



Contents lists available at ScienceDirect

Disability and Health Journal

journal homepage: www.disabilityandhealthjnl.com

Original Article

Comparing effects of question set order and location within a survey instrument of two commonly used disability question sets among a U.S. population of adults

Debra L. Brucker, MPA, PhD

University of New Hampshire, Institute on Disability, 10 West Edge Drive, Suite 101, Durham, NH, 03824, USA

ARTICLE INFO

Article history:

Received 8 July 2022

Received in revised form

22 November 2022

Accepted 3 December 2022

Keywords:

Disability measurement

Survey research

Washington Group Short Set

Six question sequence

Disability

Disability prevalence

ABSTRACT

Background: In nationally representative household surveys conducted in the United States (U.S.), two distinct sets of questions are commonly used to identify persons with disabilities. The six-question sequence (6QS) measures, in a yes/no fashion, limitations in cognition, hearing, independent living, self-care, vision, and walking. The Washington Group Short Set (WG-SS) captures more nuanced yet similar information, although instead of including a measure of independent living asks about communication. To date, research has not estimated, among the same set of survey respondents, variations in disability prevalence using these two sets of questions nor how prevalence estimates vary by question set order and placement of these questions at the beginning or end of a survey.

Objective/Hypothesis: The objective was to examine adjusted differences in disability prevalence among three measures of disability based on the 6QS and the WG-SS question sets, controlling for differences in question set order and placement within a survey.

Methods: We fielded an Internet survey ($N = 13,277$) in September 2020 that included these questions, but varied question set order and placement among respondents, using four different versions of the survey. We first tested for bivariate differences by survey design between an “any disability” measure as well as between specific types of limitations using Chi square. Finally, we examined pairwise adjusted differences in prevalence estimates.

Results: The 6QS provided the most consistent prevalence estimates (26%–28%) ($p < .05$), regardless of survey design. Estimates varied more widely for the WG-SS measures, ranging from 43 to 60% for WG-SS1 and from 10% to 15% for WG-SS2, among survey versions.

Conclusions: Question set order and placement was not associated with differences in prevalence for the 6QS but was associated with differences in estimates from the WG-SS. Further research is needed to understand the possible survey priming effects that might influence estimates from the WG-SS.

© 2022 Elsevier Inc. All rights reserved.

The accurate measurement of disability through the collection of household survey data provides important information that federal, state, and local agencies and organizations can use to direct the allocation of funding and to develop and provide appropriate services to support persons with disabilities. In nationally representative household surveys conducted in the United States (U.S.), two distinct sets of questions are commonly used to identify persons with disabilities. The first set of questions is known as the six-question sequence (6QS). The 6QS have been included on the American Community Survey, the annual demographic survey

conducted by the Census, each year since 2008.¹ Carefully developed by federal agencies through an iterative process, these ACS questions have also been included in other nationally representative surveys conducted by federal agencies, under guidance from the U.S. Department of Health and Human Services.^{1,2} The 6QS set includes questions which measure limitations in ambulation, cognition, hearing, independent living, self-care, and vision in a binary fashion. Respondents simply state whether they have one of these limitations or not.

A second set of questions, the Washington Group Short Set (WG-SS), is gaining prominence in the U.S. and abroad.³ The six WG-SS questions were developed on the international stage and measure limitations in ambulation, communication, cognition, hearing, self-

E-mail address: debra.brucker@unh.edu.<https://doi.org/10.1016/j.dhjo.2022.101424>

1936-6574/© 2022 Elsevier Inc. All rights reserved.

care, and vision. This set of questions differs from the 6QS in two important ways. First, the WG-SS does not include a measure of independent living but does include a question about communication.¹ Second, rather than capturing responses in a binary “yes/no” fashion, these questions allow respondents to choose whether they have different levels of difficulty in each area (“no difficulty,” “some difficulty,” “a lot of difficulty,” or “cannot do”). This allows for a more nuanced measure of limitations that is more in line with the International Classification of Functioning, Disability, and Health Model⁵ and allows for a broadening or narrowing of the measurement of disability among a population. A broad measure, for example, would include any persons reporting any level of limitation while a narrower measure might include only persons reporting “a lot of difficulty” or “cannot do” with regards to each limitation. Other researchers³ have categorized the broad WG-SS measure as WG-SS1 and the narrow measure as WG-SS2. We follow a similar approach in our analysis, as discussed in our Methods section.

Prior research has compared estimates obtained using the 6QS and WG-SS questions sets, albeit among different sets of respondents. Lauer et al.³ used data from the 2010 and 2013–2015 National Health Interview Survey (NHIS), in which respondents answered either the 6QS or the WG-SS of questions but not both sets of questions, and found that the broadest definition of disability (measured as any level of limitation within the WG-SS framework) provided the highest prevalence estimate and the narrower WG-SS definition (measured as having “a lot of difficulty” or “cannot do”) provided the smallest estimate, while the 6QS prevalence estimate fell somewhere in between.

In addition to the types of questions used to collect data from or about persons with disabilities, other survey related factors can influence disability estimates. Mathiowitz et al.⁷ outline the importance of considering other non-observation errors (sampling error, coverage error, non-response error) alongside observation related errors (questionnaire issues, respondent error, interview error) when examining the measurement of disability. The number of questions used to determine the prevalence and severity of disabilities and the context of the questions immediately proximate to the question of interest can all influence estimates.⁷ Overall survey content can influence estimates as well. Surveys that primarily gather health-related information may prime respondents to be thinking about disability^{7–9} while issues of justification bias may arise in surveys that focus on employment related issues as respondents may overstate their level of disability to justify non-employment and welfare receipt.¹⁰ These findings would suggest that where disability questions are placed (i.e., the beginning or end of a survey) might influence disability estimates, as the placement of these questions prior to or after other possibly priming questions might bias estimates.

Research has not, to date, examined 1) whether disability prevalence estimates from the 6QS and WG-SS vary when asked of the same respondents in a survey, 2) whether estimates vary based on whether the 6QS or the WG-SS questions are asked first, and, in cases where respondents are asked both sets of questions, 3) whether estimates vary based on whether these questions are placed at the beginning or end of a survey that gathers additional demographic, disability, economic, and health information. The research presented here fills these gaps by testing for differences in disability estimates using data collected using an Internet survey that was specifically designed to model these variations. Based on

prior research, we expect differences in prevalence estimates by question type, with the WGSS-1 providing the highest estimate, the 6QS providing a middling estimate, and the WGSS-2 providing the lowest estimate. We also expect that estimates across all question types will be lower when these questions are asked at the beginning of survey rather than at the end, as the survey content may be priming individuals to report disability.

Methods

Data

We designed a survey instrument that captured a variety of demographic, disability, economic, and health information. Although the purpose of the survey was described to participants as a study to find out about people’s recent access to health care, employment, and healthy food, some of the introductory language (including the title of the organization conducting the research and the name of the research funder) and some of the survey questions might have biased respondents towards reporting disability. The instrument included questions, for example, that asked respondents to rate their overall health and mental health and to provide some information about their employment status. We therefore structured our survey administration to include four versions which had different disability question set orders and placement. In all cases, both the 6QS and WG-SS questions were asked. In Version 1, the disability questions were asked at the beginning of the survey, with the 6QS questions asked first and the WG-SS questions asked second, before the potentially biasing questions mentioned above. In Version 2, the WG-SS questions were asked first and the 6QS questions were asked second, all at the beginning of the survey. In Version 3, the disability questions were asked at the end of the survey, with the 6QS questions posed first and the WG-SS questions asked second. In Version 4, the WG-SS questions were asked first and the 6QS questions were asked second, at the end of the survey.

The survey was conducted online in September 2020. Adults ages 18 to 64 who resided in the U.S. and were members of a Qualtrics nonprobability Internet panel were recruited by Qualtrics and its partners. Quotas were established based on American Community Survey estimates for age category, gender, race and ethnicity, and socioeconomic status to ensure that our sample included similar proportions of individuals in these categories as the proportions estimated from the American Community Survey. More details on survey design, recruitment, inclusion, incentives, and representativeness have been published elsewhere (_____) and confirm that our use of quotas resulted in a sample that closely matched the American Community Survey on the targeted characteristics.² Informed consent to participate was obtained in accordance with requirements of the (____) Institutional Review Board. Once survey administration was completed, we downloaded the data from Qualtrics into Stata for analysis. Our final analytic sample included 13,277 adults. The median time to complete the survey was 9 min 15 s.

Measures

We used three measures of disability. We included a set of six

¹ As of October 2022, the U.S. Census was testing for possible inclusion of the WG-SS communication question along with the other 6QS questions in its American Community Survey.⁴

² While the use of quotas ensured that our sample included equal proportions of respondents in the aforementioned categories as the American Community Survey, our sample differed from the U.S. population in other ways from American Community Survey estimates, including having higher levels of education. We discuss the implications of these differences in our Discussion section.

questions which are the same as those included in the 6QS included in federal surveys and measure limitations in cognition, hearing, independent living, self-care, vision, and walking. Possible responses to these 6QS questions include yes or no. Persons responding affirmatively to any one of these questions were considered to have a 6QS disability.

We also included the WG-SS questions which are included in the NHIS and elsewhere. The WG-SS measures limitations in cognition, communication, hearing, self-care, vision, and walking. In contrast to the 6QS questions, WG-SS questions allowed respondents to select among the following options for each question: No difficulty; Yes, some difficulty; Yes, a lot of difficulty; Cannot do at all.

The exact wording of these question sets is shown in Table 1.

In all cases, the 6QS questions and the WG-SS questions were asked in tandem, directly after one another. For half the sample, the 6QS was asked first and the WG-SS questions were asked second. For the other half of the sample, the WG-SS questions were asked first and the 6QS questions were asked second.

We used the data collected via these question sets to develop relatively comparable disability status measures, using the five questions which overlap between the two question sets. As shown in Table 1, the question wording for each limitation question varies between the question sets. Nevertheless, each question set includes questions that assess limitations in five areas: cognition, hearing, self-care, vision, and walking.

For this study, the 6QS disability measure thus included persons who noted having any limitation in cognition, hearing, self-care, vision, or walking.

For demographic characteristics, we gathered data on age, gender (male, female, other), race (White only, Black only, Asian only, other), ethnicity (Hispanic or Spanish origin or not), and education (less than high school, high school diploma or GED, some college, bachelor's degree).

Analysis

We first provided descriptive statistics for our sample, examining differences in the prevalence of disability by type of disability definition and by demographic characteristics. We used Chi square to examine differences among nominal variables and *t*-test to test differences by age.

Second, we examined the tetrachoric correlations among the three measures of disability as well as their individual components (where appropriate) as measure of internal validity.

We next calculated the percent of respondents with a 6QS limitation in cognition, hearing, vision, or self-care who responded

to each of the levels of difficulty captured by the WG-SS questions to better understand the distribution of responses.

Before moving on to our final analyses, we also examined demographic differences among the four different sub-samples that completed different versions of the survey (Version 1, Version 2, Version 3, Version 4) so that we could identify whether the groups of individuals included in these sub-samples differed on key characteristics.

Last, we calculated the predicted probabilities of having a disability for each disability definition, controlling for any differences found among the four sub-samples identified in the prior step. Respondents missing disability and other key measures were excluded from the analyses. We tested for differences among these predicted probabilities using pairwise comparison of probabilities with alpha set to 0.05. To correct for making multiple comparisons, we used Bonferroni's correction. All analyses were conducted in Stata.

Results

Table 2 shows the characteristics of our sample overall and by comparable disability definition (based on limitations in cognition, hearing, self-care, vision, and walking). The mean age of our working-age sample was 41 years. Fifty-one percent of our sample was female, 72% was White, and 18% was Hispanic. Forty-five percent of our sample had a bachelor's degree or higher levels of education. Twenty-eight percent of our sample reported a 6QS disability (as measured using the five cognitive, hearing, self-care, vision, and walking questions). Fifty-one percent reported a WG-SS1 disability (as measured using the five cognitive, hearing, self-care, vision, and walking questions) and 13% reported a WG-SS2 disability. No differences in mean age were found between persons with and without disabilities across all disability definitions. Across all definitions, however, persons with disabilities were more likely to be female, Hispanic, and have lower levels of education than persons without disabilities.

Table 3 provides a comparison across sub-questions, where appropriate. Please note that the question wording among question sets varies and thus we would not expect exact congruence across limitations measured in each question set. In addition, the two question sets do not exactly align. The 6QS does not include a question on communication and the WG-SS does not include a question on independent living. Differences by individual questions are evident. As an example, six percent of working-age persons reported a cognitive limitation using the WG-SS2 definition of experiencing "a lot of difficulty" or "cannot do" and 31% reported any cognitive limitation using the WG-SS1 definition. Eighteen

Table 1
Question wording of question sets.

6QS	WG-SS
1) Are you deaf or do you have serious difficulty hearing?	1) Do you have difficulty hearing, even if using a hearing aid?
2) Are you blind or do you have difficulty seeing, even when wearing glasses?	2) Do you have difficulty seeing, even if wearing glasses?
3) Do you have serious difficulty walking or climbing stairs?	3) Do you have difficulty walking or climbing steps?
4) Because of a physical, mental, or emotional condition, do you have serious difficulty concentrating, remembering, or making decisions?	4) Do you have difficulty remembering or concentrating?
5) Do you have difficulty dressing or bathing?	5) Do you have difficulty with self-care such as washing all over or dressing?
6) Because of a physical, mental, or emotional condition, do you have difficulty doing errands alone such as visiting a doctor's office or shopping?	6) Using your usual (customary) language, do you have difficulty communicating, for example, understanding or being understood?

Notes.

6QS = 6 question sequence; WG-SS = Washington Group - Short Set; WG-SS1 = Washington Group Short Set 1; WG-SS2 = Washington Group Short Set 2.

For the analysis conducted in this study, two variables (WG-SS1 and WG-SS2) were created using the WG-SS questions noted above.

For the WG-SS1 measure, persons responding as having any level of difficulty among the five questions relating to cognition, hearing, self-care, vision, and walking were considered to have a WG-SS1 limitation.

For the WG-SS2 measure, persons responding as having "a lot of difficulty" or "cannot do at all" to the same set of five WG-SS were considered to have a WG-SS2 limitation.

Table 2
Descriptive statistics by disability.

N	All	6QS			WG-SS1			WG-SS2		
		Difficulty			Difficulty			Difficulty		
		Yes	No	Sig.	Any	No	Sig.	Lot of or cannot do	Some or no	Sig.
		13,270	3705	9565	—	6718	6552	—	1643	11,627
	%	%	%	%	%	%	%	%	%	
Disability	—	27.92	—	—	50.63	—	—	12.79	—	—
Age (mean, standard deviation)	40.60	40.24	40.74	—	40.76	40.44	—	39.71	40.73	**
	0.118	0.231	0.137	—	0.172	0.161	—	0.345	0.125	—
Gender										
Male	48.29	42.78	50.43	***	44.95	51.72	***	43.52	48.97	***
Female	50.89	55.06	49.28	—	53.69	48.02	—	54.23	50.42	—
Other	0.81	2.16	0.29	—	1.35	0.26	—	2.25	0.61	—
Race										
White only	72.28	72.23	72.29	***	73.61	70.91	***	71.33	72.41	***
Black only	12.68	11.55	13.12	—	11.70	13.69	—	12.54	12.70	—
Asian only	5.35	3.13	6.21	—	3.75	6.99	—	3.35	5.63	—
Other	9.69	13.09	8.37	—	10.94	8.41	—	12.78	9.25	—
Ethnicity										
Hispanic or Spanish origin	17.64	21.36	16.20	***	19.04	16.21	***	23.26	16.85	***
Not	82.36	78.64	83.80	—	80.96	83.79	—	76.74	83.15	—
Education										
Less than high school	1.98	3.37	1.44	***	2.60	1.34	***	3.53	1.76	***
High school/general education diploma	18.32	22.56	16.68	—	20.66	15.92	—	22.95	17.67	—
Some college	35.09	40.84	32.86	—	39.30	30.77	—	38.16	34.65	—
Bachelor's degree	44.61	33.23	49.02	—	37.44	51.97	—	35.36	45.92	—

Notes:**p < .01, ***p < .001.

Rather than using all six questions in each question set, disability was measured as limitations in cognition, hearing, self-care, vision, or walking.

6QS = Six question sequence; WG-SS1 = Washington Group - Short Set 1; WG-SS2 = Washington Group - Short Set 2.

Question wording, even when measuring similar constructs, varies between the 6QS and the WG-SS.

WG-SS1 is a broader definition of disability. WG-SS2 is a narrower definition of disability.

percent of working-age persons reported a 6QS cognitive limitation. Estimates more closely aligned for self-care, ranging from two percent when using the WG-SS2 measure to six percent when using the 6QS measure to nine percent when using the WG-SS1 measure.

Table 4 presents the tetrachoric correlations among the three disability measures, showing high correlations between the 6QS and the WG-SS1 (0.7966) and the 6QS and the WG-SS2 (0.7427). Correlations among specific items are shown as well. The cognitive measures had the highest correlations between question sets (0.8457 between the 6QS and the WGSS-1 cognitive items and 0.7359 between the 6QS and WGSS-2 cognitive items) and the vision measures had the lowest correlations (0.5925 between the 6QS and the WGSS-1 vision items and 0.6096 between the 6QS and the WGSS-2 vision items).

Table 5 shows the percent of adults with specific 6QS limitations

who report different levels of difficulty according to WG-SS measures. Between 11 and 42% of persons who had responded affirmatively that they had a 6QS limitation reported “no difficulty” when asked the comparable WG-SS questions. Only small portions (less than 1%–3%) responded “cannot do at all”.

For the sake of brevity, our analysis of demographic differences among the four samples is not shown in a table. We note here, however, that demographic characteristics other than education were similar among all four groups. As differences in education were noted ($p < .001$), our final analyses adjust for educational attainment.

Table 6 shows the predicted probabilities of having a disability for each disability definition by survey version, controlling for education. 6QS estimates of disability (based on limitations in cognition, hearing, self-care, vision, and walking), ranging from 26% to 29%, are not significantly different across the four different

Table 3
Disability prevalence estimates by question type.

Total N	6QS		WGS1		WGS2	
	Any difficulty		Any difficulty		Lot of difficulty or cannot do	
	13,270		13,270		13,270	
	%		%		%	
Cognitive	17.94		30.87		5.65	
Independent living	12.13		N/A		N/A	
Hearing	5.88		12.69		2.32	
Self-care	5.48		8.65		2.00	
Vision	5.80		26.95		3.72	
Walking	11.18		19.56		4.90	
Communication	N/A		9.15		1.86	
Any disability	27.92		50.63		12.38	

Notes: “Any disability” measures are based on limitations in cognition, hearing, self-care, vision, and walking.

6QS = Six question sequence; WG-SS1 = Washington Group - Short Set 1; WG-SS2 = Washington Group - Short Set 2.

Table 4
Tetrachoric correlations among disability measures.

	Any 6QS			Any WG-SS1			Any WG-SS2		
Any 6QS	1.0000								
Any WG-SS1	0.7966			1.0000					
Any WG-SS2	0.7427			1.0000			1.0000		
	Cog 6QS	Cog WG-SS1	Cog WG-SS2	Vis 6QS	Vis WG-SS1	Vis WG-SS2	Self 6QS	Self WG-SS1	Self WG-SS2
Cog 6QS	1.0000			Vis 6QS 1.0000					
Cog WG-SS1	0.8457 1.0000			Vis WG-SS1 0.5925 1.0000					
Cog WG-SS2	0.7359 1.0000 1.0000			Vis WG-SS2 0.6096 1.0000 1.0000					
Hear 6QS	1.0000			Self 6QS 1.0000					
Hear WG-SS1	0.6597 1.0000			Self WG-SS1 0.8996 1.0000					
Hear WG-SS2	0.6479 1.0000 1.0000			Self WG-SS2 0.6822 1.0000 1.0000					

Notes.
6QS = Six question sequence. WG-SS1 = Washington Group - Short Set 1; WG-SS2 = Washington Group - Short Set 2.
Cog = Cognitive; Hear = Hearing; Vis = Vision; Self = Self-care.

question order and survey placement variations ($p < .05$).
The WG-SS1 estimate of disability is consistent (43%–44%) when the WG-SS questions follow the 6QS questions, regardless of whether the questions are included at the beginning or end of the survey. When the WG-SS questions are posed first, however, WG-SS1 estimates of disability (based on any limitation) are significantly higher ranging from 55% to 60%, than estimates obtained when the 6QS questions are posed first ($p < .05$).

Results are mixed for the WG-SS2 estimates. Where the WG-SS questions are asked after the 6QS questions, regardless of placement in the survey, WG-SS2 estimates are not significantly different from the comparison (10%–12%). The WG-SS2 estimates are also similar between Version 2 (WG-SS first, 6QS second at the beginning of the survey) (13%) and Version 3 (6QS first, WG-SS second at the end of the survey) (12%). Posing the WG-SS questions first, before the 6QS questions, and at the end of the survey provided a significantly higher WG-SS2 estimate than all other survey versions (15%) ($p < .05$).

Discussion

The findings from this study confirm prior research⁶ that has found variations in disability prevalence by question type and the operationalization of disability, with the WG-SS1 providing the highest estimates, the WG-SS2 providing the lowest estimates, and the 6QS providing an intermediate estimate. While these results are not surprising as the question wording and response choices vary between question sets, this paper provides additional documentation of these similarities and differences that can provide a useful

Table 5
Percent of adults with 6QS limitations reporting different levels of difficulty on WG-SS questions.

	6QS Cognitive $n = 2380$	6QS Hearing $n = 780$	6QS Vision $n = 770$	6QS Self-care $n = 727$	6QS Ambulatory $n = 1483$
	%	%	%	%	%
WG-SS No difficulty	12.69	41.54	24.81	20.22	11.13
WG-SS Yes, some difficulty	62.82	39.49	50.65	60.66	55.23
WG-SS Yes, a lot of difficulty	23.74	17.05	22.47	16.09	31.09
WG-SS Cannot do at all	0.76	1.92	2.08	3.03	2.56

Notes: 6QS = Six question sequence; WG-SS = Washington Group - Short Set.

Table 6
Predicted margins of disability by question set order and placement, controlling for education.

	6QS			WG-SS1			WG-SS2		
	%	s.e.	Group	%	s.e.	Group	%	s.e.	Group
Version 1	26.25	0.76	A	44.01	0.86	A	10.30	0.53	A
Version 2	28.27	0.77	A	60.08	0.85		12.48	0.57	B
Version 3	28.36	0.77	A	43.41	0.85	A	11.60	0.55	A B
Version 4	28.80	0.78	A	55.02	0.86		15.16	0.62	

*Margins sharing a letter in the group label are not significantly different at the 5% level.

NOTES.
Disability measures are based on limitations in cognition, hearing, self-care, vision, and walking.

Version 1 = 6QS first, WG-SS second, beginning of survey.

Version 2 = WG-SS first, 6QS second, beginning of survey.

Version 3 = 6QS first, WG-SS second, end of survey.

Version 4 = WG-SS first, 6QS second, end of survey.

Notes.

6QS = 6 question sequence.

WG-SS1 = Washington Group - Short Set 1; WG-SS2 = Washington Group - Short Set 2.

benchmark for other disability and health researchers.

Among the three measures, the 6QS provide the most consistent prevalence estimates, regardless of survey placement (beginning or end of the survey) and question set order (6QS prior to WG-SS and vice versa). This contradicts other research that has suggested that disability estimates are particularly sensitive to the context of the survey questions immediately proximate to the question of interest⁶ and that overall survey content might influence estimates.^{6–9} While the results presented here can provide some level of confidence to other researchers that estimates from the 6QS are stable regardless of survey placement or question order, results are more mixed for the WG-SS. We found significantly higher WG-SS1 estimates when the WG-SS were asked first and at the beginning of the survey (60%) than when the WG-SS were asked first at the end of the survey (55%), counter to what one would expect if priming issues were at play. This result did not hold when the WG-SS were asked second to the 6QS, and results were more mixed when considering the WG-SS2 measure. In sum, our findings cannot provide a definitive recommendation regarding the placement of the WG-SS questions and thus point to a need for further research in this area.

The correlations among the three disability measures were high overall, 0.80 between the 6QS and the WG-SS1 and 0.74 between the 6QS and the WG-SS2, suggesting that these sets of questions were capturing similar constructs. Correlations among specific items varied across question sets, however. The cognitive measures had the highest correlations between question sets and the vision measures had the lowest correlations. Differences in question wording likely account for these variations, although additional research can explore this in more detail.

While the overall correlations among our three disability measures were high, our results showing the percent of adults with

specific 6QS limitations who report different levels of difficulty according to WG-SS measures show incongruity between the measures. One would expect, for example, that the percentage of persons reporting “no difficulty” when responding to the WG-SS questions would be quite low for this group of individuals who had responded affirmatively that they had a limitation when the 6QS was posed to them. Instead, between 11 and 42% reported “no difficulty.” While some of this variation might have arisen due to slight differences in question wording between the question sets, further exploration of this disparity is warranted. Of note also is that only very small portions of people who reported a 6QS limitation responded “cannot do at all” when responding to the respective WG-SS question, suggesting that the 6QS is primarily picking up persons who respond that they have either “yes, some difficulty” or “yes, a lot of difficulty” in certain areas.

A source of major variation in disability prevalence estimates arises from the ability of respondents to select “some difficulty” on the WS-SS. The inclusion of persons who report “some difficulty” accounts for the largest proportion of individuals included in the overall WG-SS disability estimate and in specific limitation prevalence estimates. This demonstrates the value of the WG-SS as moving beyond a binary definition of ‘having a disability’ to a measurement tool that better captures the spectrum of functional loss.⁵

The broad WG-SS measure (WG-SS1), where any disability is measured by responses of “Yes, some difficulty,” “Yes, a lot of difficulty” or “Cannot do at all,” provided significantly higher estimates (55%–60%) when posed before the 6QS questions than when those questions were asked after the 6QS (43%–44%) ($p < .05$). The binary nature of the 6QS may have some priming effect on later consideration of limitations by respondents and may have resulted in lower estimates from the WG-SS questions. Cognitive testing, perhaps using a “think aloud” method, should explore this finding in more detail to see how respondents are considering the different nuances in question wording and response options when these question sets are paired. Such methods were used in the development of each of these questions sets separately^{2,11} but additional testing when these questions are asked in tandem can provide an additional method of understanding the interrelationship between these question sets. While it is unlikely that these question sets will be asked in tandem in other surveys, cognitive testing of the approach used in this survey can offer other researchers, particularly those who might include additional health-related questions on surveys, additional information that can inform the choice and placement of questions.

The findings about the narrow WG-SS disability measure (WG-SS2) also bear further research, as we found significantly higher estimates of disability for this measure when the WG-SS questions were posed first at the end of the survey, compared to other versions of the survey. The economic and health-related topic areas covered earlier in our survey might have primed respondents to be more likely to report substantial difficulties with the limitations that were measured.

Using a disability measure based on the five comparable 6QS questions (limitations in cognition, hearing, self-care, vision, and walking) and controlling for educational attainment suggests that approximately 26%–29% of American adults experience a disability. This range is similar to the 28% estimate found in the Behavioral Risk Factor Surveillance Survey (BRFSS) (author calculations) but is substantially higher than estimates reported using all six questions on other nationally representative surveys. The 2019 ACS, for example, estimates that approximately ten percent of the U.S. population aged 18–64 has a disability.¹² This ACS estimate is closest to the WG-SS2 estimates (10–15%) found in our survey, although our WG-SS2 measure only included five possible

limitations. As some researchers have recommended caution in using Internet surveys to accurately gather information about disability,¹³ further research into the possible implications of using Internet surveys to gather data on disability is warranted. Taking our results at face value, respondents to Internet surveys such as the one we administered here have characteristics (such as a higher rate of disability and higher levels of education) that differ greatly from the general population. While re-weighting such Internet surveys to benchmarks from the ACS might be one approach to address this disparity, additional research which closely examines differences in the survey respondent populations could highlight other opportunities to fine tune Internet survey results.

Our estimates of disability might have been upwardly biased for at least two reasons. As mentioned earlier, the introductory language used to inform participants about our study could have primed respondents to report more limitations than they would have reported for a different study. In addition, the study was conducted seven months into the COVID-19 pandemic and four months before any vaccines were available. Concerns about health and function were particularly high across all groups and particularly among persons with disabilities at this time, which may have increased reporting of disability.¹⁴

This study has several additional limitations. First, as noted above, the use of an Internet survey might have resulted in findings that would be different had the survey been administered via a different survey mode (telephone, in-person, etc.). As many nationally representative household surveys in the U.S. use these disability questions, replicating these results by varying question placement within these other surveys could confirm the findings presented here.

Second, although our sample matched the U.S. population on some key characteristics, our sample did have notably higher levels of education than the U.S. adult population which may equate to higher levels of reading comprehension among survey respondents. Expansions of the work presented here should be sure to test these findings among a population that has educational attainment levels more in line with U.S. estimates to ensure a more comparable level of comprehension among survey respondents. Also, other studies have shown an inverse relationship between educational attainment and disability,¹⁵ suggesting that our sample may report lower rates of disability than the general population. Although we adjust for differences in educational attainment in our results, future studies should ensure that the proportion of respondents with different levels of educational attainment reflects that of the general population.

The use of an Internet survey also likely included persons who differ on other characteristics from the general population in terms of Internet access and familiarity with computers, further biasing our results. Lastly, the survey did not include other questions which might have been useful in establishing external validity for disability as a measure. Including such questions on future research in this area could address this concern.

Funding

Funding for this study was provided by the Rehabilitation Research and Training Center on Disability Statistics at the University of New Hampshire, which is funded by the National Institute for Disability, Independent Living, and Rehabilitation Research, in the Administration for Community Living, at the U.S. Department of Health and Human Services under grant number 90RTGE0001.

Disclaimer

The contents do not necessarily represent the policy of DHHS

and you should not assume endorsement by the federal government (EDGAR, 75.620 (b)).

References

1. Brault MW. Review of changes to the measurement of disability in the 2008. *American Community Survey*. 2009;17.
2. Brault M, Stern S. *Evaluation Report Covering Disability*. vol. 111. 2007.
3. Washington Group on Disability Statistics. *The Washington Group Short Set on Functioning (WG-SS)* [Internet]; 2020. Available from: https://www.washingtongroup-disability.com/fileadmin/uploads/wg/Documents/Questions/Washington_Group_Questionnaire__1_-_WG_Short_Set_on_Functioning.pdf.
4. Steinweg A. *Disability Statistics from the U.S. Census Bureau. 2022 State of the Science on Disability Statistics*. 2022 (Washington, D.C).
5. Centers for Disease Control and Prevention. *The ICF: An Overview* [Internet]; 2010. Available from: https://www.cdc.gov/nchs/data/icd/icfoverview_finalforwho10sept.pdf.
6. Lauer EA, Henly M, Coleman R. Comparing estimates of disability prevalence using federal and international disability measures in national surveillance. *Disabil Health J*. 2019 Apr;12(2):195–202.
7. Mathiowetz NA, Wunderlich GS, eds. *Survey Measurement of Work Disability Summary of a Workshop*. Washington, D.C.: National Academy Press; 2000: 28–52.
8. U.S. Census Bureau. About Disability [Internet]. Census.gov [cited 2022 Jul 8]. Available from: <https://www.census.gov/topics/health/disability/about.html>.
9. Haber LD. Appendix B: issues in the definitions of disability and the use of disability survey data. In: *Disability Statistics: An Assessment: Report of a Workshop* [Internet]. Washington, D.C.: National Academies Press (US); 1990 [cited 2022 Sep 28]. Available from: <https://nap.nationalacademies.org/read/20312/chapter/7>.
10. Black N, Johnston DW, Suziedelyte A. Justification bias in self-reported disability: New evidence from panel data. *J Health Econ*. 2017 Jul 1;54: 124–134.
11. The Washington Group on Disability Statistics. *Cognitive Testing of the Washington Group Translated Questions* [Internet]; 2020. Available from: https://www.washingtongroup-disability.com/fileadmin/uploads/wg/Documents/Questions/Upload_-_WG_Implementation_Document__7_-_Cognitive_Testing_of_the_WG_Translated_Questions.pdf.
12. Paul S, Houtenville A. *Annual Disability Statistics Compendium* [Internet]; 2021 [cited 2022 Jan 5]. Available from: disabilitycompendium.org.
13. Houtenville AJ, Phillips KG, Sundar V. Usefulness of Internet surveys to identify people with disabilities: a cautionary tale. *Journal of Survey Statistics and Methodology*. 2021 Apr 1;9(2):285–308.
14. Affect, Disability and the Pandemic - Goodley - *Sociology of Health & Illness* - Wiley Online Library [Internet] [cited 2022 Nov 14]. Available from: <https://onlinelibrary-wiley-com.unh.idm.oclc.org/doi/full/10.1111/1467-9566.13483>.
15. Montez JK, Zajacova A, Hayward MD. Disparities in disability by educational attainment across US states. *Am J Publ Health*. 2017 Jul;107(7):1101–1108.