

Comparing BRFSS Suppression Guidelines for Statistical Reliability

An Example Using Maine BRFSS Data

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Caitlin Pizzonia, MPH

University of Southern Maine/Maine Center for Disease Control and Prevention



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Overview

- Compare suppression guidelines using data from Maine's BRFSS
 - Background/History
 - Methods comparison
 - Results of comparison analysis
 - Interpretation/takeaways
 - Maine's BRFSS suppression guidelines

Why is suppression is used in surveys?

- Mask calculated estimate when it is considered statistically unreliable
 - Statistical reliability is based on sample size or measures of variance.

CDC suppression guidelines for BRFSS survey

- CDC released updated recommended suppression guidelines in 2011 when the survey changed to include cell phone respondents and a new weighting methodology.

Recommended suppression guidelines

- Prior to 2011: 95% confidence half-widths > 10 or total respondents < 50
- Updated Recommendations (2011): relative standard error (RSE) > 30 or total respondents < 50

$$\text{Relative Standard Error} = \frac{\text{Standard Error}}{\text{Point Estimate (Percentage)}} \times 100$$

Data Source: U.S. CDC, National Center for Chronic Disease Prevention and Health Promotion, Division of Population Health. Behavioral Risk Factor Surveillance System. Comparability of Data: BRFSS 2011.

Available at: https://www.cdc.gov/brfss/annual_data/2011/pdf/compare_11_20121212.pdf

Application of the revised recommendations

Result:

- Increased suppression of point estimates close to 0% or 100%, even with narrow 95% confidence intervals
- Decreased suppression of point estimates close to 50%, even with wide 95% confidence intervals

Is RSE a suitable measure of statistical reliability for percentages?

How were other states handling BRFSS data suppression?

- **Not every state followed revised suppression guidelines.**
 - Some states suppress estimates using all available methods.
 - RSE > 30, 95% CI half-widths > 10, & total respondents < 50
 - Some states suppress estimates if RSE > 50 and mark or flag estimates if RSE > 30.
 - Other states do not suppress estimates, but mark or flag estimates if RSE > 30.

Literature on sample survey data suppression

- University of Utah Data Suppression Decision Rules Workgroup

- RSE should be calculated 2 different ways

1. If prevalence < 50%, RSE =

$$\frac{\textit{Standard Error}}{\textit{Point Estimate (Percentage)}} \times 100$$

2. If prevalence > 50%, RSE =

$$\frac{\textit{Standard Error}}{1 - \textit{Point Estimate (Percentage)}} \times 100$$

NCHS workgroup—proposed suppression methods for percentages

Proposed guidelines for routinely published estimates in reports like Health, United States and Healthy People 2020

Need for new guidelines since guidelines and practice varied across data divisions and programs at NCHS.

1. Discontinue use of RSE as the suppression criterion.
2. Use effective sample size ≥ 30

$$\cdot \text{Effective Sample Size} = \frac{\text{Sample Size}}{\text{Design Effect}}$$

NCHS workgroup—proposed suppression methods for percentages

3. Use Clopper-Pearson 95% confidence intervals

Asymmetric approach used for complex surveys described by Korn and Graubard – more fully incorporates information from survey design (design effects and effective sample size)

- **Absolute width** = UCL - LCL
 - Less than 6% should NOT be suppressed
 - Greater than 20% should always be suppressed
- **Relative width** = $\left(\frac{(UCL - LCL)}{\text{Survey Estimate}} \right) \times 100$
 - Greater than 120% should be suppressed

Methods for determining if suppression is needed

	Measure of Variance	Sample Size
Method 1	95% confidence interval half-widths > 10	Total respondents < 50
Method 2	Relative standard error > 30	Total respondents < 50
Method 3	Relative standard error > 30 Using revised formula for prevalence > 50%	Total respondents < 50
Method 4*	Clopper-Pearson (asymmetric) 95% confidence interval half-widths Absolute and relative half-widths	Degrees of freedom*
Method 5		Effective sample size (n/Design effect)

*Did not recommend a required number of degrees of freedom but estimates with less than 8 degrees of freedom should be evaluated. Typically, estimated proportions with < 8 DF have RSE > 50%

Methodology for comparison analysis

- **Applied each method to cross-tabulations of Maine BRFSS diabetes module questions & demographic questions**
 - **Varying prevalence rates**
 - Some near 0% or 100%, some close to 50%
 - **Smaller sample size**
 - Only asked of adults with diabetes
 - Only asked on one part of the survey

Indicators selected

- **Diabetes prevalence—9.5-9.7%**
- **Prediabetes prevalence—6.3-7.8%**
- **Two HA1c tests in past year among adults with diabetes—75.5-79.0%**
- **Influenza vaccine among adults with diabetes—59.6-63.2%**

Method 1—95% confidence interval half-widths > 10 and total respondents < 50

This analysis uses 95% CI half-widths and sample size as the comparison or reference method in this suppression method comparison analysis.

Traditional method (1) versus RSE methods (2 & 3)

- The RSE methods (2 & 3) result in the suppression of more estimates than the traditional method (1).

Prevalence of prediabetes among adults by race, Maine, 2011-2014

Race	Total Respondents	n	Avg Annual N	%	95% CI	RSE %	RSE - new formula %
	White	21,927	1,781	71,598	7.1	6.7-7.6	3.1
Black or African American	94	7	852	7.1	6.7 - 7.6	57.9	57.9
American Indian or Alaska Native	116	11	607	8.1	2.8 - 13.4	33.2	33.2
Native Hawaiian or Pacific Islander	64	6	236	7.1	0.9 - 13.3	44.8	44.8
Asian	194	14	742	7.8	1.7 - 13.8	39.6	39.6
Multiracial	235	16	699	4.9	2.0 - 7.9	30.5	30.5
Other Race	7	1	49	12.7	0.0 - 36.6	95.9	95.9

Traditional method (1) versus RSE methods (2 & 3)

- The RSE methods (2 & 3) do not suppress estimates that are suppressed when the traditional method is applied—even with wide confidence intervals.

Traditional method (1) versus RSE methods (2 & 3)

Two or more A1c tests among adults with diabetes by demographics, Maine, 2011-2014							
	Total Respondents	n	Avg Annual N	%	95% CI	RSE	RSE - new formula
Maine Total	2,527	2,015	72,220	77.0	74.7 - 79.2	1.5	5.0
Age							
18-24	8	7	1,098	95.3	85.5 - 100.0	5.3	106.5
25-34	31	23	1,920	69.5	48.5 - 90.6	15.4	35.2
35-44	113	81	5,382	70.5	60.3 - 80.6	7.3	17.5
45-54	354	266	13,169	70.9	64.7 - 77.0	4.4	10.8
55-64	670	535	19,464	78.4	74.3 - 82.4	2.6	9.6
65 and over	1,337	1,091	30,746	80.1	77.2 - 82.9	1.8	7.3
Health Insurance Type							
Private	660	528	24,144	74.8	70.2 - 79.3	3.1	9.2
MaineCare	189	150	8,563	81.4	75.1 - 87.7	4.0	17.4
Medicare	904	748	27,447	81.7	78.4 - 85.1	2.1	9.3
Other*	185	151	6,556	83.1	76.9 - 89.3	3.8	18.6
None	110	66	3,815	59.9	48.2 - 71.5	9.9	14.8

Traditional method (1) versus RSE methods (2 & 3)

Two or more A1c tests among adults with diabetes by county Maine, 2011-2014

	Total		Avg Annual			RSE	RSE - new formula
	Respondents	n	N	%	95% CI		
Maine Total	2,527	2,015	72,220	77.0	74.7 - 79.2	1.5	5.0
County							
Androscoggin	185	141	6,151	78.0	71.0 - 84.9	4.5	16.1
Aroostook	170	128	5,783	68.7	58.8 - 78.5	7.3	16.0
Cumberland	335	273	11,633	80.4	74.9 - 86.0	3.5	14.5
Franklin	89	73	1,849	78.4	66.4 - 90.3	7.8	28.2
Hancock	89	69	2,172	65.9	51.2 - 80.6	11.4	21.9
Kennebec	236	177	6,263	72.8	64.7 - 80.9	5.7	15.2
Knox	81	65	1,555	83.0	73.2 - 92.8	6.0	29.4
Lincoln	105	86	2,098	76.1	64.1 - 88.1	8.1	25.6
Oxford	119	94	3,144	70.5	58.3 - 82.6	8.8	21.0
Penobscot	272	227	9,379	82.8	77.3 - 88.3	3.4	16.3
Piscataquis	70	55	1,211	69.5	54.7 - 84.3	10.8	24.7
Sagadahoc	96	78	2,082	81.4	71.1 - 91.6	6.4	28.0
Somerset	106	84	3,741	75.2	65.0 - 85.4	6.9	21.0
Waldo	112	91	2,236	80.3	70.4 - 90.2	6.3	25.6
Washington	128	110	2,410	80.5	68.3 - 92.6	7.7	31.6
York	271	220	8,981	80.4	74.3 - 86.5	3.9	15.8

Methods 2 & 3—Relative standard error > 30 and total respondents < 50

- Resulted in increased suppression of estimates compared to Method 1.
- Methods 2 & 3 failed to suppress estimates with wide confidence intervals—even when the confidence interval widths are as wide as 30%.

Traditional method (1) versus Clopper-Pearson method (4)

- Applying the Clopper-Pearson method (4) results in the suppression of more estimates than the traditional method (1).
- No instances where applying the Clopper-Pearson method (4) results in the suppression of fewer estimates than the traditional method.
- No instance of estimates where degrees of freedom were less than 8.

Traditional method (1) versus Clopper-Pearson method (4)

- Applying the Clopper-Pearson method (4) results in the suppression of more estimates than the traditional method (1)

Prevalence of diabetes by race, Maine, 2011-2014

	Total Respondents	n	Avg Annual N	%	95% CI	Clopper-Pearson 95% CI	Relative widths
Race							
White	21,927	1,781	71,598	7.1	6.7-7.6	6.7 - 7.6	12.7
Black or African American	94	7	852	7.1	6.7 - 7.6	2.3 - 32.4	423.9
American Indian or Alaska Native	116	11	607	8.1	2.8 - 13.4	3.7 - 15.0	139.5
Native Hawaiian or Pacific Islander	64	6	236	7.1	0.9 - 13.3	2.2 - 16.3	198.6
Asian	194	14	742	7.8	1.7 - 13.8	2.9 - 16.2	170.5
Multiracial	235	16	699	4.9	2.0 - 7.9	2.4 - 8.8	130.6
Other Race	7	1	49	12.7	0.0 - 36.6	0.2 - 56.2	440.9

Traditional method (1) versus Clopper Pearson method (4)

Influenza vaccine among adults with diabetes by county, Maine, 2011-2014

County	Total Respondents		Avg Annual			Clopper-Pearson 95% CI	Relative widths
	n	N	%	95% CI			
Androscoggin	331	222	5,890	69.6	63.6 - 75.6	61.2 - 77.2	23.0
Aroostook	317	173	3,742	48.6	41.7 - 55.5	37.9 - 57.7	40.7
Cumberland	601	388	9,727	63.6	58.7 - 68.6	57.5 - 70.9	21.1
Franklin	153	94	1,450	57.9	47.5 - 68.4	43.5 - 74.4	53.3
Hancock	168	104	2,198	61.8	51.8 - 71.7	52.7 - 78.4	41.6
Kennebec	420	264	5,654	61.2	55.3 - 67.1	54.8 - 71.1	26.6
Knox	163	108	1,445	62.4	50.9 - 74.0	52.3 - 80.3	44.9
Lincoln	181	125	1,701	70.4	61.9 - 78.9	58.0 - 81.3	33.1
Oxford	202	128	2,995	62.9	54.7 - 71.2	44.6 - 68.9	38.6
Penobscot	467	273	6,224	55.9	50.2 - 61.7	44.6 - 60.0	27.5
Piscataquis	126	74	1,128	56.0	44.0 - 68.0	42.8 - 72.9	53.8
Sagadahoc	156	111	1,660	69.2	59.4 - 79.0	48.1 - 75.6	39.7
Somerset	186	111	2,771	58.3	49.9 - 66.7	48.9 - 71.4	38.6
Waldo	192	113	1,471	56.3	47.3 - 65.2	45.2 - 69.0	42.3
Washington	229	150	1,823	64.9	57.1 - 72.7	49.9 - 73.6	36.5
York	515	341	8,405	65.5	60.4 - 70.6	59.6 - 74.3	22.4

Method 4—Absolute & relative widths of Clopper-Pearson 95% confidence intervals

- Suppressed about the same number of estimates as Method 1, though sometimes more estimates were suppressed when using Method 4.
- Relative confidence intervals require additional calculation and are not a widely-known statistical method.

Traditional method (1) versus Effective sample size (5)

- Applying the effective sample size method (5) results in the suppression of more estimates than the traditional method (1)

Prevalence of prediabetes by race, Maine, 2011-2014

Race	Total Respondents	n	Avg Annual			Effective Sample Size
			N	%	95% CI	
White	21,927	1,781	71,598	7.1	6.7-7.6	13,683
Black or African American	94	7	852	7.1	6.7 - 7.6	22
American Indian or Alaska Native	116	11	607	8.1	2.8 - 13.4	104
Native Hawaiian or Pacific Islander	64	6	236	7.1	0.9 - 13.3	67
Asian	194	14	742	7.8	1.7 - 13.8	76
Multiracial	235	16	699	4.9	2.0 - 7.9	208
Other Race	7	1	49	12.7	0.0 - 36.6	9

Traditional method (1) versus Effective sample size (5)

- Applying the effective sample size method (5) results in the suppression of fewer estimates than the traditional method.

Traditional method (1) versus Effective sample size (5)

Two or more A1c tests among adults with diabetes by demographics, Maine, 2011-2014						
	Total Respondents	n	Avg Annual N	%	95% CI	Effective Sample Size
Race						
American Indian or Alaska Native	14	12	535	71.5	31.7 - 100.0	5
Asian	33	25	1,040	77.7	59.8 - 95.6	21
Black or African American	10	7	296	69.5	30.8 - 100.0	6
Other Race	2	1	9	10.4	0.0 - 36.3	11
Native Hawaiian or Pacific Islander	6	5	212	98.7	95.7 - 100.0	69
Two or more races	32	22	1,019	74.7	57.2 - 92.2	25
White	2,393	1,915	67,596	77.0	74.7 - 79.3	1,263
Health Insurance Type						
Private	660	528	24,144	74.8	70.2 - 79.3	269
MaineCare	189	150	8,563	81.4	75.1 - 87.7	137
Medicare	904	748	27,447	81.7	78.4 - 85.1	497
Other*	185	151	6,556	83.1	76.9 - 89.3	316
None	110	66	3,815	59.9	48.2 - 71.5	79

Traditional method (1) versus Effective sample size (5)

Influenza vaccine among adults with diabetes by sexual orientation, Maine, 2011-2014						
Sexual Orientation	Total Respondents	n	Avg Annual N	%	95% CI	Effective Sample Size
Bisexual	42	23	707	53.7	34.1 - 73.2	26
Heterosexual or Straight	4,162	2,627	55,576	60.9	59.0 - 62.8	2,513
Homosexual (Gay or Lesbian)	72	36	712	48.3	33.3 - 63.2	44
Other	35	20	323	51.1	30.6 - 71.7	23

Method 5—Use effective sample size >50 compared to total respondents >50

- Overall, fewer demographic estimates were suppressed, but this method failed to suppress an estimate for Native Hawaiian or Pacific Islander when there were only 6 respondents.

Conclusions

- **Method 1 vs. Methods 2 & 3**
 - Compared to using the 95% CI half-widths, using the RSE is more apt to suppress percentages close to 0 or 100%, even when the CI is narrow, and less apt to suppress percentages close to 50%, even when the CI is very wide.
 - Little difference in suppression using the revised RSE method and standard RSE method.

Conclusions continued

- **Method 1 vs. Method 4**
 - No major difference in which groups are suppressed using either the Clopper-Pearson method (4) or traditional method (1), though sometimes the Clopper-Pearson method (4) resulted in the suppression of more estimates than the traditional method (1).
 - Asymmetric confidence intervals and relative widths require additional calculation.
 - Relative confidence interval width is not a widely-known statistical method.
 - Benefit of using the standard 95% confidence intervals is that the confidence interval values produced by Maine CDC will match the values produced by the U.S. CDC.

Conclusions continued

- **Method 1 vs. Method 5**
 - Overall, fewer demographic estimates were suppressed, but failed to suppress an estimate for Native Hawaiian or Pacific Islander when there were only 6 respondents.
- **Applying method 1 (95% CI half-widths) results in the suppression of fewer estimates presented by race in Maine than other suppression methods.**

Final Conclusion—Current Maine BRFSS analysis

- **Use initial CDC BRFSS suppression recommendations**
 - 95% confidence interval half-width > 10
 - Total respondents < 50

References

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