Sampling Design and Weighting Refinements for the National Youth Tobacco Survey

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PRESENTATION TOPICS

- NYTS methodology
- Frame development and maximizing coverage
- Sample size and racial/ethnic oversampling
- Trends in response rates and sample sizes over prior NYTS cycles
- Sample design refinements and rationale
- Benefits of new design
- Weighting

NYTS METHODOLOGY

- The NYTS employs a multistage stratified sampling design to produce a nationally representative sample of middle school and high school students
- Sixteen primary strata are defined by urban status and by minority concentrations
- Sampling units at the three stages are as follows:
  - **Primary Sampling Units (PSUs):** counties, or groups of small counties, or part of a very large county
  - **Secondary Sampling Units (SSUs):** schools or linked schools
  - **Third-stage:** Intact classrooms within each selected school

NYTS METHODOLOGY CONT.

- Selection with probabilities proportional to size (PPS) methods at the first two stages
- Participating students complete the survey via pencil and paper using a self-administered, scannable questionnaire booklet
- Participation in the NYTS is voluntary at both the school and student levels
  - At the student level, participation is anonymous
  - Schools use either passive or active permission forms at their discretion
  - Schools and participants are not identifiable in the final weighted data file

SAMPLING FRAME DEVELOPMENT AND MAXIMIZING COVERAGE

- Frame construction changed in 2013 and uses two sources:
  - National Center for Education Statistics (NCES)
  - Market Data Retrieval Inc. (MDR), a commercial vendor
- Goal is to maximize coverage of target population of schools and students
  - MDR data includes contact information for schools and districts as well as data used in the sampling design, such as enrollment by grade and minority enrollment
  - Schools not meeting eligibility criteria are excluded from sampling frame
    - Examples: Adult education centers, Juvenile Justice centers, Department of Defense schools, Bureau of Indian Affairs schools, students who are home-schooled

SAMPLE SIZES

- Sample sizes are developed to ensure precision of point estimates for
  - Each grade
  - Three racial/ethnic groups–non-Hispanic white, non-Hispanic black and Hispanic students
  - Each gender
- In some cycles, sample sizes have been developed to balance the yields at both school levels—middle and high schools—so as to generate approximately equal precision at both levels
  - This requirement involves selecting more middle schools than high schools as the former have 3 eligible grades and the latter have 4 grades
  - Balancing yields by grade has required linking schools to be used as second stage units (SSUs) so that each SSU contains a complete set of grades for the level

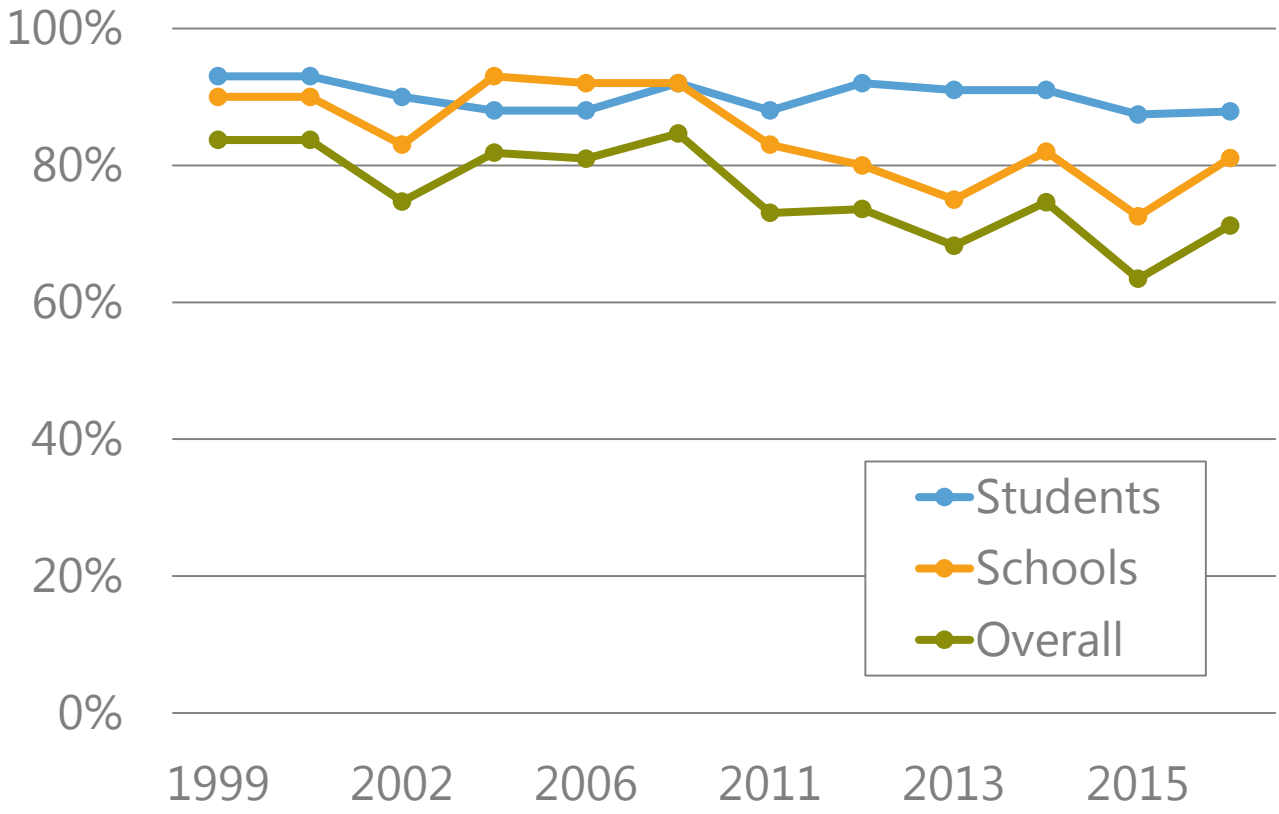
OVERSAMPLING OF RACIAL/ETHNIC MINORITIES

- Multiple strategies have been used to increase the number of non-Hispanic black and Hispanic students included in the sample
- Starting in 2013, two strategies were considered to be no longer necessary
  - Oversampling areas with high minority concentrations
  - Using a weighted measure of size (MOS)
- Dropping these strategies enhanced the precision of overall survey estimates
- The design still oversamples by selecting double classes in large, high minority schools

TRENDS IN PARTICIPATION RATES: 2013-2016

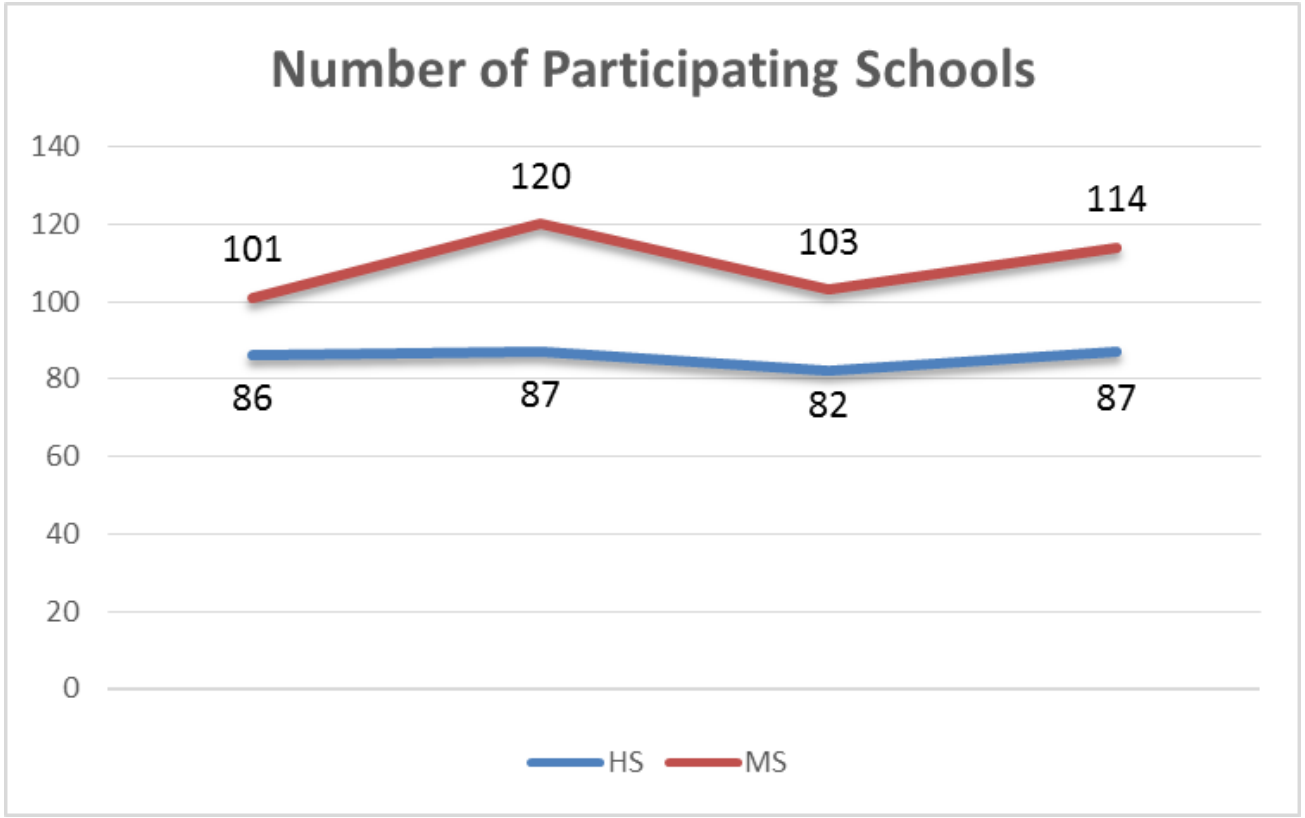
- We look at participation rates at the school and student levels for the 2013, 2014, 2015 and 2016 surveys
- Also look at total numbers of participants overall, by school level and by racial/ethnic group for the same survey cycles

RESPONSE RATES



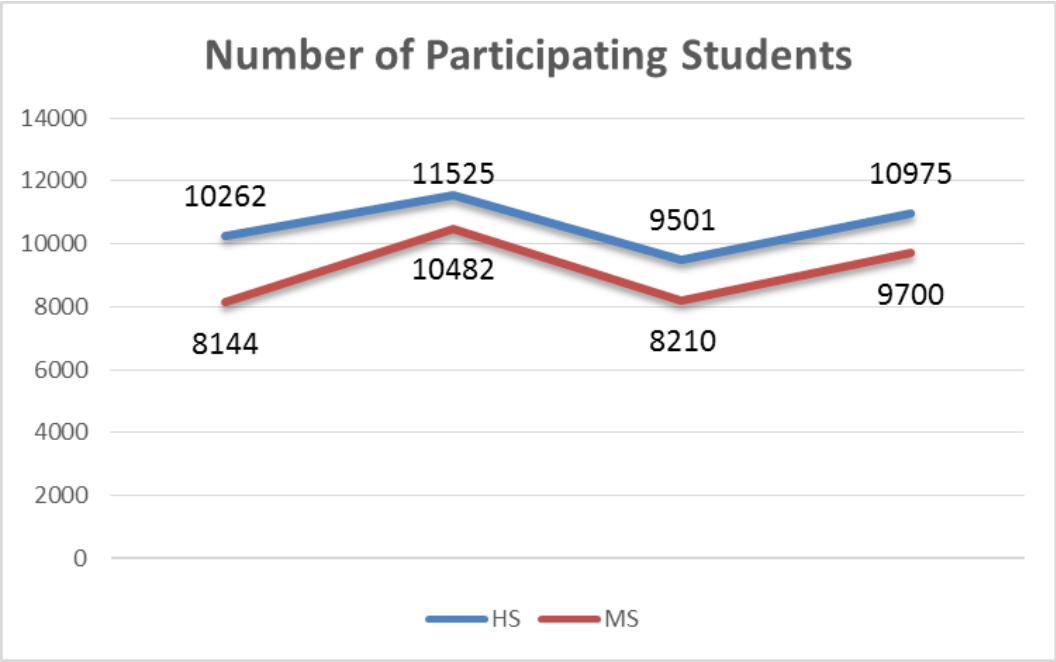
TRENDS IN SAMPLE SIZES (2013-2016)

SCHOOL SAMPLE SIZES BY LEVEL



TRENDS IN SAMPLE SIZES (2013-2016)

PARTICIPATING STUDENT TOTALS



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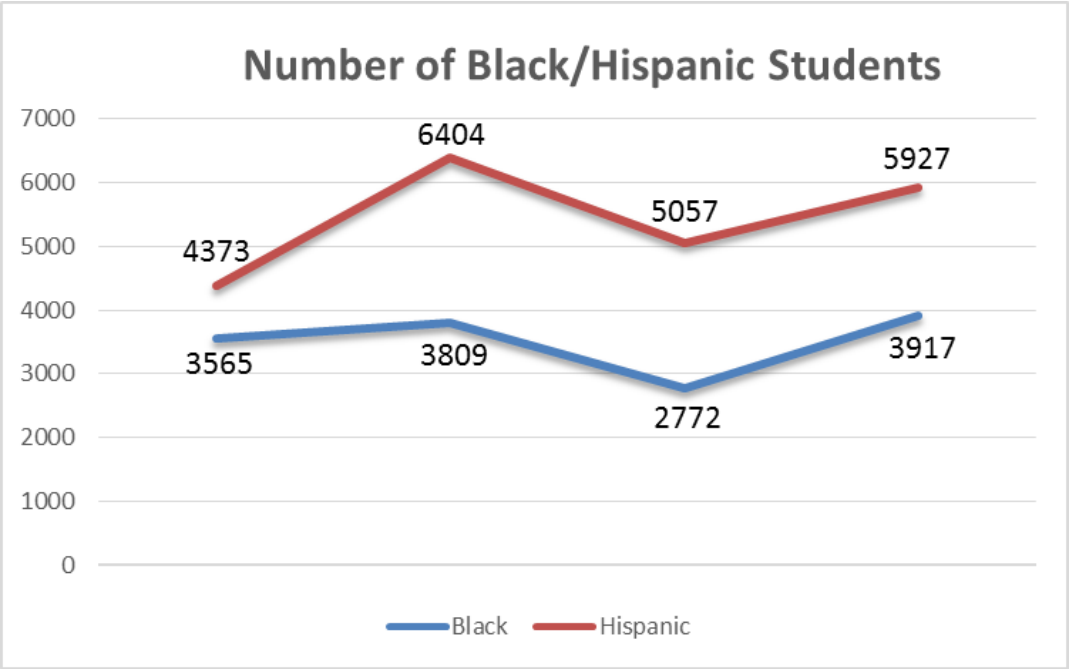
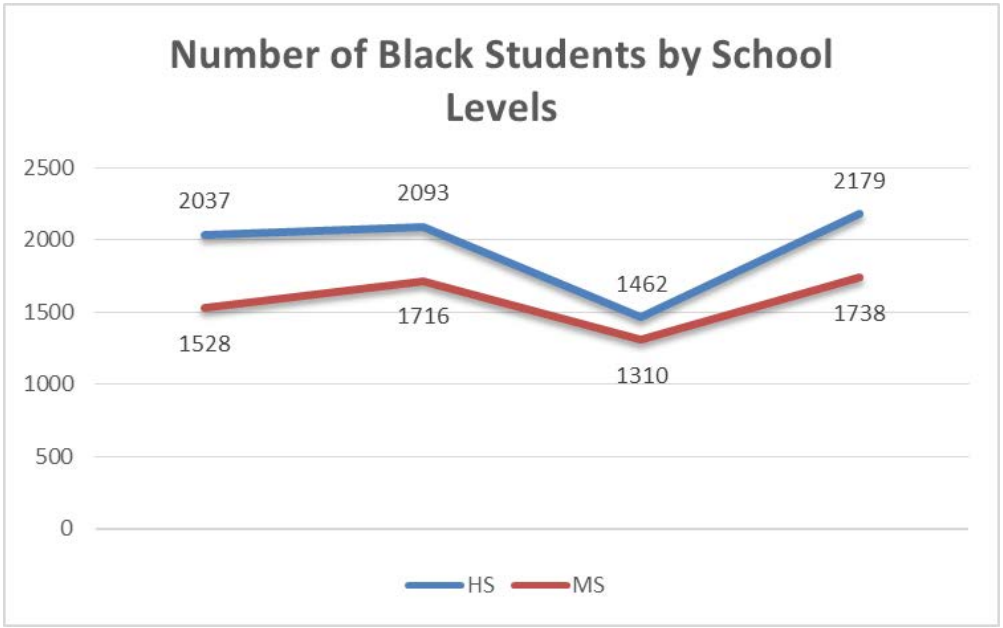


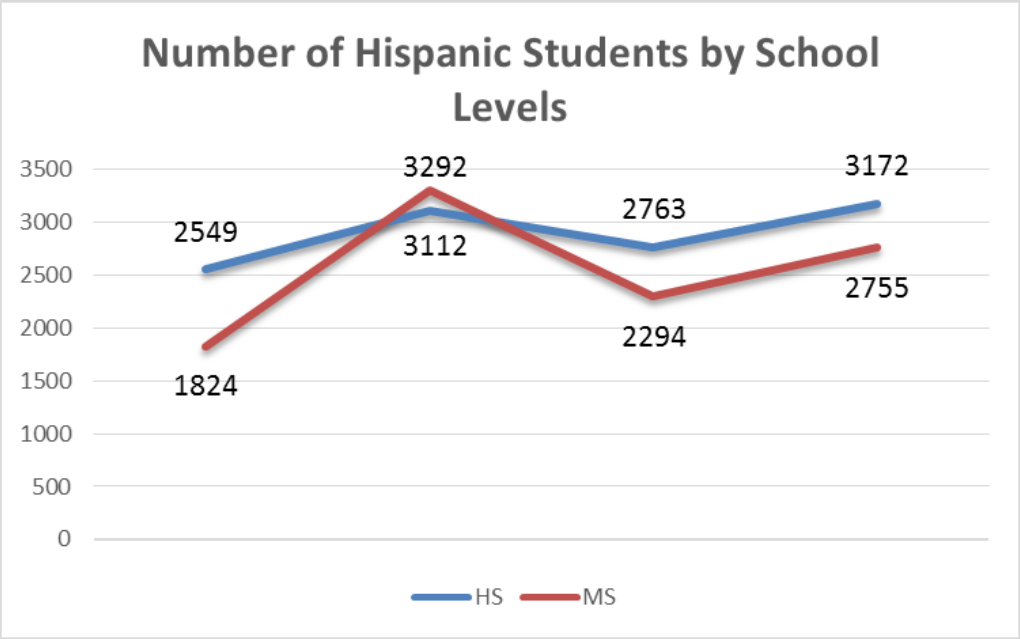
TRENDS IN SAMPLE SIZES (2013-2016)

PARTICIPATING BLACK STUDENT TOTALS



TRENDS IN SAMPLE SIZES (2013-2016)

PARTICIPATING HISPANIC STUDENT TOTALS



SCHOOL PARTICIPATION RATES: 2014-2016

- We examine school participation rates in key analytic subgroups
- These bivariate analyses help inform the construction of non-response weight adjustment classes that minimize potential bias due to non-participation
- Participation rates vary by region, school type, school size and urban status

SCHOOL PARTICIPATION RATES BY CENSUS REGION

Year	Census Region	Participating Schools	Sampled Schools	Response Rate	Chi-Square P-value
2016					0.04
	Midwest	39	57	**68.4%**	
	Northeast	28	34	**82.4%**	
	South	85	99	**85.9%**	
	West	49	57	**86.0%**	
2015					0.01
	Midwest	51	64	**79.7%**	
	Northeast	28	45	**62.2%**	
	South	71	107	**66.4%**	
	West	37	42	**88.1%**	
2014					0.69
	Midwest	46	57	**80.7%**	
	Northeast	36	48	**75.0%**	
	South	80	96	**83.3%**	
	West	45	57	**78.9%**	

SCHOOL PARTICIPATION RATES BY SCHOOL TYPE

Year	School Type	Participating Schools	Sampled Schools	Response Rate	Chi-Square P-value
2016					
	Non-Public	13	22	**59.1%**	<0.01
	Public	188	225	**83.6%**	
2015					
	Non-Public	14	30	**46.7%**	<0.01
	Public	173	228	**75.9%**	
2014					0.04
	Non-Public	19	29	**65.5%**	
	Public	188	229	**82.1%**	

SCHOOL PARTICIPATION RATES BY SCHOOL SIZE

Year	School Size	Participating Schools	Sampled Schools	Response Rate	Chi-Square P-value
2016					
	Large	174	209	**83.3%**	0.06
	Small	26	37	**70.3%**	
2015					
	Large	159	213	**74.6%**	0.09
	Small	28	45	**62.2%**	
2014					0.9
	Large	183	228	**80.3%**	
	Small	23	29	**79.3%**	

SCHOOL PARTICIPATION RATES BY URBAN STATUS

Year	Urban Status	Participating Schools	Sampled Schools	Response Rate	Chi-Square P-value
2016					
	Non-Urban	108	127	**85.0%**	0.12
	Urban	92	119	**77.3%**	
2015					
	Non-Urban	102	131	**77.9%**	0.05
	Urban	85	127	**66.9%**	
2014					0.23
	Non-Urban	104	125	**83.2%**	
	Urban	102	132	**77.3%**	

SCHOOL PARTICIPATION RATES: SUMMARY

- Participation rates vary by region, school type, school size and urban status
  - Schools in the South and the West have greater participation rates
  - Public schools have greater participation rates
  - Large schools have greater participation rates
  - Non-urban schools have greater participation rates

SAMPLING DESIGN REFINEMENTS

- Consider using schools as second stage units rather than linked schools
  - Schools are linked to provide second stage units (SSUs) with complete grades
  - Linking schools leads to inefficiencies in fielding the survey, and in weighting
- Consider selecting one class per grade in all schools
  - Selection of double classes in large schools is necessary to boost the student yield in a cost-effective way
  - Selecting two classes per grade in a majority of schools leads to lower response rates (recruitment and burden issues) and to weighting inefficiencies

BENEFITS OF MODIFIED DESIGN

- Analysis shows that a sampling design with unlinked schools and one class per grade can yield sample sizes which are comparable to the current design
- This new modified design has advantages in both
  - Reducing Design Effects (DEFFs) and variances
  - Increasing response rates

WEIGHTING

- Survey weights are computed for each participating student to adjust for nonresponse and for varying probabilities of selection
- Sampling weights are computed as the reciprocal of the probabilities of selection
  - Weight = W1 * W2 * W3
  - W1, W2 and W3 are the first-stage (PSU), second-stage (SSU or school), and third-stage (student) selection weights
- Weights are post-stratified iteratively (raked) to ensure that the weighted estimates in each grade match known national population totals

NONRESPONSE ADJUSTMENTS

- Weights are adjusted in each weighting cell
  - Thus in each cell, the sum of adjusted weights over respondents sum is the same as the sum of unadjusted weights over respondents and non-respondents
- Student-level nonresponse
- School-level nonresponse
  - Non-response bias analysis suggests which variables to use in nonresponse adjustment classes

POST-STRATIFICATION

- Force weights to sum to known population totals available from external data, e.g., population control totals
- For the NYTS, use data available from the National Center for Education Statistics (NCES) for public schools and private schools, the Common Core Data (CCD) and Private School Survey (PSS) data, respectively
- Post-stratification variables:
  - School type (public vs non-public)
  - Grade
  - Gender
  - Race/ethnicity

POST-STRATIFICATION (CONT.): RAKING

- Starting with the 2014 NYTS, deeper post-stratification was used and implemented with an iterative, raking approach
- With raking, less collapsing of categories is necessary for the post-stratification variables
- Raking also can be implemented in tandem with weight trimming

CONCLUSIONS

- The NYTS provides excellent coverage of the target population
  - Reaching out to special populations (e.g., DoD or BIA schools) would be prohibitively expensive, and would not dramatically increase coverage
- Response rates continue to be high even though there has been a slight decline over time
- Simple design modifications may lead to lower variances and higher response rates

Thank you

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For more information, contact CDC
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TTY: 1-888-232-6348 www.cdc.gov

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

INVESTIGATION OF NEW DESIGN: PROS AND CONS

- Simulation study led to new design parameters with larger school sample sizes and fewer numbers of students
  - Sample design with unlinked schools with one class per grade
  - Much lower design effects (DEFFs), and larger effective sample sizes

Sample Schools	Participating Students
Large: 200	13,230
Small: 40	3,240
Total: 240	16,470

Student yields by grade for the 2017 design compared to two modified designs: a) same number of schools but unlinked, and b) larger number of sample schools arising from 90 sample PSU's (over 100 simulated samples)

	(1) Yields for 2017 Design	(2) Yields for design with unlinked schools (same parameters)	(3) Yields for design with unlinked schools and 90 PSUs	Relative change in yields from (1) to (3)
Grade 6	4325.50	3902.88	4042.01	-7%
Grade 7	4367.02	4048.91	4331.01	-1%
Grade 8	4359.59	4062.43	4303.29	-1%
Grade 9	4350.41	4154.55	4446.77	2%
Grade 10	4384.69	4218.33	4521.85	3%
Grade 11	4404.87	4273.33	4567.48	4%
Grade 12	4390.88	4262.70	4543.45	3%
Overall	30582.95	28923.13	30755.86	1%

Non-Hispanic black student yields by grade for the 2017 design compared to two modified designs: a) same number of schools but unlinked, and b) larger number of sample schools arising from 90 sample PSU's

	(1) Yields for 2017 Design	(2)Yields for design with unlinked schools (same parameters)	(3) Yields for design with unlinked schools and 90 PSUs	Relative change in yields from (1) to (3)
Grade 6	1083.63	1003.03	1032.79	-5%
Grade 7	1103.56	1031.07	1077.45	-2%
Grade 8	1099.95	1034.92	1052.77	-4%
Grade 9	1099.95	1050.32	1145.09	4%
Grade 10	1107.75	1057.12	1171.36	6%
Grade 11	1106.85	1070.56	1172.01	6%
Grade 12	1099.41	1053.32	1147.67	4%
Overall	7701.10	7300.34	7799.15	1%

Hispanic student yields by grade for the 2017 design compared to two modified designs: a) same number of schools but unlinked, and b) larger number of sample schools arising from 90 sample PSU's

	(1) Yields for 2017 Design	(2) Yields for design with unlinked schools (same parameters)	(3) Yields for design with unlinked schools and 90 PSUs	Relative change in yields from (1) to (3)
Grade 6	912.48	855.00	921.88	1%
Grade 7	901.69	856.34	969.72	8%
Grade 8	899.70	851.93	969.82	8%
Grade 9	835.60	781.54	896.84	7%
Grade 10	846.08	796.87	914.94	8%
Grade 11	855.20	814.67	937.35	10%
Grade 12	853.29	813.98	934.05	9%
Overall	6104.04	4915.33	6544.60	7%