

# Double the Data, Double the Insight?: Blending Two Probability-based Samples with Differing Levels of Bias

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AccuSurvey  
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# Study Background

**Disclaimer:** The Rapid Surveys System (RSS) is conducted by the Centers for Disease Control and Prevention's (CDC's) National Center for Health Statistics (NCHS). The findings and conclusions in this presentation are based solely on publicly available documents and data and are those of the authors of this report and do not necessarily represent the official position of CDC/NCHS or other funding partners.



# Study Background

**The National Center for Health Statistics (NCHS) was interested in developing methods to assess emergent topics that could be done more rapidly than possible with their large-scale data collection programs. To do so, NCHS established the Rapid Surveys System (RSS) to collect survey data to generate national population estimates of health-related experiences and behaviors.**

**Each RSS Round of data collection has involved two probability-based online survey panels fielding at the same time—NORC’s AmeriSpeak panel and Ipsos’ KnowledgePanel (KP).**

**This paper relies on public use data files and documentation from Rounds 1 and 2, which are available here:**

**<https://www.cdc.gov/nchs/rapid-surveys/documentation/round-1.html>**

**<https://www.cdc.gov/nchs/rapid-surveys/documentation/round-2.html>**

# Study Purpose

**With two separate probability-based samples being fielded using the same questionnaire in parallel for each Round, the RSS data affords a unique opportunity to study the sample quality and biases in the separate probability-based panel samples and examine ways of blending these samples to potentially reduce the biases in the survey estimates obtained from the separate samples.**

# Study Purpose – Bias Assessment

To identify biases, there have been two major approaches:

1. Examination of specific items in terms of whether the survey estimation encompasses a population parameter, given a margin of sampling error (which is affected by the total number of completes AND weighting efficiency, which determines the effective sample size).
2. Examination of total divergence between all survey measures and population parameters, which can be obtained either by way of absolute differences (Yeager et al., 2011) or by root mean square error (MacInnis et al., 2018).

**In this study, we will use an average absolute deviation across a number of population parameters as our primary measure of bias.**

# Study Purpose – Sample Blending

**While there are a number of ways to blend two different samples, the two most common ways are:**

- 1. Treating each sample as equally valid – samples are pooled together equal to each sample's number of participants from each constituent sample, so that the sample weights are not recomputed (typically each sample's mean will equal 1.00) and, in merging, the new mean is also equal to 1, even if the variances of the weights for the different samples are different.**
- 2. Combining the samples based on their relative effective sample sizes (ESS weight). This approach takes into account the weighting variance of each sample – the sample with a less efficient weight (lower effective sample size) is reduced in its relative size compared to the sample that is more efficient. The recomputed weight is then rescaled to the total combined sample size.**

**We will present the results for both blending approaches to examine if one might yield consistently lower bias.**



# Method

# Method – Round 1 Fielding (RSS-1)

Study Components	Provider	
	NORC	Ipsos
<b>Invited Sample</b>	<b>11,568</b>	<b>6,739</b>
<b>Completed Sample</b>	<b>2,898</b>	<b>4,701</b>
<b>Effective Sample Size</b>	<b>1,366</b>	<b>3,675</b>
<b>Weighting Efficiency</b>	<b>47.1%</b>	<b>78.2%</b>
<b>Relative Sample Size</b>	<b>27.1%</b>	<b>72.9%</b>
<b>Begin Field</b>	<b>1-Aug-23</b>	<b>4-Aug-23</b>
<b>End Field</b>	<b>23-Aug-23</b>	<b>29-Aug-23</b>

From: <https://www.cdc.gov/nchs/data/rss/survey-description.pdf>

	Provider 1	Provider 2
<b>Cumulative Response Rate</b>	<b>4.0%</b>	<b>4.1%</b>
<b>Survey Duration (minutes)</b>	<b>12.0</b>	<b>12.6</b>

From: <https://www.cdc.gov/nchs/data/rss/round2/quality-profile.pdf>



# Method – Round 2 Fielding (RSS-2)

Study Components	Provider	
	NORC	Ipsos
<b>Invited Sample</b>	<b>12,842</b>	<b>6,086</b>
<b>Completed Sample</b>	<b>2,849</b>	<b>4,197</b>
<b>Effective Sample Size</b>	<b>1,199</b>	<b>3,396</b>
<b>Weighting Efficiency</b>	<b>42.1%</b>	<b>80.9%</b>
<b>Relative Sample Size</b>	<b>26.1%</b>	<b>73.9%</b>
<b>Begin Field</b>	<b>16-Oct-23</b>	<b>12-Oct-23</b>
<b>End Field</b>	<b>6-Nov-23</b>	<b>7-Nov-23</b>

From: <https://www.cdc.gov/nchs/data/rss/round2/survey-description.pdf>

	Provider 1	Provider 2
<b>Cumulative Response Rate</b>	<b>3.8%</b>	<b>4.0%</b>
<b>Survey Duration (minutes)</b>	<b>13.9</b>	<b>13.2</b>

From: <https://www.cdc.gov/nchs/data/rss/round2/quality-profile.pdf>



# Method – Questionnaire Differences by Round

**Round 1** – Topics included a number of health-related behaviors, along with questions on specific topics, such as long COVID, preventive care, genetic testing, and sunscreen use.

**Round 2** – Topics included a number of health-related behaviors contained in Round 1, along with questions on specific topics, such as chronic pain, birth control, and prescription drug misuse.



# Method – Benchmarks

**To assess bias, we first identified a number of benchmarks available from the final 2023 National Health Interview Survey (NHIS) that corresponded with items in the Round 1 and 2 questionnaires. In Round 1, we identified 7 secondary demographics and 22 health-related items that were presented to all participants and sufficiently diverse. In Round 2, we identified the same 7 secondary demographic and 13 health-related items (that also appeared in Round 1).**



# Method – Round 1 Health-related Benchmarks

<b>Self-rated health - excellent/very good</b>	<b>Work limitations</b>
<b>Hypertension</b>	<b>Worry about ability to pay medical bills (somewhat/very worried)</b>
<b>High cholesterol</b>	<b>Had last dental examination more than a year ago</b>
<b>Coronary heart disease</b>	<b>Last saw doctor about health more than a year ago</b>
<b>Asthma</b>	<b>Hospitalized overnight - past 12 months</b>
<b>Cancer</b>	<b>Had eye exam - past 12 months</b>
<b>Prediabetes</b>	<b>Had rehab therapy - past 12 months</b>
<b>Diabetes</b>	<b>Used of internet to search for health info - past 12 months</b>
<b>BMI - OBESE - derived from height and weight</b>	<b>Anxiety - daily/weekly</b>
<b>Difficulty doing errands alone (some, a lot, cannot do)</b>	<b>Depression - daily/weekly</b>
<b>Difficulty participating in social activities (some, a lot, cannot do)</b>	<b>Current smoker (some, every day) - derived from ever/current smoker</b>



# Method – Round 2 Health-related Benchmarks

<b>Self-rated health - excellent/very good</b>
<b>Hypertension</b>
<b>High cholesterol</b>
<b>Asthma</b>
<b>Cancer</b>
<b>Difficulty doing errands alone (some, a lot, cannot do)</b>
<b>Difficulty participating in social activities (some, a lot, cannot do)</b>
<b>Work limitations</b>
<b>Worry about ability to pay medical bills (somewhat/very worried)</b>
<b>Last saw doctor about health more than a year ago</b>
<b>Hospitalized overnight - past 12 months</b>
<b>Used of internet to search for health info - past 12 months</b>
<b>Current smoker (some, every day) - derived from ever/current smoke</b>



# Method – Secondary Demographic Benchmarks

**Same benchmarks for Rounds 1 & 2:**

<b>Married</b>
<b>3 or more people in HH</b>
<b>Sexual orientation- not straight</b>
<b>Worked in past week</b>
<b>Volunteered - past 12 months</b>
<b>Voted in last local election</b>
<b>Speaks other than English at home</b>

# Methodology – Weighting

**We used the study demographic sample weights constructed by each Provider. Starting with base weights, the weights were adjusted for similar demographic targets derived from the CPS 2022 March Supplement for age, sex, race-ethnicity, education, and region (Census division/region). There were some differences between Providers in the use of income, language proficiency, and some nesting of weight targets for the calculation of the demographic weights.**



# Methodology – Weighting

**In addition to the Provider-specific weights, we formed a Pooled weight, which merely combined the Provider-specific weights unchanged.**

**We also formed an ESS weight, which used the relative effective sample size to create a weight that weighted down the less efficient Provider (Provider 1) and weighted up the more efficient Provider (Provider 2). This was in addition to Provider 1 having fewer overall completes.**





# Results



# Results – Computation of Survey Estimates

**We first established the benchmark values for the health-related and secondary demographic items by using the final NHIS 2023 public use data file using the national demographic weight computed for the data file.**

**We then calculated both the unweighted and demographically weighted study estimates for each sample for both Provider 1 and Provider 2.**



## Results – Computation of Bias

**We also calculated the ‘Pooled’ unweighted and weighted estimates (Pooled is the value of both samples without adjustment for relative efficiency).**

**Finally, we calculated the ‘ESS’ weighted estimates using the relative effective sample size (based on the weighting variance) of the two samples.**

**To compute bias, we computed the absolute difference between the NHIS benchmark and the study estimate.**

**We then added the absolute differences and averaged the absolute differences by sample type to obtain an average bias estimate.**

# Results – Round 1 Computation of Survey Estimates

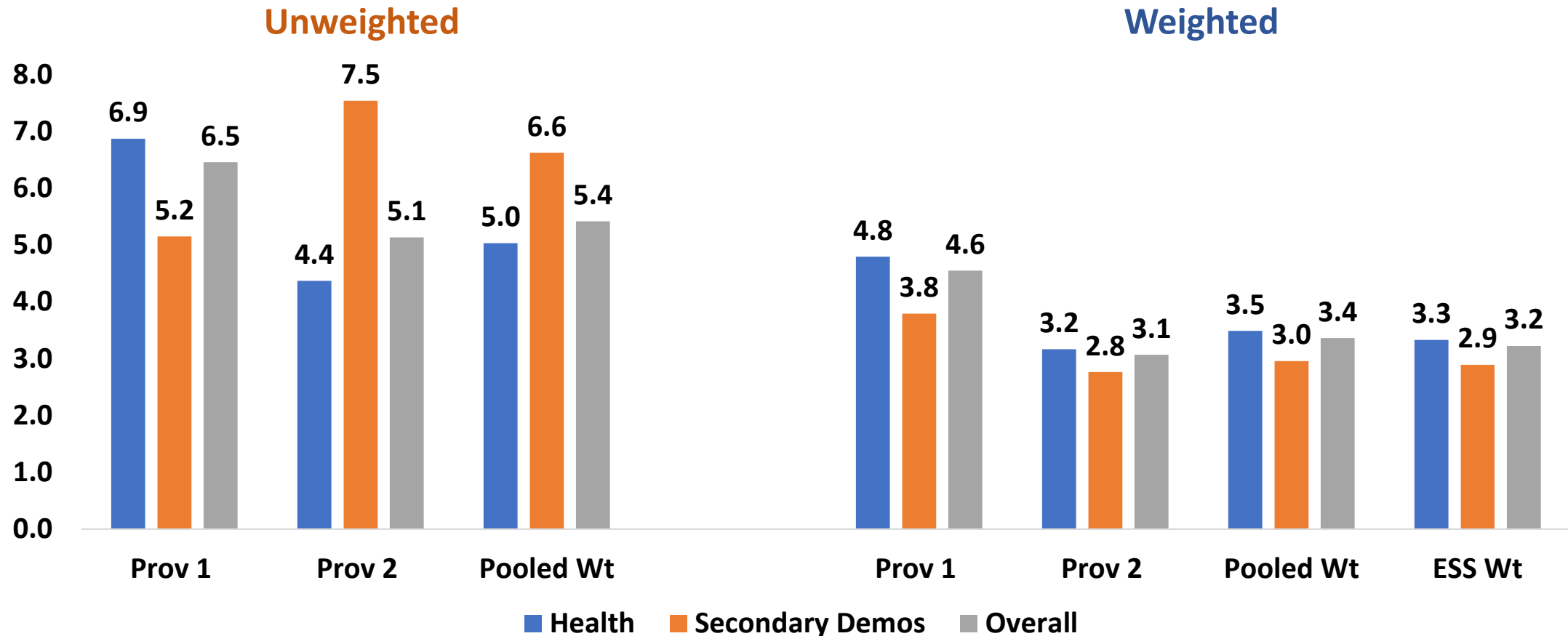
Benchmarks	NHIS Weighted	Unweighted				Weighted			
		NHIS	RSS1 Prov 1	RSS1 Prov 2	RSS1 Pooled	RSS1 Prov 1	RSS1 Prov 2	RSS1 Pooled Wt	RSS1 ESS Wt
HBENCH01 Self-rated health - Excellent/Very good	55.6%	54.0%	43.1%	46.4%	45.1%	47.3%	46.4%	46.7%	46.6%
HBENCH02 Hypertension	32.3%	37.6%	38.1%	38.6%	38.4%	33.4%	31.8%	32.4%	32.2%
HBENCH03 High cholesterol	28.3%	32.6%	38.1%	39.9%	39.2%	28.7%	28.7%	28.7%	28.7%
HBENCH04 Coronary heart disease	4.8%	6.2%	7.4%	5.4%	6.1%	6.3%	4.0%	4.9%	4.6%
HBENCH05 Asthma	15.1%	14.8%	18.2%	14.0%	15.6%	17.8%	14.2%	15.6%	15.2%
HBENCH06 Cancer	9.7%	12.8%	12.1%	13.0%	12.7%	11.0%	10.1%	10.4%	10.3%
HBENCH07 Prediabetes	16.1%	17.8%	26.1%	24.7%	25.2%	22.1%	21.2%	21.5%	21.4%
HBENCH08 Diabetes	9.8%	11.2%	12.9%	13.0%	13.0%	10.6%	11.3%	11.0%	11.1%
HBENCH09 BMI - OBESE - derived from height and weight	33.8%	33.3%	38.4%	35.8%	36.8%	34.5%	35.3%	35.0%	35.1%
HBENCH10 Difficulty doing errands alone (some, a lot, cannot do)	9.2%	9.9%	21.1%	14.3%	16.9%	17.6%	14.4%	15.6%	15.2%
HBENCH11 Difficulty participating in social activities (some, a lot, cannot do)	11.8%	12.1%	28.1%	19.5%	22.8%	23.4%	19.7%	21.1%	20.7%
HBENCH12 Work limitations	19.5%	21.5%	24.5%	20.6%	22.1%	20.1%	19.2%	19.5%	19.4%
HBENCH13 Worry about ability to pay medical bills (somewhat/very worried)	44.9%	42.4%	57.9%	46.4%	50.8%	56.9%	50.4%	52.9%	52.2%
HBENCH14 Had last dental examination more than a year ago	34.4%	33.5%	40.2%	31.6%	34.9%	37.7%	35.3%	36.2%	35.9%
HBENCH15 Last saw doctor about health more than a year ago	15.5%	13.4%	23.4%	16.6%	19.2%	25.4%	21.3%	22.9%	22.4%
HBENCH16 Hospitalized overnight - past 12 months	8.9%	9.8%	8.4%	8.3%	8.3%	6.9%	7.5%	7.3%	7.4%
HBENCH17 Had eye exam - past 12 months	52.8%	56.3%	52.2%	60.2%	57.2%	49.5%	54.3%	52.4%	53.0%
HBENCH18 Had rehab therapy - past 12 months	12.7%	14.6%	14.3%	14.0%	14.1%	13.2%	11.8%	12.4%	12.2%
HBENCH19 Used of internet to search for health info - past 12 months	62.5%	63.9%	78.5%	75.6%	76.7%	77.2%	72.9%	74.5%	74.0%
HBENCH20 Anxiety - daily/weekly	29.5%	28.2%	35.6%	29.6%	31.9%	34.0%	30.6%	31.9%	31.5%
HBENCH21 Depression - daily/weekly	10.5%	10.8%	21.5%	16.9%	18.6%	20.5%	17.8%	18.9%	18.6%
HBENCH22 Current smoker (some, every day) - derived from ever/current smoke	10.8%	11.0%	12.4%	8.9%	10.2%	12.4%	9.5%	10.6%	10.3%
SDEMOBENCH01 Married	51.4%	45.8%	52.0%	60.7%	57.4%	51.3%	51.4%	51.3%	51.3%
SDEMOBENCH02 3 or more people in HH	47.6%	31.8%	46.3%	41.2%	43.1%	49.5%	46.5%	47.6%	47.3%
SDEMOBENCH03 Sexual orientation- not straight	5.3%	4.9%	9.4%	8.4%	8.8%	8.9%	9.7%	9.4%	9.5%
SDEMOBENCH04 Worked in past week	60.9%	55.4%	52.6%	51.4%	51.9%	52.3%	53.0%	52.7%	52.8%
SDEMOBENCH05 Volunteered - past 12 months	22.6%	24.0%	30.1%	30.6%	30.4%	27.9%	26.5%	27.0%	26.9%
SDEMOBENCH06 Voted in last local election	52.3%	56.7%	61.2%	63.6%	62.7%	54.4%	54.0%	54.2%	54.1%
SDEMOBENCH07 Speaks other than English at home	22.8%	19.1%	17.5%	17.6%	17.6%	17.8%	22.5%	20.7%	21.2%

# Results – Round 2 Computation of Survey Estimates

Benchmarks	NHIS Weighted	Unweighted				Weighted			
		NHIS	RSS2 Prov 1	RSS2 Prov 2	RSS2 Pooled	RSS2 Prov 1	RSS2 Prov 2	RSS2 Pooled Wt	RSS2 ESS Wt
HBENCH01 Self-rated health - Excellent/Very good	55.6%	54.0%	42.2%	46.2%	44.5%	46.5%	47.0%	46.8%	46.9%
HBENCH02 Hypertension	32.3%	37.6%	39.8%	38.2%	38.8%	34.6%	32.2%	33.2%	32.9%
HBENCH03 High cholesterol	28.3%	32.6%	38.3%	39.2%	38.9%	27.7%	27.8%	27.8%	27.8%
HBENCH05 Asthma	15.1%	14.8%	19.8%	15.3%	17.1%	18.3%	15.4%	16.6%	16.2%
HBENCH06 Cancer	9.7%	12.8%	15.3%	13.6%	14.3%	13.4%	10.7%	11.8%	11.4%
HBENCH10 Difficulty doing errands alone (some, a lot, cannot do)	9.2%	9.9%	25.7%	14.8%	19.3%	21.1%	14.9%	17.4%	16.5%
HBENCH11 Difficulty participating in social activities (some, a lot, cannot do)	11.8%	12.1%	34.3%	21.4%	26.7%	29.6%	21.4%	24.7%	23.6%
HBENCH12 Work limitations	19.5%	21.5%	26.5%	18.8%	21.9%	21.3%	17.1%	18.8%	18.2%
HBENCH13 Worry about ability to pay medical bills (somewhat/very worried)	44.9%	42.4%	59.5%	48.3%	52.8%	58.6%	50.8%	54.0%	52.9%
HBENCH15 Last saw doctor about health more than a year ago	15.5%	13.4%	17.3%	16.3%	16.7%	19.0%	20.3%	19.8%	20.0%
HBENCH16 Hospitalized overnight - past 12 months	8.9%	9.8%	10.7%	7.7%	8.9%	10.9%	7.3%	8.8%	8.3%
HBENCH19 Used of internet to search for health info - past 12 months	62.5%	63.9%	82.9%	76.2%	78.9%	80.4%	73.1%	76.0%	75.0%
HBENCH22 Current smoker (some, every day) - derived from ever/current smoke	10.8%	11.0%	12.6%	9.0%	10.5%	12.7%	9.4%	10.8%	10.3%
SDEMOBENCH01 Married	51.4%	45.8%	49.4%	57.7%	54.3%	51.8%	51.8%	51.8%	51.8%
SDEMOBENCH02 3 or more people in HH	47.6%	31.8%	44.1%	40.4%	41.9%	49.9%	45.5%	47.3%	46.6%
SDEMOBENCH03 Sexual orientation- not straight	5.3%	4.9%	9.3%	9.0%	9.2%	7.3%	10.1%	8.9%	9.3%
SDEMOBENCH04 Worked in past week	60.9%	55.4%	51.5%	52.6%	52.2%	53.0%	53.7%	53.4%	53.5%
SDEMOBENCH05 Volunteered - past 12 months	22.6%	24.0%	33.6%	30.0%	31.5%	28.5%	26.2%	27.1%	26.8%
SDEMOBENCH06 Voted in last local election	52.3%	56.7%	62.9%	62.8%	62.8%	53.1%	53.0%	53.1%	53.1%
SDEMOBENCH07 Speaks other than English at home	22.8%	19.1%	15.5%	18.5%	17.3%	17.0%	22.3%	20.2%	20.9%

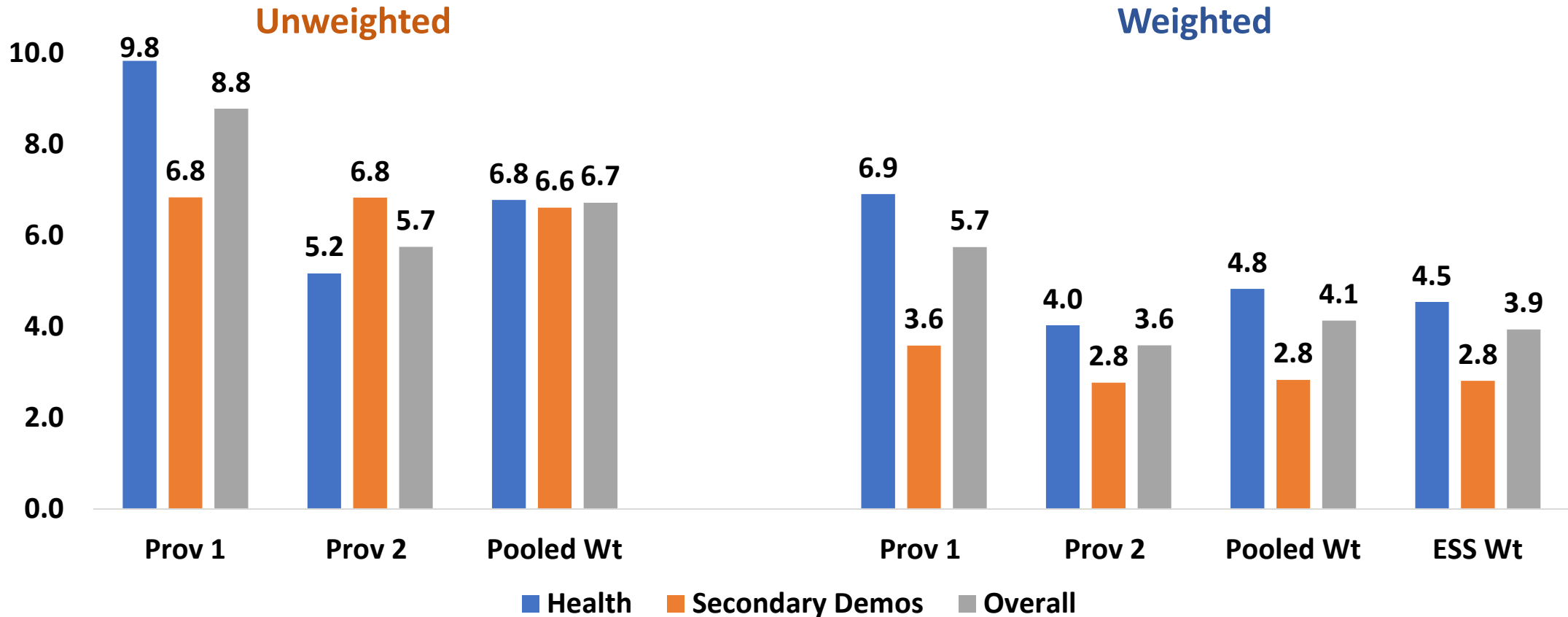
# Round 1 Results – Bias by Group

**Weighting reduced bias in all groups. However, Provider 1 had higher average bias, which increased bias when pooled with the lower bias Provider 2.**



# Round 2 Results – Bias by Group

Replicating Round 1, weighting reduced bias for all groups. However, Provider 1 again had higher average bias, which increased bias when pooled with the lower bias Provider 2.





# Discussion



# Discussion and Conclusions

**In Round 1 and Round 2, the average bias of Provider 1 after weighting was about 50% higher than Provider 2 (4.6% vs. 3.1% in RSS1 and 5.7% vs. 3.6% in RSS2). When using both the Pooled weight and the ESS weight (which incorporated the samples' effective sample sizes), blending the samples did not lead to a reduction of bias below that of Provider 2.**

**We should also note that the Pooled weight was not much higher in bias than the Combined weight (about 0.2% difference in each study).**

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# Discussion and Conclusions

**We often encounter the need to blend samples, sometimes blending probability with other probability samples or with opt-in samples.**

**Based on this study, a probability sample is not a guarantee of quality – there are differences in bias in the probability world just as there are in the opt-in world. When blending samples, we have to consider the sample’s number of participants and bias more than other factors. However, it appears that just because a sample is less efficient (higher weighting variability), that does not indicate it would be of lower quality once weighted.**

**It is our conclusion that the field does not yet have an optimal solution to blending samples – when a more biased sample has higher efficiency and more completes, it will create a combined final sample with higher bias, which is not typically the goal of blending.**

**Thank you!**

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