DISABILITY AND REHABILITATION: ASSISTIVE TECHNOLOGY, 2015
VOL. 11, NO. 2, 124–132
http://dx.doi.org/10.3109/17483107.2015.1090487

Taylor & Francis
Taylor & Francis Group

RESEARCH PAPER

Assistive technology use by disability type and race: exploration of a population-based health survey

Daudet Ilunga Tshiswaka[1], Shondra Loggins Clay[1], Chung-Yi Chiu[1], Reginald Alston[1], and Allen Lewis[2]

[1]Department of Kinesiology and Community Health, University of Illinois at Urbana-Champaign, Urbana, IL, USA and [2]Department of Health Sciences, James Madison University, Harrisonburg, VA, USA

ABSTRACT

Purpose: To examine the relationships among Assistive Technology (AT) use, race, type of disability and selected other demographic characteristics. *Method*: Using 2009 National Health Interview Survey, descriptive statistics, statistical interactions and binary logistic regression were performed to identify, contrast and predict the likelihood of using AT based on the type of disability among African Americans (AAs) and European Americans (EAs). *Results*: We found that more AAs (10% within group proportion of total AAs) used AT compared to EAs (7.5% within group proportion of total EAs). Physical ($p < 0.001$), auditory ($p = 0.028$) and emotional ($p = 0.008$) impairments were statistically significant predictors of AT use. However, physical impairment as a predictor of AT use was greater among AAs (OR = 222.49, CI: 64.04–773.04, $p < 0.001$) than EAs (OR = 50.77, CI: 31.78–81.12, $p < 0.001$). EAs had a greater number of disabling conditions that predict the use of AT than AAs, whereas AAs had more demographic characteristics beyond race that predict AT use than EAs. *Conclusions*: Disparities were observed in AT usage by disability types and demographic characteristics between AAs and EAs. Moreover, the predictive strength of AT usage based on disability types and other demographic variables differed by races. Overall, the findings about the different relationships among race, disability type, and AT use are found.

➤ IMPLICATIONS FOR REHABILITATION

- The finding may inform the development of initiatives by rehabilitation leaders to encourage the use of AT by AAs and EAs according to their type of impairment.
- Having identified physical impairment as statistically significant predictor of AT use greater among AAs, rehabilitation leaders should ensure that people living with those types of disability have access to the corresponding type of AT and can use them effectively.

ARTICLE HISTORY
Received 5 June 2015
Revised 1 August 2015
Accepted 1 September 2015
Published online
25 September 2015

KEYWORDS
Assistive technology, disparities, disability type, NHIS, race, rehabilitation

Introduction

Assistive technology (AT) is central to the field of disability study and policy [1] and has fast become a key instrument in the discipline of rehabilitation due to its potential to play a substantial role in enhancing people's daily functioning and community participation. Following the Assistive Technology Act of 1998, the 2004 amendments to the Assistive Technology Act of 1998 – the Improving Access to Assistive Technology for Individuals with Disabilities Act – has aimed to improve accessibility and usage of AT among people with disabilities (PWD) in order to fully participate in education, employment and daily activities (Association of Assistive Technology Act Programs, 2015). By law, each state and territory is granted to develop an Assistive Technology Act Project.[2] This enhancement is manifested in the lives of those with disabilities based on degree of *independent living*. Scholars agree that in making full participation in daily life activities possible, AT usage has emerged as a great asset for individuals with disabilities.[3–5] Societal participation is a key outcome according to the International Classification of Functioning, Disability and Health of the World Health Organisation.[6] A growing number of articles focus specifically on independent living resulting from AT usage as it promotes quality of life among PWD.[4,7]

In 2013, it was reported that about 53 million Americans had any disability,[8] while in 2009, it was estimated that about 19.5 million people had disability.[9] In general, we speculate that the proportion of people with any disability increases with the advance of technology. The number of PWD using AT devices was approximately 7.4 million for mobility impairments, 4.5 million for hearing aids and 0.5 million for visual

Address for correspondence: Daudet Ilunga Tshiswaka, Department of Kinesiology and Community Health, University of Illinois at Urbana-Champaign, 906 South Goodwin Avenue, Urbana, IL 61820, USA. Tel: +1 2173332461. ilungat1@illinois.edu

impairments.[10] In recent years, several studies have been published on the value of AT for employment. Studies have found AT to be instrumental in the successful employment for individuals with disabilities.[11,12] Chiu et al. [13,14] used the US Department of Education, Rehabilitation Services Administration's RSA-911 database and found that receiving AT was related to the successful outcome of employment for people with diabetes and multiple sclerosis. Another study found that incorporating the use of AT through worksite modifications can eliminate physical or cognitive barriers and empower those with disabilities to fulfil their job duties.[15] Relatedly, Koester et al. [12] focussing on the effectiveness of AT devices found that adjusting keyboard and mouse settings increased the performance of people with physical impairments in workplaces.

The Individuals with Disability Education Improvement Act of 2004 (IDEA) has stipulated that the Individualized Education Program (IEP) team is required to 'consider whether the child *needs* (emphasis added) assistive technology devices and services (§300.324 Development, review, and revision of IEP)'. IDEA has defined an AT device as 'any item, piece of equipment, or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve the functional capabilities of a child with a disability. The term does not include a medical device that is surgically implanted, or the replacement of such device (§ 300.5)'. A study by Bryant and Seay [16] found that AT has improved the learning experiences of individuals with certain types of learning disabilities in school settings. The same study reported that the reauthorisation of the Tech Act in 1994 resulted in the proliferation of technological discoveries that led to greater usage of AT for educational purposes by students with physical and cognitive disabilities.

In terms of disparities in AT use among persons with disabilities, Loggins et al. [17] found that 12.8% of African Americans (AAs) compared to 9.5% of European Americans (EAs) used AT. Similarly, Cornman and Freedman [18] found that AAs had higher rates of AT use (mobility equipment) than EAs in late life. This contradicts Tomita et al. [19] who found that a lower proportion of AA elders used and owned AT devices (mobility equipment) compared to EA elders. Likewise, Alston et al. [20] reported that 85.3% of EAs compared to 14.7% of AAs used AT. When considering physical impairment, Tomita et al. [19] asserted that predictor variables associated with AT usage (for mobility equipment) varied significantly for AA and EA elders. These findings suggested that there are racial disparities in AT use, although the specific patterns of usage are not definitive.

The purpose of the current study is to examine use of AT by disability type among AAs and EAs. The study utilises the most recent data from the National Health Interview Survey [21] to explore the relationships among users of AT, race, other demographic characteristics (i.e. age, gender and marital status) and type of disability. The guiding research questions are: (1) What are the differences in the use of AT for AAs and EAs? (2) What types of disabilities are associated with AT usage for EAs and AAs? and (3) What role do demographic factors (age, gender and marital status) play in the use of AT by race and disability type? We hypothesised that there would be differences in the use of AT for AAs and EAs and that types of disability would moderate usage among AAs and EAs.

Methods

Study design

We utilised the NHIS dataset of 2009 to assess the use of AT by race and type of disability. As a cross-sectional interview survey, the NHIS is the principal source of information pertaining to health in the USA and is one of the major data collection programmes of the National Center for Health Statistics (NCHS), which is part of the Centers for Disease Control and Prevention.[22] NHIS data consist of a broad range of responses to topical, health-related questions that are collected through personal household interviews by the US Census Bureau. This data collection covers nearly 87 500 individuals from the 50 states and the District of Columbia. The NHIS questionnaire has two components: core and supplementary questions. The core questions are unchanged from year to year, while the supplementary questions are tailored to collect data on new public health issues as they arise. This study used data found under the core questionnaire section.[10]

Selection of participants

Race was formatted in the original NHIS survey with several possible responses: *European American*, *African American*, *Indian American*, *Asian Indian*, *Chinese*, *Filipino* or *Other Asian*. Because of small sample sizes in non-EA and non-AA race groups and since research has revealed significant racial differences in AT use between EAs and AAs,[17] only EAs and AAs were used for this analysis. After excluding other races and missing entries, there were a total of 2022 EAs and AAs that used AT. The sample size of EAs who used AT was 1565 (77.4%) compared to 457 AAs (22.6%) who used AT.

Predictors and outcomes

AT use (outcomes). From the original NHIS survey item, 'Have health problem that requires special equipment', we created the *AT* dichotomous variable (0 = no and 1 = yes). Respondents were considered users of AT if they answered *yes* to the following question in the survey: 'Do you now have any health issue that requires you to use special equipment, such as a cane, a wheelchair, a special bed occasionally or permanently?' All missing or *don't know* data entries were excluded from this study.

Predictors

Gender. This variable was measured as a dichotomous variable in the NHIS 2009 dataset and in our study as *male* or *female*. The original NHIS gender question asked: 'Are you male or female?'

Age. Age was measured as a continuous variable in the NHIS 2009 dataset and in our study. Possible answers were: *age in years*, *refused* or *don't know*. We excluded all missing, *refused* and *don't know* entries from our study.

Marital status. From the original NHIS *marital status* item, which asked 'What is your marital status,' there were several response choices: e.g. *married with spouse in household*, *married with spouse not in household*, *married with spouse in household unknown*, *widowed*, *divorced*, *separated*, *never married*, *living with partner* and *unknown marital status*. In our study, we aggregated the response choices to create a dichotomous variable as 0 = unmarried and 1 = married. Married was operationalised as either married with spouse in household, married with spouse not in household or married with spouse in household unknown. Unmarried was formatted as widowed, divorced, separated, never married, living with partner and unknown marital status.

Physical disability. This variable was originally a nominal variable in the NHIS survey that asked: 'How difficult is it to walk ¼ mile without special equipment.' Responses to this question were: *not at all difficult*, *only a little difficult*, *somewhat difficult*, *very difficult*, *can't do it at all*, *do not do this activity, refused*, *not ascertained*, *don't know*. We recoded this into a dichotomous variable 0 = *no*, *not at all difficult* and 1 = *yes*, *can't do at all* depending on whether an individual reported experiencing difficulty in walking one-quarter of a mile without AT. We only used *can't do it at all (yes)* and *not at all difficult (no)* responses as they were the most clearly defined to assess difficulty levels associated with walking ¼ mile.

Auditory disability. The original NHIS variable was nominal, measuring, 'Now use a hearing aid'. The original answers were formatted as follows: *yes*, *no*, *refused*, *not ascertained* and *don't know*. We excluded *refused, not ascertained* and *don't know* entries, and recoded the remainder as dichotomous (0 = *not using a hearing aid*, 1 = *now using a hearing aid*).

Visual disability. The visual condition variable was originally coded as 'Trouble seeing even with glasses or lenses'. The original answers were formatted as follows: *yes, no*, *refused*, *not ascertained* and *don't know*. We excluded *refused*, *not ascertained* and *don't know* entries and created a dichotomous variable (0 = *no trouble seeing*, 1 = *trouble seeing*).

Emotional disability. The NHIS captured this as a nominal variable, asking if 'Feelings interfered with life, past 30 days'. The answers were as follows: *a lot*, *some*, *a little*, *not at all*, *refused*, *not ascertained* and *don't know*. We excluded *refused*, *not ascertained* and *don't know* entries and recoded as a dichotomous variable (0 = *no*, *not at all* and 1 = *yes*, *a lot*). We only used *not at all* and *a lot* answers, as they were straightforward in determining whether the respondent experienced recent emotional issues or challenges.

Statistical analysis

We used the IBM SPSS 22.0 (Armonk, NY) statistical package to compute the descriptive statistics and then performed chi-square analyses to estimate differences for AT use within and across race for gender, marital status, age and the different disabilities (physical, auditory, visual and emotional impairments). We performed multivariate statistical models to assess confounding and effect modification (statistical interactions) of race and other variables in the analyses. Additional logistic regression analyses were used to estimate the likelihood of using AT for EAs and AAs. We limited the number of predictor variables in the regression model to reduce the risk of their intercorrelation by chance since the total sample size difference between EAs and AAs could affect our logistic regression analysis.[17]

Results

Descriptive statistics

The original NHIS dataset had a total of 25 352 EA and AA respondents who participated in the survey: 82.0% (n = 20 781) EAs and 18.0% (n = 4,571) AAs (Table 1). Most were either unmarried (55.1%) or females (56.0%). Among the various types of disabilities explored (physical, auditory, visual and emotional), the majority of respondents in the general population (n = 25 352) reported having no difficulty walking a quarter mile with AT (79.3%), did not need or use a hearing aid (97.0%)

Table 1. Descriptive statistics of at use and types of disabilities, NHIS 2009.

	General population ($n = 25\,352$)		Use AT ($n = 2022$ or 8.0%)		Whites use AT ($n = 1565$ or 7.5%)		Blacks use AT ($n = 457$ or 10.0%)		
	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent	p Values
Race									
White	20 781	82.00%	1,565	77.40%	1565	100.00%	n/a	n/a	
Black	4571	18.00%	457	22.60%	n/a	n/a	457	100.00%	<0.001
Gender									
Male	11 167	44.00%	827	40.90%	906	57.90%	168	36.80%	
Female	14 185	56.00%	1195	59.10%	659	42.10%	289	63.20%	0.041
Marital status									
Married	11 326	44.70%	712	35.20%	599	38.30%	113	24.70%	
Not married	13 970	55.10%	1308	64.70%	965	61.70%	343	75.10%	<0.001
Mean age ± SD	48.04 ± 7.982		65.47 ± 16.269		66.45 ± 16.437		62.10 ± 15.223		
Physical disability									
Yes	1273	5.00%	866	42.80%	674	43.10%	192	42.00%	0.119
No	20 115	79.30%	286	14.10%	235	15.00%	51	11.20%	
Auditory disability									
Now using a hearing aid	758	3.00%	246	12.20%	227	14.50%	19	4.20%	<0.001
Not using a hearing aid	24 591	97.00%	1776	87.80%	1338	85.50%	438	95.80%	
Visual disability									
Trouble seeing even w/glasses/lenses	2283	9.00%	543	26.90%	407	26.00%	136	29.80%	0.106
No trouble seeing even w/glasses/lenses	23 059	91.00%	1478	73.10%	1158	74.00%	320	70.00%	
Emotional disability									
Feelings interfered with life a lot	1040	4.10%	255	12.60%	188	12.00%	67	14.70%	0.319
Feelings did not interfere with life at all	3157	12.50%	228	11.30%	177	11.30%	51	11.20%	

Notes: AT is defined as 'special equipment' in the dataset. For physical condition, the scale ranked from not at all difficult to can't do at all. The percentages reflect those who said 'not difficult at all or can't do at all'. For feelings interfered with life, the percentages reflect those who said 'a lot or not at all'. Some percentages may not add up to 100% because it does not include other categories included in the original data.

and had no trouble seeing even without glasses or lenses (91.0%). Among EAs and AAs who used AT ($n = 2022$), 77.4% was EAs ($n = 1565$) and 22.6% was AAs ($n = 457$). In our study, the average age for people who used AT was 65.47 years (SD = 16.269). The average age for all survey participants was 48.04 years (SD = 17.982).

Racial differences in the use of AT

In general, the analysis indicated that more EAs (77.4%) used AT than AAs (22.6%). However, when performing within racial group analysis, we found that AAs (10.0%) had a higher percentage of individuals who used AT within group compared to EAs (7.5%) within group. We also found that more females (59.1%) used AT compared to males (40.9%). In terms of race, while more AAs females (63.2%) used AT compared to AA males (36.8%), more EA males (57.9%) used AT compared to EA females (42.1%).

With respect to marriage, more unmarried participants (64.7%) used AT than married ones (35.2%). However, unmarried AAs who used AT accounted for 75.1% compared to married AAs (24.7%) and unmarried EAs who used AT accounted for 61.7% compared to married EAs (38.3%). Other demographic differences revealed that EAs who used AT were slightly older (66.45, SD = 16.437) than AAs who used AT (62.10, SD = 15.223).

For the physical, visual and emotional impairments, race was not a statistically significant factor in terms of AT use. However, for auditory impairment, race was a statistically significant factor ($p < 0.001$) in AT use; fewer AAs (4.2%) reported using hearing aids than EAs (14.5%).

The establishment of additional multivariate statistical models were used to assess and explore confounding and effect modification (statistical interactions). The purpose was to specifically explore if race interacts with other variables in the analyses including both EAs and AAs who use assistive devices. The only statistically significant interaction was race and marital status (Table 2). The OR on the interaction of race and marital status was also negative. The interaction effect indicates that race may be working differently in the use of assistive devices in married persons compared to those who are not married. Given that a racial difference was identified, analyses were desegregated by race.

Predictors of AT usage

Three binary logistic regression models were performed to analyse predictors of AT use for EAs and AAs together, only EAs and only AAs (Table 3). These models included both the demographic data elements (age, gender and marital status) and physical, auditory, visual and emotional impairment types as predictive factors.

The first logistic regression model for both EAs and AAs together yielded a Cox & Snell $R^2 = 0.274$.

The significant independent variables associated with an increased likelihood of using AT among EAs and AAs included: being male (OR = 1.47, CI: 1.00–2.14, $p = 0.048$), older age (OR = 1.03, CI: 1.02–1.04, $p < 0.001$), having a physical impairment (OR = 61.80, CI: 40.50–94.32, $p < 0.001$), having an auditory impairment (OR = 2.44, CI: 1.10–5.40, $p = 0.028$), and having an emotional impairment (OR = 1.72, CI: 1.15–2.58, $p = 0.008$).

The second model for EAs alone yielded a Cox & Snell $R^2 = 0.261$. The predicting variables that were significantly associated with an increased likelihood of using AT included: older age (OR = 1.03, CI: 1.02–1.05, $p < 0.001$), having a physical impairment (OR = 50.77, CI: 31.78–81.12, $p < 0.001$), and being emotional impaired (OR = 1.67, CI: 1.06–2.63, $p = 0.027$). Auditory impairment was the unique marginally significant variable in this model (OR = 2.10, CI: 0.94–4.71, $p = 0.072$) but also had a positive association.

The third model for AAs alone yielded a Cox & Snell $R^2 = 0.334$. The statistically significant independent variables showing a positive association to AT use included: being male (OR = 3.54, CI: 1.10–11.38, $p = 0.034$), and physical impairment (OR = 222.49, CI: 64.04–773.04, $p < 0.001$). The marginally significant variables, which also were positively associated with an increased likelihood of using AT, included: being married (OR = 2.61, CI: 0.93–7.34, $p = 0.069$) and auditory impairment (OR = 10.82, CI: 0.92–127.99, $p = 0.059$).

Table 2. Test for interactions, NHIS 2009.

	Use AT			
	Both ($n = 25\,352$)			
	OR	95% CI		p Values
Whites (ref = Blacks) & Male (ref = female)	0.94	0.75	1.18	0.608
White (ref = Blacks) & Married (ref = not married)	0.72	0.56	0.92	0.009
White (ref = Blacks) & age	1.01	0.18	1.00	1.012
Disabilities				
White (ref = Blacks) & Physical (ref = no)	0.81	0.53	1.24	0.323
White (ref = Blacks) & Auditory (ref = no)	1.28	0.71	2.32	0.412
White (ref = Blacks) & Visual (ref = no)	1.06	0.82	1.37	0.668
White (ref = Blacks) & Emotional (ref = no)	1.07	0.67	1.69	0.790

Discussion

Our results indicate the use of AT differs between AAs and EAs. In general, among individuals with disabilities, more EAs used AT in comparison to AAs who used AT. This suggests perhaps a greater awareness of AT options among EAs in the general population of PWD or a greater willingness to use AT. However, in terms of within racial group proportions among individuals who use AT, more AAs use AT than EAs, indicating that maybe once awareness across groups is at consistent levels, AAs use AT slightly more. This aligns with the finding that AAs are more likely to have a disability compared to EAs [17] or may have severe disabilities (e.g. physical disabilities), and therefore use AT more. This does not, however, concur with Tomita et al.,[19] who found that AAs used AT less than EAs. So, our study adds to the landscape of mixed findings about AT use and race. It is important to note that Tomita et al. conducted their study 20 years ago. The findings in the current study may more accurately reflect contemporary usage patterns by EAs and AAs.

According to a large scale study by Community Research for Assistive Technology in 2005, the researchers mailed out 14 000 surveys randomly to participants in 20 independent living centres and found a lower usage rate among AAs (57%) in comparison to the rate among EAs (71%).[23] Furthermore, the researchers looked into the AT usage rate by the following technology categories: (1) high-tech (e.g. computers, software, communication and talking devices), (2) medium-tech (e.g. scooters/electric wheelchairs, flashing devices and books on tape) and (3) low-tech (e.g. manual wheelchair, magnifiers, cans/walkers); they found a 10% higher usage of high-tech among EAs than AAs, 9% higher usage of medium-tech among EAs than AAs and 13% higher usage of low-tech among EAs than AAs.[23] Similar to the current study, the investigation by Reed et al. revealed disparities in AT usage popularity and technology levels between EAs and AAs. In addition, it is notable that the participants in the study by Reed et al. lived in the independent living centres where there were more

Table 3. Predictors of at use by race, NHIS 2009.

	Both ($n = 25\,352$)				White				Black			
	OR	95% CI		p Values	OR	95% CI		p Values	OR	95% CI		p Values
Whites (ref = Blacks)	0.66	0.43	1.03	0.070								
Males (ref = female)	1.47	1.00	2.14	0.048	1.28	0.85	1.93	0.243	3.54	1.10	11.38	0.034
Married (ref = not married)	1.07	0.73	1.55	0.738	0.90	0.60	1.35	0.617	2.61	0.93	7.34	0.069
Age	1.03	1.02	1.04	<0.001	1.03	1.02	1.05	<0.001	1.02	0.99	1.05	0.158
Disabilities												
Physical (ref = no)	61.80	40.50	94.32	<0.001	50.77	31.78	81.12	<0.001	222.49	64.04	773.04	<0.001
Auditory (ref = no)	2.44	1.10	5.40	0.028	2.10	0.94	4.71	0.072	10.82	0.92	127.99	0.059
Visual (ref = no)	1.07	0.69	1.67	0.755	1.29	0.79	2.10	0.316	0.63	0.21	1.85	0.396
Emotional (ref = no)	1.72	1.15	2.58	0.008	1.67	1.06	2.63	0.027	1.91	0.75	4.87	0.176

opportunities to know healthcare resources, like AT, from health professionals and environments. However, obvious AT usage disparities remained. Such multi-dimensional disparities may be due to health literacy factors (e.g. knowledge of general AT and awareness of AT services), negative cultural values and attitudes toward AT among potential users and accessibility barriers such as socioeconomic status (e.g. health insurance coverage and income).

Consistent with several studies, including the results of Loggins et al.,[17] when we considered both EAs and AAs together, we found females used AT more than males.[24–26] Potentially accounting for this is that men may have a greater sense of machismo or bravado than women. However, in examining race, we found more AAs females (63.2%) used AT compared to AA males (36.8%). There may be factors such as educational level, marital status and healthcare accessibility accounting for that within group disparity.[27] Our study indicated more EA males (57.9%) used AT compared to EA females (42.1%). We speculate that EA males had higher rates of AT use primarily due to their increased exposure to work-related injuries compared to female EAs.[28] Moreover, we found a higher percentage of AA females used AT compared to their EA female counterparts. Perhaps, it could be explained by Martin et al. [29] study that showed more AA females had disability than EA females. Therefore, as found by Carrasquillo et al.,[27] AA females are more likely to use AT compared to EA females. We also found a lower percentage of AA males used AT compared to their EA counterparts. Maybe EA men are less concerned with the stigma attached to using AT.

Additionally, we found that AA males used AT less than any other groups (i.e. AA females, EA males and EA females). This lower proportion of AT use by AA males could be explained by factors such as lower income and/or lower educational attainment as noted by Alston et al. [20] It could also be explained because AA males tend to be more marginalised; and therefore, less integrated into the mainstream of the disability world where AT use is normalised.

For marital status, fewer married respondents used AT than unmarried respondents. The results were related to our findings from the statistical interactions. The coefficient on the marital interaction with race was negative and statistically significant indicating that race has a negative relationship to AT use in married persons compared to unmarried individuals. Whereas results from the interactions suggest married persons use AT less than unmarried persons, the statistical significance also suggests that this can differ by race. Results from the disaggregated logistic regressions yielded statistically significant ORs for married AAs; however, no statistical significance was observed for married EAs. AAs who are married were 2.6 times more likely to use AT compared to AAs who were unmarried. Perhaps, a spouse may function in a role otherwise met by an AT device. Further analyses indicated that for specific disability conditions, only auditory impairment was statistically different among AAs and EAs, with 4.2% and 14.5% using a hearing aid, respectively. Kaye et al. [25] also found that AAs were less likely to use hearing aids compared to their EA counterparts and that AAs in general had lower levels of high-tech AT usage in comparison to EAs.[25] We assume that these differences may be due to different poverty levels between EAs versus AAs. Hearing aids and other high tech AT devices can be expensive. Thus, disproportionately fewer AAs may have access to these pricey options.

In this study, predictive factors associated with AT usage were explored among AAs and EAs. In general, AAs had fewer disability types predicting the use of AT, while EAs had more. Both groups had one demographic factor beyond race to predict AT use. Considering both EAs and AAs together based on an estimated probability of AT use, males were 47% more likely to use AT than females. Males are perhaps more distressed about the loss of functioning due to a disability than females. Results in the current study are incongruent with previous findings that females are more likely to use AT than males.[17,25] When disaggregated by race, being male was not associated with using AT for EAs; however, for AAs, males were more than three times more likely to use AT than AA females. This can partially be explained by a high proportion of unmarried AA males in this study. Considering that AA males are more likely to have a severe disability than any other demographic group, including AA females, their functional need for AT would be greater. Their unmarried status would likely compound the need for AT because of lack of spousal support with activities of daily living.

In this study, being EA decreases the likelihood of AT usage compared to being AA, but only by a marginally significant amount. Keep in mind, this is based on proportions of use within homogeneous race groupings only. Perhaps, the type of disability and less than optimal healthcare access among AAs explains that disparity. As reported by Alston et al. [20] being a Medicaid recipient or a veteran benefits recipient and having a mental impairment decreased the likelihood of using AT among EAs. Further, we maintain that this might be linked to our findings reporting that a lower rate of unmarried EAs used AT than unmarried AAs.

With increased age, participants were more likely to use any type of AT. This is an interaction between

functional impairment due to disability and impairment due to natural aging. This aligns with research arguing that age plays a crucial role when it comes to certain types of disabilities thereby increasing the probability of AT use.[30] However, after exploring racial differences, age was positively associated with an increased likelihood of AT use for EAs. In addition, we found that the mean age of EAs using AT was slightly higher than AAs. Perhaps aging contributes less to degree of impairment in AAs with disabilities than EAs. The difference falls on opposite sides of the standard retirement age of 65 with the mean age of AT use for EAs being above 65 and the mean age of AT use for AAs being slightly less than 65 years of age. This difference may be related to eligibility for Medicare for AAs and may partially explain why age was a significant predictor of AT use for EAs compared to AAs. In other words, the fact that fewer AAs are eligible for Medicare at 65, which could help pay for AT, could mean less use of devices in this group compared to EAs.

EAs and AAs with a physical impairment had an increased likelihood of using AT. The fact that physical disability decreases functioning is undeniable. Persons with physical impairments were 61.80 times more likely to use AT compared to those without a physical impairment. Our finding aligns partially with Alston et al. [20] that reported physical impairment predicts AT usage for AAs only. Here, we surmise that the severity of physical impairment along with type and affordability of AT devices used might explain the difference between AAs and EAs. When considering race, we found that physical impairment predicted AT usage for both EAs and AAs, and a huge disparity in terms of odds-ratio was observed between EAs and AAs (physical disability had four times the predictive value of AT use in AAs). The collinearity or high correlation existing between physical condition and AT use may explain the high odds-ratio.[31]

Although there was an increase likelihood of AT use for auditory and emotional impairments in EAs and AAs, the magnitude was not as strong as physical impairments. We also found that individuals with emotional impairment were more likely to use AT compared to individuals without emotional impairment. This aligns with a study by Czajka and DeNisi [32] that found people with emotional disabilities experience challenges in interacting with others, performing well in schools, and finding relevant jobs. The authors concluded in light of this that there is a need for AT devices to improve social interactions along with school and job performance among individuals with emotional disabilities. One example of AT for persons with emotional disability is the MotivAider. It is a classroom timer that buzzes after a certain period of time to help children stay focus. Another AT device for students with emotional disabilities is the Talk Light, which helps students settle down by flashing a light according to noise in the room. However, after we examined racial differences, an association of emotional impairment and AT use was only found in EAs and not AAs. EAs in this study were older than AAs on average; and thus, they would be more prone to develop some mental diseases such as Alzheimer's or dementia than their AA counterparts.[33]

Disparities in AT usage frequency, popularity, accessibility, and technology levels could be possibly due to multi-layers reasons, although the most considered reason is the prevalence rate of disability. The highest disability rate is among AAs (22.2%), more than the 18% of all US non-institutionalised citizens.[34] The disability rate of AA males is 13.4%, while the disability rate of EA males is 12.4%.[35] The disability rate of AA females is 14.4%, while the disability rate of EA females is 12.6%.[35] Needless to say, healthcare services are needed to resolve AT usage disparities in AAs. More importantly, improvements in rehabilitation service provision, including AT services, for AAs with disabilities is compelling. Removing environmental barriers through universal design along with using AT are part of suggested ways to promote independent living and have been encouraged by policies such as the ADA, AT Act and former President Bush's 'New Freedom Initiatives'.[36] These acts highlight the advantages of AT usage and emphasise efficient delivery services in areas such as rehabilitation counselling. For example, a rehabilitation counsellor has the service capabilities and authority to assist clients with getting customised AT devices.

To address ethnic differences in AT usage, expanding cultural competency training to rehabilitation Counsellors could be implemented. As suggested by Guzman and Ostrander,[37] the attitudes and values of minority communities should be a part of evaluating AT needs among underrepresented groups such as AAs and Hispanics. More insights about the perspectives of minorities would help the rehabilitation service system design effective outreach strategies and health marketing approaches that are culturally tailored to populations such as AAs and Latinos.[38,39]

Conclusions

The overall finding of this investigation indicates that the use of AT is different for AAs and EAs. The current study revealed more AAs used AT compared to EAs. This finding does not align with results from several other studies stating that fewer AAs use AT than EAs.[19,25] Therefore, the current findings raise questions related to the distribution of AT usage in terms of race and suggest

avenues for future exploration. For example, Czajka and DeNisi [32] found that people with emotional disabilities experience challenges in interacting with others and need AT. We found that emotional impairment was a likely predictor of AT use among EAs. In light of this result should one conclude (1) that AAs have fewer emotional impairment conditions, (2) that AAs with emotional conditions may have less access than their EA counterparts to AT for these impairments or (3) that AAs less frequently recognise AT as an instrument to reduce the impact of emotional impairments? Further research could clarify these questions.

The significance of the current findings is twofold. First, they require us to nuance our understanding of the distribution of AT usage when considering race and type of disability as distinguishing factors. There is not a definitive pattern that emerges at this point. Second, these findings highlight the predicting factors that play a major role in the likelihood of using AT among specific groups of people. Since physical impairment was a predictor of AT use among AAs and EAs, in this study, it suggests directions we might pursue when developing future studies to further explore AT use. Subsequently, once future studies begin to reveal more consistent findings regarding race, type of disability and AT use, more effective policies and interventions can be developed.

The 2009 NHIS dataset does not contain potential moderating variables such as income, educational level and health insurance status. We acknowledge that these variables could influence access and use of AT devices. In addition, we did not look at severity of disability. For example, with auditory disability, we did not consider that one reason for the different patterns in AT (i.e. hearing aid) use might be a difference in severity of hearing impairment. It could be that less severity accounts for less AT use, and not a decision related to whether to use AT or not. Future investigations should include the examination of demographic variables such as income and educational level and construct factors such as severity of disability.

Declaration of interest

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of this article.

References

1. Hersh MA, Johnson MA. On modelling assistive technology systems – part I: modelling framework. Technol Disabil. 2008;20:193–215.
2. ATAP. Association of Assistive Technology Act Programs. Springfield (IL): Governmental Relations Partners; 2015. Available from: http://www.ataporg.org/contact.html [last accessed 19 Mar 2015].
3. Agree EM, Freedman VA. A comparison of assistive technology and personal care in alleviating disability and unmet need. The Gerontologist. 2003;43:335–344.
4. Agree EM. The potential for technology to enhance independence for those aging with a disability. Disabil Health J. 2014;7:S33–S39.
5. Scherer MJ. Outcomes of assistive technology use on quality of life. Disabil Rehabil. 1996;18:439–448.
6. World Health Organization. International classification of functioning, disability and health. Geneva: World Health Organization; 2011.
7. Campbell PH, Milbourne S, Dugan LM, et al. A review of evidence on practices for teaching young children to use assistive technology devices. Top Early Childhood Spec Educ. 2006;26:3–13.
8. Courtney-Long EA, Carroll DD, Zhang QC, et al. Prevalence of disability and disability type among adults – United States, 2013. Morbidity and Mortality Weekly Report (MMWR). Washington, DC: Morbidity and Mortality Weekly Report (MMWR); 2013. Available from: http://www.cdc.gov/mmwr/preview/mmwrhtml/mm6429a2.htm [last accessed 19 Mar 2015].
9. Brault MW. Disability among the working age population: 2008 and 2009. Washington, DC: US Census Bureau, American Community Survey; 2010. Available from: https://www.census.gov/prod/2010pubs/acsbr09-12.pdf [last accessed 19 Mar 2015].
10. National Center for Health Statistics. Trends and differential use of assistive technology devices: United States, 1994. Atlanta (GA): US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics; 1997.
11. Hedrick B, Pape T, Heinemann AW, et al. Employment issues and assistive technology use for persons with spinal cord injury. J Rehabil Res Dev. 2006;43:185
12. Koester H, Simpson R, Mankowski J. Software wizards to adjust keyboard and mouse settings for people with physical impairments. J Spinal Cord Med. 2013;36:300–312.
13. Chiu C-Y, Tansey TN, Chan F, et al. Effect of rehabilitation technology services on vocational rehabilitation outcomes of individuals with multiple sclerosis. Rehabil Res Policy Educ. 2015;29:183–192.
14. Chiu C-Y, Sharpb S, Pfallerb J, et al. Differential vocational rehabilitation service patterns related to the job retention and job placement needs of people with diabetes. J Vocat Rehab. 2015;42:177–185.
15. Cook AM, Polgar JM. Cook and Hussey's assistive technologies: principles and practice. St Louis (MO): Elsevier Health Sciences; 2013.
16. Bryant BR, Seay PC. The technology-related assistance to individuals with disabilities act: relevance to individuals with learning disabilities and their advocates. J Learn Disabil. 1998;31:4–15.
17. Loggins S, Alston R, Lewis A. Utilization of assistive technology by persons with physical disabilities: an examination of predictive factors by race. Disabil Rehabil Assist Technol. 2013;9:487–492.
18. Cornman JC, Freedman VA. Racial and ethnic disparities in mobility device use in late life. J Gerontol B Psychol Sci Soc Sci. 2008;63:S34–S41.
19. Tomita MR, Mann WC, Fraas LF, et al. Racial differences of frail elders in assistive technology. Assist Technol. 1997;9:140–151.

20. Alston R, Lewis A, Loggins S. Assistive technology and veterans with severe disabilities: examining the relationships among race, personal factors, medical support, income support, and use. Med Care. 2014;52:S17–S24.
21. National Health Interview Survey [Internet]. CDC. 2009; [cited 2015 Mar 19] Available from: http://www.cdc.gov/nchs/nhis/nhis_2009_data_release.htm.
22. CDC. National Health Insurance Survey. Atlanta (GA): CDC; 2012. Available from: http://www.cdc.gov/nchs/nhis/about_nhis.htm [last accessed 14 Jul 2014].
23. Reed M, Kaye S, Yeager P. Assistive technoligy and racial/ethnic minorities [Internet]. 2005. Available from: https://abilitytools.org/about/docs/AT%20Race%20Data%20FINAL.pdf [cited 2015 Mar 19].
24. Karmarkar AM, Dicianno BE, Cooper R, et al. Demographic profile of older adults using wheeled mobility devices. J Aging Res. 2011;2011:560358.
25. Kaye HS, Yeager P, Reed M. Disparities in usage of assistive technology among people with disabilities. Assist Technol. 2008;20:194–203.
26. Simsek TT, Yümin ET, Sertel M, et al. Assistive device usage in elderly people and evaluation of mobility level. Top Geriatr Rehabil. 2012;28:190–194.
27. Carrasquillo O, Lantigua RA, Shea S. Differences in functional status of Hispanic versus non-Hispanic White elders: data from the Medical Expenditure Panel Survey. J Aging Health. 2000;12:342–361.
28. Kachan D, Fleming LE, LeBlanc WG, et al. Worker populations at risk for work-related injuries across the life course. Am J Indus Med. 2012;55:361–366.
29. Martin LG, Schoeni RF, Freedman VA, et al. Feeling better? Trends in general health status. J Gerontol B Psychol Sci Soc Sci. 2007;62:S11–S21.
30. Muurinen SM, Soini HH, Suominen MH, et al. Vision impairment and nutritional status among older assisted living residents. Arch Gerontol Geriatr. 2014;58:384–387.
31. Lyman O, Longnecker M. An introduction to statistical methods and data analysis. Boston (MA): PWS-Kent; 1988.
32. Czajka JM, DeNisi AS. Effects of emotional disability and clear performance standards on performance ratings. Acad Manage J. 1988;31:394–404.
33. Krishnan K, Hays JC, Blazer DG. MRI-defined vascular depression. Am J Psychiatry. 1997;154:497–501.
34. Brault MW. Americans with disabilities: 2010. Current Population Reports. U.S. Census Bureau. 2012:70–131 [cited 2015 Mar 19]. Available from: http://www.census.gov/prod/2012pubs/p70-131.pdf.
35. Erickson W, Lee C, Von Schrader S. Disability Statistics from the 2012 American Community Survey (ACS). Ithaca, NY: Cornell University Employment and Disability Institute (EDI). 2014 [cited 2015 Mar 19]. Available from: www.disabilitystatistics.org.
36. Freedman VA, Martin LG, Cornman J, et al. Trends in assistance with daily activities: racial/ethnic and social economic disparities persist in the U.S. older population. 2005 [cited 2015 Mar 19]. Available from: http://www.psc.isr.umich.edu/pubs/pdf/tr05-2.pdf.
37. Guzman A, Ostrander N. Hispanic's awareness of assistive technology. Assist Technol. 2009;21:28–34.
38. Balcazar EF, Suarez-Balcazar Y, Taylor-Ritzler T. Cultural competence: development of a conceptual framework. Disabil Rehabil. 2009;31:1153–1160.
39. Middleton RA, Rollins CW, Sanderson PL, et al. Endorsement of professional multicultural rehabilitation competencies and standards: a call to action. Rehabil Counsel Bullet. 2000;3:219–240.