Changes in Self-reported Insurance Coverage, Access to Care, and Health Under the Affordable Care Act

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ABSTRACT

Context: The Affordable Care Act (ACA) completed its second open enrollment period in February 2015. Assessing the law's effects has major policy implications.

Objective: To estimate national changes in self-reported coverage, access to care, and health during the ACA's first two open enrollment periods, and to assess differences between low-income adults in states that expanded Medicaid and in states that did not expand Medicaid.

Design, Setting, and Participants: Analysis of the 2012-2015 Gallup-Healthways Well-Being Index, a daily national telephone survey. Using multivariable regression to adjust for pre-ACA trends and sociodemographics, we examined changes in outcomes for the nonelderly US adult population aged 18-64 (n= 507,055) since the first open enrollment period began in October 2013. Linear regressions were used to model each outcome as a function of a linear monthly time trend and quarterly indicators. We then compared pre- (January 2012-September 2013) and post-ACA (January 2014-March 2015) changes for adults with incomes below 138% of the poverty level in Medicaid expansion states (n = 48,905 in 28 states and Washington D.C.) versus non-expansion states (n=37,283 in 22 states) using differences-in-differences.

Exposure: Beginning of the ACA's first open enrollment period (October 2013).

Main Outcomes: Being uninsured, lacking a personal physician, lacking easy access to medicine, inability to afford needed care, self-reported health, and health-related activity limitations.

Results: Among the 507,055 adults in this survey, pre-ACA trends were significantly worsening for all outcomes. Compared to the pre-ACA trend, the adjusted uninsured rate decreased 7.9 percentage points (95% CI -9.1, -6.7) by the first quarter of 2015; lacking a personal physician decreased 3.5 percentage points (95% CI -4.8, -2.2); lack of easy access to medicine decreased 2.4 percentage points (95% CI -3.3, -1.5); inability to afford care decreased 5.5 percentage points (95% CI -6.7, -4.2); the proportion reporting "fair" or "poor" health decreased 3.4 percentage points (95% CI -4.6, -2.2); and days with activities limited by health decreased 1.7 percentage points (95% CI -2.4, -0.9). Coverage changes were largest among minorities; for example, the decrease in the uninsured rate was larger among Latino adults (-11.9 percentage points; 95% CI -15.3%, -8.5%) than white adults (-6.1 percentage points; 95% CI -7.3, -4.8). Medicaid expansion was associated with significant reductions among low-income adults in the uninsured rate (differences-in-differences estimate, -5.2 percentage points; 95% CI -7.9, -2.6), lacking a personal physician, and difficulty accessing medicine.

Conclusions: The ACA's first two open enrollment periods were associated with significantly improved trends in self-reported coverage, access to primary care and medications, affordability, and health. Low-income adults in states that expanded Medicaid reported significant gains in insurance coverage and access compared to adults in states that did not expand Medicaid.

INTRODUCTION

The Affordable Care Act's Medicaid expansion and new subsidized private coverage from insurance Marketplaces have entered their second year. The law's first two open enrollment periods are complete, the most recent finishing February 15, 2015. The U.S. Department of Health and Human Services (HHS) reported that 11.7 million individuals signed up for Marketplace coverage,[1] and 12.2 million more were enrolled in Medicaid and the Children's Health Insurance Program as of March 2015 compared to mid-2013.[2] Surveys show significant decreases in the uninsured rate since early 2014,[3-5] with coverage gains largest in states that expanded Medicaid.[6-8] However, most prior analyses have not adjusted for factors other than the ACA that can affect coverage, including the economy and baseline trends.

Moreover, how coverage expansion is affecting access to care and health remain important questions. Several analyses have found preliminary declines in cost-related barriers to care under the ACA.[8,9] Prior expansions (state Medicaid expansions, Massachusetts' 2006 health reform, and the ACA's 2010 provision allowing young adults to stay on their parents' plans until 26) also produced improvements in access to care and self-reported health within the first two years of coverage.[10-15] Whether similar changes have occurred in the current coverage expansion is unknown.

The objectives of this study were to assess national changes in self-reported coverage, access to care, and health during the law's first two open enrollment periods, and to assess differences between low-income adults in states that expanded Medicaid and their counterparts in non-expanding states.

METHODS

This study used a survey approved by the Gallup Corporation's Institutional Review Board. The authors at HHS only had access to de-identified data, which is exempted as non-human subjects research under the HHS Common Rule.

Study Design

This study examined changes in trends over time for the uninsured rate, measures of access to care, and self-reported health status under the ACA using multivariable regression to adjust for important confounders such as unemployment and income. Two alternative models were used, one using quarterly indicators to measure changes from the baseline pre-ACA trend, and the other using an interrupted time-series design in which the slope of changes in each outcome was allowed to shift as of October 2013, when the first open enrollment period began. The data spanned January 1, 2012, through March 31, 2015. The study period began in 2012 because major insurance changes were occurring throughout 2010-2011 due to the ACA's dependent coverage provision.[7,16,17]

While there is no clear control group to assess the law's overall effect across all income groups, the Medicaid expansion – which began on January 1, 2014, in most participating states – did offer a natural control group for lower-income adults: states that elected not to expand Medicaid. A differences-in-differences design was used to compare changes in outcomes among low-income adults in expansion versus non-expansion states.

Data

The data source for these analyses was the Gallup-Healthways Well-Being Index (WBI), a continuously-fielded daily telephone survey of U.S. adults that includes cell phone and landline

users in all 50 states and Washington DC. The WBI offers several advantages: a large national sample; rapid availability of data allowing for analysis of results after the end of the second open enrollment period; and several outcomes related to access to care and health. The survey's primary limitation is its low response rate, between 5-10%, similar to other household telephone polls without financial incentives for participation.[18,19] However, previous research showed that the WBI provides estimates of changes in the uninsured rate over time and estimates related to access to care and health status that correlate closely to those from federal surveys generally considered the "gold-standard" for these outcomes.[20] Moreover, previously published analyses with the WBI have shown strong correlation with official enrollment statistics for the ACA and with subsequently-released survey data from the federal interview surveys.[7,8,21,22] Following previous work,[8] these results were weighted to national demographic benchmarks from Census data to mitigate potential non-response bias.[23] See the online supplement for additional details on the WBI.

The main study outcomes were six self-reported measures: being uninsured, not having a personal physician, whether or not it is "easy to get" medications, difficulties affording needed medical care for an individual or family member in the past year, overall health status, and percentage of days in the past month in which activities were limited by poor health. See the online supplement for question wording. To facilitate comparison, all measures were converted so that higher proportions indicated adverse outcomes (being uninsured, lacking a personal physician, poor health status, etc.).

Statistical Analysis

The first part of the analysis used the full national sample of non-elderly adults, ages 18-64, surveyed between January 1, 2012, and March 31, 2015. Linear regressions modeled each outcome as a function of a linear monthly time trend, and quarterly indicators since the beginning of the first open enrollment period in October 2013. Although coverage in the Marketplaces did not begin until January 2014, October-December 2013 was treated as part of the ACA implementation period because some open enrollment applicants were found eligible for Medicaid during this time, and other respondents may have reported having coverage even though it did not take effect until January 1. The quarterly indicators (culminating in the first quarter [Q1] of 2015) measured changes from the baseline trend in each outcome. The models adjusted for age, sex, race/ethnicity, marital status, employment, income, urban vs. rural residence, state-year specific unemployment rate,[24] calendar month (to adjust for seasonality), and state of residence. As an alternative, an interrupted time-series analysis also was conducted, which allowed for distinct linear monthly trends in each outcome before and after October 1, 2013. See the online supplement for full regression equations.

Subgroup analyses were conducted based on race/ethnicity, gender, urban vs. rural residence, and the presence of at least one chronic condition measured in the survey (whether a respondent had "ever been told" by a health professional that they had hypertension, high cholesterol, diabetes, depression, heart attack, asthma, and cancer). For each subgroup category (e.g. race), the analysis used the primary model described above, with the addition of interaction terms between each category of subgroup (e.g. white, black, Latino, and other) and the time trend and quarterly indicators, and then tested for between-group differences in the Q1 2015 estimates across subgroups.

The second part of the analysis focused on adults with estimated incomes below 138% of the Federal Poverty Level (FPL), corresponding to the ACA's Medicaid expansion criteria. Changes in outcomes were compared for low-income adults in expansion versus non-expansion states: 27 states (including Washington, DC) expanded in the year 2014, and two additional states (Pennsylvania and Indiana) expanded between January and March 2015.[25] The differences-in-differences estimate came from the variable *Medicaid Expansion,* equal to one for interviews conducted in states with expansions in effect as of the first day of the survey month (allowing for differential expansion start dates by state), and zero otherwise. The model also directly adjusted for state and month-year fixed effects. This approach measured the mean pre-post change in expansion states, compared to the pre-post change in non-expansion states. The pre-period was January 1, 2012, through September 30, 2013; Q4 2013 was excluded as a washout period. This analysis used a linear model and robust standard errors clustered at the state-level to account for serial autocorrelation.[26] Sociodemographic covariates were the same as above.

The time-series analysis using all income groups controlled for household income as reported in the survey, in 10 discrete categories plus one for missing/unreported income. For the analysis of the Medicaid expansion, these categories were converted into a percentage of the federal poverty level, using the midpoint of the income categories, household size, and federal poverty guidelines (see online supplement for details on missing values and sensitivity analyses).[27]

Analyses were conducted using Stata 12.0. Statistical significance was set at $p \leq 0.05$, using two-tailed tests.

RESULTS

The full sample included 507,055 adults, and the low-income sample included 48,905 in the 28 states and Washington D.C. that expanded Medicaid prior to March 2015 and 37,283 adults in the 22 states that had not expanded Medicaid (Table 1). Compared to the full sample, the low-income sample was younger and less likely to be white, male, or employed. Roughly half of both samples reported at least one chronic condition.

Figure 1 presents the unadjusted monthly means for each outcome during the study period. Five of the six measures showed worsening trends in the 2012-2013 period, particularly between March and September 2013, with improvement in trends for five of six measures after the ACA's first open enrollment period began in October 2013. There was no apparent post-2013 reversal in trend for percentage of days limited by poor health.

Table 2 shows for each outcome the pre-ACA mean and monthly trend, unadjusted estimates for Q1 2014, Q3 2014, and Q1 2015, and adjusted changes for those quarters from the baseline trend. All six study outcomes demonstrated significantly increasing (i.e. worsening) trends prior to the ACA's first open enrollment period. By Q1 2015, when the second open enrollment period ended, adjusted changes from the pre-ACA trend were -7.9 percentage points (95% CI -9.1, -6.7) for the uninsured rate; -3.5 percentage points (95% CI -4.8, -2.2) for the proportion without a personal doctor; -2.4 percentage points (95% CI -3.3, -1.5) for the proportion without easy access to medications; and -5.5 percentage points (95% CI -6.7, -4.2) for inability to afford needed care. The adjusted proportion reporting "fair/poor" health decreased 3.4 percentage points (95% CI -4.6, -2.2), and the adjusted proportion of days with activities limited by poor health decreased 1.7 percentage points (95% CI -2.4, -0.9). All adjusted changes were significant at $p<0.001$.

Interrupted time-series models (eTable 1) showed that for all 6 outcomes, post-ACA changes demonstrated significant improvements from the pre-ACA adverse trends. For 5 of 6 variables, the coefficient for the adjusted post-ACA trend was larger than the pre-ACA trend, indicating a net reversal in trend after October 2013. For example, before the ACA, the uninsured rate increased by 0.10% per month (95% CI 0.08 0.13); in the post-ACA period, the differential change in trend was -0.44% per month (95% CI -0.49, -0.39), yielding an absolute change after the ACA of -0.34% per month (95% CI -0.39, -0.30). Figure 2 shows the adjusted scatterplot for the uninsured rate, with the superimposed regression-based time trends. eFigures 1-5 show similar scatterplots for the remaining outcomes. For days limited by poor health, the pre-ACA adverse trend slowed but did not reverse after October 2013.

Adjusted Q1 2015 changes by subgroup are shown in Table 3. Changes in insurance and access to medications varied significantly by race, with greater changes among racial and ethnic minorities. The reduction in the uninsured rate among Latinos (-11.9%; 95% CI -15.3, -8.5) was greater than the reduction among whites (-6.1%; 95% CI -7.3, -4.8; between-group difference <0.001). Changes in the uninsured rate, lack of a personal physician,, and self-reported health did not vary significantly by gender, rurality, or the presence of chronic medical conditions. Improvement in access to medicine was significantly greater for urban than rural residents, and affordability of care improved significantly more for men than women.

The results of the differences-in-differences analysis of the Medicaid expansion (Table 4) demonstrated that the uninsured rate declined among low-income adults in both expansion and non-expansion states, but with a significantly greater reduction in the expansion states (differences-in-differences estimate -5.2 percentage points; 95% CI -7.9, -2.6). Lacking a personal physician (-1.8 percentage points; 95% CI -3.4, -0.3) and limited access to medications

(-2.2 percentage points; 95% CI -3.8, -0.7) both declined significantly more in expansion states than non-expansion states. Inability to afford care declined from 35.5% to 33.1% in expansion states, but the differences-in-differences estimate was not statistically significant (-1.3 percentage points; 95% CI -3.7, -1.0; p=0.27). There were no significant changes in fair/poor health or activity limitations due to health. Results were similar when using an alternative imputation approach for income or excluding missing values (eTable 2). Pre-ACA trends for study outcomes did not differ significantly by expansion status, except for difficulty affording care, which was slightly worsening in expansion states relative to non-expansion states prior to 2014 (eTable 3). Figure 3 shows the unadjusted time trend in the uninsured rates for low-income adults in expansion versus non-expansion states, demonstrating a sharp divergence beginning in January 2014.

DISCUSSION

This analysis of a large national survey of U.S. adults demonstrated significant improvements in trends for self-reported coverage, access to a personal physician and medications, and health after the ACA's first and second open enrollment period. Consistent with other research,[28] we found that national trends in coverage and access prior to the ACA were worsening. Those trends improved after October 2013, when the ACA's open enrollment began. Subgroup analyses demonstrated that the largest improvements in coverage and access to medicine occurred among racial/ethnic minorities. The results suggest that the ACA may be associated with reductions in long-standing disparities in access to care,[29] one of the goals of the ACA.

Whether these changes are related directly to the ACA's coverage expansions is not possible to determine with a time-series study design. For instance, the economic recovery may have also influenced the study outcomes, though the analysis did adjust for several potential confounders including income, individual employment, and state unemployment rates. The pattern of coverage gains accompanied by improved self-reported health has been documented previously in a randomized trial of Medicaid[11,14] and several quasi-experimental studies of coverage expansions.[10,12,13,30,31] From a clinical perspective, it is notable that we detected positive trends in self-reported health and functional status among individuals with chronic medical conditions, who may potentially benefit most from expanded coverage. These results might reflect changes in the management of chronic conditions,[32] peace of mind from gaining insurance,[33] or factors unrelated to the ACA. Meanwhile, coverage gains for adults with and without out such conditions were similar, showing no evidence of adverse selection.

The analysis of the Medicaid expansion among low-income adults represents a stronger research design than the time-series analysis because it included a control group to account for secular trends unrelated to the ACA, although this analysis had a much smaller sample. This analysis provides evidence of significant positive changes among low-income adults in coverage, access to primary care, and access to medications, compared to non-expansion states. These findings are consistent with recent reports showing increases in coverage and Medicaid prescription drug spending in expansion states in 2014, compared to non-expansion states.[6,34] As states continue to debate whether to expand Medicaid under the ACA, these results add to the growing body of research indicating that such expansions are associated with significant benefits for low-income populations.[35] However, in contrast to prior Medicaid studies,[14,15] we did not find statistically significant changes in self-reported health. This could potentially be due to differences between the underlying features of the ACA Medicaid expansion versus prior state Medicaid expansions. Alternatively, it may reflect the limited statistical power of this analysis, with a sample size roughly one-sixth as large as the time-series analysis. For instance, the 95% confidence interval for changes in fair/poor health included a reduction of 1.7 percentage points, which would represent a 5% relative reduction from the baseline mean of 34.3%; this would be a clinically meaningful change, but the estimates are not precise enough to rule it out.

Our study has several important limitations. First, to provide timely analysis of a rich set of ACA-related outcomes, we used the WBI national telephone survey, which has a much lower response rate (ranging from 5% to 10% during the study period, and that has also declined in recent years) than federal surveys that typically become available a minimum of 6-12 months after data collection. Non-response bias can be mitigated – but not necessarily eliminated – through appropriate demographic weighting, which we have done.[18,23] More importantly, WBI

data from 2008-2012 have been compared to government surveys and found to produce similar estimates of insurance coverage changes over time and access to care;[20] in addition, previously published estimates of changes under the ACA based on the WBI have been consistent with subsequently-released data from government sources.[7,8,16,21,36] Although the WBI historically has produced approximately 2 percentage-point lower estimates of the uninsured rate than federal surveys and slightly higher estimates of the proportion in fair/poor health (see the online supplement), these differences should have minimal influence on our study design, which assessed changes in outcomes over time, rather than the absolute level of each outcome.

The WBI is not reliable at distinguishing between different types of insurance, which is why this analysis focused on the uninsured rate.[20] The WBI's household income measure is limited and does not correspond directly to the definition of family income used for ACA eligibility determinations, which led us to test multiple alternative approaches to defining the low-income sample.

Another key limitation is the lack of a control group for the time-series analysis of adults across the full income range, because all states are affected by numerous provisions of the law. This limited our study to an observational analysis exploring changes in trends after adjustment for potential confounders. The Medicaid expansion analysis used a more rigorous design but was still subject to potential bias from any unmeasured confounders that differentially changed over time in expansion versus non-expansion states.

In addition, surveys are subject to recall bias and social desirability bias. In part, this may explain the improvements in health trends reported in the national sample, as some individuals' perceptions of health may be influenced by the law or by acquiring insurance even if underlying physiologic measures have not necessarily improved.[11] However, social desirability

seems an unlikely explanation for these results, as the ACA remains a polarizing law with nearly equal numbers of Americans opposing it and supporting it.[37] Future research using claims data and other objective measures will be necessary to better understand changes in utilization and health outcomes related to the ACA.

Conclusions

The ACA's first two open enrollment periods were associated with significantly improved trends in self-reported coverage, access to primary care and medications, affordability of care, and health. Low-income adults in states that expanded Medicaid reported significant gains in insurance coverage and access compared to adults in states that did not expand Medicaid.

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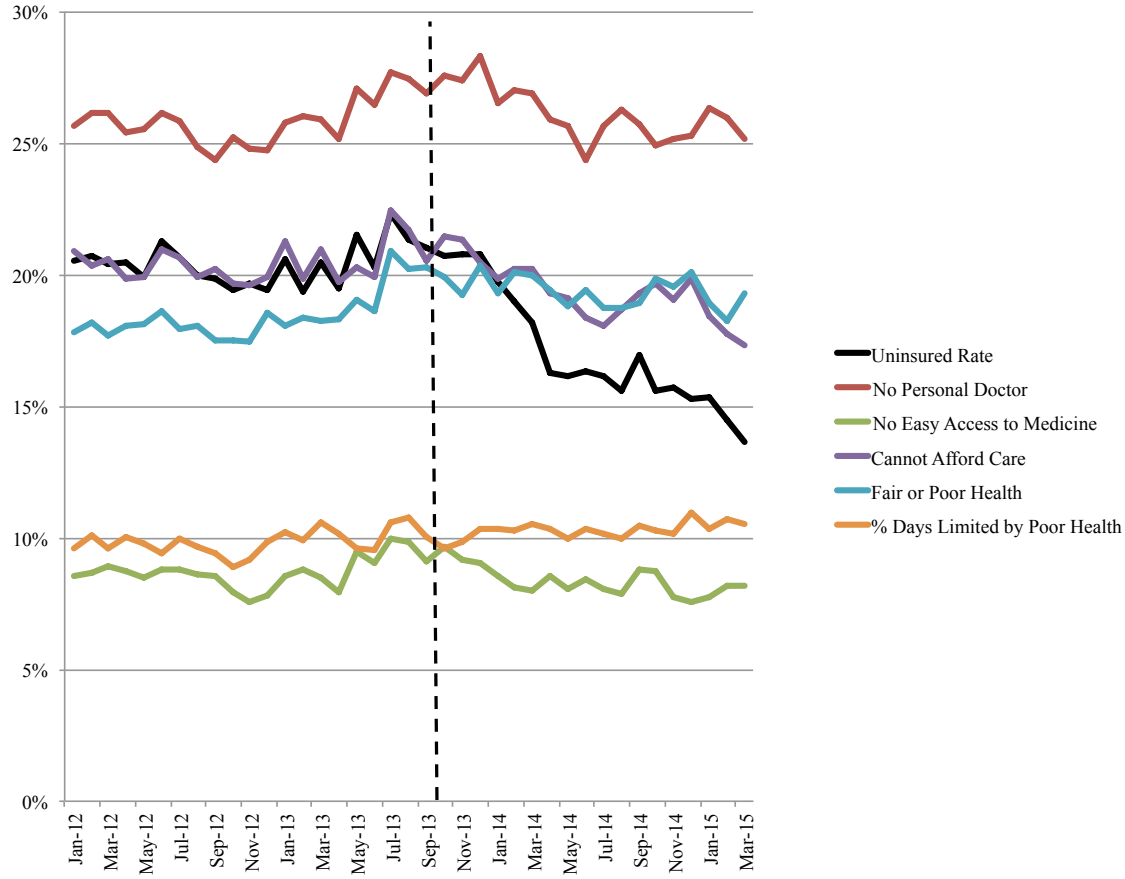
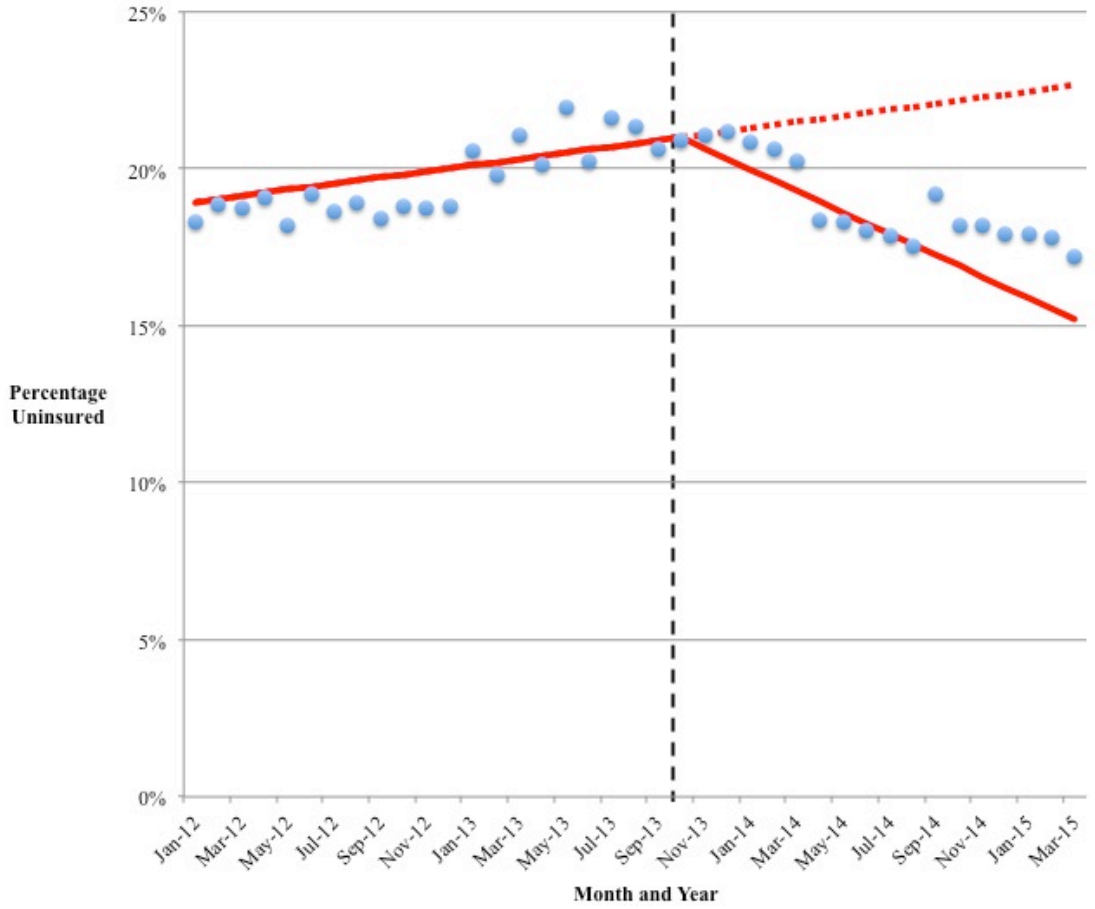
Figure 1: Unadjusted Trends in Coverage, Access, and Self-Reported Health, 2012-2015



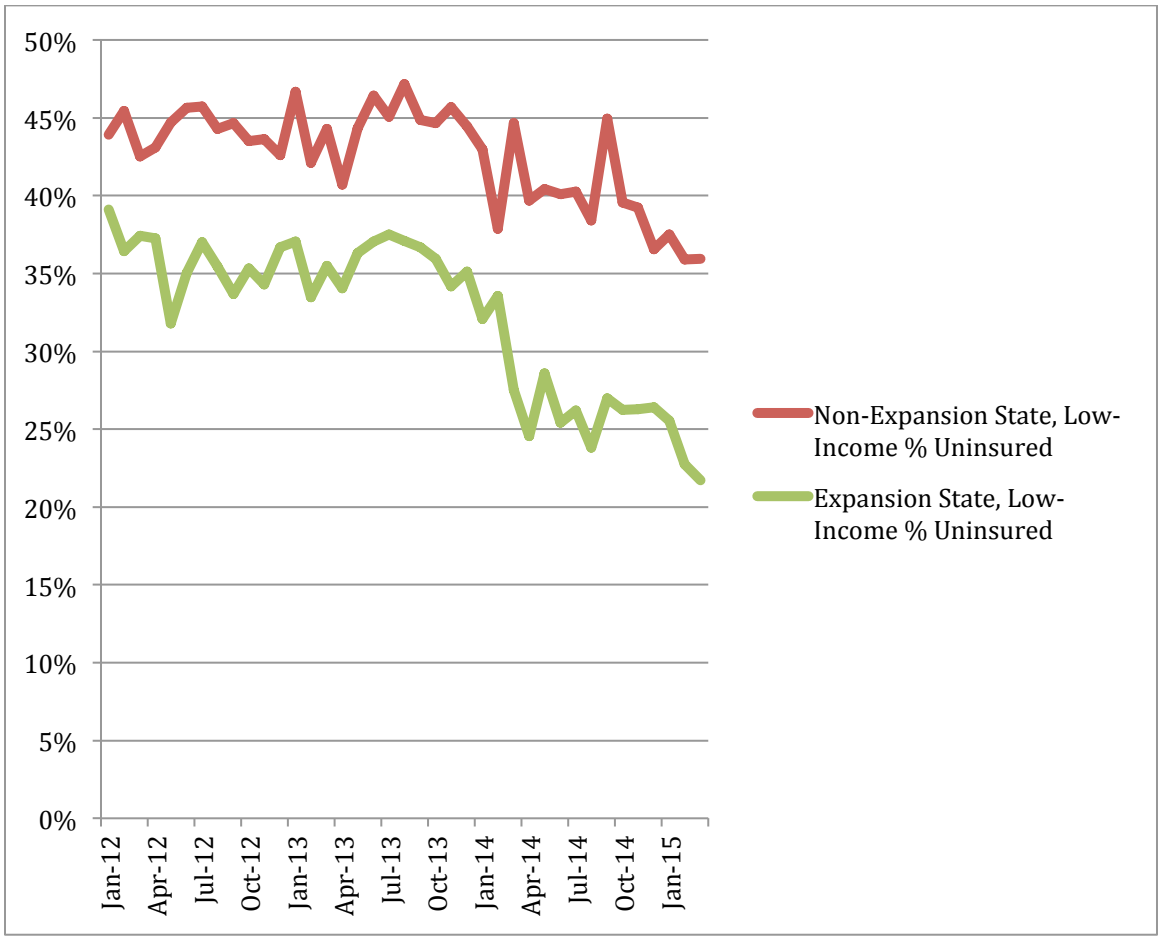
Notes: Sample for each variable contains adults ages 18-64, n=507,055. Dotted vertical line represents the beginning of the Affordable Care Act's initial open enrollment period on October 1, 2013. All estimates presented are monthly unadjusted means.
Monthly standard errors:
Uninsured Rate: +/-0.4 to 0.6%
No Personal Physician : +/-0.4 to 0.6%
No Easy Access to Medicine: +/-0.2 to 0.4%
Cannot Afford Care: +/-0.4 to 0.6%
Fair or Poor Health: +/-0.3 to 0.5%
Percentage of the Previous 30 Days with Activities Limited by Poor Health: +/-0.2 to 0.3%

Figure 2: Interrupted Time Series Analysis of the Uninsured Rate



Notes: Sample contains adults ages 18-64.
Red lines show adjusted time trends for the outcome for the pre-ACA (January 1, 2012-September 30, 2014) and the post-ACA (October 1, 2013-March 31, 2015) periods. Blue dots show the adjusted monthly mean values for the outcome, based on a multivariable regression model controlling for state, age, sex, race/ethnicity, marital status, urban vs. rural residence, employment status, income, state-year unemployment rate, and calendar month.

Figure 3: Unadjusted Trends in the Uninsured Rate for Low-Income Adults, in Medicaid Expansion versus Non-Expansion States 2012-2015



Notes: Sample contains adults ages 18-64 with income at or below 138% of the Federal Poverty Level. All estimates presented are monthly unadjusted means.

TABLE 1: Descriptive Statistics for Study Sample

Variable	Full Sample	Low-Income Adults, Income < 138% Poverty§		
		Medicaid Expansion States	Non-Expansion States	p-value, Expansion versus Non-Expansion
Sample Size	*507,055*	*48,905*	*37,283*	--
Age (mean [y], 95% CI)	41.0 (41.0, 41.1)	37.5 (37.3, 37.6)	37.6 (37.5, 37.8)	0.16
Male	50.0%	43.0%	42.5%	0.16
Married	51.0%	31.3%	32.8%	<0.001
Employed	71.1%	51.2%	51.0%	0.67
Rural	19.7%	19.6%	27.5%	<0.001
≥ 1 chronic medical condition†	48.9%	53.0%	53.4%	0.35
Race/Ethnicity				
White, Non-Latino	62.6%	42.0%	41.4%	0.10
Latino	15.6%	34.0%	25.9%	<0.001
Black, Non-Latino	10.6%	11.9%	20.0%	<0.001
Other*	11.2%	12.1%	12.8%	0.003
Household Income				
0-138% FPL	24.3%	100%	100%	--
139-400% FPL	45.0%	0%	0%	--
Over 400% FPL	30.7%	0%	0%	--

Notes:
"FPL" = Federal Poverty Level. Income imputed as a percentage of FPL based on annual household income and household size, see Appendix eMethods for details.
"95% CI" = 95% Confidence Interval
§ Low-income sample for Medicaid expansion excludes the fourth quarter of 2013 as a washout period.
* "Other" for race/ethnicity also includes individuals reporting more than one race and those who did not provide an answer to this question.
† Chronic conditions in the survey are hypertension, high cholesterol, diabetes, depression, prior heart attack, asthma, and cancer.
Medicaid Expansion States: AR, AZ, CA, CO, CT, DC, DE, HI, IA, IL, IN, KY, MA, MD, MI, MN, ND, NH, NJ, NM, NV, NY, OH, OR, PA, RI, VT, WA, WV.
Medicaid Non-Expansion States: AK, AL, FL, GA, ID, KS, LA, ME, MO, MS, MT, NC, NE, OK, SC, SD, TN, TX, UT, VA, WI, WY.

TABLE 2: Adjusted Changes in Coverage, Access to Care, and Self-Reported Health After the ACA's First Open Enrollment Period

Variable	Uninsured	No personal physician	No easy access to medicine	Cannot afford care	Fair/poor health	% of last 30 days in which activities were limited by poor health
Sample Size	*507,055*	*506,188*	*502,019*	*504,818*	*507,055*	*502,134*
Pre-ACA mean (95% CI)	20.3% (20.2, 20.5)	25.7% (25.5, 25.9)	8.6% (8.5, 8.8)	20.4% (20.2, 20.6)	18.3% (18.1, 18.5)	9.8% (9.7, 9.9)
Pre-ACA monthly trend (95% CI)	0.12% (0.08, 0.15)	0.13% (0.09, 0.17)	0.10% (0.07, 0.13)	0.15% (0.11, 0.19)	0.15% (0.11, 0.18)	0.07% (0.05, 0.10)
Q1 2014						
Unadjusted mean (95% CI)	19.0% (18.4, 19.5)	26.8% (26.1, 27.4)	8.2% (7.8, 8.6)	20.1% (19.5, 20.7)	19.8% (19.2, 20.4)	10.4% (10.1, 10.7)
Adjusted change from trend (95% CI)	-2.8% (-3.7, -1.9)	-1.4% (-2.4, -0.4)	-1.5% (-2.2, -0.8)	-2.3% (-3.2, -1.3)	-1.2% (-2.1, -0.3)	-1.2% (-1.7, -0.6)
Q3 2014						
Unadjusted mean (95% CI)	16.2% (15.7, 16.8)	25.9% (25.3, 26.5)	8.2% (7.8, 8.6)	18.7% (18.1, 19.2)	18.8% (18.3, 19.4)	10.2% (9.9, 10.5)
Adjusted change from trend (95% CI)	-5.5% (-6.4, -4.6)	-2.1% (-3.1, -1.1)	-1.6% (-2.3, -0.9)	-3.3% (-4.2, -2.4)	-2.3% (-3.1, -1.4)	-0.9% (-1.5, -0.4)
Q1 2015						
Unadjusted mean (95% CI)	14.5% (14.0, 15.0)	25.8% (25.2, 26.4)	8.0% (7.6, 8.4)	17.8% (17.3, 18.4)	18.8% (18.3, 19.4)	10.5% (10.2, 10.9)
Adjusted change from trend (95% CI)	-7.9% (-9.1, -6.7)	-3.5% (-4.8, -2.2)	-2.4% (-3.3, -1.5)	-5.5% (-6.7, -4.2)	-3.4% (-4.6, -2.2)	-1.7% (-2.4, -0.9)
p-value for Q1 2015 adjusted change from trend	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Notes: Sample contains adults ages 18-64. Each column excludes item non-response for that outcome (ranging from 0 to 1.0%, depending on the outcome – see 'Sample Size' row).
"95% CI" = 95% confidence interval.
"Pre-ACA Mean" refers to the sample-wide mean value for each outcome prior to Q4 2013.
"Adjusted change from trend" based on multivariable linear regression model controlling for a pre-ACA linear time trend, state, age, sex, race/ethnicity, marital status, urban vs. rural residence, employment status, income, state-year unemployment rate, and calendar month.

TABLE 3: Changes in Coverage, Access to Care, and Self-Reported Health After the ACA's First Open Enrollment Period, by Subgroup

ble	Sample Size	Q1 2015 Adjusted Change, Compared to Pre-ACA Trend											
		Uninsured		No personal physician		No easy access to medicine		Cannot afford care		Fair/poor health		% of last 30 days in which activities were limited by poor health	
		Adjusted Change (95% CI)	Between group p-value	Adjusted Change (95% CI)	Between group p-value	Adjusted Change (95% CI)	Between group p-value	Adjusted Change (95% CI)	Between group p-value	Adjusted Change (95% CI)	Between group p-value	Adjusted Change (95% CI)	Between group p-value
PLE	507,055	-7.9% (-9.1, -6.7)	N/A	-3.5% (-4.8, -2.2)	N/A	-2.4% (-3.3, -1.5)	N/A	-5.5% (-6.7, -4.2)	N/A	-3.4% (-4.6, -2.2)	N/A	-1.7% (-2.4, -0.9)	N/A
Non-	347,849	-6.1% (-7.3, -4.8)		-3.0% (-4.4, -1.6)		-0.8% (-1.8, -0.1)		-5.3% (-6.6, -3.9)		-3.4% (-4.7, -2.1)		-1.9% (-2.7, -1.1)	
	55,126	-11.9% (-15.3, -8.5)		-3.5% (-7.0, -0.1)		-5.1% (-7.6, -2.5)		-6.0% (-9.2, -2.8)		-0.2% (-3.4, 3.0)		-1.7% (-3.2, -0.1)	
Non-	41,905	-10.8% (-14.1, -7.4)	<0.001	-5.8% (-9.4, -2.2)	0.48	-4.4% (-7.1, -1.8)	<0.001	-5.0% (-8.5, -1.4)	0.49	-6.6% (-9.9, -3.2)	0.02	-2.2% (-4.3, -0.2)	0.21
*	62,175	-10.6% (-13.8, -7.4)		-4.3% (-7.9, -0.7)		-6.1% (-8.6, -3.5)		-7.8% (-11.1, -4.6)		-5.6% (-8.8, -2.4)		0.3% (-1.7, 2.3)	
ic al tion(s)†	262,318	-7.7% (-9.2, -6.2)		-3.4% (-4.9, -1.9)		-2.8% (-4.0, -1.5)		-4.7% (-6.4, -3.0)		-3.7% (-5.4, -2.0)		-1.7% (-2.8, -0.6)	
ronic tions	244,737	-8.3% (-9.8, -6.7)	0.58	-4.2% (-6.0, -2.5)	0.44	-1.9% (-3.0, -0.8)	0.24	-5.7% (-7.2, -4.2)	0.33	-2.3% (-3.6, -1.0)	0.17	-1.2% (-1.9, -0.5)	0.40
	401,291	-7.9% (-9.2, -6.6)		-3.6% (-5.0, -2.2)		-3.1% (-4.0, -2.1)		-5.4% (-6.7, -4.1)		-3.6% (-4.9, -2.4)		-1.7% (-2.5, -1.0)	
	105,764	-8.0% (-10.3, -5.6)	0.95	-3.4% (-5.8, -0.9)	0.89	0.3% (-1.7, 2.3)	0.001	-5.9% (-8.3, -3.4)	0.71	-2.5% (-4.8, -0.2)	0.35	-1.4% (-2.9, 0.1)	0.69
	266,200	-7.3% (-8.8, -5.7)		-2.9% (-4.7, -1.2)		-2.4% (-3.5, -1.2)		-6.8% (-8.3, -5.2)		-3.0% (-4.5, -1.5)		-2.1% (-2.9, -1.2)	
en	240,855	-8.6% (-10.1, -7.0)	0.18	-4.1% (-5.7, -2.5)	0.28	-2.5% (-3.7, -1.2)	0.90	-4.2% (-5.9, -2.5)	0.01	-3.9% (-5.4, -2.3)	0.36	-1.3% (-2.3, -0.3)	0.19

Notes:
"95% CI" = 95% confidence interval.
"Adjusted change from trend" based on multivariable linear regression model controlling for a pre-ACA linear time trend, state, age, sex, race/ethnicity, marital status, urban vs. rural residence, employment status, income, state-year unemployment rate, and calendar month. Each subgroup model (race, chronic condition, urban/rural, and gender) included interaction terms for each subgroup with the time trend and quarterly indicators from Q4 2013 through Q1 2015 (only the latter is reported in the Table for simplicity), as well as a binary indicator for each listed subgroup.
"Between-group p-value" reports the p-value for the adjusted Wald test of equivalence across subgroups of the Q1 2015 "adjusted change" estimates.
* "Other" for race/ethnicity also includes individuals reporting more than one race and those who did not provide an answer to this question.
† Chronic conditions in the survey are hypertension, high cholesterol, diabetes, depression, prior heart attack, asthma, and cancer.
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TABLE 4:
Changes in Coverage, Access to Care, and Health Among Low-Income Adults in Medicaid Expansion versus Non-Expansion States

OUTCOME	Expansion States (n=48,905)		Non-Expansion States (n=37,283)		Difference-in-Difference Adjusted Estimate	
	Unadjusted Pre-ACA Mean (95% CI)	Unadjusted Post-ACA Mean (95% CI)	Unadjusted Pre-ACA Mean (95% CI)	Unadjusted Post-ACA Mean (95% CI)	Net Post ACA Change (95% CI)	p-value
Uninsured	35.9% (35.3, 36.5)	26.5% (25.8, 27.3)	44.3% (43.5, 45.0)	39.7% (38.9, 40.6)	-5.2% (-7.9, -2.6)	<0.001
No personal physician	38.5% (37.8, 39.1)	35.8% (35.0, 36.7)	43.0% (42.3, 43.7)	43.0% (42.0, 44.0)	-1.8% (-3.4, -0.3)	0.02
No easy access to medicine	17.3% (16.8, 17.8)	15.0% (14.4, 15.7)	18.8% (18.2, 19.4)	18.7% (17.9, 19.5)	-2.2% (-3.8, -0.7)	0.005
Cannot afford care	35.5% (34.9, 36.1)	33.1% (32.3, 33.9)	40.2% (39.5, 41.0)	39.5% (38.5, 40.5)	-1.3% (-3.7, 1.0)	0.27
Fair/poor health	34.2% (33.6, 34.8)	34.9% (34.0, 35.7)	34.3% (33.6, 35.0)	34.1% (33.2, 35.1)	-0.1% (-1.7, 1.4)	0.84
% of last 30 days in which activities were limited by poor health	16.4% (16.0, 16.8)	16.6% (16.0, 17.1)	17.4% (17.0, 17.9)	17.2% (16.6, 17.8)	-0.1% (-0.9, 0.7)	0.78

Notes:
"95% CI" = 95% confidence interval.
Sample contains adults ages 18-64 with incomes estimated to be below 138% of the federal poverty level (n=86,188), excluding the fourth quarter of 2013 as a washout period (5753 observations) and excluding observations with non-response for a given outcome. Analyses used multivariable linear regression models adjusted for state, month and year, age, sex, marital status, race/ethnicity, urban vs. rural residence, employment status, income, and state-year unemployment rate. Analyses used robust standard errors clustered by state. Pre-ACA mean is the mean for each outcome from January 2012-September 2013. Post-ACA mean is the mean for each outcome from January 2014-March 2015.

APPENDIX eMETHODS

Regression Equations:

Changes in Coverage, Access, and Health Trends, with Multivariable Adjustment

$$Uninsured_{ist} = \beta_0 + \beta_1 TimeTrend_t + \beta_2 Q4\ 2013_t + \beta_3 Q1\ 2014_t + \beta_4 Q2\ 2014_t$$
$$+ \beta_5 Q3\ 2014_t + \beta_6 Q4\ 2014_t + \beta_7 Q1\ 2015_t + \beta_8 UnemploymentRate_{st}$$
$$+ \beta_x X_i + \Omega\ State_s + \pi\ CalendarMonth_t + \varepsilon_{ist} \qquad \text{Equation (1)}$$

where *i* indexed person, *s* state, and *t* date. *TimeTrend* was a linear variable measuring the number of months since the beginning of the study period (January 2012). X_i was a vector of sociodemographic variables (age, self-reported race/ethnicity, urban vs. rural residence[†], marital status, sex, income, and employment status). *UnemploymentRate* was the state-year specific unemployment rate, from the U.S. Bureau of Labor Statistics. Ω was a vector of state fixed effects, and π was a vector of binary indicators for the 12 calendar months to adjust for seasonality. The coefficients β_2 through β_7 captured the quarterly changes in the uninsured rate compared to the pre-existing trend, since the beginning of the first open enrollment period in October 2013. All models were survey-weighted linear regressions.

The models for access to care measures and self-reported health used the same equation, other than the dependent variable.

Interrupted Time-Series Model

$$Uninsured_{ist} = \beta_0 + \beta_1 TimeTrend_t + \beta_2 PostACA\_TimeTrend_t + \beta_3\ UnemploymentRate_{st}$$
$$+ \beta_x X_i + \Omega\ State_s + \pi\ CalendarMonth_t + \varepsilon_{ist} \qquad \text{Equation (2)}$$

[†] Rural residence was defined based on living in a zip code classified as "rural" by the Federal Office of Rural Health Policy in the U.S. Department of Health and Human Services.

where *i* indexed person, *s* state, and *t* date. The coefficient of interest is β_2, which captured the change in slope of the monthly time trend since the beginning of the first open enrollment period in October 2013 (the variable $PostACA\_TimeTrend_t$). The remaining variables were defined similarly as in Equation 1. All models were survey-weighted linear regressions.

Differences-in-Differences Analysis of Coverage for Low-Income Adults:

$$Uninsured_{ist} = \beta_0 + \beta_1 MedicaidExpansion_{st} + \beta_2 UnemploymentRate_{st} + \beta_x X_i + \Omega State_s + \partial Month\text{-}Year_t + \varepsilon_{ist}$$

Equation (3)

MedicaidExpansion was equal to 1 for observations in states in which the Medicaid expansion was in effect as of the first of the month, and 0 for all other observations; this approach allows for differential start dates of the Medicaid expansion by state. State fixed effects (Ω) captured any state-level differences in outcomes across the full study period, including the direct impact of living in an expansion state. Month-year fixed effects (∂) captured any nationwide differences in outcomes for each month during the study, including the direct impact of the post-ACA period. β_1 was the differences-in-differences estimate for how much the uninsured rate changed in Medicaid expansion states in 2014-2015, compared to non-expansion states. The remaining variables were defined similarly as in Equation 1. All models were survey-weighted linear regressions.

Pre-ACA Trend Comparison for Expansion versus Non-Expansion States in the Differences-in-Differences Analysis

$$Uninsured_{ist} = \beta_0 + \beta_1 TimeTrend_t + \beta_2 ExpansionState_s * TimeTrend_t + \beta_3 UnemploymentRate_{st} + \beta_x X_i + \Omega State_s + \varepsilon_{ist}$$

Equation (4)

A key assumption in a differences-in-differences analysis is that the pre-policy period trends between the two comparison groups are similar. This analysis (presented in Appendix eTable3) tested the pre-ACA trends in expansion vs. non-expansion states. Using data limited to the Pre-ACA period (Q1 2012-Q3 2013), we modeled each outcome as a function of a monthly time trend and an interaction term for the monthly time trend and whether a state ever expanded Medicaid during the study period (*ExpansionState)*. β_2 identified any diverging pre-ACA trend in expansion states, compared to non-expansion states. All models were survey-weighted linear regressions.

Income Estimates and Defining the Low-Income Sample:

To convert income from the survey's ten discrete categories into a percentage of the federal poverty level, we converted each income category into a dollar term using the midpoint of the category range (e.g. $9000 for people reporting income between $6000 and $12,000), and used multivariable regression to impute missing income for the 12% of the sample that did not report income, based on sex, age, race/ethnicity, education, marital status, household size, employment, and state of residence. This differs from the imputation method in a prior analysis of Gallup data (reference 8 in the manuscript), which incorporated insurance and other health measures into the imputation model; here, we excluded our study outcomes from the imputation process used to identify the low-income sample. Missing values for household size were imputed using the same regression approach. We then used household size and the U.S. federal poverty guidelines to convert income into a percentage of FPL.

Our regression-based imputation model had an R-squared of 0.35, with sex, age, race/ethnicity, education, marital status, household size, employment, and state of residence all

highly significant predictors ($p<0.001$) of income. Prior research (see Skopec et al., 2014) showed that regression-based imputation for missing values in the Gallup WBI produces an income distribution closer to that observed in Census survey data (particularly for the fraction of low-income adults), compared to omitting missing values.

In sensitivity analyses, we treated each income category as the lowest value in the respective category (e.g. $6000 for people reporting income between $6000 and $12,000), which produced a higher proportion of individuals with incomes below 138% of FPL, and we also considered the impact of excluding observations with missing values for income. See Appendix eTable 2 for these results.

Additional Details on the Gallup WBI Methods and Comparison to Federal Survey Data

Skopec et al. (2014) conducted a systematic comparison of national and state estimates of health insurance coverage, access to care, and self-reported health status in the Gallup WBI compared to the following federal surveys: Current Population Survey (CPS), the American Community Survey (ACS), the Medical Expenditure Panel Survey (MEPS), the National Health Interview Survey (NHIS), and the Behavioral Risk Factor Surveillance System (BRFSS). Key findings were as follows:

- The WBI provides similar though slightly lower estimates of the national uninsured rate (approximately 2 percentage-points lower) compared to other surveys, though the correlation in national trends in the uninsured rate over time was high: 0.87 with the CPS, 0.85 with the ACS, and 0.82 with the NHIS. Estimates of type of coverage (Medicaid, private, Medicare, or other) were less reliable in the WBI, particularly for public coverage types.

- WBI state-level estimates of the uninsured rate showed very high correlation with Census surveys, with correlation coefficients of 0.95 with the ACS and 0.89 with the CPS.
- Estimates related to access to care and self-reported health in the WBI generally fell within the range of estimates from the federal surveys that measured these variables, including the BRFSS, NHIS, and MEPS. However, the WBI sample had a slightly higher proportion of individuals in fair or poor health (14.8% and 5.6% respectively, vs. 11.8% and 4.3% in the BRFSS, for instance).
- The sample size for the WBI from 2008-2012 (the time period used for analysis by Skopec et al.) was approximately 1000 adults per day, which was reduced to 500 per day in 2013. This change only affected the sample size, not the sampling frame or weighting procedures. While this reduced the precision of the data for the study period analyzed here, it should not have introduced any systematic bias to the surveys' estimates.
- Prior to June 2013, the WBI sample frame used random-digit dialing (RDD) for cell phones and then randomly selected households from listed landlines. At that time, roughly 3% of households were estimated to have unlisted landlines, which could have introduced bias since these households were not eligible for the survey unless they were also cell phone users. If anything, this bias was more likely to affect high-income households, who are presumably more likely to pay a fee for unlisted status. Accordingly, the impact on our estimates of the uninsured rate and barriers to health care – outcomes concentrated among lower-income households – was likely minimal. Beginning in June 2013, however, the WBI shifted to an RDD approach for both landlines and cell phones. To examine the potential impact of this change, we tested the effect of adding a binary variable to our regressions indicating pre- or post June 2013.

The results of our analyses were essentially unchanged, offering reassurance that this potential source of bias did not substantially impact our findings.

Survey Questions for Study Outcomes

A) Do you have health insurance coverage?
1 Yes
2 No

B) Do you have a personal doctor?
1 Yes
2 No

C) In the city or area where you live, is it easy or not easy to get medicine?
1 Easy
2 Not easy

D) Have there been times in the past twelve months when you did not have enough money to pay for health care and/or medicines that you or your family needed?
1 Yes
2 No

E) Would you say your own health, in general, is___?
1 Excellent
2 Very good
3 Good
4 Fair
5 Poor

F) During the past 30 days, for about how many days did poor health keep you from doing your usual activities?
0-30 days, open-ended response *(converted to percentage by dividing by 30)*

Appendix eTable 1: Interrupted Time-Series Models for Coverage, Access, and Health after the ACA's First Open Enrollment Period

Variable	Pre-ACA Period (Q1 2012-Q3 2013)			Post-ACA Period (Q4 2013-Q1 2015)		
	Monthly Trend	95% CI	p-value	Monthly Trend	95% CI	p-value
Uninsured	0.10%	0.07, 0.13	<0.001	-0.44%	-0.49, -0.39	<0.001
No personal doctor	0.13%	0.10, 0.17	<0.001	-0.22%	-0.28, -0.16	<0.001
No easy access to medicine	0.10%	0.07, 0.12	<0.001	-0.11%	-0.15, -0.07	<0.001
Cannot afford care	0.13%	0.09, 0.16	<0.001	-0.23%	-0.29, -0.17	<0.001
Fair/poor health	0.13%	0.10, 0.17	<0.001	-0.16%	-0.21, -0.10	<0.001
% of last 30 days in which activities were limited by poor health	0.05%	0.03, 0.07	<0.001	-0.04%	-0.07, -0.00	0.03

Notes:
"95% CI" = 95% confidence interval.
Sample contains adults ages 18-64, n=507,055 minus item non-response for each row (see Table 2 in text for sample sizes).
"Monthly trend" based on multivariable regression model controlling for state, age, sex, race/ethnicity, marital status, urban vs. rural residence, employment status, income, state-year unemployment rate, and calendar month.

Appendix eTable 2: Difference-in-Differences Analysis of the Medicaid Expansion, Using Alternative Approaches to Defining the Low-Income Sample

OUTCOME	Alternative Model 1			Alternative Model 2		
	Coefficient	**95% CI**	**p-value**	**Coefficient**	**95% CI**	**p-value**
Uninsured	-5.1%	-7.8, -2.4	<0.001	-5.2%	-7.6, -2.7	<0.001
No personal doctor	-1.8%	-3.5, -0.2	0.03	-2.2%	-3.5, -0.8	0.002
No easy access to medicine	-2.4%	-3.9, -0.9	0.002	-2.3%	-3.5, -1.1	<0.001
Cannot afford care	-1.4%	-3.8, -1.1	0.27	-1.8%	-3.9, 0.3	0.09
Fair/poor health	-0.1%	-1.8, 1.5	0.85	-0.2%	-1.5, 1.1	0.79
% of last 30 days in which activities were limited by poor health	-0.0%	-0.9, 0.9	0.99	-0.2%	-0.9, 0.4	0.48
Analysis Details						
Analysis of Income Category for % FPL	Median Point of Income Category			Lowest Dollar Value in Income Category		
Imputation of Missing Values?	No			Yes		
Sample Size	81,977			118,826		

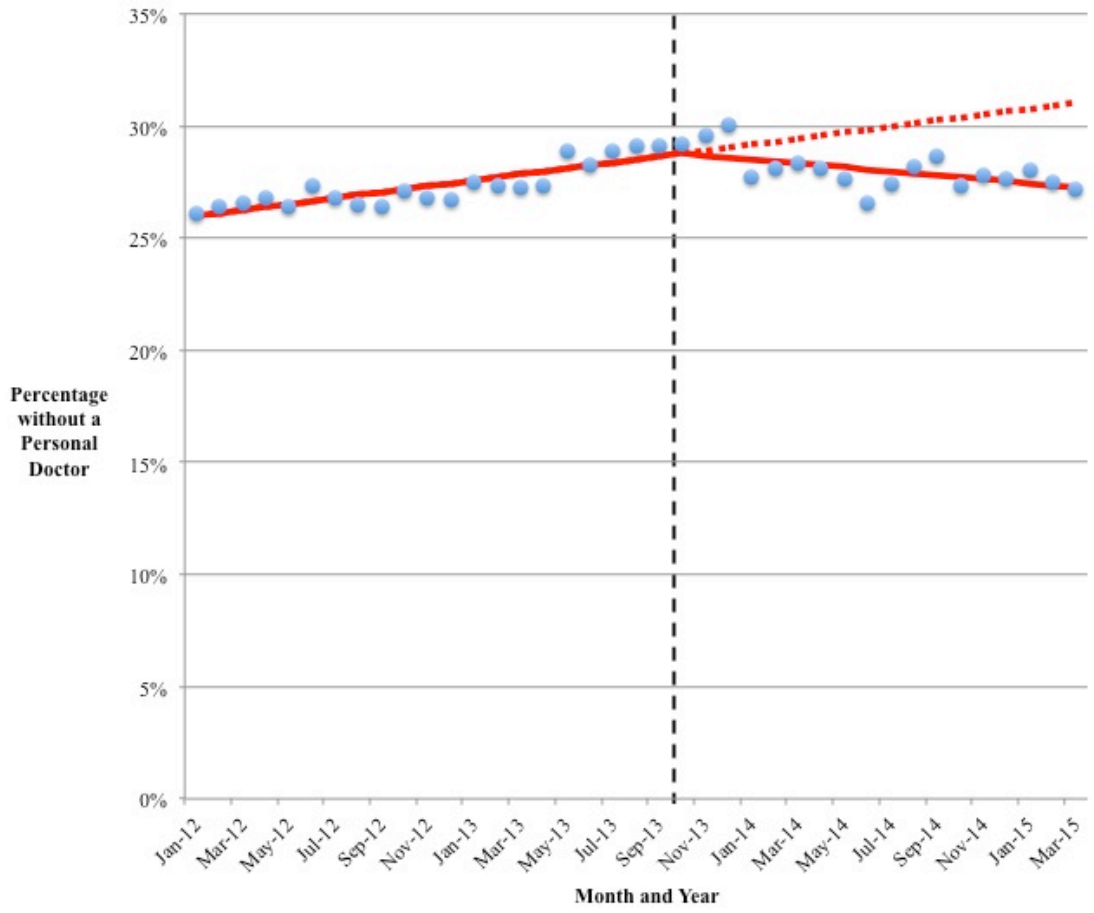
Notes:
"95% CI" = 95% confidence interval.
Sample contains adults ages 18-64 with incomes estimated to be below 138% of the federal poverty level, depending on the imputation methods described in the table. Sample excludes the fourth quarter of 2013 as a washout period, and excludes observations with non-response for a given outcome. Analyses adjusted for state, month and year, age, sex, marital status, race/ethnicity, urban vs. rural residence, employment status, income, and state-year unemployment rate. Analyses used robust standard errors clustered by state.

Appendix eTable 3: Pre-ACA Trends in Coverage, Access to Care, and Health Among Low-Income Adults in Medicaid Expansion versus Non-Expansion States

OUTCOME	Sample Size	Differential Trend in Medicaid Expansion States (vs. Non-Expansion States)		
		Coefficient	95% CI	p-value
Uninsured	56,570	0.01%	-0.15, 0.16	0.92
No personal doctor	56,420	0.04%	-0.11, 0.19	0.62
No easy access to medicine	55,825	0.03%	-0.10, 0.16	0.70
Cannot afford care	56,160	0.17%	0.01, 0.32	0.04
Fair/poor health	56,570	-0.08%	-0.23, 0.07	0.32
% of last 30 days in which activities were limited by poor health	55,360	0.04%	-0.05, 0.14	0.38

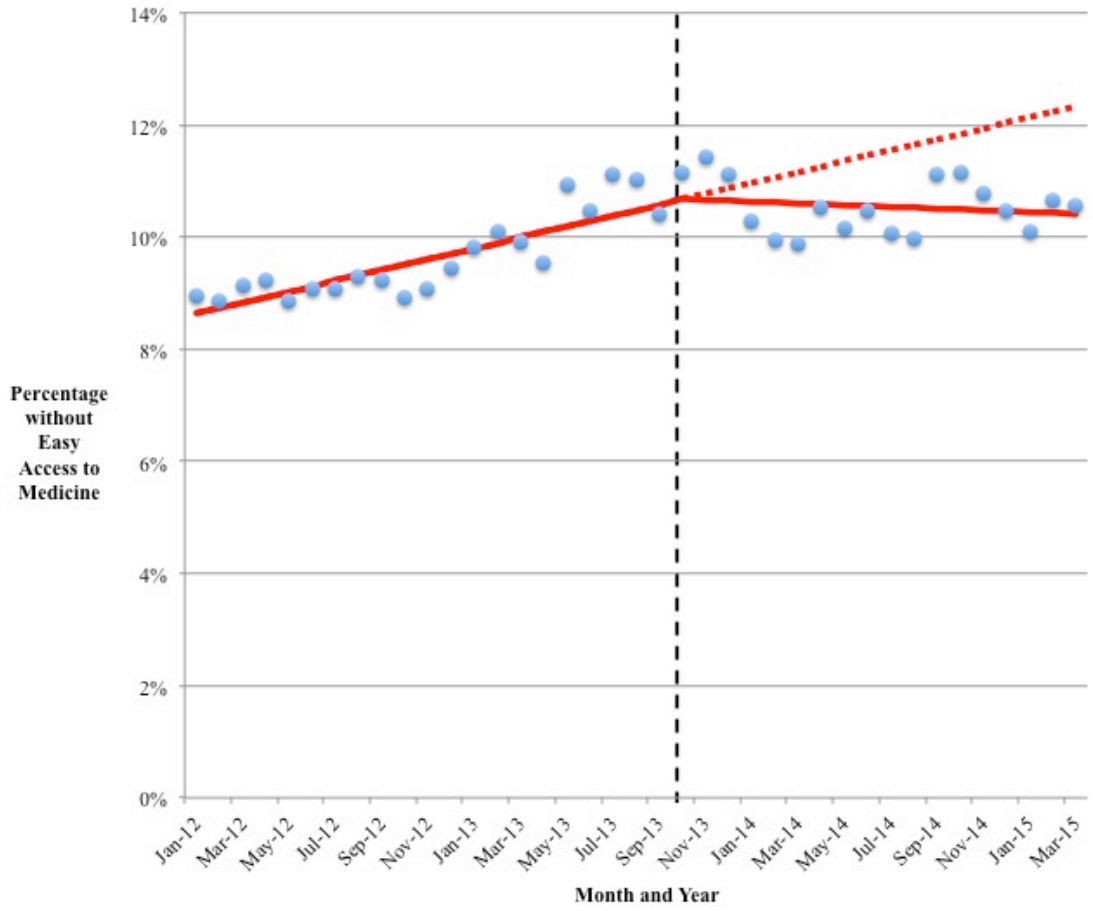
Notes:
"95% CI" = 95% confidence interval.
Sample contains data from prior to the fourth quarter of 2013 for adults ages 18-64 with incomes estimated to be below 138% of the federal poverty level. Each row excludes item non-response for that outcome.
Analyses adjusted for a linear time trend, state, age, sex, marital status, race/ethnicity, urban vs. rural residence, employment status, income, and state-year unemployment rate.
"Differential Trend" shows the coefficient on the interaction between a linear monthly time trend and an indicator for Medicaid expansion state.

Appendix eFigure 1: Interrupted Time-Series Analysis of Not Having a Personal Doctor



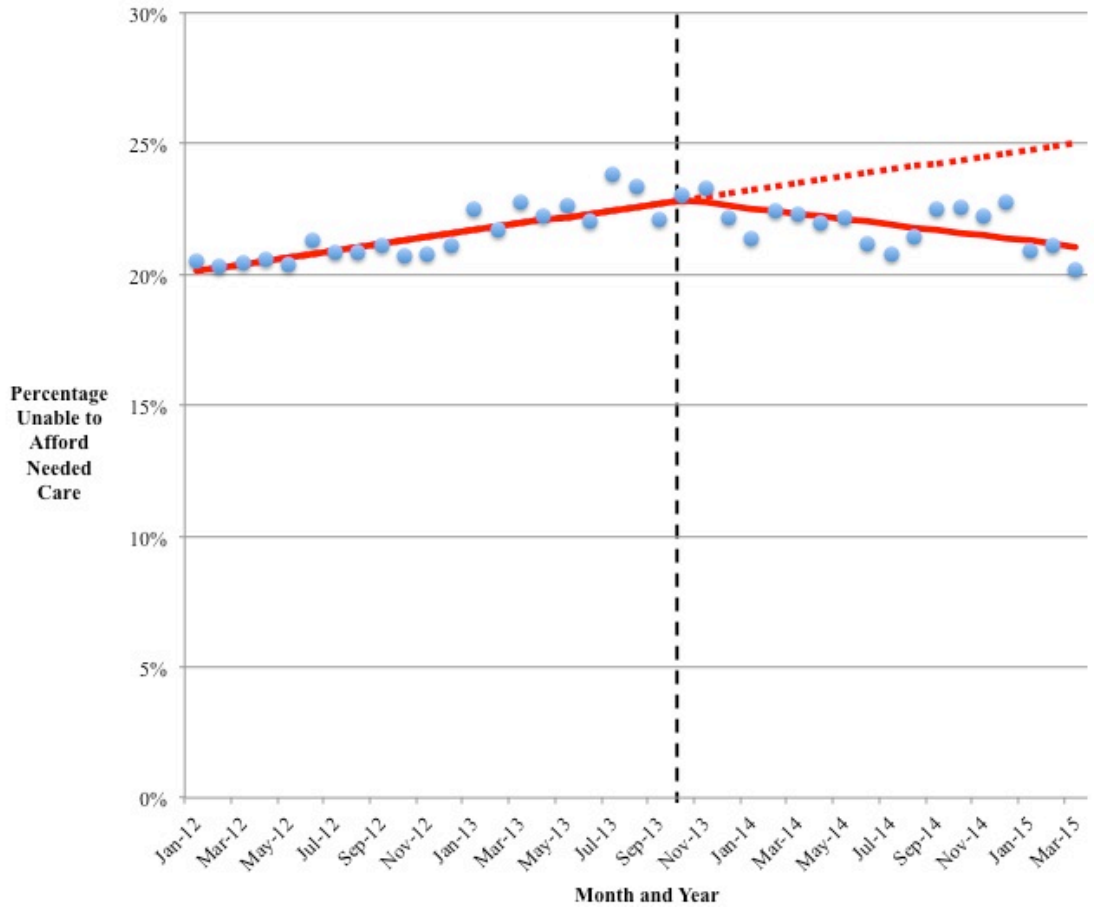
Notes: Sample contains adults ages 18-64.
The solid red lines show the adjusted time trends for the pre-ACA (January 1, 2012-September 30, 2013) and post-ACA (October 1, 2013-March 31, 2015) periods. The dashed red line shows the predicted trajectory if there had been no change in slope in the post-ACA period. The vertical dashed black line shows the beginning of the ACA's first open enrollment period in October 2013. The blue dots show the adjusted monthly mean values for the outcome, based on a multivariable regression model controlling for state, age, sex, race/ethnicity, marital status, urban vs. rural residence, employment status, income, state-year unemployment rate, and calendar month.

Appendix eFigure 2: Interrupted Time-Series Analysis of No Easy Access to Medicines



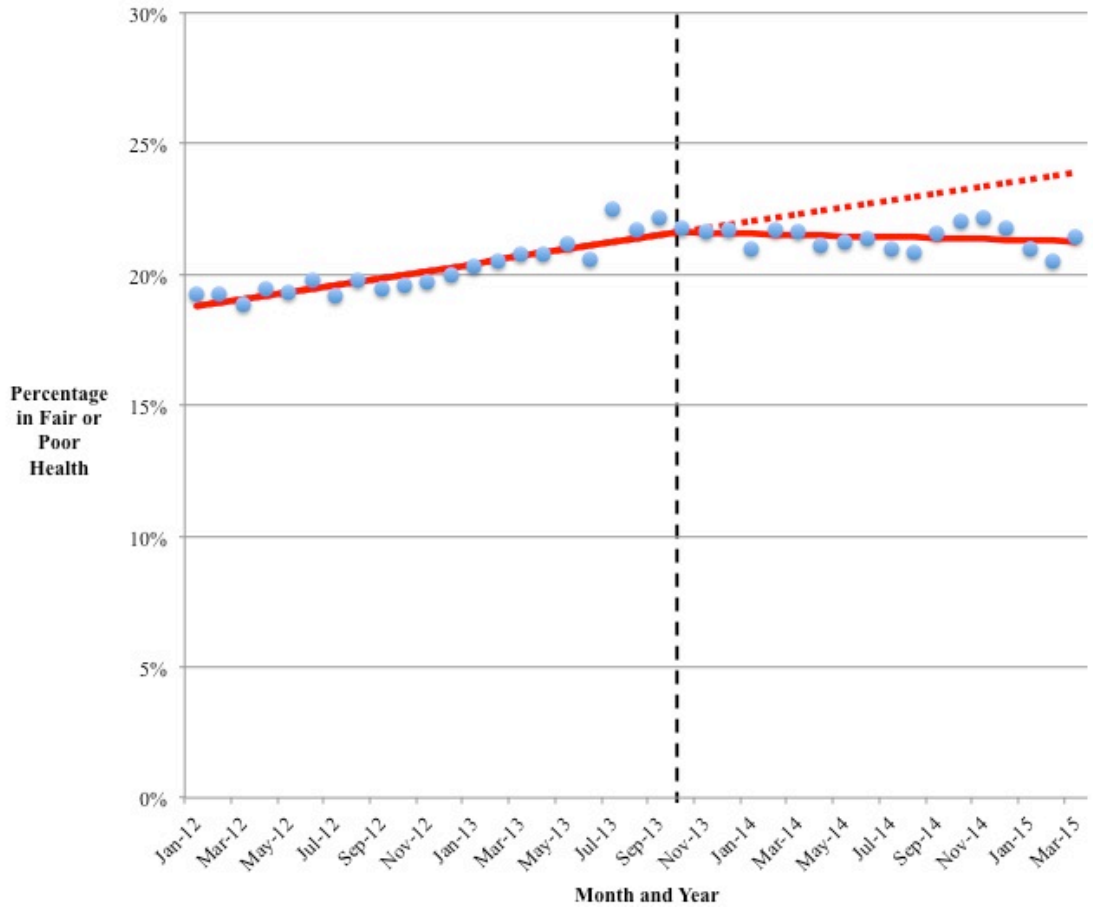
Notes: Sample contains adults ages 18-64.
The solid red lines show the adjusted time trends for the pre-ACA (January 1, 2012-September 30, 2013) and post-ACA (October 1, 2013-March 31, 2015) periods. The dashed red line shows the predicted trajectory if there had been no change in slope in the post-ACA period. The vertical dashed black line shows the beginning of the ACA's first open enrollment period in October 2013. The blue dots show the adjusted monthly mean values for the outcome, based on a multivariable regression model controlling for state, age, sex, race/ethnicity, marital status, urban vs. rural residence, employment status, income, state-year unemployment rate, and calendar month.

Appendix eFigure 3: Interrupted Time-Series Analysis of Inability to Afford Care



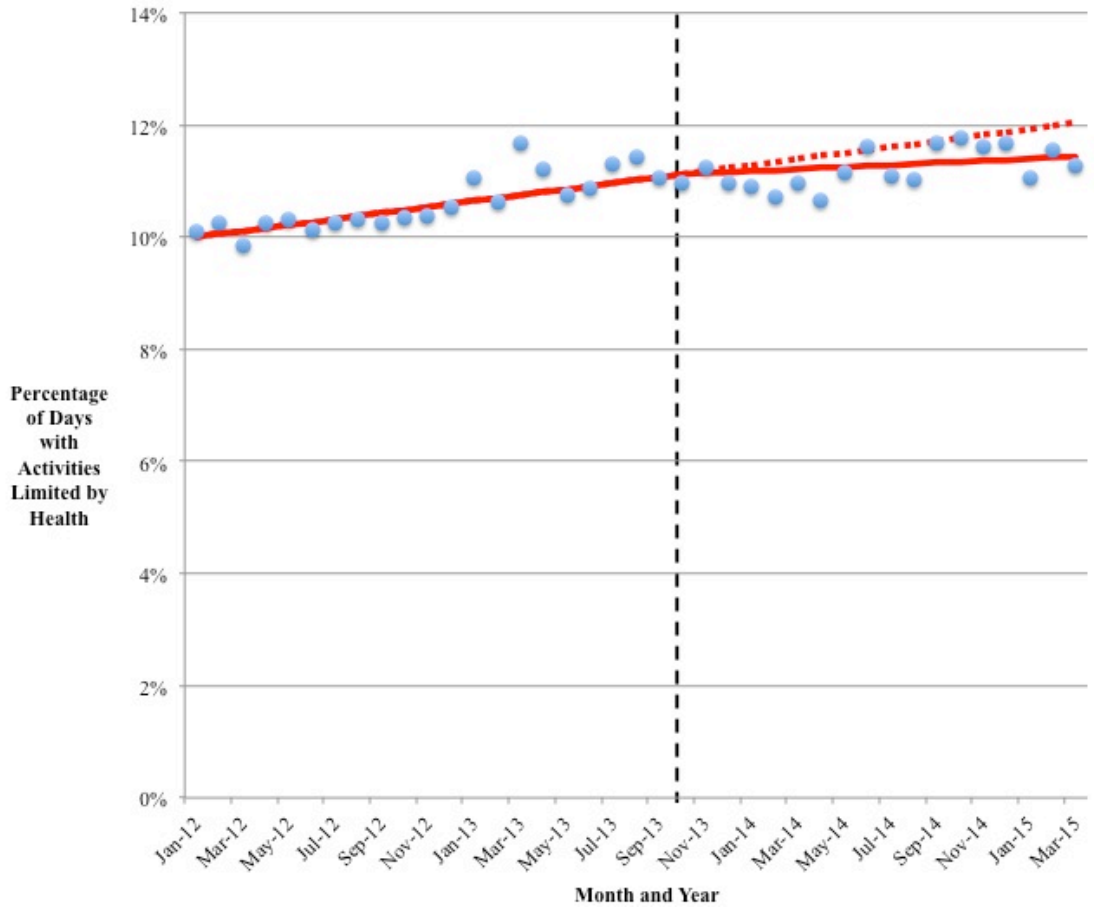
Notes: Sample contains adults ages 18-64.
The solid red lines show the adjusted time trends for the pre-ACA (January 1, 2012-September 30, 2013) and post-ACA (October 1, 2013-March 31, 2015) periods. The dashed red line shows the predicted trajectory if there had been no change in slope in the post-ACA period. The vertical dashed black line shows the beginning of the ACA's first open enrollment period in October 2013. The blue dots show the adjusted monthly mean values for the outcome, based on a multivariable regression model controlling for state, age, sex, race/ethnicity, marital status, urban vs. rural residence, employment status, income, state-year unemployment rate, and calendar month.

Appendix eFigure 4: Interrupted Time-Series Analysis of Fair or Poor Self-Reported Health



Notes: Sample contains adults ages 18-64.
The solid red lines show the adjusted time trends for the pre-ACA (January 1, 2012-September 30, 2013) and post-ACA (October 1, 2013-March 31, 2015) periods. The dashed red line shows the predicted trajectory if there had been no change in slope in the post-ACA period. The vertical dashed black line shows the beginning of the ACA's first open enrollment period in October 2013. The blue dots show the adjusted monthly mean values for the outcome, based on a multivariable regression model controlling for state, age, sex, race/ethnicity, marital status, urban vs. rural residence, employment status, income, state-year unemployment rate, and calendar month.

Appendix eFigure 5: Interrupted Time-Series Analysis of Percentage of Days with Activities Limited by Poor Health



Notes: Sample contains adults ages 18-64.
The solid red lines show the adjusted time trends for the pre-ACA (January 1, 2012-September 30, 2013) and post-ACA (October 1, 2013-March 31, 2015) periods. The dashed red line shows the predicted trajectory if there had been no change in slope in the post-ACA period. The vertical dashed black line shows the beginning of the ACA's first open enrollment period in October 2013. The blue dots show the adjusted monthly mean values for the outcome, based on a multivariable regression model controlling for state, age, sex, race/ethnicity, marital status, urban vs. rural residence, employment status, income, state-year unemployment rate, and calendar month.