Supplementary Online Content

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This supplementary material has been provided by the authors to give readers additional information about their work.

eAppendix: Technical Appendix and Sensitivity Analyses

Near/Far Matching

A major concern in evaluating the effect of SNAP participation on healthcare expenditures is selection bias—those who choose to enroll in SNAP may be different from similarly eligible individuals who do not. Some of that difference is likely due to observable factors such as age, income, health insurance, and illness, but other factors that drive enrollment may remain unobserved. To address selection bias, we used an instrumental variable approach called near/far matching.[1-3] Instrumental variable analysis uses instruments to help overcome issues of selection bias related unobservable factors. A suitable instrument is one that a) influences receipt of the treatment, and b) where all causal pathways between the instrument and the outcome, other than through the treatment of interest, can be blocked or do not exist. In other words, an instrument should, conditional on observable factors, affect the outcome only by influencing the receipt of the treatment. This functions analogously to treatment allocation in a randomized clinical trial. In this study, our instruments were policy variables that make it easier or harder to enroll in SNAP when one is eligible. While SNAP eligibility is broadly similar at a national level, SNAP is administered by each state, and differences in state policy, such as the presence of an online application, or the requirement to provide fingerprints when enrolling, can influence the ease of SNAP enrollment. In this sense, these instruments serve as 'nudges', or forms of 'encouragement' or 'discouragement', that may help or hinder an eligible individual considering applying for SNAP. Because state-level variation in how easy or hard it is to sign up for SNAP should influence whether one signs up for SNAP, but should not otherwise be related to healthcare expenditures, conditional on observable features about the states and individuals, these policy variations are theoretically justified instruments. These policies were abstracted from the SNAP policy database[4] and in effect over the 2011 NHIS survey recall period. The policies used were 1)an option for online submission of a SNAP application, 2)presence of a broad-based categorical eligibility policy (which extends SNAP eligibility to those eligible for other assistance programs, such as Supplemental Security Income (SSI)), and 3) whether the state uses simplified reporting requirements for households with earnings (which reduces the burden of qualification paperwork).[4] Further, these instruments have been used and validated in prior studies of SNAP.[5,6] The 'near/far' matching type of instrumental variable analysis combines elements of nearest neighbor matching and traditional instrumental variable techniques. Using a probabilistic simulated annealing algorithm[7] that finds the optimal nonbipartite match[8], and prior to examining the outcome, study participants are matched, using the Mahalanobis distance of the vector of their covariates, to be as similar as possible ('near') on observable characteristics that may influence the outcome, but as dissimilar as possible ('far') on the values of the instrument.[3] This essentially filters a cohort to reveal its most informative pairs—those who are sociodemographically and clinically as similar as possible, but who differ on whether they were 'encouraged' or 'discouraged' to enroll in SNAP. This design uses differences in receipt of 'encouragement' to enroll in SNAP to yield an effect estimate for SNAP receipt that is not confounded by unmeasured factors which influence both SNAP receipt and healthcare expenditures, and thus mirrors a matched-pairs randomized clinical trial.

To test the instrumental variables, we examined their association with SNAP receipt in a logistic regression model and checked they were not correlated with other state-level factors that may affect the outcome, such as per beneficiary Medicaid expenditures[9] or state Temporary Aid to Needy Families

benefit generosity.[10] We conducted Sargan and Basmann tests of overidentifying restrictions, which test whether the residuals in the first stage model are correlated with the instruments (they should be uncorrelated to be valid instruments). Because weak instruments can lead to biased effect estimates, we also evaluated the first-stage statistic of the instruments, using a cut-off > 13 to indicate a sufficiently strong instrument. Finally, we conducted the Durbin-Wu-Hausman test for endogeneity, to determine whether instrumental variable methods were truly needed. To examine the precision of the match, we evaluated absolute standardized differences between the means of the covariates in those 'encouraged' vs. 'discouraged' to enroll in SNAP. An absolute standardized difference > 0.2 represented a concerning imbalance in matching.

Tests of instrumental variable assumptions

For our instrumental variable (IV), an index of SNAP policies in place in a given state as of 1/1/2010 (i.e. in place at the beginning of the lookback period regarding SNAP receipt in 2011 NHIS), weighted by their partial f-statistic from a model predicting SNAP receipt, we conducted several tests of the instrumental variable assumptions, summarized in the table below. Because our IV used state level SNAP policy information, we wanted to examine other state level factors that may be correlated with the IV, to lend confidence to the assumption that the IV is associated with the outcome only through receipt of SNAP (we also adjusted for state-level fixed effects in both stages of the IV analysis to account for this as well). We first calculated an intraclass correlation (ICC) between individual-level healthcare expenditures and the states those individuals lived in. This revealed that that state of residence, apart from individual-level factors like health insurance or SNAP receipt, explained little variation in healthcare expenditures—only 0.6% (95% confidence interval 0.3% to 1.2%). We next examined whether the IV was correlated with state level Medicaid spending per beneficiary, using Medicaid expenditure data from the Kaiser Family Foundation, or maximum Temporary Aid for Needy Families (TANF) benefit for a single parent caring for 2 children, an indicator of state TANF generosity. Unlike SNAP where benefits are set at the federal level, states have broad leeway in setting TANF levels, and so this can indicate the 'generosity' of TANF, and potentially other, social service programs in the state. Using Spearman correlations, the IV was weakly and not statistically significantly correlated with these factors, giving confidence in the idea that the IV operated through SNAP receipt and not other state level factors.

Next, we conducted tests of the instrument itself, assessing whether it was associated with receipt of SNAP in a logistic regression model that included the other covariates adjusted for in our main analysis and accounted for the survey design information. We also assessed the first-stage partial deviance statistic, both before and after the 'near/far' match, in order to determine the strength of the instrument (< 13 would indicate an instrument too weak to use). We also used overidentification tests to help assess the validity of the instruments (for this test, higher p-values are better, with $p < 0.05$ indicating potentially invalid instruments). The instrument met all these tests.

Finally, we calculated tests of endogeneity, which indicate whether IV analysis is truly needed, although, owing to questions regarding the power of these tests, some experts recommend proceeding with IV analysis even if the endogeneity tests do not suggest the need for IV analysis (which could be

interpreted as a false negative situation). For these tests, a p-value < 0.05 generally indicates a 'positive' result, i.e., that IV analysis is needed. Interestingly, the endogeneity tests indicated that IV methods may not be needed, which suggests the 'standard' regression model may have adequately accounted for confounding on its own.

Statistical analysis

In addition to variables used in the standard regression, the near/far analysis included information on per-enrollee state healthcare expenditures in the year prior to MEPS[11], to help account for other state-level factors that would be reflected in participants' healthcare expenditures. After creation of the matched cohort, we performed an instrumental variable analysis using the two-stage residual inclusion (2SRI) approach[12,13], adjusting for covariates, with a logit model to estimate SNAP receipt, a gamma regression model to estimate expenditures, and bias-corrected bootstrapped confidence intervals (500 replications). The near/far analysis was conducted on those residing in the 29 most-populous states, as AHRQ does not release state-level codes for the other states owing to privacy concerns (eTable 3 for list of included states). Survey design information could not be incorporated into the near/far analysis

Summary of Near/Far Analysis Results

For the near/far matching analysis, our instrument was strongly associated with participation in SNAP, and passed tests of overidentifying restrictions. Interestingly, endogeneity tests suggested that instrumental variable methods may not have been needed (p=0.72). The near/far match resulted in 3676 participants who comprised 1838 matched pairs (Figure 1), and the instrument was strong (first-stage partial deviance statistic: 42.5) (eTable 2). Analyses using the 2SRI method, adjusted for the same factors as the standard regression, and state spending, demonstrated lower expenditures for SNAP receipt (-$5,160 per year; 95% CI -$6,924 to -$438) (full model in eTable 5).

Augmented Inverse Probability Weighting

As an alternative to the instrumental variable-based analysis, we conducted an analysis using augmented inverse probability weighting (AIPW) (see Technical Appendix for more detail). a 'doubly-robust' technique to mitigate selection bias by estimating the likelihood of receiving SNAP and then using response-weights to achieve balance in measured covariates between the group that did and did not receive SNAP.[14] This approach does not rely on instrumental variable assumptions, but may not be able to achieve balance on unmeasured confounders. To justify this approach, we examined post-weighting balance between covariates and conducted tests of overidentifying restrictions, which are tests of covariate balance between the treated and untreated groups.[15] We again calculated replication based confidence intervals (bias-corrected confidence intervals using 500 bootstrap replications). Survey design information could not be incorporated into the AIPW analysis.

Summary of AIPW Results

AIPW analyses, conducted on the entire cohort, successfully balanced observed factors (eTable 6), and passed tests of overidentifying restrictions. The AIPW analysis estimated the average treatment effect of SNAP enrollment to be -$931 (95% CI -$2,026 to -$152) (full model in eTable 7), again representing lower yearly expenditures with SNAP participation.

eTable 1: Generalized Linear Regression, full model

	β	Standard Error	P	95% CI Lower	95% CI Upper
SNAP	-0.27671	0.123321	0.026	-0.5199288	-0.03348
Age	-0.00761	0.019378	0.695	-0.0458239	0.030613
Age Squared	0.000125	0.000186	0.504	-0.0002423	0.000492
Female	0.485189	0.119815	<.0001	0.248882	0.721496
Race/ethnicity					
Non-Hispanic White	Reference	--	--	--	--
Non-Hispanic Black	-0.23553	0.128266	0.068	-0.4885058	0.017444
Hispanic	-0.26699	0.158689	0.094	-0.5799668	0.045987
Asian/multi-/other	-0.40676	0.210805	0.055	-0.8225273	0.008999
% Federal Poverty Level	0.050526	0.03032	0.097	-0.0092732	0.110325
Rural	0.346176	0.197889	0.082	-0.044113	0.736466
Northeast	0.167307	0.151833	0.272	-0.1321491	0.466763
Midwest	0.383049	0.179933	0.035	0.0281737	0.737925
South	0.085328	0.142547	0.55	-0.195812	0.366469
Died	0.951147	0.460975	0.04	0.0419825	1.860312
Insurance					
Private	0.608314	0.180358	0.001	0.252599	0.964028
Medicare	0.39253	0.17477	0.026	0.0478369	0.737223
Other Public	0.81397	0.128968	<.0001	0.5596103	1.06833
Uninsured	Reference	--	--	--	--
Educational Attainment					
< High School Diploma	Reference	--	--	--	--
High School Diploma	0.007068	0.134297	0.958	-0.2578015	0.271937
> High School Diploma	0.095854	0.150446	0.525	-0.2008652	0.392573
Obese	-0.00772	0.111718	0.945	-0.2280609	0.212616
HTN	0.282779	0.108835	0.01	0.0681267	0.497432
Stroke	0.191746	0.180082	0.288	-0.1634246	0.546917
CAD	0.782025	0.150553	<.0001	0.4850943	1.078955
Diabetes	0.646371	0.123672	<.0001	0.4024565	0.890286
Arthritis	0.585317	0.127068	<.0001	0.3347054	0.835928
COPD	0.276941	0.240333	0.251	-0.1970601	0.750943
Disability	0.515666	0.115145	<.0001	0.288569	0.742762

Results from a generalized linear model with gamma distribution and log link, accounting for survey design information, and adjusted for all variables in table

eTable 2: Tests of IV

	Result
Intraclass correlation between individual healthcare expenditures grouped by state of residence in MEPS	0.0061 (95% CI 0.0029 to 0.0129)
Spearman Correlation between instrumental variable and Medicaid spending per beneficiary[a]	0.10592 (p=0.464)
Spearman Correlation between instrumental variable and maximum TANF benefit[b]	0.11265 (p= 0.436)
First-stage Partial Deviance Statistic, before 'near/far' match	33.2
First-stage Partial Deviance Statistic, after 'near/far' match	42.5
Overidentifying	
Sargan (2SLS)	p = 0.307
Basmann (2SLS)	p = 0.310
Endogeneity	
Durbin (2SLS)	p = 0.724
Wu-Hausman F (2SLS)	p = 0.725
Residual (2SRI)	p = 0.298

[a]Medicaid data from Kaiser Family Foundation http://kff.org/medicaid/state-indicator/medicaid-spending-per-enrollee/view/print/?currentTimeframe=0&print=true

[b]TANF data from Congressional Research Service TANF report http://greenbook.waysandmeans.house.gov/sites/greenbook.waysandmeans.house.gov/files/R43634_gb_0.pdf

eTable 3: List of included states

Alabama
Arizona
California
Colorado
Connecticut
Florida
Georgia
Illinois
Indiana
Kentucky
Louisiana
Massachusetts
Maryland
Michigan
Minnesota
Missouri
North Carolina
New Jersey
New York
Ohio
Oklahoma
Oregon
Pennsylvania
South Carolina
Tennessee
Texas
Virginia
Washington
Wisconsin

eTable 4: post-'Near/Far' matching demographics, by 'encouragement' status

	'Discouraged' % (n) or mean (SE) N=1838	'Encouraged' % (n) or mean (SE) N=1838	Absolute Standardized Difference
Age (y)	40.77693 (.3959409)	40.38901 (.382705)	0.0232383
Female	58.81 (1,081)	58.54 (1,076)	0.0055231
Race/Ethnicity			
Non-Hispanic White	21.82 (401)	21.49 (395)	0.0079234
Non-Hispanic Black	25.84 (475)	25.84 (475)	0.0000000
Hispanic	45.38 (834)	45.65 (839)	0.0054613
Asian/multi-/other	6.96 (128)	7.02 (129)	n/a
Educational Attainment			
< High School Diploma	6.64 (122)	5.98 (110)	n/a
High School Diploma	61.70 (1,134)	62.51 (1,149)	0.0168186
> High School Diploma	31.66 (582)	31.50 (579)	0.0035103
Income*	3.829706 (.0451396)	3.818825 (.0446944)	0.0056506
Census Region			
Northeast	15.18 (279)	19.80 (364)	0.1219256
Midwest	14.31 (263)	15.45 (284)	0.0320989
South	41.57 (764)	41.19 (757)	0.0077308
West	28.94 (532)	23.56 (433)	n/a
Rural Residence	11.53 (212)	11.59 (213)	0.0017010
Insurance			
Private	18.99 (349)	18.50 (340)	0.0125440
Medicare	8.65 (159)	8.11 (149)	0.0196323
Other Public	29.92 (550)	30.25 (556)	0.0071158
Uninsured	42.44 (780)	43.14 (793)	n/a
Died	0.71 (13)	0.33 (6)	0.0531158
Disabled	13.44 (247)	13.28 (244)	0.0047967
Obesity	34.49 (634)	34.98 (643)	0.0102813
Hypertension	34.49 (634)	34.49 (634)	0.0000000
Heart Disease	10.55 (194)	10.17 (187)	0.0095687
Diabetes	13.60 (250)	13.28 (244)	0.0124919
Stroke	3.81 (70)	3.92 (72)	0.0056450
Arthritis	24.05 (442)	24.21 (445)	0.0200404
COPD	2.01 (37)	1.74 (32)	0.0038137
2011 State adjusted per capita healthcare spending	9892.758 (20.30371)	9858.425 (21.61006)	0.0381945

n/a = not directly calculated due to 'dummy' coding categorical variables for the matching process
*The National Health Interview Survey arranges income in ordinal categorizes, corresponding to percentage of federally poverty level. Category 3 corresponds to income between 75 and 99% of the federal poverty level, and category 4 corresponds to income 100% to 124% of the federal poverty level. Therefore the mean post-match income was a little less than 100% of the federal poverty level in both groups.

eTable 5: post-'Near/Far' Matching Two stage residual inclusion model

	β Coefficient	Lower 95% Confidence Interval	Upper 95% Confidence Interval
First Stage Model: Logistic Regression of SNAP receipt			
Age	0.0142	-0.0115	0.0399
Age squared	-0.0004	-0.0007	-0.0002
State 2011 Per Enrollee Medicare Spending, $	0.0000	-0.0002	0.0001
Female	0.2613	0.0992	0.4233
Non-Hispanic White Race/ethnicity	0.4694	0.1037	0.8351
Non-Hispanic Black Race/ethnicity	1.1213	0.7586	1.4839
Hispanic Race/ethnicity	0.3142	-0.0214	0.6497
Private Insurance	-0.6542	-0.8964	-0.4119
Medicare Insurance	0.0715	-0.3213	0.4644
Other Public Insurance	1.1540	0.9552	1.3529
High School Diploma Education	-0.3704	-0.5654	-0.1755
> High School Diploma Education	-0.1971	-0.4068	0.0126
Income as % Federal Poverty Level	-0.3569	-0.4011	-0.3127
Rural Residence	0.1675	-0.0858	0.4208
Northeast Residence	-0.3328	-0.7195	0.0539
Midwest Residence	0.2125	-0.1703	0.5954
South Residence	-0.1061	-0.4834	0.2712
Obesity	0.2084	0.0347	0.3822
Hypertension	0.1525	-0.0602	0.3651
Heart Disease	0.0500	-0.2236	0.3235
Diabetes	0.2790	-0.0142	0.5722
Stroke	0.2807	-0.2074	0.7688
Chronic Obstructive Pulmonary Disease	0.2601	-0.3910	0.9112
Arthritis	0.1422	-0.0987	0.3830
Died during Study Period	-0.7316	-2.3483	0.8852
Disability	0.3289	0.0656	0.5922
Instrumental Variable	1.4581	0.9869	1.9292
Model Constant	-0.3197	-1.5501	0.9108
Second Stage Model: Generalized Linear Regression (gamma distribution, log link) of healthcare expenditures			
SNAP	-1.2351	-3.0280	-0.0621
Age	0.0061	-0.0294	0.0399
Age squared	0.0000	-0.0003	0.0004
State Per Enrollee Medicare Spending, 2011	-0.0002	-0.0003	0.0000

Female	0.6574	0.3430	0.8615
Non-Hispanic White	0.7511	0.3691	1.2103
Non-Hispanic Black	0.5601	0.0799	1.0856
Hispanic	0.3191	-0.0587	0.7435
Private	0.4280	0.1149	0.7983
Medicare	0.4248	0.0915	0.7296
Other Public	0.8785	0.5181	1.2937
High School Diploma	0.1258	-0.1096	0.4020
> High School Diploma	0.0897	-0.2050	0.4377
Income as % Federal Poverty Level	-0.0221	-0.1605	0.0846
Rural Residence	0.2456	-0.1510	0.6638
Northeast Residence	0.4307	0.0987	0.7975
Midwest Residence	0.4780	0.0610	0.9860
South Residence	0.5131	0.0150	0.9322
Obesity	0.0069	-0.2288	0.2218
Hypertension	0.5043	0.2507	0.7608
Heart Disease	0.6915	0.4489	0.9852
Diabetes	0.6533	0.3667	0.9212
Stroke	0.3270	-0.1061	0.6790
Chronic Obstructive Pulmonary Disease	0.1917	-0.2836	0.5181
Arthritis	0.3328	0.0927	0.5476
Died during Study Period	-0.8834	-2.2756	0.1852
Disability	0.6606	0.4300	0.9515
First Stage Residual	0.7731	-0.3715	2.5608
Model Constant	8.0036	6.3549	9.7676

NB: Regression parameters in gamma regression models can be exponentiated to give the ratio between the mean of the outcome in the group of interest divided by the mean of the outcome in the control group. To aid interpretation, we then used the predicted margins command to convert this to a 2 year total cost difference, and then annualized the estimate by dividing in half. Because the predictive margins command uses a delta-method standard error, and we thought the bias-corrected bootstrap method would give more accurate results in this case, the 95% Confidence Intervals for the predictive margins were calculated by taking the mean of the reference level (in this case, no SNAP), and multiplying it by the exponentiated form of the lower and upper bounds of the 95% confidence interval

eTable 6: Balance statistics and overidentifying restrictions test for augmented inverse probability weighted analyses

	Standardized differences (values closer to 0 represent better balance)		Variance ratio (values closer to 1 represent better balance)	
	Raw	Weighted	Raw	Weighted
Age	-.1904464	.040384	.8136129	1.096444
Age squared	-.20052	.0517001	.7360837	1.186927
Female	.1865776	.0056819	.9356206	.9983576
Race/Ethnicity				
Non-Hispanic White				
Non-Hispanic Black	.4066883	.0135829	1.557532	1.014918
Hispanic	-.1369969	-.0126716	.9533653	.9954143
Asian/multi-/other	-.1906064	.0650038	.5186053	1.210807
Educational Attainment				
< High School Diploma				
High School Diploma	.0295217	-.0061007	1.023929	.9949781
> High School Diploma	-.2310974	-.0266195	.8296893	.9795665
Income (as % of federal poverty level)	-.7753642	.0140216	.8544885	1.025691
Census Region				
Northeast	.0827734	.0045639	1.162505	1.008478
Midwest	.1117232	-.0083641	1.228365	.9844889
South	.0879722	-.0287469	1.032809	.9882156
West				
Rural Residence	.1197136	-.0242665	1.265335	.9527688
Insurance				
Private	-.4253892	-.0094037	.4864964	.986345
Medicare	-.2158266	.0549826	.5225464	1.152112
Other Public	.6797021	-.0017013	1.699563	.9984802
Uninsured				
Died during study period	-.0376257	.0084814	.6128734	1.105798
Obesity	.1753457	-.0081076	1.116208	.9944992
Hypertension	.1523917	-.0059545	1.092679	.9963328
Heart Disease	.0792404	-.0158846	1.17876	.9669949
Diabetes	.0824979	.0001572	1.224196	1.000359
Asthma	.2196648	-.0007727	1.711926	.9980225
Cancer	-.0266049	-.0119199	.9123387	.9575479
Chronic Obstructive Pulmonary Disease	.0967024	.0026392	1.904168	1.018058
Arthritis	.1196742	-.0078693	1.14302	.9911282
Overidentification test[a]	P=0.7111			

[a]null hypothesis is that covariates are balanced so higher p-values represents less evidence to reject null

eTable 7: Auxiliary equations for augmented inverse probability weighting analyses

	β Coefficient	Lower 95% Confidence Interval	Upper 95% Confidence Interval
Average Treatment Effect Estimate			
SNAP (compared with No SNAP) (two-year estimate)	-1861.15	-4052.11	-304.37
Potential Outcome Mean Estimate			
No SNAP (two-year estimate)	8291.55	6827.60	10224.87
Auxiliary Equations			
Untreated Potential Outcome Equation			
Age	-41.90	-362.72	189.14
Age squared	0.14	-2.42	4.38
Female	569.09	-1914.33	2551.68
Race/ethnicity			
Non-Hispanic White	Referent	--	--
Non-Hispanic Black	-460.40	-3451.52	2526.26
Hispanic	-1183.46	-3332.95	985.32
Asian/multi-/other	534.46	-4019.92	9652.16
Health Insurance			
Uninsured	Referent	--	--
Private	1947.30	-14.07	4263.45
Medicare	15.98	-5339.30	4013.55
Other Public	3351.54	522.84	7328.61
Income as % Federal Poverty Level	-224.69	-958.23	217.98
Education			
< High School Diploma	Referent	--	--
High School Diploma	1697.39	-92.92	3521.06
> High School Diploma	2164.64	172.58	4600.28
Rural Residence	221.96	-2518.49	4018.17
Northeast Residence	974.21	-1218.64	3713.78
Midwest Residence	-132.17	-2481.92	3298.75
South Residence	597.76	-1596.29	4371.85
Obesity	-11.27	-2095.38	1848.98
Hypertension	441.70	-2652.54	3198.17
Heart Disease	11638.60	6384.61	20098.73
Diabetes	6345.61	2087.54	10499.17
Asthma	1296.67	-2562.33	4963.15

Arthritis	4630.79	991.66	9943.60
Cancer	5502.77	558.37	10932.25
Chronic Obstructive Pulmonary Disease	4224.76	-3763.91	17236.73
Stroke	-483.40	-7335.07	4913.90
Died during Study Period	5345.19	-6927.20	28733.24
Disability	8393.79	2850.37	16299.53
Model Constant	2064.63	-4364.70	8973.98
Treated Potential Outcome Equation			
Age	-466.70	-921.48	-124.87
Age squared	6.61	2.22	12.20
Female	458.79	-1614.58	2274.93
Race/ethnicity			
Non-Hispanic White	Referent	--	--
Non-Hispanic Black	-3978.39	-6198.79	-1231.65
Hispanic	-2125.77	-4632.61	740.98
Asian/multi-/other	951.38	-5914.88	12871.56
Health Insurance			
Uninsured	Referent	--	--
Private	3571.15	727.53	7044.33
Medicare	-1143.65	-6913.24	7461.07
Other Public	2974.45	1512.25	4738.22
Income as % Federal Poverty Level	-178.58	-711.35	297.90
Education			
< High School Diploma	Referent	--	--
High School Diploma	112.63	-1874.66	1971.42
> High School Diploma	426.10	-1648.52	2847.93
Rural Residence	1843.96	-1006.21	5692.62
Northeast Residence	2812.31	-553.66	7230.71
Midwest Residence	361.45	2651.56	2827.96
South Residence	-1164.34	-3943.40	802.81
Obesity	-288.64	-2115.48	1470.49
Hypertension	3452.02	1269.89	5729.02
Heart Disease	6879.11	2488.05	12294.64
Diabetes	5166.46	1415.40	10535.20
Asthma	718.91	-1863.54	4336.88
Arthritis	2682.16	-1007.73	5661.81
Cancer	-585.02	-5087.81	4439.41
Chronic Obstructive Pulmonary Disease	220.88	-6908.89	7995.38
Stroke	6859.88	-355.82	13156.78
Died during Study Period	39484.41	-10719.36	102110.90

Disability	6051.96	3209.58	9773.55
Model Constant	8704.02	1765.86	16364.06
Probability of Treatment Equation			
Age	0.01	-0.01	0.02
Age squared	0.00	0.00	0.00
Female	0.12	0.04	0.21
Race/ethnicity			
Non-Hispanic White	Referent	--	--
Non-Hispanic Black	0.35	0.23	0.48
Hispanic	-0.07	-0.19	0.05
Asian/multi-/other	-0.24	-0.44	-0.08
Health Insurance			
Uninsured	Referent	--	--
Private	-0.30	-0.43	-0.18
Medicare	0.05	0.14	0.27
Other Public	0.67	0.56	0.77
Income as % Federal Poverty Level	-0.20	-0.23	-0.18
Education			
< High School Diploma	Referent	--	--
High School Diploma	-0.17	-0.29	-0.07
> High School Diploma	-0.29	-0.40	-0.19
Rural Residence	0.17	0.04	0.30
Northeast Residence	0.23	0.10	0.38
Midwest Residence	0.39	0.22	0.54
South Residence	0.25	0.14	0.39
Obesity	0.10	0.00	0.18
Hypertension	0.16	0.04	0.27
Heart Disease	0.02	-0.12	0.15
Diabetes	0.11	-0.05	0.27
Asthma	0.19	0.05	0.32
Cancer	-0.09	-0.26	0.10
Arthritis	0.13	0.00	0.25
Chronic Obstructive Pulmonary Disease	0.26	-0.05	0.58
Died during Study Period	-0.13	0.84	0.45
Model Constant	0.21	-0.10	0.56

β Coefficients are in 2-year dollars for outcome equations; for treatment equation they are from probit model used in estimating probability of receiving SNAP

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eFigure 1. Change in estimated difference between participating and not participating in SNAP, in a series of nested models to explore potential confounders