



Weighting Procedures and Bias Assessment for the 2021-2023 National Health Interview Survey – Teen 30-month File

Matthew D. Bramlett, Lindsey I. Black, James M. Dahlhamer and Benjamin
Zablotsky

Division of Health Interview Statistics
National Center for Health Statistics
Hyattsville, Maryland

Centers for Disease Control and Prevention
U.S. Department of Health and Human Services

September 2024

Abstract

This report describes the weighting procedures that were used to produce the final sampling weights for the National Health Interview Survey (NHIS) – Teen 30-month file, a followback to the NHIS for Sample Children ages 12-17 whose parent or guardian had completed an NHIS interview between July 2021 to December 2023. The procedures included the use of recursive partitioning models using the `ctree()` function in the R package `partykit` (CTREE) to model parental permission and teen participation, to inform adjustments to the weights at each stage of nonresponse. CTREE was also used to generate a variable formed from the interactions of 8 predictors of teen interview completion to use as a raking variable in calibrating the weights to control totals derived from the original NHIS. A bias assessment of survey estimates based on these weights was performed. Results reveal that:

- Implementation of weighting adjustments among teen interview cases led to a 75.1% reduction in observed bias across 125 estimates.
- The file retains some statistically significant biases after weighting adjustments; 11 out of 125 biases remained significant at the 0.05 level, including an underrepresentation of teens with developmental and learning disabilities (multiple indicators), ever or current asthma, and ever experienced emotional abuse, and an overrepresentation of teens who wear glasses.
- The 114 nonsignificant biases after weighting adjustments are mostly small, with only 3 biases larger than 1.5 percentage point.

Some text used from a prior report with permission.

Suggested citation: Bramlett MD, Black LI, Dahlhamer JM and Zablotsky B. Weighting procedures and bias assessment for the 2021-2023 National Health Interview Survey – Teen 30-month file. Published September 2024.

Weighting Procedures

I. Introduction

The National Health Interview Survey (NHIS) collects data continuously and releases annual data regarding the health status and health care access and utilization of adults and children in the United States (1). Households are first rostered, and an adult is randomly selected from among all adults (ages 18 and older) in the household (known as the “Sample Adult”) and a child is randomly selected from among the children (ages 0-17) in the household, if any (known as the “Sample Child”). Separate interview modules for the Sample Adult and Sample Child are conducted, sometimes with the same respondent and sometimes with different respondents from within the household. The Sample Child’s data are not collected directly from the children themselves but are provided by proxy response, by a parent or other adult guardian in the household who is knowledgeable and responsible for the child’s health (2).

The National Health Interview Survey – Teen (NHIS – Teen) is a followback survey that collects additional data from households with Sample Children ages 12-17. The distinguishing feature of NHIS – Teen is that survey responses are collected directly from the teens themselves. Prior to engaging directly with the teen, parental permission is obtained. NHIS – Teen data collection started in July 2021.

This report describes the weighting procedures for the July 2021- December 2023 NHIS – Teen 30-month file and the analysis of bias reduction due to weighting adjustments. NHIS – Teen data collection concluded in March 2024, allowing at least 3 months for teens who gained permission in December 2023 to complete the survey.

II. Background

Typically, each year's NHIS public data release consists of an annual file that is created by concatenating four quarterly files, each of which is nationally representative on its own. Therefore, concatenating the quarter 3 (Q3) and quarter 4 (Q4) 2021 data with data for the four quarters of 2022 and the four quarters of 2023 produces a 30-month file that is also nationally representative of the population of teens ages 12-17 in 2021-2023. Because each quarter represents the full population, quarterly weights must be divided by four when concatenating four quarters to produce an annual file, or divided by ten when concatenating ten quarters to produce a 30-month file, to ensure the sum of the weights matches that of the total population.

Thus, for the purposes of the 2021 Q3-Q4 & 2022-2023 NHIS – Teen, the sample frame is the set of completed Sample Child interviews for Sample Children ages 12-17 from Q3 and Q4, 2021 and all of 2022 and 2023. There were 7,323 Sample Children ages 12-17 in the 2021 Q3-Q4 and 2022-2023 NHIS. A total of 7,027 were considered eligible for NHIS – Teen because the Sample Child respondent was asked for permission to invite the teen's participation (those who broke off the Sample Child interview early did not reach that question). Of those, 60.4% (n=4,242) received permission from their parents or guardians to be invited to participate in NHIS – Teen. Of those, 46.2% of teens completed an NHIS – Teen interview, resulting in an overall response rate (permission rate * participation rate) of 27.9% and a final sample size of 1,958.

For the remainder of this document, references to 2021 include only Q3 and Q4 of 2021 such that '2021-2023' refers to Q3 and Q4 of 2021 and all of 2022-2023; the 30-month file is referred to as the 2021-2023 NHIS - Teen.

III. The NHIS-Teen 30-month Weight

The goal in weighting the NHIS – Teen interview cases is to make the respondents (n=1,958) represent the 2021-2023 child population ages 12-17 (i.e., the same population as

represented by the 7,323 children ages 12-17 in the original Sample Child files). The sum of the NHIS – Teen weights needs to equal the sum of the original Sample Child weights. Thus, the starting point, or base weight, is the final Sample Child weight from 2021-2023:

Step 1: Base weight

- The base weight is equal to the original Sample Child weight if the Sample Child was ages 12-17 and equals zero otherwise.

The base weight has already been adjusted for NHIS nonresponse and calibrated to the 2021-2023 population (2-4). However, because 73.3% of the 7,323 original Sample Children ages 12-17 did not complete the NHIS – Teen interview – either because the teen did not receive permission to participate or refused to participate – the original Sample Child weight can no longer be considered representative and must be adjusted for NHIS – Teen noninterview. A 2021-2023 Sample Child is classified as an NHIS – Teen noninterview at each of the following stages:

1. Sample Child respondent refused to provide permission to invite the teen’s response (or was not asked for permission)(nonpermission);
2. Teen refusal to participate (nonresponse).

Adjustments were made to the base weights to account for each of these stages, and the resulting weights were calibrated to population control totals derived from the original survey. The specific steps are described below, while the overall scheme is presented in Flowchart 1.

Due to ineligibility, nonpermission and nonresponse, the size of the NHIS – Teen interview respondent group is approximately 26.7% that of the original 2021-2023 Sample Child respondents ages 12-17. An interview rate that low carries with it the potential for considerable bias in estimates, if estimates are related to the likelihood of gaining permission or to participation propensity. However, a major advantage of the followback design is the availability of information about nonrespondents that typically is not available when adjusting weights to account for nonresponse bias. Specifically, the complete data from the 2021, 2022 and 2023 Sample Child interviews are available for both NHIS – Teen respondents and

noninterviews. Thus, it is possible to identify the specific original survey characteristics that are associated with subsequent noninterview, and to use those covariates to form adjustment cells for weighting adjustments. This technique has been demonstrated to reduce or eliminate biases in followback surveys (5-8).

Because of the very large number of potential predictors of response propensity, recursive partitioning models in the R package CTREE were used to model NHIS – Teen permission, participation (teen response), and interview propensity. Recursive partitioning models produce a set of nodes by first splitting the sample by the strongest predictor of response, and then within each of the resulting subgroups, splitting the subgroup by the strongest predictor, continuing this process until no predictor meets the significance criteria for further splitting, ending up with a tree of branches, each of which ends in a terminal node (9). The model selects the best categorizations for covariates; for example, if race/ethnicity is included in the set of covariates with 4 categories (Hispanic, non-Hispanic White, non-Hispanic Black and non-Hispanic other race) the model may split that covariate into two categories (non-Hispanic Black versus all others, e.g.) in creating the nodal splits, because that is where the differentiation on response is concentrated. The model also effectively selects the relevant interaction effects among combinations of variables (subsequent splits within subgroups are essentially interactions between the variables used to predict response propensity), without the researcher having to prespecify the interaction terms. This is particularly useful when dealing with a large set of potential covariates and little *a priori* knowledge of their interrelationships and associations with the dependent variables. The primary benefit of this approach, however, is that it results in a set of mutually exclusive and exhaustive categories (terminal nodes) which are differentiated by response propensity and defined by interactions of variables associated with key survey outcomes of interest. These terminal nodes can be used to form adjustment cells for precise weighting adjustments.

The set of 107 covariates used as potential predictors in the models was chosen to best leverage the full survey data that was available for both respondents and nonrespondents (since every case had a completed Sample Child interview). The set of covariates included

demographics (age and race/ethnicity of the teen and of the original Sample Child respondent, teen sex and nativity, number of parents in the household); household-level socioeconomic indicators (income, education, employment status, housing tenure); geographic indicators (region, metropolitan statistical area (MSA) status); household telephone status; multiple health and healthcare measures from each of four main domains (health status, healthcare access, healthcare utilization, and stressful life events and behavioral problems), plus health insurance coverage type; and operational data recorded by field interviewers in the Contact History Instrument. A major advantage of using sociodemographic and health covariates from the Sample Child file in the models is that they will tend to be associated with key Teen outcomes.

CTREE was used to separately model permission (comparing those permitted and those not permitted, among all Sample Children ages 12-17 from the 2021-2023 Sample Child files); participation (comparing teen respondents and nonrespondents among those permitted); and overall interview (comparing teen interview respondents to all remaining Sample Children ages 12-17 among the 2021-2023 Sample Child files). The same set of potential covariates was used for models of permission, participation, and overall interview. Covariates with a bivariate association with the dependent variable (permission, participation or interview) of $p < 0.15$ screened into the model. Variables used to form terminal nodes are listed in Table 1.

Permission model—Among all eligible cases (Sample Children ages 12-17 from 2021 Q3-Q4 and 2022-2023), some were not permitted by their parents or guardians to be invited to participate (and some were ineligible because the Sample Child respondent did not get far enough into the Sample Child interview to be asked for permission). Of 7,323 total, 4,242 received permission. The CTREE permission model resulted in 12 terminal nodes (ranging from 138 to 1,234 cases and with permission rates ranging from 41.5% to 76.8%). The primary split was by frequency of anxiety, with subsequent splits by householder(s) expressed privacy concerns; receipt of flu vaccine in previous 12 months; receipt of special education services; receipt of free or reduced meals at school; age; region of residence; householder(s) expressed time constraints; and food

often/sometimes didn't last in previous 12 months. (Unless otherwise noted, these covariates represent characteristics of the Sample Child.) The permitted cases were adjusted to account for the nonpermitted cases in step 2:

Step 2: Nonpermission adjustment

- Cases that were permitted received a ratio adjustment to the base weight: $1 /$ (the permission propensity in the CTREE permission model terminal node).

Participation model—Among permitted cases, some of the teens did not participate, i.e., were nonrespondents. Of 4,242 permitted, 1,958 participated. The CTREE participation model resulted in 6 terminal nodes (ranging from 377 to 1,291 cases and with participation rates ranging from 31.7% to 60.7%). The primary split was by highest education in the family with subsequent splits by receipt of COVID-19 vaccination; number of COVID-19 vaccinations; health insurance coverage type; and race and Hispanic ethnicity of Sample Child. The respondent cases were adjusted to account for the nonrespondents in step 3:

Step 3: Nonparticipation adjustment

- Cases that were NHIS – Teen interview completes received a ratio adjustment to the nonpermission-adjusted weight: $1 /$ (the participation propensity in the CTREE participation model terminal node).

Finally, the weights were calibrated to the original population control totals. Rather than raking the weights to the external population control totals that the original 2021 - 2023 Sample Child weights were raked to, internal control totals (estimated from the 2021 Q3-Q4 and 2022-2023 Sample Child files) were used to enable the inclusion of raking dimensions which are not typically available for the population.

Overall interview model—The overall interview model uses the same dependent variable as the participation model (1,958 teens participated) but with the overall sample from the permission model (7,323 Sample Children ages 12-17 total). The overall interview CTREE model produced 11 terminal nodes (ranging from 219 to 1,418 cases and with interview rates ranging from 16.3% to 48.4%). The primary split was by number of COVID-19 vaccinations, with subsequent

splits by frequency of anxiety; highest education in family; number of parents; receipt of flu vaccine in previous 12 months; receipt of special education services; householder(s) expressed time constraints; and race/ethnicity of Sample Child. The 11 nodes were used to create a single variable with 11 mutually exclusive and exhaustive categories, which was added to the raking dimensions.

Step 4: Calibration to population control totals

- For cases that were NHIS – Teen interview completes, the nonparticipation-adjusted weight was raked to internal control totals based on the 2021 Q3-Q4 and 2022-2023 raking dimensions: age; sex; race and Hispanic ethnicity; housing tenure; region; MSA status; family income relative to Federal Poverty Level; insurance coverage; and the 11-category variable derived from the overall interview CTREE model.

An examination of the variance inflation associated with the weighting adjustments led to an evaluation of alternatives to limit the variance inflation while maximizing bias reduction. The alternatives included capping the nonpermission and/or nonparticipation adjustments, or trimming the calibrated weights and re-raking. Capping is a process that truncates weighting adjustments beyond a certain threshold, such that if the cap were set to 3, then any adjustments larger than 3 would be reset to 3. Similarly, trimming is a process whereby extreme weights are truncated beyond a certain threshold, and the weights are re-raked such that the marginal totals are restored (essentially, the “excess weight” that is trimmed from sample cases with extremely large weights is redistributed to other sample cases with similar characteristics). Capping alternatives evaluated included 2.0, 2.25, 2.5 and 3.0, and capping options were evaluated with and without also trimming at the 99th percentile. The alternatives were evaluated based on bias reduction and reduction in average mean squared error (MSE) and average root MSE across an array of key survey outcomes relative to the uncapped, untrimmed weight from step 4 above.

The best combination of bias reduction and noninflation of variance was achieved with the following adjustments: an uncapped permission adjustment; an uncapped participation

adjustment; and trimming at the 99th percentile. Trimming and re-raking were added for the final adjustment:

Step 5: Trim extreme weights and re-rake

- For cases that were NHIS – Teen interview completes, the calibrated weights were trimmed at the 99th percentile and re-raked to the same control totals as in step 4.

The resulting weight is the final weight for analysis of the NHIS – Teen 30-month file: WTF30m_TEEN. Note that the raking dimensions included measures of income, health insurance coverage, health status (anxiety), healthcare utilization (flu and COVID-19 vaccinations), as well as paradata from field operations (whether the householder(s) expressed time constraints) in addition to the typical demographics (see Table 1). This is more specific adjustment than is typically possible and targeted directly at increasing (or decreasing) the estimated prevalence of the attributes that are under-(over)represented among the respondent cases.

Bias Assessment

IV. Introduction

While the section above described how the final weight was created, the process of determining the appropriate weighting adjustments was iterative and several weighting methods and weights were considered. The final weight was selected based on an optimization on reduction of bias, minimization of variance inflation due to weighting heterogeneity, and minimization of suppression of estimates due to unreliability. This section describes the process of evaluating the bias associated with NHIS – Teen noninterview across a set of estimates, and how well the weighting adjustments worked to reduce that bias.

V. Bias analysis for the NHIS – Teen 30-month file

One major advantage of the followback design is the ability to directly quantify noninterview bias and the reduction in that bias when the weights are adjusted. Because the goal is for the adjusted NHIS – Teen weights to represent the same population as the original Sample Child files, estimates based on the original survey are ‘gold standards’ for bias assessment. Estimates based on the NHIS – Teen interview cases (before and after weighting adjustments) can be compared with 2021-2023 estimates, and the bias resulting from completing the NHIS – Teen interviews with only a subset of the original respondents can be assessed. The analysis of noninterview bias in the NHIS – Teen interview sample is presented in Table 2 and is intended to represent the breadth of survey topical domains as well as demographic, socioeconomic and geographic characteristics (a total of 125 indicators from 74 variables).

Bias was measured directly, not estimated, as the difference in the NHIS estimates as calculated using data from the NHIS – Teen interview respondents and as calculated using data from the full set of original 2021-2023 Sample Children ages 12-17. Bias reduction was

assessed by summing the absolute values of the biases, across all the indicators, for the NHIS – Teen interview respondents weighted by the final 2021-2023 Sample Child weight (i.e., before the adjustments described above) and for the NHIS – Teen interview respondents weighted by the final adjusted 30-month weight WTF30m_TEEN. The ratio of summed bias after adjustment to summed bias before adjustment is the proportion of total bias (across 125 indicators) remaining after adjustment; its complement is the reduction in bias directly attributable to the weighting adjustments. The total bias reduction that can be directly attributed to the weighting adjustments was thus quantified at 75.1%.

Of the 125 indicators shown in Table 2, 109 improved (i.e., showed less absolute bias) while 16 worsened after weighting adjustment; that is, 109 (16) indicators show smaller (larger) differences between columns (1) and (3) than between columns (1) and (2). Of the 16 estimates that worsened, none showed an increase of bias of one percentage point (ppt) or higher. The maximum increase in bias was 0.86 ppt, for One adult in child’s family working fulltime.

For 114 indicators in Table 2, remaining bias after weighting adjustments is zero or statistically nonsignificant; only 11 show remaining biases that are significantly different than zero. (A conservative significance test was used, that adjusted the error term for the overlap of NHIS – Teen interview respondents to the 2021-2023 Sample Children, to account for the covariance due to the nonindependence of the samples; this technique is conservative in the context of testing for bias nonsignificance because it makes smaller differences appear to be statistically significant.) The 11 significant biases after weighting adjustments are heavily concentrated (10/11) in the Health Status domain, largely reflecting an underrepresentation of 1-2 ppt for teens with developmental and learning disabilities. The 11 significant biases consist of: ever and current asthma (1.8 ppt and 2 ppt underestimated respectively); wears glasses or contact lenses (2.8 ppt overestimated); any learning difficulty (1.9 ppt underestimated); ever and current ADD/ADHD (2.6 ppt and 2.2 ppt underestimated, respectively); ever and current learning disability (1.8 ppt and 1.6 ppt underestimated, respectively); current autism spectrum

disorder (0.9 ppt underestimated); any developmental disability (2 ppt underestimated); and ever experienced emotional abuse (1.2 ppt underestimated).

Although the remaining biases are not statistically significant, there remain a few estimates with relatively large biases after weighting adjustments, and researchers should be aware of the specific biases noted and interpret their findings in the context of these known biases. There were 3 estimates with remaining biases that were not statistically significant, yet the bias was 1.5 ppt or larger. These include 4-10 years at current residence (1.7 ppt overestimated); never depressed (1.7 ppt underestimated); and 1-5 school days missed due to illness or injury (1.6 ppt overestimated).

VI. Conclusion

The richness of the data available for nonrespondents to the NHIS – Teen interview allowed for more precise adjustment to the sampling weights than is usually possible in most surveys – adjustments tailored to reduce noninterview bias in health estimates. The followback structure of the NHIS – Teen survey also allows for the actual quantification of bias and of bias reduction. The observed bias was reduced by 75% after implementing weighting adjustments among interview cases. Thus, NHIS – Teen estimates were shown to be relatively low in bias when representing the 2021-2023 population. Relatively large and/or statistically significant biases after weighting adjustments were observed for several health status measures; ever experienced emotional abuse; years at current residence; and number of school days missed due to illness or injury. Researchers should be aware of the specific biases noted and interpret their findings in the context of these known biases.

References

1. Moriarity C, Parsons VL, Jonas K, Schar BG, Bose J and Bramlett MD. Sample design and estimation structures for the National Health Interview Survey, 2016–2025. *Vital and Health Statistics* 2(191). Hyattsville, MD: National Center for Health Statistics, 2022.
2. National Center for Health Statistics. National Health Interview Survey, 2021. Public-use data file and documentation. https://ftp.cdc.gov/pub/Health_Statistics/NCHS/Dataset_Documentation/NHIS/2021/srvyd_esc-508.pdf. 2022.
3. National Center for Health Statistics. National Health Interview Survey, 2022. Public-use data file and documentation. https://ftp.cdc.gov/pub/Health_Statistics/NCHS/Dataset_Documentation/NHIS/2022/srvyd_esc-508.pdf. 2023.
4. National Center for Health Statistics. National Health Interview Survey, 2023. Public-use data file and documentation. https://ftp.cdc.gov/pub/Health_Statistics/NCHS/Dataset_Documentation/NHIS/2023/srvyd_esc-508.pdf. 2024.
5. Bramlett MD, Foster EB, Frasier AM, *et al.* Design and operation of the National Survey of Adoptive Parents, 2007. *Vital and Health Statistics* 1(50). Hyattsville, MD: National Center for Health Statistics, 2010.
6. Bramlett MD, Brooks KS, Foster EB, *et al.* Design and operation of the National Survey of Adoptive Parents of Children with Special Health Care Needs, 2008. *Vital and Health Statistics* 1(51). Hyattsville, MD: National Center for Health Statistics, 2010.
7. Zablotsky B, Bramlett MD, George JM, *et al.* Design and operation: 2013 National Survey of Children in Nonparental Care and 2014 National Survey of the Diagnosis and Treatment of ADHD and Tourette Syndrome. *Vital and Health Statistics* 1(63). Hyattsville, MD: National Center for Health Statistics, 2019.
8. Bramlett MD, Dahlhamer JM and Bose J. Weighting procedures and bias assessment for the 2020 National Health Interview Survey. Published September 2021. Available from: [Weighting Procedures and Bias Assessment for the 2020 National Health Interview Survey \(cdc.gov\)](#)

9. Hothorn T, Zeileis A. *partykit*: A modular toolkit for recursive partytitioning in R. *Journal of Machine Learning Research* 16: 3905-9, 2015.

Table 1: Variables used to define terminal nodes and adjustment cells, by adjustment

| Non-permission adjustment | Nonparticipation adjustment | Overall interview raking adjustment |
|--|---|---|
| Frequency of anxiety | Highest education in family | Number of COVID-19 vaccinations |
| Householder(s) expressed privacy concerns | Receipt of COVID-19 vaccination | Frequency of anxiety |
| Flu vaccine in previous 12 mos. | Number of COVID-19 vaccinations | Highest education in family |
| Receives special education services | Health Insurance coverage type | Number of parents in household |
| Receives free/reduced meals at school | Race and Hispanic ethnicity of Sample Child | Flu vaccine in previous 12 mos. |
| Age of Sample Child | | Receives special education services |
| Region of residence | | Householder(s) expressed time constraints |
| Householder(s) expressed time constraints | | Race and Hispanic ethnicity of Sample Child |
| Food often/sometimes didn't last, previous 12 mos. | | |

Note: variables ordered by nodal split hierarchy.

Table 2: Bias analysis among NHIS – Teen cases relative to original survey estimates

| <i>Indicator</i> | <i>2021 Q3-Q4 & 2022-3 Sample Child file (1)</i> | <i>Teens with Sample Child weight (2)</i> | <i>Teens with final Teen weight (3)</i> | <i>Remaining bias</i> |
|---|--|---|---|-----------------------|
| Age of the teen | <i>Percent (standard error)</i> | | | <i> (3) – (1) </i> |
| 12 | 16.1 (0.53) | 13.9 (0.96) | 16.1 (1.14) | 0.00 |
| 13 | 15.6 (0.51) | 15.6 (1.06) | 15.6 (1.12) | 0.00 |
| 14 | 17.8 (0.54) | 18.6 (1.03) | 17.8 (1.11) | 0.00 |
| 15 | 17.1 (0.51) | 18.6 (1.05) | 17.1 (1.07) | 0.00 |
| 16 | 17.5 (0.51) | 18.0 (0.96) | 17.5 (1.03) | 0.00 |
| 17 | 15.9 (0.47) | 15.5 (0.89) | 15.9 (0.96) | 0.00 |
| Sex of the teen | | | | |
| Male | 51.3 (0.72) | 48.2 (1.38) | 51.3 (1.48) | 0.00 |
| Race/ethnicity of the teen | | | | |
| Hispanic | 26.5 (0.71) | 21.8 (1.15) | 26.5 (1.36) | 0.00 |
| Black, non-Hispanic | 15.2 (0.58) | 12.0 (0.95) | 15.2 (1.20) | 0.00 |
| Asian, non-Hispanic | 5.9 (0.28) | 7.1 (0.57) | 5.9 (0.51) | 0.00 |
| Other single & multiple races, non-Hispanic | 52.5 (0.78) | 59.0 (1.32) | 52.5 (1.44) | 0.00 |
| Age of the Sample Child respondent (SCR) | | | | |
| 18-34 | 8.4 (0.43) | 5.7 (0.70) | 7.0 (0.85) | 1.39 |
| 35-44 | 42.2 (0.72) | 41.2 (1.36) | 42.7 (1.45) | 0.46 |
| 45 and up | 49.4 (0.71) | 53.1 (1.29) | 50.3 (1.36) | 0.93 |
| Race/ethnicity of the SCR | | | | |
| Hispanic | 26.2 (0.72) | 21.7 (1.15) | 26.4 (1.37) | 0.16 |
| White, non-Hispanic | 50.4 (0.78) | 57.1 (1.34) | 50.4 (1.43) | 0.04 |
| Black, non-Hispanic | 11.9 (0.55) | 9.1 (0.87) | 12.0 (1.16) | 0.07 |
| Other single & multiple races, non-Hispanic | 11.5 (0.47) | 12.1 (0.86) | 11.3 (0.93) | 0.20 |
| Education of the SCR | | | | |
| Less than high school | 11.1 (0.48) | 9.5 (0.84) | 12.0 (1.07) | 0.88 |
| High school/General Equivalence Degree | 20.0 (0.58) | 15.9 (0.95) | 19.1 (1.19) | 0.94 |
| Some college | 28.0 (0.61) | 24.6 (1.10) | 27.7 (1.24) | 0.25 |
| Bachelor's or more | 41.0 (0.73) | 50.0 (1.30) | 41.3 (1.35) | 0.32 |
| Highest education in the family | | | | |
| Less than high school | 6.0 (0.37) | 4.5 (0.60) | 5.8 (0.81) | 0.22 |
| High school/General Equivalence Degree | 15.8 (0.53) | 12.2 (0.91) | 16.0 (1.20) | 0.22 |
| Some college | 28.6 (0.62) | 24.4 (1.11) | 29.3 (1.30) | 0.63 |
| Bachelor's or more | 49.6 (0.74) | 58.9 (1.27) | 49.0 (1.40) | 0.63 |
| Number of parents in household | | | | |
| One parent | 35.8 (0.72) | 29.3 (1.33) | 34.9 (1.53) | 0.88 |

| <i>Indicator</i> | <i>2021 Q3-Q4 & 2022-3 Sample Child file (1)</i> | <i>Teens with Sample Child weight (2)</i> | <i>Teens with final Teen weight (3)</i> | <i>Remaining bias</i> |
|---|--|---|---|-----------------------|
| Nativity of the teen | | | | |
| U.S. born | 93.8 (0.35) | 93.7 (0.63) | 93.2 (0.76) | 0.56 |
| Owning or renting residence | | | | |
| Own/buying | 68.6 (0.71) | 75.7 (1.19) | 68.6 (1.46) | 0.00 |
| Income source | | | | |
| Wages, salaries, commissions, bonuses, tips, or self-employment | 93.4 (0.36) | 94.6 (0.69) | 93.2 (0.91) | 0.19 |
| Interest-bearing accounts or investments | 23.1 (0.63) | 28.6 (1.20) | 24.0 (1.13) | 0.85 |
| Social Security or Railroad Retirement | 9.9 (0.40) | 8.9 (0.72) | 9.6 (0.81) | 0.31 |
| Supplemental Security Income or Social Security Disability Income | 7.8 (0.39) | 6.6 (0.69) | 7.7 (0.81) | 0.06 |
| Retirement, survivor, or disability pensions | 6.3 (0.33) | 6.4 (0.61) | 5.9 (0.59) | 0.38 |
| Any other sources of income | 15.6 (0.55) | 14.2 (0.99) | 14.9 (1.09) | 0.71 |
| Family income¹ | | | | |
| < 1.00 | 14.3 (0.55) | 10.0 (0.93) | 14.3 (1.32) | 0.00 |
| 1.00 - < 2.00 | 21.5 (0.62) | 20.1 (1.10) | 21.5 (1.21) | 0.00 |
| 2.00 - < 4.00 | 27.9 (0.62) | 27.5 (1.22) | 27.9 (1.25) | 0.00 |
| 4.00+ | 36.3 (0.73) | 42.4 (1.35) | 36.3 (1.35) | 0.00 |
| Food security | | | | |
| Food secure | 89.3 (0.46) | 90.4 (0.88) | 88.7 (1.06) | 0.61 |
| Food insecure | 6.5 (0.37) | 6.1 (0.71) | 7.4 (0.90) | 0.87 |
| Very food insecure | 4.2 (0.30) | 3.5 (0.53) | 3.9 (0.63) | 0.25 |
| Couldn't afford to eat balanced meals in past 30 days | 11.8 (0.49) | 10.2 (0.92) | 11.9 (1.10) | 0.10 |
| Food often/sometimes didn't last in past 30 days | 13.4 (0.51) | 11.4 (0.96) | 13.3 (1.15) | 0.04 |
| Worry food would run out in past 30 days | 16.0 (0.56) | 13.5 (1.01) | 16.0 (1.21) | 0.03 |
| Free or reduced meals at school past 12 months | 52.9 (0.76) | 50.3 (1.34) | 53.3 (1.46) | 0.40 |
| Received food stamps past 12 months | 20.8 (0.64) | 17.1 (1.14) | 21.6 (1.39) | 0.82 |
| Received WIC benefits past 12 months | 5.5 (0.42) | 4.6 (0.73) | 5.8 (0.92) | 0.28 |
| Number of adults in teen's family working | | | | |
| 0 | 6.1 (0.33) | 4.5 (0.56) | 5.7 (0.75) | 0.48 |
| 1 | 33.8 (0.67) | 30.7 (1.20) | 33.4 (1.34) | 0.46 |
| 2+ | 60.1 (0.71) | 64.8 (1.28) | 61.0 (1.44) | 0.94 |
| Number of adults in teen's family working full-time | | | | |
| 0 | 11.7 (0.47) | 9.7 (0.79) | 11.7 (0.99) | 0.02 |

| <i>Indicator</i> | <i>2021 Q3-Q4 & 2022-3 Sample Child file (1)</i> | <i>Teens with Sample Child weight (2)</i> | <i>Teens with final Teen weight (3)</i> | <i>Remaining bias</i> |
|---|--|---|---|-----------------------|
| 1 | 44.0 (0.72) | 43.9 (1.29) | 44.9 (1.36) | 0.93 |
| 2+ | 44.3 (0.70) | 46.4 (1.30) | 43.4 (1.37) | 0.91 |
| Teen's years at current residence | | | | |
| 3 years or less | 31.9 (0.69) | 27.2 (1.23) | 30.6 (1.40) | 1.27 |
| 4 to 10 years | 35.0 (0.67) | 37.0 (1.27) | 36.7 (1.37) | 1.73 |
| 10 or more years | 33.1 (0.65) | 35.8 (1.23) | 32.6 (1.28) | 0.47 |
| Region | | | | |
| Northeast | 15.6 (0.56) | 15.0 (1.00) | 15.6 (0.90) | 0.00 |
| Midwest | 20.7 (0.67) | 23.3 (1.24) | 20.7 (0.97) | 0.00 |
| South | 39.5 (0.82) | 36.3 (1.46) | 39.5 (1.33) | 0.00 |
| West | 24.3 (0.76) | 25.4 (1.37) | 24.3 (1.22) | 0.00 |
| Metropolitan Statistical Area (MSA) Status | | | | |
| In an MSA | 87.0 (1.17) | 87.5 (1.43) | 87.0 (1.50) | 0.00 |
| Telephone Status | | | | |
| At least one phone that is currently working and is not a cell phone | 22.3 (0.59) | 24.9 (1.18) | 23.4 (1.20) | 1.12 |
| Health status | | | | |
| Excellent/very good health | 83.4 (0.50) | 84.7 (0.95) | 83.4 (1.08) | 0.00 |
| Ever had asthma | 14.8 (0.50) | 12.7 (0.86) | 13.0 (0.94) | 1.78* |
| Still have asthma | 8.4 (0.38) | 6.6 (0.63) | 6.4 (0.64) | 1.99* |
| Any difficulty seeing | 6.7 (0.38) | 6.7 (0.67) | 7.1 (0.74) | 0.38 |
| Wear glasses or contact lenses | 38.2 (0.66) | 41.6 (1.31) | 41.0 (1.38) | 2.80* |
| Any learning difficulty | 10.9 (0.45) | 8.4 (0.76) | 9.0 (0.83) | 1.89* |
| Any difficulty remembering | 9.5 (0.43) | 8.2 (0.74) | 8.8 (0.80) | 0.73 |
| Disability status | 14.5 (0.50) | 13.4 (0.97) | 13.2 (0.98) | 1.29 |
| Ever diagnosed with Attention Deficit Disorder (ADD) or Attention-Deficit/Hyperactivity Disorder (ADHD) | 15.5 (0.50) | 13.4 (0.90) | 12.9 (0.91) | 2.59* |
| Currently has ADD/ADHD | 13.8 (0.47) | 12.3 (0.86) | 11.6 (0.85) | 2.19* |
| Ever had a learning disability (LD) | 10.3 (0.42) | 7.4 (0.70) | 8.4 (0.82) | 1.82* |
| Currently has LD | 8.6 (0.39) | 6.0 (0.65) | 7.0 (0.76) | 1.62* |
| Currently has autism spectrum disorder (ASD) | 4.0 (0.27) | 2.8 (0.46) | 3.0 (0.49) | 0.92* |
| Currently has any other developmental disability (DD) | 3.3 (0.26) | 2.3 (0.44) | 2.9 (0.55) | 0.42 |
| Ever any developmental disability (ADHD/ASD/DD/ID/LD) | 19.7 (0.56) | 17.5 (1.05) | 17.7 (1.11) | 1.99* |

| <i>Indicator</i> | <i>2021 Q3-Q4 & 2022-3 Sample Child file (1)</i> | <i>Teens with Sample Child weight (2)</i> | <i>Teens with final Teen weight (3)</i> | <i>Remaining bias</i> |
|--|--|---|---|-----------------------|
| Frequency of anxiety symptoms | | | | |
| Never | 41.3 (0.70) | 34.1 (1.27) | 41.7 (1.50) | 0.39 |
| A few times a year/monthly | 38.5 (0.68) | 43.6 (1.32) | 37.7 (1.36) | 0.75 |
| Weekly/daily | 20.3 (0.57) | 22.4 (1.14) | 20.6 (1.13) | 0.35 |
| Frequency of depression symptoms | | | | |
| Never | 59.6 (0.74) | 53.7 (1.33) | 57.9 (1.42) | 1.69 |
| A few times a year | 24.1 (0.63) | 27.6 (1.18) | 25.3 (1.22) | 1.22 |
| Monthly/weekly/daily | 16.4 (0.53) | 18.7 (1.05) | 16.8 (1.05) | 0.46 |
| Ever received special education services | 18.7 (0.53) | 16.0 (1.00) | 17.3 (1.12) | 1.44 |
| Currently receive special education services | 12.3 (0.45) | 9.1 (0.75) | 11.1 (0.91) | 1.15 |
| Number of school days missed due to injury/illness | | | | |
| 0 | 39.3 (0.69) | 37.7 (1.36) | 40.0 (1.48) | 0.72 |
| 1-5 | 40.3 (0.67) | 43.5 (1.33) | 41.9 (1.43) | 1.60 |
| 6-10 | 11.8 (0.46) | 11.5 (0.86) | 10.6 (0.85) | 1.20 |
| 11+ | 8.6 (0.41) | 7.4 (0.70) | 7.4 (0.77) | 1.12 |
| Stressful Life Events (SLEs)/Social support/Behavioral problems | | | | |
| Ever lived with anyone with an alcohol/drug problem | 11.8 (0.48) | 11.0 (0.85) | 11.9 (0.96) | 0.08 |
| Ever lived with a parent who was incarcerated | 8.0 (0.40) | 6.7 (0.74) | 7.6 (0.84) | 0.41 |
| Ever lived with anyone mentally ill/severely depressed | 11.3 (0.49) | 12.4 (0.91) | 12.4 (0.97) | 1.11 |
| Ever experienced emotional abuse | 6.8 (0.37) | 5.4 (0.59) | 5.6 (0.66) | 1.18* |
| Ever treated/judged based on race/ethnicity | 8.2 (0.39) | 7.7 (0.68) | 8.4 (0.80) | 0.15 |
| Ever victim of/witnessed neighborhood violence | 8.3 (0.42) | 7.9 (0.77) | 8.7 (0.87) | 0.38 |
| Ever had basic needs not met | 4.4 (0.31) | 4.0 (0.55) | 4.3 (0.63) | 0.10 |
| Experienced two or more SLEs | 86.3 (0.52) | 87.7 (0.91) | 86.8 (1.02) | 0.49 |
| Has community support | 88.3 (0.49) | 91.3 (0.73) | 89.7 (0.89) | 1.45 |
| Any difficulty with changes in routine | 22.2 (0.58) | 23.2 (1.11) | 22.2 (1.13) | 0.06 |
| Any difficulty controlling behavior | 13.3 (0.46) | 12.5 (0.92) | 12.8 (0.98) | 0.52 |
| Any difficulty concentrating | 7.4 (0.37) | 7.5 (0.70) | 7.7 (0.76) | 0.30 |
| Any difficulty making friends | 13.2 (0.46) | 14.9 (0.90) | 14.7 (0.98) | 1.43 |
| Health care service use | | | | |
| Saw doctor within last year | 92.3 (0.39) | 92.2 (0.73) | 91.5 (0.87) | 0.87 |

| <i>Indicator</i> | <i>2021 Q3-Q4 & 2022-3 Sample Child file (1)</i> | <i>Teens with Sample Child weight (2)</i> | <i>Teens with final Teen weight (3)</i> | <i>Remaining bias</i> |
|---|--|---|---|-----------------------|
| Usual place of care is a doctor's office or health center | 91.1 (0.45) | 92.2 (0.78) | 90.5 (0.99) | 0.57 |
| Telehealth visits in past 12 months | 18.1 (0.52) | 19.1 (1.03) | 18.3 (1.07) | 0.20 |
| Urgent care visits in past 12 months | | | | |
| 0 visits | 71.8 (0.64) | 70.4 (1.29) | 71.3 (1.35) | 0.54 |
| 1 visit | 16.0 (0.51) | 16.5 (0.99) | 16.1 (1.06) | 0.15 |
| 2+ visits | 12.2 (0.47) | 13.1 (0.94) | 12.6 (0.96) | 0.39 |
| Wellness visit within last year | 89.5 (0.43) | 89.2 (0.83) | 89.6 (0.82) | 0.06 |
| ER visit(s) in past 12 months | | | | |
| 0 visits | 86.8 (0.46) | 87.8 (0.84) | 87.0 (0.97) | 0.80 |
| 1 visit | 9.1 (0.38) | 8.0 (0.70) | 8.3 (0.80) | 0.57 |
| 2+ visits | 4.1 (0.27) | 4.1 (0.52) | 4.7 (0.60) | 0.57 |
| Received flu shot in past 12 months | 43.0 (0.73) | 48.0 (1.39) | 43.1 (1.46) | 0.12 |
| Took medications for emotions in past 12 months | 13.3 (0.47) | 13.6 (0.94) | 13.1 (0.94) | 0.23 |
| Received mental health counseling/therapy in past 12 months | 17.3 (0.52) | 19.3 (1.03) | 17.8 (1.02) | 0.53 |
| Ever diagnosed with COVID-19 | 34.2 (0.68) | 33.9 (1.32) | 33.4 (1.38) | 0.77 |
| Received a COVID-19 vaccination | 59.2 (0.77) | 69.5 (1.33) | 59.7 (1.51) | 0.48 |
| Prescribed medication in past 12 months | 38.4 (0.69) | 40.0 (1.34) | 38.7 (1.38) | 0.26 |
| Health care access/Health insurance | | | | |
| Unable to pay medical bills in past 12 months | 7.9 (0.40) | 7.0 (0.76) | 8.0 (0.86) | 0.10 |
| Worried about paying medical bills | 32.4 (0.66) | 32.2 (1.20) | 33.0 (1.33) | 0.54 |
| Delayed or did not receive medical care due to cost in past 12 months | 2.7 (0.22) | 2.3 (0.39) | 2.6 (0.45) | 0.11 |
| Health insurance coverage type | | | | |
| Private | 57.5 (0.74) | 64.1 (1.31) | 57.4 (1.48) | 0.05 |
| Public | 38.2 (0.72) | 32.7 (1.27) | 38.3 (1.44) | 0.05 |
| No coverage | 4.3 (0.28) | 3.2 (0.44) | 4.3 (0.63) | 0.00 |

¹ Family income as a proportion of Federal Poverty Level, using imputed income;

*Remaining bias is significantly >0 at the 0.05 level.

Note, WIC is Women, infants and children.

Source: National Health Interview Survey, 2021-2023; National Health Interview Survey -Teen 30-month file

Flowchart 1: NHIS-Teen 30-month weighting adjustments

