



U.S. Department of Commerce  
U.S. CENSUS BUREAU  
*census.gov*

October 2nd, 2019

# 2018 National Survey of Children's Health

---

## Nonresponse Bias Analysis

The U.S. Census Bureau reviewed this data product for unauthorized disclosure of confidential information and approved the disclosure avoidance practices applied to this release. CBDRB-FY19-POP001-0052

## Nonresponse Bias Analysis for the 2018 National Survey of Children's Health

### Executive Summary

In accordance with Office of Management and Budget standards, a nonresponse bias analysis is conducted annually for the National Survey of Children's Health (NSCH) in order to identify potential sources of bias in the estimates due to the nonresponse, and determine the degree to which survey weight adjustments alleviate any bias that is found. The goals for the analysis of each year of the NSCH are: (1) to describe how the NSCH nonrespondents are different from the respondents; (2) to describe how well the weighting adjustments used to correct for nonresponse performed; and (3) to present and discuss the effect of nonresponse, and the weighting corrections for nonresponse, on selected key survey estimates.

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) from respondents is compared to all of the cases eligible for the Screener and for the Topical NSCH questionnaires. 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 key survey estimates. Evidence of bias are also further examined by comparing NSCH estimates to similar estimates from other surveys.

Notable findings for the 2018 NSCH:

- Nonresponse was generally greater in areas with larger non-White populations and areas having lower household incomes, less homeownership, and fewer college graduates. As such, there is a possibility that some bias related to income remains in the 2018 NSCH estimates. However, the analysis of the estimates did not provide consistent support for an income bias; therefore, the expectation is that if an income bias exists, it is small.
- The small biases found in frame information translate into even smaller biases in key survey estimates. Nineteen of 21 key survey estimates had a remaining bias of less than four percent after nonresponse weighting adjustments were applied.
- Some differences exist between 2018 NSCH estimates and similar estimates from other surveys; however there was not evidence of a large bias in the 2018 NSCH estimates being compared. These differences may reflect differences in the timing of data collection, item wording, and/or the mode of data collection.

Taking all analyses into account, there is no strong or consistent evidence of nonresponse bias after survey weights were applied.

## I. Introduction

### Motivation

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 2018 National Survey of Children’s Health (NSCH) are:

- To describe how the 2018 NSCH Screener and Topical nonrespondents are different from their respective Screener and Topical respondents.
- To describe how well the 2018 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))<sup>1</sup>, 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.

A comparison of response rates across the frame variables, comparing above and below the median, could indicate the presence of nonresponse bias in the 2018 NSCH. If the response rate is lower (or higher) for a particular subgroup<sup>2</sup> relative to that of other subgroups, then that

---

<sup>1</sup> 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.

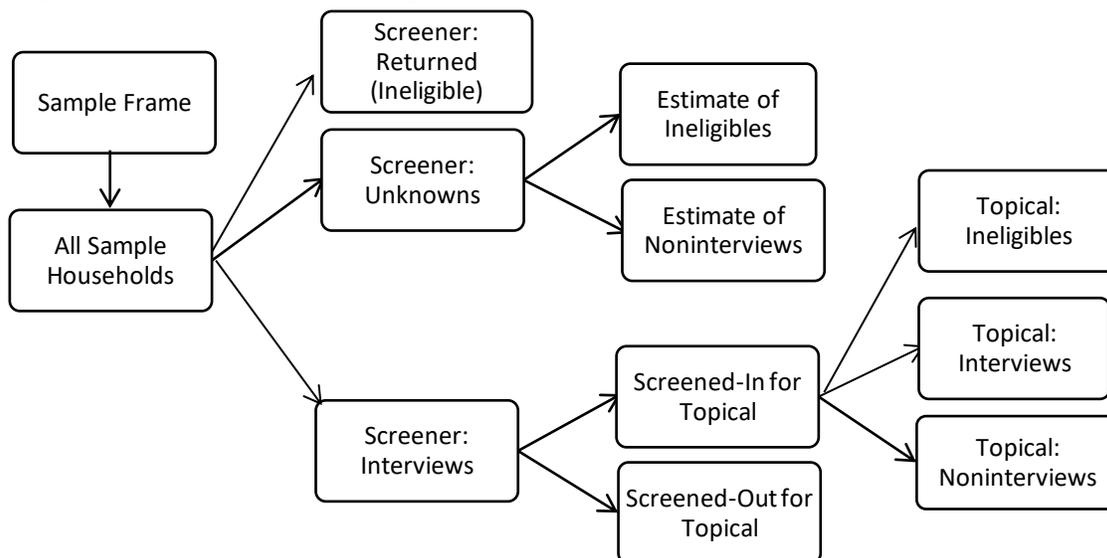
<sup>2</sup> Percent Owner is an example of a frame ‘variable’ or ‘characteristic’; an example of a ‘subgroup’ is greater than the median for the frame variable Percent Owner.

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 2018 NSCH (Tersine, 2019), 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<sup>3</sup>, Screener children, and interviewed<sup>4</sup> children via the Topical.

**Figure 1. 2018 National Survey of Children’s Health - Sample Frame to Final Outcome<sup>5</sup>**



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 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

<sup>3</sup> Since the household-level weight is not addressed in this report, discussion of its factors is omitted.

<sup>4</sup> Children or households are not actually interviewed in the 2018 NSCH; the term ‘interviewed’ is used to represent information gathered from the paper and web questionnaires.

<sup>5</sup> 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.

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<sup>6</sup> as necessary, was lastly performed. The weighting process for all Screener children was a subset of these six factors.

$$\text{Final Weight for Interviewed Children} = \text{BW} \times \text{SNA} \times \text{CLSF} \times \text{WHSF} \times \text{TNA} \times \text{RAK}$$

$$\text{Final Weight for Screener Children} = \text{BW} \times \text{SNA} \times \text{CLSF}$$

## 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<sup>7</sup> 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 =

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

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

<sup>6</sup> A weight was considered extreme if it exceeded the median weight plus six times the interquartile range of the weights in a state.

<sup>7</sup> 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 2018 NSCH Methodology Report (U.S. Census Bureau, 2019) 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 16 cells depending on imputed poverty/non-poverty status (based on 150 percent of the poverty rate), web group (high paper vs. low paper/high web), tenure (owner occupied or not), and presence of a child with special health care needs (CSHCN). The Topical nonresponse adjustment was calculated within each of the 16 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 and tract level data from the 2017 ACS 5-year Summary File could be attached to the entire NSCH sample. Each household is located in a single tract and 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 or tract based on ACS data<sup>8</sup>. The block group or tract measure was assigned to each household in the associated block group or tract. 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 or tract’s value was

---

<sup>8</sup> If there were no data for a specific ACS frame variable for a block group, or if there were too many missing values at the block group level, then the ACS data for that variable were summarized to the tract level. This happened for median income, median home value, and median gross rent.

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.

Median comparisons at the block group or tract level were not necessary for data that were available for each individual sample address. This includes data from NSCH Screener interviews (number of eligible children in the household and presence of CSHCN) and data that were available for each individual address on the NSCH sample frame (stratum and MSA status).

**Table 1. Information Available for Both Respondents and Nonrespondents**

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
MSA‡ Status .....	Indicator of whether the household is inside or outside of a MSA
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 alone
Percent White Alone .....	Percent of the population in the block group that is White alone
Percent Asian Alone .....	Percent of the population in the block group that is Asian alone
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

‡ MSA – Metropolitan 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, which have remained in this analysis since the launch of the redesigned NSCH in 2016, 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<sup>9</sup>
8. Percent of children (1-17 years) with “excellent” condition of teeth
9. Percent of children in excellent or very good health
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<sup>10</sup>
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 screen time<sup>11</sup>
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 2018 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

---

<sup>9</sup> The underlying item for KSE 7 changed in 2018 and we saw a dramatic increase in the prevalence estimate.

<sup>10</sup> The feeder question for KSE 16 (i.e. any medical care in the past year) changed in 2018 and we saw a dramatic drop in the prevalence estimate.

<sup>11</sup> In 2016 and 2017, KSE 18 only referred to TV time. In 2018, the TV item was combined with the item asking about time spent on a computer, video games, etc., resulting in a single “screen time” item.

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 overall median value of the variable for all Screener or Topical respondents and nonrespondents, as described in Section III. As a reminder, each median was calculated as the overall median of all sampled households' block group or tract-level values, and subgroups were formed based on whether a household's individual block group or tract-level value is above or below that overall median.

Table 2. Response Rates Across Various Frame Subgroups

Frame Variable/Subgroup	Screener Respondents		Topical Respondents	
	Frequency	Weighted Response Rate <sup>12</sup> (%)	Frequency	Weighted Response Rate <sup>13</sup> (%)
--- National Survey of Children's Health Screener Response Data ---				
<b># of Eligible Children in Household</b>				
1 .....			12,500	79.68
2 .....			12,000	78.64
3 .....			4,300	76.33
4+ .....			1,800	73.82
<b>Presence of Children with Special Health Care Needs</b>				
Yes .....			9,000	79.19
No .....			21,500	77.08
--- Frame Data: National Survey of Children's Health ---				
<b>Presence of Child Flag</b>				
Stratum 1 .....	43,500	43.22	28,500	78.61
Stratum 2a .....	26,500	47.82	2,300	73.25
<b>Metropolitan Statistical Area (MSA) Status</b>				
In MSA .....	54,500	45.40	24,500	77.88
Not in MSA .....	15,500	50.10	6,100	76.38
--- Frame Data: American Community Survey Block Group or Tract Data ---				
<b>Median Household Income</b>				
≤ median .....	29,500	40.17	11,000	74.50
> median .....	39,000	52.15	19,000	79.97
<b>Median Home Value</b>				
≤ median .....	30,500	42.73	12,000	75.74
> median .....	37,500	49.58	17,500	79.03
<b>Median Gross Rent</b>				
≤ median .....	32,500	44.80	13,000	75.29
> median .....	35,500	46.91	16,500	79.02
<b>Tenure: Percent Owner</b>				
≤ median .....	30,000	39.88	11,500	75.81
> median .....	38,500	53.49	18,000	79.17
<b>Percent College Graduate</b>				
≤ median .....	29,500	40.65	11,500	73.54
> median .....	39,000	51.60	18,000	81.17
<b>Percent Hispanic</b>				
≤ median .....	36,500	51.70	16,000	78.90
> median .....	31,500	42.23	13,500	76.74
<b>Percent Black Alone</b>				
≤ median .....	38,500	52.35	17,000	78.69
> median .....	30,000	41.19	13,000	76.63
<b>Percent White Alone</b>				
≤ median .....	30,000	40.59	12,500	76.85
> median .....	38,500	53.20	17,500	78.51
<b>Percent Asian Alone</b>				
≤ median .....	33,500	45.46	14,000	75.77
> median .....	35,000	46.67	16,000	78.94
<b>Percent Other Race</b>				
≤ median .....	36,500	50.21	16,000	78.17

<sup>12</sup> Using BW of all sample cases.

<sup>13</sup> Using weights of all households receiving a Topical: BW × SNA × CLSF × WHSF.

> median .....	32,000	42.57	13,500	77.09
----------------	--------	-------	--------	-------

Source: U.S. Census Bureau, 2018 National Survey of Children's Health internal data

The 2018 response rates of all Screener subgroup pairs were significantly different at the 95 percent confidence level. For the Topical, the response rates for all of the subgroup pairs were also significantly different with the exception of the following pairs:

- Households with one eligible child vs. households with two eligible children
- Households with two eligible children vs. households with three eligible children
- Households with three eligible children vs. households with four eligible children
- Percent White
- Percent Other Race

Table 2 shows that Screener response rates were five percentage points different for Stratum 1 versus Stratum 2a and for MSA status. It is likely that Screener response was greater in Stratum 2a because there were fewer households with children, thereby easing the task of responding. Looking at both Screener and Topical response, it was generally more difficult to obtain interviews from households in areas with larger non-White populations and areas having lower household incomes, less homeownership, and fewer college graduates (all around 11 to 13 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.

#### 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 nonresponse adjustment and then using the weight with the 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 (columns one and four), with the Topical adjustment

performing better than the Screener adjustment. These results indicate that the adjustments mitigated a large portion of the nonresponse bias.

**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 <sup>14</sup> (4)	Topical Respondents	
		Using Base Weight (2)	Using NR* Adjusted Weight <sup>15</sup> (3)		Using Weight Prior NR Adjustment (5)	Using NR Adjusted Weight <sup>16</sup> (6)
--- NSCH <sup>†</sup> Screener Interview Data ---						
<b># of Eligible Children in Household</b>						
1 .....				<b>23.18</b>	23.76	23.83
2 .....				<b>40.98</b>	41.47	41.30
3 .....				<b>22.18</b>	21.79	21.83
4+ .....				<b>13.66</b>	12.98	13.05
<b>Presence of CSHCN<sup>‡</sup></b>						
Yes .....				<b>29.90</b>	30.47	30.21
No .....				<b>70.10</b>	69.53	69.79
--- Frame Data: NSCH ---						
<b>Presence of Child Flag</b>						
Stratum 1 .....	<b>37.82</b>	35.47	40.78	<b>83.16</b>	84.12	83.92
Stratum 2a .....	<b>62.18</b>	64.53	59.22	<b>16.84</b>	15.88	16.08
<b>MSA<sup>§</sup> Status</b>						
In MSA .....	<b>85.52</b>	84.26	86.36	<b>88.47</b>	88.66	88.44
Not in MSA .....	<b>14.48</b>	15.74	13.64	<b>11.53</b>	11.34	11.56
--- Frame Data: American Community Survey Block Group or Tract Data ---						
<b>Median Household Income</b> .....	<b>64,920</b>	70,000	69,360	<b>71,700</b>	73,250	72,250
<b>Median Home Value</b> .....	<b>249,700</b>	262,800	262,700	<b>266,500</b>	271,800	268,500
<b>Median Gross Rent</b> .....	<b>1,113</b>	1,137	1,140	<b>1,181</b>	1,195	1,185
<b>Tenure: Percent Owner</b> .....	<b>63.15</b>	67.64	66.60	<b>67.57</b>	68.10	67.59
<b>Percent College Graduate</b> .....	<b>38.98</b>	41.89	41.48	<b>40.50</b>	41.61	41.09
<b>Percent Hispanic</b> .....	<b>16.93</b>	13.91	14.91	<b>18.55</b>	17.87	18.05
<b>Percent Black Alone</b> .....	<b>13.26</b>	10.19	10.88	<b>11.87</b>	11.40	11.56
<b>Percent White Alone</b> .....	<b>72.90</b>	77.14	76.01	<b>73.97</b>	74.54	74.38
<b>Percent Asian Alone</b> .....	<b>5.23</b>	5.21	5.32	<b>5.52</b>	5.57	5.49
<b>Percent Other Race</b> .....	<b>8.61</b>	7.45	7.80	<b>8.64</b>	8.48	8.57

Source: U.S. Census Bureau, 2018 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

<sup>14</sup> BW × SNA × CLSF × WHSF<sup>15</sup> BW × SNA<sup>16</sup> BW × SNA × CLSF × WHSF × TNA

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 17.84 percent (calculated as  $(13.91 - 16.93) / 16.93 = -17.84$  percent) for the Screener and biased downward 3.67 percent (calculated as  $(17.87 - 18.55) / 18.55 = -3.67$  percent) for the Topical. Using the weights that have been adjusted for nonresponse, the sample is biased downward 11.93 percent and 2.70 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 four or more eligible children, which remains biased downward 4.47 percent, and Stratum 2a, which remains biased downward 4.51 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, owner occupancy status, and presence of CSHCN were three of the four variables used to define the 16 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 including additional and/or different variables to the Screener and Topical nonresponse adjustments in the 2019 NSCH.

#### 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.

For example, using the weight before the Topical nonresponse adjustment, the observed median household income is \$73,250. Taking the bias into account, the expected value is  $73,250 \times (64,920/70,000) \times (71,700/73,250) = \$66,500^{12}$ . Similarly, using the Topical

nonresponse adjusted weight, the observed value is \$72,250. Taking the bias into account, the expected value is  $72,250 \times (64,920/69,360) \times (71,700/72,250) = \$67,110^{17}$ .

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

	Using Weight Prior to Nonresponse Adjustment		Using Nonresponse Adjusted Weight	
	Observed	Expected <sup>12</sup>	Observed	Expected <sup>12</sup>
<b>In Metropolitan Statistical Area (MSA) .....</b>	88.66	89.79	88.44	87.61
<b>Not in MSA .....</b>	11.34	10.61	11.56	12.24
<b>Median Household Income .....</b>	73,250	66,500	72,250	67,110
<b>Median Home Value .....</b>	271,800	253,200	268,500	253,300
<b>Median Gross Rent .....</b>	1,195	1,156	1,185	1,153
<b>Tenure: Percent Owner .....</b>	68.10	63.08	67.59	64.07
<b>Percent College Graduate .....</b>	41.61	37.69	41.09	38.06
<b>Percent Hispanic .....</b>	17.87	22.58	18.05	21.06
<b>Percent Black Alone .....</b>	11.40	15.45	11.56	14.47
<b>Percent White Alone .....</b>	74.54	69.90	74.38	70.94
<b>Percent Asian Alone .....</b>	5.57	5.54	5.49	5.43
<b>Percent Other Race .....</b>	8.48	9.99	8.57	9.54

Source: U.S. Census Bureau, 2018 National Survey of Children's Health internal data

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:

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

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  $\beta$  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

<sup>17</sup> Reported values are rounded to four significant digits.

was generated that could be attributed to biases in 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 (-13.74 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 (14 percent). Using the nonresponse adjusted weights, this bias was somewhat improved for both estimates, resulting in a downward bias of 11.99 percent for KSE 21 and an upward bias of 10.85 percent for KSE 14.<sup>18</sup> 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.<sup>19</sup>

Looking at the model output in Table 5, one percent of children have someone who smokes inside their home. With such a small number, even small changes to the number can produce relatively large percent changes. So for KSE 21, the change of only 0.1 percentage points between the model evaluated at the observed means versus at the expected means leads to 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.

**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 <sup>20</sup>	Model evaluated at means expected under full response	Est. bias <sup>21</sup> (%)	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)	18.8	18.8	0.28	18.6	18.6	-0.19

<sup>18</sup> 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.

<sup>19</sup> The 2018 survey estimate for KSE 14 is 22.0 percent (from Table 6) with a 95 percent confidence interval of (20.1, 23.9). Factoring in a 10.85 percent upward bias would lead to an estimate of 19.8 percent, since  $22.0/1.1085 = 19.8$ , which is less than the lower limit of the 95 percent confidence interval.

<sup>20</sup> 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.

<sup>21</sup> (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 <sup>20</sup>	Model evaluated at means expected under full response	Est. bias <sup>21</sup> (%)	Model evaluated at observed respondent means	Model evaluated at means expected under full response	Est. bias (%)
2. Percent of children with emotional, developmental, or behavioral problem needing treatment/counseling	9.4	9.5	-0.70	9.3	9.4	-0.76
3. Percent of children with current asthma	7.3	7.6	-3.86	7.3	7.5	-3.47
4. Percent of children with current ASD <sup>†</sup>	2.2	2.3	-4.84	2.2	2.3	-3.53
5. Percent of children with current anxiety	7.2	6.9	4.40	7.0	6.8	3.02
6. Percent of children ever diagnosed with ADD <sup>‡</sup> or ADHD <sup>§</sup>	8.3	8.2	1.18	8.2	8.2	-0.36
7. Percent of children (6-17) who have been bullied in past 12 months	48.5	47.0	3.21	48.5	47.5	-1.92
8. Percent of children (1-17) with excellent teeth condition	49.1	46.8	4.79	48.7	47.0	3.54
9. Percent of children in excellent or very good health	91.8	90.9	1.03	91.7	91.0	0.76
10. Percent of children (0-5) ever breastfed	84.5	83.0	1.83	84.3	83.2	1.39
11. Percent of children with a personal doctor/nurse	74.4	72.3	2.98	74.1	72.5	2.18
12. Percent of children who were ever covered by health insurance/plan during the past 12 months	96.3	95.6	0.64	96.2	95.8	0.43
13. Percent CSHCN who were ever covered by any health insurance/plan during the past 12 months	97.8	97.6	0.21	97.7	97.5	0.12
14. Percent CSHCN whose families paid ≥\$1000 out-of-pocket for medical/health care in past 12 months	22.7	19.9	14.00	22.2	20.0	10.85
15. Percent CSHCN whose health caused family members to cut back/stop working in the past 12 months	19.2	20.2	-4.77	19.4	20.1	-3.37
16. Percent CSHCN (12-17) who had ≥1 preventative visit with health care professional in past 12 months	95.4	95.7	-0.25	95.5	95.6	-0.12
17. Percent of children (6-17) physically active ≥ 1 day during past week, for ≥1 hour	91.2	90.6	0.63	91.1	90.7	0.47
18. Percent of children (1-5) with >1 hour/day of screen time (tv, computer, cellphone, other electronic device)	49.9	52.0	-4.01	50.1	51.6	-2.88
19. Percent of children with family meals every day	42.4	43.8	-3.33	42.6	43.7	-2.48
20. Percent of children with neighborhood sidewalks/paths	79.5	81.0	-1.79	79.6	80.4	-1.01
21. Percent of children where someone smokes in the household	1.0	1.1	-13.74	1.0	1.1	-11.99

Source: U.S. Census Bureau, 2018 National Survey of Children's Health internal data

\* NR – Nonresponse

† ASD – Autism Spectrum Disorder

‡ ADD – Attention Deficit Disorder

<sup>5</sup> ADHD – Attention Deficit/Hyperactivity Disorder

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 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”, presents analysis that makes use of the final, raked weights.

## VI. Comparison to Similar Estimates from Other Sources

By comparing 2018 NSCH estimates to similar estimates from other surveys, evidence of bias analyzed thus far can be further investigated. If an estimate is close to the similar estimate from another survey it provides further evidence that the weighting strategy was able to adequately account for nonresponse. Data from other surveys can also help detect potential biases beyond standard demographic variables. In addition to possible nonresponse biases, differences between estimates can often be attributed to differences in mode, timing of data collection, and/or wording of key items.

Table 6 provides a comparison of several 2018 NSCH KSEs, and a few additional health-related measures, to estimates from the 2016 and 2017 NSCH and the 2016 and 2017 National Health Interview Survey (NHIS).

When considering the estimates and their 95 percent confidence intervals, the following 2018 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 children who missed 11 or more days of school in the past 12 months because of illness or injury

Significant differences were found for the following estimates:

- **Percent of children in excellent or very good health (KSE 9)** – The 2018 NSCH estimate is comparable to the 2016 and 2017 NSCH, but higher than the NHIS. However, given the low estimate of bias in this KSE in Table 5, as well as the closeness of the estimate to past NSCH survey years, the 2018 NSCH estimate being higher than the NHIS does not seem to

be a result of nonresponse. The NSCH estimate has been higher than the NHIS since the inception of the redesigned NSCH in 2016.

- **Percent of children who have a usual place for sick care** – The 2018 NSCH estimate is lower than the 2016 and 2017 NSCH, as well as the 2016 and 2017 NHIS. The NSCH estimate has remained lower than the NHIS since 2016. The difference in estimates could be due to some differences in item wording between the two surveys, which can influence response patterns, leading to a difference in estimates.
- **Percent of children uninsured at the time of interview** – The 2018 NSCH estimate is comparable to the 2016 and 2017 NSCH, but higher than the 2016 and 2017 NHIS. The NSCH estimate has remained higher than the NHIS since the NSCH redesign in 2016.

Disparities in all of the estimates could also be due to mode effects. While the 2016, 2017, and 2018 NSCH were solely mail and web surveys, the NHIS is conducted in-person. It is possible that having no interviewer present in the NSCH contributed to some of the differences observed here.

Table 6. Comparison of 2018 National Survey of Children's Health Estimates to Other Surveys

Estimates from the 2018 NSCH* and Other Surveys	Using Weight Prior NR <sup>†</sup> Adj.	Using NR Adj. Weight	Using Final Weight	95 Percent Confidence Interval
<i>Percent of children with special health care needs, KSE 1</i>				
<b>2018 NSCH (Screener)</b> .....	18.9	18.9	18.6	(18.0, 19.2)
<b>2018 NSCH (Topical)</b> .....	19.0	18.7	18.8	(18.0, 19.7)
2017 NSCH (Screener).....			18.1	(17.5, 18.7)
2017 NSCH (Topical).....			18.2	(17.1, 19.2)
2016 NSCH (Screener).....			18.9	(18.4, 19.4)
2016 NSCH (Topical).....			19.4	(18.6, 20.1)
<i>Percent of children with current asthma, KSE 3</i>				
<b>2018 NSCH</b> .....	7.6	7.6	7.7	(7.0, 8.3)
2017 NSCH.....			7.5	(6.7, 8.2)
2016 NSCH.....			8.4	(7.9, 8.9)
2017 NHIS <sup>‡</sup> .....			8.4	(7.7, 9.1)
2016 NHIS.....			8.4	(7.8, 9.0)
<i>Percent of children ever diagnosed with Attention Deficit Disorder or Attention Deficit/Hyperactivity Disorder, KSE 6</i>				
<b>2018 NSCH, aged 3-17</b> .....	9.9	9.8	9.9	(9.2, 10.6)
2017 NSCH, aged 3-17.....			9.7	(8.8, 10.5)
2016 NSCH, aged 3-17.....			9.9	(9.4, 10.5)
2017 NHIS, aged 3-17.....			9.4	(8.6, 10.2)
2016 NHIS, aged 3-17.....			9.4	(8.6, 10.2)
<i>Percent of children in excellent or very good health, KSE 9</i>				
<b>2018 NSCH</b> .....	90.9	90.9	90.3	(89.5, 91.0)
2017 NSCH.....			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)
<i>Percent of children who have a usual place for sick care</i>				
<b>2018 NSCH</b> .....	77.9	77.5	75.4	(74.3, 76.6)
2017 NSCH.....			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)
<i>Percent of children who missed 11 or more days of school in the past 12 months because of illness or injury</i>				
<b>2018 NSCH, aged 5-17</b> .....	4.6	4.6	4.5	(3.9, 5.1)
2017 NSCH, aged 5-17.....			3.5	(2.9, 4.1)
2016 NSCH, aged 5-17.....			3.9	(3.5, 4.4)
2017 NHIS, aged 5-17.....			4.4	(3.8, 5.0)
2016 NHIS, aged 5-17.....			4.2	(3.6, 4.8)
<i>Percent of children uninsured at the time of interview</i>				
<b>2018 NSCH</b> .....	5.3	5.4	6.2	(5.5, 6.9)
2017 NSCH.....			5.9	(5.0, 6.7)
2016 NSCH.....			5.7	(5.1, 6.2)
2017 NHIS.....			5.0	(4.2, 5.8)
2016 NHIS.....			5.1	(4.5, 5.7)

Sources: U.S. Census Bureau, 2016, 2017, and 2018 National Survey of Children's Health internal data

National Center for Health Statistics, 2016 and 2017 National Health Interview Survey external data

\* NSCH – National Survey of Children's Health

† NR – Nonresponse

‡ NHIS – National Health Interview Survey

## 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 is hoped that reasonably accurate conclusions about the level of nonresponse bias in KSEs can 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 (11.99 percent downward for smoking in household and 10.85 percent upward for out-of-pocket costs). All other KSEs had a remaining bias of four percent or less, some upward and some downward, after nonresponse adjustments.

Table 6 compares 2018 NSCH estimates to similar estimates from other surveys. While some differences exist between the 2018 NSCH estimate and the similar estimate from another survey, these may reflect differences in the timing of data collection, item wording, and/or the mode of data collection. For example, 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 2018 NSCH. Although, response was higher where household income (as well as generally related factors such as education levels, rates of home ownership, and median monthly rent) 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, particularly related to income. Consequently, there is a possibility that some bias related to income remains in the 2018 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

- Bramlett, M.D., Blumberg, S.J., Ormson, A.E., George, J.M., Williams, K.L., Frasier, A.M., ... Wang, F. (2014). *Design and Operation of the National Survey of Children with Special Health Care Needs, 2009–2010*. National Center for Health Statistics. *Vital Health Stat* 1(57). (Appendix XIII. Nonresponse Bias Analysis, pgs. 242-256.)
- Clarke, T.C., Norris, T., & Schiller, J.S. (2019). Early release of selected estimates based on data from the National Health Interview Survey. National Center for Health Statistics. Available from: <https://www.cdc.gov/nchs/nhis>. Retrieved on September 3, 2019.
- Executive Office of the President of the United States, Office of Management and Budget. (2006). *Standards and Guidelines for Statistical Surveys*. Available from [https://unstats.un.org/unsd/dnss/docs-nqaf/USA\\_standards\\_stat\\_surveys.pdf](https://unstats.un.org/unsd/dnss/docs-nqaf/USA_standards_stat_surveys.pdf). Retrieved on September 3, 2019.
- Skalland, B.J. & Blumberg, S.J. (2012). *Nonresponse in the National Survey of Children’s Health, 2007*. National Center for Health Statistics. *Vital Health Stat* 2(156).
- Tersine Jr., A.G. (2019). “Source and Accuracy Statement for the 2018 National Survey of Children’s Health.” U.S. Census Bureau Memorandum from Anthony G. Tersine, Jr. to Carolyn M. Pickering dated September 11, 2019.
- U.S. Census Bureau. (2019). 2018 National Survey of Children’s Health Methodology Report. Available from <https://www.census.gov/content/dam/Census/programs-surveys/nsch/tech-documentation/methodology/2018-NSCH-Methodology-Report.pdf>. Retrieved on October 1, 2019.
- U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Health Statistics. (2017). *FastStats Homepage. Child Health*. Atlanta, Georgia: May 3, 2017. Online at <https://www.cdc.gov/nchs/fastats/child-health.htm>. Retrieved on September 3, 2019.