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RESEARCH ARTICLE

Racial/Ethnic Differential Effects of Medicaid Expansion on Health Care Access

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Objective. To assess racial/ethnic differential impacts of the ACA's Medicaid expansion on low-income, nonelderly adults' access to primary care.

Data Sources. Behavioral Risk Factor Surveillance System, State Physicians Workforce Data Book, and Bureau of Labor Statistics, in 2013 and 2015.

Study Design. Quasi-experimental design with difference-in-differences analyses. Outcomes included health insurance coverage, having personal doctor(s), being unable to see doctors because of cost, and receiving a flu shot. We tested racial/ethnic differential impacts using the "Seemingly unrelated estimation" method. Multiple imputations and survey weights were used.

Data Collection/Extraction Methods. Low-income, nonelderly adults were identified based on age, household income, and family size.

Principal Findings. Among the low-income, nonelderly adults, Medicaid expansion was associated with statistically significant gains in health insurance coverage, having personal doctors, and affordability. Hispanics got the fewest benefits, which significantly widened racial/ethnic disparities for the Hispanic group. Racial/ethnic disparity in having personal doctors narrowed for non-Hispanic black and non-Hispanic others, although not statistically significant.

Conclusion. Medicaid expansion improved access to primary care, but it had differential effects among racial/ethnic groups resulting in mixed effects on disparities. Further research is necessary to develop tailored policy tools for racial/ethnic groups.

Key Words. Medicaid expansion, health care access, racial/ethnic disparities

The Patient Protection and Affordable Care Act (ACA) was signed into law in 2010 and is the most comprehensive health system legislation in the United States since the creation of Medicare and Medicaid in 1965 (Kominski 2013). With the ultimate goal of improving health care access, the ACA was designed to provide coverage to Americans who were previously uninsured, in part by making private insurance more affordable and expanding eligibility for public

coverage. One of the biggest changes included in the ACA involves the expansion of Medicaid. Beginning in 2014, the ACA required states to expand the eligibility of their Medicaid programs to cover all legal residents with incomes below 138 percent of the federal poverty level (Kominski 2013). Prior to the implementation of this policy, however, in June 2012, the Supreme Court ruled that the mandatory characteristic of Medicaid expansion was unconstitutional, making Medicaid expansion voluntary on the part of states (Kominski 2013).

Many previous studies have examined the immediate effects of Medicaid expansion among the low-income population using survey data from 2014. These studies found that expansion was positively associated with insurance coverage gains, access to care, affordability of health care, and utilization of health services, both at the national and state level (Sommers et al. 2015; Benitez, Creel, and Jennings 2016; Sommers, Blendon, and Orav 2016a; Wherry and Miller 2016). Even more recent work used newly released 2015 data to update these studies. They confirmed the Medicaid expansion's effects on health care access but also found that it was associated with longer wait times for appointments, with differential effects between rural and urban areas (Sommers et al. 2016b; Miller and Wherry 2017; Simon, Soni, and Cawley 2017; Soni, Hendryx, and Simon 2017). In addition, there is mounting evidence showing that under the ACA, racial/ethnic disparities in health insurance coverage among the nonelderly population of all income levels have been narrowed (Chen et al. 2016), and there exists larger effects among minority groups, as well as heterogeneous effects within-Latino groups (Sommers et al. 2015; Courtemanche et al. 2017; Gonzales and Sommers 2018; Wehby and Lyu 2018). These results may be due to the fact that minority groups typically have larger proportions of low-income adults eligible for Medicaid under expansion. However, there is a paucity of studies focusing on the ACA's effect on racial/ethnic disparities among the Medicaid expansion eligible population.

In this article, we examine whether eligible populations in all racial and ethnic groups benefit equally from Medicaid expansion. We built on previous

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studies and made several extensions. In addition to health insurance coverage, we examined more health access indicators to provide further insights on disparities in health care access. Moreover, we restricted our study population to nonelderly adults with incomes below 138 percent of the federal poverty level. Examining differential effects of Medicaid expansion is important for evaluating the policy returns and understanding how health disparities changed following the expansions. Although Medicaid is an entitlement program, eligible racial/ethnic minority populations, particularly Hispanics, may have more barriers to enroll and benefit from this kind of social welfare program. These barriers to accessing health care include income inequalities (Clark et al. 2016), low levels of awareness of the ACA (Garcia Mosqueira, Hua, and Sommers 2015), and language proficiency and other health system barriers (Ortega, Rodriguez, and Vargas Bustamante 2015). Focusing on this specific eligible population, we were able to examine the differential effects of the expansion on health access and racial/ethnic disparities.

We hypothesized that Medicaid expansion would increase insurance coverage and facilitate access to care among low-income, nonelderly adults. However, we expected that these effects vary across racial and ethnic groups.

METHODS

Data and Measures

We used the 2013 and 2015 Behavioral Risk Factor Surveillance System (BRFSS) for our main analyses (CDC 2017). The BRFSS consists of annual telephone surveys of noninstitutionalized adults ages 18 or older, collecting information on health status, access to care, health behaviors, and other demographic characteristics. The survey collected nationally representative samples using a stratified probability sampling design. Importantly, the BRFSS public file dataset includes state identifiers, which enabled us to distinguish observations in expansion states from those in nonexpansion states.

We also merged the state-year specific number of active primary care physicians and employment rate to the BRFSS dataset. These state-level data were from 2013 and 2015 state physicians workforce data book (AAMC 2013, 2015) and the Bureau of Labor Statistics website (BLS 2013, 2015).

The primary outcome was "health insurance coverage," which was asked in the BRFSS questionnaire as "Do you have any kind of health care coverage, including health insurance, prepaid plans such as HMOs, or government plans such as Medicare, or Indian Health Service?" Our secondary

outcomes included "having personal doctors," "being unable to see doctors because of cost in the past 12 months," and "received a flu shot in the past 12 months." All outcomes were coded as binary variables.

Because BRFSS only includes categorical measures of annual income, we constructed a dummy variable to indicate whether an individual's income is below or equals to 138 percent FPL; given the household size of each individual, we compared the upper bound of income categories with the Federal Poverty Guideline in 2013 and 2015, respectively. For example, the 138 percent FPL for a household size of three is $20,090 in 2015. Respondents with a family size of three and annual income less than $10,000 or "$10,000 to $15,000" or "$15,000 to $20,000" were coded as "low-income."

Study Design

We used a quasi-experimental difference-in-differences study design comparing expansion and nonexpansion states. States that implemented the Medicaid expansion in 2014 or 2015 were defined as expansion states, while those states that did not expand their Medicaid programs until 2016 were considered nonexpansion states. Similar to other studies (Wherry and Miller 2016; Miller and Wherry 2017), we excluded five states that already expanded Medicaid or provided insurance coverage to low-income, nonelderly adults. We also excluded Guam and Puerto Rico from the dataset. Our final analysis included 25 states in the expansion group and 21 states in the nonexpansion group (Section S1).

The units of analysis are individuals in each wave. We compared changes between 2013 and 2015 for adults age 19–64 with incomes below 138 percent of the federal poverty level (FPL) in expansion states versus nonexpansion states. Given that not all eligible adults in expansion states successfully enrolled in Medicaid, this study was set to explore the intent-to-treat effect of Medicaid expansion.

Statistical Analysis

Descriptive statistics for respondents in 2013 were calculated separately for expansion states and nonexpansion states. We generated two dummy variables, Expansion = 1 if respondents were living in expansion states; 0 otherwise. Post = 1 if data were from 2015, and Post = 0 if data were from 2013. The difference-in-differences models were specified as follows:

$$y_{ij} = \alpha_j + \beta_{1j}\text{Expansion}_i + \beta_{2j}\text{Post}_i + \gamma_j\text{Expansion}_i * \text{Post}_i + \xi X_i + \varepsilon_i$$

where γ_j indicates the difference-in-differences estimate (comparing pre–post differences in expansion states and nonexpansion states), capturing the treatment effect of Medicaid expansion on the jth outcome. Covariates (X_i) of this analysis included self-reported health, gender, race, age, education, marital status, employment status, language of the interview, state fixed effects, number of children in household, number of adults in household, state-year specific unemployment rate, and state-year specific number of primary care physicians per 10,000 people. For ease of interpretation, we used a linear regression model to fit these models.

We constructed our measure of health disparities as unadjusted differences in means (Buchmueller et al. 2016) using non-Hispanic whites as the reference group. For example, the white-Hispanic disparity in health insurance coverage was calculated as the insured rate of non-Hispanic whites minus that in Hispanic group. We then did difference-in-differences models to check how Medicaid expansion influenced health disparities. To examine whether these difference-in-differences estimates differ among racial/ethnic groups, ideally, we could add three-way interaction terms (Expansion*Post*Race) in the above model; the coefficients of these three-way interactions terms are differential effects compared with the reference group (e.g., non-Hispanic white as the reference). However, we were unable to include these three-way interaction terms in our imputation models due to multicollinearity problems. Alternatively, we separately estimated difference-in-differences models for each racial and ethnic group: non-Hispanic white, non-Hispanic black, Hispanic, and others. Then, we applied the "seemingly unrelated estimation (SUEST)" method (Clogg, Petkova, and Haritou 1995) to compare whether treatment effects (difference-in-differences coefficients), γ_j, are different across regression models (or racial and ethnic groups). The difference between γ_j across race and ethnic groups is also the adjusted difference-in-differences estimate of health disparities (Section S3). Bonferroni correction method was used to correct the significance level of multiple comparisons. We used multiple imputations to impute missing values and survey weights to correct standard errors and get national estimates (Section S2). All analyses were conducted using Stata, version 14.2 (StataCorp. 2015. College Station, TX: StataCorp LP, USA).

We examined the sensitivity of our results to different sample definitions that included only nonelderly adults with incomes below 100 percent FPL,

excluded those younger than 26, and excluded states that expanded Medicaid in 2015. We also evaluated different model specifications that used survey-weighted regression with three-way interactions to check the differential effects across race and ethnic groups (Section S4).

In addition, we estimated difference-in-differences-in-differences (DDD) models by using low-income adults over the age of 65 as the unaffected group (Section S5). If DDD estimates were consistent with our main analyses, it would suggest our results were robust to state-specific policy changes and the "parallel trend" might hold. To further check the "parallel trend" assumption for our difference-in-differences models, we pooled 2011 to 2015 data and visualized the temporal trend of outcomes in two groups (Figure S1–S4). Furthermore, an interrupted time series with comparison series analysis based on quarterly data (Section S6) was performed to present explicit tests for parallel pretrends of outcomes in the two groups.

RESULTS

Descriptive Analysis

Table 1 presents baseline descriptive statistics of dependent variables and the demographic characteristics of respondents separately for expansion and nonexpansion states in 2013. There were 18,408 observations in the nonexpansion group and 16,964 observations in the expansion group. Respondents in the expansion group are more likely to have health insurance and a personal doctor, and less likely to have unmet medical needs because of cost. Most of the demographic characteristics of the two groups were quite similar, except that number of state active primary physicians per 100,000-population, and the state unemployment rate is slightly higher in expansion states than those in the nonexpansion group.

Effects of Medicaid Expansion on Access to Care. Table 2 shows the adjusted difference-in-differences estimates of the impacts of Medicaid expansions on outcome variables in the overall sample and by racial/ethnic groups. A detailed comparison of these indicators in 2013 and 2015, and unadjusted difference-in-differences estimates were documented in Table S1 (Supplemental Material).

Among the low-income, nonelderly adult population, Medicaid expansion was associated with a 7.10 percentage-point increase in health insurance coverage, a 6.63 percentage-point increase in the probability of having

Table 1: Characteristics of Low-Income, Nonelderly Adults in 2013

	Nonexpansion States		*Expansion States*	
	Unweighted Sample Size	*Weighted Statistics*	*Unweighted Sample Size*	*Weighted Statistics*
Observations	18,408	45.63	16,946	54.37
Outcomes				
Health insurance coverage	12,017	64.12	12,226	70.53
Having personal doctors	13,467	70.35	12,948	71.55
Unable to see doctors because of cost	6,280	32.02	4,728	27.14
Received a flu shot	6,154	32.70	6,013	32.70
Covariates				
Age (SD)	18,408	44.55(0.63)	16,946	43.66(0.60)
Female %	12,357	60.75	11,085	59.45
Married %	7,183	47.97	6,742	46.81
General health %				
Excellent	1,954	12.46	1,992	12.80
Very good	3,647	21.54	3,713	23.04
Good	6,002	34.84	5,359	33.27
Fair	4,107	20.37	3,747	21.40
Poor	2,698	10.79	2,135	9.49
Annual household income %				
<10,000	4,404	43.31	3,758	43.10
<15,000	3,990	13.39	3,535	14.13
<20,000	3,356	19.64	2,859	19.08
<25,000	5,676	17.20	5,888	16.50
<35,000	872	5.69	745	6.01
<50,000	94	0.65	144	1.19
<75,000	16	0.13	17	0.00
Race %				
White, non-Hispanic	11,446	55.67	11,182	56.00
Black, non-Hispanic	3,527	20.73	1,687	9.71
Hispanic	1,883	18.25	2,256	25.65
Others, non-Hispanic	1,552	5.35	1,821	8.64
Education level %				
Did not graduate high school	3,471	25.87	2,729	26.10
Graduated high school	7,009	34.12	6,318	32.84
Attended college or technical school	5,220	28.02	4,884	28.26
Graduated from college or technical school	2,708	11.98	3,015	12.80
Employed %	6,835	42.53	6,645	43.77
English language speaker %	17,356	89.32	15,904	85.88
Number of children in household (SD)	18,408	1.01(0.07)	16,946	1.08(0.06)
Number of adults in household (SD)	18,408	2.58(0.07)	16,946	2.70(0.06)

Continued

Table 1. *Continued*

	Nonexpansion States		*Expansion States*	
	Unweighted Sample Size	*Weighted Statistics*	*Unweighted Sample Size*	*Weighted Statistics*
State primary physicians (per 100,000) (SD)	18,408	79.90(0.14)	16,946	93.32(0.13)
State unemployment rate (mean)	18,408	6.88	16,946	7.93

Note. The unweighted sample size was calculated from the first imputed dataset, while weighted statistics were based on 10 multiple imputations. Observations with any missing outcome variables were excluded.
SD denotes standard error.

Table 2: Difference-in-Differences Estimates of Effects of Medicaid Expansion on Access to Primary Care

	Health Insurance Coverage		*Having Personal Doctors*		*Unable to See Doctors Because of Cost*		*Received a Flu Shot*	
	DiD	*p*	*DiD*	*p*	*DiD*	*p*	*DiD*	*p*
All	7.10	<.01	6.63	<.01	−2.72	.03	−0.68	.60
Non-Hispanic white	11.02	<.01	5.67	<.01	−4.45	<.01	2.20	.15
Non-Hispanic black	7.67	.06	12.63	<.01	−7.69	.06	−6.24	.08
Hispanic	−1.21	.76	4.93	.24	3.37	.39	−5.12	.20
Non-Hispanic others	2.50	.57	9.98	.04	−2.58	.54	−0.85	.85

Notes. All estimates were from difference-in-differences analysis with multiple imputations and survey weights, adjusting for covariates. Each cell represents the result from a separate regression model and sample group.

personal doctors, and a 2.72 percentage-point reduction in the probability of being unable to see doctors because of cost. These estimates were statistically significant after controlling for covariates. There were small and statistically insignificant changes in receiving a flu shot in the past 12 months.

Heterogeneous Effects of Medicaid Expansion. Stratified analysis found that the effects of the Medicaid expansion were weakest among Hispanics (Table 2). Non-Hispanic whites saw the largest coverage gains with adjusted difference-in-differences estimates equal to 11.02 percentage points. However, Medicaid expansion was associated with a 1.21 percentage-point reduction in health insurance coverage among the Hispanic group, although this effect was not significant. Medicaid expansion increased the probability of having personal

doctors for all groups, with the most substantial increase in the non-Hispanic black group (DiD estimates: 12.63 percentage points, $p < .01$), and the least improvements among Hispanics (DiD estimate: 4.93, $p = .24$).

In terms of being unable to see doctors because of cost, there was a 4.45 percentage-point reduction for non-Hispanic whites ($p < .01$), a 7.69 percentage-point reduction for non-Hispanic blacks ($p = .06$), and a 2.58 percentage-point reduction in non-Hispanic others (not statistically significant), associated with Medicaid expansion. However, Hispanics had a 3.37 percentage-point increase for this measure, although this was not statistically significant. While we did not detect any statistically significant changes in the probability of receiving a flu shot in the past 12 months, it is worth noting that Medicaid expansion was associated with reductions among the non-Hispanic black and Hispanic groups, with effect sizes equal to −6.24 percentage points and −5.12 percentage points, respectively.

Effects on Racial/Ethnic Disparities. Table 3 shows the unadjusted racial/ethnic gaps in health care access indicators with non-Hispanic whites as the reference group. Based on these measurements of gaps, unadjusted and adjusted difference-in-differences estimates compared with counterparts in the nonexpansion states group are also provided in Table 3.

Among low-income, nonelderly adults, insurance coverage gaps between non-Hispanic whites and minorities have widened. Specifically, Medicaid expansion was associated with a 12.22 percentage-point increase in the insurance coverage gap between Hispanics and non-Hispanic whites, which is statistically significant. The coverage gap for non-Hispanic blacks and non-Hispanic others compared to non-Hispanic whites increased by 3.35 percentage points and 8.52 percentage points, respectively.

Disparities in having personal doctors and being unable to see doctors because of cost did not post statistically significant changes. Compared to non-Hispanic whites, the gap of having personal doctors among those in expansion states reduced by 6.96 percentage points more than among states that did not expand Medicaid for non-Hispanic blacks and by 4.32 percentage points for non-Hispanic others. There were minor and insignificant changes for disparities in Hispanics. For the probability of being unable to see doctors because of cost, the white–black disparity was narrowed by 3.25 percentage points, while the white-Hispanic disparity and the white-others disparity increased by 7.82 and 1.87 percentage points, respectively.

Finally, in terms of the probability of receiving a flu shot, there were substantially enlarged disparities between non-Hispanic whites and non-Hispanic

Table 3: Changes in Racial/Ethnic Disparities among Low-Income Poor Population in Medicaid States and Nonexpansion States

		Expansion States		*Nonexpansion States*		*Unadjusted DiD*	*Adjusted DiD*
		Pre	*Post*	*Pre*	*Post*		
Health insurance coverage	W-B	3.18	3.16	6.89*	4.91*	1.95	3.35
	W-H	15.10*	26.04*	30.64*	31.27*	10.31*	12.22*
	W-O	−0.61	1.07	4.21	0.54	5.36	8.52
Having personal doctors	W-B	3.40	3.36	3.63	3.79	−0.05	−6.96
	W-H	21.02*	21.88*	22.20*	25.53*	0.87	0.74
	W-O	9.65*	7.32*	7.08	10.75*	−2.33	−4.32
Unable to see doctors because of cost	W-B	−5.66	−2.13	−5.85*	−2.57	0.24	3.25
	W-H	−5.65	−8.64*	−11.42*	−6.11*	−8.29	−7.82
	W-O	−0.49	1.92	−1.78	0.32	0.31	−1.87
Flu shot	W-B	1.49	5.63*	3.98	2.16	5.97	8.44
	W-H	−1.02	3.01	3.24	2.86	4.41	7.33
	W-O	−4.90	−0.80	−2.85	−1.38	2.63	3.05

Notes. 1. W-B indicates mean outcomes for non-Hispanic white minus mean outcomes for non-Hispanic black. W-H indicates mean outcomes for non-Hispanic white minus mean outcomes for Hispanic. W-O indicates mean outcomes for non-Hispanic white minus mean outcomes for non-Hispanic others. 2. "Pre" stands for unadjusted values in 2013, and "Post" stands for unadjusted values in 2015. 3. All estimates used multiple imputations and survey weights. 4. * indicates $p < .05$ after Bonferroni correction that corrected significance levels for multiple comparisons. 5. Statistical significance tests for pre- and post-racial/ethnic disparities were based on survey-weighted F test among multiple imputations. DiD estimates were generated from SUEST methods with covariates controlled for adjusted DiD. Each cell represents the result from a separate regression model and sample group.

blacks, associated with Medicaid expansion. The difference-in-differences estimate was 8.44 percentage points, although not statistically significant. Table 3 also shows a 7.33 percentage point increase in the gap between non-Hispanic whites and Hispanics and a 3.05 percentage point increase between non-Hispanic whites and non-Hispanic others. All these changes were not statistically significant.

Sensitivity Analyses. A wide range of sample definitions in sensitivity analyses found no meaningful changes in the results (Table S2–S4). Survey-weighted regression with three-way interactions (Table S5) and triple differences (Table S6) also showed consistent estimates. Moreover, an interrupted time series analysis showed no violations of the "parallel trend" assumption for most scenarios with some exceptions, which are worth noting (Table S7, Figure S1–S4). Pretrend differences in the probability of being insured between expansion states and nonexpansion states were found statistically significant in the all groups analysis and marginally significant in the subgroup analysis

for non-Hispanic whites and non-Hispanic blacks. Before Medicaid expansion, respondents living in expansion states had a lower annual growth rate of coverage than their counterparts in nonexpansion states. In addition, non-Hispanic blacks in expansion states also had statistically significant lower annual reduction rate in the probability of being unable to see doctors because of cost. These may lead our DiD estimates, with the parallel trend assumption, to be underestimated.

DISCUSSION

In this study, we examined the impacts of Medicaid expansion on access to health care among low-income, nonelderly adults by comparing changes in expansion states with nonexpansion states. We also explored the heterogeneous effects of the Medicaid expansion across racial/ethnic groups and tested how these effects influence racial/ethnic disparities in access to health care.

Among the low-income, nonelderly adult population, we found that living in expansion states was associated with higher probability of being insured, higher probability of having personal doctors, and lower probability of being unable to see a doctor because of cost, compared to those living in nonexpansion states, adjusting for socioeconomic factors. These results are consistent with other national studies examining 2-year effects of Medicaid expansion among low-income nonelderly population based on BRFSS (Simon, Soni, and Cawley 2017), the National Health Interview Survey (Wherry and Miller 2016; Miller and Wherry 2017), the American Community Survey (Soni, Hendryx, and Simon 2017), and the Gallup-Healthways Well-Being Index Survey (Sommers et al. 2015), as well as evaluation results from specific states (Pande et al. 2011; Benitez, Creel, and Jennings 2016; Sommers et al. 2016b). Similar to other studies (Miller and Wherry 2017; Simon, Soni, and Cawley 2017), we did not find any significant changes in flu vaccination compared to nonexpansion states.

Our study showed remarkable differential effects across racial and ethnic groups; the low-income, nonelderly adult Hispanic population in expansion states saw fewer benefits from Medicaid expansion, compared with other racial/ethnic groups. These results are similar to results from a prior analysis of insurance coverage gains when it used the similar sample definition as ours (Wehby and Lyu 2018). Moreover, specific Latino subgroups (Mexican and Central American) were also found to have less coverage gains relative to non-Latino whites (Alcala et al. 2017). Heterogeneous effects within the

Latino group were further evidenced by one study examining 2014 Medicaid expansion; the effect size on uninsured rate ranges from −0.0087 to −0.0839 within Latinos and was −0.0427 for whites (Gonzales and Sommers 2018). But our results contrast with findings that insurance disparities diminished in Oregon based on electronic health record data (Heintzman et al. 2017). In our study, non-Hispanic whites in expansion states had the largest improvements in being insured, which further enlarged the coverage gap relative to racial/ethnic minorities, especially for Hispanics. Our findings are pretty consistent with a recent study using electronic health record data of 359 community health centers that support increased insurance coverage gaps between non-Hispanic whites and Hispanics (Angier et al. 2017). Although several prior studies (Sommers et al. 2015; Buchmueller et al. 2016; Chen et al. 2016) focusing on all-income-level nonelderly adults documented larger improvement in coverage gains among racial/ethnic minorities, these results did not hold for the subpopulation of lower income adults.

Similar to previous studies about racial/ethnic disparities in having personal physicians and doctor visits after the ACA (Sommers et al. 2015; Manuel 2018), we found statistically significant increase in the probability of having personal doctors across all racial/ethnic groups except for Hispanics. Although Hispanic populations in expansion states had 4.93 higher probability of having personal doctors associated with Medicaid expansion, it was not statistically significant. Medicaid expansion helped narrow the racial/ethnic disparities for non-Hispanic blacks and non-Hispanic others in the probability of having personal doctors, but these effects were also not found to be statistically significant.

Furthermore, we found that, except for Hispanics, there were reductions in the probability of being unable to see doctors because of cost. In contrast to recent evidence from Arkansas, Kentucky, and Texas (Sommers et al. 2016b), the effects were only statistically significant for non-Hispanic whites. Non-Hispanic blacks had the largest drop in this measure, which narrowed the gap relative to non-Hispanic whites by 7.82 percentage points, although this was not statistically significant. However, Hispanics saw the highest probability of financial hardships in access to care. These results were consistent with a study examining individuals who forgo care because of cost based on National Health Interview Survey (Alcala et al. 2017), which showed that, compared to non-Latino whites, statistically significant higher odds of having to forgo care post-ACA were found for Cubans (OR: 1.52) and Central Americans (OR: 1.35). Because BRFSS asked respondents about their experience during the previous 12 months of this measure, our models may suffer from measurement error if states that expanded Medicaid expansion in 2015 were coded as expansion

states. After excluding these states (Pennsylvania, Indiana, and Alaska), we found greater decreases in this outcome across all racial/ethnic groups with statistically significant effects for non-Hispanic whites and non-Hispanic blacks. Hispanics still had the least improvements; the difference-in-differences estimate was −0.49 percentage points (and was not statistically significant).

In terms of flu vaccination rates, compared to the rates in nonexpansion states, non-Hispanic white respondents in expansion states increased while the rate for non-Hispanic blacks and Hispanic respondents decreased, even when we excluded the three states that provided expansions in 2015. The effect, among non-Hispanic others group, was slightly sensitive to whether we included these three states or not. Although all these effects were not statistically significant, it is still surprising to see decreases in flu vaccination rates among Hispanics, and particularly, non-Hispanic black respondents. Evidence from California showed that blacks were less likely to receive a flu shot than whites (Almario et al. 2016). The racial/ethnic disparities in the rate of flu shots increased among low-income, nonelderly adults in expansion states, although not statistically significant.

This study has several limitations. The health insurance coverage question in BRFSS asked if respondents have any insurance and did not distinguish insurance types. This prohibited us from examining how Medicaid take-up changed, which is the direct effect of Medicaid expansion. In addition, the BRFSS's household income measure was in categorical form and did not directly correspond to the definition of family income for Medicaid expansion eligibility determinants. BRFSS did not include an immigration status variable, which may influence our analyses, especially for Hispanics. Moreover, there were 16.17 percent and 15.13 percent observations with missing values in income and household size, which led us to use multiple imputation and various alternative approaches to define the low-income sample. Potential recall bias was also possible in the survey dataset.

The difference-in-differences analysis assumed that states would have the same trend if there were no Medicaid expansion. Although our falsification tests show no severe violation of assumptions and results were consistent after controlling for pretrend difference, we cannot guarantee exchangeability between respondents in expansion states and nonexpansion states without randomization. Although our difference-in-differences analysis was able to control for time-invariant factors, many time-varying confounders were left uncontrolled. We added state-level unemployment rate and the number of primary care physicians in our models; however, these variables may not precisely capture changes of physician supply and economic trends at local

levels. For example, we were unable to accurately control how local supplies of flu shot influenced flu vaccination rate. Finally, generalization of study results should be cautious. The difference-in-differences analysis mainly focused on the marginal change in health insurance status; the treatment effect in this study only generalizes to that population that changed their status of being insured during our study time.

Despite these limitations, we still found that Medicaid expansion was significantly associated with gains in health care coverage, access, and affordability. However, among low-income, nonelderly adults, these effects vary across racial/ethnic groups with non-Hispanic whites benefiting the most and Hispanics the least. Our findings indicate more innovative interventions are needed to increase take-up among eligible adults particularly among Hispanics, to make the policy more impactful in narrowing long-standing disparities in the United States. Future research could focus on exploring reasons for these disparities and developing feasible policy tools to bridge these gaps.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the supporting information tab for this article:

Appendix SA1: Author Matrix.

Appendix SA2: Supplementary Materials.

Table S1: Unadjusted Difference-in-Differences Estimates for Outcomes.

Table S2: Difference-in-Differences Analysis for Non-Elderly Adults with Income below 100% Federal Poverty Line.

Table S3: Difference-in-Differences Analysis for Adults Age 27–64 with Income below 138% Federal Poverty Line.

Table S4: Difference-in-Differences Analysis after Excluding States Expanded Medicaid in 2015.

Table S5: Survey Weighted Regression with a Three-Way Interaction Term.

Table S6: Triple Differences.

Table S7: Interrupted Time Series with Comparison Series.

Figure S1: Scatter Plots of Health Insurance Coverage by Race/Ethnicity in Expansion States and Non-Expansion States.

Figure S2: Scatter Plots of Having Personal Doctors by Race/Ethnicity in Expansion States and Non-Expansion States.

Figure S3: Scatter Plots of Being Unable to See Doctors Because of Cost by Race/Ethnicity in Expansion States and Non-Expansion States.

Figure S4: Scatter Plots of Receiving a Flu Shot by Race/Ethnicity in Expansion States and Non-Expansion States.