

Part B: COLLECTIONS OF INFORMATION EMPLOYING STATISTICAL METHODS

1. Describe the potential respondent universe and any sampling or other respondent selection methods to be used.

The purpose of the survey is to gather information on the appropriate restraint use for all child occupants, and in particular, the use of booster seats, among children ages 4-7. The survey will visit sampled gas stations, recreation centers, day care centers, and seven specific fast food restaurant chains (McDonald's, Taco Bell, Burger King, Wendy's, Kentucky Fried Chicken, Dairy Queen, and Sonic). Data collectors will approach as many vehicles as possible that appear to have at least one child occupant under the age of 13 in order to allow for data collector observation of restraint use for all occupants, and subsequent interviews to determine age, height, weight, race and ethnicity for child occupants.

In this sense, the potential respondent universe consists of all child motorists (age 12 and under) who frequent gas stations, recreation centers, day care centers, and seven specific fast food restaurants (not located in shopping centers).

These site types (gas stations, recreation centers, day care centers, and fast food restaurants (those not located in shopping centers)) were chosen because they are frequented by child motorists, and business' parking lots are usually small enough that data collectors can likely approach vehicles as they are parking, before child restraints have been unfastened and occupants have entered nearby buildings.

Data collectors will approach as many motorists as possible who appear to have at least one child under the age of 13 in their vehicle for possible participation in the survey.

2. Describe the collection of information procedures.

The sample design information presented below is summarized from the publication: *Redesign of the National Survey of the Use of Booster Seats*, March 18, 2015. The report was prepared under NHTSA Contract DTNH22-13-D-00284.

Sampling Frame

The sample design is a three-stage design, where geographic areas are sampled as the first-stage clusters (PSUs), and data collection sites are selected from sampled PSUs at the second-stage, and lastly, vehicles with child passengers are observed from the respondent sites.

PSU Formation and Measure of Size (MOS)

The county is the building block of NSUBS as it is one of the most recognizable geographic units with rich auxiliary information including the Census population data of various age groups. PSUs were formed with two basic principles: (1) PSUs should be geographically contiguous and compact so that the travel cost of the data collectors is minimized; (2) yet they should be large enough in terms of the MOS so that data collection efforts are not wasted due to small sample yield.

Considering that NSUBS covers children of ages 0-12, the size of this age group of children could be used as the MOS for selection of NSUBS PSUs by the PPS method. However, we chose to use the number of children of ages 0-7 as the MOS because this age group is more inclusive of children of booster seat age, and there are nearly straight line linear relationships with nearly perfect correlations among the MOSs based on different age groups.

In forming new PSUs, Westat first tried to use 2,000 children of ages 0-7 as the minimum PSU MOS, but it was found to not have a large enough number of eligible data collection sites in each PSU. So, the MOS was increased to 3,000. Furthermore, a population of at least 4,000 children was sought insofar as the preferred PSU geographic size would allow.

PSUs were formed respecting state boundaries to stratify PSUs by census region and by state's status of child restraint use laws. This PSU formation process resulted in 1,601 PSUs that cover the continental U.S. excluding Alaska and Hawaii. The PSUs consist of 1.94 counties on average, and have an average MOS of 20,044 children of ages 0-7.

PSU Stratification

PSUs are stratified by census region and the status of the specific state's child restraint use laws. All states and the District of Columbia (DC) have some child restraint use laws, but a restriction was imposed that the law should cover children of ages 0-7 at the minimum. There are 30 states and DC that satisfy this restriction. This resulted in 8 strata, with two strata in each region by the law status.

PSU Sample Size and Allocation

NSUBS includes 30 PSUs with proportional allocation to the total MOS, which called for selecting 5, 6, 12, and 7 PSUs from the Northeast, Midwest, South, and West regions, respectively.

Secondary Sampling Units and Sample Selection

Data are collected at four data collection site types (daycare centers, recreation centers, fast food restaurants, and gas stations) on the basis that using these four site types to conduct the survey does not cause a significant bias. Seven fast food restaurant chains (McDonald's, Burger King, Wendy's, Taco Bell, Kentucky Fried Chicken, Sonic and Dairy Queen) were selected because they are commonly found nationwide. Site selection considerations are that the businesses typically have a good number of children and dedicated parking lots for data collection.

The recreation centers were combined with daycare centers into one site stratum to avoid sampling and weighting issues due to the small size of the recreation center site frame as it accounts for only 6 percent of the total sites. Oversampling is one way to handle the issue, but it is inferior to the combining approach because it causes some loss in the sampling efficiency. Moreover, even with oversampling it was expected that some PSUs would not have any respondent recreation centers, which would cause difficulty in weighting.

The goal is to obtain 10 respondent sites per PSU (300 sites overall). In order to account for business refusals to participate, 523 sites were chosen in order to obtain 300 respondent sites.

Site frames were developed for the sampled PSUs, and a site sample was selected from each type of sites separately with a predetermined sampling rate. The site type of recreation centers has the smallest population size (about 3% of all site frame size, see Table 1), yet it yields the highest number of child passengers per site. We allocated site selection proportionately to the sizes of site frames for each sampled PSU.

Table 1. Site frame and sample distribution for NSUBS

Site type	Frame	Percent distribution	Site sample	Percent distribution	Resp rate	Resp sample size	Resp percent
Daycare	7,019	46.6	280	41.2	38.2	107	25.0
Recreation	424	2.8	51	7.5	62.7	32	7.5
Fast Food	2,276	15.1	152	22.4	83.6	127	29.7
Gas Station	5,351	35.5	197	29.0	82.2	162	37.9
Total	15,070		680		62.9	428	

Another difference was the selection of the site sample systematically using the site type and the zip code as the sort variables disregarding the site boundaries. To address the differential response rates in systematic selection, we used the PPS method. The MOS is defined by the inverse of the response rate for the most recent NSUBS deployments; that is, 2.5 for

daycare/recreation centers and 1.25 for fast food restaurants and gas stations

The expected distribution of the respondents sample closely follows the frame distribution. We also selected a reserve sample of 211 sites (40% of the regular sample) to prepare for unexpectedly low response rates.

Data Collection Schedule

NSUBS data collection protocol calls for two hour observation periods of restraint use for all passenger vehicles with child occupants who enter selected data collection locations. Once the vehicles stop, the drivers are approached for short interviews. Because of the requirement for observations, data are collected only during daylight hours, typically defined as between 7 a.m. and 6 p.m.

Trained data collectors approach passenger vehicles appearing to have child occupants under the age of 13; observe the restraint use of up to nine occupants in the first three rows of seats; and conduct interviews to obtain the race and ethnicity of all occupants; and the heights, weights, and ages of child occupants appearing to be under age 13. The approximate ages of other occupants (expressed as an age range, such as 16-24 years), and the genders of all occupants are subjectively assessed by the data collectors.

In accordance with Office of Management and Budget (OMB) standards, the data on race/ethnicity in NSUBS are collected via self-reporting. In order to capture restraint use before children unfasten the restraints, data collectors observe restraint use prior to or just as the vehicles come to a stop except at fast food drive-through lanes. In that case, restraint use is observed prior to the vehicles reaching the drive-through window.

In order to reach as wide an audience as possible, NSUBS uses some Spanish-speaking data collectors in PSUs with known populations of Spanish speaking residents.

Data are recorded on paper forms that have been assembled into booklets (Appendix 4). These booklets are bar-coded so that they can be identified by PSU. The booklets are shipped to Westat each evening, and are examined for completeness the following day. The data are double-blind entered into a database, and any out-of-range responses are examined by project technical staff for feasibility.

Information Collected

If an adult in the approached vehicle agrees to participate in the survey, data collectors will ask the adult for the following information:

- Children's ages
- Children's heights
- Children's weights
- Children's races and ethnicities
- Adult's races and ethnicities

In addition, data collectors will collect the following information by observation only, and not by interview:

- Date
- Time
- Survey site
- Urbanicity
- Site type (e.g. gas station, fast food restaurant, etc.)
- Vehicle type
- Seating position of each occupant
- Restraint use for each occupant, specifying the types of child restraints used

- Gender of each occupant
- Estimated age range for adult occupants

Data Collection Form

The data collection form used by the survey is shown as Appendix 4.

Data collectors for this survey will fill out the cover of the form (site type, weather, etc.) when they arrive at each data collection site. Data collectors will then fill out one page of the form for each observed vehicle, even if the occupants refuse to agree to participate in the survey. This is because the observation data are retained and used, even in the absence of related interview data.

On page 1 of the form, the PSU and site numbers are identification numbers for the survey site assigned by the project staff. The “booklet” consists of the entire package of forms filled out by the data collector on a given day. For information on “misses and refusals”, please see the explanation below.

Data collectors will recite the text on the cover of the booklet, “Hi, my name is ___ ...” to all potential respondents to ensure them that their participation is voluntary and that any information they give will be kept confidential.

For motorists who agree to participate, data collectors will interview an adult motorist for answers to the questions on the form, and fill out the form’s information on restraint use based on observing the children in the vehicle.

Information on the vehicle type and on the age category, gender, and restraint use of the adult occupants will be filled out by the data collector based on observation.

Data collectors will keep track of the number of vehicles that they missed and the number of vehicles whose occupants declined to participate in the survey, and who refused due to language barriers, and record these counts on the booklet cover when they leave the site.

Data collectors receive extensive training in protocols for interviewing motorists and observing restraint use in a manner that is professional and as unobtrusive as possible.

Statistical Editing, Imputation, Estimation, and Variance Estimation

Simple range edits will be performed on the data to improve data quality. For instance the data will be edited to ensure that children's ages fall between 0 and 12 years. Data that fall out of range will be treated as missing.

Restraint use will be estimated by the following:

Base Weighting

To calculate the site level base weight, we need two probabilities, the PSU selection probability and the site selection probability within PSU.

Alternatively, we can use the PSU base weight, which is the inverse of the PSU selection probability, and the within-PSU site base weight, which is the inverse of the within-PSU site selection probability.

Site Selection Probability and Base Weight

The within-PSU site selection probability was the desired unconditional site selection probability. Therefore, the within-PSU site base weight would be the inverse of this probability. Under the Keyfitz method, the sample size is not fixed but random, and the expected sample size is not necessarily the same as the actual sample size.

Let $f_{ijk(13)}$ be the 2013 site selection probability conditional on selected PSUs for site k in (site type) stratum j of PSU i , and $W_{ijk(13)}$ be the within-PSU site base weight, which is defined by:

$$W_{ijk(13)} = \frac{1}{f_{ijk(13)}}.$$

Then the overall site base weight for site ijk is the product of the overall PSU base weight (W_i) and the within-PSU site base weight ($W_{ijk(13)}$) as follows:

$$W_{ijk} = W_i W_{ijk(13)}.$$

The base weight is defined for all sites selected in the site sample. This weight is called the base weight because it is the basis of deriving the final weight used in estimation after applying a series of adjustments. Starting with the base weight, various adjustments are applied in sequential manner to obtain an adjusted weight each time, to which the next round of adjustment is applied. This is the topic of the next section.

Site Level Nonresponse Adjustment

The NSUBS employs standard unit nonresponse adjustment; that is, applying the ratio of total weighted sample cases to total weighted respondent cases within adjustment cells. The first type of nonresponse is defined for eligible sites, as an eligible site is considered “responded” if it participated in the survey.

For the site level adjustment, we define the nonresponse adjustment cells by partitioning the site sample. The cells are first defined by the site type strata within PSUs, but some cells are too small or the adjustment factors are too large. Those situations are resolved by combining cells, in this example, the final number of cells is 57. We denote the nonresponse adjustment cells for site level adjustment as:

$$C_a^{(S)} \text{ for } 1 \leq a \leq 57,$$

where the superscript (S) symbolizes the “site” sample. Each cell can consist of up to four kinds of sites: (1) eligible and participated (responded); (2) eligible but did not participate (not responded); (3) ineligible; and (4) unknown eligibility. These categories are denoted, respectively, by $C_{1a}^{(S)}$, $C_{2a}^{(S)}$, $C_{3a}^{(S)}$, and $C_{4a}^{(S)}$. Some of them may be empty if there is no such kind of sites in the cell.

The basic philosophy of the adjustment is to make the participating sites represent the eligible nonparticipating sites. If there are any sites with unknown eligibility (i.e., $C_{4a}^{(S)}$ is non-empty for some a), an estimate is used to portion the number of sites with unknown eligibility to be included in the group of eligible nonparticipating sites. Applying this principle, we define the site level nonresponse adjustment factor for cell $C_a^{(S)}$ as:

$$A_a^{(S)} = \frac{\sum_{ijk \in C_{1a}^{(S)}} w_{ijk} + \sum_{ijk \in C_{2a}^{(S)}} w_{ijk} + e_a}{\sum_{ijk \in C_{1a}^{(S)}} w_{ijk}} \quad \text{for } 1 \leq a \leq 57$$

where e_a is an estimated number of eligible units in $C_a^{(S)}$ given by

$$e_a = \sum_{ijk \in C_{4a}^{(S)}} w_{ijk} \frac{\sum_{ijk \in C_{1a}^{(S)}} w_{ijk} + \sum_{ijk \in C_{2a}^{(S)}} w_{ijk}}{\sum_{ijk \in C_{1a}^{(S)}} w_{ijk} + \sum_{ijk \in C_{2a}^{(S)}} w_{ijk} + \sum_{ijk \in C_{3a}^{(S)}} w_{ijk}}.$$

If $ijk \in C_{1a}^{(S)}$ (i.e., site ijk is a respondent in nonresponse adjustment cell $C_{1a}^{(S)}$), then the site level nonresponse adjusted weight for site ijk is given by:

$$A_a^{(S)} w_{ijk}.$$

This adjusted weight needs another site level adjustment: adjustment for variation in duration of data collection. The data collectors may have for a variety of reasons for collected data at a given site for a period of time that is longer or shorter than the scheduled 2 hours. The duration adjusted weight for respondent site ijk in nonresponse adjustment cell $C_{1a}^{(S)}$ is defined by:

$$w_{ijk}^{(S)} = \frac{120}{D_{ijk}} A_a^{(S)} w_{ijk} \quad .$$

where D_{ijk} is the time in minutes for which the data collectors collected data from site ijk .

Vehicle Level Nonresponse Adjustment

The same method of unit level nonresponse adjustment is made for vehicle nonresponse from the participating sites. A vehicle is a response if it is observed either with or without an interview with the driver. The nonresponse (non-observation) adjustment cells are the participating sites with some observed vehicles, which are denoted as $C_a^{(V)}$ with a being the index for the participating sites. Each cell can be partitioned into two groups: respondent group (denoted as $C_{1a}^{(V)}$) and nonrespondent group (denoted as $C_{2a}^{(V)}$). All respondent vehicles in site ijk in $C_a^{(V)}$ are given the vehicle level nonresponse adjusted weight defined as follows:

$$w_{ijk}^{(V)} = A_a^{(V)} w_{ijk}^{(S)} \quad ,$$

where

$$A_a^{(V)} = \frac{\sum_{ijk \in C_{1a}^{(V)}} w_{ijk}^{(S)} + \sum_{ijk \in C_{2a}^{(V)}} w_{ijk}^{(S)}}{\sum_{ijk \in C_{1a}^{(V)}} w_{ijk}^{(S)}} \quad .$$

This same adjusted weight is given to all occupants in the vehicle, and is sometimes called the observation weight. Since not all observed occupants are interviewed, we need another nonresponse adjustment for interviewed occupants, which is discussed in the following section. Because we need to produce restraint use estimates for the interviewed child occupants separately from other interviewed occupants, two sets of interview weights are developed, one for the interviewed child occupants and the other for interviewed adult occupants. Note that a child occupant is defined as an occupant under age 13 and an adult occupant is an occupant of age 13 or older.

Child Interview Nonresponse Adjustment

Nonresponse adjustment for child occupant interview nonresponse is also similarly done using nonresponse adjustment cells, which are defined by site type strata within PSUs. Note that a child is treated as interviewed only if the child's age is obtained. After elimination of small cells or cells with too large adjustment factors through collapsing, 55 cells are defined. They are denoted as $C_a^{(I)}$ for

$1 \leq a \leq 55$. All interviewed children in site ijk belonging to $C_a^{(I)}$ are given the nonresponse adjusted weight defined by:

$$w_{ijk}^{(I)} = A_a^{(I)} w_{ijk}^{(V)} \quad \text{for } 1 \leq a \leq 55,$$

where

$$A_a^{(I)} = \frac{\sum_{ijk \in C_{1a}^{(I)}} w_{ijk}^{(V)} + \sum_{ijk \in C_{2a}^{(I)}} w_{ijk}^{(V)}}{\sum_{ijk \in C_{1a}^{(I)}} w_{ijk}^{(V)}},$$

and $C_{1a}^{(I)}$ is the set of interviewed children and $C_{2a}^{(I)}$ is the set of observed but not interviewed children.

Adult Occupant Interview Nonresponse Adjustment

Nonresponse adjustment for adult occupant interview is exactly the same as for child interview nonresponse adjustment except the occupant interview status is defined differently - an adult occupant has an interview status if the interview at the vehicle level is complete or partially complete. There are 54 nonresponse adjustment cells formed, which are denoted as $C_a^{(A)}$ for $1 \leq a \leq 54$. All interviewed adult occupants in site ijk which belongs to $C_a^{(A)}$ are given the nonresponse adjusted weight defined by:

$$w_{ijk}^{(A)} = A_a^{(A)} w_{ijk}^{(V)} \quad \text{for } 1 \leq a \leq 54,$$

where

$$A_a^{(A)} = \frac{\sum_{ijk \in C_{1a}^{(A)}} w_{ijk}^{(V)} + \sum_{ijk \in C_{2a}^{(A)}} w_{ijk}^{(V)}}{\sum_{ijk \in C_{1a}^{(A)}} w_{ijk}^{(V)}},$$

and $C_{1a}^{(A)}$ is the set of interviewed adult occupants and $C_{2a}^{(A)}$ is the set of observed but not interviewed adult occupants.

It is important to select the proper weight type for a given estimate to be produced. For example, to produce a restraint use estimate for all occupants observed in day care centers, the vehicle observation weight, $w_{ijk}^{\dot{c}}$ must be used. Sometimes, however, two valid estimates can be produced for a restraint use rate. For example, the restraint use rate of children (age < 13) in vehicles driven by female drivers can be estimated using either the vehicle observation weight, $w_{ijk}^{\dot{c}}$ or the child interview weight, $w_{ijk}^{\dot{c}}$. Although both estimates are valid, the estimate obtained using the vehicle observation weight, $w_{ijk}^{\dot{c}}$ is better because there are more cases used in estimation, and thus it has a better precision (i.e., smaller variance).

Variance Estimation

Variance estimates will be computed using WesVar, reflecting the jackknife variance estimation method.

3. Describe the methods used to maximize response rates and to deal with issues of nonresponse.

The refusal rate by year is described in the following table:

Table 2. Interview refusal rate by drivers by survey year

Year	Total number of observed vehicles	Total number of interviews	Total number of refusal	Refusal rate
2006	3489	2920	548	15.7
2007	4828	4199	181	3.7
2008	6204	4899	224	3.6
2009	6033	4601	286	4.7
2011	6350	5191	300	4.7
2013	7229	6070	288	4.0

We do not expect many missing values in the observed portion of the data (both the site information on the cover of the data collection booklet and the observed motorist data on pages 1-20) because the data collectors will be well trained and they should have adequate time to record site information and restraint use.

As can be seen in Table 2 above, the interview refusal rate for drivers is generally less than five percent for recent years.

Imputation

For occupant variables including a vehicle variable, Westat's imputation software, AutoImpute, is used. AutoImpute is a convenient tool since it can perform imputation for categorical and continuous variables at the same

time. It uses regression modeling to create imputation classes and carries out hot-deck imputation using the created imputation classes through regression modeling. One of its strengths is its ability to use all available variables as predictors in the regression modeling so that it can maintain, in the imputed data, the correlation structure of the data set among variables used in imputation. Since it utilizes hot-deck imputation, AutoImpute performs donor imputation, where for a missing value, a donor is randomly picked from the non-missing cases in the imputation class to which the missing case belongs, and the donor value is used to impute the missing value. This imputation procedure is applied to all variables with missing values, except for a few variables that are not imputed (mostly site characteristics plus observer name, number of refusals, number of missed vehicle, seating position) and a few variables imputed as special cases (site identifiers and administrative data).

Data Quality

Data collectors for the National Survey of the Use of Booster Seats undergo extensive training in order to minimize errors that could arise from their categorizing or recording data incorrectly.

NHTSA does not believe that there is reliable information with which to adjust the survey results to account for inaccurate responses given by motorists, motorists who choose not to participate in the survey, motorists who do not frequent the site types, or motorists who frequent the site types outside of the observation period. The Agency's published report will clearly state that the results are based on motorists who visit the site types and voluntarily chose to participate in the survey.

4. Describe any tests of procedures or methods to be undertaken.

The National Survey of the Use of Booster Seats was designed in 2006. A Pilot Test was conducted at that time, and the results of that test were incorporated into the revised survey procedures. Subsequently, NSUBS has been conducted seven times (through 2015). In 2015, the survey was

redesigned and expanded from 16 PSUs to 30 PSUs (as is described above) in order to reduce the variance, and enhance the statistical precision of the estimates. No changes were made to the data collection protocol as a result of the 2015 sample redesign.

5. Provide the name and telephone number of individuals consulted on statistical aspects of the design and the name of the Agency unit, contractor(s), grantee(s), or other person(s) who will actually collect and/or analyze the information for the Agency.

This survey was designed and will be conducted under Federal Contract with Westat, Inc. The Contracting Officer's Representative is Mr. Timothy M. Pickrell who can be reached at (202) 366-2903. The program manager at Westat, Inc. is Dr. Doreen De Leonardis who can be reached at (301) 315-5963.