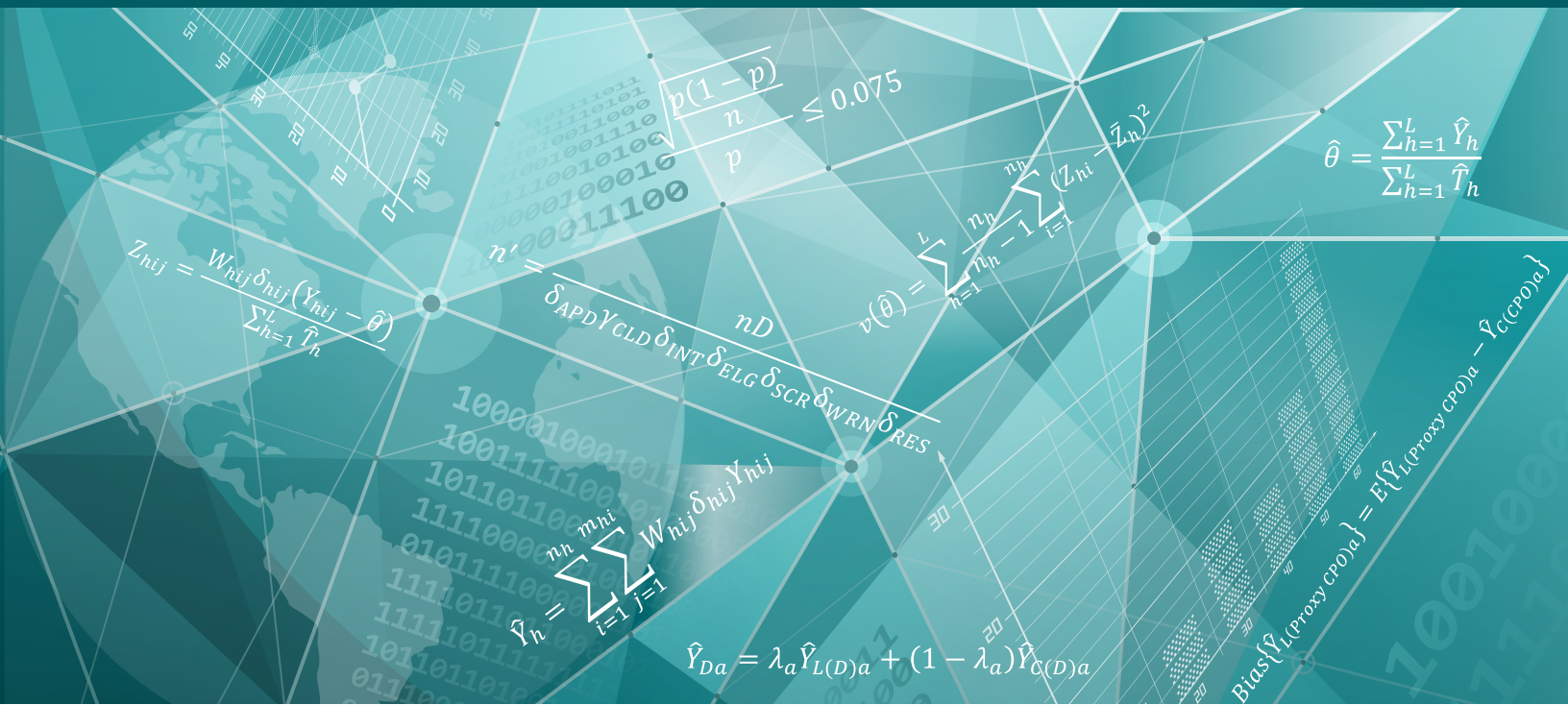




Methodological Research Informing Weighting, Combination, and Quality Assessment for the National Center for Health Statistics Rapid Surveys System Rounds 1–4

Data Evaluation and Methods Research



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Methodological Research Informing Weighting, Combination, and Quality Assessment for the National Center for Health Statistics Rapid Surveys System Rounds 1–4

Data Evaluation and Methods Research

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Centers for Disease Control and Prevention
National Center for Health Statistics

Hyattsville, Maryland
July 2026

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Methodological Research Informing Weighting, Combination, and Quality Assessment for the National Center for Health Statistics Rapid Surveys System Rounds 1–4

by Katherine E. Irimata, Ph.D., James M. Dahlhamer, Ph.D., Matthew D. Bramlett, Ph.D., Bill Cai, M.Sc., Yulei He, Ph.D., Van L. Parsons, Ph.D., and Rong Wei, Ph.D.

Abstract

Objectives

The National Center for Health Statistics's Rapid Surveys System (RSS) was established in 2022. It uses two probability-based commercial online panels, NORC at the University of Chicago's AmeriSpeak panel and Ipsos's KnowledgePanel, to enable fast data collection on emerging or priority health topics. RSS Rounds 1–4 (RSS 1–4) were collected between August 2023 and May 2024. This report describes the methodology implemented in the early rounds of RSS for weighting and variance estimation, methods for combining multiple panels, and quality assessment.

Methods

RSS 1–4 were weighted to a set of control totals for selected demographic and health variables from the National Health Interview Survey (NHIS). Estimates from the two online panels were combined using a convex combination based on effective sample sizes to produce one set of health estimates for release each round. As part of an ongoing quality evaluation, quality metrics were assessed and reported for each round and were used to inform the RSS methodology in successive rounds.

Results

RSS 1–4 had sample sizes ranging from 7,046 (Round 2) to 8,705 (Round 4), with cumulative response rates ranging from 3.8% to 9.9% across the two panel providers. Quality metrics including nonresponse rates and breakoff rates were evaluated and found to be consistent for the two panel providers. In addition, a set of benchmark variables collected on RSS and NHIS were evaluated to assess bias. While the magnitude of bias varied by health variable and across health domains, most health variables had low bias across the four rounds.

Conclusion

The methodology for RSS has evolved and allowed for changes to improve the quality of the program and the resulting estimates. This report describes the early methodology implemented in the first four rounds of RSS.

Keywords: commercial panel surveys • convex combination • raking • complex health survey • probability-based web surveys • National Health Interview Survey (NHIS)

Introduction

The National Center for Health Statistics (NCHS) established the Rapid Surveys System (RSS) to provide relevant and timely data on new, emerging, and priority health topics. This survey platform collects data using commercially available probability-based online panels several times a year on behalf of partners at the Centers for Disease Control and Prevention (CDC) and the broader U.S. government. The content of each survey varies based on

CDC and Department of Health and Human Services (HHS) needs and covers a broad range of topics. Data files and relevant tables of estimates are disseminated each round. A summary of the content made available each round, including selected estimates and dashboards, and data files and documentation is available online: www.cdc.gov/nchs/rss/about.html.

RSS has accelerated NCHS's health data collection and dissemination capabilities by expanding the range of data sources available and enhancing analytical tools and

techniques. While RSS’s online data collection through commercial survey panels differs from NCHS’s traditional household surveys, the RSS survey program is still designed to provide data fit for decision-making. To accomplish this, RSS has a rigorous weighting methodology and performs ongoing scientific and statistical evaluations to review program methods and the quality of the public health estimates and make changes accordingly. This report provides an overview of the weighting and variance estimation, data combination methods from multiple panels, and quality assessment used in RSS Rounds 1–4 (RSS 1–4), as well as changes to the methods implemented in these rounds based on the ongoing evaluations.

Commercial Survey Panels

RSS is fielded using two commercial survey panels, NORC at the University of Chicago’s AmeriSpeak panel (amerispeak.norc.org/) and Ipsos’s KnowledgePanel (www.ipsos.com/en-us/solutions/public-affairs/knowledgepanel). Both panels are created using probability samples of the population of U.S. households, where prospective panelists are sampled and invited to join the panel using address-based sampling (ABS) methods. KnowledgePanel has about 60,000 panelists age 13 and older in 44,000 households. The AmeriSpeak panel includes about 59,000 panelists age 13 and older in 53,000 households. Although both panels include teenagers ages 13–17, these younger panelists are not included in RSS 1–4, because the target population for each round was U.S. adults age 18 and older. All members of both panels are asked to complete questions about demographics and household composition (called the panel profile information) before participating in any surveys.

While RSS surveys are conducted using samples from two separate panels, data collection is standardized by surveying each panel’s sample over the same time period using identical survey instruments so that the two samples can be combined. However, the two panels differ slightly in administration, as the AmeriSpeak panel collects responses using web and phone, while KnowledgePanel collects responses using only web but provides tablets and internet access to panelists who do not have access to the online surveys on joining the panel.

RSS 1–4 Data Collection

Data collection for RSS–1 began in August 2023, with RSS–4 collection concluding less than a year later in May 2024. [Table A](#) reports RSS 1–4’s data collection dates and the number of completed interviews per round (the total from both panel providers). Data were collected for about 4 weeks for each round, and the total number of completed interviews ranged from 7,046 (Round 2) to 8,705 (Round 4).

Both panel providers offer participants the option to complete questionnaires in English or Spanish based on their reported language preference as collected during

Table A. Data collection dates and number of completed interviews per round: Rapid Surveys System Rounds 1–4

Round	Data collection dates	Number of completed interviews
1	8/1/2023–8/29/2023	7,599
2	10/12/2023–11/7/2023	7,046
3	1/15/2024–2/15/2024	8,375
4	4/24/2024–5/20/2024	8,705

SOURCES: National Center for Health Statistics, Rapid Surveys System Round 1, 2023; Rapid Surveys System Round 2, 2023; Rapid Surveys System Round 3, 2024; and Rapid Surveys System Round 4, 2024.

recruitment. Overall, from 3.4% (Rounds 2 and 3) to 3.9% (Round 1) of interviews were completed in Spanish. [Table B](#) presents the distribution of English and Spanish interviews per round by panel provider. Across all four rounds, a greater percentage of Panel Provider 2 participants completed interviews in Spanish compared with Panel Provider 1 (4.4% compared with 2.7%).

AmeriSpeak participants may complete the questionnaire via web or telephone. As with language of interview, participants are initially contacted by their preferred mode as indicated during recruitment. Participants initially contacted by telephone may request to complete the web questionnaire. The percentage of AmeriSpeak interviews completed by telephone was 4.7% in Round 1, 9.2% in Round 2, 10.9% in Round 3, and 8.5% in Round 4.

Rounds 1–4 included content on a variety of topics. The topics, sponsoring agencies, and links to the estimates and data can be filtered by round using the RSS Topic by Round Lookup Table available from: wwwn.cdc.gov/NHISDataQueryTool/RSS5/SearchTool/index.html.

Weighting and Variance Estimation

Panel Weighting Approaches

The AmeriSpeak panel and KnowledgePanel are probability-based and use ABS to recruit U.S. adult participants. A detailed report of the AmeriSpeak panel’s sampling and weighting methods appears in NORC’s technical overview (amerispeak.norc.org/content/dam/amerispeak/about-amerispeak/pdf/amerispeak-technical-overview.pdf). KnowledgePanel’s sampling and weighting methods are reported in Ipsos’s documentation (including the methodological overview, available here: www.ipsos.com/sites/default/files/ipsosknowledgepanelmethodology.pdf, and the sampling and weighting methodology, available here: www.ipsos.com/sites/default/files/kpsamplingandweighting.pdf). Because NORC’s and Ipsos’s methodologies are proprietary, discussions of their approaches are limited.

Table B. Language of survey completion, unweighted, by round and panel provider: Rapid Surveys System Rounds 1–4

Rapid Surveys System round	Panel provider 1		Panel provider 2		Combined	
	Sample size	Percent	Sample size	Percent	Sample size	Percent
RSS–1						
English	2,822	97.4	4,481	95.3	7,303	96.1
Spanish	76	2.6	220	4.7	296	3.9
RSS–2						
English	2,795	98.1	4,015	95.7	6,810	96.7
Spanish	54	1.9	182	4.3	236	3.4
RSS–3						
English	4,079	97.0	4,015	96.3	8,094	96.6
Spanish	126	3.0	155	3.7	281	3.4
RSS–4						
English	4,382	97.1	3,991	95.2	8,373	96.2
Spanish	132	2.9	200	4.8	332	3.8
Combined						
English	14,078	97.3	16,502	95.6	30,580	96.4
Spanish	388	2.7	757	4.4	1,145	3.6

NOTE: RSS is Rapid Surveys System.

SOURCES: National Center for Health Statistics, Rapid Surveys System Round 1, 2023; Rapid Surveys System Round 2, 2023; Rapid Surveys System Round 3, 2024; and Rapid Surveys System Round 4, 2024.

For each round of RSS, a probability sample of potential respondents is selected from both existing panel sample frames, with only one panelist eligible to participate per household. For the AmeriSpeak panel, the RSS sample is stratified by age, race and Hispanic origin, education, and sex. In RSS 1–3, the entire AmeriSpeak panel was considered for selecting the RSS sample, but in RSS–4, the sampling frame was limited to 31,565 panelists who had completed an AmeriSpeak survey in the past 12 months. This change improved the alignment between the two panel providers (see “An Evaluation of Inactive Survey Panelists” for more details).

For KnowledgePanel, probability proportional to size (PPS) sampling is used to select the RSS sample from the panel. The measure of size for the PPS selection is a KnowledgePanel weight calibrated to population benchmarks, including sex, age, race and Hispanic origin, education, census region, household income, homeownership status, and metropolitan status from the Current Population Survey (CPS), and English and Spanish language proficiency from the American Community Survey. For both KnowledgePanel and the AmeriSpeak panel, the number of panelists selected and invited to participate in each RSS round is estimated based on historical completion and data cleaning rates.

Both NORC and Ipsos use proprietary approaches to adjust for the overall probability of selection into the panel and the study. NORC uses a weighting class adjustment for nonresponse, and both NORC and Ipsos calibrate selected demographic variables to population controls. The set of

calibration variables varies between the two panels. NORC and Ipsos provide these adjusted weights (panel provider weights) to NCHS along with the data after collection is complete. Information needed for variance estimation is also provided. For KnowledgePanel, which uses a weighted with replacement sampling design, the weights are sufficient for mean and variance estimation. For the AmeriSpeak sample, which uses a stratified weighted cluster design, the weights along with the sampling information are required for mean and variance estimation. Complex-survey software packages produced by SAS, SUDAAN, and R can be used to produce the estimates.

NCHS’s Weighting Approach

At NCHS, web-based panel surveys and weighting approaches have been studied using the Research and Development Survey (RANDS). Similar to RSS, RANDS is an ongoing series of surveys conducted using probability-based commercial survey panels (www.cdc.gov/nchs/rands). However, RANDS is designed for research and evaluation purposes, including supplemental question evaluation and development studies, as well as methodological research such as evaluating weighting procedures for panel surveys. Unlike RSS, RANDS is not designed to produce population estimates of health outcomes or surveillance, although it was used to monitor health outcomes during the COVID-19 pandemic. Studies using RANDS have revealed that, while the weighting procedures used by probability-based panels adjust for potential sources of bias (such as nonresponse) and align selected demographic variables to population

control totals, some bias may still exist—particularly when assessing the alignment of health variables (1,2). As a result, a two-stage weighting approach was developed for RANDS using the panel provider’s standard weighting procedure (panel provider weights), followed by a secondary weighting step using raking to calibrate on selected health variables from NCHS’s household surveys (2).

Based on findings from the RANDS weighting investigation, RSS similarly implements the secondary weighting approach to adjust on selected variables from NCHS’s household surveys. While RANDS weights have primarily been adjusted in this step using raking via a SAS macro or the R survey package, the secondary raking adjustment for RSS 1–4 was performed using the WTADJUST procedure in SAS-callable SUDAAN, and estimation and standard-error production was conducted using SAS PROC DESCRIPT under the assumption that the calibration-variable totals estimated using the reference data set do not contribute to the standard error. The variance estimation approach from SAS PROC DESCRIPT uses a Taylor series linearization approximation. Both RANDS and RSS use similar approaches to select the reference data set and set of calibration variables used in this weighting step, which are described in the following sections.

Reference data

The National Health Interview Survey (NHIS) is the source for benchmark estimates and control totals for RSS calibration. NHIS was selected for this role for many practical reasons. NHIS has been the nation’s primary population health monitoring survey for over 60 years. NHIS collects adult and child health data from the civilian noninstitutionalized population in the United States. NHIS mainly uses face-to-face interviewing. NHIS data are used widely by researchers, academics, and policy analysts to monitor the nation’s health and track progress in reaching national health objectives. Due to NHIS’s reliability, it has traditionally been used as a gold standard for health estimates in the United States.

Several features of NHIS data collection make it particularly useful for RSS calibration. Given the accelerated schedule of RSS 1–4 (four separate, sequential survey modules with public data releases in one calendar year), weighting processes were streamlined by RSS and NHIS being able to share staffing and resources since they are both in the Division of Health Interview Statistics (DHIS). Several RSS staff members from DHIS and NCHS’s Division of Research and Methodology also work on and have great familiarity and expertise with NHIS sampling and weighting. This access to the full internal data for both surveys, including information from the sample frames for nonrespondents, enables more informed weighting adjustments. This arrangement also enabled DHIS to add variables to the 2023 NHIS questionnaire specifically for use as

calibration variables for RSS (such as questions about civic engagement).

Perhaps even more critically, NHIS provides a timely source for RSS benchmarking and calibration. NHIS collects data continuously, producing and releasing an annual public data file based on 1 year of data collection. Each monthly NHIS sample is designed to be nationally representative, and DHIS releases selected estimates on a quarterly basis via the NHIS Early Release (ER) program (www.cdc.gov/nchs/nhis/early-release/index.html), which requires the quarterly generation of analytic data files with weights. As a result, a new NHIS data file with sampling weights is available to DHIS staff every 3 months. This closely parallels RSS’s timing for Rounds 1–4, with a new data file requiring weighting adjustments every 3 months.

As a result, waiting for an annual NHIS file was unnecessary. Instead, staff selected the NHIS ER file most closely matching the RSS round’s data collection period, avoiding the influence of seasonality on benchmark estimates.

The specific NHIS ER files used for RSS 1–4 were NHIS 2023 Quarter 1, NHIS 2023 Quarter 2, NHIS 2023 Quarter 3, and NHIS 2023 Quarter 4.

Calibration variables

For each round of RSS, the weight calibration to NHIS is performed on selected demographic, health, and related variables. Evaluations are performed to identify an appropriate set of calibration variables before data collection from NHIS content. While most content considered has historically been collected in NHIS, new content on internet use, health information technology (HIT) use, and civic engagement was included in NHIS in support of calibration weighting for RSS starting in 2023.

As described in the RANDS weighting documentation (2), calibration-variable selection is performed by evaluating the correlation between potential calibration variables and the outcomes of interest, as well as evaluating the balance of the covariate distribution between RSS and NHIS. In addition, key covariates for adjustment are identified using logistic regression models on the combined survey data. Variable selection approaches, including backward selection and leave-one-out model assessments of potential calibration variables on the selection indicator for survey source or on benchmark variables correlated to the outcome of interest, are used to identify important adjustment variables. After selecting the potential set of calibration variables, adjustments are performed using various sets of weights to assess extreme weights and impacts on the design effects. The following sections describe the application of these variable selection approaches in RSS 1–4.

Selection of calibration variables for RSS 1–3

Variables were selected for calibration of RSS weights in at least three ways. First, variables used in the calibration of RANDS weights (raked to NHIS control totals) were considered. NCHS staff previously evaluated sociodemographic and health covariates for use in weight calibration and identified a core set that optimally reduced coverage and nonresponse biases in RANDS estimates (2). Second, variables were considered based on the recommendations of an NCHS Board of Scientific Counselors working group. For example, the working group recommended measures of civic engagement that have been found to be important for accurate calibration of panel survey weights (3,4). Based on this recommendation, a short set of questions on volunteering, voting in local elections, and participating in local meetings were adapted from the CPS Civic Engagement module (5) and added to the NHIS Sample Adult Questionnaire in Quarter 3 of 2022. Third, variables were considered based on a review of literature focused on adjusting for coverage and nonresponse error in panel estimates. This review led NCHS staff to consider questions on internet access, use of HIT, difficulties participating in social activities (already part of the core NHIS questionnaire), and language spoken at home and used in specific settings (such as while talking with a doctor, participating in social activities, or listening to music or reading print or online media). Like the civic engagement items, questions on internet access and HIT use were added to the 2022 Quarter 3 Sample Adult Questionnaire. Language questions were added to the 2023 Quarter 2 Sample Adult Questionnaire. See [Table C](#) for a list of items that were added to NHIS in support of RSS weight calibration. Other measures were highlighted in the literature (such as certain types of technology use and shopping behaviors) but were passed over due to a lack of topical relevance for NHIS.

For items added to NHIS specifically for the possible calibration of RSS weights, initial assessments of their usability in this role were undertaken. More specifically, the new items were regressed on a large set of health outcomes, controlling for the aforementioned RANDS calibration variables (12 in total; see [Table I](#)) with the goal of determining if including the new variables on civic engagement or HIT use further benefited calibration.

A more detailed summary of this assessment and findings is provided in Appendix I.

In addition to assessments using NHIS data, RANDS data were used for evaluation. RANDS 7 included the variables measuring internet use, civic engagement, and social difficulty and work limitations described earlier to perform some early calibration weighting assessments. RANDS 7 also included content on traumatic brain injury and firearm safety, topics proposed by the CDC National Center for Injury Prevention and Control (6). Based on investigations using RANDS 7, 2022 Quarter 3 NHIS Early Release data,

and 2023 Quarter 2 NHIS Early Release data, variables related to civic engagement, HIT use, and emotional, social, and work limitations were identified as more highly correlated to the selection source indicator compared with other variables and, as a result, were included in RANDS 7 for calibration weighting (6) and considered for inclusion as calibration variables in the early RSS rounds.

Based on all of the investigations described above, the final set of calibration variables for Rounds 1–3 weights included age, sex, race and Hispanic origin, educational attainment, marital status, household income, housing tenure, census region, urbanization level, ever diagnosed with high cholesterol, difficulty participating in social activities, and civic engagement. The set of calibration variables was fixed across the first three rounds to aid in the evaluation of a rotating set of benchmark variables covering various health domains in these rounds. In addition, the same set of calibration variables were used for weighting data from NORC and Ipsos to perform assessments between the two sources, and because data were not previously available to inform differential calibration procedures.

Selection of calibration variables for RSS–4

While the calibration variables for Rounds 1–3 were selected based on the previous evaluations using data from NHIS and RANDS, the Round 4 calibration variables were selected based on evaluations using the RSS–1 data. Several assessments were used to identify the set of RSS–4 calibration variables, including a random search of calibration variables and a leave-one-out approach to assess the impact of each individual variable. A detailed description of the assessments and findings is included in Appendix II. The final set of calibration variables for Round 4 weights included 12 variables: age, sex, race and Hispanic origin, educational attainment, household income, employment status, census region, urbanization level, ever diagnosed with high cholesterol, difficulty participating in social activities, any HIT use, and adult has a working cell phone.

Data Combination Method

RSS 1–4 collected data using two commercial panels, NORC’s AmeriSpeak panel and Ipsos’s KnowledgePanel. To produce one set of estimates and one data file for each round, a method to combine the data from the two panels had to be researched and selected. The combination method was selected to meet the following two criteria: 1) based on robust and established statistical techniques, and 2) implementable in a standardized production system to meet data release timelines. After evaluation using data collected from RANDS, a convex combination approach was selected to combine the survey estimates from the two panels. This approach creates a combined estimate for RSS by adjusting the individual survey estimates from the two

Table C. Items added to or existing on the National Health Interview Survey considered for calibration of Rapid Surveys System weights

Topic and question	Response	Universe	NHIS variable name	Added to NHIS
Internet access				
Do you have access to the internet?	1=Yes 2=No	Adults age 18 and older	ACCSSINT_A	2022, Quarter 3
Do you have access to the internet from your home?	1=Yes 2=No	Adults age 18 and older with internet access	ACCSSHOM_A	2022, Quarter 3
Health information technology use				
During the past 12 months, have you used the internet for any of the following reasons? To look for health or medical information.	1=Yes 2=No	Adults age 18 and older with internet access	HITLOOK_A	2022, Quarter 3
During the past 12 months, have you used the internet for any of the following reasons? To communicate with a doctor or doctor's office.	1=Yes 2=No	Adults age 18 and older with internet access	HITCOMM_A	2022, Quarter 3
During the past 12 months, have you used the internet for any of the following reasons? To look up medical test results.	1=Yes 2=No	Adults age 18 and older with internet access	HITTEST_A	2022, Quarter 3
Volunteering				
During the past 12 months, did you spend any time volunteering for any organization or association?	1=Yes 2=No	Adults age 18 and older	CEVOLUN1_A	2022, Quarter 3
Some people don't think of activities they do infrequently or for children's schools or youth organizations as volunteer activities. During the past 12 months, have you done any of these types of activities?	1=Yes 2=No	Adults age 18 and older who did not spend time volunteering in the past 12 months or don't know	CEVOLUN2_A	2022, Quarter 3
Civic engagement				
During the past 12 months, did you attend a public meeting, such as a zoning or school board meeting, that discussed a local issue?	1=Yes 2=No	Adults age 18 and older	CEMMETNG_A	2022, Quarter 3
Did you vote in the LAST LOCAL elections, such as for mayor, councilmembers, or school board?	1=Yes 2=No	Adults age 18 and older	CEVOTELC_A	2022, Quarter 3
Language				
Do you speak a language other than English at home?	1=Yes 2=No	Adults age 18 and older	LANGHM_A	2023, Quarter 2
When you watch television, read news online or in print, or listen to the radio, which language do you use most often?	1=English 2=Other language	Adults age 18 and older who speak a language other than English at home	LANGMED_A	2023, Quarter 2
When you see a doctor or other health care professional, which language do you use most often?	1=English 2=Other language	Adults age 18 and older who speak a language other than English at home	LANGDOC_A	2023, Quarter 2
When you participate in social activities, such as visiting friends, attending clubs and meetings, or going to parties, which language do you use most often?	1=English 2=Other language	Adults age 18 and older who speak a language other than English at home	LANGSOC_A	2023, Quarter 2
Social and work limitations				
Because of a physical, mental, or emotional condition, do you have difficulty doing errands alone such as visiting a doctor's office or shopping?	1=Yes 2=No	Adults age 18 and older	SOCERRNDS_A	Part of Sample Adult Questionnaire
Because of a physical, mental, or emotional condition, do you have difficulty participating in social activities such as visiting friends, attending clubs and meetings, or going to parties?	1=No difficulty 2=Some difficulty 3=A lot of difficulty 4=Cannot do at all	Adults age 18 and older	SOCSCLPAR_A	Part of Sample Adult Questionnaire
Are you limited in the kind OR amount of work you can do because of a physical, mental or emotional problem?	1=Yes 2=No	Adults age 18 and older	SOCWRKLIM_A	Part of Sample Adult Questionnaire

See footnotes at end of table.

Table C. Items added to or existing on the National Health Interview Survey considered for calibration of Rapid Surveys System weights—Con.

Topic and question	Response	Universe	NHIS variable name	Added to NHIS
Life satisfaction				
In general, how satisfied are you with your life?	1=Very satisfied 2=Satisfied 3=Dissatisfied 4=Very dissatisfied	Adults age 18 and older	LSATIS4_A	Part of Sample Adult Questionnaire

NOTE: NHIS is National Health Interview Survey.

SOURCE: National Center for Health Statistics, National Health Interview Survey, 2022–2023.

panels based on their effective sample sizes, with a larger contribution from the panel with the larger effective sample size. The effective sample sizes are also used to adjust the individual panel weights to create a final RSS weight for the released data set. The theory and details of this approach, and additional information on the investigation, are described in Appendix III.

This approach creates a combined mean estimate for RSS ($\hat{Y}_{1,2}$) by using a convex combination of the individual survey mean estimates from the two panels ($\hat{Y}_1$ and $\hat{Y}_2$), where these are estimated using the design-based methodologies described in the Weighting and Variance Estimation section:

$$\hat{Y}_{1,2} = \lambda_e \hat{Y}_1 + (1 - \lambda_e) \hat{Y}_2$$

The two panel estimates are combined using the ratio of the global effective sample size for the survey, where the panel with the larger effective sample size is given more weight, with the ratio calculated as:

$$\lambda_e = \frac{n_{1,eff}}{n_{1,eff} + n_{2,eff}}$$

Similarly, the variance estimate ($\widehat{var}(\hat{Y}_{1,2})$) can be derived using this ratio of effective sample sizes and the variance of the estimates from the two panels ($\widehat{var}(\hat{Y}_1)$ and $\widehat{var}(\hat{Y}_2)$):

$$\widehat{var}(\hat{Y}_{1,2}) = \lambda_e^2 \widehat{var}(\hat{Y}_1) + (1 - \lambda_e)^2 \widehat{var}(\hat{Y}_2)$$

To create a combined data file for release, the ratio of effective sample sizes is used to reweight the NHIS-calibrated weights of the two surveys to create a final, combined RSS weight on a combined data set.

This approach has several limitations, including that no universal optimal combination factor applies to all variables collected by the two surveys. For the purposes of RSS, including meeting a production timeline, the effective sample sizes for the two surveys are used to create one combination factor for all estimates. However, variance or effective sample size estimates may differ by specific health domains or for particular variables. In addition, for subdomain estimates such as by age or sex, the best practice would be to calculate the effective sample size when restricted to those subdomains rather than using the global combination factor.

However, the convex combination approach is simple to implement and allows RSS, which targets a wide variety of health variables over a broad spectrum of population domains, to quickly and reliably combine data from two separate panels to produce estimates. In addition, this approach is flexible and could be adapted to account for more than two data sources in the calculation of the estimate.

Quality Assessment

Quality assessment is an important component of the RSS program to evaluate the methodology and quality of the data and adjust accordingly. This section describes some of the quality assessment components and metrics, including benchmark variables and bias analyses, response and completion rates, survey completion times, survey breakoffs, item nonresponse, and assessments using panel profile data. In the public data release for each round of RSS, this information is described in the accompanying documentation, including the Preferred Reporting Items for Complex Sample Survey Analysis (PRICSSA), Survey Description Document, and Quality Profile. This documentation can be found on the data files and documentation page (www.cdc.gov/nchs/rss/access.html). Because the evaluations transparently report the quality of the estimates and the overall survey platform, quality metrics for each panel provider are anonymously labeled as Panel Provider 1 and Panel Provider 2.

Benchmark Variables and Bias Analyses

In each round, the RSS questionnaire includes questions from NHIS for calibration as well as benchmarking purposes. Benchmark variables are used to assess potential bias of the estimates in RSS compared with NHIS. In RSS 1–3, a rotating set of benchmark variables was selected to report on the performance on several health domains. Starting in RSS–4, benchmark variables related to the main survey content were selected. The number of benchmark variables and health domains evaluated vary by round, with 43 benchmark variables in RSS–1, 45 in RSS–2, 54 in RSS–3, and 37 in RSS–4. Table D lists all benchmark variables and health domains represented by round.

Table D. Benchmark variables and health domains: Rapid Surveys System Rounds 1–4

Health domain and variable	Round 1	Round 2	Round 3	Round 4
Disability				
Wear glasses or contact lenses	...	...	X	X
Vision difficulty (a lot of difficulty, cannot do at all)	...	...	X	X
Use a hearing aid	...	...	X	X
Hearing difficulty (a lot of difficulty, cannot do at all)	...	...	X	X
Difficulty walking or climbing steps (a lot of difficulty, cannot do at all)	...	...	X	X
Difficulty communicating (a lot of difficulty, cannot do at all)	...	...	X	X
Difficulty remembering or concentrating (a lot of difficulty, cannot do at all)	...	...	X	X
Difficulty with self-care (a lot of difficulty, cannot do at all)	...	...	X	X
Disability status	...	...	X	X
Did difficulty begin before age 22?	...	...	...	X
Employment				
Mean number of work days missed in past year due to illness	...	X	...	...
Missed 6 or more work days in past year due to illness	...	X	...	...
Health behaviors				
Height, in inches (mean)	X	...	...	...
Height, in inches (mean), male	X	...	...	...
Height, in inches (mean), female	X	...	...	...
Weight, in pounds (mean)	X	...	...	...
Weight, in pounds (mean), male	X	...	...	...
Weight, in pounds (mean), female	X	...	...	...
BMI (mean)	X	...	...	...
Obese	X	...	...	...
Ever smoked 100 cigarettes	X	X	X	X
Current cigarette smoking	X	X	X	X
Currently smoke every day or some days	...	...	X	X
Ever smoked an e-cigarette	...	...	X	...
Currently smoke e-cigarettes every day or some days	...	...	X	...
Current e-cigarette smoking	...	...	X	...
Health status				
Chronic health conditions:				
Ever diagnosed with coronary heart disease	X	...	...	...
Ever diagnosed with hypertension	X	X	X	X
Current hypertension	X	...	...	...
Ever diagnosed with asthma	X	X	X	X
Still have asthma	...	...	X	...
Asthma attack in the past 12 months	...	...	X	...
Ever diagnosed with cancer	X	X	X	X
Ever diagnosed with prediabetes	X	...	...	...
Ever diagnosed with gestational diabetes	X	...	...	...
Ever diagnosed with diabetes	X	...	...	...
Chronic pain:				
Pain on most days or every day in past 3 months	...	X	...	...
Had a lot of pain last time experienced pain	...	X	...	...
High impact chronic pain in past 3 months ¹	...	X	...	...
Mental and self-rated health:				
Feel worried, nervous, or anxious daily or weekly	X	...	...	X
Take medication for feeling worried, nervous, or anxious	X	...	...	X
A lot of worry, nervousness, or anxiety last time had feelings	X	...	...	X
Regularly had feelings of worry, nervousness, or anxiety	X	...	...	X
Feel depressed daily or weekly	X	...	...	X
Take medication for depression	X	...	...	X
A lot of depression last time felt depressed	X	...	...	X
Regularly had feelings of depression	X	...	...	X
Excellent or very good self-rated health	X	X	X	X
Little interest or pleasure in doing things several days or more in past 2 weeks	...	X	...	...
Feeling down, depressed, or hopeless several days or more in past 2 weeks	...	X	...	...
PHQ–2: Screened for depression (depression subscale)	...	X	...	...
Feeling nervous, anxious, or on edge several days or more in past 2 weeks	...	X	...	...
Not being able to control or stop worrying several days or more in past 2 weeks	...	X	...	...

See footnotes at end of table.

Table D. Benchmark variables and health domains: Rapid Surveys System Rounds 1–4—Con.

Health domain and variable	Round 1	Round 2	Round 3	Round 4
Health status—Con.				
GAD–2: Screened for anxiety (anxiety subscale)	...	X	...	...
PHQ–2 and GAD–2: Neither depression nor anxiety	...	X	...	...
PHQ–2 and GAD–2: Depression only	...	X	...	...
PHQ–2 and GAD–2: Anxiety only	...	X	...	...
PHQ–2 and GAD–2: Both anxiety and depression	...	X	...	...
Healthcare access				
Delayed dental care due to cost	X	...	...	...
Did not get dental care due to cost	X	...	...	...
Place usually go to when sick and need health care	X	X	X	X
What kind of place: Doctor's office or health center	X	X	X	X
What kind of place: Urgent care center or clinic in drug store	X	X	X	X
What kind of place: All other kinds	X	X	X	X
Usual source of care	X	X	X	X
Very worried about paying medical bills	X	X	...	...
Problems paying medical bills in past 12 months	...	X	...	...
Skipped medication doses to save money in past 12 months	...	X	...	...
Took less medication to save money in past 12 months	...	X	...	...
Delayed filling prescription to save money in past 12 months	...	X	...	...
Did not take prescription medication as prescribed in past 12 months	...	X	...	...
Did not get prescription medication due to cost in past 12 months	...	X	...	...
Delayed mental health care due to cost in past 12 months	...	X	...	X
Did not receive mental health care due to cost in past 12 months	...	X	...	X
Delayed medical care due to cost in past 12 months	...	...	X	...
Did not get needed medical care due to cost in past 12 months	...	...	X	...
Healthcare use				
Dental cleaning in past 12 months	X	...	...	...
Saw doctor or other health professional in past 12 months	X	X	X	X
Hospitalized overnight in past 12 months	X	...	...	X
Eye exam in past 12 months	X	...	...	...
Therapy in past 12 months ²	X	...	...	...
Blood pressure checked in past 12 months	X	...	...	...
Cholesterol checked in past 12 months	X	...	...	...
Blood sugar checked in past 12 months	X	...	...	...
Received mental health counseling in past 12 months	...	X	...	X
Currently receiving mental health counseling	...	X	...	X
Hospitalized overnight in past 12 months	...	X	...	...
Took prescription medication in past 12 months	...	X	...	...
Took prescription medication in past 12 months to help with emotions or with concentration, behavior, or mental health	...	X	...	X
Received a flu vaccination in the past 12 months	...	X	...	...
Ever had a pneumonia shot	...	X	...	...
Visited an urgent care center in the past 12 months	...	...	X	...
Number of urgent care center visits in the past 12 months: 0	...	...	X	...
Number of urgent care center visits in the past 12 months: 1	...	...	X	...
Number of urgent care center visits in the past 12 months: 2	...	...	X	...
Number of urgent care center visits in the past 12 months: 3 or more	...	...	X	...
Visited an emergency room in the past 12 months	...	...	X	...
Number of emergency room visits in the past 12 months: 0	...	...	X	...
Number of emergency room visits in the past 12 months: 1	...	...	X	...
Number of emergency room visits in the past 12 months: 2	...	...	X	...
Number of emergency room visits in the past 12 months: 3 or more	...	...	X	...
Hospitalized overnight in past 12 months	...	...	X	...
Housing costs and transportation				
Unable to pay mortgage, rent, or utility bills in the past 12 months	...	X	...	...
Lack of reliable transportation kept you from medical appointments, meetings, work, or from getting things you needed for daily living in past 12 months	...	X	...	...

See footnotes at end of table.

Table D. Benchmark variables and health domains: Rapid Surveys System Rounds 1–4—Con.

Health domain and variable	Round 1	Round 2	Round 3	Round 4
Social determinants of health				
Sometimes or often true that worried whether food would run out before got money to buy more in last 30 days	...	...	X	...
Sometimes or often true that the food bought just didn't last and didn't have money to buy more in last 30 days	...	...	X	...
Sometimes or often true couldn't afford to eat balanced meals in last 30 days	...	...	X	...
Cut the size of or skipped meals in last 30 days because there wasn't enough money for food	...	...	X	...
Cut the size of or skipped meals on 3 or more days in last 30 days	...	...	X	...
Ate less than you felt you should in last 30 days because there wasn't enough money for food	...	...	X	...
Ever hungry but didn't eat in last 30 days because there wasn't enough money for food	...	...	X	...
Lose weight in last 30 days because there wasn't enough money for food	...	...	X	...
Ever not eat for a whole day in the last 30 days because there wasn't enough money for food	...	...	X	...
Did not eat for a whole day 3 or more days in the last 30 days	...	...	X	...
High food security	...	...	X	...
Marginal food security	...	...	X	...
Low food security	...	...	X	...
Very low food security	...	...	X	...

... Category not applicable.

¹Defined as adults with chronic pain that impacts their work and life activities on most days or every day.

²Includes physical therapy, speech therapy, rehabilitative therapy, and occupational therapy.

NOTES: BMI is body mass index. PHQ is patient health questionnaire. GAD is generalized anxiety disorder.

SOURCES: National Center for Health Statistics, Rapid Surveys System Round 1, 2023; Rapid Surveys System Round 2, 2023; Rapid Surveys System Round 3, 2024; and Rapid Surveys System Round 4, 2024.

The benchmark variables are used to assess data quality through analyses evaluating the bias of the estimates of the benchmark variables relative to the reference data set (NHIS). Two metrics, absolute bias and standardized bias, have been used for reporting in NCHS reports and documentation. These metrics are reported in the Quality Profile and the accompanying Quality Profile Tables for each round, which can be found on the RSS webpage: www.cdc.gov/nchs/rss/access.html.

The absolute bias is calculated as:

$$|\text{estimate}_{\text{panel}} - \text{estimate}_{\text{NHIS}}|$$

The standardized bias is computed for percentages as:

$$\frac{|\text{estimate}_{\text{panel}} - \text{estimate}_{\text{NHIS}}|}{\sqrt{\text{estimate}_{\text{NHIS}}(100 - \text{estimate}_{\text{NHIS}})}}$$

and for continuous variables as:

$$\frac{|\text{estimate}_{\text{panel}} - \text{estimate}_{\text{NHIS}}|}{SE_{\text{NHIS}} \sqrt{n_{\text{NHIS}} / \text{deff}_{\text{NHIS}}}}$$

Table E reports the thresholds used for categorizing absolute and standardized bias into low, medium, and high categories (2).

Table E. Thresholds for low, medium, and high bias, by metric

Metric	Low	Medium	High
Absolute bias	< 2	≤ 2 – < 5	≤ 5 – < 10
Standardized bias	< 0.10	≤ 0.1 – < 0.3	≤ 0.3 – < 0.5

SOURCE: National Center for Health Statistics, Research and Development Survey, 2023.

Survey Response and Completion Rates

For each round of RSS, survey completion and final response rates are presented in the documentation accompanying that round's data release, including the Survey Description document and the Quality Profile. For the Quality Profile, completion rates are also presented for selected sociodemographic characteristics of the panelist, including age group, sex, race and Hispanic origin, education, and urbanization level.

Table F presents the final cumulative response rates by each provider for RSS 1–4, along with component rates included in the calculation of a final response rate. The two data collection providers compute their final response rates differently, which makes direct comparison of rates by provider difficult and precludes the calculation of one overall response rate for each round. While both providers include a panel recruitment rate, panel retention rate, and the survey completion rate in their calculations, Panel Provider 2 includes a panel profile rate. The panel recruitment rate represents

Table F. Household panel recruitment, retention, and profile rates, survey completion rate, and final cumulative response rate, by panel provider: Rapid Surveys System Rounds 1–4

Round and panel provider	Household panel recruitment rate ¹	Household panel retention rate ²	Household panel profile rate ³	Unweighted survey completion rate ⁴	Cumulative response rate ⁵
RSS–1					
Panel Provider 1.....	20.6	80.3	...	25.1	4.1
Panel Provider 2.....	9.7	32.0	59.5	69.8	4.0
RSS–2					
Panel Provider 1.....	21.5	78.9	...	22.2	3.8
Panel Provider 2.....	9.7	31.2	59.6	69.0	4.0
RSS–3					
Panel Provider 1.....	22.1	78.8	...	27.4	4.8
Panel Provider 2.....	10.2	25.7	59.7	72.0	4.4
RSS–4					
Panel Provider 1.....	22.3	78.9	...	56.1	9.9
Panel Provider 2.....	9.6	29.4	60.8	70.9	4.1

... Category not applicable.

¹Represents the percentage of sampled households where at least one adult successfully completed the recruitment survey and joined the panel.

²Represents the percentage of recruited households that remain on the panel and are available for sampling for a survey.

³Represents the percentage of recruited households where at least one adult resident completes a profile survey. The profile survey collects more detailed information about the person and household.

⁴Rate uses the American Association for Public Opinion Research (AAPOR) RR5 response rate definition from Standard definitions: Final dispositions of case codes and outcome rates for surveys. 10th edition. 2023.

⁵Rate follows the American Association for Public Opinion Research (AAPOR) CUMRR1 definition (AAPOR, 2016). However, Panel Providers 1 and 2 compute CUMRR1 differently. For Panel Provider 1, it is the product of the panel recruitment rate, the panel retention rate, and the study-specific survey completion rate. For Panel Provider 2, it is the product of the panel recruitment rate, panel profile rate, and the study-specific survey completion rate.

SOURCES: National Center for Health Statistics, Rapid Surveys System Round 1, 2023; Rapid Surveys System Round 2, 2023; Rapid Surveys System Round 3, 2024; and Rapid Surveys System Round 4, 2024.

the percentage of sampled households where at least one adult successfully completed the recruitment survey and joined the panel. The panel retention rate represents the percentage of recruited households that remain on the panel and are available for sampling for a survey. The survey completion rate represents the percentage of panelists who completed the survey among the panelists who were invited to participate. The profile rate, used by Panel Provider 2, represents the percentage of recruited households where at least one adult resident completes a profile survey, which is used to collect more detailed information about the person and household.

Final response rates for RSS 1–4 (Table F) were fairly consistent across providers and round, with the exception of Round 4. For Rounds 1–3, final cumulative response rates ranged from 4.0% for Panel Provider 2 in Rounds 1 and 2 to a high of 4.8% for Panel Provider 1 in Round 3. Due to a decision made before RSS–4 to limit Panel Provider 1’s sample frame to adult panelists who had completed a survey within the past year, the final cumulative response rate for Panel Provider 1 roughly doubled to 9.9% in Round 4. Before RSS–4, Panel Provider 1 retained all adult panelists in the sample frame, including panelists who had not participated in a survey for over 6 months. These inactive panelists were included in the frame to improve the chances of meeting the target number of completed surveys (target completes) set for Rounds 1–3. However, the inclusion of inactive panelists and their anticipated low rates of participation meant that much larger samples

needed to be drawn. This had the negative effect of depressing survey completion rates.

Survey completion rates for Rounds 1–4 are also shown in Table F. Rates were consistent for Panel Provider 2 across all rounds, ranging from 69.0% in RSS–2 to 72.0% in RSS–3. Rates were also consistent for Panel Provider 1 for Rounds 1–3, ranging from 22.2% in RSS–2 to 27.4% in RSS–3. As noted, a substantial jump to 56.1% occurred in RSS–4 due to the decision to limit Panel Provider 1’s sample frame to panelists who had participated in a survey in the past year.

Survey completion rates by selected sociodemographic characteristics were largely consistent across panel provider and round (not shown here). Among age groups, for example, adults 65 and older generally had the highest completion rates across round and provider, while adults ages 18–24 tended to have the lowest completion rates. Similarly, Hispanic adults tended to have the lowest completion rates, regardless of panel provider or round, compared with other race and Hispanic-origin groups, while adults with less than a high school education generally participated at lower rates than adults with higher education levels. More variation was observed in completion rates by provider and round for sex and urbanization level. Rates by sex, however, were generally within a few percentage points across provider and round. For specific rates by sociodemographic characteristic and provider, see the Quality Profiles for each of the first four rounds (7–10).

Survey Completion Times

Survey completion times are also checked within a round and by provider to assess whether median survey times are under the 20-minute threshold allowable under the Office of Management and Budget protocol. Section times are also computed by provider, giving a check for potentially difficult or burdensome sections, as well as identifying low-quality interviews for removal due to speeding (completing the survey in one-quarter of the median survey duration or less). Particularly long sections could be streamlined for possible future administrations.

Completion times are only evaluated among respondents who completed interviews in 60 minutes or less in a single visit, because survey durations were calculated from the initial entry into the instrument until the survey was submitted (which could be over multiple hours or days for respondents who return to the instrument at another time).

Table G shows the median survey completion times for Rounds 1–4. For RSS 2–4, completion times are reported among respondents who completed interviews in 60 minutes or less in one visit to the survey instrument. For RSS–1, the times reported are for interviews completed in one visit without the time limitation (consistent with what is reported in the RSS–1 Quality Profile [7]). Completion times were consistent across rounds and by provider. RSS–4 was the shortest of the four rounds at 11.5 minutes for Panel Provider 1 and 11.8 minutes for

Panel Provider 2, while RSS–2 was the longest (13.9 minutes for Panel Provider 1 and 13.2 minutes for Panel Provider 2). Median completion times for all four rounds were well under the 20-minute mark.

Survey Breakoffs

Survey breakoffs for RSS are defined as starting, but not completing, a survey. Panelists who break off before fully completing the survey are considered nonrespondents for response and completion rate calculations and are not included in final data files. Breakoff rates are calculated overall and by panel provider. Within panel provider, breakoff rates are further computed by main interview sections. Sections with high breakoff rates may need further testing and revision if they are to be administered in future rounds of RSS.

Table H presents overall breakoff rates for each round and by provider. As observed with other quality metrics, survey breakoff rates were low and fairly consistent across all rounds and by provider. Overall or combined breakoff rates ranged from a low of 2.9% in RSS–4 to a high of 4.2% in RSS–2. Generally, breakoff rates were slightly higher for Panel Provider 2. While variation in breakoff rates was observed by interview section in any given round, the bulk of breakoffs—regardless of round or provider—tended to occur in introductory screens up to the first question of the first main interview section.

Table G. Median overall survey times for interviews completed in 60 minutes or less in a single visit, by panel provider: Rapid Surveys System Rounds 1–4

Round	Number of questions	Median survey completion time (minutes) ¹	
		Panel Provider 1	Panel Provider 2
RSS–1 ²	144	12.0	12.6
RSS–2	158	13.9	13.2
RSS–3	166	12.8	13.3
RSS–4	178	11.5	11.8

¹Times were limited to complete interviews collected in 60 minutes or less in a single visit to the survey instrument. Completions meeting these criteria accounted for 82.4% to 89.0% of all completed surveys depending on round.

²RSS–1 times were limited to complete interviews collected in one visit to the survey instrument (not limited to 60 minutes or less).

NOTE: RSS is Rapid Surveys System.

SOURCES: National Center for Health Statistics, Rapid Surveys System Round 1, 2023; Rapid Surveys System Round 2, 2023; Rapid Surveys System Round 3, 2024; and Rapid Surveys System Round 4, 2024.

Table H. Unweighted survey breakoff rates, by round and panel provider: Rapid Surveys System Rounds 1–4

Round	Number of questions	Panel Provider 1		Panel Provider 2		Combined	
		Number of breakoffs	Breakoff rate (percent)	Number of breakoffs	Breakoff rate (percent)	Number of breakoffs	Breakoff rate (percent)
RSS–1	144	71	2.4	163	3.4	234	3.0
RSS–2	158	83	2.8	229	5.2	312	4.2
RSS–3	166	116	2.7	182	4.2	298	3.4
RSS–4	178	104	2.2	159	3.7	263	2.9

NOTES: RSS is Rapid Surveys System. A breakoff is defined as an interview that was started but not fully completed.

SOURCES: National Center for Health Statistics, Rapid Surveys System Round 1, 2023; Rapid Surveys System Round 2, 2023; Rapid Surveys System Round 3, 2024; and Rapid Surveys System Round 4, 2024.

Across the first four rounds, these screens accounted for 25.2% (RSS–3) to 37.2% (RSS–1) of all breakoffs (7–10).

Item Nonresponse

Item nonresponse rates for questions asked in each round of RSS were produced and reviewed. Item nonresponse is defined as skipping a question for which the panelist was eligible (soft refusal) in computer-assisted web interviewing, and “don’t know” or “refused” responses entered by interviewers in computer-assisted telephone interviewing (CATI) (used by Panel Provider 1).

Item nonresponse rates are summarized by main interview section and level of item nonresponse, overall and for both panel providers. Items with a nonresponse rate of more than 5% are individually described in the quality profile that accompanies that round’s public-use data file release. The primary concern with high item nonresponse is the risk of biased survey estimates for that item (11). Item nonresponse also increases the variance of a point estimate because the observed sample size is smaller than the actual sample size for that item. For items with moderate to high item nonresponse (over 5%), data users are encouraged to investigate the differences between item respondents and nonrespondents and address possible biases.

Table J presents combined item nonresponse rates from the first four RSS rounds. These rates were computed by summing the total number of missing responses (don’t know, refused, and did not answer) across all questions and dividing by the total number of responses (missing and valid) across all questions in a round. As shown, combined rates were low overall, ranging from a low of 1.0% in RSS–2 to a high of 1.8% in RSS–3. In addition, rates are largely consistent across panel providers. Table K summarizes the number and percentage of questions by level of item nonresponse for the first four rounds. At least 90% of the questions in each round produced item nonresponse rates less than 5%, with at least 50% of items in each round producing rates under 1%. In turn, less than 10% of items in each round produced item nonresponse rates of 5% or higher. In RSS–4, both panel providers had a higher percentage of questions with item nonresponse rates of 10% or higher compared with previous rounds. This may reflect the more sensitive content of RSS–4, such as technology-facilitated sexual violence, coercive control, and psychological aggression. More information on these items along with section-level item nonresponse rates can be found in the quality profile accompanying each round.

Table J. Item nonresponse rate overall, by panel provider: Rapid Surveys System Rounds 1–4

Round	Number of questions	Item nonresponse rate ¹		
		Panel Provider 1	Panel Provider 2	Combined
RSS–1	144	1.1	1.2	1.2
RSS–2	158	1.2	0.9	1.0
RSS–3	166	1.5	2.0	1.8
RSS–4	178	1.3	1.2	1.3

¹Computed by dividing the sum of all missing (don’t know, refused, and did not answer) responses by the sum of all responses (valid and missing).

NOTE: RSS is Rapid Surveys System.

SOURCES: National Center for Health Statistics, Rapid Surveys System Round 1, 2023; Rapid Surveys System Round 2, 2023; Rapid Surveys System Round 3, 2024; and Rapid Surveys System Round 4, 2024.

Assessment of Profile Data

Because information is collected on the panelists over time, the use of commercial survey panels allows the RSS program to conduct additional assessments beyond what is collected in the questionnaire. This has included the evaluation of panelists who actively respond to surveys compared with those who have not recently responded to surveys (active versus inactive), as well as the ability to track panelists across rounds.

An evaluation of inactive survey panelists

As implied by the discussion of completion and response rates, the two panel providers approach panel maintenance differently. After Panel Provider 1 recruits panelists, they remain on the panel unless they specifically ask to be removed (temporarily or permanently). As a result, panelists who have not participated for extended periods of time (more than 6 months, for example) will remain on the frame and are eligible for sample selection unless specific steps are taken to limit sample draws to active panelists. Panelists were considered inactive if they had not participated in at least one survey in the past 6 months. Panel Provider 2, on the other hand, proactively removes inactive panelists from the panel, minimizing the likelihood that inactive panelists are selected in any given sample. As noted previously, Panel Provider 1’s decision to include inactive panelists in the sample for RSS 1–3 centered on concerns that limiting the sample to active panelists may result in falling short of target completions. For RSS 1–3, Panel Provider 1 provided a flag variable on their data sets that indicated if the panelist was considered active or inactive. This flag enabled assessments of the impact of including inactive panelists in their RSS 1–3 samples, including:

- Comparisons of completion rates for active and inactive panelists.

Table K. Number and unweighted percentage of questions at different levels of item nonresponse, by round and panel provider: Rapid Surveys System Rounds 1–4

Round	Item nonresponse level			
	Less than 1%	1%–less than 5%	5%–less than 10%	10% or more
Round 1				
Combined:				
Number of questions	74	56	10	4
Percent of questions.	51.4	38.9	6.9	2.8
Panel Provider 1:				
Number of questions	82	53	4	5
Percent of questions.	56.9	36.8	2.8	3.5
Panel Provider 2:				
Number of questions	79	54	6	5
Percent of questions.	54.9	37.5	4.2	3.5
Round 2				
Combined:				
Number of questions	104	47	1	6
Percent of questions.	65.8	29.7	2.5	1.9
Panel Provider 1:				
Number of questions	107	44	1	6
Percent of questions.	67.7	27.8	0.6	3.8
Panel Provider 2:				
Number of questions	104	50	2	2
Percent of questions.	65.8	31.6	1.3	1.3
Round 3				
Combined:				
Number of questions	89	71	4	2
Percent of questions.	53.6	42.8	2.4	1.2
Panel Provider 1:				
Number of questions	92	67	5	2
Percent of questions.	55.4	40.4	3.0	1.2
Panel Provider 2:				
Number of questions	85	72	7	2
Percent of questions.	51.2	43.4	4.2	1.2
Round 4				
Combined:				
Number of questions	93	73	0	12
Percent of questions.	52.2	41.0	0.0	6.7
Panel Provider 1:				
Number of questions	90	73	3	12
Percent of questions.	50.6	41.0	1.7	6.7
Panel Provider 2:				
Number of questions	98	68	0	12
Percent of questions.	55.1	38.2	0.0	6.7

SOURCES: National Center for Health Statistics, Rapid Surveys System Round 1, 2023; Rapid Surveys System Round 2, 2023; Rapid Surveys System Round 3, 2024; and Rapid Surveys System Round 4, 2024.

- Comparisons of sociodemographic distributions (using weight calibration variables), before calibration to NHIS control totals, for Panel Provider 1's total (inactive and active panelists) and active-only samples compared with NHIS.
- Comparisons of bias for benchmarking variables, after calibration to NHIS, for Panel Provider 1's total and active-only samples compared with NHIS estimates.

Analyses were initially conducted on fully processed RSS–1 data so that decisions could be made before the RSS–4 sample design was finalized (in March 2024). Based on the RSS–1 evaluation, the decision starting with RSS–4 was to limit Panel Provider 1 samples to panelists who had participated in at least one survey in the past 12 months. The Round 1 evaluation revealed that active and inactive

panelists did not significantly differ by key sociodemographic features, as defined by weight calibration variables, and that estimates of benchmark variables changed little or not at all when based on active-only panelists compared with the total sample (active and inactive panelists). In addition, inactive panelists composed a very small percentage of the respondent pool (2.9%, 85 panelists) and, therefore, did not greatly contribute to meeting the target completes. In fact, Panel Provider 1 fell short of target completes (2,898 final completes compared with 3,000 target completes) even after including inactive panelists.

The analyses performed in RSS–1 were repeated for Rounds 2 and 3. Detailed results from all three rounds can be found in an Appendix to the RSS–4 Quality Profile (12). To summarize the results across all three rounds:

- The number of respondents from the inactive group was low in all three rounds, with unweighted completion rates ranging from 0.5% in RSS–3 to 2.8% in RSS–2.
- The inclusion of inactive panelists appears to improve sample representativeness, as RSS estimates moved closer to NHIS estimates for most calibration variables. However, when comparing Panel Provider 1's full responding sample to the active-only sample, differences in calibration-variable estimates were small. Across all three rounds, 80% of 75 comparisons revealed differences of less than one-half of a percentage point.
- Among the 11 benchmark variables collected across all three rounds, all had the same level of standardized bias compared with NHIS in the total (active plus inactive) and active-only samples for each of the three rounds.

The benefit of limiting Panel Provider 1 sample draws to active-only panelists for Round 4 and future

rounds is that it brings the samples for the two panel providers into better alignment. For example, Panel Provider 1 drew a sample of 11,568 panelists for Round 1, of which 6,824 (59.0%) were considered inactive (had not participated in a survey in the past 6 months). The very low survey completion rate among inactive panelists (1.3%) drove the survey completion rate for Panel Provider 1's total sample down to 25.1%. Had the sample been limited to the 4,744 active panelists, the survey completion rate would have been 59.3%, which aligns more closely with the Round 1 survey completion rate for Panel Provider 2 (69.8%). (See Table A1 of the Appendix to the RSS-4 Quality Profile [12].)

Evaluating overlapping respondents between rounds

One limitation of fielding frequent surveys through a commercial survey panel is that the same set of panelists is eligible to be sampled each round, so RSS surveys may have overlapping respondents between rounds. This results in nonunique responses and increases the respondent burden. Because the panels use a probability-based sample design and can identify the panelists who were selected for each study, panel providers are able to track which panelists were sampled and which panelists responded across the rounds. While RSS 1–4 did not impose limitations on who could be sampled in each round based on prior round participation, the information has been useful for assessing the percentage of overlapping respondents between rounds. This allows RSS to monitor and make informed decisions about the sample sizes, desired frequency between rounds, and disclosure risk when planning public data releases.

Assessment of Data Collection Methodologies

RSS allows NCHS to collect data on emerging and priority health topics more quickly than using traditional household surveys. However, statistical inference from web-based

panel surveys may be at higher risk of potential biases, such as nonresponse or coverage biases, when compared with traditional household surveys. One strategy to reduce bias is to enhance the data collection methodologies to improve nonresponse follow-up. To investigate the robustness of the data collection methodologies used by NORC and Ipsos for RSS, NCHS had each panel provider investigate an alternative data collection approach in RSS-1 and RSS-2. For these two rounds, NORC and Ipsos each conducted their data collection using their standard approach (also used in Rounds 3 and 4) and a secondary enhanced approach to assess if the enhanced approach reduced bias in the RSS estimates.

The two collection approaches for each panel provider were compared by analyzing the completion rates, as well as the estimates of demographic features and health outcomes for differences. The analyses in this section suggest that the enhanced data collection methodology resulted in some improvement of completion rates but did not impact the resulting health outcome estimates, and so the decision was made not to make changes to enhance the data collection protocols in RSS-3 and beyond.

NORC

The AmeriSpeak federal panel is a subset of the AmeriSpeak panel, with 40% of households receiving nonresponse follow-up during recruitment into the panel compared with the 20% of households that receive nonresponse follow-up for the AmeriSpeak panel. NORC's enhanced method selected the sample of panelists from the AmeriSpeak federal panel, rather than the AmeriSpeak panel, and used an adjusted protocol. Adjustments included limiting the sample to panelists who have responded to a survey in the past 6 months, increasing the number of study contacts and survey reminders, allowing longer data collection field time, and sending prenotification postcards (Table L).

The enhanced data collection methodology had a higher completion rate in Round 1 (27.6% compared with 25.1%), but a lower completion rate in Round 2 (19.7% compared

Table L. Standard and enhanced data collection methods: NORC, Rapid Surveys System Rounds 1 and 2

Survey protocol	Standard	Enhanced
Data collection modes	CAWI and CATI	CAWI and CATI
Nonresponse follow up	Fed Ex mailing, in person	Fed Ex mailing, in person
Nonresponse follow-up sampling rate	20%	40%
Standard study sample	Full panel	6-month active panelists
Study incentive	\$5 for web and \$10 for phone	\$5 for web and \$10 for phone
Study contacts	Five emails, up to three call attempts	Seven emails; up to five call attempts
Data collection field	2 weeks	4 weeks
Additional efforts	...	Prenotification postcards to panelists with low cooperation rates in prior surveys, and to phone-preferred panelists. Reminder postcards to all nonrespondents after Day 10.

... Category not applicable.

NOTES: CAWI is computer-assisted web interviewing. CATI is computer-assisted telephone interviewing.

SOURCES: National Center for Health Statistics, Rapid Surveys System Round 1, 2023 and Rapid Surveys System Round 2, 2023.

Table M. Unweighted rates of response outcomes, by data collection method: NORC, Rapid Surveys System Rounds 1 and 2

Response outcome	Round 1						Round 2					
	Standard		Enhanced		Total		Standard		Enhanced		Total	
	Number of respondents	Unweighted rate	Number of respondents	Unweighted rate	Number of respondents	Unweighted rate	Number of respondents	Unweighted rate	Number of respondents	Unweighted rate	Number of respondents	Unweighted rate
Complete	2,898	25.1	4,031	27.6	6,929	26.5	2,849	22.2	3,184	19.7	6,033	20.8
Never accessed the instrument	8,546	73.9	10,390	71.3	18,936	72.4	9,867	76.8	12,816	79.2	22,683	78.2
Accessed instrument but dropped off.	71	0.6	106	0.7	177	0.7	83	0.6	136	0.8	219	0.8
Completed interview but case dropped due to quality concerns	53	0.5	55	0.4	108	0.4	43	0.3	36	0.2	79	0.3

SOURCES: National Center for Health Statistics, Rapid Surveys System Round 1, 2023; and Rapid Surveys System Round 2, 2023.

Table N. Unweighted completion rates, by data collection method and panelist characteristic: NORC, Rapid Surveys System Rounds 1 and 2

Domain and subgroup	Round 1						Round 2					
	Standard			Enhanced			Standard			Enhanced		
	Sample	Number of respondents	Unweighted completion rate	Sample	Number of respondents	Unweighted completion rate	Sample	Number of respondents	Unweighted completion rate	Sample	Number of respondents	Unweighted completion rate
Age												
18–34	4,519	789	17.5	2,926	537	18.4	5,042	778	15.4	3,198	607	19.0
35–49	2,853	715	25.1	4,143	945	22.8	3,266	599	18.3	5,064	837	16.5
50–64	2,463	723	29.4	3,866	1,075	27.8	2,559	676	26.4	4,220	752	17.8
65 and older	1,733	671	38.7	3,646	1,474	40.4	1,976	796	40.3	3,691	988	26.8
Sex												
Male	6,251	1,402	22.4	5,573	1,586	28.5	6,697	1,253	18.7	5,633	1,170	20.8
Female	5,318	1,496	28.1	9,009	2,445	27.1	6,143	1,596	26.0	10,539	2,014	19.1
Race and ethnicity												
Black, non-Hispanic	1,859	340	18.3	2,273	500	22.0	2,007	326	16.2	2,881	480	16.7
Hispanic ¹	3,288	507	15.4	3,058	478	15.6	3,469	376	10.8	3,742	543	14.5
Other, non-Hispanic ²	890	214	24.0	1,262	293	23.2	1,105	247	22.4	1,339	211	15.8
White, non-Hispanic	5,434	1,814	33.4	7,958	2,756	34.6	6,167	1,887	30.6	8,124	1,931	23.8
Education												
Less than high school	1,467	203	13.8	1,517	208	13.7	1,662	194	11.7	1,709	234	13.7
High school diploma or equivalent	2,776	545	19.6	3,376	744	22.0	3,052	489	16.0	3,382	531	15.7
Some college or higher	7,325	2,150	29.4	9,688	3,079	31.8	8,128	2,166	26.7	11,081	2,419	21.8
Metropolitan status												
Metropolitan	10,148	2,475	24.4	12,991	3,527	27.2	11,275	2,440	21.6	14,481	2,789	19.3
Nonmetropolitan	1,422	423	29.8	1,593	504	31.6	1,567	409	26.1	1,691	395	23.4

¹People of Hispanic origin may be of any race.²Includes non-Hispanic single-race groups other than White and Black and non-Hispanic people of two or more races.

SOURCES: National Center for Health Statistics, Rapid Surveys System Round 1, 2023; and Rapid Surveys System Round 2, 2023.

with 22.2%) (Table M). The completion rates for the two approaches were within 2.5% of each other for both rounds, without clear results on if the enhanced method improved the completion rates.

A comparison of completion rates by demographic features for Rounds 1 and 2 suggested that the enhanced data collection methodology may improve the completion rates of adults younger than age 35, males, Black non-Hispanic adults, and Hispanic adults (Table N). A higher completion rate for the enhanced data collection was also observed for some demographics in only one of the two rounds, including adults age 65 and older (Round 1), White non-Hispanic adults (Round 1), adults with less than a high school education (Round 2), adults with a high school diploma or equivalent (Round 1), and adults with some college or higher education (Round 1), as well as adults living in metropolitan (Round 1) and nonmetropolitan (Round 1) areas (Table N).

In addition, estimates of selected health outcomes were compared between the two samples collected using the two data collection methodologies. Both samples were used to produce adult population estimates from RSS–1 and RSS–2 and were statistically tested using a Rao–Scott chi-square test (Tables O and P). Comparing the estimates revealed that only 1 of the 21 selected outcomes in Round 1 had a statistically significant difference (hospitalized overnight in the past 12 months, with a *p* value of 0.017), and only 1 of the 14 selected outcomes in Round 2 had

a statistically significant difference (ever diagnosed with cancer, with a *p* value of 0.033), suggesting that the difference in the two samples did not greatly affect any potential bias in the estimates.

The evaluation of the two data collection methodologies for NORC did not suggest a clear improvement when sampling from the AmeriSpeak federal panel compared with the AmeriSpeak panel. While the completion rate for the enhanced data collection methodology was higher than the completion rate for the standard data collection methodology in Round 1, the completion rate was lower in Round 2. In addition, comparisons between the health outcome estimates suggested that most of the estimates did not significantly differ (20 out of 21 evaluated estimates in Round 1 and 13 out of 14 evaluated estimates in Round 2).

Ipsos

Ipsos’s enhanced method included telephone prompting and telephone interviewing for survey nonrespondents, compared with the standard method which only allows panelists to respond via the web. While the study contacts and data collection field time remained the same between the two samples, the enhanced methodology included a call to nonrespondents on Day 11 of the field period during which the panelist was offered the opportunity to complete the interview by phone or prompted to complete the survey online (Table Q). Each panelist was

Table O. Estimate, standard error, and statistical test of health outcomes, by data collection method: NORC, Rapid Surveys System Round 1

Health outcome	Standard		Enhanced		<i>p</i> value ¹
	Estimate	Standard error	Estimate	Standard error	
Excellent or very good self-rated health	43.7	1.5	41.6	1.5	0.327
Ever diagnosed with coronary heart disease	7.7	1.1	7.3	0.7	0.699
Ever diagnosed with hypertension	37.2	2.2	38.2	2.1	0.684
Current hypertension	32.5	2.3	34.3	2.1	0.489
Ever diagnosed with asthma	18.9	1.1	19.7	1.1	0.610
Ever diagnosed with cancer	11.6	1.2	12.7	1.2	0.468
Ever diagnosed with prediabetes	24.9	1.4	28.3	1.5	0.079
Ever diagnosed with gestational diabetes	8.0	0.7	9.7	0.8	0.170
Ever diagnosed with diabetes	12.4	1.1	13.1	1.0	0.602
Feel worried, nervous, or anxious daily or weekly	35.9	1.4	35.2	1.6	0.695
Feel depressed daily or weekly	22.9	1.2	23.4	1.4	0.794
Ever smoked 100 cigarettes	41.1	1.7	39.5	1.6	0.496
Current smoking	13.3	1.1	14.5	1.1	0.494
Dental cleaning in past 12 months	60.6	1.6	57.2	1.9	0.151
Saw doctor or other health professional in past 12 months	75.8	1.8	76.6	1.7	0.683
Hospitalized overnight in past 12 months	8.0	0.7	10.5	0.9	0.017
Eye exam in past 12 months	50.8	1.9	51.5	1.7	0.776
Therapy in past 12 months ²	14.3	0.9	15.2	0.8	0.453
Blood pressure checked in past 12 months	79.6	1.7	80.7	1.7	0.594
Cholesterol checked in past 12 months	61.1	2.3	64.0	2.3	0.246
Blood sugar checked in past 12 months	56.2	2.2	59.3	2.2	0.180

¹Statistical testing was conducted using the Rao–Scott chi square test.

²Includes physical therapy, speech therapy, rehabilitative therapy, and occupational therapy.

SOURCE: National Center for Health Statistics, Rapid Surveys System Round 1, 2023.

Table P. Estimate, standard error, and statistical test of health outcomes, by data collection method: NORC, Rapid Surveys System Round 2

Health outcome	Standard		Enhanced		p value ¹
	Estimate	Standard error	Estimate	Standard error	
Excellent or very good self-rated health	42.6	1.4	43.0	1.4	0.811
Ever diagnosed with hypertension	38.2	1.3	38.3	1.4	0.926
PHQ-2: Screened for depression (depression subscale)	14.6	1.6	15.7	1.7	0.674
GAD-2: Screened for anxiety (anxiety subscale)	18.8	1.8	20.0	1.8	0.607
PHQ-2 and GAD-2: Neither depression nor anxiety	71.6	2.3	69.2	2.5	² 0.869
PHQ-2 and GAD-2: Depression only	4.3	1.0	5.4	1.1	² 0.869
PHQ-2 and GAD-2: Anxiety only	11.1	1.8	12.6	1.5	² 0.869
PHQ-2 and GAD-2: Both anxiety and depression	13.0	2.1	12.9	1.9	² 0.869
Ever diagnosed with asthma	20.0	1.1	18.8	0.9	0.449
Ever diagnosed with cancer	14.5	0.9	12.2	0.6	0.033
Ever smoked 100 cigarettes	37.7	1.1	40.7	1.3	0.055
Current smoking	14.2	1.0	13.7	0.8	0.679
Saw doctor or other health professional in past 12 months	81.0	1.1	78.0	1.2	0.077
Hospitalized overnight in past 12 months	11.9	1.0	10.3	1.0	0.226

¹Statistical testing was conducted using the Rao–Scott chi square test.

²p value is for 4-category combined PHQ-2 and GAD-2 health outcome.

NOTES: PHQ is patient health questionnaire. GAD is generalized anxiety disorder.

SOURCE: National Center for Health Statistics, Rapid Surveys System Round 2, 2023.

Table Q. Standard and enhanced data collection methods: Ipsos, Rapid Surveys System Rounds 1 and 2

Survey protocol	Standard	Enhanced	
Experimental condition	...	Phone interview	Phone prompt
Data collection modes	CAWI	CAWI or CATI	CAWI
Study incentive	\$1	\$1	\$1
Study contacts	A prenotification email 2 days before fielding; reminders on Days 3, 7, 11, 14, 18, and 20 for hard-to-reach groups, otherwise reminders on Days 3, 14, 18, and 20	A prenotification email 2 days before fielding; reminders on Days 3, 7, 11, 14, 18, and 20 for hard-to-reach groups, otherwise reminders on Days 3, 14, 18, and 20	A prenotification email 2 days before fielding; reminders on Days 3, 7, 11, 14, 18, and 20 for hard-to-reach groups, otherwise reminders on Days 3, 14, 18, and 20
Data collection field	3 weeks	3 weeks	3 weeks
Additional nonresponse follow-up	...	Calls to nonrespondents on Day 11 of the field period, up to five call attempts A phone interview was attempted	Calls to nonrespondents on Day 11 of the field period, up to five call attempts A human caller prompted them to take the survey online

... Category not applicable.

NOTES: CAWI is computer-assisted web interviewing. CATI is computer-assisted telephone interviewing. Hard-to-reach group is defined as young adults ages 18–19, panelists of racial and ethnic minority groups, or panelists with a high school or less education.

SOURCES: National Center for Health Statistics, Rapid Surveys System Round 1, 2023; and Rapid Surveys System Round 2, 2023.

randomly assigned to the phone interview or phone prompt group before the start of data collection, although only nonresponding panelists were contacted using these methods.

For Ipsos, the two enhanced methods (phone interviewing and phone prompting for completing the web survey) appeared to improve completion rates, with rates of 76.1% and 75.5% for the phone interview and phone prompt groups, respectively, compared with 69.8% using

the standard method in Round 1, and 75.7% and 74.4% compared with 69.0% in Round 2 (Table R). The completion rates for both rounds had at least a 5% improvement for both enhanced experimental groups compared with the sample receiving Ipsos’s standard methodology.

An evaluation of completion rates by demographic subgroups in Rounds 1 and 2 revealed that the enhanced conditions improved completion rates among all demographic groups evaluated (age, sex, race and Hispanic

Table R. Unweighted rates of response outcomes, by data collection method: Ipsos, Rapid Surveys System Rounds 1 and 2

Response outcome	Standard		Enhanced, phone interview		Enhanced, phone prompt		Total	
	Number of respondents	Unweighted rate	Number of respondents	Unweighted rate	Number of respondents	Unweighted rate	Number of respondents	Unweighted rate
Round 1								
Complete	4,701	69.8	1,777	76.1	1,770	75.5	8,248	72.2
Never accessed the instrument	1,848	27.4	481	20.6	506	21.6	2,883	25.2
Accessed instrument but dropped off.	163	2.4	64	2.7	58	2.5	285	2.5
Completed interview but case dropped due to quality concerns	27	0.4	12	0.5	11	0.5	50	0.4
Round 2								
Complete	4,197	69	1,612	75.7	1,579	74.4	7,388	71.5
Never accessed the instrument	1,636	26.9	448	21	469	22.1	2,553	24.7
Accessed instrument but dropped off.	229	3.8	59	2.8	65	3.1	353	3.4
Completed interview but case dropped due to quality concerns	24	0.4	11	0.5	8	0.4	43	0.4

SOURCES: National Center for Health Statistics, Rapid Surveys System Round 1, 2023; and Rapid Surveys System Round 2, 2023.

Table S. Unweighted completion rates, by data collection method and panelist characteristic: Ipsos, Rapid Surveys System Rounds 1 and 2

Domain and subgroup	Standard			Enhanced, phone interview			Enhanced, phone prompt		
	Sample	Number of respondents	Unweighted completion rate	Sample	Number of respondents	Unweighted completion rate	Sample	Number of respondents	Unweighted completion rate
Age									
Round 1									
18–34	1,503	863	57.4	510	333	65.3	488	309	63.3
35–49	1,700	1,086	63.9	580	422	72.8	585	406	69.4
50–64	1,867	1,379	73.9	677	552	81.5	639	509	79.7
65 and older.	1,669	1,373	82.3	567	470	82.9	633	546	86.3
Sex									
Male	3,176	2,288	72.0	1,088	838	77.0	1,103	846	76.7
Female	3,563	2,413	67.7	1,246	939	75.4	1,242	924	74.4
Race and ethnicity									
Black, non-Hispanic	743	462	62.2	248	168	67.7	249	172	69.1
Hispanic ¹	1,040	610	58.7	377	249	66.1	380	232	61.1
Other, non-Hispanic ²	507	347	68.4	180	135	75.0	181	131	72.4
White, non-Hispanic	4,363	3,228	74.0	1,508	1,211	80.3	1,511	1,219	80.7
Education									
Less than high school	493	289	58.6	160	122	76.3	161	98	60.9
High school diploma or equivalent. . . .	1,703	1,174	68.9	593	432	72.9	628	446	71.0
Some college or higher	4,543	3,238	71.3	1,581	1,223	77.4	1,556	1,226	78.8
Metropolitan status									
Metropolitan.	5,807	4,073	70.1	1,997	1,525	76.4	2,010	1,529	76.1
Nonmetropolitan	903	616	68.2	329	248	75.4	327	239	73.1

See footnotes at end of table.

Table S. Unweighted completion rates, by data collection method and panelist characteristic: Ipsos, Rapid Surveys System Rounds 1 and 2—Con.

Domain and subgroup	Standard			Enhanced, phone interview			Enhanced, phone prompt		
	Sample	Respondents	Unweighted completion rate	Sample	Respondents	Unweighted completion rate	Sample	Respondents	Unweighted completion rate
Age									
				Round 2					
18–34	1,368	773	56.5	463	297	64.2	452	281	62.2
35–49	1,566	1,004	64.1	553	398	72.0	521	367	70.4
50–64	1,667	1,216	73.0	589	468	79.5	596	474	79.5
65 and older	1,485	1,204	81.1	525	449	85.5	552	457	82.8
Sex									
Male	2,845	1,997	70.2	1,024	793	77.4	981	742	75.6
Female	3,241	2,200	67.9	1,106	819	74.1	1,140	837	73.4
Race and ethnicity									
Black, non-Hispanic	616	402	65.3	216	163	75.5	261	188	72.0
Hispanic ¹	973	590	60.6	326	209	64.1	324	214	66.1
Other, non-Hispanic ²	523	348	66.5	180	138	76.7	152	113	74.3
White, non-Hispanic	3,909	2,815	72.0	1,383	1,091	78.9	1,362	1,051	77.2
Education									
Less than high school	417	268	64.3	153	106	69.3	146	98	67.1
High school diploma or equivalent	1,559	1,060	68.0	535	400	74.8	518	389	75.1
Some college or higher	4,110	2,869	69.8	1,442	1,106	76.7	1,457	1,092	75.0
Metropolitan status									
Metropolitan	5,210	3,597	69.0	1,810	1,363	75.3	1,829	1,365	74.6
Nonmetropolitan	867	594	68.5	318	247	77.7	289	214	74.1

¹People of Hispanic origin may be of any race.

²Includes non-Hispanic single-race groups other than White and Black and non-Hispanic people of two or more races.

SOURCES: National Center for Health Statistics, Rapid Surveys System Round 1, 2023; and Rapid Surveys System Round 2, 2023.

origin, education, and metropolitan status) (Table S). The minimum improvement in completion rate for the phone interview group was for adults age 65 and older (82.9% compared with 82.3% for the standard method in Round 1) and for the phone prompt group was for adults with a high school degree or equivalent (71.0% compared with 68.9% for the standard method in Round 1).

Similar to NORC, estimates of selected health outcomes in the two rounds were compared between samples using the standard and enhanced data collection methodologies and were statistically tested for differences using the Rao–Scott chi-square test (Tables T and U). The phone interview and phone prompting groups were combined into a single enhanced data collection group for this comparison (estimates between the two groups were checked for alignment before combining). No significant differences were detected between the estimates of health outcomes compared between the two sampled groups for the two rounds.

Although the evaluation of the two data collection methodologies for Ipsos resulted in an improvement in the completion rates for the phone interview and phone prompt groups, no differences in the estimates of selected health outcomes were detected. While the standard

methodology resulted in a lower response rate and could have potential for bias, these comparisons verified no additional bias existed. Due to the increased cost and time needed for data collection using a phone component, the enhanced procedure was not implemented.

Conclusion

This report describes the RSS methodology from Rounds 1–4. RSS is an evolving program that uses probability-based commercial survey panels for faster data collection on emerging and priority health topics at CDC and HHS. The program methodology, including calibration weighting to NHIS, the combination of two panels, and quality assessment approaches, has been used to reduce potential bias in the estimates and allowed NCHS to further explore the use of statistical models that combine the accuracy of its traditional household probability-based surveys with the timeliness and relevance of online data collection using commercial probability-sampled survey panels. Each round allows for regular review of the methodology and transparent reporting of the data quality through the published survey documentation. RSS was designed to be an evolving program, with ongoing quality evaluations and changes to methodology to reflect scientific findings.

Table T. Estimate, standard error, and statistical test of health outcomes, by data collection method: Ipsos, Rapid Surveys System Round 1

Health outcome	Standard		Enhanced ¹		p value ²
	Estimate	Standard error	Estimate	Standard error	
Excellent or very good self-rated health	46.2	0.8	47.2	0.9	0.438
Ever diagnosed with coronary heart disease	4.5	0.3	5.2	0.4	0.126
Ever diagnosed with hypertension	33.8	0.7	33.5	0.8	0.767
Current hypertension	30.2	0.7	29.8	0.8	0.723
Ever diagnosed with asthma	14.3	0.6	14.5	0.7	0.795
Ever diagnosed with cancer	10.4	0.4	10.3	0.5	0.845
Ever diagnosed with prediabetes	22.7	0.6	21.9	0.7	0.408
Ever diagnosed with gestational diabetes	7.1	0.6	7.3	0.7	0.829
Ever diagnosed with diabetes	12.0	0.5	11.3	0.5	0.332
Feel worried, nervous, or anxious daily or weekly	30.9	0.8	30.1	0.9	0.495
Feel depressed daily or weekly	17.9	0.6	16.4	0.7	0.100
Ever smoked 100 cigarettes	33.6	0.7	34.7	0.9	0.301
Current smoking	9.3	0.5	10.2	0.6	0.198
Dental cleaning in past 12 months	66.1	0.8	64.8	0.9	0.280
Saw doctor or other health professional in past 12 months	80.1	0.7	78.3	0.8	0.091
Hospitalized overnight in past 12 months	7.8	0.4	7.1	0.5	0.262
Eye exam in past 12 months	55.9	0.8	55.6	0.9	0.837
Therapy in past 12 months ³	12.4	0.5	12.7	0.6	0.688
Blood pressure checked in past 12 months	82.3	0.7	82.4	0.8	0.908
Cholesterol checked in past 12 months	65.7	0.8	66.5	0.9	0.525
Blood sugar checked in past 12 months	60.3	0.9	61.7	1.0	0.286

¹Includes phone prompting and phone interviewing groups.

²Statistical testing was conducted using the Rao–Scott chi square test.

³Includes physical therapy, speech therapy, rehabilitative therapy, and occupational therapy.

SOURCE: National Center for Health Statistics, Rapid Surveys System Round 1, 2023.

Table U. Estimate, standard error, and statistical test of health outcomes, by data collection method: Ipsos, Rapid Surveys System Round 2

Health outcome	Standard		Enhanced ¹		p value ²
	Estimate	Standard error	Estimate	Standard error	
Excellent or very good self-rated health	46.5	0.8	48.6	1.0	0.106
Ever diagnosed with hypertension	33.9	0.8	33.3	0.9	0.641
PHQ–2: Screened for depression (depression subscale)	15.8	1.3	13.7	1.4	0.272
GAD–2: Screened for anxiety (anxiety subscale)	19.3	1.3	19.7	1.6	0.808
PHQ–2 and GAD–2: Neither depression nor anxiety	70.0	1.8	69.2	2.3	³ 0.123
PHQ–2 and GAD–2: Depression only	3.9	0.8	2.9	0.9	³ 0.123
PHQ–2 and GAD–2: Anxiety only	10.1	1.2	14.6	1.8	³ 0.123
PHQ–2 and GAD–2: Both anxiety and depression	16.1	1.5	13.3	1.7	³ 0.123
Ever diagnosed with asthma	15.6	0.6	14.4	0.7	0.194
Ever diagnosed with cancer	10.9	0.5	9.7	0.5	0.093
Ever smoked 100 cigarettes	33.8	0.8	33.5	0.9	0.809
Current smoking	9.2	0.5	9.6	0.6	0.560
Saw doctor or other health professional in past 12 months	80.9	0.7	81.2	0.8	0.820
Hospitalized overnight in past 12 months	7.4	0.4	7.1	0.5	0.620

¹Includes phone prompting and phone interviewing groups.

²Statistical testing was conducted using the Rao–Scott chi square test.

³p value is for 4-category combined PHQ–2 and GAD–2 health outcome.

NOTES: PHQ is patient health questionnaire. GAD is generalized anxiety disorder.

SOURCE: National Center for Health Statistics, Rapid Surveys System Round 2, 2023.

Future methodological decisions and analyses will be similarly documented.

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Appendix I. Selection of Rapid Surveys System 1–3 Calibration Variables

Questions were added to the 2022 Quarter 3 (2022 Q3) and 2023 Quarter 2 (2023 Q2) National Health Interview Survey (NHIS) sample adult modules to produce variables for possible calibration of Rapid Surveys System (RSS) weights. Once data became available for these items, their potential for RSS weight calibration was evaluated. For these items to be useful in adjusting for coverage and nonresponse error in RSS estimates, they need to be differentially associated with participation in RSS and NHIS as well as being associated with health outcomes of interest on RSS surveys. Initial evaluations of possible calibration variables were limited to explorations of associations with health content in NHIS. This entailed multivariate analyses focused on the associations between potential weight calibration variables and health outcomes, excluding 12 variables previously used in calibration of Research and Development Survey (RANDS) weights to NHIS control totals (2). Health outcomes selected for this evaluation were drawn from four domains: health status, healthcare service use, healthcare access (including health insurance coverage), and health behaviors.

Table I lists the 12 control variables and Table II lists the full set of health outcomes. Because all health outcomes were dichotomous, logistic regressions were estimated in which a potential calibration variable was entered as the independent variable and the 12 RANDS calibration variables were entered as controls. In total, 7 possible calibration variables (based on 15 items; see factor analysis results below) were assessed, with 5 being available with 2022 Q3 Early Release adult data ($n = 7,149$) and all 7 available with 2023 Q2 Early Release adult data ($n = 7,310$). Table C provides a breakdown of items behind the potential calibration variables. Because these analyses were performed on partially edited data and before final weights were available, analyses were weighted using the sample adult base weight (household base weight multiplied by the inverse of sample adult probability of selection). Logistic regression analyses were performed in SAS-callable SUDAAN (13) to account for NHIS's complex sample design.

Before multivariate analyses were performed, exploratory factor analyses (EFA) were undertaken with tetrachoric/polychoric correlations between items considered for calibration (Table I) as inputs. The correlations and subsequent EFAs were unweighted and did not account

Table I. Control variables used in assessments of potential calibration variables

Control variable	Coding for logistic regressions
Age group	1=18–29 2=30–44 3=45–64 4=65 and older
Sex	1=Male 2=Female
Race and Hispanic origin	1=Hispanic 2=Non-Hispanic White 3=Non-Hispanic Black 4=Non-Hispanic other
Education	1=Less than high school 2=High school diploma/GED 3=Some college/Associate's degree 4=Bachelor's degree or higher
Total family income	1=\$0–\$34,999 2=\$35,000–\$74,999 3=\$75,000–\$99,999 4=\$100,000 or more 5=Unknown
Marital status	1=Never married 2=Married 3=Divorced/separated 4=Widowed
Census region of residence	1=Northeast 2=Midwest 3=South 4=West
Urbanicity	1=Metropolitan 2=Non-metropolitan
Ever diagnosed with high cholesterol	1=Yes 2=No
Ever diagnosed with asthma	1=Yes 2=No
Ever diagnosed with diabetes	1=Yes 2=No
Ever diagnosed with hypertension	1=Yes 2=No

SOURCES: National Center for Health Statistics, National Health Interview Survey, 2022 Quarter 3 and 2023 Quarter 2 Early Release adult data files.

Table II. Health outcomes included in assessment of possible calibration variables

Health domain and outcome	Coding for logistic regressions	Time period		
		2022 Quarter 3	2023 Quarter 2	
Health status				
Disability status	0=Without disability 1=With disability	X	X	
6 or more work days missed in past 12 months	0=No 1=Yes	X	X	
Ever diagnosed with a cardiovascular condition	0=No 1=Yes	X	X	
Ever diagnosed with COPD	0=No 1=Yes	X	X	
Regularly had feelings of worry, nervousness, or anxiety	0=No 1=Yes	X	X	
Regularly had feelings of depression	0=No 1=Yes	X	X	
Ever diagnosed with COVID-19	0=No 1=Yes	X	X	
Excellent or very good health	0=No 1=Yes	X	X	
Ever diagnosed with cancer	0=No 1=Yes	X	X	
Ever diagnosed with arthritis	0=No 1=Yes	X	X	
Healthcare service use				
Doctor visit in the past 12 months	0=No 1=Yes	X	X	
Emergency room visit in the past 12 months	0=No 1=Yes	X	X	
Received mental health counseling in the past 12 months	0=No 1=Yes	X	X	
Dental examination in the past 12 months	0=No 1=Yes	X	X	
Received flu vaccination in past 12 months	0=No 1=Yes	X	X	
Urgent care visit in past 12 months	0=No 1=Yes	X	X	
Hospitalized overnight in the past 12 months	0=No 1=Yes	X	X	
Eye examination in the past 12 months	0=No 1=Yes	X	X	
Physical, speech, or rehabilitative therapy in the past 12 months	0=No 1=Yes	X	X	
Received two or more COVID-19 shots	0=No 1=Yes	X	X	
Received the pneumococcal vaccine	0=No 1=Yes	X	X	

See footnotes at end of table.

Table II. Health outcomes included in assessment of possible calibration variables—Con.

Health domain and outcome	Coding for logistic regressions	Time period	
		2022 Quarter 3	2023 Quarter 2
Healthcare access			
Did not receive medical care in past 12 months due to cost	0=No 1=Yes	X	X
Did not receive mental health care in past 12 months due to cost	0=No 1=Yes	X	X
Did not take medications as prescribed in past 12 months	0=No 1=Yes	X	X
Usual source of care	0=No 1=Yes	X	X
Lack of reliable transportation for performing activities of daily living in the past 12 months	0=No 1=Yes	X	X
Encountered a non-cost barrier to care in the past 12 months	0=No 1=Yes	X	X
Food insecure household	0=No 1=Yes	X	X
Household received SNAP benefits in the past 12 months	0=No 1=Yes	X	X
Public health insurance coverage	0=No 1=Yes	X	X
Private health insurance coverage	0=No 1=Yes	X	X
Uninsured	0=No 1=Yes	X	X
Health behaviors			
Current smoker	0=No 1=Yes	X	X
Current e-cigarette use	0=No 1=Yes	X	X
Ever smoked a pipe	0=No 1=Yes	...	X
Ever used smokeless tobacco	0=No 1=Yes	...	X
Binge drink at least once in past 12 months	0=No 1=Yes	X	...
Walk for transportation in the past 7 days	0=No 1=Yes	X	...
Doctor advised adult to stop or cut alcohol use	0=No 1=Yes	X	...
Doctor advised adult to increase physical activity	0=No 1=Yes	X	...
Trouble falling asleep	0=No 1=Yes	X	...
Trouble staying asleep	0=No 1=Yes	X	...
Engage in sufficient aerobic activity	0=No 1=Yes	X	...
Engage in strengthening activities	0=No 1=Yes	X	...
BMI: Obese	0=No 1=Yes	X	X

See footnotes at end of table.

Table II. Health outcomes included in assessment of possible calibration variables—Con.

Health domain and outcome	Coding for logistic regressions	Time period	
		2022 Quarter 3	2023 Quarter 2
Health behaviors—Con.			
Exposed to chemicals on the job for 4 or more hours a week in the past 12 months	0=No 1=Yes	...	X
Exposed to tobacco smoke on the job for 4 or more hours a week in the past 12 months	0=No 1=Yes	...	X

... Category not applicable.

NOTES: SNAP is Supplemental Nutrition Assistance Program. BMI is body mass index. COPD is chronic obstructive pulmonary disease.

SOURCE: National Center for Health Statistics, National Health Interview Survey, 2022 Quarter 3 and 2023 Quarter 2 Early Release adult data files.

Table III. Results of an unweighted minimum average partials analysis of items considered for calibration of Rapid Surveys System weights

Number of factors	MAP value ¹	
	NHIS 2022 Quarter 3 ²	NHIS 2023 Quarter 2 ³
1.....	0.140	0.142
2.....	0.077	0.146
3.....	0.062	0.100
4.....	0.105	0.081
5.....	0.149	0.100
6.....	0.251	0.140
7.....	0.367	0.171
8.....	0.455	0.262

¹MAP refers to the mean squared partial correlations among variables after extracting a given number of factors. The number of factors associated with the smallest mean squared partial correlations is the optimal number of factors.

²Variables included in the MAP analysis for 2022 Quarter 3: Used the internet to communicate with a doctor or doctor's office; used the internet to look for health or medical information; used the internet to look up medical test results; life satisfaction; attended a public meeting that discussed a local issue in the past 12 months; voted in the last local election; volunteered in the past 12 months; limited in the kind or amount of work due to a physical, mental, or emotional problem; difficulty participating in social activities; and difficulty doing errands alone.

³Variables used in the MAP analysis for 2023 Quarter 2: Used the internet to communicate with a doctor or doctor's office; used the internet to look for health or medical information; used the internet to look up medical test results; life satisfaction; attended a public meeting that discussed a local issue in the past 12 months; voted in the last local election; volunteered in the past 12 months; limited in the kind or amount of work due to a physical, mental, or emotional problem; difficulty participating in social activities; difficulty doing errands alone; language used most often when watching television, reading news online or in print, or listening to the radio; language used most often when seeing a doctor or other health care professional; and language used most often when participating in social activities.

NOTES: NHIS is National Health Interview Survey. MAP is minimum average partials.

SOURCE: National Center for Health Statistics, National Health Interview Survey, 2022–2023.

for the complex sample design of NHIS. The EFAs were estimated with the R package “psych” using a weighted least squares estimation method with promax rotation. Promax rotation is an oblique rotation method that allows factors to correlate with one another, which is often more useful for health-related constructs (14). The goal was to determine if items on similar topics aligned conceptually, allowing for creation of composite measures for the subsequent logistic regression analyses. For example, whether the items on volunteering, voting in the last local election, and participating in a local meeting align on a single underlying factor of civic engagement.

To identify the number of factors to be retained, Velicer’s (15) minimum average partials (MAP) analysis was performed. MAP works by assessing how much common variance remains in a data set after extracting successive factors. After a factor is extracted, the residual correlation matrix is calculated by removing the

variance explained by the factor. The squared partial correlations in the residual matrix are then averaged.

The point where the average squared partial correlation is minimized indicates the number of factors that best explains the common variance while leaving minimal systematic variance in the residuals.

The MAP analysis applied to the 2022 Q3 data revealed three factors, consistent with expectations

(Table III). Table IV presents the standardized factor loadings from an exploratory factor analysis where the number of factors was set to three based on the MAP results.

Standardized factor loadings reflect the strength and direction of the relationship between an observed variable and a latent factor. Like correlation coefficients, standardized factor loadings range from -1 to 1.

A threshold of 0.40 (absolute value) was used to delineate loadings to retain (0.40 or above) or to drop (below 0.40), with loadings below 0.40 not shown in Tables IV and V.

Not surprisingly, the work limitation (WORKLIM), difficulty participating in social activities (SOCDIFF), and difficulty running errands (ERRDIFF) items all strongly loaded on a single factor (factor 1). The second factor consisted of all three health information technology (HIT) use items: used the internet to look up health information (HITLOOK), used the internet to communicate with a doctor or doctor's office (HITCOMM), and used the internet to look up

Table IV. Unweighted standardized factor loadings from exploratory factor analysis of items considered for calibration of Rapid Surveys System weights: National Health Interview Survey, 2022 Quarter 3

Item	Item description	Standardized factor loading (cut point = 0.40) ¹		
		Factor 1	Factor 2	Factor 3
HITCOMM	During the past 12 months, have you used the internet for any of the following reasons? To communicate with a doctor or doctor's office.....	...	0.89	...
HITLOOK	During the past 12 months, have you used the internet for any of the following reasons? To look for health or medical information.	...	0.79	...
HITTEST	During the past 12 months, have you used the internet for any of the following reasons? To look up medical test results.	...	0.90	...
LIFESAT	In general, how satisfied are you with your life? Are you very satisfied, satisfied, dissatisfied, or very dissatisfied?	...	...	...
MEETLOC	During the past 12 months, did you attend a public meeting, such as a zoning or school board meeting, that discussed a local issue?	...	...	0.75
VOTELOC	Did you vote in the LAST LOCAL elections, such as for mayor, councilmembers, or school board?	...	...	0.62
VOLUNTEER	During the past 12 months, did you spend any time volunteering for any organization or association?	...	...	0.60
WORKLIM	Are you limited in the kind OR amount of work you can do because of a physical, mental, or emotional problem?	0.83	...	...
SOCDIFF	Because of a physical, mental, or emotional condition, do you have difficulty participating in social activities such as visiting friends, attending clubs and meetings, or going to parties?	0.91	...	...
ERRDIFF	Because of a physical, mental, or emotional condition, do you have difficulty doing errands alone such as visiting a doctor's office or shopping?	0.99	...	...

... Category not applicable.

¹Standardized factor loadings range from -1 to 1. Loadings that did not exceed the threshold of |0.40| are not shown.

SOURCE: National Center for Health Statistics, National Health Interview Survey, 2022.

medical test results (HITTEST). Finally, the third factor consisted of the items volunteering (VOLUNTEER), voting in the last local election (VOTELOC), and attending a public meeting on a local issue (MEETLOC). The life satisfaction item (LIFESAT) did not align with any of the three factors.

Based on these results, three composite measures were constructed for the subsequent multivariate analysis: any difficulty participating in social activities (a “yes” response to ERRDIFF or WORKLIM, or a response of “a lot of difficulty” or “cannot do at all” to SOCDIFF, versus “no” responses to ERRDIF and WORKLIM and a response of “no difficulty” or “some difficulty” to SOCDIFF), any HIT use (at least one “yes” response to HITLOOK, HITCOMM, or HITTEST versus “no” responses to all three items), and civic engagement (at least one “yes” response to VOLUNTEER, VOTELOC, or MEETLOC versus “no” responses to all three items). As life satisfaction did not load on any of the three factors, the multivariate analysis included it as a separate variable.

The above EFA was repeated with NHIS 2023 Q2 sample adult data and included the three language items added to the 2023 Q2 questionnaire: language used most often when watching television, listening to the radio, or reading news online or in print (LANGMED); language

used most often when seeing a doctor or other healthcare professional (LANGDOC); and language used most often when participating in social activities (LANGSOC). The MAP analysis (Table III) identified four factors.

Table V presents the standardized factor loadings from an EFA where the number of factors was set to four. The first factor consists of the three language items, with strong standardized loadings ranging from 0.97 to 1.00. The second factor consists of the three work and social limitation items, consistent with results based on the 2022 Q3 data. Similarly, factors three and four consist of the HIT and civic engagement items, respectively. Life satisfaction aligned with the social and work limitation items in this EFA, but the sign was negative (-0.43), indicating a negative relationship with the underlying factor. However, given that the life satisfaction item did not align with this factor in the analysis of 2022 Q3 data, and that the standardized loading for this item was considerably smaller than for the other three items, the multivariate analysis retained it as a separate item. Once again, composite measures of social difficulties, HIT use, and civic engagement were created, following the logic applied to the 2022 Q3 data. A composite measure of language other than English used in different settings was also created (at least one “yes”

Table V. Unweighted standardized factor loadings from exploratory factor analysis of items considered for calibration of Rapid Surveys System weights: National Health Interview Survey, 2023 Quarter 2

Item	Item description	Standardized factor loading (cut point = 0.40) ¹			
		Factor 1	Factor 2	Factor 3	Factor 4
HITCOMM	During the past 12 months, have you used the internet for any of the following reasons? To communicate with a doctor or doctor's office.	...	...	0.90	...
HITLOOK	During the past 12 months, have you used the internet for any of the following reasons? To look for health or medical information.	...	...	0.77	...
HITTEST	During the past 12 months, have you used the internet for any of the following reasons? To look up medical test results.	...	...	0.89	...
LIFESAT	In general, how satisfied are you with your life? Are you very satisfied, satisfied, dissatisfied, or very dissatisfied?	...	-0.43	...	...
MEETLOC	During the past 12 months, did you attend a public meeting, such as a zoning or school board meeting, that discussed a local issue?	...	...	...	0.89
VOTELOC	Did you vote in the LAST LOCAL elections, such as for mayor, councilmembers, or school board?	...	...	...	0.47
VOLUNTEER	During the past 12 months, did you spend any time volunteering for any organization or association?	...	...	...	0.50
WORKLIM	Are you limited in the kind OR amount of work you can do because of a physical, mental, or emotional problem?	...	0.83	...	...
SOCDIFF	Because of a physical, mental, or emotional condition, do you have difficulty participating in social activities such as visiting friends, attending clubs and meetings, or going to parties?	...	0.91	...	...
ERRDIFF	Because of a physical, mental, or emotional condition, do you have difficulty doing errands alone such as visiting a doctor's office or shopping?	...	0.90	...	...
LANGMED	When you watch television, read news online or in print, or listen to the radio, which language do you use most often?	0.97	...	...	...
LANGDOC	When you see a doctor or other health care professional, which language do you use most often?	0.98	...	...	...
LANGSOC	When you participate in social activities, such as visiting friends, attending clubs and meetings, or going to parties, which language do you use most often?	1.00	...	...	...

... Category not applicable.

¹Standardized factor loadings range from -1 to 1. Loadings that did not exceed the threshold of |0.40| are not shown.

SOURCE: National Center for Health Statistics, National Health Interview Survey, 2023.

response to LANGMED, LANGDOC, or LANGSOC versus “no” responses to all three items).

Table VI presents the number and percentage of statistically significant associations between each potential calibration variable and 43 health outcomes based on 2022 Q3 NHIS sample adult data. Each outcome was regressed on a potential calibration variable while controlling for 12 variables (Table I) used in calibrating RANDS weights to NHIS control totals. Of the five possible calibration variables explored, difficulty participating in social activities had the greatest number of significant associations at 34 (79.1%). The 34 associations were well distributed across the four health domains, with statistically significant associations with at least one-half of the outcomes in each domain. Measures of life satisfaction and HIT use also performed well, net of controls. Life satisfaction was significantly associated with 33 health outcomes (76.7%), while HIT use was significantly associated with 31 outcomes (72.1%).

Consistent with difficulty participating in social activities, both HIT use and life satisfaction were significantly associated with at least one-half of the outcomes in each of the four health domains. The measure of civic engagement was associated with just over one-half of the 43 health outcomes (51.2%), with statistically significant associations with at least one-half of the outcomes in the health status, health care service use, and health behavior domains. Conversely, the measure was only associated with 3 of 11 health care access outcomes (27.3%), net of the 12 controls, suggesting this measure may be of limited use in weight calibration if health care access is a primary focus of an RSS survey. Finally, internet access at home was significantly associated with only 20.9% (9 of 43) of health outcomes, with most of those associations ($n = 5$) observed with health care service use outcomes.

Table VII presents the number and percentage of significant associations between each potential calibration variable

Table VI. Number and percentage of statistically significant associations between possible calibration variables and health outcomes: National Health Interview Survey, July–September 2022

Possible calibration variable	Health status outcomes (<i>n</i> = 10)		Healthcare service use outcomes (<i>n</i> = 11)		Healthcare access outcomes (<i>n</i> = 11)		Health behavior outcomes (<i>n</i> = 11)		Total (<i>n</i> = 43)	
	Number of statistically significant associations	Percent	Number of statistically significant associations	Percent	Number of statistically significant associations	Percent	Number of statistically significant associations	Percent	Number of statistically significant associations	Percent
Internet access at home	1	10.0	5	45.5	2	18.2	1	9.1	9	20.9
Health information technology use	6	60.0	11	100.0	6	54.5	8	72.7	31	72.1
Civic engagement	5	50.0	8	72.7	3	27.3	6	54.5	22	51.2
Life satisfaction	8	80.0	8	72.7	8	72.7	9	81.8	33	76.7
Difficulty participating in social activities	9	90.0	6	54.5	10	90.9	9	81.8	34	79.1

NOTE: Total sample size was 7,149.

SOURCE: National Center for Health Statistics, National Health Interview Survey, 2022.

Table VII. Number and percentage of statistically significant associations between possible calibration variables and health outcomes: National Health Interview Survey, April–June, 2023

Possible calibration variable	Health status outcomes (<i>n</i> = 10)		Healthcare service use outcomes (<i>n</i> = 10)		Healthcare access outcomes (<i>n</i> = 11)		Health behavior outcomes (<i>n</i> = 7)		Total (<i>n</i> = 38)	
	Number of statistically significant associations	Percent	Number of statistically significant associations	Percent	Number of statistically significant associations	Percent	Number of statistically significant associations	Percent	Number of statistically significant associations	Percent
Internet access at home	3	30.0	5	50.0	4	36.4	3	42.9	15	39.5
Health information technology use	7	70.0	10	100.0	5	45.5	3	42.9	25	65.8
Civic engagement	6	60.0	8	80.0	5	45.5	4	57.1	23	60.5
Life satisfaction	8	80.0	6	60.0	10	90.9	3	42.9	27	71.1
Difficulty participating in social activities	9	90.0	7	70.0	10	90.9	4	57.1	30	78.9
Speak a language other than English at home	5	50.0	2	20.0	3	27.3	3	42.9	13	34.2
Proxy measure of limited English proficiency	3	30.0	2	20.0	4	36.4	4	57.1	13	34.2

NOTE: Total sample size was 7,310.

SOURCE: National Center for Health Statistics, National Health Interview Survey, 2023.

and 38 health outcomes based on 2023 Q2 NHIS sample adult data ($n = 7,310$). In addition to the five potential calibration variables examined with 2022 Q3 data, results in [Table VII](#) include two language variables: Speak a language other than English at home and use a language other than English in different settings (a composite measure based on the factor analysis results described above). As observed with 2022 Q3 data, difficulty participating in social activities produced the greatest number of significant associations ($n = 30$, 78.9%) with the 38 health outcomes. This measure was associated with 70.0% or more of the outcomes in the health status, health care service use, and health care access domains. Measures of life satisfaction, HIT use, and civic engagement were associated with at least 60% of the 38 health outcomes, and at least 42.9% of items within each health domain. Internet access at home performed better with the 2023 Q2 data, producing significant associations with 15 (39.5%) of the 38 health outcomes, net of the 12 control variables. Of the 7 potential calibration variables, the two language measures produced the fewest significant associations at 13 (34.2%) each. Speaking a language other than English at home performed best within the health status domain, producing significant associations with 50.0% of the 10 health status measures, while the composite language measure performed best within the health behaviors domain (associations with 57.1% of 7 outcomes).

Appendix II. Selection of Rapid Surveys System Round 4 Calibration Variables

Because the final data file for Rapid Surveys System 1 (RSS-1) was available before the production deadline to select the calibration variables for RSS-4, RSS-1 was used for analytically assessing the calibration variables for Round 4. The 2023 Quarter 1 National Health Interview Survey (NHIS) Early Release file was used as the benchmark data set for assessments, consistent with what was used for the RSS 1–3 weighting and benchmarking.

For this evaluation, propensity score weighting was used for assessing various weighting combinations, although raking was used as the final weighting approach for the RSS-4 data. Calibration variables that were used in RSS-1 had been imputed using multiple imputation, and the imputed values were available for the analysis. For remaining panel and questionnaire variables that had not been previously used for calibration but were candidates for RSS-4, missing values were imputed using proportional allocation for evaluation purposes.

Table VIII. List of potential calibration variables from Rapid Surveys System Round 1 used to investigate Round 4 calibration procedure

Number	Variable
1	Household income
2	Marital status
3	Ever diagnosed high cholesterol
4	Difficulty participating in social activities
5	Civic engagement
6	Housing tenure
7	Employment status
8	Difficulty doing errands
9	Limited in the kind or amount of work you can do
10	Reported a social or work limitation
11	Access to the internet from home (among adults with internet access)
12	Access to the internet from home (among all adults)
13	Used internet to look up health or medical information
14	Used internet to communicate with a doctor or doctor's office
15	Used internet to look up medical test results
16	Any health information technology use
17	Spent time volunteering in past 12 months
18	Spent time volunteering for child's school or youth organization in past 12 months
19	Spent time volunteering in past 12 months (including child's school or youth organization)
20	Attend a public meeting on a local issue in past 12 months
21	Vote in last local elections
22	Civic engagement (attending public meeting, voting in last local elections)
23	Civic engagement including volunteering (attending public meeting, voting in last local elections, volunteering)
24	Working phone other than a cell phone in the home
25	Sample adult has a cell phone
26	Someone in household has a cell phone
27	Telephone service for household

SOURCE: National Center for Health Statistics, Rapid Surveys System Round 1, 2023.

A random search was performed to identify a set of 12 calibration variables that resulted in low standardized bias overall and across a range of domains. For each set of 12 variables, 6 variables were fixed to ensure that the standard demographics were included in the adjustment. This set of six variables included: age group, sex, race and Hispanic origin, education, census region, and metropolitan status. The remaining 6 variables were randomly selected from 27 potential calibration variables. For evaluation, a set of 35 benchmark variables was selected. The complete list of calibration and benchmark variables is included in [Tables VIII and IX](#), respectively.

The random search evaluated 99,969 unique combinations of calibration variables. For each set of calibration variables, the propensity score-adjusted weights for RSS-1 were calculated, and corresponding estimates were calculated for the selected set of benchmark variables. The standardized bias metric was used to evaluate bias for each benchmark variable. The total standardized bias for all benchmark variables, which summed the standardized biases for all benchmark variables, was assessed as well as the total standardized bias for only the benchmark variables in the Health Status: Mental and Self-Rated Health domain, as these variables tended to have relatively larger standardized biases in RSS-1 compared with variables in other health domains.

[Table X](#) reports the standardized bias for RSS-1 (NORC and Ipsos combined) for each of the benchmark

Table IX. List of benchmark variables from Rapid Surveys System Round 1 used to investigate Round 4 calibration procedure

Number	Variable	Domain
1	Ever diagnosed with coronary heart disease	Health Status: Chronic Health Conditions
2	Ever diagnosed with hypertension	Health Status: Chronic Health Conditions
3	Now taking medication for hypertension	Health Status: Chronic Health Conditions
4	Current hypertension	Health Status: Chronic Health Conditions
5	Ever diagnosed with asthma	Health Status: Chronic Health Conditions
6	Ever diagnosed with cancer	Health Status: Chronic Health Conditions
7	Ever diagnosed with prediabetes	Health Status: Chronic Health Conditions
8	Ever diagnosed with gestational diabetes	Health Status: Chronic Health Conditions
9	Ever diagnosed with diabetes	Health Status: Chronic Health Conditions
10	Feel worried, nervous, or anxious daily/weekly	Health Status: Mental and Self-Rated Health
11	Take medication for feeling worried, nervous, or anxious	Health Status: Mental and Self-Rated Health
12	Regularly had feelings of worry, nervousness, or anxiety	Health Status: Mental and Self-Rated Health
13	Feel depressed daily/weekly	Health Status: Mental and Self-Rated Health
14	Take medication for depression	Health Status: Mental and Self-Rated Health
15	Regularly had feelings of depression	Health Status: Mental and Self-Rated Health
16	Excellent or very good self-rated health	Health Status: Mental and Self-Rated Health
17	Ever smoked 100 cigarettes	Health Behaviors
18	Currently smoke every day or some days	Health Behaviors
19	Current smoking	Health Behaviors
20	Delayed dental care due to cost	Healthcare Access
21	Did not get dental care due to cost	Healthcare Access
22	Place usually go to when sick and need health care	Healthcare Access
23	What kind of place: Doctor's office or health center	Healthcare Access
24	What kind of place: Urgent care center/clinic in drug store	Healthcare Access
25	What kind of place: All other kinds	Healthcare Access
26	Usual source of care	Healthcare Access
27	Very worried about paying medical bills	Healthcare Access
28	Dental cleaning in past 12 months	Healthcare Utilization
29	Saw doctor/other health professional in past 12 months	Healthcare Utilization
30	Hospitalized overnight in past 12 months	Healthcare Utilization
31	Eye exam in past 12 months	Healthcare Utilization
32	Therapy in past 12 months ¹	Healthcare Utilization
33	Blood pressure checked in past 12 months	Healthcare Utilization
34	Cholesterol checked in past 12 months	Healthcare Utilization
35	Blood sugar checked in past 12 months	Healthcare Utilization

¹Includes physical therapy, speech therapy, rehabilitative therapy, and occupational therapy.

SOURCE: National Center for Health Statistics, Rapid Surveys System Round 1, 2023.

variables and total based on the weighting procedure used in RSS-1 compared with the minimum standardized bias calculated for each benchmark variable during the random search. This evaluation was used to gauge the expected improvement that could be achieved among the set of calibration variables available. The evaluation demonstrated that using the weighting approach that resulted in the minimum standardized bias for each benchmark variable resulted in some reduction of the standardized bias. However, a large difference was not found. For example, across all benchmark variables, the mean standardized bias was 0.10 using the RSS-1 calibration procedure but was 0.09 when using the various weighting procedures that resulted in the minimum standardized bias for each benchmark variable.

Among the combinations evaluated in the random search, the combinations resulting in the minimum total standardized bias for all benchmark variables, and the minimum total standardized bias for the mental and self-rated health benchmark variables were identified.

Table XI compares the variables selected for the calibration weighting procedure in RSS-1 to the two sets of variables identified through the random search that minimized the bias of the two sets of benchmark variables. The first six demographic variables were in all three combinations by design of the investigation. However, some differences were seen in the selected health variables. While both random search combinations selected ever diagnosed with high cholesterol and difficulty participating in social activities, which were both included in the RSS-1 calibration, several new variables were identified as reducing the total standardized bias for the set of benchmark variables evaluated, including variables related to employment status, reported a social or work limitation, access to internet from home (among adults with internet access), any health information technology use (HIT), and someone in household has a cell phone.

Finally, a leave-one-out approach was evaluated on the propensity score model to assess the impact of each potential calibration variable on the adjusted weights.

Table X. Standardized bias by benchmark variable using Rapid Surveys System Round 1 calibration weighting approach and calibration variables that resulted in minimum standardized bias for a combined NORC and Ipsos Rapid Surveys System estimate

Benchmark variable	RSS-1 calibration weighting approach	Weighting approach with minimum standardized bias	Improvement ¹
Ever diagnosed with coronary heart disease	0.02	0.02	0.00
Ever diagnosed with hypertension	0.02	0.02	0.00
Now taking medication for hypertension	0.12	0.12	0.00
Current hypertension	0.00	0.01	-0.01
Ever diagnosed with asthma	0.00	0.00	0.00
Ever diagnosed with cancer	0.01	0.00	0.01
Ever diagnosed with prediabetes	0.15	0.16	-0.01
Ever diagnosed with gestational diabetes	0.01	0.02	-0.01
Ever diagnosed with diabetes	0.05	0.05	0.00
Feel worried, nervous, or anxious daily or weekly	0.04	0.03	0.01
Take medication for feeling worried, nervous, or anxious	0.07	0.06	0.01
Regularly had feelings of worry, nervousness, or anxiety	0.10	0.09	0.01
Feel depressed daily or weekly	0.24	0.22	0.02
Take medication for depression	0.08	0.07	0.01
Regularly had feelings of depression	0.21	0.19	0.02
Excellent or very good self-rated health	0.19	0.18	0.01
Ever smoked 100 cigarettes	0.03	0.03	0.00
Currently smoke every day or some days	0.07	0.07	0.00
Current smoking	0.58	0.58	0.00
Delayed dental care due to cost	0.16	0.15	0.01
Did not get dental care due to cost	0.17	0.15	0.02
Place usually go to when sick and need health care	0.02	0.01	0.01
What kind of place: Doctor's office or health center	0.10	0.06	0.04
What kind of place: Urgent care center or clinic in drug store	0.08	0.07	0.01
What kind of place: All other kinds	0.04	0.02	0.02
Usual source of care	0.04	0.01	0.03
Very worried about paying medical bills	0.06	0.04	0.02
Dental cleaning in past 12 months	0.03	0.00	0.03
Saw doctor/other health professional in past 12 months	0.19	0.17	0.02
Hospitalized overnight in past 12 months	0.05	0.06	-0.01
Eye exam in past 12 months	0.02	0.04	-0.02
Therapy in past 12 months ²	0.00	0.01	-0.01
Blood pressure checked in past 12 months	0.20	0.16	0.04
Cholesterol checked in past 12 months	0.21	0.19	0.02
Blood sugar checked in past 12 months	0.21	0.19	0.02
Total	3.58	3.25	0.33
Average	0.10	0.09	0.01

0.00 Quantity more than zero but less than 0.005.

¹Calculated as the difference between the standardized bias using the RSS 1 weighting approach and the standardized bias using the weighting approach with the minimum standardized bias. Due to rounding, the improvement may differ from the difference of the RSS 1 calibration weighting approach and the weighting approach with minimum standardized bias.

²Includes physical therapy, speech therapy, rehabilitative therapy, and occupational therapy.

NOTES: RSS is Rapid Surveys System.

SOURCE: National Center for Health Statistics, Rapid Surveys System Round 1, 2023.

Table XII reports the total standardized bias and number of benchmark variables with low, medium, and standardized bias. This analysis was evaluated for all benchmark variables and for the subset of mental health and self-rated health variables.

For the evaluation based on all benchmark variables, removing age group, employment status, or access to the internet from home (among adults with internet access) increased the number of benchmark variables with high standardized bias. Removing ever diagnosed high cholesterol decreased the number of benchmark variables

with high standardized bias from two to one (compared with including all variables) but did not have an impact on any of the benchmark variables related to mental and self-rated health. Additionally, removing certain calibration variables also shifted the number of benchmark variables by bias severity (decreasing the number with medium bias and increasing the number with low bias).

In general, large changes in the number of Mental Health and Self-Rated Health benchmark variables with low, medium, and high bias after removing certain calibration variables were not observed. The removal of three variables

Table XI. Calibration variables selected in Rapid Surveys System Round 1 calibration procedure and resulting in minimum sum of standardized bias, by set of benchmark variables

Variable	RSS-1 calibration weighting approach	Weighting approach with minimum sum of standardized bias for set of benchmark variables	
		All benchmark variables	Health Status: Mental and Self-Rated Health benchmark variables
Age group	X	X	X
Sex	X	X	X
Race and Hispanic origin	X	X	X
Educational attainment	X	X	X
Census region	X	X	X
Urbanization level	X	X	X
Household income	X	...	...
Marital status	X	...	...
Ever diagnosed high cholesterol	X	X	X
Difficulty participating in social activities	X	X	X
Civic engagement	X	...	...
Housing tenure	X	...	...
Employment status	...	X	X
Difficulty doing errands	...	...	...
Limited in the kind or amount of work you can do	...	...	...
Reported a social or work limitation	...	X	...
Access to the internet from home (among adults with internet access)	...	X	X
Access to the internet from home (among all adults)	...	...	...
Used internet to look up health or medical information	...	...	...
Used internet to communicate with a doctor or doctor's office	...	...	...
Used internet to look up medical test results	...	...	...
Any health information technology use	...	...	X
Spent time volunteering in past 12 months	...	...	...
Spent time volunteering for child's school or youth organization in past 12 months	...	...	...
Spent time volunteering in past 12 months (including child's school or youth organization)	...	...	...
Attend a public meeting on a local issue in past 12 months	...	...	...
Vote in last local elections	...	...	...
Civic engagement (attending public meeting, voting in last local elections)	...	...	...
Civic engagement including volunteering (attending public meeting, voting in last local elections, volunteering)	...	...	...
Working phone other than a cell phone in the home	...	...	...
Sample adult has a cell phone	...	...	...
Someone in household has a cell phone	...	X	X
Telephone service for household	...	...	...

... Category not applicable.

SOURCE: National Center for Health Statistics, Rapid Surveys System Round 1, 2023.

caused the number of variables with medium bias to decrease and the number of variables with low bias to increase, including limited in the kind or amount of work you can do, access to the internet from home (among adults with internet access), and access to the internet from home (among all adults).

The results from the drop-one-variable analysis demonstrate the importance of determining the impact for each variable, although this is dependent on the variables remaining in the model. This type of analysis was repeated several times throughout the variable selection process to evaluate the impact of each variable on a smaller set of variables. These analyses were used to inform decision-making for the selection of calibration variables in RSS-4, which included 12 variables: age, sex, race and Hispanic

origin, educational attainment, household income, employment status, region, urbanization level, ever diagnosed with high cholesterol, difficulty participating in social activities, any HIT use, and adult has a working cell phone.

Table XII. Total standardized bias and number of benchmark variables with low, medium, and high standardized bias for leave-one-out propensity score model evaluation

Variable removed	All benchmark variables				Mental Health and Self-Rated Health variables			
	Total standardized bias	Count of variables in bias threshold			Total standardized bias	Count of variables in bias threshold		
		Low	Medium	High		Low	Medium	High
None (full model)	9.06	18	15	2	1.88	3	4	0
Age group	9.48	17	13	5	1.99	3	4	0
Sex	8.95	17	16	2	1.80	3	4	0
Race and Hispanic origin	9.05	18	15	2	1.88	3	4	0
Educational attainment	8.78	20	13	2	1.83	3	4	0
Census region	9.06	18	15	2	1.88	3	4	0
Urbanization level	9.06	18	15	2	1.88	3	4	0
Household income	9.27	19	14	2	1.94	3	4	0
Marital status	9.05	18	15	2	1.87	3	4	0
Ever diagnosed high cholesterol	8.81	20	14	1	1.99	3	4	0
Difficulty participating in social activities	9.30	17	16	2	1.99	3	4	0
Civic engagement	9.08	18	15	2	1.88	3	4	0
Housing tenure	8.99	19	14	2	1.88	3	4	0
Employment status	9.25	17	13	5	1.90	3	4	0
Difficulty doing errands	8.89	19	14	2	1.85	3	4	0
Limited in the kind or amount of work you can do	8.79	20	13	2	1.80	4	3	0
Reported a social or work limitation	8.85	20	13	2	1.85	3	4	0
Access to the internet from home (among adults with internet access)	8.36	22	10	3	1.37	4	3	0
Access to the internet from home (among all adults)	7.87	22	11	2	1.35	4	3	0
Used internet to look up health or medical information	8.87	20	13	2	1.88	3	4	0
Used internet to communicate with a doctor or doctor's office	8.92	20	13	2	1.94	3	4	0
Used internet to look up medical test results	8.85	20	13	2	1.89	3	4	0
Any health information technology use	8.98	20	13	2	1.91	3	4	0
Spent time volunteering in past 12 months	9.04	17	16	2	1.89	3	4	0
Spent time volunteering for child's school or youth organization in past 12 months	8.94	19	14	2	1.89	3	4	0
Spent time volunteering in past 12 months (including child's school or youth organization)	9.07	18	15	2	1.88	3	4	0
Attend a public meeting on a local issue in past 12 months	9.10	18	15	2	1.88	3	4	0
Vote in last local elections	9.05	18	15	2	1.88	3	4	0
Civic engagement (attending public meeting, voting in last local elections)	9.06	18	15	2	1.88	3	4	0
Civic engagement including volunteering (attending public meeting, voting in last local elections, volunteering)	9.16	18	15	2	1.90	3	4	0
Working phone other than a cell phone in the home	9.18	18	15	2	1.91	3	4	0
Sample adult has a cell phone	8.91	19	14	2	1.83	3	4	0
Someone in household has a cell phone	9.26	19	14	2	1.95	3	4	0
Telephone service for household	9.10	18	15	2	1.89	3	4	0

SOURCE: National Center for Health Statistics, Rapid Surveys System Round 1, 2023.

Appendix III. General Theory of Convex Combinations, Application to Rapid Surveys System, and Investigation Using RANDS During COVID-19

Basic Theory of Convex Combinations

- Let Y_1 and Y_2 be two independent random variables with means μ_1 and μ_2 , with respective variances σ_1^2 and σ_2^2 .
Let $Y_{1,2} = \lambda Y_1 + (1 - \lambda) Y_2$ be a combined convex estimator, with $0 \leq \lambda \leq 1$. The basic expectations of the estimator are $E(Y_{1,2}) = \lambda \mu_1 + (1 - \lambda) \mu_2$ and $Var(Y_{1,2}) = \lambda^2 \sigma_1^2 + (1 - \lambda)^2 \sigma_2^2$. The estimator is convex as it has a rounded shape, which ensures that any local minima are also the global minima.
- The λ that minimizes $var(Y_{1,2})$ occurs when

$$\lambda = \frac{\sigma_1^{-2}}{\sigma_1^{-2} + \sigma_2^{-2}}$$

and the minimum value of

$$var(Y_{1,2}) = \frac{1}{\sigma_1^{-2} + \sigma_2^{-2}}$$

- For this optimality property to be useful, both Y_1 and Y_2 should have the same expectations, that is, $\mu_1 = \mu_2$. If not, the combined estimator $Y_{1,2} = \lambda Y_1 + (1 - \lambda) Y_2$ has a bias, $Bias_{1,2} = \lambda(\mu_1 - \mu) + (1 - \lambda)(\mu_2 - \mu)$ where μ is the target population mean. The ratio

$$\frac{Bias_{1,2}^2}{Var_{1,2}}$$

can be used to assess the theoretical optimality of the combined estimator.

Practical limitations

In the outline above, all variances are theoretical and variable dependent. First, the variance depends on the variable of interest; there is no universal constant that provides an optimal variance over all variables of interest. Second, in practice all variances must be estimated, thus the estimated optimal λ ,

$$\hat{\lambda} \equiv \hat{\lambda}_y = \frac{\hat{\sigma}_1^{-2}}{\hat{\sigma}_1^{-2} + \hat{\sigma}_2^{-2}}$$

(the dependence upon the target y will be implicit) is a random variable, which complicates any sampling theory associated with an estimated convex form $\hat{y}_{1,2} = \hat{\lambda} \hat{y}_1 + (1 - \hat{\lambda}) \hat{y}_2$. Furthermore, bias is difficult to assess in realistic survey sampling situations as bias may greatly vary among response variables and domains.

Application to Two Panel Surveys

Let D_1 and D_2 be two surveys with weighted sample means $\hat{Y}_1$ and $\hat{Y}_2$, respectively. The weights for each survey may have been adjusted, and by some prior estimate evaluations the two estimators are assumed to be unbiased for a common population target.

Consider a combined convex survey estimator $\hat{Y}_{1,2} = \lambda \hat{Y}_1 + (1 - \lambda) \hat{Y}_2$. As mentioned earlier, no universal optimal λ covers all variables covered by the two surveys. For surveys with complex sampling designs, an effective sample size approach can be used for combination to circumvent the involved sampling and weighting procedures used in the individual surveys.

Consider the sampling properties of a complex-survey estimated mean, but now with an imposed simple random sample (SRS) structured form that mimics the theoretical means and variances of complex structures. Assume that a variable y collected from each survey has population mean μ and population variance σ_y^2 . Let n_1 and n_2 be the nominal survey sample sizes and let $n_{1,eff,y}$ and $n_{2,eff,y}$ be the respective effective SRS sample sizes needed to achieve the same level of precision. For a specified y variable, the optimal λ becomes

$$\lambda_{e,y} = \frac{n_{1,eff,y}}{n_{1,eff,y} + n_{2,eff,y}}$$

which depends on y . That is, more weight is given to the

sample with the larger effective sample size. For global work, assume that the effective sample sizes are invariant to the y variable. As a result,

$$\lambda_e = \frac{n_{1,eff}}{n_{1,eff} + n_{2,eff}}$$

for any y variable. The standard rule-of-thumb global effective sample size is often taken as

$$n_{k,eff} = \frac{n_k}{1 + CV^2(w_k)}$$

for $k = 1, 2$, where the CV^2 term is the coefficient of variation of survey k 's weights squared. These values can be determined by inspection of the weights of the two separate surveys being combined.

To produce extensive multivariable tables, the following can be used:

$$\hat{Y}_{1,2} = \lambda_e \hat{Y}_1 + (1 - \lambda_e) \hat{Y}_2$$

for a combined estimate and

$$\widehat{var}(\hat{Y}_{1,2}) = \lambda_e^2 \widehat{var}(\hat{Y}_1) + (1 - \lambda_e)^2 \widehat{var}(\hat{Y}_2)$$

for the estimated variance where $\hat{Y}_1$ and $\hat{Y}_2$ are the mean estimates from the two surveys and

$$\widehat{var}(\hat{Y}_1) \text{ and } \widehat{var}(\hat{Y}_2)$$

are the corresponding variance estimates. These forms can be computed easily from the standalone surveys.

Using λ_e to Reweight the Two Surveys and Form a Single Sample

An objective of the Rapid Surveys System (RSS) is to produce a public-use database that combines the two web panels. If survey 1 has total weight W_1 , and survey 2 has total weight W_2 , then it can be shown that any reweighting that satisfies

$$\frac{c_1 W_1}{c_2 W_2} = \frac{n_{1,eff}}{n_{2,eff}} = \frac{\lambda_e}{(1 - \lambda_e)}$$

will lead to consistent results with the combined mean form

$$\hat{Y}_{1,2} = \lambda_e \hat{Y}_1 + (1 - \lambda_e) \hat{Y}_2$$

The individual survey scale-factors c_1 and c_2 can be chosen so that $c_1 W_1 + c_2 W_2 = W^*$, where W^* is a selected total over all weights.

For variance estimation, the two surveys are treated as distinct major strata with the standalone designs embedded within. All adjusted combined weights are treated as sampling weights in standard survey software packages.

Investigation Using RANDS During COVID-19

Methodological research for combining panel surveys, including an evaluation of the convex combination procedures, was completed before the delivery of the first round of survey data using data from the Research and Development Survey (RANDS) During COVID-19 (www.cdc.gov/nchs/rands/during-covid-19/index.html). The Round 1 survey, conducted by NORC, included a probability sample collected from the AmeriSpeak panel (<http://amerispeak.norc.org/>) and a nonprobability sample collected by Dynata (www.dynata.com/). These two surveys, which were conducted simultaneously and contained the same content, were used as proxies for the surveys conducted by NORC and Ipsos for RSS, which are similarly conducted over the same time period and use identical questionnaires. Each sample from RANDS During COVID-19 was first recalibrated to the same NHIS controls before combining.

Table XIII presents some of the results from this study. Four selected health variables and five selected race and Hispanic-origin domains were used to study the convex combination method. The table is based on the forms (designating the AmeriSpeak probability sample as 1 and Dynata nonprobability sample as 2): Using λ_e as the global effective sample ratio,

$$\hat{Y}_{1,2} = \lambda_e \hat{Y}_1 + (1 - \lambda_e) \hat{Y}_2$$

as the combined estimate, and

$$\widehat{SE}(\hat{Y}_{1,2}) = \sqrt{\lambda_e^2 \widehat{var}(\hat{Y}_1) + (1 - \lambda_e)^2 \widehat{var}(\hat{Y}_2)}$$

as the standard error, a 95% confidence interval is computed using the form $estimate \pm 2SE(estimate)$. For reference, the standalone 95% confidence intervals are also presented.

The nature of the convex combination is such that the combined form is between the two standalone forms. For the domain covering all adults, the combined confidence interval width is shorter than the minimum standalone confidence interval width. However, the choice of λ_e may not be close to optimal for some variables and domains. For the variable ever diagnosed with coronary heart disease for the domains Hispanic and Other non-Hispanic, a standalone confidence interval may be narrower than the combined interval (Table XIII). As an omnibus combination strategy, the global effective sample size ratio appeared to work well for RANDS During COVID-19 and, consequently, was implemented in RSS.

Table XIII. Percentages and confidence intervals of health outcomes among adults, overall and by race and Hispanic origin for RANDS During COVID-19 Round 1 probability and nonprobability samples

Health variable and domain	Combined samples ¹	Probability sample ²	Nonprobability sample ³
Ever diagnosed with coronary heart disease		Percent (95% confidence interval)	
All.	4.7 (4.2–5.2)	4.9 (4.3–5.6)	4.5 (3.9–5.2)
Black, non-Hispanic	3.9 (2.8–5.3)	4.5 (2.9–6.6)	3.5 (2.1–5.4)
Hispanic ⁴	6.4 (4.8–8.4)	2.9 (1.8–4.4)	9.0 (6.5–12.2)
Other, non-Hispanic ⁵	3.3 (2.1–5.0)	3.8 (1.5–7.6)	2.9 (1.8–4.6)
White, non-Hispanic	4.6 (4.1–5.1)	5.7 (4.9–6.5)	3.7 (3.1–4.4)
Health insurance coverage			
All.	86.2 (85.3–87.1)	90.2 (88.7–91.5)	83.3 (82.2–84.5)
Black, non-Hispanic	79.0 (76.2–81.6)	85.1 (81.0–88.6)	74.5 (70.6–78.1)
Hispanic ⁴	77.7 (74.9–80.3)	83.9 (79.8–87.6)	73.0 (69.2–76.6)
Other, non-Hispanic ⁵	87.1 (84.6–89.3)	90.4 (86.7–93.4)	84.6 (81.2–87.6)
White, non-Hispanic	89.7 (88.7–90.7)	92.7 (91.2–94.0)	87.5 (86.2–88.8)
Excellent or very good self-rated health			
All.	53.9 (52.8–55.0)	51.2 (49.6–52.9)	55.9 (54.5–57.4)
Black, non-Hispanic	45.6 (42.5–48.7)	38.0 (33.8–42.3)	51.2 (47.1–55.3)
Hispanic ⁴	53.8 (50.7–56.9)	51.0 (46.1–56.0)	55.9 (51.8–59.9)
Other, non-Hispanic ⁵	53.7 (50.1–57.2)	51.5 (45.3–57.6)	55.3 (50.9–59.6)
White, non-Hispanic	55.6 (54.3–56.9)	53.8 (52.0–55.7)	56.9 (55.1–58.7)
Ever smoked 100 cigarettes			
All.	38.0 (36.9–39.1)	41.8 (40.1–43.6)	35.1 (33.7–36.5)
Black, non-Hispanic	33.9 (30.9–36.9)	37.8 (33.1–42.7)	31.0 (27.1–35.0)
Hispanic ⁴	32.2 (29.2–35.3)	35.1 (30.1–40.3)	30.1 (26.4–34.0)
Other, non-Hispanic ⁵	25.2 (22.5–28.0)	31.1 (26.5–35.9)	20.8 (17.3–24.6)
White, non-Hispanic	41.7 (40.3–43.2)	45.6 (43.2–48.1)	38.8 (37.1–40.7)

¹The estimates from the RANDS During COVID-19 Round 1 probability and nonprobability surveys were combined using a convex combination of the two estimates based on the ratio of estimated effective sample sizes of each survey.

²The RANDS During COVID-19 Round 1 probability sample weights from NORC were adjusted to control totals from the 2018 National Health Interview Survey.

³The RANDS During COVID-19 Round 1 nonprobability sample did not have sampling weights. A weight of 1 was assigned to each observation and was adjusted to control totals from the 2018 National Health Interview Survey.

⁴People of Hispanic origin may be of any race.

⁵Includes non-Hispanic single-race groups other than White and Black and non-Hispanic people of two or more races.

SOURCES: National Center for Health Statistics, Research and Development Survey During COVID-19 Round 1 Probability Sample, 2023; and Research and Development Survey During COVID-19 Round 1 Nonprobability Sample, 2023.