

Transportation and Community Participation Among Autistic Adults

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Abstract

This study investigated how the amount, breadth, and sufficiency of community participation differed in terms of transportation modes used by autistic adults ($N = 751$). Autistic adults who had access to more transportation modes had a greater amount of community participation. Driving was related to enhanced participation. Those dependent on others or service transportation had poorer participation outcomes than those who used more independent transportation options. The associations are generally similar regardless of the richness of public transit available, although they appear stronger in more limited transit areas. These findings have several implications for providing support to enable autistic adults to participate in their communities in the areas that are important to them and to the extent they desire.

Keywords: autism, adults, community participation, transportation, driving

AAIDD is making an exception to AAIDD Style Policy by using identity first language in this article. Community participation refers to engagement in a meaningful social situation, such as work, school, social, civic, and leisure activities, and is essential to health and functioning (World Health Organization, 2001). Participation is associated with improved mental health and quality of life (Billstedt et al., 2011; Bishop-Fitzpatrick et al., 2017; Stacey et al., 2019). Unfortunately, there is evidence that unemployment or underemployment, one domain of participation, and social isolation—a consequence of lack of participation, are everyday experiences among many autistic adults (Billstedt et al., 2011; Farley et al., 2018; Howlin et al., 2013; Orsmond et al., 2013; Tobin et al., 2014). A recent study found that autistic adults experienced participation disparities compared with adults in the general population in amount, breadth, and sufficiency of participation across a full range of community-based activities, including leisure, social, and productive activities (Song, Shea, et al., 2022). One less explored area for the growing population of autistic adults in the United States is knowledge about their communi-

ty mobility, especially transportation use, and how it may impact community participation. This article uses identity-first language for adults, which has emerged as the preferred way of being addressed in the autism community (Bottema-Beute et al., 2021; Kenny et al., 2016).

Full participation in the community typically requires the ability to move around in one's environment, ranging from walking to driving a car and using public transportation. Approximately 13.4 million American adults (18–64 years old) living with disabilities have difficulty getting outside the home (Brumbaugh, 2018). Individuals encountering social, financial, psychological, or physical limitations in access to transportation may be excluded from society in ways that adversely impact them as a result (Mackett & Thoreau, 2015). The need to understand transportation support needs among autistic individuals has been identified as a priority (Kersten et al., 2020, 2021). Autistic individuals have identified a lack of transportation options as a significant barrier to community participation (Askari et al., 2015).

Two empirical studies highlight the transportation issues among autistic individuals, and both support the notion that access to transportation is linked to better participation (Chan et al., 2020; Zalewska et al., 2016). Zalewska and colleagues (2016) obtained a nationally representative sample and found that transportation independence (i.e., driving, public transit, walking, or biking) was associated with a fivefold increase in employment outcomes for young autistic adults. The second study used Geographic Information System data to show that greater access to public transportation, as measured by the number of bus stops within 0.5 miles of their home locations, was related to the increased amount of volunteering, social activities, and service use (Chan et al., 2020).

Several critical research questions remain regarding how transportation is associated with community participation among autistic adults. For example, how could supporting autistic adults in diversifying and expanding their transportation options beyond one or two ways of getting around their communities enhance their ability to get out of the house and do things that are important to them? The Chan et al. (2020) study showed that living near more bus stops was associated with greater participation. Another study also found that individuals with developmental disabilities who live in a neighborhood with more bus stops had fewer unmet needs related to work and shopping (Wasfi et al., 2017). Expanding transportation options, such as adding biking or supports around walking to use public transportation, may also result in participation that is aligned with individual preferences.

A second issue is whether transportation independence, specifically, the degree to which an autistic adult can be mobile with limited dependence on others, impacts participation. The majority of adults on the autism spectrum rely on their social networks, including family, friends, and support staff, to provide rides (i.e., as in passenger vehicles driven by others; Deka et al., 2016). However, dependence on others, especially family members, for mobility options is believed to undermine opportunities for community participation (Deka et al., 2016; Farley et al., 2018). Driving arguably represents the greatest independence in community mobility in the sense that it allows for shorter transit time and longer distances to be more easily covered. However, autistic adults experience documented challenges in obtaining a driver's license and may need specific driver

instruction or support compared to non-autistic peers (Curry et al., 2018; Lindsay, 2017). If driving is not an option, then public transportation, where it is available, offers a relatively flexible, low-cost alternative that still allows for a great degree of independence and opportunities for participation for autistic adults (Falkmer et al., 2015). Most people on the autism spectrum or other developmental disabilities believe that using public transportation would increase independence (Pfeiffer et al., 2020). However, the use of public transportation can present challenges to some autistic adults as a result of sensory issues associated with noise and crowding that could lead to stress and anxiety, issues associated with trip planning and managing transfers, and concerns about prejudice and discrimination from operators and other passengers (Deka et al., 2016).

A third issue is a need to understand how one major contextual factor, living in a more urban environment with a richer public transportation system versus a less urban environment with more limited public transportation, might differentially impact the relationship between transportation use and participation. Research has found that people with disabilities who live in rural areas use public transportation less and experience more frequent problems using public transportation for social and recreational activities than those living in urban areas (Bezyak et al., 2020). Another study found that car access was a critical factor in understanding the community participation of adults with psychiatric disabilities in less urban settings (Townley et al., 2018). Public transportation is less available, including fewer routes and stops and more limited schedules, in rural than urban settings. For those who live in more limited public transportation environments and do not drive, dependence on others for mobility and, consequently, participation may be more critical.

This study uses data from a large, statewide survey of autistic adults to examine how the number and types of transportation modes used by autistic adults may be associated with their community participation in a broad range of areas. We paid particular attention to how access to varying degrees of independent transportation—driving, use of public transportation if one cannot drive, and mobility based on rides from other sources, is related to participation. Specifically, this study addresses the following questions:

1. Is the number of transportation options associated with participation?
2. Are there any differences in participation outcomes between autistic adults who drive and those who do not drive?
3. Among those who do not drive, are there any differences in the participation outcomes between autistic adults who use public transit and those who do not?
4. Are there any differences in the participation outcomes between autistic adults who only take rides or use service transportation and those who use other transportation modes (i.e., car driving, public transit, ride-sharing, and active transport)?

Findings are contextualized regarding the richness of public transportation available to them, as this factor may differentially impact the relationship between transportation use and participation. These results will further inform the field about the role that transportation plays in the community living of autistic adults and shed light on possible policies and services that might be necessary to enhance their community living outcomes.

Method

Data and Sample

The data used in this study came from the Pennsylvania Autism Needs Assessment (PANA) which was approved by the Drexel University Institutional Review Board. The survey was conducted between May 2017 and June 2018, and all Pennsylvania residents who had a self-reported autism spectrum diagnosis (ASD) and their caregivers were eligible to participate. Two recruitment strategies were used. First, invitation letters were sent to everyone enrolled in Medicaid with a claim or encounter for ASD diagnosis (ICD-9 299.XX or ICD 10 F84.X) with information about the study, including the survey link or contact phone number and email to request a paper copy. Second, information about the survey was also distributed through ASD-specific advocacy and policy organizations in Pennsylvania.

The PANA included questions requesting demographic information, clinical characteristics, psychiatric hospitalizations, and service use and needs. Questions about the living situation, education, social relationships, participation, and transportation use and access were included. The

survey was translated into 14 languages. The English version is available at www.paaautism.org/needsassessment. A total of 1,383 individuals on the autism spectrum who were 18 years old or older started the survey by themselves or with assistance from caregivers or staff. The final sample for this study was 752 autistic adults who answered the questions about transportation use, indicated their county of residence, and responded to at least 75% of the community participation questions (described in the Measures section) after data cleaning. Among the 752 autistic adults, 46% ($n = 343$) completed the paper version of the survey, and 54% ($n = 409$) completed the online version.

Measures

Transportation Variables

Participants responded to the following question: “In terms of transportation, how do you typically get where you need to go? (Choose all that apply)” by selecting one or more options from the following list: (1) Drive yourself in a private car; (2) Passenger in a private car with parents or family; (3) Passenger in a private car with friends; (4) Bus/van operated by county, municipality, or nonprofit; (5) Taxi or other for-hire vehicles; (6) Walk; (7) Bicycle; (8) Passenger in a private car with volunteer driver; (9) Public transit; (10) Transportation is provided by a day program; (11) Transportation is provided by a group home; (12) Transportation is provided by school/educational institution; (13) Ride Sharing (Uber/Lyft); and (14) Car Share (e.g., ZipCar, Enterprise CarShare). Respondents were also able to choose “other” and enter free text. The other responses were coded into existing answer choices or a new category (e.g., motorcycle, skate).

Each category was then coded into one of seven transportation modes. The first mode was driving, which included driving oneself in a private car, using Car Share, or riding a motorcycle (based on the text responses). The second mode was the use of public transit. The third mode was active transportation, including walking, biking, or skating (based on the text responses). The fourth mode was private services, including ride-sharing, taxis, or other for-hire vehicles. The fifth mode was bus/van operated by a county, municipality, or nonprofit. The sixth mode was getting rides from others, including as a passenger in a private

car with parents or family, a passenger in a private car with friends, or a passenger in a private car with a volunteer driver. The seventh mode was service transportation, including transportation provided by a day program, a group home, or by school/education institution.”

To address our research question, we further created four independent variables. First, the number of transportation modes used by each respondent was calculated by summing all the options used among the seven mode categories. Second, we identified those who drove as a transportation mode and those who did not. Third, we identified those who used public transit and those who did not, among those who did not drive. Last, we identified those who only received rides from others or used service transportation and those who had access to the other more independent forms of transportation (i.e., driving, public transit, active transportation, and private services).

Community Participation

The Temple University Community Participation measure was used to examine a wide range of participation. The measure assesses the number of days of participation over the past 30 days without support from a staff person from a list of 24 areas, whether each activity is important to respondents (“Yes” or “No”), and whether the current level of participation is sufficient (“Not enough,” “Enough,” or “Too much”). Some examples of participation activities include going to a place of worship, going to a movie theater, working for pay, and getting together with family and friends. The measure has been used with autistic adults in previous studies (Song, Shea, et al., 2022) and has demonstrated good test-retest reliability (Song, Salzer, et al., 2022).

Three participation outcomes were calculated based on the responses:

1. Amount of participation, calculated by summing the number of days of participation across the 24 areas, with a higher number indicating a higher amount of participation.
2. Breadth ratio, calculated by dividing the number of important activities with at least one day of participation by the number of important activities, with higher scores reflecting the greater breadth of participation.
3. Sufficiency ratio, calculated by dividing the number of important activities engaged in

enough by the number of important activities. A ratio of 1 indicates that an individual does “enough” in all important areas. A ratio of 0 indicates they do “enough” in no areas that are important to them.

Transit Areas

Rich transit areas were defined as the counties that were extensively served by the two largest urban transportation systems in the state of Pennsylvania—Port Authority of Allegheny County and Southeastern Pennsylvania Transportation Authority (American Society of Civil Engineers, 2018). These two transit systems offer services to more than 4.8 million people in the state who live in six counties, which is approximately 42% of the state population. Public transit authorities and transportation exist in other counties, but to a much more limited degree in terms of coverage (i.e., most central area of an otherwise low-density population county/region) and availability (i.e., hours of service). The remaining 61 counties represent the limited transit areas. Respondents provided their county of residence, which was used to determine if they lived in a rich or limited transit area.

Other Sociodemographic and Clinical Variables

Demographic characteristics were self-reported, including age in years and self-identified gender (i.e., male, female, and other). Race/ethnicity included Non-Hispanic Black, Hispanic/Latino, Non-Hispanic White, and Others. Insurance coverage type indicates if the autistic individual was covered by public insurance (e.g., Medicaid) or not. Participants also indicated whether they received a high school education or lower (vs. some college education). Respondents identified if they obtained any out of 21 services (e.g., mental health service, case management, social skill training) and whether the individual needed more of each type of service. These were summed to indicate the level of services used and needed. Finally, respondents indicated whether they had any co-occurring mental health diagnoses, including anxiety disorder, attention-deficit/hyperactivity disorder, bipolar disorder, conduct disorder, depression, obsessive-compulsive disorder, oppositional defiant disorder, post-

traumatic stress disorder, schizophrenia, or other psychotic disorder.

Analytic Strategy

All analyses were performed using SPSS 26.0. Patterns of transportation use among autistic adults were examined using descriptive statistics and categorized based on whether they lived in a limited or rich transit area. Chi-square tests were conducted between the use of three transportation modes (i.e., driving, public transit, and rides/service transportation) and sociodemographic and clinical characteristics, including gender, age, race and ethnicity, co-existing intellectual disability (ID), mental health diagnosis, living arrangement, and insurance status. We dichotomized race and ethnicity into non-Hispanic Whites and racial and ethnic minorities in Chi-square tests because of the small sizes of individual racial and ethnic minority groups. In the examination of the association between transportation use and community participation, first, Pearson correlations were used to examine the relationship between the number of transportation modes used and participation outcomes—amount, breadth ratio, and sufficiency ratio. Independent samples *t* tests were then conducted to compare participation outcomes based on the three groupings: (1) those who drove and those who did not; (2) those who took public transit and those who did not take among the non-drivers; and (3) those who only took rides or used service transportation with those who used any other of the four more independent transportation modes (i.e., driving, public transit, private services, and active transportation). Separate analyses were conducted for those who lived in the rich transit areas and limited transit areas. *P* values less than .05 were used as the criterion for statistical significance in all analyses.

Results

Sample Characteristics

Roughly 73% ($n = 544$) of the sample lived in limited transit areas and 27% ($n = 207$) in rich transit areas. The average age of the sample was 27.9 years ($SD = 10.3$), with the majority being male (72%, $n = 558$) and non-Hispanic White (82%, $n = 601$). Most participants lived with family members (80%, $n = 595$). About half of our sample had an education of more than a high school degree (52%, $n = 377$), with a higher

percentage of participants in the rich transit area having more than a high school degree than those in the limited transit area (64% vs. 48%, $\chi^2 = 14.69$, $p < 0.001$). Most participants were covered by public insurance (77%, $n = 562$), with a slightly higher percentage in limited transit areas than in rich transit areas (79% vs. 71%, $\chi^2 = 5.02$, $p = 0.025$). About four in five adults reported at least one unmet service needs (77%, $n = 563$), and the distribution of the number of unmet needs was similar across the two residential areas. For clinical characteristics, one in five autistic adults had a co-existing ID (20%, $n = 158$), and three-quarters had at least one mental health diagnosis (75%, $n = 565$). No significant differences were found in the amount, breadth, and sufficiency of participation between the limited and rich transit areas (see Table 1).

Patterns of Transportation Use

Responses pertaining to the diversity of transportation modes are summarized in Table 2. All participants reported at least one transportation mode. Thirty-seven percent ($n = 277$) of the sample reported only one transportation mode to get around, and 12% ($n = 88$) used four or more modes. Getting rides from others was the most common transportation mode for those living in both limited and rich transit areas, followed by active transportation (e.g., walking, riding a bike). Ridesharing/taxi and service transportation were the least used. About one third of the sample drove, with similar proportions in limited and rich transit areas (30% vs. 32%). About one fourth of the sample used public transportation, with a lower proportion of adults in the limited transit areas than in the rich transit areas using this form of transportation (22% vs. 30%, $\chi^2 = 5.68$, $p = 0.017$).

Respondents who drove tended to be less likely to use other forms of transportation (except for ride-sharing/taxi) than those who drove. Specifically, there was a lower percentage of autistic adults who drove versus those who did not drive in use of public transit (13% vs. 29%, $\chi^2 = 20.52$, $p < 0.001$), active transportation (36% vs. 45%, $\chi^2 = 4.29$, $p = 0.038$), rides from others (48% vs. 84%, $\chi^2 = 103.02$, $p < 0.001$), and service transportation (4% vs. 23%, $\chi^2 = 38.84$, $p < 0.001$). Similar patterns were observed within the limited and rich transit areas except for active transportation, which did not show differences between

Table 1
Sample Characteristics of the Whole Sample and by Transit Areas

Variables	Limited transit areas (<i>n</i> = 545)	Rich transit areas (<i>n</i> = 207)	All (<i>N</i> = 752)
Gender: Male, %	380, 71	148, 76	558, 72
Age, <i>SD</i>	27.4, 10.1	29.1, 10.7	27.9, 10.3
Race/ethnicity			
Non-Hispanic White, %	438, 82	163, 82	601, 82
Non-Hispanic Black, %	45, 8	16, 8	61, 8
Hispanic/Latino, %	18, 3	9, 5	27, 4
Other, %	30, 6	14, 7	44, 6
Living arrangement: living with family	433, 79	162, 78	595, 79
Education: more than high school	249, 48	128, 64	377, 53
Insurance: Public, %	419, 79	143, 71	562, 77
Number of unmet needs for services			
None, %	129, 24	43, 21	178, 23
1–4, %	167, 31	73, 36	254, 33
5–8, %	129, 24	41, 20	184, 24
9 and above, %	108, 20	47, 23	166, 21
Intellectual Disability, %	111, 20	43, 21	154, 20
Mental health problems, %	408, 75	156, 75	564, 75
Community participation			
Participation days, <i>SD</i>	29.75, 33.66	28.29, 28.12	29.34, 32.28
Breadth ratio, <i>SD</i>	0.42, 0.34	0.45, 0.33	0.43, 0.33
Sufficiency ratio, <i>SD</i>	0.48, 0.32	0.49, 0.33	0.48, 0.32

drivers and non-drivers in rich transit areas (43% vs. 48%).

drive than those with more education (15% vs. 45%; $\chi^2 = 73.60$, $p < 0.001$, $\psi = 0.32$).

Characteristics Associated With the Use of Various Forms of Transportation

Driving

Results of Chi-square tests revealed that non-Hispanic Whites were more likely to report that they drove versus racial and ethnic minorities (34% vs. 15%; $\chi^2 = 18.28$, $p < 0.001$, $\psi = 0.16$). A lower percentage of participants who were covered by public insurance drove than those who were not covered by public insurance (25% vs. 48%; $\chi^2 = 34.52$, $p < 0.001$, $\psi = 0.22$). Participants without co-existing ID were less likely to drive than those without ID (3% vs. 37%; $\chi^2 = 69.94$, $p < 0.001$, $\psi = 0.31$). Participants who lived in non-family settings were slightly less likely to drive than those who lived with family (24% vs. 32%; $\chi^2 = 4.23$, $p = 0.040$, $\psi = 0.08$). Those who had a high school education or lower were less likely to

Public Transportation

Among those who did not drive, non-Hispanic White respondents were less likely to use public transit (10% vs. 21%; $\chi^2 = 18.07$, $p < 0.001$, $\psi = 0.16$) and those who lived with family members versus those living in other situations (21% vs. 35%; $\chi^2 = 14.02$, $p < 0.001$, $\psi = 0.14$). Participants with lower education levels who did not drive were less likely to use public transit than those with higher education levels (18% vs. 30% $\chi^2 = 13.61$, $p < 0.001$, $\psi = 0.14$).

Rides/Service Transportation Only

Chi-square tests were conducted to examine factors associated with only getting rides or using service transportation to get around the community. Results showed that participants who were covered by public insurance were more likely only to obtain rides/service transportation than those who were not covered by public insurance (30%

Table 2
Transportation Mode Used in General and by Those Who Drove and Those Who Did Not

Transportation use	Limited transit areas		Rich transit areas		All areas	
	<i>n</i>	%	<i>n</i>	%	<i>n</i>	%
Number of transportation modes						
1 mode	199	367	78	378	277	37
2 modes	180	33	49	24	229	31
3 modes	93	17	45	22	138	18
4+ modes	73	13	35	17	108	14
Prevalence of individual transportation mode						
Drive	161	30	66	32	227	30
Public transit	118	22	62	30	180	24
Driver	14	9	16	24	30	13
Non-driver	104	27	46	33	150	29
Ridesharing/taxi	54	10	35	17	89	12
Driver	8	5	11	17	19	8
Non-driver	46	12	24	17	70	13
Active transportation	233	43	88	43	321	43
Driver	51	32	31	48	82	36
Non-driver	182	47	57	40	239	45
Rides from others	406	75	143	69	549	73
Driver	77	48	31	48	107	48
Non-driver	329	86	112	79	442	84
Service transportation	94	17	38	18	132	18
Driver	7	4	2	3	9	4
Non-driver	87	23	36	25	123	23

vs. 16%; $\chi^2 = 12.46$, $p < 0.001$, $\psi = 0.13$). Participants with ID were more likely to obtain rides than those without ID (51% vs. 21%; $\chi^2 = 55.78$, $p < 0.001$, $\psi = 0.27$). Finally, participants with higher education levels were less likely to depend on rides from others solely (14% vs. 39%; $\chi^2 = 57.28$, $p < 0.001$, $\psi = 0.28$).

Transportation Use and Community Participation

Number of Transportation Modes

The number of transportation modes was positively associated with participation days in limited transit areas ($r = 0.18$, $p < 0.001$). For example, the average amount of participation was 24.86 days ($SD = 30.11$) for participants who had one transportation mode, which was much lower than the amount of participation for those who used four or more transportation modes (40.91 ± 37.7). This pattern held for

those living in rich transit areas ($r = 0.18$, $p = 0.008$) and those living in limited transit areas ($r = 0.18$, $p < 0.001$). However, the number of transportation modes was not associated with the proportion of important areas that were participated in at least once (i.e., breadth ratio) or the proportion of important areas done enough (i.e., sufficiency ratio).

Driving

As shown in Table 3, participants in limited transit areas who drove, regardless of whether they used other modes of transportation, participated more (39.96 ± 35.10 vs. 25.54 ± 32.15 ; $d = 0.44$, $p < 0.001$), had a higher breadth ratio (0.51 ± 0.31 vs. 0.39 ± 0.34 ; $d = 0.34$, $p < 0.001$), and had a higher sufficiency of participation ratio (0.54 ± 0.30 vs. 0.45 ± 0.33 ; $d = 0.27$, $p = 0.004$) than those who did not drive. Among participants in the rich transit areas, those who drove also had more participation days than those who did not (38.41 ± 30.02 vs. 23.56 ± 25.97 ; $d = 0.54$, $p < 0.001$).

Table 3
Driving and Community Participation

Participation outcomes	Driving		Not-driving		<i>t</i> test	
	<i>n</i>	<i>M</i> (<i>SD</i>)	<i>n</i>	<i>M</i> (<i>SD</i>)	<i>d</i>	<i>p</i>
Limited transit areas						
Participation days	161	39.96 (35.10)	383	25.54 (32.15)	0.44	<0.001
Breadth ratio	155	0.51 (0.31)	361	0.39 (0.34)	0.34	<0.001
Sufficiency ratio	155	0.54 (0.30)	361	0.45 (0.33)	0.27	0.004
Rich transit areas						
Participation days	66	38.41 (30.02)	141	23.56 (25.97)	0.54	<0.001
Breadth ratio	66	0.47 (0.31)	132	0.43 (0.34)	0.11	0.475
Sufficiency ratio	132	0.48 (0.35)	132	0.48 (0.35)	0.06	0.715

0.001) but did not differ on breadth ratio or sufficiency ratio.

Public Transportation

Among participants in the limited transit areas (see Table 4), those who did not drive but used public transportation participated more than those who did not (32.02 ± 29.19 vs. 23.05 ± 32.88 ; $d = 0.29$, $p = 0.015$). Those who did not drive but used public transportation had a higher breadth ratio than those who did not (0.45 ± 0.32 vs. 0.37 ± 0.35 ; $d = 0.24$; $p = 0.049$). Similarly, among participants in the rich transit areas, those who did not drive but used public transportation had a higher breadth ratio than those who did not (0.56 ± 0.29 vs. 0.37 ± 0.34 ; $d = 0.66$; $p = 0.002$).

Rides/Service Transportation

As results shown in Table 5, survey respondents who only received rides from others or used

service transportation participated less frequently compared with those who used more independent transportation modes (14.32 ± 25.32 vs. 35.40 ± 35.67 ; $d = 0.65$, $p < 0.001$) in the limited transit areas. They also had a lower breadth ratio (0.29 ± 0.34 vs. 0.46 ± 0.32 ; $d = 0.57$, $p < 0.001$) and sufficiency ratio (0.42 ± 0.36 vs. 0.49 ± 0.31 ; $d = 0.23$, $p = 0.024$). In rich transit areas, those who only took rides or used service transportation had a lower breadth ratio compared with those with other transportation options (0.36 ± 0.36 vs. 0.49 ± 0.32 ; $d = 0.35$, $p = 0.033$).

Discussion

This study provides important information about factors associated with the types of transportation that autistic adults use to get around their communities and how it relates to their community participation in terms of amount, breadth, and sufficiency. Overall, study results indicate that

Table 4
The Differences in Participation Between Adults Using Public Transit and Among Those Who Did Not Drive

Participation outcomes	Using public transit		Not using public transit		<i>t</i> test	
	<i>n</i>	<i>M</i> (<i>SD</i>)	<i>n</i>	<i>M</i> (<i>SD</i>)	<i>d</i>	<i>p</i>
Limited transit areas						
Participation days	104	32.02 (29.19)	280	23.05 (32.88)	0.29	0.015 ^a
Breadth ratio	101	0.45 (0.32)	261	0.37 (0.35)	0.24	0.049
Sufficiency ratio	101	0.46 (0.33)	261	0.44 (0.33)	0.06	0.600
Rich transit areas						
Participation days	46	28.74 (24.07)	95	21.05 (26.60)	0.30	0.099
Breadth ratio	45	0.56 (0.29)	87	0.37 (0.34)	0.66	0.002
Sufficiency ratio	45	0.45 (0.32)	87	0.50 (0.37)	0.29	0.480

Note. ^a indicates insignificance after controlling for the number of transportation modes used.

Table 5

The Differences in Participation Between Adults Who Used Rides and Service Transportation Only and Those Used Other Transportation

Participation outcomes	Rides/service transportation only		Access to other transportation		<i>t</i> test	
	<i>n</i>	<i>M</i> (<i>SD</i>)	<i>n</i>	<i>M</i> (<i>SD</i>)	<i>d</i>	<i>p</i>
Limited transit areas						
Participation days	146	14.32 (25.32)	399	35.40 (34.58)	0.65	< 0.001
Breadth ratio	135	0.29 (0.34)	382	0.47 (0.32)	0.57	< 0.001
Sufficiency ratio	135	0.42 (0.36)	382	0.49 (0.31)	0.23	0.024
Rich transit areas						
Participation days	56	22.99 (29.31)	151	30.26 (27.51)	0.26	0.099
Breadth ratio	51	0.36 (0.36)	147	0.48 (0.31)	0.35	0.033
Sufficiency ratio	51	0.51 (0.39)	147	0.48 (0.31)	0.08	0.608

access to more transportation modes is associated with a greater amount of community participation and that driving is also related to enhanced community participation. If not driving, public transportation is related to the amount of community participation for autistic adults in the limited transit areas. Finally, those dependent on others for their transportation have poorer participation outcomes than those who utilize more independent transportation options (i.e., driving, public transit, walking or biking, and ride-sharing). The findings are generally the same regardless of the richness of public transit, although the relationship appears stronger in more limited transit areas.

The patterns of transportation use showed that one in three autistic adults in our sample drove. Autistic adults without ID and autistic adults with greater educational attainment (i.e., greater than high school education) were more likely to drive. The percentage of autistic adults who reported driving was similar to a previous study of young autistic adults without ID (Curry et al., 2018), but much higher than the proportion reported in a study mainly based on caregiver reports (Deka et al., 2016). Our study involved self-report data, which may have excluded individuals who experience challenges completing a survey for themselves, raising the likelihood that our results about driving are over estimates of driving among all autistic adults. Nonetheless, although we did not ask respondents if they had a driver's license, our results may suggest that the proportion of autistic adults who do have licenses may be lower than the approximately 85% of the driving-age population in the United States who

have a license (U.S. Department of Transportation Federal Highway Administration, 2019).

About one fourth of autistic adults in our study used public transportation. Autistic adults who had low education levels, lived with family members, and racial and ethnic minorities were less likely to use public transportation, which calls for special attention to those subgroups. We also found that individuals who did not drive a car were more likely to use public transit than those who drove. This echoes the notion that difficulties with driving or lack of access to a car may lead to a preference for public transit among autistic adults (Falkmer et al., 2015). We also found that individuals in rich transit areas were more likely to use public transit than those in limited transit areas. This finding is not surprising in that we categorized limited and rich transit areas based on area-specific transportation availability. We expected that individuals living in rich transit areas would have increased access to local and public transit. This indicates that public transit may be less of a deliberate choice and more likely a result of availability or increased exposure to public transit as an option for transportation.

Regarding the association between transportation use and community participation, we first examined whether the number of transportation modes was related to community participation. Utilizing more modes of transportation was positively associated with a higher amount of participation in both limited and rich transit areas but not with breadth or sufficiency of participation. This suggests that multiple transportation modes support autistic adults getting out into their communities, but only to a limited degree.

For instance, some transportation options are not available at certain times, such as a caregiver not being available to provide a ride, necessitating that they take a bus instead if one is available. However, more modes do not necessarily expand engagement in a broader range of important activities or do more of the important activities as often as they would like. It is plausible that even a small number of transportation options, especially if driving is one of them, may support engagement in a more diverse range of activities.

Second, we examined whether driving was related to participation. Driving has been suggested to improve independent living (e.g., errands, shopping) and secure and maintain employment for people on the autism spectrum (Huang et al., 2012; Zalewska et al., 2016). Because driving and independent living skills are linked (Lindsay, 2017), it may be that the social or clinical characteristics of individuals who do drive are aligned with differences in participation preferences or experiences. Our findings indicate that driving has a particularly significant impact on all aspects of participation—amount, breadth, and sufficiency, in limited transit areas. Limited transit areas in our study are less urban, including numerous rural counties, where driving could reduce travel time and allow respondents to cover longer distances compared to other transportation modes. Thus, driving can increase the amount of participation and allow respondents to engage in a broader range of activities, including the amount of participation they prefer (i.e., sufficiency).

In contrast, driving was only associated with the amount of participation in rich transit areas. Rich transit areas tend to have more community resources (e.g., corner stores or restaurants, family members within walking distance) that may require less time and shorter distances. Given better public transit coverage and walkable neighborhoods in rich transit areas, autistic individuals could rely on other transportation modalities like walking and public transit to get to a broader range of important activities without depending on a car. Additionally, rich transit areas are more likely to have complex intersections and traffic that may present specific challenges or require services and supports, such as travel training, for autistic individuals to feel comfortable and be successful at navigating safely. Autistic adults are more likely to underperform in unpredictable traffic scenarios in driving, especially in urban areas with dense traffic (Chee et al., 2015, 2019). They may use

specific strategies to navigate their communities by car, such as tending to drive on low-risk and familiar routes from home to work (Myers et al., 2021). Although these strategies may increase success, they may also limit the range of activities they can access or the level of involvement they desire. Thus, driving may have fewer advantages in more urban areas with less predictability in driving patterns or situations.

We examined whether public transit, if one was unable to drive, was related to participation. Autism communities and advocacy groups have promoted that public transportation provides greater autonomy and improves the quality of life (Falkmer et al., 2015; Lubin & Feeley, 2016). The use of public transit was expected to be essential for those who did not drive, especially for those in limited transit areas where walking, for example, would be less of an option in getting to desired locations. Moreover, public transportation can be an affordable opportunity to travel substantial distances without having to drive. Among those who did not drive, public transit was positively related to the amount of community participation for those in limited transit areas, suggesting that it can assist them in getting out more. The use of public transit was also positively related to the range of participation in important activities for both limited and rich transit areas.

However, the lack of association with the satisfaction levels with participation level indicates that likely limitations in routes and schedules may have hampered the impact of using public transit to participate in activities that are important to respondents as much as they want. Hass and colleagues (2020) explored the experiences of young autistic adults in using public transport in a large metropolitan city. They found that autistic adults had considerable anxiety, often induced by uncertainty and sensory overload when using public transit. Autistic individuals living in metropolitan areas may also limit the use of public transportation to avoid “peak hours” when the trains and buses are crowded (Falkmer et al., 2015). These challenges may serve as restrictions in using public transportation to go to various important destinations and instead only use public transportation to go more to a few important areas.

Finally, we examined how independent transportation was related to community participation. Autistic adults in limited transit areas with access to independent transportation options, including

driving, public transport, active transportation, and ride-sharing/taxi, reported better participation outcomes than those who only relied on rides from others or service transportation. Independent transportation was only associated with the breadth of participation for people in the rich transit areas. This finding is consistent with previous research on independent transportation and employment of young adults on the autism spectrum (Zalewska et al., 2016). Rides from others and service transportation generally cannot satisfy all individuals' travel needs (Deka et al., 2016; Farley et al., 2018). Autistic individuals and their families may be forced to make decisions about time and resources needed to ensure that time-sensitive trips linked to medical care are a higher priority than other trips, such as social and recreational activities. Examining how different transportation options impact specific types of participation based on personal preferences, such as employment and social activities, more extensively would be an exciting direction for future research.

Similar to the findings of driving, independent transportation plays a more prominent role in participation for autistic adults in limited transit areas than those in rich transit areas. In rich transit areas, using rides and service transportation may allow autistic adults to participate as much as they want. However, it does not help them participate as broadly as possible. It is possible that destinations that require less time and shorter distances to get to in more urban areas, which are in the majority of rich transportation areas, than less urban areas. Thus, it may be easier for family members or friends to support autistic individuals to get to places they want to go. Also, the service transportation is relatively adequate in more urban areas than less urban areas, which could match the needs of autistic individuals better than other options like public transit. Additionally, given that the busy streets and heavy traffic are also common in the rich transit areas, independent transportation, like driving, public transit, and walking, may not be preferred by autistic adults. Consequently, the benefit of independent transportation becomes less evident in rich transit areas.

Limitations and Future Directions

This study provides additional information about the transportation use of autistic people and how it is associated with their community participation, but it has some limitations. There were

several limits to the generalizability of the study findings. First, it only provides perspectives from autistic adults in the state of Pennsylvania. The findings may not be generalizable to other states in the United States or to the population level. Second, the sample is predominantly comprised of non-Hispanic White participants. The proportion of individuals in our sample identified as White (84%) is higher than the within-state (76%) and U.S. population (60%) in 2019 (U.S. Census Bureau, 2019). More research is needed to focus on racial and ethnic minority groups to understand their community participation experiences and how transportation modes affect their participation. Third, this study only involves self-report data, and findings may not apply to autistic adults who are not able or do not have access to provide such responses. Fourth, this is a cross-sectional study involving correlational analyses that is unable to identify causal relationships definitively.

The survey was also limited in the types of transportation and characteristics associated with transportation use (e.g., usage rates of each mode, travel needs, preferences of transportation modes, and challenges associated with each mode). To better understand travel needs and preferences, future research should also examine how autistic individuals make decisions about participation and the extent to which access to various modes of transportation is a factor in those decisions. Additionally, paratransit is a specific form of public transportation that people with disabilities often use. However, our survey did not specifically inquire about paratransit use. Some who used paratransit may have responded that they used public transit. In contrast, others may have not and possibly indicated other transportation modes instead, such as “bus/van operated by county, municipality, or nonprofit.” Future studies should specifically examine the potential impact of paratransit use on participation.

Implications

Autistic adults experience lower participation in their communities than adults in the general population (Song, Shea, et al., 2022). This study suggests that some autistic adults who have limited access to independent transportation are less able to engage in important activities. As found in a previous study (e.g., Deka et al., 2016), getting rides from family, friends, staff, and others to get where they needed to go was the most common transportation mode

among autistic adults. A quarter of our sample depended on rides from others and service transportation to get around in their communities. Without increased attention to transportation independence, autistic individuals will continue to experience such disparities in participation. Interventions and supports aimed at improving their knowledge of transportation and community mobility are crucial to address these disparities.

Our study also identified driving as crucial for adults on the autism spectrum. It can substantially reduce their dependence on others and less reliable options (e.g., service transportation). Although driving can improve participation opportunities, autistic adolescents and adults may have specific services and support needs to help them maximize their comfort and positive outcomes associated with driving (Lindsay, 2017). Travel training programs have been suggested to support driving skills and acclimation (Cox et al., 2017; Davies et al., 2010; Reimer et al., 2013; Zhang et al., 2017), but the evidence on how to effectively support individuals on the spectrum to drive independently, when they want to do so, is minimal (Wilson et al., 2018). Our study also found that being non-Hispanic White, living with family members, attaining higher education (more than a high school education), and having no ID are associated with a higher likelihood of driving. Future efforts to support the expansion of mobility options should primarily target people of color and those living individually, with lower education levels, and with co-occurring ID.

It is also crucial to concentrate efforts on improving the accessibility and effectiveness of other independent transportation, including public transit, active transportation (e.g., walking), and ride-sharing. Public transit does not rely on the availability of family and friends and is often cost-effective. In this study, the lack of benefit of public transit among non-drivers, especially those in the rich transit areas, highlights problems with using public transportation for community activities. Given the social, sensory, and cognitive demands of public transit, supporting autistic adults through practice and learning strategies to become confident and independent is vital to achieving optimal community participation. Technology solutions have been explored to reduce barriers and promote greater independent travel (Davies et al., 2010; Rezae et al., 2020; Simões et al., 2018). More importantly, we should advocate

building community capacity to increase the effectiveness and efficiency of public transit for autistic individuals. For instance, extending hours for a public transportation system to meet better the needs of individuals who rely on public transportation has been suggested. Limited availability during evenings and weekends prevents participation in relatively spontaneous activities, including social and recreational activities (Bezyak et al., 2020). The full array of preferences and goals for transportation access among autistic individuals should be sought and prioritized from their perspectives.

Given the different associations between transportation use and community participation by transit areas found in this study, autistic adults may have different travel experiences and face different barriers. Future research should continue to explore the experiences of autistic adults in using different forms of transportation by considering their residential environments. The approach we used to categorize limited and rich transit areas was based on two major urban transportation systems unique to Pennsylvania. Future studies should consider using more refined measures to create a universal criterion, such as GIS-derived measures of public transit accessibility and possibly GPS tracking community mobility.

Conclusion

Accessible, affordable, and reliable transportation is an essential component of community inclusion. Our study investigated the relationship between participation outcomes of adults on the autism spectrum and their transportation use. We also looked at the relationship between participation and rich transit areas or limited transit areas separately. Contrary to prior research, our findings did not reveal a difference in participation between public and non-public transit users. Driving oneself had a positive relationship with the amount of participation for both rich and limited transit areas. However, it played a smaller role in the breadth and sufficiency of participation, which both assess participation in various important activities people want to engage in. Compared with autistic adults who only took rides from others or used service transportation, autistic adults who had access to independent transportation had participation outcomes that were more aligned with their goals. However, this relationship is more salient in the limited transit areas.

Undoubtedly, support for community participation of adults on the autism spectrum needs to improve. Thus, more research needs to include and engage autistic adults to understand their experiences and preferences in navigating community spaces.

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