**Supplement 2. Nonresponse bias analysis**

Overview

In all survey-only based studies, final estimates are based solely on the survey’s respondents. Errors may arise in the estimates resulting from nonresponse if there are systematic differences between individuals who respond to a survey and those who do not. Nonresponse-adjusted weights attempt to account for these differences by identifying characteristics available for both respondents and nonrespondents that are associated both with the likelihood of responding and key outcomes. This is done by adjusting the weights of the respondents to compensate for the nonrespondents using these characteristics. In studies where these adjustments can successfully account for differences between nonrespondents and respondents, the survey estimates would have minimal potential for nonresponse bias.

The nonresponse adjustments applied to the sampling weights in the National Survey of Health in America, 2022 appear to have effectively accounted for differences between respondents and nonrespondents, thereby minimizing the potential for nonresponse bias. The study team cannot directly measure nonresponse bias without knowing how nonrespondents would have answered survey items; however, we can examine variables available for both respondents and nonrespondents that we believe are correlated with responses to survey items.

Our analysis indicates that the nonresponse adjustment alleviated differences observed between respondents and nonrespondents in the sample for the variables that we had at our disposal. The largest relative differences that did exist occurred with age by sex by race/ethnicity, education by race/ethnicity, income by race/ethnicity, Metropolitan Statistical Areas (MSA) by race/ethnicity, and race/ethnicity.

Results

We used the initial weights to compare the distributions of the variables across the frame and the total sample. We also compared the distributions of variables between the respondents and nonrespondents, to establish how respondents and nonrespondents differed. We then compared estimates using respondents only (using nonresponse-adjusted weights) and the Current Population Survey (CPS) estimates in Table 1. We used SAS survey procedures to calculate standard errors to properly account for unequal weights. The sample statistics consist of proportions with an attribute (presented as percentages). The variables have trivial numbers of missing, and in each case, the proportions with each attribute that were used in the following analyses were calculated among cases without missing data. The values are percentages for each level of the categorical variables, with the associated standard errors (se).

Comparison of entire sample with frame

Before conducting a nonresponse analysis, the first step is to check whether the sample distribution adequately matches the frame distribution on important variables that may not have been controlled for in the sampling process. This is necessary to ascertain whether the estimates using the sampling weights produce estimates that are consistent with population values. Statistics estimated from the entire sample (using the initial sampling weight) among all adults are close to those computed with the full frame but are not exact. The sample somewhat underrepresents young, black men (18–29 Male Non-Hispanic Black) and overrepresents young, non-Hispanic women (18–29 Female Non-Hispanic White). The sample also somewhat overrepresents lower income whites (Under $24,999, Non-Hispanic White, $25,000–$49,999 Non-Hispanic White) and underrepresents high income adults regardless of race/ethnicity (income $150,000 and over) (not shown).

Assessment of differences between respondents and nonrespondents before nonresponse adjustment

We then compared respondents and nonrespondents. We calculated the t-statistic by calculating the differences between the proportions within the levels of each demographic covariate and creating an estimate of the variance of the difference by combining the standard error estimates obtained from the SAS survey procedure. Respondents were very different from nonrespondents on every variable we looked at. The biggest drivers of nonresponse appear to be that (1) age is very highly correlated with response, with the highest response rate among adults over 60, and (2) response among blacks and Hispanics is low relative to all other groups. Respondents were also more likely to be higher educated (bachelor’s degree or higher) (not shown).

Nonresponse adjustment

Nonresponse adjustments made to initial weights seek to reduce the potential for bias that might result from differential nonresponse based on a set of variables. These variables (1) should be available for both respondents and nonrespondents, (2) be related to the likelihood of responding, and (3) be correlated to key survey outcomes. The sampling design weights for survey respondents—including all who answered the screener questions regardless of case or contact status—were adjusted to represent the 18 and over US population for the geodemographic variables and categories using an iterative proportional fitting (raking) procedure. The needed benchmarks were obtained from the 2021 March Supplement of the CPS, except language proficiency, which is not available from CPS and was obtained from the 2019 American Community Survey.

Age (18–29, 30–44, 45–59, 60+) by Gender (Male, Female) by Race-Ethnicity (Non-Hispanic White, Non-Hispanic Black, Non-Hispanic Other/2+ Races, Hispanic)

Education (Less than High School, High School, Some College, Bachelor or Higher) by Race-Ethnicity (Non-Hispanic White, Non-Hispanic Black, Non-Hispanic Other/2+ Races, Hispanic)

Household Income (Under $24,999, $25,000–$49,999, $50,000–$74,999, $75,000–$99,999, $100,000–$149,999, $150,000 and over) by Race-Ethnicity (Non-Hispanic White, Non-Hispanic Black, Non-Hispanic Other/2+ Races, Hispanic)

Census Region (Northeast, Midwest, South, and West) by Race-Ethnicity (Non-Hispanic White, Non-Hispanic Black, Non-Hispanic Other/2+ Races, Hispanic)

Metropolitan Status (Metro, Non-Metro) by Race-Ethnicity (Non-Hispanic White, Non-Hispanic Black, Non-Hispanic Other/2+ Races, Hispanic)

Race-Ethnicity (Non-Hispanic White, Non-Hispanic Black, Non-Hispanic American Indian or Alaska Native, Non-Hispanic Asian, Native Hawaiian, Pacific Islander, Non-Hispanic Other Race/2+ Races, Hispanic)

Hispanic Origin (Non-Hispanic, Mexican Hispanic, Puerto Rican Hispanic, Cuban Hispanic, Other Hispanic Origins)

Language Proficiency within Hispanic (English Proficient Hispanic, Bilingual Hispanic, Spanish Proficient Hispanic, Non-Hispanic)

In the final step, the resulting weights were trimmed as needed and scaled to sum to the 18 and over US population size.

Comparison of respondents and ineligibles to the sampling frame after nonresponse adjustment

The purpose of nonresponse adjustments is to account for any differences between respondents and nonrespondents, to make respondents look like the original sample as much as possible. In this section, we evaluate how well the nonresponse adjustments accounted for those differences.

Below, we included percentages from the CPS, estimated percentages from the entire sample (using initial sampling weights), and nonresponse-adjusted weighted estimated percentages among respondents. We compare estimates using nonresponse-adjusted weights to the CPS because the survey panel distribution should match the CPS distributions. As Supplement 2 Table 1 indicates, the nonresponse adjustments to the sampling weights alleviated most of the differences observed between respondents and nonrespondents. When compared to CPS there are no differences. As described above, the weights are adjusted to CPS distributions and the final nonresponse adjustments result in no differences between the weighted estimates and CPS distributions.

Summary and implications for analyses

Our analysis has shown that the selected sample for the National Survey of Health in America, 2022 was representative of the populations of interest among variables used for selection. Because we did not achieve an 80% response rate,[[1]](#footnote-1) the main purpose of this nonresponse bias analysis was to determine if systematic differences between respondents and nonrespondents were alleviated by nonresponse adjustments to the weights, or if the potential for nonresponse bias was still likely in the weighted estimates.

We found that the nonresponse adjustments alleviated most of the differences observed between respondents and nonrespondents. In addition, it does not appear that the nonresponse adjustments created new biases.

Percentages with various attributes (categorical variables measured in CPS), comparing CPS percent with final weighted estimate (using nonresponse-adjusted weights)

| Variable | CPS percent | Entire sample percent using initial weights | | Respondents with attribute | Respondents weighted percent using adjusted weights | |
| --- | --- | --- | --- | --- | --- | --- |
| Percent | (se) | Percent | (se) |
| Age (in years), Sex, Race/Ethnicity |  |  |  |  |  |  |
| 18–29 Male, Non-Hispanic White | 5.5 | 5.4 | 0.16 | 601 | 5.5 | 0.22 |
| 18–29 Female, Non-Hispanic White | 5.3 | 6.9 | 0.18 | 734 | 5.3 | 0.20 |
| 30–44 Male, Non-Hispanic White | 7.2 | 7.4 | 0.18 | 1139 | 7.3 | 0.21 |
| 30–44 Female, Non-Hispanic White | 7.2 | 6.7 | 0.18 | 977 | 7.2 | 0.23 |
| 45–59 Male, Non-Hispanic White | 7.3 | 7.4 | 0.18 | 1358 | 7.3 | 0.20 |
| 45–59 Female, Non-Hispanic White | 7.6 | 6.8 | 0.17 | 1200 | 7.6 | 0.22 |
| 60+ Male, Non-Hispanic White | 10.5 | 11.0 | 0.21 | 2346 | 10.5 | 0.22 |
| 60+ Female, Non-Hispanic White | 11.9 | 11.0 | 0.21 | 2210 | 12.0 | 0.25 |
| 18–29 Male, Non-Hispanic Black | 1.4 | 0.8 | 0.06 | 80 | 1.3 | 0.16 |
| 18–29 Female, Non-Hispanic Black | 1.4 | 1.4 | 0.08 | 112 | 1.4 | 0.15 |
| 30–44 Male, Non-Hispanic Black | 1.5 | 1.3 | 0.08 | 197 | 1.6 | 0.12 |
| 30–44 Female, Non-Hispanic Black | 1.7 | 2.0 | 0.09 | 260 | 1.8 | 0.11 |
| 45–59 Male, Non-Hispanic Black | 1.3 | 1.4 | 0.07 | 249 | 1.3 | 0.09 |
| 45–59 Female, Non-Hispanic Black | 1.6 | 1.7 | 0.08 | 306 | 1.6 | 0.10 |
| 60+ Male Non-Hispanic Black | 1.3 | 1.5 | 0.08 | 314 | 1.3 | 0.08 |
| 60+ Female Non-Hispanic Black | 1.8 | 1.9 | 0.09 | 401 | 1.8 | 0.10 |
| 18–29 Male, Non-Hispanic Other/2+ Races | 1.0 | 0.8 | 0.07 | 76 | 1.0 | 0.13 |
| 18–29 Female, Non-Hispanic Other/2+ Races | 1.0 | 1.0 | 0.07 | 82 | 0.9 | 0.13 |
| 30-44 Male Non-Hispanic Other/2+ Races | 1.2 | 1.3 | 0.08 | 192 | 1.2 | 0.11 |
| 30–44 Female, Non-Hispanic Other/2+ Races | 1.4 | 1.5 | 0.08 | 205 | 1.4 | 0.13 |
| 45–59 Male, Non-Hispanic Other/2+ Races | 0.9 | 1.2 | 0.07 | 189 | 0.9 | 0.09 |
| 45–59 Female, Non-Hispanic Other/2+ Races | 1.1 | 1.0 | 0.07 | 173 | 1.1 | 0.11 |
| 60+ Male Non-Hispanic Other/2+ Races | 0.8 | 0.9 | 0.06 | 177 | 0.8 | 0.09 |
| 60+ Female Non-Hispanic Other/2+ Races | 1.1 | 1.0 | 0.07 | 186 | 1.1 | 0.12 |
| 18–29 Male, Hispanic | 2.4 | 1.8 | 0.09 | 162 | 2.3 | 0.21 |
| 18–29 Female, Hispanic | 2.3 | 2.3 | 0.10 | 232 | 2.3 | 0.16 |
| 30–44 Male, Hispanic | 2.7 | 2.6 | 0.11 | 363 | 2.7 | 0.16 |
| 30–44 Female, Hispanic | 2.6 | 2.8 | 0.11 | 332 | 2.6 | 0.16 |
| 45–59 Male, Hispanic | 2.0 | 2.2 | 0.10 | 371 | 2.0 | 0.12 |
| 45–59 Female, Hispanic | 2.0 | 2.2 | 0.10 | 360 | 2.0 | 0.12 |
| 60+ Male, Hispanic | 1.3 | 1.6 | 0.08 | 327 | 1.3 | 0.08 |
| 60+ Female, Hispanic | 1.6 | 1.4 | 0.08 | 256 | 1.6 | 0.11 |
| Education, Race/Ethnicity |  |  |  |  |  |  |
| Less than High School, Non-Hispanic White | 3.6 | 4.3 | 0.16 | 469 | 3.6 | 0.17 |
| High School, Non-Hispanic White | 16.9 | 17.7 | 0.28 | 2434 | 17.0 | 0.33 |
| Education, Race/Ethnicity (continued) |  |  |  |  |  |  |
| Some College, Non-Hispanic White | 17.4 | 16.8 | 0.25 | 2971 | 17.4 | 0.31 |
| Bachelor or Higher, Non-Hispanic White | 24.6 | 23.8 | 0.28 | 4691 | 24.7 | 0.34 |
| Less than High School, Non-Hispanic Black | 1.2 | 1.1 | 0.08 | 123 | 1.2 | 0.12 |
| High School, Non-Hispanic Black | 4.1 | 3.6 | 0.13 | 460 | 4.1 | 0.22 |
| Some College, Non-Hispanic Black | 3.6 | 3.9 | 0.12 | 667 | 3.6 | 0.16 |
| Bachelor or Higher, Non-Hispanic Black | 3.1 | 3.4 | 0.11 | 669 | 3.1 | 0.13 |
| Less than High School, Non-Hispanic Other/2+ Races | 0.7 | 0.5 | 0.05 | 41 | 0.6 | 0.12 |
| High School, Non-Hispanic Other/2+ Races | 1.8 | 1.6 | 0.10 | 172 | 1.7 | 0.16 |
| Some College, Non-Hispanic Other/2+ Races | 1.9 | 2.1 | 0.10 | 299 | 1.9 | 0.16 |
| Bachelor or Higher, Non-Hispanic Other/2+ Races | 4.2 | 4.5 | 0.14 | 768 | 4.3 | 0.19 |
| Less than High School, Hispanic | 4.1 | 3.7 | 0.14 | 406 | 4.1 | 0.23 |
| High School, Hispanic | 5.5 | 5.4 | 0.16 | 645 | 5.5 | 0.24 |
| Some College, Hispanic | 4.2 | 4.3 | 0.13 | 716 | 4.2 | 0.18 |
| Bachelor or Higher, Hispanic | 3.1 | 3.4 | 0.11 | 636 | 3.1 | 0.14 |
| Income, Race/Ethnicity |  |  |  |  |  |  |
| Under $24,999, Non-Hispanic White | 6.9 | 8.4 | 0.20 | 1135 | 6.9 | 0.21 |
| $25,000–$49,999, Non-Hispanic White | 9.7 | 10.6 | 0.21 | 1674 | 9.8 | 0.24 |
| $50,000–$74,999, Non-Hispanic White | 9.7 | 10.1 | 0.21 | 1643 | 9.7 | 0.24 |
| $75,000–$99,999, Non-Hispanic White | 8.4 | 8.8 | 0.19 | 1518 | 8.4 | 0.22 |
| $100,000–$149,999, Non-Hispanic White | 11.9 | 11.4 | 0.21 | 2033 | 11.9 | 0.26 |
| $150,000 or more, Non-Hispanic White | 16.0 | 13.2 | 0.22 | 2562 | 16.1 | 0.31 |
| Under $24,999, Non-Hispanic Black | 2.6 | 3.4 | 0.12 | 429 | 2.6 | 0.15 |
| $25,000–$49,999 Non-Hispanic Black | 2.5 | 2.5 | 0.10 | 396 | 2.5 | 0.15 |
| $50,000–$74,999 Non-Hispanic Black | 2.2 | 2.1 | 0.09 | 351 | 2.2 | 0.15 |
| $75,000–$99,999 Non-Hispanic Black | 1.4 | 1.4 | 0.07 | 264 | 1.4 | 0.10 |
| $100,000–$149,999 Non-Hispanic Black | 1.7 | 1.5 | 0.08 | 274 | 1.7 | 0.12 |
| $150,000 or more Non-Hispanic Black | 1.6 | 1.1 | 0.07 | 205 | 1.6 | 0.13 |
| Under $24,999, Non-Hispanic Other/2+ Races | 0.9 | 1.2 | 0.08 | 132 | 0.9 | 0.11 |
| $25,000–$49,999, Non-Hispanic Other/2+ Races | 1.1 | 1.3 | 0.08 | 174 | 1.1 | 0.12 |
| $50,000–$74,999, Non-Hispanic Other/2+ Races | 1.2 | 1.4 | 0.08 | 202 | 1.2 | 0.12 |
| $75,000–$99,999, Non-Hispanic Other/2+ Races | 1.0 | 1.2 | 0.08 | 200 | 1.0 | 0.11 |
| $100,000–$149,999, Non-Hispanic Other/2+ Races | 1.6 | 1.5 | 0.08 | 256 | 1.5 | 0.12 |
| $150,000 and more, Non-Hispanic Other/2+ Races | 2.8 | 1.9 | 0.09 | 316 | 2.7 | 0.18 |
| Under $24,999, Hispanic | 2.4 | 3.7 | 0.13 | 401 | 2.4 | 0.14 |
| $25,000–$49,999, Hispanic | 3.7 | 4.4 | 0.14 | 560 | 3.7 | 0.18 |
| $50,000–$74,999, Hispanic | 3.2 | 3.1 | 0.12 | 456 | 3.2 | 0.18 |
| $75,000–$99,999, Hispanic | 2.4 | 2.0 | 0.09 | 314 | 2.4 | 0.16 |
| $100,000–$149,999, Hispanic | 2.8 | 2.1 | 0.09 | 387 | 2.8 | 0.16 |
| $150,000–Over Hispanic | 2.4 | 1.6 | 0.08 | 285 | 2.4 | 0.17 |
| Geographic Region, Race/Ethnicity |  |  |  |  |  |  |
| Northeast, Non-Hispanic White | 11.6 | 12.0 | 0.23 | 1959 | 11.7 | 0.26 |
| Midwest, Non-Hispanic White | 16.1 | 16.0 | 0.25 | 2794 | 16.1 | 0.30 |
| South, Non-Hispanic White | 22.3 | 22.0 | 0.28 | 3617 | 22.3 | 0.35 |
| West, Non-Hispanic White | 12.6 | 12.6 | 0.23 | 2195 | 12.6 | 0.27 |
| Northeast, Non-Hispanic Black | 1.8 | 1.8 | 0.09 | 280 | 1.8 | 0.13 |
| Midwest, Non-Hispanic Black | 2.0 | 2.1 | 0.09 | 336 | 2.0 | 0.13 |
| South, Non-Hispanic Black | 7.0 | 6.9 | 0.17 | 1117 | 7.0 | 0.24 |
| West, Non-Hispanic Black | 1.1 | 1.1 | 0.07 | 186 | 1.1 | 0.10 |
| Northeast, Non-Hispanic Other/2+ Races | 1.5 | 1.4 | 0.08 | 196 | 1.5 | 0.14 |
| Midwest, Non-Hispanic Other/2+ Races | 1.1 | 1.3 | 0.08 | 202 | 1.1 | 0.11 |
| South, Non-Hispanic Other/2+ Races | 2.4 | 2.6 | 0.11 | 379 | 2.3 | 0.16 |
| West, Non-Hispanic Other/2+ Races | 3.6 | 3.3 | 0.12 | 503 | 3.5 | 0.20 |
| Northeast, Hispanic | 2.2 | 2.0 | 0.09 | 287 | 2.2 | 0.15 |
| Midwest, Hispanic | 1.4 | 1.3 | 0.07 | 192 | 1.4 | 0.12 |
| South, Hispanic | 6.6 | 6.7 | 0.16 | 956 | 6.6 | 0.25 |
| West, Hispanic | 6.6 | 6.9 | 0.17 | 968 | 6.6 | 0.24 |
| MSA Category, Race/Ethnicity |  |  |  |  |  |  |
| Non-Metro, Non-Hispanic White | 10.8 | 11.2 | 0.22 | 1732 | 10.8 | 0.26 |
| Metro, Non-Hispanic White | 51.8 | 51.4 | 0.34 | 8833 | 51.9 | 0.45 |
| Non-Metro, Non-Hispanic Black | 1.0 | 1.0 | 0.07 | 143 | 1.0 | 0.10 |
| Metro, Non-Hispanic Black | 11.0 | 11.0 | 0.20 | 1776 | 11.0 | 0.29 |
| Non-Metro, Non-Hispanic Other/2+ Races | 0.7 | 0.8 | 0.06 | 118 | 0.7 | 0.09 |
| Metro, Non-Hispanic Other/2+ Races | 8.0 | 7.8 | 0.19 | 1162 | 7.8 | 0.29 |
| Non-Metro, Hispanic | 1.0 | 0.9 | 0.07 | 130 | 1.0 | 0.10 |
| Metro, Hispanic | 15.9 | 15.9 | 0.24 | 2273 | 15.9 | 0.36 |
| Race/Ethnicity |  |  |  |  |  |  |
| Non-Hispanic White | 62.5 | 62.5 | 0.33 | 10565 | 62.7 | 0.45 |
| Non-Hispanic Black | 12.0 | 12.0 | 0.21 | 1919 | 12.0 | 0.31 |
| Non-Hispanic Asian, Native Hawaiian, Pacific Islander | 6.4 | 4.0 | 0.13 | 628 | 6.3 | 0.28 |
| Hispanic | 16.9 | 16.9 | 0.25 | 2403 | 16.9 | 0.37 |
| Non-Hispanic Other Race/2+ Races | 2.2 | 4.6 | 0.15 | 652 | 2.2 | 0.13 |
| Hispanic/Latino Origin |  |  |  |  |  |  |
| Non-Hispanic | 83.1 | 83.1 | 0.25 | 13764 | 83.1 | 0.37 |
| Mexican, Hispanic | 10.2 | 10.2 | 0.20 | 1397 | 10.2 | 0.30 |
| Puerto Rican, Hispanic | 1.5 | 1.6 | 0.08 | 246 | 1.5 | 0.11 |
| Cuban, Hispanic | 0.8 | 0.8 | 0.06 | 140 | 0.8 | 0.09 |
| Other, Hispanic Origin | 4.3 | 4.3 | 0.13 | 620 | 4.3 | 0.21 |

1. A random sample of 22,514 panel members was drawn from Ipsos’ KnowledgePanel®. 15,923 responded to the invitation and 9,269 qualified for the survey, yielding a final study completion rate of 70.7% and a qualification rate of 58.2% percent. [↑](#footnote-ref-1)