Results of a Pilot Post-BRFSS (Behavioral Risk Factor Surveillance System) Survey in the City of Hartford, Connecticut

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INTRODUCTION: A pilot survey in Hartford, Connecticut was conducted to determine if the Connecticut Behavioral Risk Factor Surveillance System (CT BRFSS) could be appended with local area questions to obtain town-level population-based estimates of health indicators. **METHODS:** The post-BRFSS survey was conducted from July 1, 2015 through December 31, 2015, using questions determined to be priorities within the city. Topics included the built environment, emergency medical treatment, health literacy, oral and mental health, and domestic abuse. A total of 338 Hartford residents who participated in the CT BRFSS during this time period were invited to participate in the post-BRFSS survey. Raking, propensity scoring, and adjustment for non-response bias were weighting strategies compared for generating population-based citywide estimates. **RESULTS:** The response rate for participation in the post-BRFSS survey was 55%, in which 176 respondents to the CT BRFSS agreed to participate in the post-BRFSS survey. Among those questions with sufficient power, weights created by either raking or propensity scoring, and non-response adjustment, produced comparable percent prevalence estimates and measures of variability. Valid estimates with an expected percent prevalence of at least 30% and 46% were possible with sample sizes of 338 and 176, respectively. **CONCLUSIONS:** A methodology has been developed that can be used to append local area questions to the CT BRFSS survey and to generate population-based estimates in Hartford from questions in both the CT BRFSS and post-BRFSS surveys. Multiple combined years of responses would be needed to obtain valid estimates with a wide range of percent prevalence values.

Introduction

The Connecticut Behavioral Risk Factor Surveillance System (CT BRFSS) has been offered within the state since 1989 under management of the Connecticut Department of Public Health (DPH). The survey is offered to adult residents of the state (18 years and older), and both landline and cell phone numbers are selected at random to participate in the survey.

Conducted through a cooperative agreement with the U.S. Centers for Disease Control and Prevention (CDC; *www.cdc.gov/BRFSS*), the CT BRFSS is funded by many health programs within DPH and includes questions of emerging public health relevance, as well as a variety of public health topics for state program assessment and evaluation.

During the 2015 survey year, an increase in sample size occurred with funding from the State of Connecticut Preventive Health and Health Services Block Grant and the

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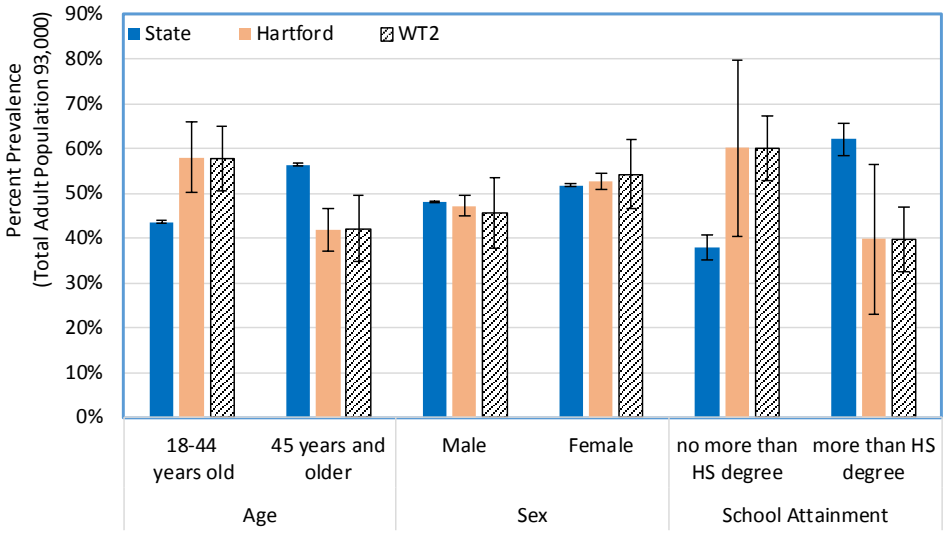
Figure 1
Demographics of the State *versus* City of Hartford



Source: State and Hartford: American Community Survey (ACS), 2014, 5-year estimates for Connecticut (blue) and City of Hartford (orange) (Table B15001); WT2: Demographic estimates obtained from WT2 weights (hatched) for Hartford, as described in **Methods** section. All estimates are shown with a 90% margin of error.

Connecticut State Innovations Model grant. This increased sample size made possible for the first time the possibility of responding to the growing need for public health data within local areas of the state, including health departments and health districts, to monitor the health and wellbeing of their communities.

The State of Connecticut generally enjoys wealth, with an overall median household income of $69,461 in calendar year 2013 [1]. Some local areas of the state, however, fare less well. For instance, the City of Hartford had a median household income in 2013 of only $29,430, a value less than half that of the state overall. Other local areas of the state suffer similar income disparities.

Local areas of Connecticut also differ from the state overall in population demographics. For instance, compared to the state overall, the City of Hartford has a significantly greater distribution of young adults (**Figure 1**). Whereas adults 18-44 years old comprise 43.6% of the state overall, 58.0% of the City of Hartford residents are within this age group. Further, whereas 38.0% of state residents have no more than a high school degree, 60.2% of Hartford residents have a low educational level.

Age and educational attainment are significant factors in many risk and protective behaviors that impact health and wellbeing. It is important, therefore, to understand the prevalence of health indicators within local areas of the state to inform both local and state population health programs.

This report describes the results of a pilot project conducted of respondents in the 2015 CT BRFSS survey who live in Hartford. The pilot project was conducted to obtain citywide population-based estimates of selected public health indicators. Weighting strategies are also compared to generate valid estimates for the city.

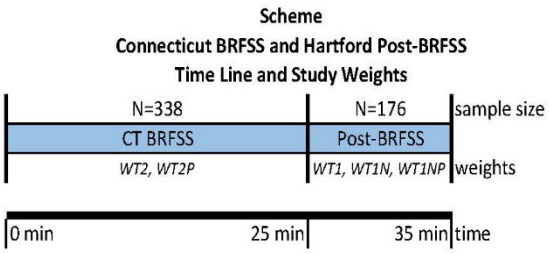
Methods

Question Set

During the months of April through June, 2015, DPH worked with staff within the City of Hartford Department of Health and Human Services (HHS) to develop a set of health questions of relevance to the City. The question set was limited to ten minutes in total length. Staff within HHS prepared and prioritized the set of questions, many of which were identified to monitor the three priorities of the Community Health Improvement Plan, a five-year, city-wide plan to develop a roadmap that highlights partnerships, community actions, and structural changes in the city [2]. Technical assistance was provided by staff within DPH to identify possible questions that related to the priority topics, and to assist with identification of questions that have been previously used for the BRFSS, either within Connecticut, or in other states. The final set of questions offered in the post-BRFSS survey is shown in the **Appendix**.

Survey Protocol

The final set of selected post-BRFSS questions was appended to the statewide 2015 CT BRFSS survey (**Scheme**). During the 2015 CT BRFSS survey, a question was asked of each respondent about their town of residence, "What town do you live in?" From July 1, 2015 through December 31, 2015, those who reported living in the City of Hartford were asked at the end of the survey if they were willing to stay on the phone to participate in the post-BRFSS survey. A $5.00 gift coupon was offered upon completion of the survey. During this time period, a total of 338 Hartford residents participated in the CT BRFSS, and the pilot survey was offered to these respondents.



The CT BRFSS is conducted in both English and Spanish, and the Hartford questions were also conducted in these two languages. The survey was conducted by trained interviewers through a state contract with ICF International (Fairfax, Virginia; *http://www.icfi.com/*). A contract amendment was executed to conduct this pilot project (state contract number 2013-0153).

The CT BRFSS has been classified as exempt by the DPH Human Investigations Committee (protocol number 54E), and the BRFSS for all participating states in the country is also approved by the CDC Human Research Protection Office (protocol number 2988.0).

Variable Construction

One health indicator selected from the CT BRFSS that was used for evaluating local area weighting methodologies was health care coverage. Prevalence estimates for this indicator were obtained from a question on the CT BRFSS, "Do you have any kind of health care insurance coverage, including health insurance, prepaid plans such as HMOs, government plans such as Medicare, or Indian Health Service?" Positive responses were coded as having health care insurance. The question was asked of all participants in the survey. The indicator was used because of the availability of an independent measure of health insurance coverage in the city, obtained from the American Community Survey (U.S. Census Bureau) [3].

Other health indicators used to evaluate the pilot project were: Current asthma, diabetes prevalence, current cigarette smoking, obesity, poor physical health at least 14 days in the past month, at least one personal doctor, flu and pneumococcal vaccination in the past year, depression prevalence, and medical checkup in the past year. More information about construction of these variables can be found in the 2014 BRFSS Summary Report [4].

Questions from the post-BRFSS survey, and the variables constructed from them, were created as shown in the **Appendix** and were calculated to create, whenever possible, a balance in the number of responses. This was done to maximize the number of questions for which a valid prevalence estimate could be generated.

All responses of "Don't Know" or "Refused" were classified as missing. All analyses were conducted with SAS (Statistical Analysis System; Cary, North Carolina).

Estimates shown in this report had a coefficient of variation (CV) less than 15%, and for the purposes of this report were considered to be valid estimates. Estimates with a CV of 15% or more were not reported.

Weight Construction

Design weights were constructed for two groups of responses: The CT BRFSS sample of Hartford respondents (N=338); and the post-BRFSS sample (N=176). Weights were calculated in four steps: 1) Calculate cell and landline design weights, 2) Combine the cell phone and landline samples, 3) Adjust for nonresponse to the Hartford related questions, and 4) Adjust (calibrate) the sample to match population distributions. For the sample of responses from the CT BRFSS (N=338), two calibration methods were evaluated, one based on raking to population controls (as described for the statewide BRFSS methodology used by CDC [5]; WT2), and a second based on a propensity score model to group respondents based on the likelihood of response to the survey (WT2P). For the sample of responses obtained from the post-BRFSS survey (N=176), two calibration methods were evaluated, with a non-response adjustment (WT1, WT1N and WT1NP).

The reference population for both methods was the 2010-2014 American Community Survey (ACS) Public Use Microdata Sample (PUMS) [6].

Sampling weights were created that corrected for disproportionate probabilities of selection. Separate design weights were created for the landline and cell phone interviews, and then averaged to create a composite weight. The landline weight was calculated as:

DESIGN_WT= (NRECSTR/NRECSEL) x (ADULTS/PHONES), where

NRECSTR = total number of records on frame
NRECSEL = total number of records selected
ADULTS = number of adults in the household
PHONES = number of telephone lines in the household.

The variables ADULTS and PHONES were capped at three to reduce weight variability.

The cell phone weight was calculated as:

DESIGN_WT = (NRECSTR/NRECSEL)

The statewide BRFSS sample design is a fully overlapping landline and cell phone dual frame, in which both cell phone and landline phone users overlap and are eligible to be surveyed in either sample. To account for this overlap, a composite weight was created. The composite factor (c) is based on the effective sample sizes needed to minimize variability for the combined sample.

The composite weight is a ratio of the effective sample sizes, c = neff1 / (neff1+ neff2), where

neff=n/deff is the effective sample size

deff = n x Σ(DESIGN_WT^2) / (ΣDESIGN_WT)^2 is a measure of variability of the design weights and n is the sample size for each group. The landline design weight is multiplied by c, where $0 < c < 1$ and the cell phone design weight by (1-c).

Before averaging the landline and cell samples, each sample was adjusted individually to match the estimated number of cell-only and landline population based on the estimated cell-only percentage (25%) from Marketing Systems Group (MSG). The MSG cell-only estimate was calculated by subtracting the estimated landline households from the estimated telephone households. The dual-frame adjustment was conducted for Hartford County, assuming an adult population size on July 1, 2014 of 698,394 [7], since the cell-only estimates were not available below the county level. The dual user adjustments were calculated as follows:

Cell-only: DUAL_ADJ = (698,394 x 25%) / **Σ(**DESIGN_WT)

Dual-user (cell phone): DUAL_ADJ = (698,394 x 75%) / Σ(DESIGN_WT) x (1-c)

Dual-user (landline phone): DUAL_ADJ = (698,394 x 75%) / Σ(DESIGN_WT) x (c)

A subset of residents from Hartford who participated in the CT BRFSS elected to also participate in the post-BRFSS survey. To account for differences in key health statistics between those who participated in the survey and those who did not, an adjustment for nonresponse bias was made. Logistic regression was used to estimate the probability that the Hartford respondents completed the Hartford related questions. The predictor variables included demographics and key health statistic:

Demographics	**Health Statistic**
Gender	Smoking status
Age	Asthma
Race/Ethnicity	Diabetes
Home Ownership	Obesity
Educational Attainment	Insurance status

Respondents (N=176) and non-respondents (N=162) were grouped into quintiles based on the predicted probabilities. Weights were then adjusted to account for the non-respondents.

As the final weighting step, the combined sample was post-stratified into demographic categories, and the weights were ratio-adjusted so that the final weighted sample matched the population with respect to the demographic characteristics. Two different methods of calibration were used: Raking and propensity score.

The raking algorithm iteratively calibrated the weighted sample to the population on these dimensions: Age (18-24; 25-34; 35-44; 45-54; 55-64; 65-74; 75+) by gender; Race/ethnicity (Hispanic; non-Hispanic white; non-Hispanic black; non-Hispanic other/multi); Education (less than high school; high school graduate; some college; Bachelor's degree or more); Marital Status (married; widowed, divorced or separated; never married); and Tenure (own house; do not own house).

The propensity score method also calibrated the sample to the population by modeling the probability of observing the respondent in the dual frame sample versus observing them in the ACS PUMS sample. The predictor variables were the same as used in the raking algorithm. Based on the probabilities, dual-frame respondents were the ACS respondents and were categorized into quintiles, and the dual-frame

Table I
Population Controls and Calibration Results, Hartford City Respondents (N=338)

Demographic	2010-2014 ACS		Raking	Propensity Scoring	Demographic	2010-2014 ACS		Raking	Propensity Scoring
	N	%	%	%		N	%	%	%
Male	38,941	45.7	45.7	45.3	18-24[2]	14,707	17.3	15.2	17.3
Female	46,251	54.3	54.3	54.7	25-34	18,745	22.0	24.1	20.7
Hispanic	36,845	43.2	43.3	45.0	35-44[3]	14,678	17.2	18.0	16.0
NH White	13,296	15.6	17.1	17.2	45-54	14,521	17.0	16.3	18.8
NH Black	30,488	35.8	35.8	34.0	55-64	11,260	13.2	13.2	13.7
NH Other[1]	4,563	5.4	3.9	3.9	65-74	6,661	7.8	7.8	7.9
Married	23,249	27.3	27.3	27.3	75+	4,620	5.4	5.4	5.6
Single/never married	44,053	51.7	51.7	51.2	Less than High School	25,430	29.9	29.9	27.9
Widowed/divorced/separated	17,890	21.0	21.0	21.5	High School Graduate	25,868	30.4	30.4	28.7
Owner	23,290	27.3	27.3	25.3	Some college	22,305	26.2	26.2	30.7
Renter	61,902	72.7	72.7	74.7	College Graduate	11,589	13.6	13.6	12.7

[1] - Non-Hispanic Other race was collapsed with non-Hispanic White; [2] - 18-24 year olds were collapsed with 25-34 year old for males and females; [3] - 35-44 year olds were collapsed with 45-54 year olds for males.

2010-2014 ACS - American Community Survey estimates for Hartford, 2010-2014 combined.

respondents were weighted to match the ACS respondents. The adjustment for each quintile would remove approximately 90% of the bias in the distributions [8].

Final weights to compare the raking and propensity scoring methodologies (WT2 *versus* WT2P, WT1N *versus* WT1NP), and weights to compare estimates with and without non-response adjustment (WT1 *versus* WT1N) were prepared as follows:

WT2 = DESIGN_WT x DUALADJ x RAKEADJ

WT2P =DESIGN_WT x DUALADJ x PROPADJ

WT1 = DESIGN_WT x DUALADJ x RAKEADJ

WT1N = DESIGN_WT x DUALADJ x NRADJ

WT1NP = DESIGN_WT x DUALADJ x NRADJ x PROPADJ

As expected, both the raking and propensity scoring resulted in demographics that were very similar to the 2010-2014 ACS population controls (**Table I**).

Weight Comparison and Analysis

For each weight generated (WT2, WT2P, WT1, WT1N, and WT1NP), percent prevalence estimates (% Prev), standard errors of the percent prevalence (SE), and coefficients of variation (CV) were generated, using the SAS program SURVEYFREQ procedure. All analyses were conducted as previously described by CDC for BRFSS datasets [9], using stratification variables of geography and population density. There were seven strata for WT2, WT2P, and WT1NP, and six strata for WT1 and WT1N.

Weighting methodologies were compared using SE and CV, as well as root mean squared error (RMSE). Whereas SE and CV were obtained directly from the SAS program, RMSE was calculated by $RMSE = \sqrt{SE^2 + (\%\ Prev_{BRFSS} - \%\ Prev_{ACS})^2}$.

Table II
Comparison of Weighting Strategies for Health Insurance Coverage
Adults 18 years old and older, Hartford, July 1, 2015 - December 31, 2015

N	Weight	% Prev	SE	CV (%)	RMSE (%)
338	WT2	89.8%	3.25%	3.61%	5.13%
	WT2P	89.7%	3.22%	3.59%	5.03%
176 Post-BRFSS	WT1	92.5%	3.08%	3.34%	7.35%
	WT1N	93.0%	2.88%	3.10%	7.73%
	WT1NP	92.9%	3.13%	3.37%	7.73%
USCB (2014)		85.8%	15.11%		

% Prev - percent prevalence estimate; SE - standard error of the prevalence estimate; CV - coefficient of variation of the prevalence estimate (%); RMSE - root mean squared error (%).

USCB - Estimate of healthcare insurance coverage for Hartford adults (18 years old and older) obtained through the American Community Survey (ACS), 1-year estimate, by the U.S. Census Bureau (Table B27001). The sample size upon which the estimate was generated is not known.

SE, CV, and RMSE were obtained for different weighting strategies, among all residents who particpiated in the CT BRFSS (WT2 and WT2P), and among those residents who participated in the post-BRFSS survey (WT1, WT1N, and WT1NP), as described in the **Methods** section.

Estimates of population demographics obtained from generated weights were compared to those obtained from the 2014 ACS 1-year estimates, the most recent year for which population estimates were available for Hartford. An estimate of health care insurance coverage in Hartford was also obtained from the 2014 ACS 1-year estimates. Margin of errors (ME) from the ACS, when unavailable directly, were estimated as the weighted average of individual ME by demographic.

Statewide estimates of selected health indicators were calculated as described in prior documents [4], and were based on a preliminary 2015 BRFSS dataset. Weights for the 2015 survey year were not yet available from the CDC.

Power analysis was conducted with PROC POWER for a one simple, for margins of error that ranged from 1% to 5.5%, and sample sized that ranged from 150 to 600. Analysis was conducted for percent prevalence values of 10%, 20%, 30%, and 40%.

Results

Sample Size

Among 338 Hartford residents who participated in the CT BRFSS, 176 residents agreed to participate in the post-BRFSS pilot survey, representing a response rate of 55%. Of this number, all but three completed the survey (98% completion rate). The three partially completed responses were combined with the completed responses for this study.

Weighting Strategies

Weights obtained from the raking technique (WT2) were used to estimate percent prevalence by sex, age, and educational status in the City of Hartford. The estimates were not statistically different from the 2014 ACS 1-year population estimates for the city (**Figure 1**), the most recent year for which population estimates were available for Hartford. The estimates of percent prevalence, however, were significantly different from the overall statewide estimates.

Table III
Comparison of Weights for Selected Health Indicators from the CT BRFSS
City of Hartford and Connecticut, 2015

Indicator	Hartford (WT2; N=338)				Preliminary State (N=11,888)				Risk Difference	
	n	% Prev Est	% SE	CV (%)	n	% Prev Est	% SE	CV (%)	RD	p-value
current asthma	52	*	*	22.22%						
told have diabetes	67	*	*	19.47%						
current cigarette smoking	54	*	*	17.76%						
obesity (BMI at least 30.0)	107	29.3%	4.3%	14.75%	2,837	23.4%	0.6%	2.39%	5.9%	0.0475
poor physical health at least 14 days in past month	63	*	*	20.72%						
at least one personal doctor	290	77.2%	4.2%	5.50%	10,687	85.7%	0.5%	0.63%	-8.5%	<0.0001
flu vaccine in past year	140	39.5%	5.0%	12.76%	5,539	46.5%	0.7%	1.53%	-7.0%	<0.0001
ever had pneuococcal vaccine	115	35.3%	5.2%	14.60%	3,962	33.1%	0.7%	2.06%	2.2%	0.117
told have depression	71	*	*	17.87%						
medical checkup in past year	270	70.3%	4.6%	6.56%	9,219	73.1%	0.6%	0.86%	-2.8%	0.0951

n - frequency of responses; N = total sample size; Prev Est - percent prevalence estimate; SE - standard error of the prevalence estimate; CV - coefficient of variation of the prevalence estimate (%)

particpiated in the CT BRFSS (WT2), and compared to prevalence estimates obtained among those all residents in the state, using a preliminary 2015 BRFSS dataset.

Risk differences (RD) were calculated for Hartford *versus* Statewide estimates, and tested for significantly greater or lesser risk, as descrbied in the **Methods** section.

* - Estimate not valid because CV was at least 15%.

These data indicate that the raking methodology produced population-based estimates that reflect the population distribution of Hartford, and produced estimates that can be compared statistically with those of the state.

Hartford Prevalence Estimates from the CT BRFSS

Estimates of percent prevalence within Hartford of having health care insurance were measured with each weighting strategy (**Table II**). Among the CT BRFSS responses (N=338), estimates of percent prevalence for health care insurance varied slightly from 89.8% (SE = 3.25%) with WT2 to 89.7% (SE = 3.22%) with WT2P. The standard errors between the two estimates were very similar, with a WT2-to-WT2P variance ratio of 1.017, a value that was insignificant (p = 0.438). The CV and RMSE values were also very similar. These data indicate that the raking method (WT2) and propensity scoring method (WT2P) were comparable, with a similar likelihood of producing valid population-based estimates.

A comparison of the three weighting strategies used with the subset of responses obtained from the post-BRFSS (N=176) are also shown in **Table II**. The prevalence of health care insurance obtained with WT1 (raking method) was 92.5% (SE = 3.08%), while the estimate obtained after adjustment for non-response was 93.0% (SE = 2.88%). The estimate obtained when non-response adjustments were made with propensity scoring (WT1NP; 92.9% SE = 3.13%) was similar to that obtained without propensity scoring (WT1N). The variance ratios among the three weighting strategies did not differ significantly. Further, all three methods of weighting (WT1, WT1N, and WT1NP) produced percent prevalence estimates that were similar to those produced for the larger sample (WT2 and WT2P), with comparable RMSE values.

Table IV
Post-BRFSS Hartford Questions, 2015
N=176, weight = WT1N

Indicator	n	% Prev Est	% SE	CV (%)
1. Very/somewhat pleasant neighborhood for walking	141	78.0%	5.97%	7.66%
2. Good/Very good street lighting for walking	99	55.5%	6.86%	12.35%
4. Go to private or public clinic for medical care	111	59.0%	6.73%	11.41%
5. ER used when not needed	59	*	*	15.61%
6. Delayed medical care for any reason	52	*	*	18.81%
7. Provider gave advice about lifestyle changes at last visit	92	56.4%	6.93%	12.28%
9. Dental visit in the past year	129	77.9%	6.16%	7.91%
11. Very confident filling out medical forms	100	56.8%	6.91%	12.16%
12. No problems learning from written materials	85	49.6%	6.98%	14.08%
13. Little interest or pleasure in past two weeks	77	46.5%	6.97%	14.98%
14. Felt down, depressed, or hopeless in past two weeks	53	*	*	19.57%
15. No more than 2 hrs daily watching TV	71	53.2%	6.78%	12.74%
16. No more than 2 hrs daily playing video gams	141	79.5%	5.74%	7.22%
17. East meals away from home at least twice weekly	69	51.3%	6.91%	13.48%
18. Buy fresh fruits & vegetables in neighborhood	134	86.5%	3.59%	4.14%
25. Helped an older person reduce the chance of a fall in past year	70	*	*	16.38%
Composite Abuse Score, any type of partner abuse	44	*	*	16.55%
31. Partner tried to keep track of you	25	*	*	23.94%
32. Partner made threats of harm to you	21	*	*	30.26%

Prev Est - percent prevalence estimate; SE - standard error of the prevalence estimate; CV - coefficient of variation of the prevalence estimate (%)

residents who participated in the post-BRFSS survey (WT1N), as described in the **Methods** section. Questions with a frequency of responses less than 20 were not evaluated. Follow-up questions and questions that were directed toward subpopulations were also not evaluated.

* - Estimate not reported because CV was at least 15%.

The estimated percent prevalence of adults in Hartford with health care insurance obtained from the ACS was 85.5% (SE = 15.11%; **Table II**). This estimate was lower than expected, with a higher standard error than estimates obtained from the CT BRFSS. These data suggest that the weighting strategies used in this study produced local area estimates of insurance coverage that were comparable, and that all methods produced percent prevalence estimates of insurance coverage in Hartford that were more valid than the estimate produced from the ACS 1-year estimates.

To further evaluate estimates obtained from WT2 weight, selected health indicators from the CT BRFSS were generated for the City of Hartford (**Table III**). Health indicators with a response frequency less than 20 were not evaluated. Of the ten health indicators evaluated, five produced estimates with a CV less than 15%. The other five, with response frequencies of 52 to 71, did not produce valid estimates. Those indicators for which valid estimates were possible produced SE values that ranged from 4.2% to 5.2%.

Among the five health indicators for which valid estimates were possible, state level preliminary prevalence estimates were generated and compared to Hartford values (**Table III**). Absolute risk differences varied from 2.2% to 8.5%. Whereas the percent prevalence in Hartford of ever having had the pneumococcal vaccine was 35.3% (SE = 5.2%), the percent prevalence statewide was 33.1% (SE = 0.7%),

creating an absolute risk difference of 2.2%. This risk difference was not statistically significant (p = 0.117). In contrast, the percent prevalence of having at least one personal doctor and receiving the flu vaccine in the past year were significantly less in Hartford than within the state overall, with absolute risk differences of 8.5% and 7.0%, respectively (p < 0.0001). These data indicate that a six-month sample size of 338 was sufficient for obtaining prevalence estimates in Hartford of at least 29%, and that the associated standard errors allowed inferential comparison of risk differences as small as 2.8 percentage points.

Whereas five of the selected health indicators studied produced valid estimates from the CT BRFSS Hartford sample (N=338; **Table III**), only two valid estimates were generated from the post-BRFSS sample (N=176). The percent prevalence of having at least one personal doctor was 73.7% (SE = 6.62%), and the percent prevalence of having had a checkup in the past year was 77.3% (SE = 6.48%) (*data not shown*). These estimates using WT1N were similar to those obtained with WT2.

Hartford Prevalence Estimates from the Post-BRFSS Survey

Prevalence estimates for the post-BRFSS survey (N=176) were prepared using the weighting variable WT1N (**Table IV**). Of the 41 total questions offered in the survey, 19 could be evaluated. The remaining 22 questions had less than 20 responses. The lowest response frequency for which estimates were valid was 69, obtained for question number 17. Valid estimates were possible for prevalence estimates that were as low as 46.5% (question number 13).

Discussion and Public Health Implications

The pilot post-BRFSS described in this report and conducted in Hartford followed a protocol that produced a 55% response rate. The strategy also generated population-based weights that, with sufficient sample size, could be used to produce town-level population-based estimates of health indicators from both the CT BRFSS and post-BRFSS surveys.

The weighting methodologies evaluated in this study assigned a weight to each respondent of the CT BRFSS who reported living in Hartford. This approach allows all the information available from the CT BRFSS to be accessible for estimation within the City, and also makes available appended information selected specifically for the City to support its public health needs.

There is precedence for appending surveys to the CT BRFSS. The Asthma Callback survey has been offered for many years in and collects specific information about both adults and children with asthma. In 2013, the most recent year for which data are available, a total of 1,256 residents interviewed in the 2013 CT BRFSS reported ever having had asthma. Of these, 805 agreed to participate in the Asthma Callback survey (participation rate of 64%), but only 313 eligible residents later completed the survey, an overall completion rate of only 25%. The protocol for the Asthma Callback survey involves residents being contacted up to two weeks after completing the CT BRFSS.

The post-BRFSS survey described in this report for Hartford is unique for two reasons. First, it was offered to individuals who report living in a specific geographic area of the state. Second, participants remain on the phone for an additional time period after completing the CT BRFSS, with 100% participating in the survey.

This latter characteristic of the post-BRFSS eliminated the lag that occurs in the Asthma Callback survey, and resulted in a much higher response rate.

Estimates in Hartford using the methodologies described in this report from the CT BRFSS could be compared to overall statewide estimates (**Table III**), and could also be compared to other states in the country, as well as the nation. The methodologies produced valid estimates from both the CT BRFSS and post-BRFSS surveys (**Tables III** and **IV**), with an improved estimate of insurance status compared to another independent measure (**Table II**), and with estimated demographics that match the City of Hartford (**Table I** and **Figure 1**). Comparison among local areas of the state is also possible, however, this study was conducted only in Hartford. Other towns in the state were not evaluated, and the methodologies need to be studied in other local areas of the state.

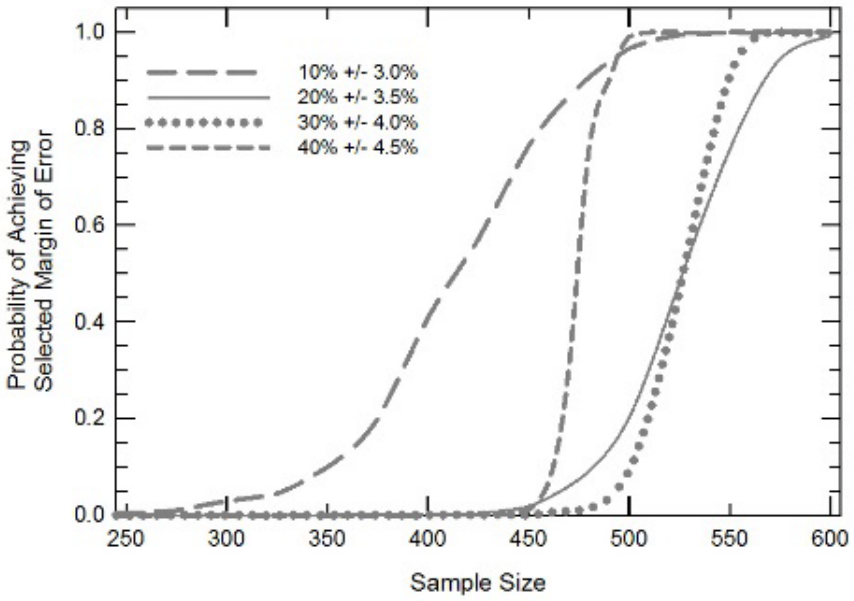
The weighting methodologies described in this report were comparable. Among the two methods examined for the CT BRFSS (WT2 and WT2P), the raking method (WT1) is the simplest to conduct. It is also similar to the method used by CDC to generate state weights for the CT BRFSS [5]. For these reasons, the raking method would appear to be the best for generating town-level weights from the CT BRFSS survey. Similarly, either WT1 or WT1N would appear to be the best methods for generating town-level weights from the post-BRFSS survey.

In addition to being able to evaluate a wide range of health topics by assigning a weight to each respondent, the weighting methodologies described in this report are superior to synthetic estimates, which simply use statewide estimates to extrapolate to the town level based on demographics [11-13]. The methodologies are also preferable to regression models developed previously with BRFSS data [14-17]. Estimates based on regression generate a single estimate for a selected health indicator based on demographics, accounting for demographics in the estimate, but without the ability to break it down by those demographics.

A limitation of the weighting methodologies evaluated in this study is that they require a sufficient sample size to obtain valid estimates. For this project, the sample size obtained for a six-month sample of Hartford residents was sufficient to estimate prevalence for a few health indicators with a prevalence of at least 46%. Even a full year of sample, which resulted in 464 Hartford responses, allowed only one additional valid estimate of the health indicators listed in **Table III** (data not shown). A larger sample size, such as combined multiple years of sampling or oversampling survey design, would be necessary to obtain a wider range of valid estimates in Hartford, and an even larger sample size would be needed to generate estimates by demographic characteristics. Follow-up questions based on responses to prior questions, as well as questions directed toward sub-populations, such as women or children, would also require larger sample sizes than those used in this study to obtain valid estimates.

A combination of CT BRFSS responses from years 2011 through 2015, may allow demographic breakdowns in Hartford of annual core health indicators. A sample of this size may also allow town-level comparisons across the state. Comparison of indicators such as cigarette smoking, obesity, general health and wellbeing, physical and mental health, and a variety of chronic conditions, as well as insurance status may be possible for many towns in the state. This ability would allow towns of high need to be identified for public health intervention, and would allow local health departments and health districts to more fully understand the needs within their communities.

Figure 2
Minimum Sample Size Needed for
Selected 90% Margin of Errors



Power analysis was conducted for expected percent prevalence values and 90% margin of errors (ME) of 10% (ME = 3.0%), 20% (ME = 3.5%), 30% (ME = 4.0%), 40% (ME = 4.5%). Sample size *versus* the probability of achieving the selcted margin of error for each percent prevalence is shown. Power calculations were conducted as described in the **Methods** section.

The combination of multiple years of data would eliminate the possibility of annual trend analysis. More work is needed to evaluate these possibilities.

As described above, the results described in this report were for samples sizes of 338 for the CT BRFSS responses in Hartford, and 176 for the post-BRFSS survey in Hartford. These sample sizes produced valid estimates for only a subset of selected health indicators. Prevalence estimates less than 46.5% were not possible with a sample size of 176, and estimates less than 29% were not possible with a sample size of 338. Power analysis indicates that percent prevalence estimates of 10%, such as that expected for diabetes [4], would be possible only within a 3.0% margin of error and only when the sample size is at least 500 (**Figure 2**). Similarly, prevalence estimates of 20%, with a margin of error of 3.5%, could only be produced with high probability when the sample size is at least 600. This sample size could produce a wide range of valid percent prevalence values.

This study demonstrates the feasibility of appending to the CT BRFSS questions specific to local areas of the state for the purposes of preparing prevalence estimates of health indicators of interest. The weighting methodology for generating population-based weights can also be used to provide estimates of health indicators offered in the body of the CT BRFSS, with sufficient sample size.

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Appendix Questions in the Post-BRFSS Pilot Survey in Hartford, July 1, 2015 - December 31, 2015			
Question	**Responses**	**Variable Construction**	**variable name**
For the first set of questions, please think about your neighborhood:			
1. Overall, how would you rate your neighborhood as a place to walk?	Very pleasant, somewhat pleasant, not very pleasant, not at all pleasant	very or somewhat pleasant, not very or not at all pleasant	Hbuilt
2. For walking a night, would you describe the street lighting in your neighborhood as…	Very good, good, fair, poor	very good or good, fair or poor	Hbuiltlight
3. How safe from crime do you consider your neighborhood to be?	Extremely safe, quite safe, slightly safe, not at all safe	Extremely/quite safe, slightly/not at all safe	Hbuiltsafe
This next set of questions are about your health and the health care you receive:			
4. If you were to get sick or need a medical professional, where would you go?	A doctor's office or private clinic, a community health center or other public clinic, a hospital emergency room, an urgent care center, a retail clinic like Walmart, some other place	doctor's office or private clinic or community center or other public clinic, other place	Hsickgo
5. The last time you went to a hospital emergency room, was it for a condition that you thought could have been treated by a regular doctor if he or she had been available?	yes, no, never been to a hospital emergency room	Yes, no	Hsicker
6. Have you delayed getting necessary medical care for any of the following reasons in the past 12 months?	you couldn't get through the telephone, you couldn't get an appointment soon enough, you did not have transportation, the office wasn't open when you got there, once you got there you had to wait too long to see the doctor, some other reason, did not delay care	yes for any reason, did not delay care	Hsickdelay
7. The last time you visited a healthcare provider, did he or she give you any advice to assist you in making changes in your habits or lifestyle that would improve your health or prevent illness?	yes, no	yes, no	Hmedadv
8. [follow up] Were you able to follow this advise?	yes, no		
9. How long has it been since you last visited a dentist or a dental clinic for any reason?	anytime less than 12 months ago, 1 year but less than 2 years ago, 2 years but less than 5 years ago, 5 or more years ago, never	anytime less than 12 months ago, at least 12 months ago	Hdentvst
10. [follow up] What is the main reason you have not visited the dentist in the last year?	fear, apprehension, nervousness, pain, dislike going; cost; don't have/know a dentist; cannot get to the office/clinic (too far away, no transportation, no appointments available); no reason to go (no problems, no teeth); other priorities; have not thought of it; other		
11.How confident are you in filling out medical forms for yourself? For example insurance forms, questionnaires, and doctor's office forms. Are you …	very confident, somewhat confident, not very confident, not confident at all	very confident, somewhat or not very or not at all confident	Hmedform
12. How often do you have problems learning about health conditions because of difficulty in understanding written information?	always, usually, sometimes, rarely, never, not applicable	never, always or usually or sometimes or rarely	Hmedlearn
13. Over the past 2 weeks, how often have you had little interest or pleasure in doing things?	not at all, several days, more than half the days, nearly every day	not at all, several or more than half or nearly every day	Hpleas
14. Over the past 2 weeks, how often have you felt down, depressed or hopeless?	not at all, several days more than half the days, nearly every day	not at all, several or more than half or nearly every day	Hdepress
This next set of questions is about activity that affect health:			
15. On an average day, not including time on the computer, about how many hours did you wat tv, videos, or DVD?	respondent selects 1-24 hours, none	none or no more than 2 hours, more than 2 hours	Htv
16. On an average day, about how many hours did you spend on the computer or playing video games?	respondent selects 1-24 hours, none	none or no more than 2 hours, more than 2 hours	Hvideo
17. During the past 7 days, how many meals did you get that were prepared away from home in places such as restaurants, fast food places, food stands, grocery stores, or from vending machines?	respondent select 1-76, none	none or less than twice weekly, at least twice weekly	Hfastf
18. Do you buy all your fresh fruits and vegetables within your community or neighborhood?	yes, no	yes, no	Hfoodbuy

19. [follow up] What is the main reason you or someone in your household does not buy all your fresh fruits and vegetables within your community or neighborhood?	there are no stores in the neighborhood, the stores in the neighborhood are poor quality fruits and vegetables, the stores in the community are too expensive, the stores in the neighborhood have poor quality service, feel uncomfortable in stores within the neighborhood, you don't cook, you don't eat fruits and vegetables, some other reason		
20. [among respondents who breastfed selected child] Previously you indicated that your child was breastfed. Thinking about when you stopped breastfeeding, what were the reasons for stopping breastfeeding? (tell all that apply)	did not want to/chose not to, did not know how to, mother's medication, mother's medical conditions, infant's medical conditions, breast soreness and/or pain, problem with milk supply, other		
Now I'd like to ask you some questions related to your reproductive health. Please keep in mind that if you feel uncomfortable with any question, you can skip it:			
21. [among adults 50 years old or less] What are you or your spouse or partner doing now to keep you from getting pregnant?	female sterilization, male sterilization, contraceptive implant, hormonal IUD, copper-baring IUD, other type of IUD, shots/injections, birth control pills, contraceptive patch, contraceptive ring, male condoms, diaphragm/cervical cap/sponge, female condoms, not having sex at certain times, withdrawal, foam/jelly/film/cream, emergency contraception, other, not currently doing anything		
Now I have some questions on motor vehicles, falls, and injuries:			
22. During the past 30 days, on how many days did you text or e-mail while driving a car or other vehicle?	0 days, 1-2 days, 3-5 days, 6-9 days, 10-19 days, 20-29 days, all 30 days	0 days, at least 1 day	Htext
23. Have you ridden a motorcycle in the past year?	yes, no	yes, no	Hmoto
24. [follow up] When you ride your motorcycle, how often do you wear a helmet?	always, nearly always, sometimes, seldom, never		
25. In the past 12 months, have you don't anything to help an older person reduce his/her chance of falling?	yes, no	yes, no	Helderfall
26. [follow up among adults at least 55 years old] In the past 12 months, have you done things to reduce your chance of falling?	yes, no		
Now I will ask some questions about smoking:			
27. During the past 7 days, how many days did anyone smoke anywhere inside your home?	respondent selects 1-7, none	none, at least one	Hsmoke
28. [among those who smoke] If you decided to give up smoking altogether, how likely do you think you would be to succeed?	very likely, somewhat likely, not at all likely		
My last set of questions is about violence in relationships. Please keep in mind that if you are uncomfortable with any question, you can skip any question that you do not want to answer:			
29. Have any of your romantic or sexual partners ever tried to keep you from seeing or talking to your family or friends?	yes, no	yes, no	Hsee
30. …ever made decisions for your that should have been yours to make, such as the clothes you wear, things you eat, or the friends you have?	yes, no	yes, no	Hdecide
31. …kept track of you by demanding to know where you were and what you were doing?	yes, no	yes, no	Htrack
32. …made threats to physically harm you?	yes, no	yes, no	Hthreat
33. …threatened to hurt him or herself or commit suicide when he or she was upset with you?	yes, no	yes, no	Hself
34. …threatened to hurt a pet or threatened to take a pet away from you?	yes, no	yes, no	Hpet
35. …threatened to hurt someone you love?	yes, no	yes, no	Helse
36. …hurt someone you love?	yes, no	yes, no	Hlove
37. …threatened to take your children away from you?	yes, no	yes, no	Hchild
38. …kept you from leaving the house when you wanted to go?	yes, no	yes, no	Hleave
39. …kept you from having money for your own use?	yes, no	yes, no	Hmoney
40. …destroyed something that was important to you?	yes, no	yes, no	Hdestroy
41. …said things like "If I can't have you, then no one can."	yes, no	yes, no	Hsaid
Composite score for partner abuse	calculated from responses of "yes" to any question	yes, no	Habuse
Variables were not constructed for follow-up qustions offered to a subset of respondents, either based on demographics on responses to prior questions.			