☑ CE Article

Stress Associated with Transportation: A Survey of Persons with Visual Impairments

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Structured abstract: *Introduction:* This study evaluated transportation-related stress and factors predicting stress among persons with visual impairments. *Methods:* Participants with visual impairments completed electronic surveys rating their stress levels experienced when completing various walking and public transportation tasks. They also indicated activities they avoided due to transportation stress. *Results:* Higher stress was reported for navigating unfamiliar bus routes, walking in urban areas without sidewalks, and walking in unfamiliar places. Significant predictors of walking stress were age, years since vision loss, dog guide use, physical limitations, and frequency of public transportation use. Significant predictors of public transportation stress were age, orientation and mobility (O&M) training, physical limitations, and frequency of public transportation use. Most-avoided activities due to transportation-related stress were entertainment or leisure activities and visiting family and friends. *Discussion:* Unfamiliar situations and unpredictable environments were associated with higher stress. Frequent public transportation use and longer time since vision loss predicted lower stress, which indicates that increased and varied experiences may affect transportation-related stress. Older persons and persons with physical limitations had more transportation-related stress. Social activities, which are important in managing stress, were most frequently avoided due to transportation stress. *Implications for practitioners:* O&M instructors should keep in mind that providing varied experiences and longer training is indicated for persons with high stress, particularly for older persons, and those with recent vision loss or physical limitations. Everyone involved in the rehabilitation process should remember that building relationships with consumers, encouraging public transportation use, participating in support groups, and overcoming travel barriers for social activities may help reduce transportation stress.

The ability to travel independently is an important component of success in vocational and community activities, particularly for persons with disabilities (National Council on Disability, 2005).

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Orientation and mobility (O&M) training facilitates the ability of persons with visual impairments to perform independent travel on foot and through the use of transportation systems. However, performing these skills and the resultant travel activities may be stressful. Although stress can be a positive factor in enhancing motivation and alertness, it may cause avoidance and irritability. This national survey of adults with visual impairments (that is, those who are blind or have low vision) gathered information about self-reported stress levels associated with various O&M skills and transportation activities. This information will be helpful to service providers, administrators, and individuals with visual impairments in receiving, planning, or providing O&M services.

Stress

Stress encompasses various psychological or physical responses, positive or negative, to demands (Pandey, Quick, Rossi, Nelson, & Martin, 2011) or a sense of uncertainty in response to unexpected events (Finan, Zautra, & Wershba, 2011). Psychological stress occurs when people perceive environmental demands as being beyond their resources and thus threatening or harmful (Smith & Kirby, 2011) as opposed to challenges that are demanding but achievable with effort (Carver, 2011). Stress can positively impact performance at its optimum level, but too much or too little stress negatively affects performance (Lindau, Almkvist, & Mohammed, 2000).

Various factors influence how people experience stress. Skills learned through participation in higher education, such as problem solving and how to use information, are helpful in confronting stressful situations (Ranchor & Sanderman, 2000). Older persons report less stress than younger persons, but that could be due to maturation, generational effects, or other variables (Avison, 2000).

Coping mechanisms are behaviors that limit or remove stress and may include confronting stressors or avoiding them. People may engage in avoidance coping when they predict that their actions will not generate a positive outcome (Bohus, 2000). Avoidance coping can be effective in the short term, but it is typically not effective when stressors are present on an ongoing basis (Carver, 2011). Social support, another factor in reducing stress, promotes feelings of control and increases self-esteem (Urchino & Birmingham, 2011). Tangible or informational social support is most helpful when facing controlled events, such as securing transportation to work, but emotional support and fostering a sense of belonging are more helpful for uncontrolled events (Urchino & Birmingham, 2011), such as losing one's driver's license due to vision loss. When encountering stressors, people must consider their individual situations and make judgments regarding whether they possess the resources to confront the stressor and whether this expenditure of resources is worth the outcome (Aldwin & Yancura, 2011).

Stress and travel for persons with visual impairments

Existing literature about how people with visual impairments experience transportation-related stress is scant and dated, yet it remains an important topic. The travel behavior and lifestyles of persons with visual impairments could be affected by personal (for example, physical or psychosocial) variables (Corn & Sacks, 1994; Gillman & Simon, 1980) and environmental factors (Marston & Golledge, 2003). For visually impaired persons, independent travel demands concentration, effort, and attention: learning new routes or environments is demanding and can lead to "tension, anxiety and feelings of insecurity" (Passini, Dupre, & Langlois, 1986, p. 906). The prospect of receiving O&M training can cause emotional stress when persons with visual impairments lack information about the nature of O&M and its training methods, and potential recipients may anticipate needing to concentrate to the point of exhaustion (Seybold, 1993). Although we might expect feedback from an O&M specialist to be reassuring to visually impaired persons, instructor intervention and contact with unexpected objects resulted in a high stress response among persons with some experience in cane travel (Ponchillia, 1984).

Persons who are visually impaired find that open areas such as lobbies and parking lots are difficult to navigate (Passini et al., 1986), presumably because these areas lack spatial and directional information (Marston & Golledge, 2003). An increased stress response is associated with unfamiliarity with an area, lack of travel skills, and route complexity (Seki & Sato, 2011; Tanaka, Murakami, & Shimuzi, 1982). Urban areas are particularly stressful, especially for older people, due to the overwhelming stimuli and constant changes in the environment (Rutberg, 1976).

Incremental exposure to increasingly stressful activities, or "desensitization" (Rutberg, 1976), and discussion groups of O&M recipients (Rutberg, 1976; Seybold, 1993) may be effective in easing stress associated with O&M instruction. Other suggestions to reduce stress included expanding the time frame for O&M training, fostering close relationships between the person with the visual impairment and the O&M specialist (Rutberg, 1976), using wayfinding devices (LaGrow et al., 2009), and using virtual training techniques (Seki & Sato, 2011).

This research evaluates walking stress, public transportation stress, activities limited by stress, and factors predicting stress among adults with visual impairments. Our research questions were:

1. Which transportation tasks are most stressful?
2. Which activities are limited due to transportation stress?
3. What factors predict walking and public transportation stress?

Methods

Transportation survey

A comprehensive survey to assess transportation issues experienced by people with visual impairments was developed with input from the National Research and Training Center (NRTC) on Blindness and Low Vision's national advisory council that included individuals with visual

impairments and O&M specialists. National transportation surveys, such as those conducted by the U.S. Census Bureau and the U.S. Department of Transportation (McKenzie & Rapino, 2011; Santos, McGuckin, Nakamoto, Gray, & Liss, 2011), were reviewed and a few pertinent items were included on this survey, along with items related to O&M, transportation methods, and transportation challenges. The survey was pilot tested with 10 people with visual impairments using various assistive technologies and browsers; their feedback resulted in modifications to content and formatting to facilitate accessibility. Pilot testing and subsequent survey administration were conducted using an electronic platform. Our university's Institutional Review Board for the Protection of Human Subjects approved this study. For more information about the survey and its development, see Crudden, McDonnall, and Hierholzer (2015).

Procedure

Two administrations of the survey were conducted. The first administration was to people in the NRTC's participant registry between ages 18 and 65 years. The registry is a list of people with visual impairments who volunteered to be contacted about participation in research. Surveys were completed between September and November 2013. Approximately 255 persons were sent the survey link and were asked to participate. A $25 gift card incentive was offered to respondents who completed all items; 140 usable surveys were generated.

Based on feedback from the first administration, the survey and some of its formatting were revised. Some redundant items were eliminated and a few items added. The second round of data collection occurred in January and February 2014, and the survey was open to all persons with visual impairments, aged 18 to 65 years. A survey link was posted on the NRTC website and an e-mail with the survey link was sent to major consumer groups, members of the NRTC national advisory council, and personal contacts with requests to forward the link to eligible individuals. Participants could be entered in a drawing for a $100 gift card by providing their contact information. The second administration produced 353 surveys, although one person completed both versions, resulting in 492 usable surveys from the two administrations. Only items found on both versions of the survey were used for data analysis.

Sample

For this study, the sample was limited to nondrivers who had access to public transportation in their local areas, resulting in 368 surveys, since missing data for some key variables reduced the sample size. To maximize power, the largest sample available was used for each analysis, resulting in sample sizes ranging from 259 to 364. Demographics presented in the Results section are for the largest possible sample of 368 (when data were available), since data from all respondents were used for one or more analyses.

Variables, measures, and statistical analyses

The variables of interest in the study presented here were related to participants' self-reported transportation stress and

variables predicting this stress. One set of questions measured the level of stress experienced, on a 0 to 10 scale, for items related to mobility with walking in specific situations, asking for assistance, arranging transportation, and using public transportation. Respondents also indicated whether stress associated with using transportation for eight activities limited their participation in those activities.

The first set of stress questions (see Table 2) was evaluated with Cronbach's alpha and exploratory factor analysis to determine the appropriateness of using the items as a combined scale. We anticipated that items related to walking mobility would be associated with one factor and the remaining items would be associated with a second factor. This hypothesis was supported by these analyses, which indicated that two factors provided a better fit for the data (based on the proportion criteria). The two factors resulted in a 4-item walking stress measure and a 6-item public transportation stress measure (see Table 2 for factor loadings and alpha coefficients). These two composite measures were utilized as dependent variables in the regression analyses. The summed scales were converted to the original 0 to 10 scale of the individual items by dividing the summed score by the number of items, with higher scores indicating higher stress.

Variables expected to predict stress were included as independent variables in the regression models. These variables were age, years since vision loss, years of education completed, whether totally blind or not, receipt of O&M training, white cane use, dog guide use, presence of a self-identified physical limitation that affected transportation options, and frequency per month of public transportation use (numerical value based on respondent's rating on a 7-point scale from "Never" to "Six or more times per week").

Descriptive statistics were used to present information about stress levels experienced with different transportation and mobility activities. Multiple regression was used to determine which variables were associated with walking and public transportation stress. Two models predicting these stress measures were developed. SAS 9.4 was used to conduct statistical analyses.

Results

Demographics

The mean age of respondents was 47.72 (SD = 12.26). Seventy-five percent of respondents were White and 37.7% were from the South. Just over half of the respondents self-reported they were legally blind, and 43.94% reported a physical limitation that affected their public transportation use. Years since vision loss ranged from 2.01 to 64.82 (M = 36.70, SD = 17.81). More than one-third of the sample (34.5%) were visually impaired since birth. See Table 1 for additional demographic information.

Mobility and public transportation use

Most respondents traveled with a white cane and over 25% used dog guides. Furthermore, 85.2% of respondents had received O&M training. Although more than 72.7% of respondents reported using public transportation more than once per month, the remaining 27.3% used it infrequently or never.

Table 1
Demographic information.

Variable	*n*	%
Race or ethnicity		
White	276	75.0
Black or African American	36	9.8
Hispanic	21	5.7
Asian	12	3.3
Multiracial	11	3.0
American Indian	3	0.8
Unknown	9	2.5
Annual household income		
< $25,000	110	29.9
$25,000 to $50,000	80	21.7
$50,000 to $75,000	44	12.0
$75,000 to $100,000	35	9.5
> $100,000	31	8.4
Chose not to answer	68	18.5
Education		
No high school diploma	10	2.8
High school graduate	29	8.0
Some college	63	17.4
Associate's degree	45	12.4
Bachelor's degree	98	27.1
Graduate or professional degree	117	32.3
Not reported	6	
Region		
Northeast	101	27.6
Midwest	68	18.6
South	138	37.7
West	59	16.1
Not reported	2	
Vision		
Totally blind	146	39.7
Legally blind	201	54.6
Less severe visual impairment	21	5.7
Travel method		
White cane	247	67.1
Dog guide	101	27.5
Neither	91	24.7

Transportation stress

Table 2 provides descriptive statistics for the 12 survey items related to stress. Respondents reported the highest stress navigating unfamiliar bus routes, walking in urban areas with no sidewalks, and walking in unfamiliar places. The lowest stress was reported for using taxis, asking other pedestrians for assistance, and asking bus drivers for assistance. Respondents most frequently indicated that transportation stress limited their participation in entertainment or leisure activities and visits to friends or family members. The least frequently avoided activity was employment (see Table 3).

Predictors of walking stress

A multiple regression analysis was conducted to determine if personal characteristics, receipt of O&M training, cane or dog guide use, and public transportation use predicted walking stress. These variables explained 13% of the variance in walking stress, F (9, 305) = 4.99, $p <$ .0001. Significant predictors included age, years since vision loss, dog guide use, physical limitations, and public transportation use (see Table 4). Holding other variables constant, walking stress was predicted to increase by .06 for every additional year of age, so that a 10-year increase in age is associated with an increase in walking stress of approximately .60. A person with physical limitations was predicted to have higher stress of .79 compared to a person without physical limitations. Holding other variables constant, walking stress was predicted to decrease by .03 for each year since vision loss; a dog guide user was predicted to have .68 lower stress than someone who does not use a dog guide; and for each use of public transportation per month, stress was predicted to decrease by .03. Daily use of public transportation (assuming 30 days per month) would predict lower walking stress of .90.

Table 2
Descriptive statistics and factor loadings for transportation stress items.

Variable	*n*	Mean (*SD*)	Factor loading: Walking	Factor loading: Public transportation
Walking stress (composite) $\alpha = .85$	**336**	5.82 (***2.52***)		
Walking in urban areas without sidewalks*	259	6.61 (*2.89*)	—	—
Walking in unfamiliar places	363	6.57 (*2.78*)	**.46**	.37
Crossing intersections without signals	361	6.22 (*3.03*)	**.49**	.29
Walking on the side of rural roads	341	5.40 (*3.19*)	**.82**	−.02
Walking in residential areas without sidewalks	356	5.26 (*3.06*)	**.95**	−.05
Public transportation stress (composite) $\alpha = .86$	**336**	4.80 (***2.34***)		
Navigating unfamiliar bus routes	350	6.80 (*2.80*)	.17	**.66**
Arranging transportation in unfamiliar locations	361	5.36 (*3.09*)	.02	**.73**
Using light rail, like a commuter train or subway*	289	5.01 (*3.41*)	—	—
Using public buses	359	4.88 (*3.25*)	.03	**.69**
Asking bus drivers for assistance	359	4.31 (*3.30*)	.04	**.75**
Asking pedestrians for assistance	364	4.11 (*2.98*)	−.02	**.70**
Using taxis	360	3.54 (*2.89*)	.07	**.60**

Items were measured on a 0–10 scale, where a 10 indicated higher stress. The range for all items is 0 to 10. The boldface in columns 2 and 3 represent the *n* and mean for the composite variables; for columns 4 and 5, boldface represents factor loadings that are above .4.
* Not included in composite measures.

Predictors of public transportation stress

A multiple regression analysis was conducted to determine if personal characteristics, receipt of O&M training, cane or dog guide use, and public transportation use predicted public transportation stress.

Table 3
Frequency and percentage of participants who limited activities due to transportation stress, despite availability of transportation (*N* = 357).

Activity	*n*	%
Entertainment or leisure	213	59.7
Visiting friends or family	179	50.1
Other shopping	163	45.7
Grocery shopping	128	35.9
Volunteer activities	125	35.0
Medical appointments	117	32.8
Worship services	104	29.1
Employment	84	23.5

Results indicated that 16% of the variance in public transportation stress can be attributed to these variables, F (9, 306) = 6.53, $p < .0001$. As shown in Table 4, significant predictors included age, receipt of O&M training, physical limitations, and public transportation use. Holding the other variables constant, each year of age was associated with an increase of .03 in public transportation stress, such that a 10-year increase in age would predict an increase in public transportation stress of approximately .30. A person with physical limitations was predicted to have higher public transportation stress of .67 compared to a person without physical limitations. Holding other variables constant, receipt of O&M training was associated with a reduction in public transportation stress of .78, and public transportation stress was predicted to

Table 4
Multiple regression results for walking stress (N = 315) and public transportation stress (N = 316).

	Walking stress			Public transportation stress		
Predictors	*B*	*SE*	*t*	*B*	*SE*	*t*
Intercept	4.26	1.10	3.87**	6.96	1.02	6.80**
Age	.06	.01	4.77**	.03	.01	2.18*
Years since vision loss	−.03	.01	−2.98**	−.02	.01	−1.87
Years of education	−.02	.06	−.28	−.10	.06	−1.72
Totally blind	−.003	.31	−.01	−.46	.28	−1.64
Physical limitations	.79	.28	2.83**	.67	.25	2.62**
O&M training	−.01	.43	−.02	−.78	.40	−1.97*
Cane use	.05	.31	.15	−.12	.28	−.42
Dog guide use	−.68	.31	−2.17*	−.44	.28	−1.55
Transportation use per month	−.03	.01	−2.35*	−.05	.01	−4.21**

* $p < .05$, ** $p < .01$

decrease by .05 for each use of public transportation per month. Daily use of public transportation is associated with a reduction in public transportation stress of 1.50.

Discussion

In the study presented here, we investigated walking stress and public transportation stress using survey data from 368 working-age, nondriving adults with visual impairments who had access to public transportation. The most stressful tasks included walking in unfamiliar places and in urban areas without sidewalks, navigating unfamiliar bus routes, and crossing uncontrolled intersections. These tasks involved unfamiliar or unpredictable travel environments, which could lead to feelings of uncertainty associated with stress (Finan et al., 2011). Many people might report feeling some stress in these environments; however, the additional cognitive demands (for example, concentration, effort, and attention) on persons with visual impairments during independent travel (Passini et al., 1986) may lead to increased stress. Less stressful tasks included using taxis and asking others (pedestrians or bus drivers) for assistance. Interestingly, asking bus drivers for assistance was slightly more stressful than asking pedestrians, and both activities were ranked as less stressful than actually using public buses.

Transportation stress may have prompted some respondents to engage in avoidance coping, since they reported limiting participation in various activities due to stress. Respondents most frequently limited participation in entertainment and leisure activities, which are generally regarded as enjoyable, stress-reducing activities. Visiting family and friends involves social support, a helpful factor in reducing stress (Urchino & Birmingham, 2011), yet respondents frequently reported limiting this activity due to transportation stress. Each person must evaluate whether performing a stressful activity is worth the expenditure of resources (Aldwin & Yancura, 2011), so some persons may forego participating in entertainment and leisure activities and visiting friends

or family members because they have exhausted their resources performing other stressful activities. On a positive note, less than a quarter of respondents indicated that transportation stress limited participation in employment.

Older age and self-reported physical limitations were associated with higher walking and public transportation stress. Rutberg (1976) found that urban areas were more stressful for older persons, and our results indicate that walking in urban areas without sidewalks was the second most stressful activity. In both regression models, more frequent transportation use per month was associated with significantly lower stress levels, even when accounting for personal characteristics, O&M training, and cane or dog guide use.

Our findings suggest that more time since vision loss is associated with less walking stress. For people with visual impairments, learning the skills for efficient, independent travel takes time. When considering the relationship between stress and time since vision loss for individuals with later-onset visual impairments, we must also consider the process of adjustment to vision loss. Persons with newly diagnosed visual impairments who have trouble finding the mailbox or walking to neighbors' houses might experience insurmountable stress at the prospect of riding a bus. More time since onset of a visual impairment also implies that a person has more opportunities to practice using these skills.

Dog guide use predicted lower walking stress, which included situations such as crossing uncontrolled intersections and walking along streets without sidewalks, environments that often have inconsistent auditory or tactile orientation clues. Dog guides alert handlers to surface changes, help them avoid contact with obstacles, and assist in maintaining a straight line of travel (Franck, Haneline, Brooks, & Whitstock, 2010), all of which could mitigate stress in these environments. Dog guide users typically travel more often than persons without dog guides and more often than before they had a dog guide (Gillman & Simon, 1982), thus increasing their travel experiences, which may influence how they perceive travel-related stress. Dog guide users report that dogs are helpful in initiating conversations (Gitlin, Mount, Lucas, Weirich, & Gramberg, 1997), another factor that might alleviate stress. Another possibility is that individuals who seek training with a dog guide might already have low stress and more sophisticated travel skills.

O&M training was not associated with walking stress; however, it was associated with lower public transportation stress. O&M training might provide more opportunities to practice and refine public transportation skills. Structured O&M learning opportunities that promote optimal stress levels could positively affect performance and use of public transportation.

The regression models did not explain a large degree of the variance in stress, indicating that other factors likely contribute to transportation stress. Future studies would benefit from inclusion of additional variables, particularly psychological variables (such as personality traits, self-efficacy, and self-esteem) and other physical and social factors.

This survey focused on transportation, not O&M; thus, the survey items were not designed to capture all possible stress-inducing mobility situations. The walking stress variables were chosen to represent

situations that persons could encounter while using public transportation that might lead to high stress. Thus, the survey did not include more routine travel tasks or additional "high stress" items, such as walking in malls or parking lots (Passini et al., 1986), and respondents were not asked for details about their prior O&M training. To provide a more comprehensive picture of stressful travel environments, future stress research could include additional O&M training variables and the relationship with the O&M provider.

Limitations

The survey used a nonprobability sampling method, which limits the generalizability of its findings. Compared to the U.S. population of individuals with visual impairments, the sample had larger percentages of people who were totally blind, had higher levels of education, and used dog guides. Further, because this survey was administered electronically, respondents were limited to persons with access and ability to use computers and the Internet.

Measures used here were based on self-reports. Although self-report measures of psychological stress are common, several other items were more open to interpretation. For example, respondents were asked about physical limitations that affected their transportation options. Those who answered "yes" were asked to specify their physical limitations, and responses included a range of disabilities.

Implications for practitioners

Many variables that predicted lower stress can be targeted for intervention. One example is frequency of public transportation use, which highlights the need for O&M specialists to incorporate many opportunities for consumers to use various transportation methods. This finding extends beyond O&M instruction, since encouraging regular public transportation use in daily life may help individuals experience less transportation-related stress.

When planning instruction, O&M specialists should be sensitive to consumers' stress levels and aware of situations that could lead to higher stress (for instance, when traveling in unfamiliar environments). Given that emotional support and a sense of belonging are helpful when confronting uncontrolled events (Urchino & Birmingham, 2011), persons who anticipate frequent travel in unfamiliar areas may benefit from discussion group participation to address concerns and share effective coping strategies. Incorporating technology such as wayfinding devices and virtual training into O&M training may impact consumers' stress and anxiety (LaGrow et al., 2009; Seki & Sato, 2011).

O&M specialists should also consider personal factors associated with stress (for example, age and physical limitations) and strategies that are most effective in reducing stress. Carefully sequenced O&M lessons can help visually impaired persons develop various skills that will empower them to face potentially stressful situations rather than avoid them. Conversely, progressing through instruction too rapidly could have a detrimental effect on performance when individuals experience high stress during lessons (Lindau et al., 2000). Accounting for the stress-related factors identified in this study during O&M training might help individuals overcome avoidance

behaviors and choose effective coping mechanisms.

Our findings indicated that walking stress and public transportation stress increased with age. Consequently, monitoring the stress levels of older consumers receiving O&M instruction is advised, particularly in unfamiliar and urban areas. Building relationships with consumers and encouraging their participation in support groups may reduce their stress levels.

Finally, respondents limited their participation in entertainment or leisure activities and visiting family or friends due to transportation-related stress. These pleasurable activities may help people manage travel-related stress and overall stress levels. Engaging consumers in dialogue about access to transportation for social activities and training in skills for using various transportation methods may promote engagement in these important activities.

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