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Can post-stratification adjustments correct bias in traditional RDD estimates

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The Problem

- Erosion of sample coverage in traditional landline RDD (TL-RDD) surveys due to rise in cell phone only households (CPOH)
- Conducting CPOH surveys is…
  - Expensive
    - Many states cannot afford
  - Complex
    - Merging CPOH and TL-RDD data to produce a single estimate is not straightforward

Research question

- Can post-stratification adjustments reduce bias associated with not sampling CPOH in TL-RDD health surveys?

- Goal of post-stratification:
  - to adjust the publicly available NHIS person weights so when applied to non-CPOH observations they produce outcome estimates that approximate those obtained from the original weights and the total NHIS sample

Methods

- Data: 2007 NHIS public use data
- Approach:
  - Remove CPOH from the data
  - Reweight non-CPOH data to NHIS control totals using an iterative process
    - Conventional: region, race/ethnicity, age
    - Less conventional: age by education, home ownership status
  - Examine each iteration and select the most efficient adjusted weight

Overview of analysis

- Contrast the total NHIS, CPOH and non-CPOH estimates for range of health related outcomes:
  - Health status, health insurance coverage, barriers to care, usual source of care, smoking and drinking
- After omitting CPOH from the sample, contrast various iterations of post-stratification adjustments (impact on variance and bias)
- Examine the extent to which the adjusted weights reduce bias from excluding CPOH

  Definition: Non-CPOH include households with landlines, no service, and unknown service
  - Non-CPOH equal 13.5% of the weighted Person File
  - Non-CPOH equal 14.4% of the weighted Sample File

Table 1. Original weight estimates by phone status – summary of results

- Non-CPOH and CPOH subsamples are significantly different on **all** health related estimates compared (B-C)
  - Non-CPOH report:
    - lower health status,
    - experience fewer cost and other barriers,
    - are more likely to be insured and have a usual source of care,
    - report healthier lifestyles (non- or former smokers and drinkers)
- Compared to the full sample, the non-CPOH sample (A-B)…
  - significantly underestimates:
    - uninsurance,
    - forgone and delayed care,
    - lacking transportation as a barrier to care,
    - reporting no usual source of care,
    - current moderate and heavy drinking behavior and current smoking status
  - significantly overestimates:
    - insurance (especially private),
    - never drinking and former smoking status
  - 13 of 24 comparisons

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Table 2. Contrast adjustments for selected health outcomes – summary of results

- Iterative post-stratification adjustments were made to the public use final person weight, sample adult and child weights
- Selection of the weight that performed best was based on Mean Squared Error (MSE) and variance estimates for 4 outcomes:
  - uninsurance,delayed care due to cost, no usual source of care, and current smoking status
- Weight that adjusts cumulatively for region, age, race/ethnicity, age by education and home ownership (wtenure) had the lowest average MSE
  - but overestimated the number of whites
- Weight with an additional adjustment for race/ethnicity (wrace2) was selected

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Table 2. Contrast adjustments for selected health outcomes – summary continued

- For the non-CPOH subsample, compared to original unadjusted public use weight
  - variance of adjusted weights increases
  - bias (MSE) is greatly reduced with the adjusted weight (by a minimum of 66%)

		Non-CPOH (Original unadjusted)	Adjusted (wrace2)
Person File	**Uninsured**		
	Design Effect (DEFF)	3.78	4.09
	% Change in variance		9.37%
	MSE/bias	40.56	2.52
	% Change in MSE		-93.79%
	Delayed Care b/c Cost		
	Design Effect (DEFF)	2.84	4.09
	% Change in variance		51.89%
	MSE/bias	25.47	8.55
	% Change in MSE		-66.43%
Sample File	**No Usual Source of Care**		
	Design Effect (DEFF)	2.59	2.87
	% Change in variance		9.36%
	MSE/bias	41.91	6.58
	% Change in MSE		-84.31%
	Current Smoking		
	Design Effect (DEFF)	2.15	2.26
	% Change in variance		-7.01%
	MSE/bias	16.62	2.93
	% Change in MSE		-82.38%

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Table 3. Contrasting total sample, unadjusted, and adjusted non-CPOH – summary of results

Contrasting total sample (A) and adjusted Non-CPOH (C)…
- The magnitude of the bias for key outcomes is modest
  - less that 1.0 in terms of the absolute difference,
  - less than 7% in terms of percent or relative difference
- The difference between the estimates is no longer statistically significant for several outcomes (comparing full file and unadjusted non-CPOH)
- The direction of the bias is toward underestimating key outcomes

Contrasting unadjusted (B) and adjusted Non-CPOH (C)… weighting reduces the bias across most of outcomes

		Total Sample (A)		CPOH Omitted (B)		Adjusted Non-CPOH (C)		Bias Reduction (1-((A-C)/(A-B))	Magnitude of Bias		Signficance T-test
									Adjusted - Total (C-A)	Percent Difference (C-A/A)	
		%	SE			%	SE				
Person File	Uninsured	14.6%	0.25%	12.9%	0.26%	14.1%	0.28%	73.2%	-0.4%	-3.0%	ns
	Delayed Care b/c Cost	7.8%	0.16%	7.0%	0.16%	7.3%	0.17%	38.2%	-0.5%	-6.5%	**
Sample File	No Usual Source of Care	12.5%	0.30%	10.6%	0.30%	11.7%	0.33%	56.5%	-0.8%	-6.7%	**
	Current Smoking	19.5%	0.40%	17.9%	0.40%	18.8%	0.42%	56.1%	-0.7%	-3.7%	ns

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Table 3. Contrasting full NHIS and adjusted non-CPOH subsample – summary continued

- The adjusted estimates perform well; the magnitude of the bias is modest and 7 of 13 outcome estimates are no longer significantly different from the total sample (gold standard)
  - uninsured, insured, private insurance, transportation barriers, moderate drinking, former and current smoking behavior
- Compared to full sample, adjusted non-CPOH sample …
  - underestimates
    - positive health status,
    - uninsurance,
    - forgone and delayed care, other barriers to care,
    - reporting no usual source of care,
    - current moderate and heavy drinking behavior,
    - former and current smoking
  - overestimates
    - insurance coverage,
    - having a usual source of care,
    - never drinking and never smoking

Conclusions and implications

- Can post-stratification adjustments correct for bias associated with not sampling CPOH in TL-RDD health surveys?
  - **Yes** – although variance increases somewhat, bias is greatly reduced for the re-weighted data
  - For key outcome central to policy reform simulations and funding formulas —**uninsurance**—bias is small and resulting estimate is not significantly different from the gold standard
- It may be more cost-effective to rely on adjusted TL-RDD data given the high cost of interviewing CPOH and uncertainty of weighting procedures that merge CPOH and TL-RDD data
  - Weighting strategy presented is but one possibility; still tinkering
- Must continue to monitor efficacy of this approach to dealing with coverage bias with changing telephony

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