2017 National Survey of Children's Health

Nonresponse Bias Analysis

U.S. Census Bureau

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Note: Frame variable, variable, and characteristic are often used interchangeably throughout this document; when necessary, distinctions are made.

Analysis of Nonresponse Bias in the 2017 National Survey of Children's Health

I.   Nonresponse in the 2017 National Survey of Children's Health

<u>Motivation</u>

Standard 1.3 of the Office of Management and Budget Standards and Guidelines for Statistical Surveys (2006) states that "Agencies must design the survey to achieve the highest practical rates of response, commensurate with the importance of survey uses, respondent burden, and data collection costs, to ensure that survey results are representative of the target population so they can be used with confidence to inform decisions." Implicit in this standard is the assumption that the frame variables (e.g., stratum) used at the design state are sufficiently predictive of the collection variables (e.g., number of eligible children in the household) for this to be feasible. Under this assumption, standard nonresponse bias analysis techniques are applied to study potential areas of nonresponse bias in the survey estimates.

Three goals of this analysis of nonresponse bias in the 2017 National Survey of Children's Health (NSCH) are:
- To describe how the 2017 NSCH Screener and Topical nonrespondents are different from their respective Screener and Topical respondents.
- To describe how well the 2017 NSCH Screener and Topical weighting adjustments that were used to correct for nonresponse performed.
- To present and discuss the effect of nonresponse, and the weighting corrections for nonresponse, on selected key survey estimates (KSEs).

Using frame information (i.e., NSCH Screener response data, NSCH frame data, and block group-level or tract-level frame data from the American Community Survey (ACS))[1], information from respondents is compared to all of the cases eligible for the Screener and for the Topical. Since most of the frame information is available for both respondents and nonrespondents of the Screener and Topical stages, the stage-specific nonresponse bias in these frame variables can be measured directly. The overall nonresponse bias is then estimated for the frame variables and logistic regression models are used to translate the estimated overall biases in the variables into estimates of bias in the KSEs.

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[1] A census block group is a geographical unit used by the U.S. Census Bureau and it is the smallest geographical unit for which the Census Bureau publishes sample data. A single block group consists of clusters of blocks within the same census tract and each tract contains at least one block group. A block group usually covers a contiguous area, and never crosses state, county, or census tract boundaries, but may cross the boundaries of any other geographic entity; it is generally defined to contain between 600 and 3,000 people.

A comparison of response rates across the frame variables, comparing above and below the median, could indicate the presence of nonresponse bias in the 2017 NSCH. (Note: Percent Owner is an example of a frame 'variable' or 'characteristic'; an example of a 'subgroup' is greater than the median for the frame variable Percent Owner.) If the response rate is lower (or higher) for a particular subgroup relative to that of other subgroups, then that would indicate that the subgroup is under-represented (or over-represented) in the final sample, and, to the extent that a KSE is different for that particular subgroup compared with other subgroups, there would be bias in the overall survey estimate. If the response rate is the same across subgroups, or if a KSE does not differ by these subgroups, the KSE could still be biased, but unequal response rates across these subgroups will have been ruled out as a source of bias.

Weighting Framework and the Types of Nonrespondents at each Stage

As presented in the Source and Accuracy Statement for the 2017 NSCH (Tersine, 2018), Figure 1 provides a framework for the weighting steps that were implemented from sample frame to final outcome. The process used the data from each phase of the data collection, from both the paper and Centurion (web) instruments, to produce final weights for the screened-in households[2], Screener children, and interviewed[3] children via the Topical.

Figure 1. 2017 National Survey of Children's Health - Sample Frame to Final Outcome[4]
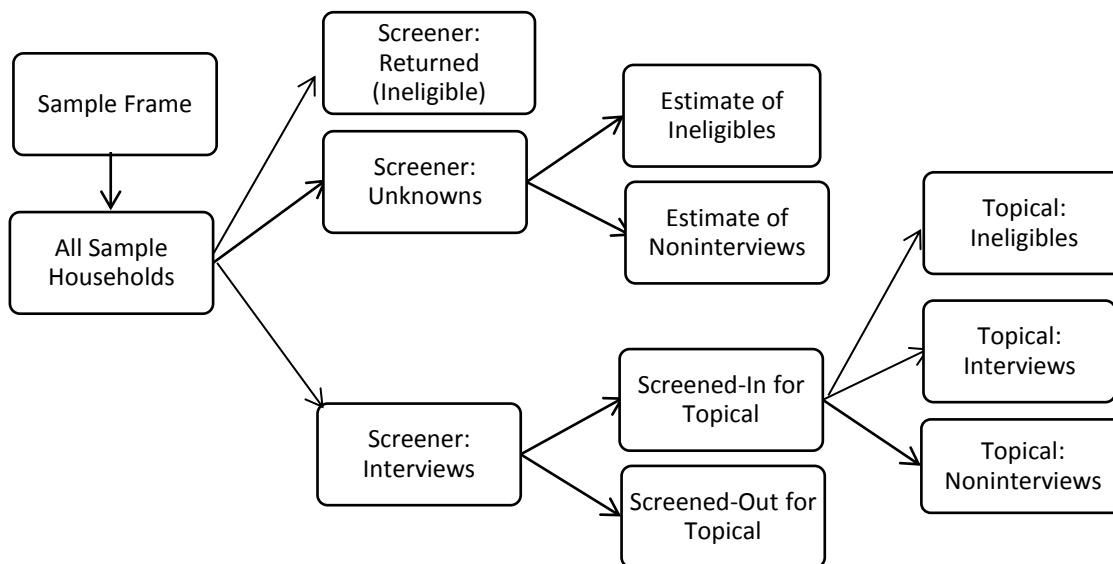
The weighting process for the interviewed children began with the base weight (BW) for each sample household, followed by a Screener nonresponse adjustment (SNA). Then, the eligible

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[2] Since the household-level weight is not addressed in this report, discussion of its factors is omitted.

[3] Children or households are not actually interviewed in the 2017 NSCH; the term 'interviewed' is used to represent information gathered from the paper and web questionnaires.

[4] Figure 1 shows a box representing Topical Ineligibles. An example would be a household that reports a child on the Screener, but then the child who was selected as the sample child is no longer present when the Topical arrives at the address.

children from the Screener interview cases were raked to population controls (Child-Level Screener Factor = CLSF), a within-household subsampling factor (WHSF) was applied to the Screener interview cases, and a Topical nonresponse adjustment (TNA) was applied to the Topical interview cases. As a factor for the final weight for interviewed children, a raking adjustment (RAK) to various demographic controls, and trimming of extreme weights as necessary, was lastly performed. The weighting process for all Screener children was a subset of these six factors.

Final Weight for Interviewed Children = BW × SNA × CLSF × WHSF × TNA × RAK
Final Weight for Screener Children = BW × SNA × CLSF

II.   Details on Base Weights and the Adjustments for Screener and Topical Nonresponse.

Base Weights

The weighting process began with the base weight for each sample household. The base weight for each sample housing unit was the inverse of its probability of selection for the Screener. Base weights were calculated separately for each of the two sampling strata[5] for each state, including the District of Columbia. If there was no nonresponse and the survey frame was complete, using this weight would give unbiased estimates for the survey population.

Adjustment for Screener Nonresponse

Following the base weight, an adjustment for Screener nonresponse was implemented to increase the weights of the households that responded to the Screener in order to account for all of the households that did not respond to the Screener. Households were put into one of 16 cells defined by stratum, a block-group poverty measure variable indicating the proportion of households with income less than 150 percent of the poverty rate, an indicator of the likelihood of households to respond by paper, and whether they reside inside or outside of a Metropolitan Statistical Area (MSA). The Screener nonresponse adjustment factor was calculated within each cell using the following formula:

$$\left(\frac{\text{weighted sum of Screener interviews } + \text{ weighted number of Screener noninterviews}}{\text{weighted sum of Screener interviews}} \right)$$

where the number of Screener noninterviews =

$$\left(\frac{\text{weighted sum of Screener interviews}}{\text{weighted sum of Screener interviews + weighted sum of Screener ineligible households}} \right) \times$$

$$\text{(weighted sum of households with unknown Screener eligibility)}$$

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[5] Households flagged as having at least one child under the age of 18 based on administrative records were assigned to Stratum 1; all other households were assigned to either Stratum 2a or 2b, with no sampling occurring in Stratum 2b. See the 2017 NSCH Methodology Report (U.S. Census Bureau, 2018) for a more detailed description of the different strata.

In other words, the count of Screener noninterviews was an estimate of the expected number of eligible households from those cases for which nothing was received back. The term eligible here refers to the address belonging to an occupied, residential household. The expected number of eligible cases was estimated by taking the eligibility rate among the known cases and applying it to the unknown cases. The Screener nonresponse adjustment was the last step of the weight processing that included the households for which there was no Screener interview as well as the Screener-interviewed households that indicated no eligible children.

Adjustment for Topical Nonresponse

Similar to the Screener nonresponse adjustment, the weights of the households responding to the Topical needed to be increased to account for all of the households not responding to the Topical. If the respondent reached Section H of the Topical questionnaire and answered at least 50 percent of the key items, then it was considered a Topical interview. (Key items are 50 items on the Topical instrument that are on path for all respondents.) A returned Topical that did not meet these conditions was considered a Topical noninterview.

All Topical eligible households were put into one of eight cells depending on imputed poverty/non-poverty status (based on 150 percent poverty rate), web group (high paper vs. low paper/high web), and presence of a child with special health care needs (CSHCN). The Topical nonresponse adjustment was calculated within each of the eight cells using the following formula:

$$\frac{\text{weighted sum of Topical interviews } + \text{ weighted sum of Topical noninterviews}}{\text{weighted sum of Topical interviews}}$$

III.   File Creation for the Nonresponse Bias Analysis

Several of the approaches used to assess nonresponse bias rely heavily on the availability of information for both respondents and nonrespondents. There is normally very limited information on nonrespondents; however, since this survey was an address based survey, block group level data from the 2016 ACS 5-year Summary File could be attached to the entire NSCH sample. Each household is located in a single block group. The proportions (e.g., Percent White Alone) and median values (e.g., median home value) for each of the frame variables used are known for each block group based on ACS data. The block group measure was assigned to each household in the associated block group. The overall median of each frame variable was then calculated and each NSCH record was put into one of two subgroups based on whether its block-group's value was above or below the overall median. Table 1 shows the information that is known for both respondents and nonrespondents, either at a geographic level or from the Screener.

For NSCH Screener interview data that were available for the Topical and NSCH frame data that were not from the ACS, median comparisons at the block group level were not necessary.[6]

<div align="center">Table 1. Information Available for Both Respondents and Nonrespondents</div>

Variable	Description
# of Eligible Children in the HH[*]	Number of children age 0-17 years in the household as indicated on the Screener
Presence of CSHCN[†]	Indicator of whether or not there are any CSHCN in the household as indicated on the Screener
Presence of Child Flag	Stratum Identifier: Households flagged as having at least one child under the age of 18 were assigned to Stratum 1, all other households were assigned to Stratum 2
CBSA[‡] Status	Indicator of whether the household is inside or outside of a CBSA
Median Household Income	Median household income in the tract
Median Home Value	Median home value in the tract
Median Gross Rent	Median gross rent in the tract
Tenure: Percent Owner	Percent of the population in the block group that owns their home
Percent College Grad	Percent of the population in the block group that is a college graduate
Percent Hispanic	Percent of the population in the block group that is Hispanic
Percent Black Alone	Percent of the population in the block group that is Black
Percent White Alone	Percent of the population in the block group that is White
Percent Asian Alone	Percent of the population in the block group that is Asian
Percent Other Race	Percent of the population in the block group that is not Black alone, White alone, or Asian alone

[*] HH – Household
[†] CSHCN – Children with Special Health Care Needs
[‡] CBSA – Core Based Statistical Area

IV.   Key Survey Estimates

As listed under the Motivation in Section I, one goal of this analysis is to examine the relationship between the nonresponse bias in the frame variables and the bias in selected KSEs. The following 21 KSEs were chosen as the focus of this analysis:

1. Percent of CSHCN
2. Percent of children with any kind of emotional, developmental, or behavioral problem needing treatment or counseling
3. Percent of children with current asthma
4. Percent of children with current Autism Spectrum Disorder (ASD)
5. Percent of children with current anxiety
6. Percent of children ever diagnosed with Attention Deficit Disorder (ADD) or Attention Deficit Hyperactivity Disorder (ADHD)
7. Percent of children (6-17 years) who are bullied
8. Percent of children (1-17 years) with "excellent" condition of teeth
9. Percent of children in excellent or very good health

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[6] The variables for which block group comparisons were not necessary include number of eligible children in the household, presence of CSHCN, stratum, and MSA status.

10. Percent of children (0-5 years) ever breastfed
11. Percent of children with a personal doctor/nurse
12. Percent of children who were ever covered by any kind of health insurance or health coverage plan during the past 12 months
13. Percent of CSHCN who were ever covered by any kind of health insurance or health coverage plan during the past 12 months
14. Percent of CSHCN whose families paid $1,000 or more out-of-pocket for medical and health care in the past 12 months
15. Percent of CSHCN whose health status caused family members to cut back or stop working in the past 12 months
16. Percent of CSHCN (12-17 years) who had at least one preventive medical visit with a doctor, nurse, or health care professional in the past 12 months
17. Percent of children (6-17 years) who exercised, played a sport, or participated in physical activity at least one day during the past week, for at least 60 minutes
18. Percent of children (1-5 years) with > 1 hour/day of TV screen time
19. Percent of children with family meals every day of the week
20. Percent of children with sidewalks or walking paths in their neighborhood
21. Percent of children where someone smokes in the household

V.   Assessing Nonresponse Bias in the 2017 NSCH

Weighted Response Rate Comparisons

As stated in Section I, a comparison of response rates across subgroups could reveal the presence of nonresponse bias in a survey. If the response rate is lower (or higher) for a particular subgroup relative to that of other subgroups, then that would indicate that the subgroup is under-represented (or over-represented) in the final sample. To the extent that a KSE is different for that particular subgroup when compared with other subgroups, there could be bias in the overall survey estimate.

Table 2 presents the national weighted response rates for Screener respondents using the base weights and the weighted response rates for Topical respondents using the adjusted weights of all households receiving a Topical, across subgroups of the frame variables. For each of the ACS block group or tract frame variables, households were classified into two subgroups: those with values above and those with values below or equal to the median value of the variable for all Screener or Topical respondents and nonrespondents.

The 2017 response rates of all Screener subgroup pairs are significantly different at the 95 percent confidence level. For the Topical, the response rates for all of the subgroup pairs are also significantly different with the exception of the following pairs:

- Households with one eligible child vs. households with two eligible children
- Households with one eligible child vs. households with at least four eligible children
- Households with three eligible children vs. households with at least four eligible children

- Presence of child flag (Stratum 1 vs. Stratum 2a)
- Percent Hispanic
- Percent Black Alone
- Percent White Alone
- Percent Other Race

Table 2 shows it was more difficult to obtain Screener responses from households that were placed into Stratum 1 with a seven percentage point difference from the response rate of those that were placed into Stratum 2a (38 percent versus 45 percent). It is very likely that Screener response is greater in Stratum 2a because there are fewer households with children, thereby easing the task of responding. Screener response rates were larger for areas with larger non-White populations by about ten percentage points. Screener response rates were only two percentage points different for areas with less than or equal to the median of Asian populations as those with greater than the median; similarly, for the variables median gross rent (three percentage points difference) and MSA status (two percentage points difference). Looking at both Screener and Topical response, it was generally more difficult to obtain interviews from households in areas having lower household incomes, less homeownership, and fewer college graduates (all around 11 to 12 percentage points different from their median counterparts).

There are two limitations to this approach. First, to form subgroups, each continuous sampling frame variable had to be categorized into groups, resulting in less precise measures of these variables. Second, the adjusted response rates presented in Table 2 reflect only the weighting adjustments for nonresponse at the Screener stage and not the adjustment for nonresponse at the Topical stage or the final raking of the Topical weights to population control totals; the extent to which these additional weighting adjustments reduced the under- or over-representativeness of a particular subgroup in the final weighted sample was not captured by this analysis.

Table 2. Response Rates Across Various Frame Subgroups

Frame Variable/'Subgroup	Screener Respondents		Topical Respondents	
	Frequency	Weighted Response Rate[7] (%)	Frequency	Weighted Response Rate[8] (%)
--- National Survey of Children's Health Screener Response Data ---				
# of Eligible Children in Household				
1 ………………………………………..			8,972	73.17
2 ………………………………………..			8,589	74.18
3 ………………………………………..			2,823	67.42
4+ ………………………………………..			1,215	69.75
Presence of Children with Special Health Care Needs				
Yes ……………………………………….			6,328	73.54
No ……………………………………….			15,270	71.10
--- Frame Data: National Survey of Children's Health ---				
Presence of Child Flag				
Stratum 1 ………………………………	34,200	38.31	19,420	72.36
Stratum 2a ………………………………	24,310	44.59	2,177	69.20
Metropolitan Statistical Area (MSA) Status				
In MSA ……………………………………	45,980	41.60	17,730	72.15
Not in MSA ……………………………	12,530	43.92	3,868	68.91
--- Frame Data: American Community Survey Block Group or Tract Data ---				
Median Household Income				
≤ median ……………………………..	24,800	35.92	7,437	66.70
> median ……………………………..	32,670	48.11	13,630	75.67
Median Home Value				
≤ median ……………………………..	25,380	38.35	8,012	66.58
> median ……………………………..	31,830	45.74	12,960	76.19
Median Gross Rent				
≤ median ……………………………..	26,920	40.25	8,673	67.49
> median ……………………………..	29,830	43.01	12,070	74.43
Tenure: Percent Owner				
≤ median ……………………………..	25,250	36.34	8,160	69.85
> median ……………………………..	32,210	48.44	12,910	73.59
Percent College Graduate				
≤ median ……………………………..	24,780	36.15	7,769	66.83
> median ……………………………..	32,690	47.94	13,300	75.98
Percent Hispanic				
≤ median ……………………………..	30,730	46.98	11,370	72.69
> median ……………………………..	26,740	38.51	9,700	71.29
Percent Black Alone				
≤ median ……………………………..	31,980	47.30	11,870	72.74
> median ……………………………..	25,490	37.78	9,202	71.08
Percent White Alone				
≤ median ……………………………..	25,230	37.03	8,874	71.20
> median ……………………………..	32,240	48.32	12,200	72.63
Percent Asian Alone				
≤ median ……………………………..	27,750	40.63	9,413	68.59
> median ……………………………..	29,720	42.97	11,660	74.15
Percent Other Race				
≤ median ……………………………..	30,230	45.73	11,460	72.50
> median ……………………………..	27,240	38.61	9,615	71.28

Source: U.S. Census Bureau, 2017 National Survey of Children's Health internal data

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[7] Using BW of all sample cases.

[8] Using weights of all households receiving a Topical: BW × SNA × CLSF × WHSF.

Comparing Respondents and Nonrespondents across Various Frame Variables – The Effect of the Screener and Topical Nonresponse Adjustments

For each stage of the survey (i.e., Screener and Topical), Table 3 shows a comparison of frame information for the entire sample eligible for the stage and for respondents to that stage, first using the weight before the Topical nonresponse adjustment and then using the weight with the Topical nonresponse adjustment. The purpose of Table 3 is twofold: to show the bias that may exist in the frame variables and to show if the Screener and Topical nonresponse adjustments were successful in reducing that bias. Ideally, we would like to see the distributions for each characteristic in the 'Using NR Adjusted Weight' columns three and six closely match the appropriate Screener or Topical bolded columns one and four. For most frame variables, the adjustment did indeed move the distribution closer from columns two and five to that of the appropriate all sample cases column, with the Topical adjustment performing better than the Screener adjustment. These results indicate that the adjustments mitigated a large portion of the nonresponse bias.

Using Table 3, the bias can be calculated using a variation of the following formula:

$$\frac{\text{information from respondents} - \text{information from all eligible cases}}{\text{information from all eligible cases}}$$

For example, using the base weights for the Percent Hispanic variable, the sample is biased downward 20.19 percent (calculated as (13.99 – 17.53) / 17.53 = -20.19 percent) for the Screener and biased downward 2.79 percent (calculated as (17.41 – 17.91) / 17.91 = -2.79 percent) for the Topical. Using the weights that have been adjusted for nonresponse, the sample is biased downward 14.83 percent and 1.01 percent for the Screener and Topical respondents, respectively. Thus, the nonresponse adjustments greatly lowered, but did not completely eliminate, the bias in the Percent Hispanic estimate. Table 3 shows that this is generally the case for the other frame variables as well. Nonresponse introduced small biases, but the nonresponse adjustments substantially reduced those biases. For the Topical respondents, the groups with the largest bias remaining after the nonresponse adjustments are households with three eligible children, which remains biased downward 5.95 percent, and Percent Black Alone, which remains biased downward 5.65 percent.

Note that the presence of child flag (i.e., Stratum), a poverty measure variable, and residence inside or outside of a MSA were three of the four variables which defined the 16 weighting cells for the Screener nonresponse adjustment; a poverty/non-poverty status variable and presence of a CSHCN were variables used to define the eight weighting cells for the Topical nonresponse adjustment. The results in Table 3 for their frame variable counterparts largely support their choice to reduce nonresponse bias. Consideration will be given to adding additional and/or other variables to the Screener and Topical nonresponse adjustments in the 2018 NSCH.

Table 3. Comparing Respondents and Nonrespondents Using Frame Information

(column #):	All Sample Cases Using Base Weight **(1)**	Screener Respondents		All Topical Eligible Cases Using Weight Prior NR Adjustment[9] **(4)**	Topical Respondents	
		Using Base Weight (2)	Using NR* Adjusted Weight[10] (3)		Using Weight Prior NR Adjustment (5)	Using NR Adjusted Weight[11] (6)
--- NSCH† Screener Interview Data ---						
# of Eligible Children in Household						
1				**23.42**	23.86	23.85
2				**40.81**	42.15	41.96
3				**23.04**	21.63	21.67
4+				**12.74**	12.37	12.52
Presence of CSHCN‡						
Yes				**29.55**	30.25	29.84
No				**70.45**	69.75	70.16
--- Frame Data: NSCH ---						
Presence of Child Flag						
Stratum 1	**42.78**	39.11	45.51	**82.99**	83.62	83.57
Stratum 2a	**57.22**	60.89	54.49	**17.01**	16.38	16.43
MSA§ Status						
In MSA	**86.82**	86.18	88.37	**90.01**	90.42	90.06
Not in MSA	**13.18**	13.82	11.63	**9.99**	9.58	9.94
--- Frame Data: American Community Survey Block Group or Tract Data ---						
Median Household Income	**62,660**	68,200	67,710	**69,260**	71,630	70,140
Median Home Value	**237,300**	253,000	253,300	**255,500**	267,000	262,100
Median Gross Rent	**1,081**	1,110	1,115	**1,147**	1,170	1,155
Tenure: Percent Owner	**63.07**	67.49	66.54	**67.49**	68.13	67.48
Percent College Graduate	**37.84**	41.20	40.90	**40.63**	42.25	41.44
Percent Hispanic	**17.53**	13.99	14.93	**17.91**	17.41	17.73
Percent Black Alone	**13.74**	10.76	11.39	**12.03**	11.13	11.35
Percent White Alone	**72.40**	76.50	75.41	**73.80**	74.60	74.38
Percent Asian Alone	**5.07**	5.20	5.31	**5.42**	5.70	5.57
Percent Other Race	**8.79**	7.55	7.90	**8.75**	8.57	8.70

Source: U.S. Census Bureau, 2017 National Survey of Children's Health internal data
* NR – Nonresponse
† NSCH – National Survey of Children's Health
‡ CSHCN – Children with Special Health Care Needs
§ MSA – Metropolitan Statistical Area

[9] BW × SNA × CLSF × WHSF
[10] BW × SNA
[11] BW × SNA × CLSF × WHSF × TNA

Observed and Expected Means of Frame Variables for Respondents

Table 4 shows the observed means of the frame variables for Topical respondents and the means that would be expected under full response. The bias is calculated as the product of two ratios the Screener estimate for all sample cases over that for Screener respondents and the Topical estimate for all eligible cases over that for Topical respondents. The bias measurement is then applied to the observed values to get the expected values in Table 4.

Table 4. Observed and Expected Means of Frame Variables for Topical Respondents

	Using Weight Prior to Nonresponse Adjustment		Using Nonresponse Adjusted Weight	
	Observed	Expected[12]	Observed	Expected[12]
In Metropolitan Statistical Area (MSA) …..	90.42	90.68	90.06	88.43
Not in MSA ……………………………………..	9.58	9.53	9.94	11.32
Median Household Income …………………….	71,630	63,630	70,140	64,090
Median Home Value …………………………….	267,000	239,600	262,100	239,400
Median Gross Rent …………………………….	1,170	1,117	1,155	1,112
Tenure: Percent Owner ………………………..	68.13	63.07	67.48	63.97
Percent College Graduate …………………....	42.25	37.32	41.44	37.59
Percent Hispanic ……………………………….	17.41	22.44	17.73	21.03
Percent Black Alone …………………………...	11.13	15.36	11.35	14.51
Percent White Alone …………………………..	74.60	69.84	74.38	70.85
Percent Asian Alone …………………………..	5.70	5.28	5.57	5.18
Percent Other Race …………………………...	8.57	10.19	8.70	9.74

Source: U.S. Census Bureau, 2017 National Survey of Children's Health internal data

For example, using the weight before the Topical nonresponse adjustment, the observed median household income is $71,630. Taking the bias into account, the expected value is $71,630 \times (62,660/68,200) \times (69,260/71,630) = \$63,630$[12]. Similarly, using the Topical nonresponse adjusted weight, the observed value is $70,140. Taking the bias into account, the expected value is $70,140 \times (62,660/67,710) \times (69,260/70,140) = \$64,090$[12].

The biases in the frame information translate into biases in the KSEs only to the extent that the frame information is related to the KSEs. To examine these relationships for each of the 21 KSEs, a logistic regression model was estimated of the following form:

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[12] Reported values are rounded to four significant digits.

$$p_i = \frac{e^{X_i'\beta}}{1 + e^{X_i'\beta}}$$

where p_i is the probability that the *i*th respondent's child is positive for the key survey variable
(e.g., has special needs, has anxiety, neighborhood has sidewalks or walking paths);
X_i' is a vector containing the frame information for the *i*th child; and
β is a vector of unknown parameters to be estimated.

By evaluating the fitted model first at the observed means of the frame information and then at the expected means of the frame information from Table 4, an estimate of the bias in each KSE was generated that could be attributed to biases in the frame variables due to nonresponse. These estimates of biases in the KSEs using this approach are shown in the next section's Table 5.

Estimates of Nonresponse Biases in the Key Survey Estimates

As Table 5 shows, the small biases in the frame information translate into even smaller biases in the KSEs. In this analysis, the largest sample biases found using the base weights were in KSE 21, the percentage of children where someone smokes in the household (-20.20 percent), and KSE 14, the percentage of CSHCN whose families paid $1,000 or more out-of-pocket for medical and health care in the past 12 months (17.16 percent). Using the nonresponse adjusted weights, this bias was somewhat improved for both estimates, resulting in a downward bias of 17.72 percent for KSE 21 and an upward bias of 13.14 percent for KSE 14.[13] When the standard errors of the estimates are taken into account, the estimate using the final weights would lead to a difference large enough to be significant at the 95 percent confidence level.[14]

Looking at the model output in Table 5, less than one percent of households have someone who smokes in the home. With such a small number, even small changes can produce relatively large percent changes. So for KSE 21, the change of only 0.2 percentage points between the model evaluated at the observed means versus at the expected means leads to such a large percent bias. Thus, looking solely at that percent bias can be misleading. The relatively high remaining upward bias for KSE 14 may be attributed to the difficulty in getting response from areas with lower household income as indicated in Table 2.

Although the results of the modeling suggest that differences between sample respondents and nonrespondents in terms of the frame information largely lead to very little bias in the KSEs, this does not necessarily mean that the KSEs are biased very little. It is possible that there are

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[13] Note that the estimates of bias are not percentage points; they indicate the percent change in the observed estimate as compared to the expected estimate. A downward bias of 5 percent indicates that the current survey estimate is 5 percent lower than the "true" estimate. If the "true" estimate is 20 percent, then the survey estimate with a bias of -5 percent would be 19 percent, since (19 - 20)/20 = - 5 percent.

[14] The 2017 survey estimate for KSE 14 is 21.9 percent (from Table 6) with a 95 percent confidence interval of (19.7, 24.1). Factoring in a 13.14 percent upward bias would lead to an estimate of 19.4 percent, since 21.9/1.1314= 19.4, which is less than the lower limit of the 95 percent confidence interval.

differences between the sample respondents and nonrespondents that are not reflected in the frame information.

The results in this section do not reflect the final raking of the nonresponse-adjusted weights to population control totals. This final raking could reduce or increase bias, but if so, that reduction or increase was not captured in the analysis in this section. Section VI of this document, "Comparison to Similar Estimates from Other Sources" does present analysis that makes use of the final, raked weights.

Table 5. Estimates of Nonresponse Biases in the Key Survey Estimates Attributable to Biases in the Frame Information

Key Survey Variable	Using Base Weight			Using NR[*] Adj. Weight		
	Model evaluated at observed respondent means[15]	Model evaluated at means expected under full response	Est. bias[16] (%)	Model evaluated at observed respondent means	Model evaluated at means expected under full response	Est. bias (%)
1. Percent of children with special health care needs (CSHCN)	18.3	18.4	-0.44	17.8	17.9	-0.75
2. Percent of children with emotional, developmental, or behavioral problem needing treatment/counseling	9.0	9.3	-2.36	8.8	9.0	-2.29
3. Percent of children with current asthma	7.2	7.7	-6.03	7.2	7.5	-4.74
4. Percent of children with current ASD[†]	2.2	2.4	-6.95	2.2	2.3	-5.18
5. Percent of children with current anxiety	5.9	5.8	3.32	5.8	5.7	2.08
6. Percent of children ever diagnosed with ADD[‡] or ADHD[§]	7.8	8.0	-2.44	7.6	7.8	-2.05
7. Percent of children (6-17) who are bullied	19.9	20.1	-1.09	19.9	20.1	-1.34
8. Percent of children (1-17) with excellent teeth condition	50.6	48.1	5.21	50.3	48.3	3.98
9. Percent of children in excellent or very good health	92.4	91.2	1.30	92.3	91.4	0.99
10. Percent of children (0-5) ever breastfed	83.4	81.4	2.39	83.3	81.7	1.89
11. Percent of children with a personal doctor/nurse	75.8	73.6	2.99	75.4	73.7	2.23
12. Percent of children who were ever covered by health insurance/plan during the past 12 months	97.5	97.0	0.51	97.4	97.0	0.40
13. Percent CSHCN who were ever covered by any health insurance/plan during the past 12 months	98.5	98.2	0.32	98.5	98.2	0.27
14. Percent CSHCN whose families paid ≥$1000 out-of-pocket for medical/health care in past 12 months	22.9	19.5	17.16	22.5	19.9	13.14

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[15] Although the logistic regression models were evaluated at the observed means of the frame information, the results are not the observed means of the key survey variables, as would be the case for linear regression models.

[16] (Model evaluated at observed means – Model evaluated at expected means)/Model evaluated at expected means.

Key Survey Variable	Using Base Weight			Using NR* Adj. Weight		
	Model evaluated at observed respondent means[15]	Model evaluated at means expected under full response	Est. bias[16] (%)	Model evaluated at observed respondent means	Model evaluated at means expected under full response	Est. bias (%)
15. Percent CSHCN whose health caused family members to cut back/stop working in the past 12 months	15.6	15.9	-1.35	15.6	15.7	-0.67
16. Percent CSHCN (12-17) who had ≥1 preventative visit with health care professional in past 12 months	97.3	97.5	-0.15	97.5	97.6	-0.09
17. Percent of children (6-17) physically active ≥ 1 day during past week, for ≥1 hour	92.2	91.6	0.65	92.1	91.6	0.50
18. Percent of children (1-5) with >1 hour/day of TV time	42.7	45.4	-5.99	43.1	45.2	-4.81
19. Percent of children with family meals every day	41.4	43.0	-3.84	41.6	42.8	-2.88
20. Percent of children with neighborhood sidewalks/paths	80.5	81.0	-0.56	80.3	80.4	-0.01
21. Percent of children where someone smokes in the household	0.7	0.9	-20.20	0.7	0.9	-17.72

Source: U.S. Census Bureau, 2017 National Survey of Children's Health internal data

* NR – Nonresponse

† ASD – Autism Spectrum Disorder

‡ ADD – Attention Deficit Disorder

§ ADHD – Attention Deficit/Hyperactivity Disorder

VI. Comparison to Similar Estimates from Other Sources

Table 6 provides a comparison of several 2017 NSCH KSEs, and a few additional health-related measures, to estimates from the following other surveys:
- 2016 NSCH
- 2015, 2016, and 2017 National Health Interview Survey (NHIS)
- 2011-2012 NSCH
- 2009-2010 National Survey of Children with Special Health Care Needs (NS-CSHCN)

When considering the estimates and their 95 percent confidence intervals, the following four 2017 NSCH estimates are comparable to those of other surveys:
- Percent of children with special health care needs (KSE 1)
- Percent of children with current asthma (KSE 3)
- Percent of children ever diagnosed with ADD or ADHD (KSE 6)
- Percent of CSHCN whose families paid $1,000 or more out-of-pocket for medical and health care in the past 12 months (KSE 14)
- Percent of children who received a well-child (preventative) checkup in the past 12 months

- Percent of children who missed 11 or more days of school in the past 12 months because of illness or injury
- Percent of children uninsured at the time of interview

Notable differences are found for the following estimates:
- Percent of children in excellent or very good health (KSE 9) – 2017 NSCH estimate is higher than the NHIS, but nearly the same as the 2016 NSCH
- Percent of children with family meals every day of the week (KSE 19) – 2017 NSCH estimate is lower than the 2011-2012 NSCH, but nearly the same as the 2016 NSCH
- Percent of children who have a usual place for sick care – 2017 NSCH estimate is lower

In comparing the 2017 NSCH to the NHIS, the NSCH over-estimates the percent of children with excellent or very good health while under-estimating the percent of children with a usual place for sick care. While the result of the first comparison is consistent with an over-representation of higher income, the second one is not. In comparing the 2017 NSCH to the 2011-2012 NSCH, the current NSCH under-estimates the percent of children with family meals every day of the week. But, there is a 5-6 year difference in the estimates. It is highly possible that a real change has occurred. This is supported by the fact that the 2017 NSCH estimate is not significantly different from that of the 2016 NSCH. On the other hand, if no real change has occurred and the assumption is that higher income households are more likely to have family meals every day, then these results do not lend support to the idea that the NSCH over-represents higher income households. Comparing the 2016 and 2017 NSCH estimates shows that the 2017 survey shows no change in the percent of CSHCN. Disparities in many of the estimates could very well be due to mode effects. While both the 2016 and 2017 NSCH were solely mail and web surveys, the NHIS is conducted in-person and the 2011-2012 NSCH and the NS-CSHCN were phone-based interviews. It is possible that having no interviewer present in the current NSCH contributed to some of the differences observed here.

Table 6. Comparison of 2017 National Survey of Children's Health Estimates to Other Surveys

Estimates from the 2017 NSCH[*] and Other Surveys	Using Weight Prior NR[+] Adj.	Using NR Adj. Weight	Using Final Weight	95 Percent Confidence Interval
% of children with special health care needs, KSE 1				
2017 NSCH (Screener)...	18.1	18.2	18.1	(17.5, 18.7)
2017 NSCH (Topical)..	18.6	18.0	18.2	(17.1, 19.2)
2016 NSCH (Screener)..			18.9	(18.4, 19.4)
2016 NSCH (Topical)...			19.4	(18.6, 20.1)
Percent of children with current asthma, KSE 3				
2017 NSCH..	7.4	7.4	7.5	(6.7, 8.2)
2016 NSCH...			8.4	(7.9, 8.9)
2016 NHIS[‡]..			8.4	(7.8, 9.0)
2015 NHIS..			8.4	(7.7, 9.1)
Percent of children ever diagnosed with Attention Deficit Disorder or Attention Deficit/Hyperactivity Disorder, KSE 6				
2017 NSCH, aged 3-17...	9.6	9.4	9.7	(8.8, 10.5)
2016 NSCH, aged 3-17..			9.9	(9.4, 10.5)

Estimates from the 2017 NSCH[*] and Other Surveys	Using Weight Prior NR[†] Adj.	Using NR Adj. Weight	Using Final Weight	95 Percent Confidence Interval
2016 NHIS, aged 3-17…………………………………..			9.4	(8.6, 10.2)
2015 NHIS, aged 3-17…………………………………..			9.8	(9.0, 10.6)
Percent of children in excellent or very good health, KSE 9				
2017 NSCH……………………………………………………	91.5	91.4	89.8	(88.7, 90.9)
2016 NSCH…………………………………………………			89.7	(89.0, 90.4)
2017 NHIS………………………………………………….			85.1	(84.2, 86.1)
2016 NHIS………………………………………………….			84.6	(83.7, 85.5)
Percent of CSHCN whose families paid ≥ $1,000 out-of-pocket for medical/health care in the past 12 months, KSE 14				
2017 NSCH……………………………………………………	25.7	25.2	21.9	(19.7, 24.1)
2016 NSCH…………………………………………………			19.6	(18.3, 20.9)
2009-2010 NS-CSHCN[§]………………………………			22.1	(21.4, 22.8)
Percent of children w/ family meals every day of week, KSE 19				
2017 NSCH……………………………………………………	41.6	41.8	43.3	(41.9, 44.8)
2016 NSCH…………………………………………………			43.2	(42.2, 44.2)
2011-2012 NSCH…………………………………………			46.7	(46.0, 47.4)
Percent of children who have a usual place for sick care				
2017 NSCH……………………………………………………	79.9	79.5	77.9	(76.5, 79.2)
2016 NSCH…………………………………………………			79.7	(78.8, 80.6)
2017 NHIS………………………………………………….			95.7	(95.1, 96.2)
2016 NHIS………………………………………………….			95.1	(94.6, 95.6)
Percent of children who received a well-child (preventative) checkup in the past 12 months				
2017 NSCH……………………………………………………	83.8	83.6	82.2	(81.0, 83.4)
2016 NSCH…………………………………………………			82.3	(81.4, 83.1)
2014 NHIS………………………………………………….			83.8	(83.0, 84.6)
Percent of children who missed 11 or more days of school in the past 12 months because of illness or injury				
2017 NSCH, aged 5-17………………………………….	3.3	3.3	3.5	(2.9, 4.1)
2016 NSCH, aged 5-17………………………………..			3.9	(3.5, 4.4)
2016 NHIS, aged 5-17………………………………..			4.2	(3.6, 4.8)
2015 NHIS, aged 5-17………………………………..			4.2	(3.7, 4.7)
Percent of children uninsured at the time of interview				
2017 NSCH……………………………………………………	4.6	4.7	5.9	(5.0, 6.7)
2016 NSCH…………………………………………………			5.7	(5.1, 6.2)
2016 NHIS………………………………………………….			5.1	(4.5, 5.7)
2015 NHIS………………………………………………….			4.5	(4.0, 5.0)

Sources: U.S. Census Bureau, 2016 and 2017 National Survey of Children's Health internal data
      National Center for Health Statistics, 2015, 2016, and 2017 National Health Interview Survey external data
      Data Resource Center for Child and Adolescent Health, 2011-2012 National Survey of Children's Health external
      data and 2009-2010 National Survey of Children with Special Health Care needs external data

[*] NSCH – National Survey of Children's Health

[†] NR – Nonresponse

[‡] NHIS – National Health Interview Survey

[§] NS-CSHCN – National Survey of Children with Special Health Care Needs

VII.   Conclusions

Assessing the extent to which nonresponse produces biased survey estimates is difficult. This analysis has applied the most commonly used methods, each of which has its shortcomings. By taking multiple approaches, it was hoped that reasonably accurate conclusions about the level of nonresponse bias in KSEs could be drawn.

Generally, the results indicate that the interviewed population was more likely to live outside of a MSA (Table 2). The interviewed population also was more likely to live in areas associated with higher levels of household income, home ownership, home values, and monthly rents. Additionally, the interviewed population was more likely to live in areas associated with a greater percentage of college graduates and non-Hispanic White persons.

Table 5 presents estimates of bias for each KSE. The largest estimates of bias were associated with the percentage of children where someone smokes in the household and the percentage of CSHCN whose families paid $1,000 or more out-of-pocket for medical and health care in the past 12 months. For each of these estimates, the nonresponse adjusted weights reduced the bias somewhat, but some bias still remains. All other KSEs have a remaining bias of five percent or less, some upward and some downward, after nonresponse adjustments.

Table 6 compares ten 2017 NSCH estimates to similar estimates from other surveys. While some differences exist between the 2017 NSCH estimate and the similar estimate from another survey, often there are differences in the timing of the data collection and the mode of the data collection. The NSCH estimate of the percent of children with excellent or very good health was larger than the NHIS estimate, but very little evidence of bias was found for this estimate in the previous analysis (Table 5).

Taking all these analyses into account, there is no strong or consistent evidence of nonresponse bias in the 2017 NSCH. Although, response was higher where household income was higher. And while the weighting did have a positive effect in reducing the difference between respondents and the full sample, it did not completely remove the differences related to income. Consequently, there is a possibility that some bias related to income remains in the 2017 NSCH estimates. But, the analysis of the estimates in Tables 5 and 6 did not provide consistent support for an income bias. Therefore, the expectation is that if an income bias exists, it is small.

VIII.   References

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