Creating Disability Severity Indicators
Using the WG Short Set on Functioning (WG-SS) (SAS)

Disability Identification – Moving Beyond A Dichotomy

Introduction

There is no 'gold standard' against which a derived measure of disability can be assessed and validated. Populations are not naturally divided into people with and without disabilities. No single question or universal standard exists that would easily and accurately differentiate between those with and those without disability or that would identify different levels of disability severity. Disability and functioning, in fact, exist along a continuum. Therefore, judgments must be made as to where to put the dividing line along that continuum, and those judgments can change based on the purpose for drawing that line. For monitoring the requirements of the UN Convention on Persons with Disability (UNCRPD), it is necessary to identify the group of people with disability whose rights are affirmed in the UNCRPD and to ensure those rights are being protected. That is, it is necessary to identify a group that, because of functional difficulties, is at greater risk than the general population of being excluded from participation because of barriers in the environment. To do this, it is necessary to find the most appropriate place on the continuum to place a threshold – where those above that threshold have disability and those below it do not. The threshold selected (often called the cut point or cutoff) should be selected to meet the needs for which the data are being collected.

The need to select a point on a continuum to define groups of interest is not unique to disability. In fact, it is a very common practice. Age, for example, exists on along continuum, but we often classify people as being children or adults. A decision is needed as to where to place the cut point. The cut point used to define the adult population is often placed at age 18 (the adult population being those 18 years and older) but could be placed at a younger (e.g., 16 years and older) or even older (e.g., 21 years and older). The choice depends on the purpose of the data collection and local/national norms and definitions. This dichotomy creates two groups that are highly heterogeneous[1] leading to the adoption of additional cut points that further classify the population. Examples of common groupings for age are 0-9, 10-17, 18-44, 45-64, 65-84 and 85 years and over. The same is true for poverty, which is why the World Bank, for example, has established multiple poverty thresholds. Disability is similar as there are no generally accepted cut points that would subdivide the continuum, but it is also more complicated as there is no naturally occurring unidimensional, underlying continuum. Unlike age, which has one component – years lived – disability can arise at different levels of functioning and across many different functional domains, for example, seeing, hearing, mobility, cognition, etc. To identify cut points for disability, it is first necessary to create the continuum and there are multiple ways to do this.

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[1] Those 0-17 may represent all children, but there is considerable variation among those within this broad age category. Similarly, 18 years and above may represent all adults, but there are notable distinctions between young adults, those middle aged and the elderly.

Disability Status Indicators

The Washington Group (WG) questions contain multiple response options that allow for the determination of more than one *overall* disability status indicator, depending on how the responses to the questions are combined and the cutoff selected for the determination. The goal with the response options [*no difficulty, some difficulty, a lot of difficulty* and *cannot do at all*] was to allow respondents to locate themselves along that continuum of functioning within each domain and to allow analysts to create different indicators to meet different needs.

The WG questions were crafted to create, among other summary statistics, an *overall* disability status identifier[2]; that is, an indicator that divides the population into two groups (those with and without disability) based on a simple way of combining information from all questions in the questions set. For the purposes of international reporting and cross-national comparability, the WG has determined that disability is defined as those who have *a lot of difficulty* with or *cannot do at all* on at least one of the basic functional domains included in the question set.

Other dichotomies can be created using the same approach either by raising the threshold to include only those who *cannot do* at least one of the core basic activities included or lowering it to include those who have at least *some difficulty* carrying out one or more of the basic activities. The former may be more suitable if the purpose of determination is to provide an estimate of those with high support needs, and the latter may be more applicable when determining the population who might benefit from universal design.

For monitoring purposes, it is most common to create a dichotomy that classifies the population into two groups. However, this results in a loss of information and creates groups that are heterogeneous in terms of their functional ability. It is possible to classify the population into a larger number of groups that better reflect the full range of functioning in the population. Just as there are many thresholds that can be used to classify the population into two groups, there are multiple ways to combine information from the WG questions to create the underlying continuum.

Disability Severity Indicators

This document describes various methods of combining the responses to the WG-SS questions to create disability indicators that reflect the severity of functional limitation across all domains. Another WG document report, ***Creating Domain Specific Indicators of Disability Using the WG Short Set on Functioning***, addresses the creation of domain specific indicators, indicators based on the number of domains where functional limitation is reported and indicators that include information on two or more indicators.

SAS syntax used to program the classifications described follows in an Appendix; however, some reference to SAS derived variable names remain in the body of the text. The choice of variable labels is up to the investigator.

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[2] Other disability identifiers based on the number of domains of functioning included, individual domains of functioning or combinations of domains will be covered in a separate document.

Previous documentation has described the steps required to create the dichotomous **Disability Status** indicators, based on the WG-SS, at different cut points along the WG continuum [see: *Analytic Guidelines: Creating Disability Status Identifiers Using the WG-SS*]. The recommended cut point is at the level of *a lot of difficulty* or *cannot do at all* on at least one of the six short set questions. For the purposes of this document that dichotomous variable is called the **SS-Disability Indicator (SS-DI)**. [Note: Currently, SS-DI is the same variable labeled as DISABILITY3 in the Disability Status document linked above. Variable names used are specific to the report.]

This document introduces the following disability severity indicators:

- **SS-Highest Difficulty (SS-HD)**: describing 'severity' based on the highest level of difficulty recorded over the six functioning domains.
- **SS-Severity Continuum (SS-SCo)**: a continuous measure based on individual domain scores that describes a continuum of functioning.
- **SS-Severity Category (SS-SC)**: a categorical measure of 'severity' based on cut points along the above continuum.

1. The Disability Status Indicator [SS-Disability Indicator (SS-DI)] Using the WG-SS (at the recommended cutoff of at least one domain coded as *a lot of difficulty* or *cannot do at all*)[3]

To review, using the WG-SS to define the category *without disability* in the table below includes all those who responded only *no difficulty* or *some diffic*ulty to all six of the WG-SS questions. The category *with disability* includes those who responded either *a lot of difficulty* or *cannot do at all* to at least one of the six WG-SS questions.

Table 1: Frequency distribution SS-Disability Indicator (SS-DI)

Disability Status: SS-DI	Frequency	Percent
Without disability	14905	88.8
With disability	1872	11.2
Total	16777	100.0

In the above table, disability prevalence as defined by the SS-DI is 11.2 %.

Because disability is measured over six domains of functioning, each with four possible response options, the WG-SS can be used to generate many other disability measures. As mentioned above, when examining disability dichotomies, the WG defined four possible disability status indicators based on different cutoffs [see: *Analytic Guidelines: Creating Disability Status Identifiers Using the WG-SS*].

[3] Data for all analyses and tables are derived from a sample of the 2013 US National Health Interview Survey (NHIS) among the adult population 18 years and older.

1. the least restrictive: those with any difficulty at all, in any domain of functioning and at any level of difficulty (minimum is at least one domain has at least *some difficulty*);
2. a slightly more conservative measure wherein at least two domains are *some difficulty*, or at least one domain is *a lot of difficulty* or *cannot do at all*;
3. the recommended cutoff: at least one domain is *a lot of difficulty* or *cannot do at all*; and
4. the most restrictive: at least one domain is *cannot do at all*.

Other dichotomies are possible, but these four were defined, proposed and adopted by the WG. Furthermore, any of these can be used to report prevalence; however, when reporting prevalence, it must be made clear what tool was used to measure disability, and what cutoff was selected for the determination of disability status. Finally, only the definition recommended by the WG [option #3 above] is 'endorsed' for international reporting and cross-country comparability.

Disability is not, however, inherently a dichotomy, but rather best described as a continuum of functioning from no difficulty in any domain of functioning to significant difficulty over multiple domains. In order to meet the need for a measure of severity that would begin to describe this continuum, the WG embarked upon an examination of different measures of severity.

2. A Simple Disability Severity Indicator Based on 'Highest' Level of Difficulty – SS-Highest Difficulty (SS-HD)

As a first approach to creating a severity indicator, it was decided to expand the two disability categories defined in the SS-Disability Indicator above into four categories based on the highest level of difficulty over all six questions as shown in Table 2.

- those who responded *cannot do at all* to any functioning domain are labeled as **more severe**[4];
- those who had no functioning domains coded as *cannot do at all* AND who responded *a lot of difficulty* to at least one functioning domain are labeled as **moderate**;
- those who had no domains coded as *cannot do at all* OR *a lot of difficulty* AND responded *some difficulty* to at least one functioning domain are labeled as **milder**; and
- those who responded *no difficulty* to ALL six functioning domains are labeled as **none**.

[SAS syntax for creation of the severity indicator [variable label: SS-HD] is found in Appendix 1a.]

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[4] Severity labels are assigned based on degree of difficulty indicated in the response option selected. Other labels could be used (like low, intermediate and high) to describe different definitions of functional level.

Table 2: Frequency distribution severity indicator based on 'highest' level of difficulty – SS-Highest Difficulty (SS-HD)

SS-HD	Frequency	Percent
None	9266	55.2
Milder	5639	33.6
Moderate	1407	8.4
More Severe	465	2.8
Total	16777	100.0

According to the approach used in SS-HD, 55.2% of the population have no disability, 33.6% have milder disability, 8.4% have moderate disability and 2.8% have more severe disability.

It is important to remember that the labels refer to *position* on the continuum, and are not absolute descriptions and there is nothing in the questions themselves that would indicate the proper label to use. The terms used, such as 'more severe', could be used to describe other cutoffs. When interpreting the results obtained when using this categorization, it is critical to refer back to the definitions of the terms rather than to rely on the labels.

The cross-tabulation in Table 3 below illustrates the differentiation of the derived disability severity indicator [SS-HD] according to the disability status indicator [SS-DI].

Table 3: Cross-tabulation – SS-Highest Difficulty (SS-HD) by the dichotomous SS-Disability Indicator3 (SS-DI3)

SS-HD	SS-DI3			
	Without disability	With disability	Total	Percent
None	9266	0	9266	55.2
Milder	5639	0	5639	33.6
Moderate	0	1407	1407	8.4
More Severe	0	465	465	2.8
Total	14905	1872	16777	100.0

This 4-point disability severity indicator differentiates *without disability* into a **none** category (all of those with *no difficulty* at all over the six domains of functioning) and a **milder** category (those with only *some difficulty* on one or more domains of functioning); and *with disability* into a **moderate** category (those with only *a lot of difficulty* on one or more domains of functioning) and a **more severe** category (those with *cannot do at al*l on one or more domains of functioning).

This approach does not, however, capture the fullness of the disability continuum. It also creates rather crude categories of severity. For example, someone with only one domain coded *some difficulty* has the same severity grade [**milder**] as someone with all six domains coded *some difficulty*. Similarly, there are other combinations which produce the same outcome. Someone with only one domain coded *a lot of difficulty* has the same severity grade [**moderate**] as someone with all six domains coded as *a lot of difficulty*, or three domains *a lot* and *three domains some;* or four domains *a lot* and two domains *no difficulty.*

3. Developing a Disability Severity Indicator Based on a Quantitative Disability Continuum – Assigning Scores to the Answer Categories

Another approach to determining severity was developed to deal with the issues raised above and better capture the fullness of the disability continuum.

The methodology assigns *scores* to the response options for the six WG-SS questions and then adds the scores over individual domains to create an individual's severity score (where the individual is on a severity continuum) and, over all individuals, a severity continuum for the entire sample.

a. Initially, responses to the WG-SS questions were *scored* on a simple numerical gradient scale: 0 (*no difficulty*), 1 (*some difficulty*), 2 (*a lot of difficulty*), 3 (*cannot do at all*).

Individual severity scores were derived by summing the values (scores) for the six questions for each individual. Considering the four possible answer options over the six WG-SS questions, there are 126 possible combinations[5] of results. Seven examples of these are shown in Table 4. (Numbers in the table refer to the response score, or graded level of difficulty, for that particular domain of functioning - 0 = no difficulty, 1 = some difficulty, 2 = a lot of difficulty and 3 = cannot do at all.) A few examples are provided. The simplest case is where the same level of difficulty is found for all domains.

Example 1 [Row 1 in Table 4 below]:
- Someone with all 6 domains 0 [*no difficulty*] has a total severity score of 6*0=**0**.

Example 2 [Row 2 in Table 4 below]:
- Someone with all 6 domains 3 [*cannot do at all*] has a total severity score of 6*3=**18**.

In more complicated cases the score for the individual is obtained by adding the different components.

Example 3 [Row 3 in Table 4 below]:
- A hypothetical person who has 1 *some* [1*1=1] + 2 *a lot* [2*2=4] + 3 *cannot do* [3*3=9] has a total severity score of 1+4+9=**14**.

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[5] *To determine how many different ways items can be chosen:*
How many different numbers are possible?   6 (n) The 6 WG questions
How many numbers are used?   4 (r) The 4 response options
Is the order of the numbers important?   No
Can you repeat a number?   Yes

Formula: $\frac{(r+n-1)!}{r!(n-1)!} = \frac{(4+6-1)!}{4!(6-1)!} = 126$

For more information on the Washington Group on Disability Statistics, visit: http://www.washingtongroup-disability.com/.

Table 4.

Example	Seeing	Hearing	Mobility	Cognition	Communication	Self-care	Severity Score
1	0	0	0	0	0	0	0
2	3	3	3	3	3	3	18
3	3	3	2	2	3	1	14
4	0	0	0	1	1	1	3
5	0	0	3	0	0	0	3
6	1	1	2	1	1	1	7
7	3	3	0	0	0	0	6

Since there is no gold standard by which to assign individual severity scores to the response categories, the choice of the numerical values assigned to the response options can lead to outcomes that are counterintuitive.

Examples 4 and 5 [**Rows 4 and 5 in Table 4 above**]:
- A person with 3 *somes* ([3*1=3] and 3 *nones* [3*0=0] = 3+0 = **3**) has the same overall score of **3** as a person with 1 *cannot do* ([1*3=3] and 5 *nones* [5*0=0] = 3+0 = **3**).

Examples 6 and 7 [**Rows 6 and 7 in Table 4 above**]:
- Another example, a person with 1 *a lot* [1*2=2] and 5 *somes* [5*1=5] scored **7** [2+5], which is higher than a person with 2 *cannot do* [2*3=6] and 4 *nones* [4*0=0] whose score is **6** [6+0].

These types of counterintuitive outcomes called this approach into question so other avenues were attempted.

b. Other numerical gradients for the response options were considered and examined.

In place of [0/1/2/3] for *no difficulty/some difficulty/a lot of difficulty/cannot do*, the following gradients were tested: [1/2/3/4], [0/4/8/12], [0/1/4/8], [0/1/6/12], [0/6/12/18], [0/8/16/24], [1/5/9/13], [1/7/13/19] and [1/9/17/25].

None of these produced logical and reasonable results for reasons similar to those indicated above.

An additional gradient, [*no difficulty*=0; *some difficulty*=1; *a lot of difficulty*=6 and *cannot do at all*=36], based on multiples of 6 was derived and tested. Six was selected being the number of questions, thus generating a greater spread of scores with less overlap between response categories.

Using the same examples of responses for the six functioning domains [Table 4 above] with the new scores for the responses the following total scores are obtained.

Example 1 [Row 1 in Table 5 below]:
  - Someone with all 6 domains 0 [*no difficulty*] their total score is 6*0=**0**.

Example 2 [Row 2 in Table 5 below]:
  - Someone with all 6 domains 36 [*cannot do at all*] their total score is 6*36=**216.**

Example 3 [Row 3 in Table 5 below]:
  - A hypothetical person who has 1 *some* [1*1=1] + 2 *a lots* [2*6=12] + 3 *cannot do* [3*36=108] their total score is **121** [1+12+108].

Examples 4 and 5 [**Rows 4 and 5 in Table 5 below**]:
  - And now, that person with 3 *somes* [3*1=3] and 3 *nones* [3*0=0] has an overall score **3** [3+0], while the person with 1 *cannot do* [1*36=36] and 5 *nones* [5*0=0] has a score of **36** [36+0].

Examples 6 and 7 [**Rows 6 and 7 in Table 5 below**]:
  - The other example, a person with 1 *a lot* [1*6=6] and 5 *somes* [5*1=5] now scores **11** [6+5], which is less than a person with 2 *cannot do* [2*36=72] and 4 [4*0=0] *nones* who now scores **72** [72+0].

Table 5.

Example	Seeing	Hearing	Mobility	Cognition	Communication	Self-care	Severity Score
1	0	0	0	0	0	0	0
2	36	36	36	36	36	36	216
3	36	36	6	6	36	1	121
4	0	0	0	1	1	1	3
5	0	0	36	0	0	0	36
6	1	1	6	1	1	1	11
7	36	36	0	0	0	0	72

The counter-intuitive results found for the other sets of scores are not found using this scoring method.

For more information on the Washington Group on Disability Statistics, visit: http://www.washingtongroup-disability.com/.

4. Developing a Disability Severity Indicator Based on a Quantitative Disability Continuum – Creating the Quantitative Severity Score [SS-Severity Continuum (SS-SCo)] and an Associated Disability Severity Indicator [SS-Severity Category (SS-SC)].

Severity scores for each person are based on the 'constellation' of levels of difficulty over the six domains of functioning for each individual.

Applying the above logic, severity scores for each individual were determined by following these steps:

1. Recode the values of the six WG-SS functioning domains so that
   * a response *no difficulty* is coded 0.
   * a response *some difficulty* is coded 1.
   * a response *a lot of difficulty* is coded 6, and
   * a response *cannot do at all* is coded 36.

   [SAS syntax for this recode is found in Appendix 1b.]

2. The overall severity score [SS-Severity Continuum (SS-SCo)] is the summation of recoded domain values for each individual. This severity score is quantitatively measured on a broad **continuum** of functioning. Table 6 shows the frequency distribution of the scores that result from the coding structure above. Note that 55.2% have a score of 0 which indicates responses of no difficulty on all domains; 20.5% have a score of 1 which indicates that some difficulty was the response on one domain and no difficulty was the response to the other domain. The other scores reflect different combinations of responses to the six questions. The scores on this continuum could be used as a continuous variable in analyses.

   [SAS syntax to compute the overall severity score [variable label: SS-SCo] is found in Appendix 1c.]

Table 6: Frequency distribution of overall Severity Score: SS-Severity Continuum (SS-SCo)

SS-Severity Continuum: SS-SCo	Frequency	Percent
.00	9266	55.2
1.00	3441	20.5
2.00	1371	8.2
3.00	579	3.5
4.00	181	1.1
5.00	56	.3
6.00	338	2.0
7.00	366	2.2
8.00	232	1.4
9.00	134	.8

10.00	48	.3
11.00	15	.1
12.00	47	.3
13.00	51	.3
14.00	57	.3
15.00	35	.2
16.00	12	.1
18.00	13	.1
19.00	27	.2
20.00	16	.1
21.00	8	.0
24.00	4	.0
25.00	8	.0
26.00	5	.0
31.00	1	.0
36.00	72	.4
37.00	70	.4
38.00	56	.3
39.00	31	.2
40.00	13	.1
41.00	4	.0
42.00	21	.1
43.00	33	.2
44.00	23	.1
45.00	17	.1
46.00	5	.0
48.00	6	.0
49.00	4	.0
50.00	13	.1
51.00	4	.0
55.00	2	.0
56.00	4	.0
60.00	1	.0
61.00	1	.0
66.00	2	.0
72.00	17	.1
73.00	12	.1
74.00	8	.0

75.00	6	.0
76.00	1	.0
78.00	3	.0
79.00	8	.0
80.00	8	.0
81.00	1	.0
85.00	2	.0
86.00	2	.0
90.00	2	.0
91.00	1	.0
108.00	4	.0
109.00	2	.0
115.00	1	.0
144.00	2	.0
145.00	1	.0
150.00	1	.0
180.00	2	.0
TOTAL	16777	100.0

3. Figure 1 (below) shows the distribution of scores starting with a score of 3 and introduces cut points along the continuum to create four categories – none, milder, moderate and more severe. As noted, the first step in creating the severity indicator was to create a quantitative continuum of severity. The above distribution of SS-SCo [Table 6], is based on a limited number of discrete response categories (*no difficulty, some difficulty, a lot of difficulty,* and *cannot do at all*) registered in the six questions which is reflected in the distribution of scores. The scores on this continuum could be used as a continuous variable in analyses but the continuum can also be categorized for use in tables and for disaggregation. Cut points for a categorical severity indicator based on this continuum [SS-Severity Category (SS-SC)] were chosen along the distribution to create categories that would be as homogenous as possible regarding the risk associated with functional limitation. As there is no external gold standard to guide the identification of categories, the selection of cut points was based on the shape of the distribution and an understanding of the risk associated with combinations of levels of functioning across domains.

For more information on the Washington Group on Disability Statistics, visit: http://www.washingtongroup-disability.com/.

Figure 1: A Continuum of Functioning - Distribution of SS-Severity Continuum (SS-SCo) and cut points for a severity indicator [SS-Severity Category (SS-SC)] Scores >=3*
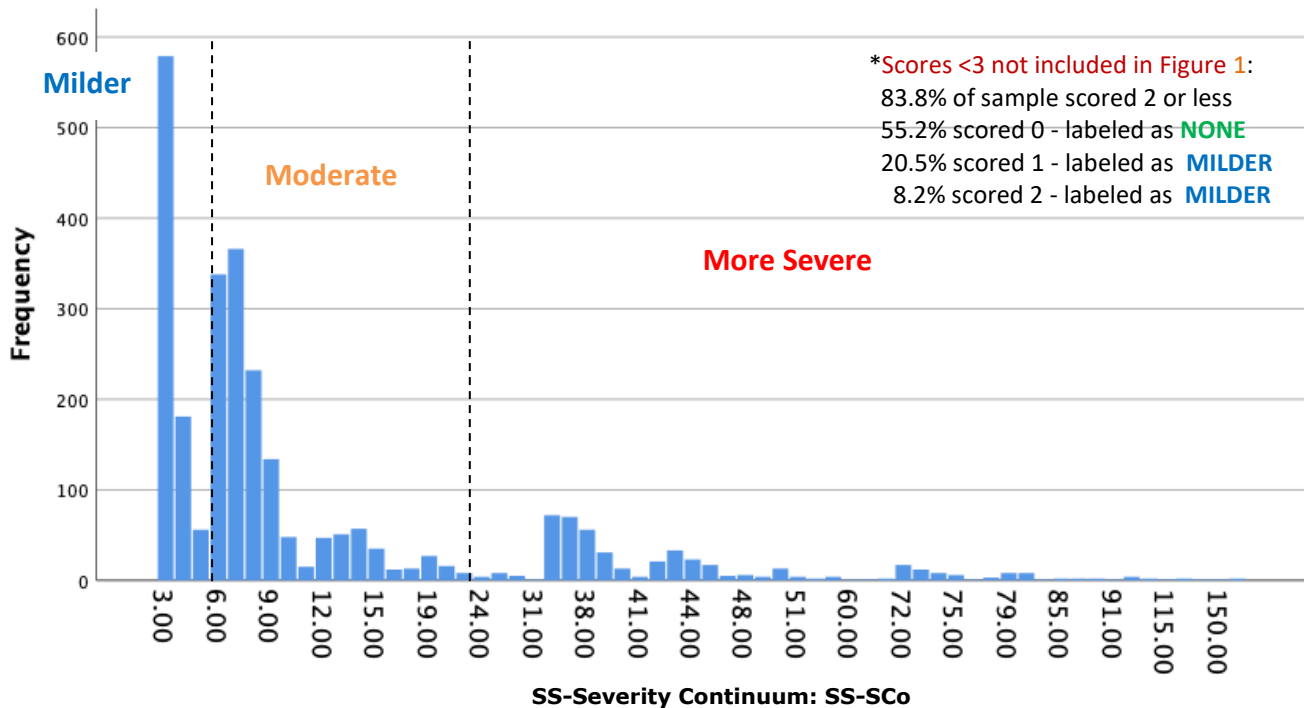
- Individuals with *no difficulty* over all 6 functioning domains were labeled as **None**[6]. SS-SCo = 0.
- Individuals with 1 – 4 functioning domains coded *some difficulty* only [no domains coded *a lot* or *cannot do at all*] were labeled as **Milder**. SS-SCo = 1 to 4.
- Individuals with 5 or 6 functioning domains coded *some difficulty* or up to 3 domains coded a lot of difficulty [no domains coded cannot do at all] were labeled as **Moderate**. SS-SCo = 5 to 23.
- Individuals with 4 or more functioning domains coded *a lot of difficulty* or any domain coded *cannot do at all* were labeled as **more Severe**. SS-SCo 24 to 216.

[SAS syntax to compute the Severity Indicator [SS-Severity Category (SS-SC)] based on the cutoffs determined above is found in Appendix 1d.]

Table 7 shows the frequency distribution for the categories of the new severity indicator [SS-Severity Category (SS-SC)]. Using this indicator 33.2% of the population has milder disability, 8.7% moderate disability and 2.9% have more severe disability.

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[6] Severity labels are assigned based on degree of difficulty indicated in the response option selected. Other labels could be used (like low, intermediate and high) to describe different definitions of functional level.

Table 7: Frequency distribution – SS-Severity Category (SS-SC)

SS-Severity Category: SS-SC	Frequency	Percent
None	9266	55.2
Milder	5572	33.2
Moderate	1455	8.7
More Severe	484	2.9
Total	16777	100.0

4. The Disability Severity Indicator [SS-SC] can be compared to the recommended Disability Status Indicator using the WG-SS [SS-DI3] and then to the Severity Indicator based on highest level of difficulty [SS-HD] to highlight the impact of the different definitions.

Table 8 below, illustrates that the severity indicator [SS-SC] differentiates those *with disability* on SS-DI into two distinct categories labeled as **moderate** and **more severe**. Those defined as *without disability* on SS-DI are divided into groups labeled **none, milder moderate**. 67 of those who are considered without disability using SS-DI are considered to have moderate disability using SS-SC.

Table 8: Cross-tabulation – SS-SC by Disability Status Indicator (SS-DI)

SS-SC	SS-DI			
	Without disability	With disability	Total	Percent
None	9266	0	9266	55.2
Milder	5572	0	5572	33.2
Moderate	67	1388	1455	8.7
More Severe	0	484	484	2.9
Total	14905	1872	16777	100.0
Percent	88.8	11.2	100.0	

Table 9 compares the severity indicator derived from the severity continuum [SS-SC] with the severity indicator based on highest the highest level of difficulty recorded [SS-HD]. Both have four discrete response categories. However, SS-SC uses the full continuum described in Table 6, and is based on the combined scaled responses rather than discrete response category used to identify the highest level of difficulty in SS-HD:

- 67 individuals who were classified as **milder** on SS-HD are classified as **moderate** on SS-SC. These are individuals with 5 or 6 domains recorded as *some difficulty* see the orange box in tables above. [These are the same 67 individuals who were *without disability* on the Disability Status indicator (SS-DI) in Table 8.]
- 19 individuals who were classified as **moderate** on SS-HD are classified as **more severe** on SS-SC. These are individuals with 4, 5 or 6 domains recorded as *a lot of difficulty* – see red box in tables above.

Table 9: Cross-tabulation – SS-Severity Category (SS-SC) by SS-Highest Difficulty (SS-HD)

SS-SC	SS-HD					
	None	Mild	Moderate	Severe	Total	Percent
None	9266	0	0	0	9266	55.2
Milder	0	5572	0	0	5572	33.2
Moderate	0	67	1388	0	1455	8.7
More Severe	0	0	19	465	484	2.9
Total	9266	5639	1407	465	16777	100.0
Percent	55.2	33.6	8.4	2.8	100.0	

5. Disaggregation of Selected Outcome Variables by Disability Status Indicator: SS-DI and the Two Disability Severity Indicators: SS-HD and SS-SC

Using the US National Health Interview Survey (NHIS), three outcome variables were selected for disaggregation analyses: Employment Status [labeled WORKING in NHIS], Health Insurance Coverage Status [labeled NOTCOV in NHIS], and Smoking Status [labeled SMKSTAT2 in NHIS]. Analyses of Employment Status are restricted to those between the ages of 18 and 64 years, other analyses are based on all adults 18 years of age and older. Disaggregation was based on SS-DI (the international standard dichotomy) and the two derived categorical severity indicators: SS-HD and SS-SC.

Table 10 below examines Employment Status by the disability identifiers: SS-DI, SS-HD and SS-SC. The dichotomous disability indicator differentiates between those with and without disability and shows that, in this sample of adults 18- 64 years of age, while 73.6% of those without disability were employed in the previous week, only 30.8% of those with disability were working.

Each of the severity indicators describes a gradient of employment by degree of difficulty. Looking first at SS-HD, 76.8% of those with severity level **None** were working, 66.9% of those with severity level **Milder** were working, and the percentages for those with **Moderate** and **More Severe** severity levels were 34.2% and 14.2% respectively.

Results for SS-SC were very similar to SS-HD: 76.8% of those with severity level **None** were working, 67.1% of those with severity level **Milder** were working, and the percentages for those with **Moderate** and **More Severe** severity levels were 35.0% and 13.7% respectively.

Table 10: Cross-tabulation – Employment status last week: Employment Status by Disability Status Indicator: SS-DI, and by Severity Indicators SS-HD and SS-SC (NHIS 2013: adult population 18-64 years of age)

SS-Disability Indicator3 (SS-DI) by Employment Status

SS-DI		Employment Status		
		not working	working	Total
Without disability	Weighted Row %	26.4%	**73.6%**	100.0%
	Unweighted Count	3160	8814	11974
With disability	Weighted Row %	69.2%	**30.8%**	100.0%
	Unweighted Count	720	303	1023
Total	Weighted Row %	29.3%	70.7%	100.0%
	Unweighted Count	3880	9117	12997

SS-Highest Difficulty (SS-HD) by Employment Status

SS-HD		Employment Status		
		not working	working	Total
None	Weighted Row %	23.2%	**76.8%**	100.0%
	Unweighted Count	1824	6214	8038
Milder	Weighted Row %	33.1 %	**66.9%**	100.0%
	Unweighted Count	1336	2600	3936
Moderate	Weighted Row %	65.8%	**34.2%**	100.0%
	Unweighted Count	569	268	837
More Severe	Weighted Row %	85.4%	**14.6%**	100.0%
	Unweighted Count	151	35	186
Total	Weighted Row %	29.3%	70.7%	100.0%
	Unweighted Count	3880	9117	12997

SS-Severity Category (SS-SC) by Employment Status

SS-SC		Employment Status		
		not working	working	Total
None	Weighted Row %	23.2%	**76.8%**	100.0%
	Unweighted Count	1824	6214	8038
Milder	Weighted Row %	32.9%	**67.1%**	100.0%
	Unweighted Count	1314	2583	3897
Moderate	Weighted Row %	65.0%	**35.0%**	100.0%
	Unweighted Count	579	285	864
More Severe	Weighted Row %	86.3%	**13.7%**	100.0%
	Unweighted Count	163	35	198
Total	Weighted Row %	29.3%	70.7%	100.0%
	Unweighted Count	3880	9117	12997

Table 11 below examines Health Insurance Coverage Status by the disability identifiers: SS-DI, SS-HD and SS-SC. The dichotomous disability indicator differentiates between those with and without disability and shows that, in this sample of adults 18 years of age and older, there is little difference in insurance coverage among those with and without disability. Those with disability have slightly higher coverage, 88.5%, compared to those without disability, 82.7% those with disability were working.

Each of the severity indicators shows a gradient across the severity levels **none**, **milder**, **moderate** and **more severe**. Interestingly, the insurance coverage gradient described below is in the opposite direction than the employment gradient described above. For SS-HD, health insurance coverage increases with increasing level of severity: from 81.7% for those with **None**, to 84.4% among those with **Milder** to 87.1% among those with **Moderate** and 93.4% for those with **More Severe**. This is likely a reflection of the coverage provided by the Social Security Disability Insurance (SSDI) program in the United States.

Results for SS-SC were very similar to SS-HD: again, health insurance coverage increases with increasing level of severity: from 81.7% for those with **None**, to 84.3% among those with **Milder** to 87.2% among those with **Moderate** and 93.4% for those with **More Severe**.

Table 11: Cross-tabulation – Health Insurance Coverage Status by Disability Status Indicator: SS-DI, and by Severity Indicators: SS-HD and SS-SC (NHIS 2013: adult population 18 years and older)

SS-Disability Indicator3 (SS-DI) by Health Insurance Coverage Status

SS-DI		Health Insurance Coverage Status			
		Not covered	**Covered**	Don't know	Total
Without disability	Weighted Row %	16.9%	**82.7%**	0.4%	100.0%
	Unweighted Count	2613	12243	49	14905
With disability	Weighted Row %	11.4%	**88.5%**	0.0%	100.0%
	Unweighted Count	209	1661	2	1872
Total	Weighted Row %	16.4%	83.2%	0.4%	100.0%
	Unweighted Count	2822	13904	51	16777

SS-Highest Difficulty (SS-HD) by Health Insurance Coverage Status

SS-HD		Health Insurance Coverage Status			
		Not covered	**Covered**	Don't know	Total
None	Weighted Row %	17.9%	**81.7%**	0.4%	100.0%
	Unweighted Count	1740	7498	28	9266
Milder	Weighted Row %	15.2%	**84.4%**	0.4%	100.0%
	Unweighted Count	873	4745	21	5639
Moderate	Weighted Row %	12.9%	**87.1%**	0.0%	100.0%
	Unweighted Count	177	1229	1	1407
More Severe	Weighted Row %	6.5%	**93.4%**	0.1%	100.0%
	Unweighted Count	32	432	1	465
Total	Weighted Row %	16.4%	83.2%	0.4%	100.0%
	Unweighted Count	2822	13904	51	16777

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http://www.washingtongroup-disability.com/.

SS-Severity Category (SS-SC) by Health Insurance Coverage Status

SS-SC		Health Insurance Coverage Status			
		Not covered	Covered	Don't know	Total
None	Weighted Row %	17.9%	**81.7%**	0.4%	100.0%
	Unweighted Count	1740	7498	28	9266
Milder	Weighted Row %	15.2%	**84.3%**	0.4%	100.0%
	Unweighted Count	864	4687	21	5572
Moderate	Weighted Row %	12.8%	**87.2%**	0.0%	100.0%
	Unweighted Count	184	1270	1	1455
More Severe	Weighted Row %	6.5%	**93.4%**	0.1%	100.0%
	Unweighted Count	34	449	1	484
Total	Weighted Row %	16.4%	83.2%	0.4%	100.0%
	Unweighted Count	2822	13904	51	16777

Table 12 below examines Smoking Status by the disability identifiers: SS-DI, SS-HD and SS-SC. The dichotomous disability indicator SS-DI differentiates between those with and without disability and shows that, in this sample of adults 18 years of age and older, those with disability were more likely to be current everyday smokers, 19.6%, compared to those without disability, 13.3%.

Each of the severity indicators, SS-HD and SS-SC, shows a gradient across severity levels **none**, **milder**, **moderate** and **more severe**, and while there is less of a patterned gradient than in the two previous examples, those with severity level **None** are less likely to be current everyday smokers than those with severity level **milder**, **moderate** or **more severe**.

For SS-HD, results for current everyday Smoking Status are: 12.0% for those with **None**, 15.5% among those with **Milder**, 21.5% among those with **Moderate** and 13.4% for those with **More Severe**.

Results for SS-SC were again similar to SS-HD: 12.0% for those with **None**, 15.6% among those with **Milder**, 20.7% among those with **Moderate** and 14.9% for those with **More Severe**.

These results can be used to raise questions and awareness about risky health behaviors and focus interventions that are directed to improve health outcomes associated with risky health behaviors among targeted populations.

Table 12: Cross-tabulation – Smoking Status by Disability Status Indicator: SS-DI3, and by Severity Indicators: SS-HD and SS-SC (NHIS 2013: adult population 18 years and older)

SS-Disability Indicator3 (SS-DI) by Smoking Status

		Smoking Status						
SS-DI		**Current every day smoker**	Current some day smoker	Former smoker	Never smoker	Smoker, current status unknown	Unknown if ever smoked	Total
Without disability	Weighted Row %	**13.3%**	4.1%	21.0%	61.5%	0.0%	0.1%	100.0%
	Unweighted #	1985	609	3179	9108	5	19	14905
With disability	Weighted Row %	**19.6%**	3.2%	28.7%	48.5%		0.1%	100.0%
	Unweighted #	363	79	533	895		2	1872
Total	Weighted Row %	13.9%	4.0%	21.8%	60.2%	0.0%	0.1%	100.0%
	Unweighted #	2348	688	3712	10003	5	21	16777

SS-Highest Difficulty (SS-HD) by Smoking Status

		Smoking Status						
SS-HD		**Current every day smoker**	Current some day smoker	Former smoker	Never smoker	Smoker, current status unknown	Unknown if ever smoked	Total
None	Weighted Row %	**12.0%**	4.0%	18.5%	65.3%	0.0%	0.1%	100.0%
	Unweighted #	1105	367	1686	6091	3	14	9266
Milder	Weighted Row %	**15.5%**	4.3%	25.5%	54.6%	0.0%	0.0%	100.0%
	Unweighted #	880	242	1493	3017	2	5	5639
Moderate	Weighted Row %	**21.5%**	3.3%	27.7%	47.5%			100.0%
	Unweighted #	301	65	396	645			1407
More Severe	Weighted Row %	**13.4%**	2.7%	31.8%	51.8%		0.4%	100.0%
	Unweighted #	62	14	137	250		2	465
Total	Weighted Row %	13.9%	4.0%	21.8%	60.2%	0.0%	0.1%	100.0%
	Unweighted #	2348	688	3712	10003	5	21	16777

SS-Severity Category (SS-SC) by Smoking Status

SS-SC		Current every day smoker	Current some day smoker	Former smoker	Never smoker	Smoker, current status unknown	Unknown if ever smoked	Total
None	Weighted Row %	**12.0%**	4.0%	18.5%	65.3%	0.0%	0.1%	100.0%
	Unweighted #	1105	367	1686	6091	3	14	9266
Milder	Weighted Row %	**15.6%**	4.3%	25.5%	54.5%	0.0%	0.0%	100.0%
	Unweighted #	871	238	1477	2979	2	5	5572
Moderate	Weighted Row %	**20.7%**	3.3%	27.5%	48.5%			100.0%
	Unweighted #	302	69	409	675			1455
More Severe	Weighted Row %	**14.9%**	2.6%	31.1%	51.1%		0.3%	100.0%
	Unweighted #	70	14	140	258		2	484
Total	Weighted Row %	13.9%	4.0%	21.8%	60.2%	0.0%	0.1%	100.0%
	Unweighted #	2348	688	3712	10003	5	21	16777

In conclusion, because of the limited number of response options to the WG-SS [*no difficulty, some difficulty, a lot of difficulty* and *cannot do at all*], SS-HD and SS-SC produce similar severity categorizations. Certainly, the approach based on highest level of difficulty over the six domains of functioning [SS-HD] is the simpler of the two to explain and calculate. However, because of the inherent nature of disability, as defined along a continuum of functioning, a severity indicator that makes more use of the continuum, as defined through the SS-SCo, may result in a better ascertainment of risk especially for large samples. The SS-SC classifies individuals with 5 or 6 domains recorded as *some difficulty* as having moderate disability whereas these individuals are classified as having milder disability on SS-HD. Similarly, individuals with 4, 5 or 6 domains recorded as *a lot of difficulty* are classified as moderate on SS-HD but are classified as more severe on SS-SC. Without an external gold standard by which to evaluate the categorizations, the choice of indicator to use in a particular analysis will depend on which classification more appropriately characterizes risk in the population.

Appendix: SAS Syntax

Appendix 1a:

SAS syntax to create this 4-category severity indicator, SS-Highest Difficulty (SS-HD). See page 4. Codes 7 (REFUSED), 8 (NOT ASCERTAINED) and 9 (DON'T KNOW) are coded as MISSING.

```
If VIS_SS in (1,2,3,4) then Vision= VIS_SS;
Else If VIS_SS in (7,8,9) then Vision=.;

If HEAR_SS2 in (1,2,3,4) then Hearing=HEAR_SS2;
Else If HEAR_SS2 in (7,8,9  ) then Hearing=.;

If MOB_SS2 in (1,2,3,4) then Mobility=MOB_SS2;
Else If MOB_SS2 in (7,8,9) then Mobility=.;

If COG_SS in (1,2,3,4) then Cognition=COG_SS;
Else If COG_SS in (7,8,9) then Cognition=.;

If COM_SS in (1,2,3,4) then Communication =COM_SS;
Else If COM_SS in (7,8,9) then Communication =.;

If UB_SS in (1,2,3,4) then Self_Care=UB_SS;
Else If UB_SS in (7,8,9) then Self_Care=.;

IF (missing(Vision ) and missing(hearing ) and missing(Mobility ) and
missing(communication ) and missing(Cognition ) and  missing(Self_Care
)   ) then SS_HD = .; *missing;
Else IF (Vision = 4 or hearing = 4 or Mobility = 4 or communication =
4 or Cognition = 4 or Self_Care = 4)then SS_HD = 4; *Severe;
Else IF SS_HD = 0 and (Vision = 3 or hearing = 3 or Mobility = 3 or
communication = 3 or Cognition = 3 or Self_Care = 3) then SS_HD = 3;
*Moderate;
Else IF SS_HD = 0 and (Vision = 2 or hearing = 2 or Mobility = 2 or
communication = 2 or Cognition = 2 or Self_Care = 2) then SS_HD=2;
*Mild;
Else IF (SS_HD = 0) then SS_HD = 1; *None;
```

Appendix 1b:

SAS syntax to recode values for WG_SS domains into NEW VARIABLES. See page 9.

VIS_SS HEAR_SS MOB_SS COM_SS UB_SS and COG_SS are the original variables in the data base. In this example their original response values are 1: no difficulty, 2: some difficulty, 3: a lot of difficulty, and 4: cannot do at all. The syntax above recodes them into NEW VARIABLES: VIS_6 HEAR_6 MOB_6 COM_6 UB_6 COG_6. They are recoded 0: no difficulty, 1: some difficulty, 6: a lot of difficulty, and 36: cannot do at all.

```
        If Vision=1 then VIS_6=0;
Else If Vision=2 then VIS_6=1;
Else If Vision=3 then VIS_6=6;
Else If Vision=4 then VIS_6=36;


         If hearing=1 then HEAR_6=0;
 Else If hearing=2 then HEAR_6=1;
 Else If hearing=3 then HEAR_6=6;
 Else If hearing=4 then HEAR_6=36;


         If Mobility=1 then Mob_6Recode=0;
 Else If Mobility=2 then Mob_6Recode=1;
 Else If Mobility=3 then Mob_6Recode=6;
 Else If Mobility=4 then Mob_6Recode=36;


        If communication=1 then COM_6=0;
 Else If communication=2 then COM_6=1;
 Else If communication=3 then COM_6=6;
 Else If communication=4 then COM_6=36;



        If Cognition=1 then COG_6=0;
Else If Cognition=2 then COG_6=1;
Else If Cognition=3 then COG_6=6;
Else If Cognition=4 then COG_6=36;


         If Self_Care=1 then UB_6=0;
Else If Self_Care=2 then UB_6=1;
Else If Self_Care=3 then UB_6=6;
Else If Self_Care=4 then UB_6=36;
```

Appendix 1c:
SAS syntax to create the severity score [SS-SCo]. This is the summation of recoded domain values for each individual. This severity score that is measured on a broad continuum of functioning. See page 9.

```
SS_SCo=sum(VIS_6 , HEAR_6 , Mob_6Recode , COM_6 ,  COG_6, UB_6).
```

Appendix 1d:
SAS syntax to compute the Severity Indicator [SS-SC] based on the established cutoffs. See page 12. Bolded numbers in the syntax below are the SS-SCo cutoff values in Table 8.

```
If missing (SS_SCo) then  SS_SC=.;
Else If SS_SCo=0 then        SS_SC=0; *None;
Else If 1 <= SS_SCo <=4   then SS_SC=1;*Mild;
Else If 5 <= SS_SCo <=23  then SS_SC=2;*Moderate;
Else If 24<= SS_SCo <=216 then SS_SC=3;*Severe;
```

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http://www.washingtongroup-disability.com/.