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NATIONAL HEALTH AND AGING TRENDS STUDY (NHATS)

Construction of performance-based summary measures of physical capacity in the National Health and Aging Trends Study

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I. Background and Overview

The NHATS disability framework (Freedman, 2009) explicitly distinguishes among measures of an individual's physical, sensory, and cognitive *capacity* to carry out activities, how activities are accomplished by individuals (*accommodations*), and difficulty carrying out activities independently given whatever accommodations have been put in place (*activity limitations*). Capacity measures are important for tracking trends in function that are independent of environmental changes or accommodations, for understanding the disablement process, and as targets for interventions to prevent or slow onset of activity limitations (LIFE Study Investigators, 2006).

NHATS includes both performance-based and self-reported measures of physical capacity. The physical performance measures are the focus of this technical paper. See NHATS' Round 1 User Guide (Kasper and Freedman, 2012) for further details about the self-reported measures and measures of sensory and cognitive capacity.

The selection of physical performance measures of capacity for NHATS was informed by prior studies including the Women's Health and Aging Study (Guralnik et al., 1995; Simonsick et al., 1997) and the Health and Retirement Survey, among others. 5 performance activities were included in the final protocol: (nested) balance tests; a 3-meter usual walking speed to measure locomotion; rapid chair stands reflecting lower body muscle function; grip strength and peak air flow, a measure of maximum outflow of air from the lungs. Numerous studies have shown these measures have good-to-excellent reliability (Seeman et al., 1994; Ferrucci et al., 1996; Jette et al. 1999; Simonsick et al. 1997; Ostir et al. 2002) and predict hospitalization, nursing home admission, death, and disability (Guralnik et al. 1994; Guralnik et al. 1995; Guralnik et al. 2000; Cesari et al. 2009; Ostir et al. 1998; Rantanen et al. 1999; Vaz Fragoso et al. 2008; Rantenen et al. 2003; Cook et al. 1991; Giampaoli et al. 1999; Studenski et al. 2011). The NHATS Activities Booklet (available with the Round 1 instruments at www.NHATS.org), NHATS Round 1 User Guide, and NHATS Round 1 Data Collection Procedures provide details on protocols for administering the NHATS performance activities.

This technical paper describes the performance activity summary measures that have been constructed for the NHATS Round 1 Sample Person File (www.nhats.org) and will be included in subsequent annual data releases. In addition to test-specific summary measures, two versions of the Short Physical Performance Battery (SPPB) have been developed from the lower extremity function measures: The Original SPPB and what we refer to as the NHATS Expanded SPPB. Appendices A and B provide variable names and labels for the measures. SAS programming statements used to create these measures also are available at (www.nhats.org/scripts/TechnicalPapers).

The Original SPPB constructed for NHATS uses the scoring approach drawn from Guralnik, et al. (1994). In that article, scores were developed using three sites from the Established Populations for Epidemiologic Studies of the Elderly (EPESE): East Boston, Massachusetts, Iowa and Washington Counties in rural Iowa, and a stratified random sample from New Haven, Connecticut. This community-based sample consisted of approximately 5,000 persons ages 71 and older in 1988-1989 who were living at home and able to complete the EPESE interview without a proxy. The Original SPPB sums balance stand, walking speed, and repeated chair stand scores. Both walking speed and the repeated chair stand score cut points were constructed by dividing the EPESE sample distribution into quartiles, whereas the balance scores reflected completion of nested tests (side-by-side, semi-tandem, and full tandem stands). In that study, a very high proportion of the sample (49%) was able to perform the most difficult balance test.

The scoring approach for all three components of the NHATS Expanded SPPB—balance, walking speed and the repeated chair stands—uses cut points reflecting quartiles of the NHATS sample distribution. The nested balance stands differ from the Original SPPB version in that a more difficult balance test—standing on one leg with eyes open—is added, making the range of functioning being tested broader and the score more sensitive at the higher end of the scale. The NHATS summary scores for grip strength and peak air flow, which are not components of the SPPB, also are scored using quartiles of the NHATS sample distribution. The NHATS sample, when weighted, represents the non-nursing home Medicare population ages 65 and older in 2011.[1]

II. Development of Performance Activity Summary Measures

Performance activity summary measures were created in three steps: 1) developing an administration result for each performance activity that reflected eligibility and test administration results for those eligible (completed, not completed, not attempted & reason missing); 2) implementing scoring criteria for each test (based on both the NHATS Expanded and the Original SPPB criteria); and 3) summing components to obtain the SPPB. To ease use, particularly for researchers who may be interested in developing imputations for missing values, we also created an indicator of reasons cases are missing on the SSPB.

Step 1: Determination of Detailed Administration Results

For each test, eligible sample persons were assigned an administration result. This indicator includes (for eligible individuals) whether the activity was completed, attempted, or not attempted. Reasons for not attempting an activity (designated here as safety-related and non-safety-related reasons) were also recorded. A brief overview of each of these classifications follows:[2]

Eligible. All NHATS participants with a Sample Person interview, including those with interviews completed with a proxy respondent,[3] were screened to determine their eligibility to participate in the performance activities. Exclusion criteria, which identified persons not eligible for an activity, are:

- Balance stands: person who in the last month either used a mobility device to get out of bed all the time or never got out of bed by self and who says he/she is unable to stand without holding on to anyone or anything
- Walking 3 meters: uses a wheelchair or scooter every time to get around inside home; unable to walk a short distance by self (even with cane/walker if used)[4]

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[1] The NHATS sample was drawn from the Medicare enrollment file. 96% of persons ages 65 and older in the United States are Medicare beneficiaries. According to the 2010 US Census, there are 40.3 million individuals ages 65 and older living in the United States (Howden and Meyer, 2011). CMS estimates Medicare enrollment for its aged beneficiaries to be 38.8 million (excluding Puerto Rico and the Virgin Islands, but including states unknown https://www.cms.gov/MedicareEnRpts/Downloads/10Aged.pdf). The NHATS non-nursing home sample represents 35.3 million people on Medicare and living in the contiguous United States.

[2] Less detailed derived variables that capture the administration status of each activity are provided in the NHATS Round 1 Final Sample Person File (ba1dblssadm; ba1dblssadm; ba1dblstadm; ba1dblftadm; ba1dblopadm; wa1dwlkadm; ch1drchradm; gr1dgripadm; pk1dpeakadm). These variables distinguish participants who were eligible, and if so, whether they had a recorded result, and whether they were administered the test because they did not complete a prior activity. Specifications for these variables can be found in National Health and Aging Trends Study Round 1 User Guide: Final Release (www.NHATS.org).

[3] Of the 583 participants in Round 1 with proxy respondents, 259 had at least one completed activity.

[4] A small number of persons who said they were not able to walk a short distance, decided to participate and completed the activity (n=41). These results were retained.

- Chair stands: person unable to get up from chair without using mobility devices or help; surgery on both hips within 3 months
- Grip strength: surgery, or flare up of pain, in both hands or wrists; surgery to both arms or shoulders within last 3 months
- Peak air flow: none

Completed and attempted. Completed cases are those where the performance activity book was marked "1: completed" and, if applicable, where seconds or readings also were recorded. Cases that are "attempted, not completed" are those marked "attempted," and those that were marked "completed" but no seconds or readings were recorded.[5]

Not administered for safety-related reasons. Before any activity was administered, the interviewer demonstrated the activity and asked the participant if he or she thought it was safe to try. If the participant, a proxy, or the interviewer felt it was unsafe for the participant to try an activity, the interviewer marked "not attempted" and indicated "safety" concerns (of the participant, proxy or interviewer). If both "safety" reasons and "non-safety" reasons were given for not attempting a test, "safety" was used as the reason the activity was not attempted for scoring purposes.

Not administered for other reasons. Non-safety reasons for not attempting an activity were: the sample person did not understand the instructions, there was no appropriate chair available for the chair stands or not enough space for the walking course, the interviewer indicated "other, specify," or the interviewer marked "not attempted" but gave no reason.[6]

Did not complete a prior activity. For balance stands, participants who attempted a stand but did not complete it or who did not attempt a stand, were not asked to attempt the next, more difficult, stand. Similarly, persons who could not complete a single chair stand without using their arms (e.g. to push off from the chair) were not asked to attempt the repeated chair stands. In practice, small numbers of participants who did not complete an easier activity, nonetheless attempted, and sometimes completed, a subsequent more difficult activity. When this occurred, results for all activities attempted or completed were retained.[7]

Table 1 summarizes the administration results for each of the performance activities. Participation was high, ranging from 86%-91%, for all except the most difficult balance stand. For example, for the side-by-side balance stand, 91% of those who could have participated (6280 completed + 56 attempted)/(6280+56+93 non safety reasons + 507 missing) completed or attempted the side-by-side balance stand. Note that as tests became more difficult, fewer individuals participated but the number of missing cases remained roughly the same, so the percentage participating declined.

With the exception of the walking course, non-administration was more often related to safety reasons than other reasons. Persons who were eligible but for whom information was missing constituted about 7% of the sample (between about 500 and 550)—lower for walking and somewhat higher for peak air flow. Persons with proxy respondents account for about half of these missing cases.

[5] 2 people completed but had no information recorded for the 1st walking course, peak air flow, and grip strength; five people met these criteria for the repeated chair stands.
[6] No reason was recorded in only a small numbers of cases: 11 for side by side balance stands; 4 for the 1st walking course; 12 for repeat chair stands; 9 for the 1st peak air flow test; and 8 for the 1st grip strength test.
[7] If persons who did not complete an easier activity went on to a more difficult one, all results were retained and the results for the more difficult task were used for scoring.

Table 1. Administration of NHATS performance activities[a]

Performance Activity	% Participating[b]	Not eligible	Administered: Completed	Administered: Attempted, not Completed	Eligible, Not Attempted by Reason: Prior Test Not Completed	Eligible, Not Attempted by Reason: Safety	Eligible, Not Attempted by Reason: Other	Missing
Balance stands								
Side by side	91.3	343	6280	56	---	330	93	507
Semi-tandem	91.5	343	5440	438	418[c]	425	37	508
Full-tandem	89.9	343	3706	1244	1207[c]	550	40	519
One leg eyes open	85.8	343	905	2467	2849[c]	486	27	532
One leg eyes closed	62.5	343	41	918	5470[c]	261	35	541
Walking course[d]	91.0	707	6181	7	---	105	373	236
Chair stands								
Single	87.8	389	5661	164	---	585	286	524
Repeated	86.4	389	5158	157	807[e]	261	312	525
Grip strength[d]	91.9	794	6211	3	---	54	49	498
Peak air flow[d]	90.3	---	6742	12	---	130	100	625

[a]n=7609. Persons with no Sample Person interview at Round 1 (468 persons in nursing homes and 168 persons in residential care with a facility staff interview only) are excluded from calculations.

[b]Percentage participating = administered / (administered + other non-safety + missing)

[c]The number of cases that did not complete a prior test does not sum to those who attempted or did not attempt the prior test for safety or not safety reasons because some persons who did not complete a prior test have results on a later test. Results on a test were retained even if an individual should not have gone on to that test based on the previous one. For example, of the 479 cases who attempted (n=56) or did not do the side by side balance stand (n = 330 for safety; n = 93 for other non-safety reasons), 418 are coded as "did not complete prior test" on the semi-tandem stand. The rest have codes for the semi-tandem stand: 44 were coded "safety" as the reason for not attempting the semi tandem; 1 attempted the semi tandem stand and 3 completed it; and 13 were coded "not safety" reasons for not attempting.

[d]1st of 2 attempts.

[e]Includes 150 who used arms for single chair stand; 145 who attempted single chair stand but did not complete; 462 who did not attempt the single chair stand for safety reasons; 50 who did not attempt the single chair stand for reasons other than safety.

Step II: Implementation of Scoring Criteria

Table 2 provides the criteria for assigning scores by activity and version (NHATS and Original SPPB). Seconds and hundredths of seconds were recorded for balance stands and repeated chair stands. Seconds and hundredths of seconds were recorded for time to walk 3 meters and converted to meters per second for scoring walking speed. The readings for grip strength were recorded in kilograms and for peak airflow, in liters per minute.

Scores of 1 to 4. Scoring cut offs (to assign values from 1 to 4) for the NHATS measures represent quartiles of the weighted distribution for non-missing, non-zero values. For the Original SPPB components, scoring cutoffs for balance and repeated chair stands are from Guralnik et al. (1994) and cutoffs for the walking speed component were interpolated for the NHATS 3 meter distance using the methodology in Guralnik et al. (2000).[8]

[8] Cutoffs for the walking speed component of the Original SPPB have been established for 2.44-meter (8-foot) and 4-meter distances (Guralnik et al 2000). Linear interpolation (a "rise over run" formula) was used to determine walking speed cutoffs for the 3m distance used in NHATS, with the 2.44m and 4m cutoffs serving as the nearest known brackets.

Table 2: Criteria for performance activity summary measure scoring

Score	Version	Balance Stands	Walking Speed[a] (m/s)	Repeated Chair Stands[a] (seconds)	Grip Strength[a] (kg)	Peak Air Flow[a] (l/min)
0 (lowest)	**NHATS**	Not eligible; Not attempted, safety reasons; Excluded from walking test and missing on balance/repeated chair stands	Not eligible; Not attempted for safety reasons; Attempted, but not completed	Not eligible; Not attempted, safety reasons; Attempted, not completed; Prior test attempted, not completed or not attempted, safety reasons; Excluded from walking test and missing on balance/repeated chair stands	Not eligible Not attempted for safety reasons; Attempted, but not completed	Not attempted for safety reasons; Attempted, but not completed
	Original SPPB				NA	NA
1	**NHATS[b]**	Same as Original SPPB or completed semi-tandem & held full tandem for 0 to 1.99 seconds[c] or did not attempt full tandem for safety reasons	≤.579	≥13.94	≤19.50	≤240
	Original SPPB	Completed side-by-side & did not complete or did not attempt semi-tandem for safety reasons	≤.441	≥16.70	NA	NA
2	**NHATS[b]**	Completed semi-tandem & held full tandem for 2 to 9.99 seconds or completed full tandem & held one leg stand eyes open for 0 to 2.99 seconds[c] or did not attempt one leg stand eyes open for safety reasons	.580 - .748	11.54 – 13.93	19.51-25.30	241 – 330
	Original SPPB	Completed semi-tandem & held full tandem for 0 to 2.99 seconds[c] or did not attempt full tandem for safety reasons	.442 - .624	13.70 – 16.69	NA	NA
3	**NHATS[b]**	Completed full tandem & attempted one leg eyes open & held for 3 to 15.99 seconds	.749 - .904	9.56 - 11.53	25.31-34.00	331 – 430
	Original SPPB	Completed semi-tandem & held full tandem for 3 to 9.99 seconds	.625 - .798	11.20 - 13.69	NA	NA
4 (highest)	**NHATS[b]**	Completed full tandem & attempted one leg eyes open & held for 16 to 30 seconds	≥.905	≤9.55	≥34.01	≥431
	Original SPPB	Completed full tandem	≥.799	≤11.19	NA	NA

[a]The best result of two tests used for scoring. [b]NHATS cut points reflect quartiles of the weighted distribution of non-missing, non-zero values. [c] In 87, 211, and 2 cases, individuals attempted the semi-tandem, full-tandem, or one-leg eyes open balance stands, respectively, but had no seconds recorded, so 0 seconds was assumed. NA = not applicable.

A Score of Zero. The same criteria were used for assigning zero for the NHATS and Original SPPB versions. A score of 0 was assigned to five distinct groups (see Table 3): participants who were not eligible; those who did not attempt an activity for safety reasons (participant, interviewer, or proxy felt it was unsafe); participants who attempted an activity but did not complete it; persons who did not complete a prior test (single chair stand) or did not attempt the prior test for safety reasons; and finally, individuals who were ineligible for the walking activity and were missing on the side by side balance stand (n=257) or the repeated chair stand (n=255).

Table 3. Cases assigned to 0 in performance activity summary measure scoring

Measure	Interview Item	Not eligible	Not attempted, safety reasons	Attempted, not completed	Prior test attempted, not completed or not attempted, safety reasons	Excluded from walking test and missing on balance/ repeated chair stands
Balance stands[a]	Unable to stand w/o holding on (PE11) (asked if always uses device to get out of bed or never got out of bed (BOX PE11))	343	330	56	NA	257
Walking	Uses wheel chair or scooter every time to get around (BOX PE13) or does not feel able to walk short distance by self (PE13)	707	105	7	NA	NA
Repeated chair stands	Serious injury or surgery on both hips last 3 months (PE9); Unable to get up out of chair by self (PE12)	389	261	157	757[b]	255
Grip strength	Serious injury or surgery to both hands or both shoulders (PE3; PE7); Current flare-up of pain to both hands (PE5)	794	54	3	NA	NA
Peak air flow	None	NA	130	12	NA	NA

[a]The balance stands measure (both Original SPPB and NHATS Expanded) assigns a score of 0 based on the side-by-side stand, which is the first test administered. [b]Of the 807 who did not complete the single chair stand (see Table 1), 50 were not assigned a 0 score. These individuals had reasons other than safety for not completing the single chair stand. NA = not applicable.

Alternative Scoring of cases to Zero. In all, 646 cases were assigned to zero on the SPPB (NHATS and Original) using the criteria described above. As noted and shown in Table 3 (last column), included were individuals who were ineligible for the walking activity and were eligible but missing on the side by side balance stand and the repeated chair stand. An alternative is to code as missing on the SPPB those who were ineligible for the walking activity and were missing on both the balance and chair stand because the performance battery was not administered (n = 226). Under this alternative approach, 420 cases are assigned to zero on both the NHATS and Original SPPB. To use this alternative scoring, implement the coding shown in Appendix C.

A Score of Missing (-9). Participants were assigned a score of missing (-9) if: they were eligible for an activity but no result was recorded; the reason for not attempting an activity was unrelated to safety or was missing or; for balance stands and repeated chair stands, if a previous balance stand or the single chair stand was not completed for reasons unrelated to safety or the reason was missing.

Score Distributions. Table 4 provides distributions on the individual summary measures. For all five NHATS measures, distributions were relatively even across scores 1-4 by design. As expected, the distributions for the components that form the SPPB (balance, walking, and chair stands), differ between the NHATS and the Original SPPB versions. On the balance stands, scores in the Original SPPB are skewed toward higher performance with 56.2% in the highest category. By contrast, 23.5% fall in the top quartile using the NHATS cut points for the balance stands. The walking speed and repeated chair stands distributions also are more skewed toward higher performance in the Original SPPB (35.4% and 33.5% in the highest quartile for walking and repeat chair stands, respectively) than in the NHATS version (21.0% and 18.5%).

Table 4. Score distribution for performance activity summary measures[a]

	NHATS					Original SPPB		
Score	**Balance Stands**	**Walking Speed (m/s)**	**Repeated Chair Stands (seconds)**	**Grip Strength (kg) [c]**	**Peak Air Flow (l/min) [c]**	**Balance Stands**	**Walking Speed (m/s)**	**Repeated Chair Stands (seconds)**
0 (lowest)	9.7	8.3	18.7	10.3	1.4	9.7	8.3	18.7
1	18.5	21.3	18.4	21.2	23.6	8.7	10.3	7.7
2	21.1	21.0	18.4	20.8	23.6	12.1	15.9	11.9
3	22.5	21.2	18.3	20.6	21.5	8.7	23.1	20.6
4 (highest)	23.5	21.0	18.5	20.9	21.8	56.2	35.4	33.4
Missing (-9)	4.7	7.1	7.7	6.2	8.1	4.7	7.1	7.7
Mean b	2.3	2.3	2.0	2.2	2.4	3.0	2.7	2.5

[a]N=7609. Persons with no Sample Person interview at Round 1 (468 persons in nursing homes and 168 persons in residential care with a facility staff interview only) are excluded from calculations. Weighted distributions shown.
[b]Mean excludes missing cases. [c]Grip strength and peak air flow are not components of the SPPB.

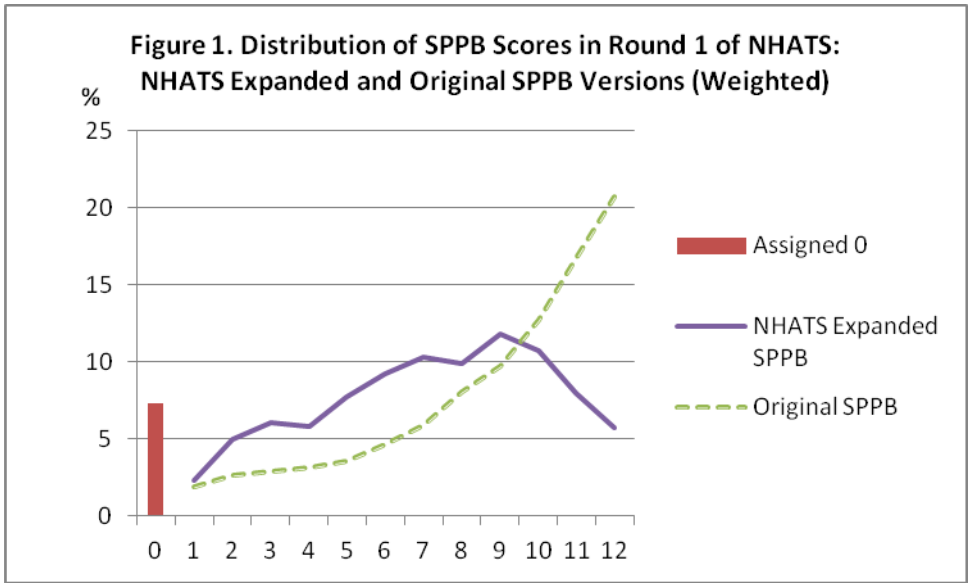
III. Creating the Short Physical Performance Battery (SPPB) Scores

The scores for balance stands, walking speed, and repeated chair stands were summed to create the NHATS Expanded and Original SPPB measures, which range from 0 to 12.

Missing values. Individuals who were missing on any one of these three scores do not receive a score on either version (n=1,031). The largest numbers of missing cases were from not having space to administer the walking course (n=242), not having an appropriate chair for the chair stands (n=192), and having a proxy interview (n=144). Of the missing cases, only 168 were missing on all 3 activities. Rather than dropping missing cases, analysts might choose to impute values for persons who are missing. A variable **r1dsppbmiss**, which indicates the reason a case is missing in the SPPB, has been provided for this purpose (Appendix B).

SPPB Distributions. Figure 1 shows the weighted distributions of the NHATS Expanded SPPB and the Original SPPB in Round 1 of NHATS. The NHATS Expanded SPPB distributes the population more evenly across the scoring range than the Original SPPB, which (like the individual component scores) shifts a

greater proportion of persons to scores at the higher end of the scale. The NHATS Expanded SPPB also exhibits a distribution that more closely approximates a normal distribution. Not surprisingly, however, the two scores are highly correlated (*r* = .96).



Means by age and gender. Table 5 provides means overall and by age and gender. On both measures, younger persons have higher mean scores than older persons and males have higher mean scores than females. Mean scores are lower for the NHATS Expanded SPPB at each age category and for both men and women, but ranges are similar for the two measures.

Table 5. Mean Scores: NHATS Expanded and Original SPPB

Mean Score	N	NHATS Expanded SPPB	Original SPPB
Total	6587[a]	6.7	8.3
Age Group			
65-69	1259	8.3	9.8
70-74	1386	7.4	9.0
75-79	1317	6.4	8.2
80-84	1287	5.4	7.0
85-89	786	4.0	5.3
90+	543	2.8	3.7
Gender			
Male	2753	7.3	8.9
Female	3825	6.2	7.8

[a]Remaining NHATS participants (n=1,031) were missing on one or more activities.

Choice of scale. The NHATS Expanded SPPB provides new, national norms for this measure of lower body capacity. Investigators studying disability trends and related causes and consequences, or interested in movement along the full spectrum of disability, may find the new measure relevant for

their purposes. The cutpoints in the Original SPPB are widely used in clinical and epidemiologic studies and are provided in the NHATS for investigators wishing to make direct comparisons with this extensive body of research.

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APPENDIX A. SPPB Variable Names and Labels*

Variable Name	Variable Label
r1dnhatssppb	R1 D NHATS SPPB SCORE
r1dnhatsbasc	R1 D NHATS BALANCE SCORE
r1dnhatswksc	R1 D NHATS WALK SCORE
r1dnhatschsc	R1 D NHATS REPEAT CHAIR SCORE
r1dnhatsgrav	R1 D NHATS AVG GRIP SCORE
r1dnhatsgrb	R1 D NHATS BEST GRIP SCORE
r1dnhatspkav	R1 D NHATS AVG AIR FLOW SCORE
r1dnhatspkb	R1 D NHATS BEST AIR FLOW SCORE
r1dsppbmiss	R1 D REASON MISSING SPPB
r1dorigsppb	R1 D ORIGINAL SPPB SCORE
r1dorigbasc	R1 D ORIGINAL BALNCE SCORE
r1dorigwksc	R1 D ORIGINAL WALK SCORE
r1dorigchsc	R1 D ORIGINAL REPEAT CHAIR SCORE

*On the NHATS R1 SP File following the performance activity variables.

Appendix B. Reason missing on SPPB (rdsppbmiss)

Persons coded as -9 on r1dnhatssppb and r1dorigsppb (n=1031) were missing (-9) on one or more of the 3 activities used to construct these measures. Explanations of the values of rdsppbmiss are provided below:

Value	Explanation
1=	cases where a proxy interview was conducted and person was eligible for one or more activities but did not participate
2-8=	eligible activities for which results were missing
9=	eligible and missing on walk because no space
10=	eligible and missing on repeated chair because no appropriate chair
11=	eligible and no space for walk and no appropriate chair
12=	missing on walk because no space and missing on one or more eligible activity
13=	missing on repeated chair because no appropriate chair and missing on one or more eligible activity
14-20=	eligible activities not done for non-safety reasons
-1=	inapplicable (values of 1-12 on r1dorigsppb/r1dnhatssppb; value of -1 [r1dresid=3 or 4] on r1dorigsppb/r1dnhatssppb)

Appendix C. Recoding from zero to missing those cases that were ineligible on walking and were eligible but missing on both the balance and chair stand because the performance battery was not administered (n = 226)

If ineligible for walking test and eligible for repeat chair stand but not administered and eligible for balance stand but not administered and eligible for peak air flow test but not administered, code as missing:

IF WA1DWLKADM = 4 AND CH1DRCHRADM = 2 AND BA1DBLSSADM = 2 AND PK1DPEAKADM = 2
THEN

R1dnhatsbasc = -9
R1dnhatschsc = -9
R1dnhatssppb = -9

R1dorigbasc = -9
R1dorigchsc = -9
R1dorigsppb = -9