NHATS Technical Paper #16

NATIONAL HEALTH AND AGING TRENDS STUDY (NHATS)
ROUND 5 SAMPLE DESIGN AND SELECTION

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Overview

The National Health and Aging Trends Study (NHATS) was initially designed to follow a nationally representative cohort of persons who were ages 65 and older and enrolled in Medicare as of September 30, 2010. The cohort has been interviewed annually. Replenishment took place in Round 5 so that the sample could be used to study disability trends as well as individual trajectories. The replenishment sample was drawn as of September 30, 2014.

The Medicare enrollment database serves as the sampling frame.[1] A Round 1 sample size of 8,500 respondents was targeted, with ample numbers to track disability trends by age and race/ethnicity. In Round 5, a total of 8,500 living respondents were targeted, with the new sample replacing both those in the youngest age group (ages 65-69) and those who had died or been lost to follow-up in older age groups.

Round 1 of NHATS used a stratified three-stage sample design: 1) selection of 95 primary sampling units (PSUs), which are individual counties or groups of counties, 2) selection of 655 secondary sampling units (SSUs), which are ZIP codes or ZIP code fragments within sampled PSUs, and 3) selection of beneficiaries within sampled SSUs who were age 65 and older as of September 30, 2010, with oversamples of the oldest age groups and of Black non-Hispanic persons. The probabilities of selection at each of the three stages were designed to yield equal probability samples and targeted sample sizes for sampling domains defined by age group and race/ethnicity. A total of 14,643 beneficiaries were sampled altogether and 12,411 cases released to the field. (For further details see Montaquila et al., 2012.)

This technical report provides details on the sample design and selection for Round 5 of NHATS. Section 1 describes the targeted sample sizes by age and race/ethnicity. Section 2 describes the sample frame. Section 3 provides details on the formation and selection of the PSUs. Section 4 describes the procedures used to create and select ZIP clusters within the sampled PSUs. The sampling of Medicare beneficiaries from the selected ZIP clusters is described in Section 5. A final section provides actual Round 5 sample sizes and effective sample sizes.

1. Target Sample Sizes

The overall target sample size for Round 5 was 8,500 responding living beneficiaries. Table 1 shows the breakdown of this target sample size by age group and race/ethnicity, and by whether the sample is continuing or newly drawn in 2014.

Of the original Round 1 sample (N=8,245), we anticipated that about 3,750 would be alive and responding to NHATS in Round 5. We therefore anticipated needing 4,750 completes to come from the newly drawn sample. In the design, we inflated this number to account for mortality between the time of sampling and fielding and for non-response, so we targeted 7,114 cases altogether to be sampled from the frame. Table 1 shows the targeted numbers of completes and number to be sampled by age and race/ethnicity groups.

Table 1. Target sample sizes by age group and race/ethnicity and by continuing/replenishment status

[1] 96% of persons ages 65 and older in the United States are Medicare beneficiaries (see Freedman & Spillman 2016)

Age group	Race/ethnicity	Overall target	CONTINUING[1]	REPLENISHMENT	
			Expected number of respondents	Target number of respondents	Number to be sampled
65 to 69	Non-Hispanic Black	346	36	310	411
	Other	1,188	129	1,059	1,550
	Total	1,535	166	1,369	1,960
70 to 74	Non-Hispanic Black	370	180	190	276
	Other	1,291	636	655	976
	Total	1,662	817	845	1,252
75 to 79	Non-Hispanic Black	391	176	215	303
	Other	1,260	597	663	1,019
	Total	1,651	773	878	1,322
80 to 84	Non-Hispanic Black	321	170	151	220
	Other	1,268	597	671	1,031
	Total	1,590	767	822	1,250
85 to 89	Non-Hispanic Black	212	127	85	127
	Other	906	531	375	549
	Total	1,119	659	460	675
90 +	Non-Hispanic Black	174	94	80	143
	Other	771	475	296	512
	Total	945	569	376	654
Total		**8,500**	**3,750**	**4,750**	**7,114**

[1]Expected number of continuing respondents calculated by obtaining Round 4 counts, aging these, and applying mortality and response rate assumptions. Assumes 86% response rate (year to year) for continuing sample (in round 5) for all sampling domains. Age-race-specific mortality rates from Round 1 applied through Round 5.

In Round 1, the 8,500 target sample was expected to yield an effective sample size of 6,831. The difference between the expected target sample and the expected effective sample was due to differential probabilities of selection by age group and race/ethnicity.

In Round 5, there are two additional sources of differential probabilities of selection. First, for the continuing sample, each 5-year age group is composed of 4 single years of age that were sampled at one rate and a 5th single year of age sampled at a rate consistent with the next highest age group. Second, for each age-race group, the replenishment sample is being sampled at a lower rate than the continuing sample.

In developing the sample design for Round 5, we attempted to attain roughly equal expected effective sample sizes (of about 1,500-1,600) for each of the 5-year age domains between 65 and 84, and for ages 85+ (with smaller effective sample sizes for 85-89 and 90+, as in the original design). Round 5 target sample and expected effective sample sizes are shown in Table 2. In Round 5, the 8,500 target sample was expected to yield an effective sample size of 6,619.

Table 2. Targeted actual and effective sample sizes by age group and race/ethnicity

	Round 1			Round 5		
Age group	Non-Hispanic Black	White/Other	Total	Non-Hispanic Black	White/Other	Total
65 to 69	371	1,287	1,658	346	1,188	1,535
	(361)	(1,272)	(1,474)	(340)	(1,180)	(1,397)
70 to 74	359	1,299	1,658	370	1,291	1,662
	(346)	(1,281)	(1,477)	(340)	(1,211)	(1,407)
75 to 79	349	1,309	1,658	391	1,260	1,651
	(314)	(1,296)	(1,492)	(375)	(1,207)	(1,412)
80 to 84	310	1,348	1,658	321	1,268	1,590
	(302)	(1,342)	(1,516)	(296)	(1,225)	(1,410)
85+	272	1,596	1,868	386	1,677	2,063
	(272)	(1,501)	(1,604)	(340)	(1,445)	(1,641)
85-89	163	870	1,033	212	906	1,119
	(163)	(861)	(953)	(183)	(793)	(898)
90 +	108	727	835	174	771	945
	(108)	(722)	(805)	(166)	(701)	(800)
Total 65+	1,661	6,840	8,500	1,815	6,685	8,500
	(1,464)	(5,968)	(6,831)	(1,524)	(5,693)	(6,619)

NOTE: Effective sample sizes are given in parentheses.

The overall target sample sizes were determined to be sufficient to support the key analytic goals of trends and trajectories by 5-year age groups (65-69, 70-74, 75-79, 80-84, 85-89, and 90+) and by race/ethnicity (non-Hispanic Black and White/Other) (see Appendix Table A1 for minimum detectable differences and half-widths of 95% confidence intervals).

2. Sampling Frame

Random subsamples from the Medicare enrollment database (EDB) served as the sampling frame for NHATS. For the Round 5 replenishment sample, beneficiary records were excluded from the frame if:

- age was less than 65 as of September 30, 2014 or the record included a date of death; or
- location was outside the contiguous United States.

3. Selection of Primary Sampling Units

In Round 5, new beneficiaries were sampled from the PSUs selected in Round 1. In Round 1, an initial 5 percent random sample of enrolled beneficiaries was used for PSU formation and selection, including calculation of the PSU measure of size. 95 PSUs were selected from the contiguous United States (i.e., excluding Alaska, Hawaii, and Puerto Rico) in 2010. The PSUs were mostly single counties, but some counties with small numbers of beneficiaries were combined to yield approximately uniform sample sizes across PSUs (with the exception of the certainty PSUs). The PSUs were sampled with probability proportionate to size, with 11 PSUs with a probability of .75 or greater selected with certainty. For details see Montaquila et al. (2012).

4. Selection of ZIP Clusters

The second stage of the design involved selection of secondary sampling units (SSUs) within sampled PSUs. The approach for Round 5 was identical to Round 1. The SSUs were ZIP clusters that were formed from ZIP fragments (entire ZIP codes if within one county, and the portion of the ZIP code within a county for ZIP codes that span multiple counties). The ZIP cluster sampling frame was constructed from a 20 percent subsample of persons enrolled in Medicare as of September 30, 2014 who resided in the 95 PSUs sampled for NHATS in Round 1.[2] The file was subset to individuals age 65 or older as of September 30, 2014 with no date of death. ZIP codes that reflected a single location (point on a map) were subsumed in the surrounding ZIP code as part of the process of forming ZIP clusters.

As in Round 1, the target number of new ZIP clusters to be selected in each PSU in Round 5 was set at 8. This approach was designed to balance the increased travel-related costs associated with a larger number of sampled ZIP clusters within each PSU against the increased clustering design effects with a smaller number of sampled ZIP clusters. The ZIP clusters were sampled using probability proportional to size sampling.

The measure of size was constructed to reflect the variable sampling rates to be applied by age and race/ethnicity. The measures of size were computed in the same manner as in Round 1; that is, a weighted sum of Medicare beneficiaries in the ZIP fragment, in which domain-level beneficiary counts were weighted by the domain sampling rate. Each ZIP fragment measure of size was checked against the minimum measure of size (to ensure that the overall sampling rate for each sampling domain could be achieved if a ZIP fragment was sampled), and if found to be below the minimum, was combined with one or more nearby ZIP fragments to form ZIP clusters.

ZIP clusters having a measure of size that was at least as large as the within-PSU sampling interval for selecting ZIP clusters were selected with certainty. For each certainty ZIP cluster, the number of hits was calculated (the ratio of the ZIP cluster measure of size to the within-PSU ZIP cluster sampling interval). The number of noncertainty ZIP clusters to be sampled in a PSU was obtained by subtracting the total number of hits of certainty ZIP clusters from 8. A total of 115 ZIP clusters qualified as certainties; all of these were in noncertainty PSUs.

Prior to sampling, the 3,246 noncertainty ZIP clusters were sorted using a geographically based serpentine sort within each PSU. A total of 553 noncertainty ZIP clusters were selected by independently sampling within each PSU from the sorted file of noncertainty ZIP clusters; the ZIP clusters were systematically sampled with probabilities proportionate to the ZIP cluster measure of size. A total of 668 ZIP clusters were selected, including those selected with certainty.

5. Selection of Beneficiaries

The final stage of sample selection was the selection of beneficiaries within sampled ZIP clusters. The 20 percent file was used for this purpose. The beneficiary sampling frame was created by subsetting this file to persons:

[2] The use of the 20 percent file at this stage rather than the 5 percent file made it possible to limit the geographic sizes of the SSUs.

- age 65 or older as of September 30, 2014 with no date of death;
- with address indicating that they resided in one of the sampled ZIP clusters.

Prior to sampling, beneficiaries in the frame file were sorted by ZIP cluster, race/ethnicity (non-Hispanic Black, Hispanic, non-Hispanic White/other), age group, and then randomly within age group. A measure of size was also assigned to each beneficiary to facilitate sample selection. This measure was equal to the desired conditional probability of selecting the person for the sample, given that the corresponding PSU and ZIP cluster had been selected (i.e., the sampling rate for the beneficiary's sampling domain, divided by the overall probability of selection of the beneficiary's ZIP cluster).

Beneficiaries were then subsampled systematically (in the same sort order as the initial selection) with equal probability, to yield a sample of 7,119 beneficiaries designated for the replenishment release.[3]

6. Actual and Effective Round 5 Sample Sizes

NHATS Round 5 achieved an overall unweighted response rate of 76% (96% for the continuing sample and 63% for the replenishment sample), yielding 8,334 complete cases. The Round 5 actual and effective sample sizes are shown in Table 3.

[3] As noted in section 1, the overall target sample size for the replenishment sample was 7,114. However, since the sample of beneficiaries was selected using systematic sampling from a sorted list (as described in section 5), the realized sample size differed slightly from the target (due to non-integer-valued sampling intervals).

Table 3. Actual and Effective Round 5 NHATS Sample Sizes

Age group	Race/ethnicity	Actual sample size			Total effective sample size
		Continuing sample	Replen-ishment sample	Total (combined) sample	
65 to 69	Non-Hispanic Black	40	278	318	283
	Other	140	938	1,078	974
	Total	180	1,216	1,396	1,135
70 to 74	Non-Hispanic Black	208	174	382	334
	Other	748	614	1,362	1,230
	Total	956	788	1,744	1,434
75 to 79	Non-Hispanic Black	181	195	376	312
	Other	645	600	1,245	1,099
	Total	826	795	1,621	1,273
80 to 84	Non-Hispanic Black	193	119	312	284
	Other	676	554	1,230	1,111
	Total	869	673	1,542	1,277
85 to 89	Non-Hispanic Black	133	85	218	190
	Other	589	301	890	804
	Total	722	386	1,108	906
90 +	Non-Hispanic Black	96	53	149	132
	Other	503	271	774	683
	Total	599	324	923	773
85 +	Non-Hispanic Black	229	138	367	321
	Other	1,092	572	1,664	1,436
	Total	1,321	710	2,031	1,622
Total 65+	Non-Hispanic Black	851	904	1,755	1,243
	Other	3,301	3,278	6,579	4,666
	Total	4,152	4,182	8,334	5,399

NOTE: The age category is age as of September 30, 2014 based on the beneficiary's month and date of birth provided on the 20% CMS Medicare EDB extract file (the HISKEW for continuing sample and the extract for replenishment sample). The race/ethnicity classification is based on the reported race and Hispanic origin from the Sampled Person Interview; when missing, the race and ethnicity information from the 20% EDB extract file were used.

References

Freedman VA., Spillman BC. 2016. Making National Estimates with the National Health and Aging Trends Study. NHATS Technical Paper #17. Johns Hopkins University School of Public Health. Available at www.NHATS.org.

Howden L, Meyer JA. 2011. Age and Sex Composition: 2010. 2010 Census Briefs. Washington, DC: US Census Bureau.

Montaquila J, Freedman VA, & Kasper JD. 2012. National Health and Aging Trends Study Round 1 Sample Design and Selection. NHATS Technical Paper #1. Baltimore: Johns Hopkins University School of Public Health. Available at www.NHATS.org.

Appendix

Table A1 illustrates the statistical power of the targeted NHATS sample (8,500). The table includes a set of minimum detectable differences in estimates of the prevalence of limitations in activities of daily living (ADL)/instrumental activities of daily living (IADL) over time (trends by age and race/ethnicity) and by race/ethnicity (disparities) and by race/ethnicity over time (trends in disparities). It also includes estimates of the precision of cross-sectional estimates of percentage estimates. That is, the table presents half-widths of the 95% confidence intervals for estimated percentages of 10, 30 and 50% respectively. The figures in this table account for expected design effects due to variations in probabilities of selection and due to clustering (assuming an intraclass correlation of 0.0045).

Table A1. Minimum detectable differences and half-widths of 95% confidence intervals for targeted sample size of 8500[1]

			Minimum detectable difference in			Half-width of 95% confidence intervals for estimates of		
	N	Percentage with ADL/IADL limitations[2] at baseline	Change in % with ADL/IADL limitations (over 4 years)[3]	Racial differences in % with ADL/IADL limitation	Change in racial differences over 4 years[2]	10%	30%	50%
AGE GROUP								
65-69		7.2	2.7			1.6	2.4	2.6
70-74		12.2	3.4			1.6	2.4	2.6
75-79		18.6	4.1			1.6	2.4	2.6
80-84		32.0	4.9			1.6	2.4	2.6
85-89		47.7	6.5			1.9	3.0	3.2
90+		72.2	6.0			2.1	3.2	3.5
Total 65+		19.9	1.9			0.8	1.3	1.4
Total 85+		56.5	3.6			1.6	2.4	2.6
RACE/ETHNICITY								
White/Other	6,840	19.4	2.0			0.9	1.3	1.4
Black, non-Hispanic	1,661	27.5	4.1			1.6	2.4	2.6
DISPARITIES								
White/Other vs. Black, non-Hispanic				3.8	4.5			

[1]These estimates assume a two-tailed test, with alpha=0.05, and power=0.8.
[2]The source for these prevalence estimates is the 1999 National Long Term Care Survey (NLTCS).
[3]These calculations assume the sample is replenished in year 5 (4 years after the baseline study) to achieve an allocation equal to the original allocation.