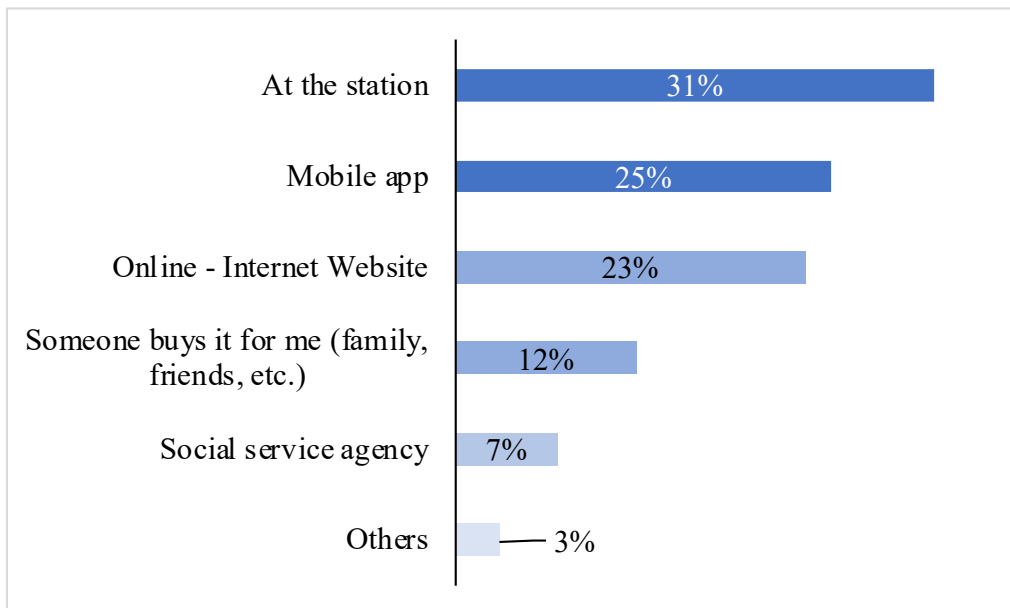


Figure 13. If you use public transportation, how do you pay for your trip?

Additionally, we asked respondents how they paid for their trips during the pandemic. Thirty-one percent of the respondents stated they pay at the station, 25% pay for their trips using mobile apps, and 23% pay using online platforms (Figure 13). Their responses prompted our investigation into the use of mobile transportation applications by older adults.

3.3 Mobile Technology

Most transit organizations have mobile applications that enable users to easily schedule and pay for trips, and find information about transit times and routes. Respondents were asked questions designed to assess whether they could easily and conveniently use mobile transit applications for transportation purposes during the pandemic. Figure 14 shows that over half of the respondents (52%) used their smartphones to get information related to public transportation. Sixty-eight percent of the respondents agree that public transportation applications are sized correctly and easily viewable on their smartphones. Seventy-three percent of the respondents agreed that using public transportation applications helps them to find information faster.

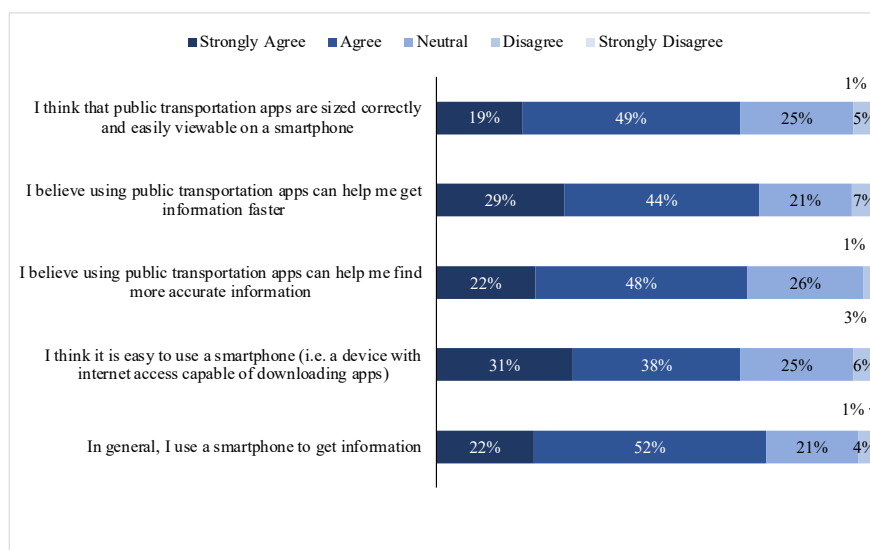


Figure 14. Please think of your smartphone usage while using public transportation over the COVID-19 pandemic (past 2 years).

We also asked respondents how often they used their smartphones to get transit information, navigation, and ridesharing services. Approximately 37% of respondents used their smartphone for navigation purposes one to two days a week, 36% checked public transit information on average one to two days a week, and 36% reserved a taxi, Uber, or Lyft once a month (Figure 15).

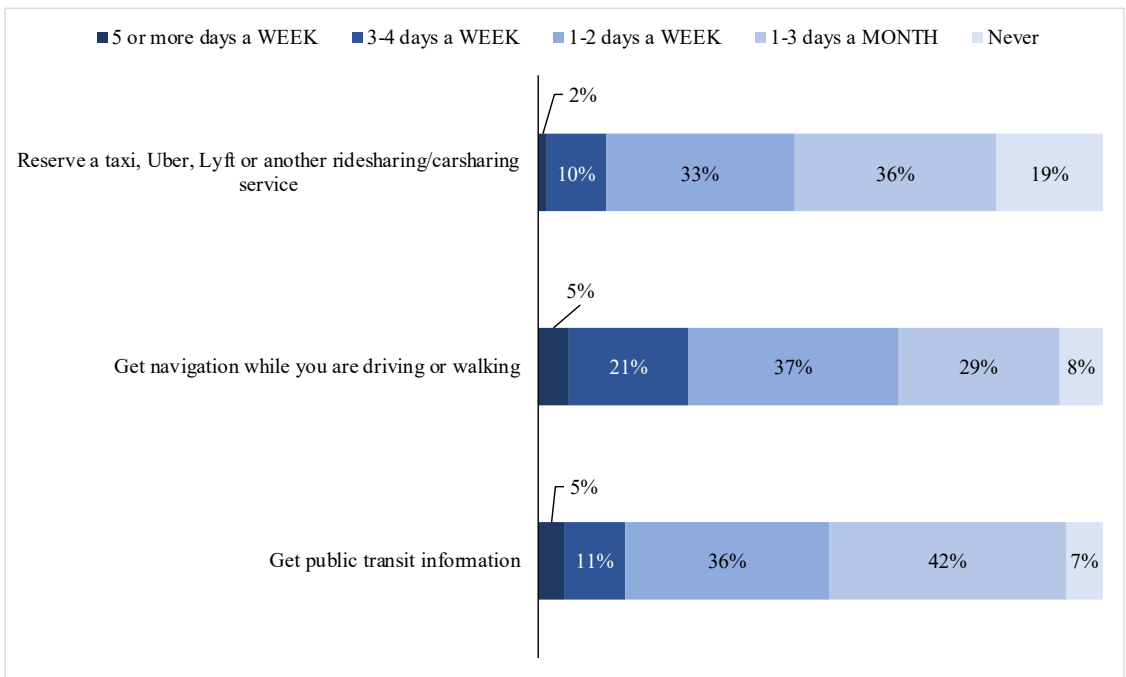


Figure 15. Over the past 2 years, how often did you use your smartphone to complete the following

Despite the benefits of mobile technology, 26% of the respondents do not use mobile apps for public transit payments.

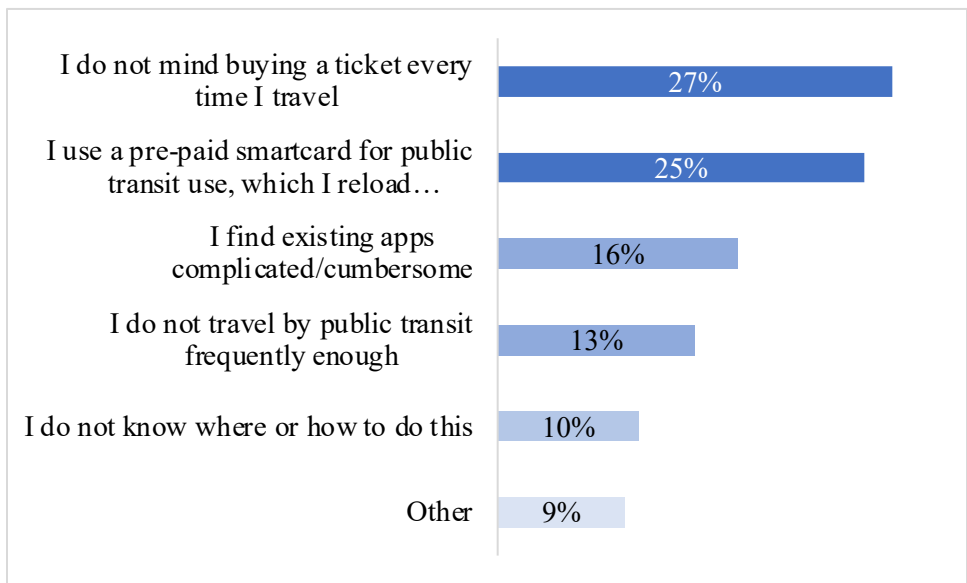


Figure 16. What are some reasons that you do not use mobile payment apps for public transit services? Please select all that apply.

As depicted in Figure 16, twenty-seven percent of the respondents stated that they preferred buying a ticket every time they traveled. Twenty-five percent used a prepaid smartcard and 16% found mobile apps too complicated or cumbersome to use. In the area of improvements to mobile transit apps, a plurality (36%) of the respondents want to see GPS tracking integration, 18% want better user experience and real-time location information, and 14% want more focus on creating alternative payment options (Refer to Figure 17).

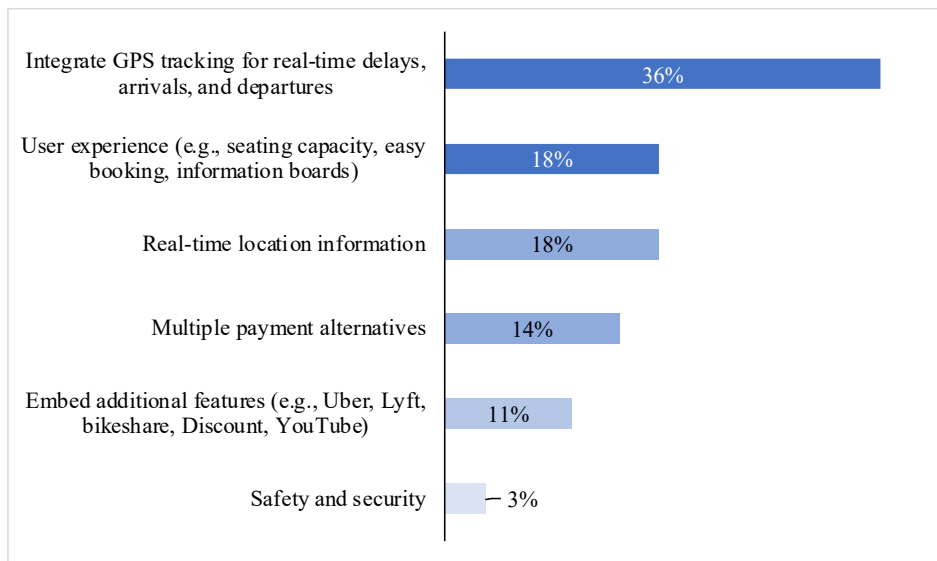


Figure 17. What kind of features do you expect to have on your public transportation mobile apps?

3.4 Non-chronological Age-related Activities

Some non-chronological age-related activities are known to mitigate declines in age-related cognitive and physical abilities in older adults. However, with lockdowns and reduced transit activities, older adults may become isolated, resulting in opportunities of being engaged in non-chronological age-related activities. Relevant questions in the survey included cognitive, physical, and social activities.

For cognitive activities, as presented in Figure 18, roughly 10% of older respondents aged 65 and above did not engage in any of the fifteen items in the cognitive scale during the pandemic. In terms of physical activities, forty percent of the respondents reported engaging in multiple exercises such as (jogging, cycling, or swimming) several times per week. In the survey, 47% of respondents cited walking as their preferred exercise for physical fitness.

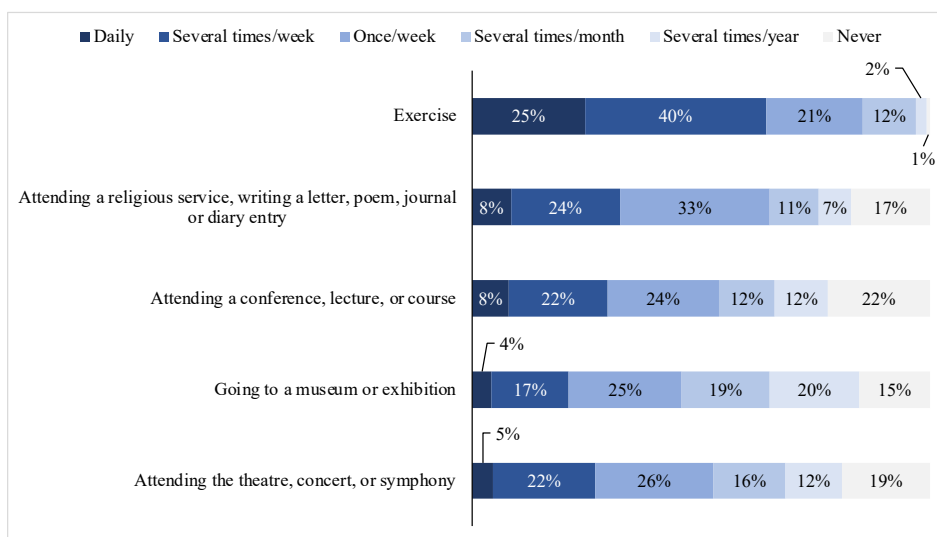
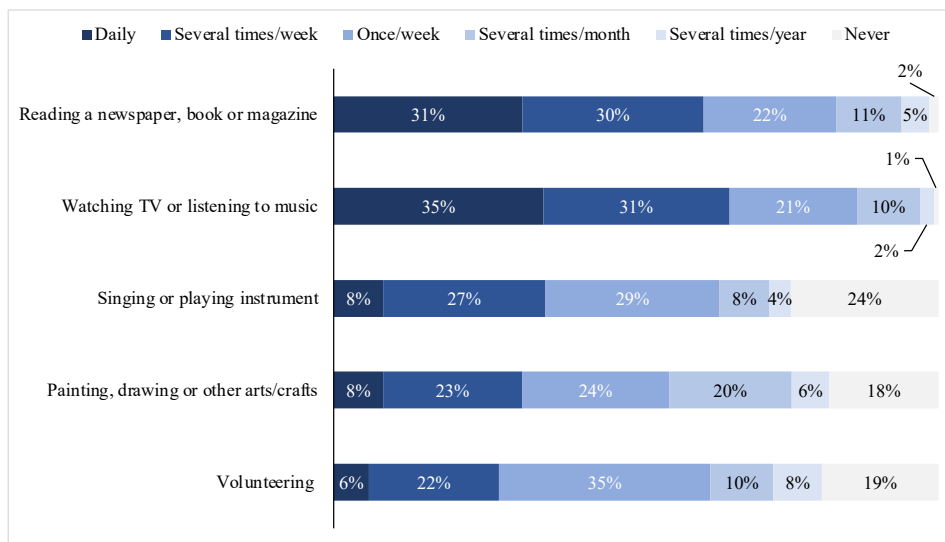
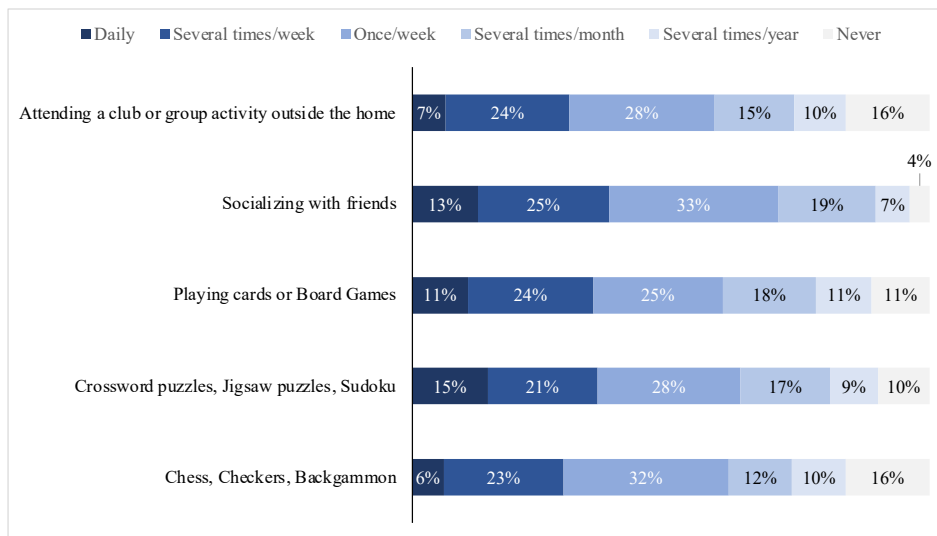


Figure 18. Thinking of your COVID-19 pandemic experience, please answer the following questions based on your cognitive and leisure activities over the past year.

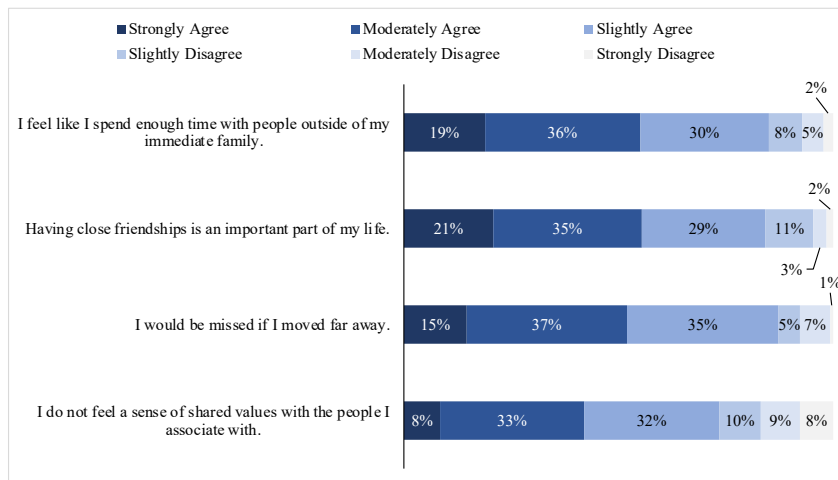
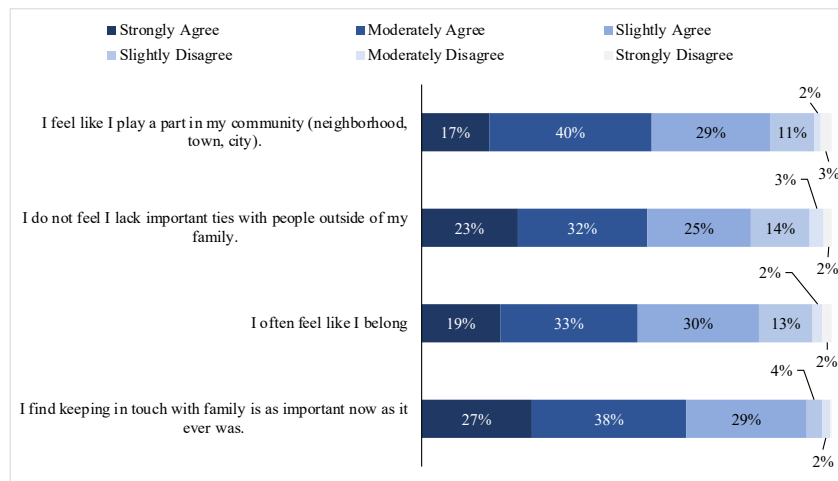


Figure 19. Please think of your activities over the COVID-19 pandemic (past 2 years). Below, you will find a series of statements. Read each statement and then select one of the six answers which best describes your present agreement or disagreement with the statement.

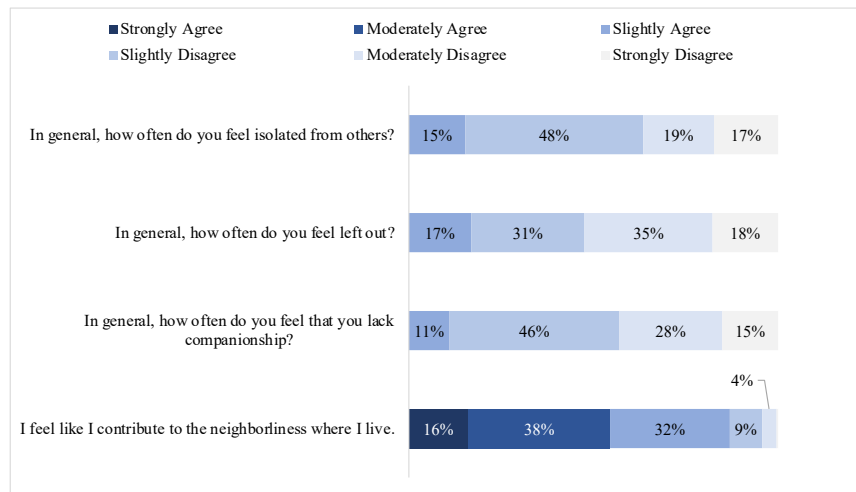


Figure 20. We would like to ask you a few more questions about your relationships with others during the COVID-19 pandemic (past 2 years). Remember, when the term “others” is used, it includes friends, neighbors, or family members.

Finally, for social activities, respondents (strongly, moderately, or slightly) agreed that they had a great sense of social connections with their family members (94%), relatives (85%), and friends (85%). As many as 86% of respondents believed that they "played a part" in the community, and 82% chose "I often feel like I belong" (see Figures 19 and 20).

4. Summary & Conclusions

This study conducted a national survey and provided evidence for how older adults maintained their mobility and perceived the use of public transportation during the COVID-19 pandemic. Overall, older adults reported that they had changed travel patterns since the breakout of the COVID-19 pandemic, experienced multiple challenges in using transit systems and expressed concerns about catching the SARS-CoV-2 virus while using public transportation.

Concerning the use of public transportation during the pandemic, 77% of respondents found that their travel patterns changed, and 78% of respondents were worried about contracting COVID-19. Thus, our findings show some of the impact of the COVID-19 pandemic on the usage of public transit systems by older adults. Follow-up qualitative studies, such as structured interviews to reveal more details about the impacted travel patterns, are necessary.

Additionally, the top three purposes for the use of public transportation in older adults were trips for medical appointments, work, and visiting family or friends, which are essential for maintaining cognitive, physical, and social health. However, more than 50% of respondents reported that they had difficulty finding transportation solutions for such trips, including a lack of information in languages other than English, inability to cross roads safely, not understanding how to make transfers, and unclear information about fares, schedules, and routes. With respect to barriers to using public transportation, mobile technology, such as apps that help older adults navigate and provide route information, could be beneficial. However, based on the respondents, the highest proportion still received transportation service information from friends or family members. Given that more than 50% of respondents used smartphones to get information related to public transportation, and over 67% of people left positive feedback on mobile apps such as "public transportation applications are sized correctly and easily viewable on their smartphones", it is necessary to publicize the benefits and availability of public transportation apps, and to continuously improve usability and accessibility for the older population.

Finally, older adults may have reduced their frequency of engaging in cognitive activities, which may have had negative effects on maintaining their cognitive and physical functioning. However, this plausible finding may not provide further implications due to the lack of comparison information such as the cognitive activity frequency pre-COVID. Follow-up studies may quantify and compare older adults' daily cognitive, physical, and social activities during and after the pandemic.

One limitation of the study is that we only used the MTurk platform, which may limit the diversity of the demographics. For example, respondents from MTurk may be a population who are more familiar with technology and thus may have different opinions on mobile technologies. Future studies may also conduct offline surveys.

These findings may provide introductory guidance for engineers and designers to increase the accessibility of public transportation and mobile technology for universal users and deliver empirical evidence for policymakers and the community to develop effective strategies to improve transportation service.

Bibliography

- Agrawal, A. W., Shirgaokar, M., Misra, A., Wachs, M., & Dobbs, B. M. 2020. "Will Ride-Hailing Enhance Mobility for Older Adults? A California Survey." *Mineta Transportation Institute Publications* report no. 20-30.
- Ballesteros, S., Kraft, E., Santana, S., & Tziraki, C. 2015. "Maintaining older brain functionality: a targeted review." *Neuroscience & Biobehavioral Reviews* 55, 453-477.
- Callow, D. D., Arnold-Nedimala, N. A., Jordan, L. S., Pena, G. S., Won, J., Woodard, J. L., & Smith, J. C. 2020. "The mental health benefits of physical activity in older adults survive the COVID-19 pandemic." *The American Journal of Geriatric Psychiatry* 28(10), 1046-1057.
- Caycho-Rodríguez, T., Vilca, L. W., Peña-Calero, B. N., Barboza-Palomino, M., White, M., & Reyes-Bossio, M. 2022. "Measurement of coronaphobia in older adults: Validation of the Spanish version of the Coronavirus Anxiety Scale." *Revista española de geriatría y gerontología* 57(1), 20-27.
- Chen, K., & Chan, A. H. 2014. "Predictors of gerontechnology acceptance by older Hong Kong Chinese." *Technovation* 34(2), 126-135.
- Colorado Department of Transportation (2014). Colorado Department of Transportation Statewide Transit Survey of Older Adults and Adults with Disabilities. <https://www.codot.gov/programs/planning/transportation-plans-and-studies/assets/elderly-and-disabled-populations-survey/upper-front-range-survey-results.pdf>
- Dal Fiore, F., Mokhtarian, P. L., Salomon, I., & Singer, M. E. 2014. "Nomads at last? A set of perspectives on how mobile technology may affect travel." *Journal of Transport Geography* 41, 97-106.
- De Pue, S., Gillebert, C., Dierckx, E., Vanderhasselt, M. A., De Raedt, R., & Van den Bussche, E. 2021. "The impact of the COVID-19 pandemic on wellbeing and cognitive functioning of older adults." *Scientific reports* 11(1), 1-11.
- Duncan, M., Torres, Y. V., Gladwin, K., Horner, M., & Wood, B. 2021. "Transit-oriented development for older adults." *Journal of Transport and Land Use* 14(1), 255-276.
- EBP US, & American Public Transportation Association. 2021. The Impact of the COVID-19 Pandemic on Public Transit Funding Needs in the US.
- Erber, J. T. 2012. *Aging and older adulthood*. John Wiley & Sons.

- Fisk, D., Charness, N., Czaja, S. J., Rogers, W. A., & Sharit, J. 2004. *Designing for older adults*. CRC press.
- Heidrich, S. M., & Ryff, C. D. 1993. "Physical and mental health in later life: the self-system as mediator." *Psychology and Aging* 8(3), 327.
- Heinz, M., Martin, P., Margrett, J. A., Yearns, M., Franke, W., Yang, H.-I., Wong, J., & Chang, C. K. 2013. "Perceptions of technology among older adults." *Journal of Gerontological Nursing* 39(1), 42–51.
- Huang, G., & Pitts, B. 2021. "Driver-Vehicle Interaction: The Effects of Physical Exercise and Takeover Request Modality on Automated Vehicle Takeover Performance between Younger and Older Drivers." In *2021 IEEE 2nd International Conference on Human-Machine Systems*, 1-4.
- Lee, S. A. 2020. "Coronavirus Anxiety Scale: A brief mental health screener for COVID-19 related anxiety." *Death studies* 44(7), 393-401.
- Levasseur, M., Généreux, M., Bruneau, J. F., Vanasse, A., Chabot, É., Beaulac, C., & Bédard, M. M. 2015. "Importance of proximity to resources, social support, transportation and neighborhood security for mobility and social participation in older adults: results from a scoping study." *BMC public health* 15(1), 1-19.
- Levasseur, M., Naud, D., Bruneau, J. F., & Généreux, M. 2020. "Environmental characteristics associated with older adults' social participation: The contribution of sociodemography and transportation in metropolitan, urban, and rural areas." *International journal of environmental research and public health* 17(22), 8399.
- Mallat, N., Rossi, M., Tuunainen, V. K., & Öörni, A. 2008. "An empirical investigation of mobile ticketing service adoption in public transportation." *Personal and Ubiquitous Computing* 12(1), 57-65.
- Nandan, N., Pursche, A., & Zhe, X. 2014. "Challenges in crowdsourcing real-time information for public transportation." In *2014 IEEE 15th international conference on mobile data management* 2, 67-72.
- National Institute on Aging. 2022. "Participating in Activities You Enjoy As You Age." Retrieved June 16, 2022.
- Olivari, Benjamin S., Matthew Baumgart, Sarah L. Lock, C. Grace Whiting, Christopher A. Taylor, John Iskander, Phoebe Thorpe, & Lisa C. McGuire. 2018. "CDC grand rounds: promoting well-being and independence in older adults." *Morbidity and Mortality Weekly Report* 67(37), 1036.

- Schuch, F. B., Bulzing, R. A., Meyer, J., Vancampfort, D., Firth, J., Stubbs, B., ... & Smith, L. 2020. "Associations of moderate to vigorous physical activity and sedentary behavior with depressive and anxiety symptoms in self-isolating people during the COVID-19 pandemic: A cross-sectional survey in Brazil." *Psychiatry research* 292, 113339.
- Sepúlveda-Loyola, W., Rodríguez-Sánchez, I., Pérez-Rodríguez, P., Ganz, F., Torralba, R., Oliveira, D. V., & Rodríguez-Mañas, L. 2020. "Impact of social isolation due to COVID-19 on health in older people: mental and physical effects and recommendations." *The journal of nutrition, health & aging* 24(9), 938-947.
- Stal, J., & Paliwoda-Pękosz, G. (2018, October). Mobile technology acceptance model: an empirical study on users' acceptance and usage of mobile technology for knowledge providing. In *European, Mediterranean, and Middle Eastern Conference on Information Systems* (pp. 547-559). Springer, Cham.
- Summerville, S., Etu, E., Sureshbabu, K., Parmar, A., & Huang, G. 2022. "Exploring the Use of Public Transportation Among Older Adults During COVID-19 Pandemic: A Pilot Study." In *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, Atlanta, GA.
- Summerville, S., Etu, E., Sureshbabu, K., Parmar, A., & Huang, G. (2022). Exploring the Use of Public Transportation Among Older Adults During COVID-19 Pandemic: A Pilot Study. 2022 *Human Factors and Ergonomics Society Annual Meeting*.
- US Census Bureau. *The Graying of America: More Older Adults Than Kids by 2035*. The United States Census Bureau. Accessed September 8, 2021.

About the Authors

Keertana Sureshbabu

Keertana is a graduate student majoring in M.S. Human Factor Ergonomics at San José State University. She received her BS in Psychology from the University of Washington in 2019.

Egbe-Etu Etu, PhD

Dr. Etu is an Assistant Professor of Business Analytics at San José State University (SJSU). He is also a Research Associate in the Mineta Transportation Institute. Before joining SJSU, Dr. Etu received his PhD in Industrial and Systems Engineering from Wayne State University in 2021 and his bachelor's degree in Civil Engineering from Covenant University, Nigeria, in 2016. His research interests center on the development of use-inspired machine learning models to solve challenging business problems in healthcare, manufacturing, and transportation. He is a member of the Industrial Engineering and Operations Management (IEOM), Institute of Industrial & Systems Engineering (IISE), and SAVE International.

Susan Summerville

Susan is a graduate student majoring in MS Human Factor Ergonomics at San José State University. She received her BS in Kinesiology from Texas Tech University in 2017.

Ankur Parmar

Ankur is a graduate student majoring in MS Artificial Intelligence at San José State University. He received his BS in Applied Petroleum Engineering from the University of Petroleum and Energy Studies in 2016. His research interests lie in Deep Learning and Reinforcement Learning.

Gaojian Huang, PhD

Dr. Huang joined San José State University (SJSU) as an Assistant Professor in the Department of Industrial and Systems Engineering in Fall 2021. Currently, he is the director of the Behavior, Accessibility, and Technology (BAT) Research Lab. He is also a Research Associate in the Mineta Transportation Institute and a Faculty Affiliate in the Center on Healthy Aging in Multicultural Population at San José State University. He received master's degrees in Cognitive Psychology from Purdue University and Safety Management from Indiana University Bloomington in 2020 and 2016, respectively, and obtained his PhD in Industrial Engineering from Purdue University in 2021.

MTI FOUNDER

Hon. Norman Y. Mineta

MTI BOARD OF TRUSTEES

Founder, Honorable Norman Mineta***
Secretary (ret.),
US Department of Transportation

Chair, Will Kempton
Retired Transportation Executive

Vice Chair, Jeff Morales
Managing Principal
InfraStrategies, LLC

Executive Director, Karen Philbrick, PhD*
Mineta Transportation Institute
San José State University

Winsome Bowen
VP, Corporate Development
Brightline

David Castagnetti
Co-Founder
Mehlman Castagnetti
Rosen & Thomas

Maria Cino
Vice President
America & U.S. Government
Relations Hewlett-Packard Enterprise

Grace Crunican**
Owner
Crunican LLC

Donna DeMartino
Retired Transportation Executive

John Flaherty
Senior Fellow
Silicon Valley American
Leadership Form

Stephen J. Gardner*
President & CEO
Amtrak

Rose Guilbault
Board Member
San Mateo County
Transit District (SamTrans)

Kyle Christina Holland
Senior Director,
Special Projects, TAP Technologies,
Los Angeles County Metropolitan
Transportation Authority (LA Metro)

Ian Jefferies*
President & CEO
Association of American Railroads

Diane Woodend Jones
Principal & Chair of Board
Lea + Elliott, Inc.

Therese McMillan
Executive Director
Metropolitan Transportation
Commission (MTC)

Abbas Mohaddes
CEO
Econolite Group Inc.

Stephen Morrissey
Vice President – Regulatory and
Policy
United Airlines

Toks Omishakin*
Secretary
California State Transportation
Agency (CALSTA)

Takayoshi (Taki) Oshima
Chairman & CEO
Allied Telesis, Inc.

Marco Pagani, PhD*
Interim Dean
Lucas College and
Graduate School of Business
San José State University

April Rai
President & CEO
Conference of Minority
Transportation Officials (COMTO)

Greg Regan*
President
Transportation Trades Department,
AFL-CIO

Paul Skoutelas*
President & CEO
American Public Transportation
Association (APTA)

Kimberly Slaughter
CEO
Systra USA

Tony Tavares*
Director
California Department of
Transportation (Caltrans)

Jim Tymon*
Executive Director
American Association of
State Highway and Transportation
Officials (AASHTO)

* = Ex-Officio
** = Past Chair, Board of Trustees
*** = Deceased

Directors

Karen Philbrick, PhD
Executive Director

Hilary Nixon, PhD
Deputy Executive Director

Asha Weinstein Agrawal, PhD
Education Director
National Transportation Finance
Center Director

Brian Michael Jenkins
National Transportation Security
Center Director

