

Disability Levels and Cognitive Functioning Reported by Patients Impaired by Gentamicin and Other Aminoglycosides

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Ann M. Kerlin¹

Abstract

The purpose of this study was to explore disability levels and cognitive functioning in patients who reported being damaged by aminoglycosides, a class of antibiotic drugs. An online questionnaire was published using the World Health Organization Disability Assessment Schedule 2.0 (WHODAS 2.0) and the NeuroQol Cognitive Functioning v.2. Gentamicin was the most frequent cause of impairment in patients, and the overall disability level was moderate (46.05%). Severe impairments were reported in mobility (Getting Around: 53.67%), Life Activities (60.20%), and Participation in Society (55.19%), and the NeuroQol Cognitive Function measure was approximately 1 standard deviation below normal. Participants who reported impairment from gentamicin and other aminoglycosides indicate a diminished quality of life, along with accompanying depression and anxiety.

Keywords

aminoglycosides, disability, cognitive impairment, WHODAS 2.0, gentamicin

Aminoglycosides are a class of antibiotics that are particularly potent against Gram-negative bacteria, but are known to have toxic effects on some patients. This class of antibiotics includes gentamicin, tobramycin, neomycin, streptomycin, amikacin, kanamycin, netilmicin, and paromomycin. Aminoglycosides are effective against aerobic Gram-negative bacilli, staphylococci, and *Mycobacterium tuberculosis*, and because of the potential side effects are usually reserved for these specific types of infections. Unfortunately, recognizing the signs of an adverse reaction in a patient can be difficult, and delayed recognition of vestibular problems is common (Gurvich, Malleria, Lithgowa, Haghgoie, & Kulkarnia, 2013).

It is well known that aminoglycosides have the potential to cause vestibular damage, which causes imbalance, usually exhibited by ataxia, and visual problems including oscillopsia (Ahmed, Hannigan, MacDougall, Chan, & Halmagyi, 2012; Black, Pesznecker, & Stallings, 2004), nystagmus, cochlear damage, which may include hearing loss and/or tinnitus (Begg & Barclay, 1995; Black et al., 2004; Suhr, 2003), nephrotoxicity (Begg & Barclay, 1995) (which is usually reversible; Mingeot-Lecercq & Tulkens, 1999), neurotoxicity (Watanabe, Hodges, Dworzack, Kepes, & Duensing, 1978), and encephalopathy (Bischoff, Meier, & Roth, 1977; Grill & Maganti, 2011; Sarva & Panichpisal, 2012; Wadlington, Hatcher, & Turner, 1977).

When reviewing the literature, the term ototoxicity is often used to refer to both vestibular damage and/or cochlear damage. At present, not all risk factors have been established that indicate why one patient may be more susceptible to adverse reactions than another (Selimoglu, 2007) and no dosing regimens are completely protective against adverse effects (Ahmed et al., 2012; Black et al., 2004). However, some risk factors have been identified that may potentiate adverse reactions from aminoglycosides including dosage and length of treatment, advanced age, impaired kidney function, preexisting hearing or balance disorders (Forge & Schacht, 2000) and/or exposure to loud noise (Li & Steyger, 2009), genetic susceptibilities (Guan, 2005; Jing et al., 2015), and overall stress and disease, meaning those with systemic infections may be more susceptible (Forge & Schacht, 2000; Koo et al., 2015). Treatment protocols that combine several ototoxic medications, such as an aminoglycoside along with furosemide, may also put patients at higher risk (Bisht & Bist, 2011; Ding & Salvi, 2005; Hamad, Cavell, Hinton, Wade, & Whittlesea, 2015).

¹Luther Rice College & Seminary, Lithonia, GA, USA

Corresponding Author:

Ann M. Kerlin, Luther Rice College & Seminary, Department of Counseling, 3038 Evans Mill Rd., Lithonia, GA 30038, USA.
Email: Ann.Kerlin@LutherRice.edu



The mechanism(s) by which such damage occur at the cellular level are the subject of ongoing studies, as are potential protective measures against adverse effects during the administration of this class of antibiotics (Huth, Ricci, & Cheng, 2011; Selimoglu, 2007; Warchol, 2010). In addition, there are data showing that impairment can continue to progress, even after the administration of the aminoglycosides end (Rogers & Peterson, 2011). Gentamicin has been detected in the cochlea of animal subjects 11 months after administration ceased (Aran, Erre, Da Costa, Debbbarh, & Dulon, 1999).

Patients with impairment from aminoglycosides often are not always diagnosed in a timely manner (Ahmed et al., 2012; Black et al., 2004) and do not understand why they have disturbing symptoms, which may negatively impact their quality of life. The only study that examined quality of life was a project by Guinand, Boselie, Guyot, and Kingma (2012) who examined 39 patients with bilateral vestibulopathy using the Short-Form Health Survey (SF-36), which assesses patients on eight domains. They found statistically significant decreases in physical functioning, role physical (limitations), general health, vitality, social functioning, and mental health when compared with similar scores of the general Dutch population. However, only seven of the 39 patients had vestibulopathy due to ototoxicity.

Cognitive symptoms are a frequent complaint of those suffering with vestibular disorders (Hanes & McCollum, 2006) but there has not been much published specifically about patients who may be suffering from adverse effects of aminoglycosides. Bigelow, Semenov, du Lac, Hoffman, and Agrawal (2016) used data from the National Health Interview Study (NHIS) to assess levels of cognitive complaints in patients who reported vestibular symptoms from any cause. However, only two questions were used to assess cognitive complaints, which were "Are you limited in any way because of difficulty remembering or because you experience periods of confusion?" and "Because of a physical, mental, or emotional condition, do you have serious difficulty concentrating, remembering, or making decisions?" Results indicated that 12.2% and 24.8% (respectively) of participants answered affirmatively, which was substantially greater than those without vestibular complaints (3.1% and 4.9%, respectively). Respondents with vestibular complaints also indicated much higher incidences of depression, anxiety, and panic disorders compared with respondents who did not report vestibular symptoms.

In another study of 76 elderly patients with vestibular disorders from a variety of causes, Caixeta and colleagues used the Mini Mental Status Exam, the Clock Test, and the Verbal Fluency Test to assess cognition. In 35 of 76 patients, they found evidence indicating cognitive decline. Depression and anxiety are well known to accompany vestibular disorders, and may be related to deficits in cognition (Caixeta, Dona, & Gazzola, 2012).

Those with bilateral as opposed to unilateral vestibulopathy seem to have more difficulty with spatial tasks, and there is some evidence that dyscalcula may be another result

(Smith, Zheng, & Darlington, 2005). In their review of the literature on cognitive symptoms and vestibular disorders, Hanes and McCollum (2006) suggest more research needs to be done exploring not only functional assessments of cognitive skills in vestibular patients, but how the vestibular system itself may be involved in cognitive tasks. Smith et al. (2005) also examined the literature on the connection between vestibular disorders and cognitive functioning, finding a growing body of evidence that suggests cognitive complaints may not simply be related to an episode of dizziness, but that atrophy of the hippocampus may be involved. They also noted that rates of depression and anxiety are common in vestibular patients, which may affect cognition.

No studies were found that assessed disability levels in vestibular patients with adverse effects specifically from aminoglycosides. This study accessed a geographically diverse group of patients reporting adverse effects from aminoglycosides to explore quality of life and cognitive abilities, using the World Health Organization's International Classification of Disability, Health and Functioning Disability Assessment Scale (WHODAS 2.0; 2016), to include not only specific symptoms, but to explore how a medical issue impacts daily functioning and social interaction in their biopsychosocial model. Because many patients with vestibular dysfunctions complain of cognitive difficulties, a measure exploring cognitive functioning was also used to further build upon the findings from Bigelow et al. (2016) and add to the WHODAS 2.0's section on cognitive functioning. The NeuroQoL measure of cognitive functioning has been validated in a study of adult epilepsy patients (Victorson et al., 2014) and used with patients who have Parkinsons' disease, Amyotrophic Sclerosis Syndrome, strokes, multiple sclerosis, traumatic brain injuries, and spinal cord injury patients (Cella & The PROMIS Health Organization on behalf of the National Institute for Neurological Disorders and Stroke [NINDS], 2015). Several nonstandard questionnaires were also used.

This is a cross-sectional, retrospective, exploratory study based on patient reports of adverse effects from aminoglycosides in a survey format; no medical evaluation substantiated their physical limitations or medical history. By exploring self-reported disability levels, and symptoms of cognitive functioning, this study hopes to add to the literature on the topic of quality of life for patients adversely affected by aminoglycosides in general, and cognitive symptoms specifically, and to help patients and their medical providers understand the impact of adverse effects from aminoglycosides may have on activities of daily living (ADL).

Method

The Institutional Review Board of Luther Rice College & Seminary approved this study, and it was published as an online survey, hosted by the college's website, with appropriate consent forms describing its scope and purpose. The survey contained a demographic form, to capture year of birth,

gender, and nationality, along with the date of the suspected damaging dose of the aminoglycoside. Participants who reported adverse effects from aminoglycosides were asked to identify which drug was administered, and to report any other medications administered at the same time, along with the route of administration. Participants were asked to complete several other nonstandard questionnaires and open-ended questions, along with the WHODAS 2.0 and the NeuroQol Item Bank v2.0-Cognitive Function–Short Form. The study questionnaire was promoted by an article in VEDA (www.vestibular.org), and on VEDA's Facebook page in January 2015, and offered to a social media support group whose members include people impaired by aminoglycosides, known as “The Wobblers.” All statistical calculations were created using IBM's SPSS Statistics Version 22.

Instruments

This study used the 36-item version of the self-administered questionnaire (which includes three extra questions about the number of days per month that are impacted) known as the WHODAS 2.0, as mentioned above (World Health Organization [WHO], 2013). The WHODAS 2.0 assesses patients across six domains: cognition, mobility, self-care, getting along, life activities, and participation. Cronbach's alphas of .94 to .98 were found as an overall score ($n = 1,565$), and test–retest reliability was established at the item level between .69 and .89; at the domain level, .93 to .96, and overall at .98 (Üstün, Kostanjsek, Chatterji, & Rehm, 2010). Written permission was obtained from WHO to use the assessment in this study.

The Neuro-QOL Item Bank v2.0-Cognitive Function–Short Form was used to assess cognitive functioning (Cella & The PROMIS Health Organization on behalf of the National Institute for NINDS, 2008). The Neuro-QOL assesses applied cognition in general concerns and executive functioning. Six validation studies were conducted, finding Cronbach's alphas of .68 to .94, and test–retest reliability was established between .56 and .85 (Cella, 2015).

Results

The survey was accessed 222 times, with 118 unique participants completing all the questions. The data were double-checked for any duplicate submissions. The date of impairment attributed to aminoglycoside adverse reactions spanned from 1972 to 2016 ($n = 117$); one participant did not provide a date. The vast majority were dated 2000 or later ($n = 104$; 88.1%), with the mean age of 52.06 years at the time of impairment ($SE = 16.62$, $n = 112$). Most participants were female ($f = 83$; $m = 35$), and ages ranged from 22 to 89 years, with a mean age of 60.0 ($SD = 14.8$; five participants did not provide a date of birth) at the time of the survey. This online survey was accessed by participants from the United States ($n = 77$), the United Kingdom ($n = 18$), Australia ($n = 12$), Canada ($n = 3$), New

Zealand ($n = 2$), and France ($n = 2$), with unique participants from South Africa ($n = 1$), Italy ($n = 1$), Qatar ($n = 1$), and Ireland ($n = 1$).

Most respondents identified gentamicin first as the aminoglycoside attributed to impairment ($n = 106$, 89.8%), followed by tobramycin ($n = 9$), amikacin ($n = 2$), or streptomycin ($n = 1$). This study asked participants to identify all medications administered at the same time as the aminoglycoside, which could have been potentiating risk factors leading to adverse effects. Vancomycin ($n = 11$) and Lasix ($n = 4$) were the most frequently identified other medications given in combination with gentamicin; drug combinations are displayed in Table 1. The aminoglycosides were mostly administered intravenously ($n = 98$, 84.3%), via ear drops ($n = 8$, 6.5%), orally ($n = 5$, 3.7%), topically ($n = 1$, 0.9%), intrathecally ($n = 1$), through dialysis ($n = 1$), via injection into the ear ($n = 1$), through inhalation ($n = 1$), and two participants did not specify the administration route ($n = 2$). Of the eight participants who indicated ear drops were the route of administration, five reported having Meniere's Disease, two reported chronic otitis media, and one reported receiving Tobramycin ear drops while having chronic sinusitis, bronchiectasis, asthma, and allergies. Ototoxic medications applied topically in the ear have been shown to penetrate the round window membrane (Pappas, Nikolopoulos, Korres, Papacharalampous, & Ferekidis, 2006). These findings are displayed in Table 2.

Participants were asked to rate their physical and mental health for the past 30 days based on the following ranking:

1. Very bad
2. Bad
3. Moderate
4. Good
5. Very good

Participants were also asked to evaluate their symptoms, by rating according to the following:

1. I feel the symptoms have improved over time
2. I feel the symptoms do not bother me as much because I have learned to adapt
3. I believe the symptoms are the same
4. I believe the symptoms are worsening over time
5. I am developing more health concerns that I believe are related to the medication toxicity.

Results were as follows: improved ($n = 5$), adapted ($n = 31$), same ($n = 36$), worse ($n = 14$), and more health problems were developing ($n = 32$). Results are displayed in Table 3.

Participants completed the self-administered WHODAS 2.0, which asks respondents to rate themselves on a variety of tasks as follows:

0. No difficulty
1. Mild difficulty

Table 1. Reported Medication Combinations With Aminoglycosides.

Gentamicin	Amikacin			Vancomycin			
Gentamicin	Amikacin	Streptomycin		Vancomycin		Clindamycin	
Gentamicin		Streptomycin		Vancomycin			
Gentamicin x4				Vancomycin			
Gentamicin				Vancomycin		Clindamycin	Other
Gentamicin				Vancomycin	Lasix		
Gentamicin			Tobramycin	Vancomycin			
Gentamicin				Vancomycin			Other
			Tobramycin				Other
			Tobramycin				
Gentamicin x2							
Gentamicin x2		Streptomycin					
Gentamicin x4					Lasix		
Gentamicin x6							Other
Total	2	4	4	11	5	2	9

Note. The category “other” refers to medications that are not aminoglycosides and were only mentioned once.

Table 2. Administration Routes.

	Gentamicin	Amikacin	Streptomycin	Tobramycin	Total
Ear drops	6	0	0	2	8
Topically	1	0	0	0	1
Orally	4	0	1	0	5
IV	91	2	0	5	98
Intrathecaly	1	0	0	0	1
Inhaled	0	0	0	1	1
Dialysis	1	0	0	0	1
Injection into ear	1	0	0	0	1
Not specified	1	0	0	1	2
Total	106	2	1	9	118

Table 3. Self-Rated Physical Health, Mental Health, and Symptom Change.

	Physical health rating <i>M</i> = 2.92	Mental health rating <i>M</i> = 3.12	Symptoms <i>M</i> = 3.31	
Very bad	10	6	Improved	5
Bad	26	22	I've adapted	31
Moderate	53	54	Stayed same	36
Good	22	24	Worsened	14
Very Good	7	12	More health problems	32

Note. Results based on a nonstandard questionnaire (*N* = 118).

2. Moderate difficulty
3. Severe difficulty
4. Extreme difficulty or cannot do.

Participants responded to the 36-item version, which was scored using item response theory per WHO scoring templates (Üstün et al., 2010) and results are displayed in Table 4. There were 15 missing responses out of 4,298 possible answers, which was less than 1%; these missing responses were left blank in the calculations and are identified within Table 3.

Four questions pertain to people engaged in work and/or school activities. Of 118 participants, only 42 indicated they were working or going to school, and they answered questions D5.5-D5.8. Overall, results in Understanding and Communicating were assessed at an average level of 40.40% disability, Getting Around at 53.67% disability, Self-Care at 26.88%, Getting Along with People at 36.71%, Life Activities at 60.20% for everyone (*N* = 118) on Questions D5.1-4, and Questions D5.5-8 for those who work (*n* = 42) at 49.22%, and Participation in Society at 55.26%. The overall disability score

was determined averaging seven categories, because Life Activities was divided into two separate categories. According to the International Classification of Functioning, Disease, and Health (ICF) guidelines on disability, the overall disability rating of 46.05%, indicate moderate levels of disability overall, but severe levels of disability in some areas of functioning.

ICF Performance and Capacity Qualifiers are:

None or Negligible: 0% to 4%

Mild Difficulty: 5% to 24%.

Moderate Difficulty: 25% to 49%.

Severe Difficulty: 50% to 95%

Complete Difficulty, Total: 96% to 100% (WHO, 2013, p. 26)

Based on the past 30 days, participants reported difficulties were present 23.4 days, and on 12.7 of those days, they were totally unable to carry out their usual activities due to health conditions, and they reported that they cut back on their usual activities on 17.6 days besides the days they were totally unable to perform normal activities. Full results are displayed in Table 4.

The NeuroQol Assessment on cognitive functioning measures abilities including memory, attention, and decision making, and their application to daily life (Cella & The PROMIS Health Organization on behalf of the National Institute for NINDS, 2008). Each item is assessed on a 5-point Likert-type scale: 1 = *never*, 2 = *rarely*, 3 = *sometimes*, 4 = *often*, and 5 = *very often*. There were five missing individual responses out of 540 potential responses which was less than 1%. Missing data were replaced with the means (George & Mallery, 2009). The resulting *T*-Score was 41 (*SE* = 2.6) Results are displayed in Table 5. A *T*-score of 50 is the norm (*SD* = 10) based on population studies (NINDS, 2015) which means participants in this study on average, reported cognitive functioning in executive abilities approximately 1 standard deviation (*SD* = 10) below the average *T*-score of 50 (NINDS, 2015).

Falling and/or the fear of falling is a frequent complaint of these patients. When asked, "How often do you fall," 118 participants responded with: Daily (*n* = 5: 4.2%), Weekly (*n* = 18: 15.3%), once a month (*n* = 23: 19.5%), rarely (*n* = 57: 48.3%), and never (*n* = 15: 12.7%); see Table 6. For 46 participants (38.9%), falls are a health hazard occurring monthly or more frequently. When asked whether they have suffered injuries from falls, 58 participants responded "yes" (49.2%).

Several participants commented on this aspect of difficulty by stating, "I'd likely fall more frequently if I attempted to do more, but fear of falling is paralyzing." Another said,

I still suffer from sore muscles, headache and back pain due to being off balance all the time . . . I believe I have back and neck problems from having to look down at the ground while I walk.

And a third added, "I may fall only once a month, but I lose my balance on a daily basis . . . [I] catch myself by falling

into a wall or catching myself on the countertop, etc." Participants were also asked whether they lost their job due to damage from gentamicin or other aminoglycosides: 53 (49.1%) stated that they did (there were three missing responses for this yes/no question, (*n* = 115). One participant commented, "Most people don't understand how difficult it is to function. My boss treats me like an idiot; because we look normal . . . we must be faking." Another severe impairment was losing the ability to drive, which 70 people reported (59.3%, *n* = 117, with 1 missing response). Because of the potential for cognitive impairment or memory problems in this population, participants were asked whether they had been diagnosed with cognitive impairment or memory loss; 36 (30.5%, *n* = 115) replied in the affirmative.

Limitations and Future Research

The survey was based on retrospective patient self-report only, and participants were self-selected, because recruitment was conducted by posting in a support group for those impaired by gentamicin and on www.vestibular.org and its accompanying Facebook page. People who had fewer symptoms may not have been searching for support and help from these internet sources, so the responses could be skewed.

Future studies done through multicenter settings that are either retrospective or prospective, using chart reviews, may be able to substantiate dosage levels and other possible potentiating factors that lead to susceptibility for some patients to adverse effects from aminoglycosides. Such a study would also help to eliminate possible confounds such as other medical conditions that may impact functions of daily living including cognition. In addition, retrospective self-reports from patients may be clouded due to inaccurate use of medical terminology and the timelines involving onset of health conditions.

In addition, the assessments used in this study are designed for adulthood, which begins at age 18 years. There may be limitations due to the general process of aging in physical abilities and cognitive functioning, because a few participants were over age 80 years. And another unexplored contribution to cognitive impairment is depression, which could be assessed more fully through a clinical interview.

In addition, other studies using qualitative methodology could be conducted, to further elucidate the problems of living with some of the symptom clusters reported. Such data might inform assessment and treatment planning, for physicians, physical and occupational therapists, mental health therapists, and those evaluating clients for disability and insurance claims. Cognitive symptoms are a common complaint of all vestibular patients. More research is needed on the mechanism(s) of cognitive impairment in this population, along with more research on the vestibular system itself, which may also help determine how and why aminoglycosides impair some patients, but not others, and provide more guidelines for safe use of this important class of antibiotics.

Table 4. Results from the WHODAS 2.0.

Question	Score
Understanding and communicating	
D1.1 Concentrating on doing something for ten minutes?	1.6949
D1.2 Remembering to do important things?	1.7542
D1.3 Analyzing and finding solutions to problems in day-to-day life?	1.6186
D1.4 Learning a new task, for example, learning how to get to a new place?	1.8136
D1.6 Generally understanding what people say?	1.4407
D1.7 Starting and maintaining a conversation?	1.3559
Level of disability as a percentage	40.32%
Getting around	
D2.1 Standing for long periods such as 30 minutes?	2.4661
D2.2 Standing up from sitting down?	1.9068
D2.3 Moving around inside your home?	1.7542
D2.4 Getting out of your home?	2.0085
D2.5 Walking a long distance such as a kilometer [or equivalent]? ^a	2.5981
Level of disability as a percentage	53.67%
Self-care	
D3.1 Washing your whole body?	1.1186
D3.2 Getting dressed?	1.1610
D3.3 Eating?	0.7414
D3.4 Staying by yourself for a few days? ^a	1.2821
Level of disability as a percentage	26.89%
Getting along with people	
D4.1 Dealing with people you do not know?	1.1695
D4.2 Maintaining a friendship?	0.9407
D4.3 Getting along with people who are close to you?	0.9407
D4.4 Making new friends? ^b	2.2568
D4.5 Sexual activities? ^a	2.0340
Level of disability as a percentage	36.71%
Life activities	
D5.1 Taking care of your household responsibilities?	2.0169
D5.2 Doing most important household tasks well? ^a	2.1624
D5.3 Getting all the household work done that you needed to do? ^a	2.4701
D5.4 Getting your household work done as quickly as needed? ^a	2.9829
Level of disability as a percentage	60.20%
D5.5 Your day-to-day work/school? ^c	1.8780
D5.6 Doing your most important work/school tasks well? ^c	1.8750
D5.7 Getting all the work done that you need to do? ^c	1.9756
D5.8 Getting your work done as quickly as needed? ^c	2.1463
Level of disability as a percentage	49.22%
Participation in society	
D6.1 How much of a problem did you have in joining in community activities (e.g., festivities, religious or other activities) in the same way as anyone else can? ^a	2.4615
D6.2 How much of a problem did you have because of barriers or hindrances in the world around you? ^a	2.3077
D6.3 How much of a problem did you have living with dignity because of the attitudes and actions of others?	1.5424
D6.4 How much time did you spend on your health condition, or its consequences?	2.2119
D6.5 How much have you been emotionally affected by your health condition? ^b	2.6121
D6.6 How much has your health been a drain on the financial resources of you or your family? ^a	2.1197
D6.7 How much of a problem did your family have because of your health problems?	2.1017
D6.8 How much of a problem did you have in doing things by yourself for relaxation or pleasure?	2.3051
Level of disability as a percentage	55.19%
Overall Level of Disability (sum of the scales/7)	46.05%
Overall, in the past 30 days, how many days were these difficulties present?	23.4492
In the past 30 days, for how many days were you <i>totally unable</i> to carry out your usual activities or work because of any health condition?	12.7288
In the past 30 days, not counting the days that you were totally unable, for how many days did you <i>cut back</i> or <i>reduce</i> your usual activities or work because of any health condition?	17.5763

Note. WHODAS-2, 36-item questionnaire (n = 118). Only 41 participants answered Questions D5.5 and D5.6.

^a117 responses (n = 117).

^b116 responses (n = 116).

^c42 participants responded they worked or attended school and therefore they are the respondents on Questions D5.5-5.8.

Table 5. Results from the NeuroQoL Cognitive Function v2.0 Assessment (N = 118).

	M (SD)
In the past 7 days,	
I had to read something several times to understand it	3.31 (1.26)
My thinking was slow	3.35 (1.26)
I had to work really hard to pay attention or I would make a mistake	3.42 (1.31)
I had trouble concentrating	3.57 (1.30)
How much DIFFICULTY do you currently have . . .	
Reading and following complex instructions (e.g., directions for a new medication)	3.01 (1.27)
Planning for and keeping appointments that are not part of your weekly routine (e.g., a therapy or doctor appointment, or a social gathering with friends and family)?	2.84 (1.29)
Managing your time to do most of your daily activities?	3.05 (1.25)
Learning new tasks or instructions?	3.09 (1.26)
Total	25.64
T-score (SE)	41 (2.6)
Average T-score (SD)	50.00 (10)

Table 6. Frequency of Falls and Injuries (N = 118).

	Number	Percentage
Daily	5	4.2
Weekly	18	15.3
Once a month	23	19.5
Rarely	57	48.3
Never	15	12.7
Injured from falls	58	49.2

Conclusion

Exploration of self-reported cognitive impairment, disability levels, and other health symptoms reported after adverse effects related to the administration of aminoglycosides, particularly gentamicin, reveal moderate levels of disability (on average), moderate levels of cognitive impairment, loss of employment, the ability to drive, and danger from falling, all of which negatively impact ADL. Physicians and other health care providers should be aware of the potential limitations to ADLs, potential dangers of falls, high rates of depression, and high levels of anxiety in this population. The WHODAS 2.0 is an instrument that offers a relatively quick way to assess patients holistically for thorough treatment planning.

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Author Biography

Ann M. Kerlin holds a PhD in counseling and is a licensed professional counselor. She is currently the program coordinator for the graduate counseling degree at Luther Rice College & Seminary. Her research interests address the intersection of mental health, physical health, and spirituality.