Disparities in the prevalence of comorbidities among US adults by state Medicaid expansion status

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Abstract

Introduction—About 92% of US older adults have at least one chronic disease or medical condition and 77% have at least two. Low-income and uninsured adults in particular experience a higher burden of comorbidities, and the Medicaid expansion provision of the Affordable Care Act was designed to improve access to healthcare in this population group. However, a significant number of US states have declined expansion. The purpose of this study is to determine the distribution of low-income and uninsured adults in expanded versus non-expanded states, and evaluate the prevalence of comorbidities in both groups.

Methods—Data from the 2013 Behavioral Risk Factor Surveillance System (BRFSS) dataset was analyzed, and Medicaid expansion status was assessed from the Center for Medicare and Medicaid Services report on State Medicaid and CHIP Income Eligibility Standards. Next, age adjusted mean number of comorbidities between expanded and non-expanded states was compared, with adjustment for socio-demographic differences.

Results—Expanded states had a higher proportion of adults with income of at least $50,000 per year (39.6% vs. 35.5%, $p < 0.01$) and a lower proportion of individuals with no health insurance coverage (15.2% vs. 20.3%, $p < 0.01$) compared with non-expanded states. Among the uninsured, there was a higher proportion of obese (31.6% vs. 26.9%, $p < 001$), and higher average number of comorbidities (1.62 vs. 1.52, $p < 0.01$) in non-expanded states compared to expanded states. Overall, the prevalence of comorbidities was higher among BRFSS participants in states that did not expand Medicaid compared with those in expanded states.

Conclusion—States without Medicaid expansion have a greater proportion of poor, uninsured adults with more chronic diseases and conditions.

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1. Introduction

The high prevalence of chronic diseases and conditions among adults in the United States (US) is increasingly recognized as a major public health issue. Diseases such as coronary artery disease, diabetes, hypertension, dyslipidemia, chronic respiratory disorders, and psychiatric conditions are highly prevalent, with over 92% of older adults in the US having at least one condition, while 77% of older adults have at least two (National Council on Aging, 2015). Multiple studies also suggest that the presence of two or more chronic diseases or comorbidities, exert significant and negative influence on survival from major chronic diseases like cancer and cardiovascular disease, accounting for more than 1.5 million deaths annually and contributing to over 60% of all adult deaths (Heron, 2013). The negative impact of comorbidities on health also results in significant treatment delays, longer duration of hospitalization, poorer post-surgical outcomes, with prior studies showing that increased number of comorbidities reduces quality of life, and increases health care utilization and cost (Lankarani and Assari, 2015; Islam et al., 2015; Assari et al., 2013; Assari, 2014; Hollisaaz et al., 2007; Baumeister et al., 2005; Diederichs et al., 2010; Noohi et al., 2007; Buchacz et al., 2012; Long and Dagogo-Jack, 2011; Gijsen et al., 2001; Tammemagi et al., 2003). For instance, patients with diabetes and other comorbid conditions have total healthcare costs that are almost double those of patients without comorbidities (Pelletier et al., 2009).

The Affordable Care Act (ACA) of 2010 was designed to provide a comprehensive reform of health insurance programs beginning in 2010. Key aspects of the law include: the prohibition of healthcare coverage denial due to pre-existing conditions, provision of health insurance tax credits and subsidies to purchase health insurance, free preventive care, expansion of insurance coverage for adults with pre-existing conditions, and the expansion of Medicaid coverage to low-income (incomes up to 133% of the federal poverty level, approximately $15,500 for a single adult in 2014) and uninsured/underinsured individuals (Manchikanti et al., 2011; Sheen, 2012; Gostin and Garcia, 2012). Expanded access to medical care through the ACA could significantly improve the prevention of comorbidities through early lifestyle interventions, early detection and adequate treatment strategies. Furthermore, the expansion of Medicaid specifically addresses barriers to medical care often experienced by low-income, uninsured or under-insured adults as well as racial minorities who are also more likely to have comorbidities compared with other groups (Waits et al., 2014). Although the initial rollout of the ACA began in 2010, certain parts of the law, specifically Medicaid expansion, remain controversial. Since the start of Medicaid expansion in 2014, many US States have declined to participate due the reluctance of state governments and legislatures to further expand government services.

Multiple studies suggest that there are marked regional variation in risk behaviors and use of preventative health services (Kilmer et al., 2008; Cory et al., 2010), driven by differences in

population characteristics such as demographics, socio-economic status (SES) and access to healthcare (Bauer et al., 2014; Braveman et al., 2011). In addition, racial minorities and low-income individuals tend to have a higher burden of diseases and comorbid conditions, and thus a greater need for healthcare services to manage those conditions (Kim et al., 2012; Shi et al., 2010). Therefore, if those states with greater healthcare need and higher proportion of low-income and racial minorities are less likely to participate in healthcare reform programs designed to provide better access to preventive healthcare, this population group will likely be left behind, and greater health disparities will be observed in the US. Healthcare reforms at the national level, focused on low-income and uninsured populations, has the potential to significantly reduce comorbidities, associated chronic diseases, and improve health outcomes in the US by eliminating barriers to adequate preventive care, regardless of race, income or geography. However, the benefit of such reforms is likely to be larger in areas with population at greatest need for healthcare.

In this study we analyze data from the Behavioral Risk Factor Surveillance System (BRFSS) to determine the socio-demographic and geographic distribution of comorbidities in the US, and assess whether states with a higher prevalence of comorbidities have elected to participate in the ACA Medicaid expansion program. Although the effect of the ACA provisions, including the Medicaid expansion program may not be fully realized for several years, identifying the burden of comorbidities in states that have declined or elected to participate in the program will provide key information for state and national policy-makers. By evaluating the burden of comorbidities among individuals in both groups, we expect to identify groups where expanded healthcare coverage may provide the greatest benefit by improving health promotion, disease prevention and affordable care.

2. Methods

2.1. Study design & data source

We performed a cross-sectional study of US adults using data from the 2013 Behavioral Risk Factor Surveillance System (BRFSS) dataset (Center for Disease Control and Prevention, 2013) The BRFSS is an ongoing, state-based, random-digit-dialed telephone survey of non-institutionalized adults residing in the US. The BRFSS routinely collects data on health risk behaviors, chronic diseases and conditions in all US states and territories. All 483,865 BRFSS participants ages 18 years and older from the fifty US states and the District of Columbia were included in this analysis.

2.2. Main study variables

Our main predictor of interest was Medicaid expansion status, categorized as expanded or non-expanded based on each state's status on adoption of the ACA. Data on state expansion status was obtained from the Center for Medicare and Medicaid Services report on State Medicaid and CHIP Income Eligibility Standards, based on state decisions as of January 1, 2015 (Services CfMaM, 2014). Our main outcome of interest was the number of diagnosed chronic diseases or conditions self-reported by individuals, including: high blood pressure, high cholesterol, prior diagnosis of heart attack, angina, stroke, asthma, any cancer (except skin cancer), skin cancer, COPD, arthritis, depression, kidney disease and diabetes. We

summed the total number of comorbidities for each individual, and estimated the state-level mean number of comorbidities by expansion status.

2.3. Other covariates

We included self-reported individual socio-demographic variables such as age, race/ethnicity, marital status and education. Health insurance status was based on individual responses to the question: '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?' Uninsured individuals were defined as those who reported currently not being covered by any health insurance or health coverage plan. We also controlled for differences in prevalence of comorbidities based on other measures of healthcare access such as having a primary doctor, and time since last visit to the doctor. Income was defined based on self-reported annual household income from all sources, and low-income individuals were categorized as those with annual household income of $25,000 per year or less. BMI data was obtained from the BRFSS dataset as a calculated variable derived from self-reported weight and height information.

2.4. Ethics statement

This study was considered exempt by the institutional review board of the University of Alabama at Birmingham, as we used existing secondary data that are publicly available and non-identifiable.

2.5. Statistical analysis

We performed all statistical analyses and geographic mapping using SAS version 9.4, QGIS version 2.8.1-Wien, and GeoDa version 1.6.7.9. We considered p-values less than or equal 0.05 as statistically significant. We applied statistical weights to account for clustering and sampling design for the BRFSS. We compared socio-demographic, socioeconomic and healthcare access variables between expanded and non-expanded states using chi-square tests for categorical characteristics and ANOVA for continuous characteristics. To estimate the age-adjusted state-level mean comorbidities, we sequentially performed three generalized linear models with mean number of comorbidities as the outcome, state expansion status as the main exposure, and accounted for strata and sampling weights. Other covariates included in three statistical models were; age, gender and race in model 1; age, gender, race and BMI in model 2; age, gender, race, BMI, household income, and healthcare access variables in model 3.

3. Results

A total of 483,865 individuals were included in the analysis, with 48.18% (n = 233,130) in non-expanded states and 51.82% (n = 250,735) in expanded states (Table 1, Fig. 1). Except for age, there were statistically significant differences by expansion status with all other study covariates (p < 0.001). Expanded states had a lower proportion of Blacks compared with non-expanded states (7.8% vs. 12.6%), and expanded states had a higher proportion of adults with at least a college degree (37.5% vs. 32.6%). In addition, expanded states had a higher proportion of adults with income of at least $50,000 per year (39.6% vs. 35.5%)

compared with non-expanded states. Expanded states had a lower proportion of individuals with no health insurance coverage compared with non-expanded states (15.2% vs. 20.3%), a lower proportion of adults with no regular medical doctor (15.3% vs. 17.1%), and a lower proportion of adults who reported not visiting any doctor for at least 5 years (7.9% vs. 9%). Overall, individuals in expanded states had a lower mean number of comorbidities compared with those in non-expanded states (2.10 vs. 2.16, $p < 0.001$).

There were clear geographic trends in both Medicaid expansion status and mean number of comorbidities (Fig. 1). The majority of Southeastern US States (except Arkansas, Kentucky and West Virginia) did not expand Medicaid, but these states had the highest burden of comorbidities, with a majority of adult populations in the third and fourth quartile of mean prevalence of comorbidities. Several Northeastern states, including Michigan, Ohio and Pennsylvania did expand Medicaid and also had adult populations with a high burden of comorbidities. Most Western US states (except Washington, Oregon and Arizona) had lower mean comorbidities, and expanded Medicaid. Data on the age-adjusted mean number of comorbidities in each of the 50 US states stratified by race/ethnicity and gender, and a map depicting number of comorbidities and Medicaid expansion status is provided in supplemental tables and maps (see Tables 1–5 and Figs. 1–4 in Ref Akinyemiju and Moore (2015)).

When the analysis was restricted to uninsured and low-income participants (Table 2), there were significant differences in the proportion of obese individuals, access to healthcare and average number of comorbidities ($p < 0.05$). Among 54, 534 total uninsured individuals, there was a higher proportion of obese in non-expanded states compared to expanded states (31.6% vs. 26.9%). In addition, average number of comorbidities was significantly higher among the uninsured in non-expanded states, compared with uninsured in expanded states (1.62 vs. 1.52, $p < 0.001$). Similar patterns were observed among low-income participants. Among 124, 386 low-income individuals, a higher proportion of obese individuals were in non-expanded states (34% vs. 31%), and the average number of comorbidities was significantly higher among low-income residents of non-expanded states (2.51 vs. 2.40, $p < 0.001$). Regardless of expansion status, low-income individuals had a greater prevalence of comorbidities compared with uninsured individuals or the entire study population. After accounting for socio-demographic (model 1), BMI (model 2) and socio-economic status and access to healthcare (model 3), we still observed significantly higher mean number of comorbidities among participants residing in non-expanded states (β mean number of comorbidities: 0.037, p-value = <0.001) compared with those in expanded states (Table 3).

4. Discussion

We evaluated the prevalence of comorbidities among US adults using the 2013 BRFSS data, and compared Medicaid expanded states with non-expanded states. We observed no difference in the proportion of older adults (ages 65 years and older) between the two groups, but observed that non-expanded states had significantly higher proportions of adults who were Black, had less than high school education and were currently uninsured compared with expanded states. When limited to low-income and uninsured adults, non-expanded states had a higher proportion of obese individuals with a higher number of

comorbidities on average compared with expanded states. Overall, individuals in non-expanded states had significantly higher number of comorbidities compared with those in expanded states, and this difference remained even after accounting for socio-demographic, socio-economic and healthcare access differences between groups.

Multiple studies have documented the negative impact of comorbidities on several aspects of health, ranging from psychological outcomes to mortality (Assari et al., 2013; Baumeister et al., 2005; Buchacz et al., 2012; Gijsen et al., 2001; Islam et al., 2015; Lankarani and Assari, 2015; Tammemagi et al., 2003). For instance, Lankarani and Assari (2015) reported that comorbidities are associated with major depressive disorder (Lankarani and Assari, 2015), and Islam et al. (2015) reported that after adjustment for age, sex, gender, race, and histologic type, comorbidities are associated with lower lung cancer survival among cancer patients (Islam et al., 2015). Despite these observations, significant socio-economic and healthcare access disparity exists in the US healthcare system, with poor and uninsured individuals who lack access to reliable healthcare also more likely to engage in harmful health behavior such as smoking, poor nutrition and low physical activity (Waits et al., 2014). Our results further show that individuals who are poor, uninsured, and belong to racial minority groups in the US are more likely to reside in non-expanded states. As a result of the underlying demographic (racial minorities), financial (low-income adults) and health (number of comorbidities) differences that exists currently between expanded and non-expanded states, it is likely that health disparities will actually widen in the coming years as individuals in states with Medicaid expansion (with higher income and less comorbidities on average) gain even better access to better preventive and medical care.

Few federal government-funded programs exist to assist low-income and uninsured adults with specific health needs; an example is the Breast and Cervical Cancer Early Detection (BCCED) Program for breast and cervical cancer screening (Miller et al., 2014; Liu et al., 2005). However, there are few federally funded programs focused on addressing highly prevalent chronic health issues such as diabetes or heart disease. The limited success of the BCCED program in reaching and screening low-income women provides some evidence that a singular focus on one aspect of health i.e. cancer screening, without a comprehensive approach that includes other health issues is likely to be inadequate, especially in low income populations where such care is most needed. (Tangka et al., 2015, 2010) Furthermore, although low-income and uninsured individuals in certain states may have access to safety net clinics, these are often severely limited in resources, capacity and scope. Medicaid expansion, on the other hand, by improving access to primary care and preventive health services such as high blood pressure and diabetes management, would constitute a comprehensive healthcare resource for sicker, poorer populations who would otherwise forgo care or obtain uncompensated care in emergency rooms.

Beyond the immediate benefit to individuals who will obtain better quality, more affordable health insurance, Medicaid expansion through the ACA is projected to provide significant economic benefits to states by reducing the amount of money spent on uncompensated care at hospitals and safety net clinics for uninsured patients (Ayanian, 2013; Holahan and Dorn, 2013). In addition, other aspects of the ACA such as the individual mandate and prohibition of exclusions based on pre-existing conditions already provide significant benefits to

individuals who are able to afford health insurance, either through an employer or on the health insurance exchange market. Unfortunately, states that forgo Medicaid expansion will likely continue to experience a greater burden on individual health and the economy, associated with having a sicker, poorer population, and individuals with incomes below 100% of federal poverty will be ineligible for subsidies or Medicaid coverage beyond current eligibility levels, dramatically increasing insurance gaps and reducing revenue for hospitals.

Our finding that adjusting for household income and access to healthcare did not eliminate the significant association between expansion status and prevalence of comorbidities suggest that other factors, such as health behaviors like smoking, alcohol and diet, may be more important determinants of comorbidities. Other studies have shown that lower socio-economic status may be associated with poor health behavior, including smoking, alcohol, lack of physical activity and obesity, as well as poorer management of chronic diseases such as high blood pressure and diabetes (White et al., 2015; Giles-Corti and Donovan, 2002; Slater and Carlton, 1985; Piper et al., 2015). Therefore, if poor health behaviors can be eliminated (e.g. through smoking cessation programs, health education campaigns to encourage physical activity and healthy diets), and preventive care encouraged without Medicaid expansion, then disparities in comorbidities between expanded and non-expanded states may not be inevitable. States could increase allocation of funds for safety net clinics, community healthcare centers and rural health clinics, and/or reduce or eliminate strict income eligibility criteria for such clinics. However, it remains to be seen whether policy makers in non-expanded states that are reluctant to commit funds and resources to Medicaid expansion (although the full cost of the program is provided by the federal government for the first several years), will be willing to fund alternative programs designed to improve the health of their vulnerable population.

There are several strengths in the current analysis. First, the use of the BRFSS data provides high-quality, nationally representative data on recent demographic, socioeconomic and healthcare access data. Secondly, all statistical analyses accounted for survey weights to account for the study design, and mean response rates by expansion status has been shown to be similar (45% in expansion states versus 47% in non-expansion states) (Sabik et al., 2015). There are also a few limitations to consider. First, the use of self-reported measures of chronic disease and conditions is a potential limitation, as diagnoses are not confirmed through medical records. However, the BRFSS is conducted by trained interviewers and focused on a wide range of health topics, therefore individual measures are unlikely to be highly biased. Second, while the ACA was signed into law during the spring of 2010, many of the provisions did not go into effect until late 2014 (Manchikanti et al., 2011). The full effect of the ACA, and its key components such as Medicaid expansion will likely not be observable for several more years. However, by conducting analysis on data prior to expansion, we are able to determine differences and similarities in expanded versus non-expanded states at baseline, pending the release of future years of data to assess changes over time. Therefore, the true association between Medicaid expansion and comorbidities has not been captured in our analysis using the 2013 BRFSS data. Future studies will be needed to determine the health disparities, if any, that may occur subsequent to Medicaid expansion program. For instance, comparing US states with a high prevalence of

comorbidities that did not expand Medicaid (e.g. Mississippi, Alabama, Tennessee, and South Carolina) with those that did expand Medicaid (e.g. Michigan, Ohio and Pennsylvania) after adjusting for socio-demographic differences, will provide a wealth of information on the potential for federally-mandated social programs to influence individual health.

5. Conclusions

States that did not participate in the ACA Medicaid expansion program experience a higher burden of comorbidities compared with states that did participate, and this finding was not accounted for by differences in socio-economic status or healthcare access. Negative health behaviors and exposures prevalent in non-expanded states may propagate this difference in the coming decades as individuals in expanded states obtain better access to preventive and medical care, unless other programs designed to improve prevention and management of disease are created in non-expanded states.

Acknowledgments

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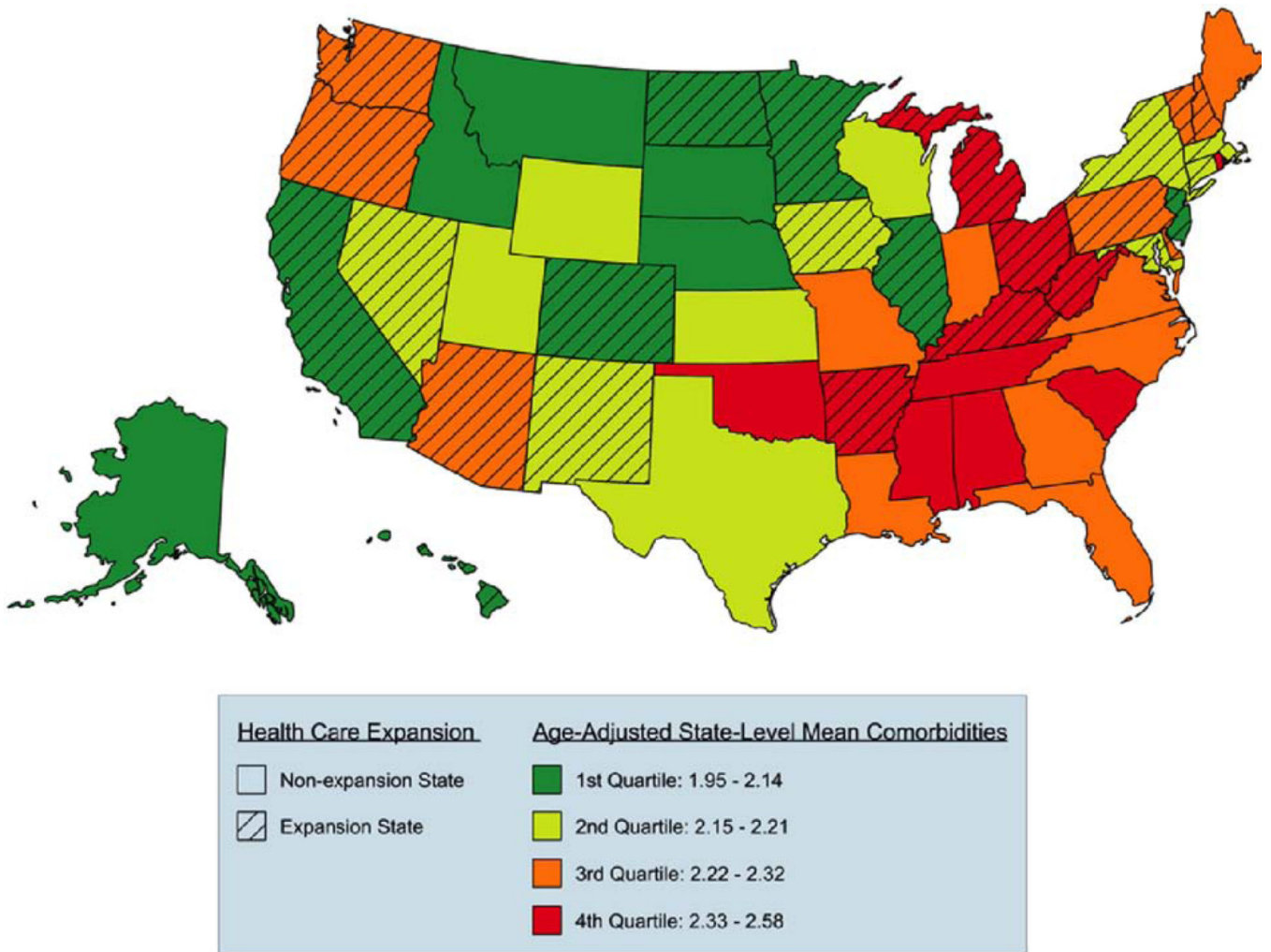White TJ, Redner R, Bunn JY, Higgins ST. Do socioeconomic risk factors for cigarette smoking extend to smokeless tobacco use? Nicotine Tob. Res. 2015 http://dx.doi.org/10.1093/ntr/ntv199.

Fig. 1.
State Medicaid expansion status and age-adjusted mean number of comorbidities.

Table 1

Comparison of socio-demographic and healthcare access characteristics by healthcare expansion status.

	Total (N = 483,865)	Non-expanded states (23) (N = 233,130)	Expanded states (28) (N = 250,735)	p value[a]
Age (%)				
18–24	26,464	12,462 (5.4)	14,002 (5.6)	0.0804
25–54	190,610	89,046 (38.2)	101,564 (40.5)	
55–64	108,105	51,585 (22.1)	56,520 (22.5)	
65	158,686	80,037 (34.3)	78,649 (31.4)	
Gender (%)				
Male	198,275	94,101 (46.1)	104,174 (46.9)	0.0064
Female	285,590	139,029 (53.9)	146,561 (53.1)	
Race (%)				
White	383,599	187,429 (69.4)	196,175 (70.2)	<0.001
Black	39,605	22,019 (12.6)	17,586 (7.8)	
Hispanic	31,054	11,997 (12.4)	19,057 (14.0)	
Asian	9054	2031 (1.8)	7023 (4.2)	
AI/AN	7788	4998 (1.3)	2790 (1.0)	
Other race	12,765	4661 (2.5)	8104 (2.9)	
Education (%)				
<High school	40,541	21,428 (10.8)	19,113 (9.0)	<0.001
High school grad	140,798	70,510 (27.8)	70,288 (25.9)	
Some college	132,418	66,333 (28.3)	66,085 (26.8)	
College	167,846	73,972 (32.6)	93,874 (37.5)	
Don't know/not sure/missing	2262	887 (0.5)	1375 (0.7)	
BMI (%)				
Underweight	8102	3938 (1.9)	4164 (1.9)	<0.001
Normal weight	152,512	70,758 (33.1)	81,754 (36.5)	
Overweight	164,251	79,390 (35.4)	84,861 (35.1)	
Obese	132,622	66,746 (29.6)	65,876 (26.5)	
Missing = 26,378				
Household income (%)				
<15,000	49,483	25,390 (12.1)	24,093 (11.9)	<0.001
15,000–25,000	74,903	38,745 (17.1)	36,158 (15.0)	
25,001–35,000	48,113	24,581 (10.2)	23,532 (9.4)	
35,001–50,000	60,857	30,506 (12.4)	30,351 (11.8)	
50,001	180,366	79,727 (35.5)	100,639 (39.6)	
Don't know/not sure/missing	70,143	34,181 (13.9)	35,962 (12.3)	
Employment (%)				
Employed	199,544	92,153 (49.1)	107,391 (49.3)	<0.001
Self-employed	39,271	19,145 (8.3)	20,126 (8.6)	
Unemployed	56,017	27,496 (13.0)	28,521 (12.8)	

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	Total (N = 483,865)	Non-expanded states (23) (N = 233,130)	Expanded states (28) (N = 250,735)	p value[a]
Student	12,329	5541 (4.8)	6788 (5.4)	
Retired/disabled	173,345	87,343 (24.1)	86,002 (23.0)	
Don't know/not sure/missing	2691	1282 (0.7)	1409 (0.8)	
Marital status (%)				
Married	251,666	123,910 (48.8)	127,756 (46.1)	<0.001
Divorced/widowed/separated	145,398	72,323 (25.8)	73,075 (24.3)	
Never married	74,036	31,633 (21.7)	42,403 (24.8)	
Unmarried couple	12,765	5264 (3.7)	7501 (4.7)	
Healthcare insurance coverage (%)				
Yes	427,435	202,683 (79.3)	224,752 (84.5)	<0.001
No	54,534	29,445 (20.2)	25,089 (15.1)	
Don't know/not sure/missing	1896	1002 (0.5)	894 (0.4)	
Doctor (%)				
Yes, only one	363,490	171,507 (63.7)	191,983 (69.3)	<0.001
More than one	40,400	20,814 (8.4)	19,586 (7.2)	
No	78,202	39,891 (27.4)	38,311 (23.2)	
Don't know/not sure/missing	1773	918 (0.5)	855 (0.4)	
Need to see doctor				
Yes	58,884	30,519 (18.4)	28,365 (15.2)	<0.001
No	423,765	201,966 (81.3)	221,799 (84.6)	
Don't know/not sure/missing	1116	545 (0.3)	571 (0.2)	
Time since visited doctor				
<12 Months	350,154	167,777 (66.8)	182,377 (66.7)	<0.001
1 year–<2 years	56,474	25,843 (12.6)	30,631 (14.2)	
2 years–<5 years	33,205	16,026 (8.5)	17,179 (9.0)	
5 years	33,393	17,810 (9.0)	15,583 (7.9)	
Don't know/not sure/missing	10,639	5674 (3.1)	4965 (2.2)	
Mean comorbidities (S.D.)	2.13 (0.01)	2.16 (0.01)	2.10 (0.01)	<0.001

(%) Denotes column percentage.(S.D.) Standard Deviation.

[a]Estimated using Chi-Square test.

Table 2

Prevalence of comorbidities among uninsured and low-income populations by ACA expansion status.

	Uninsured			Low-income		
	Non-expanded (N = 29,445)	expanded (N = 25,089)	p value[a]	Non-expanded (N = 64,135)	expanded (N = 60,251)	p value[a]
BMI (%)[d]						
Underweight	579 (2.2)	513 (2.6)	<0.001	1465 (2.3)	1390 (2.4)	<0.001
Normal weight	8840 (32.5)	8123 (36.7)		18,467 (31.7)	18,181 (34.2)	
Overweight	9092 (33.7)	7841 (33.8)		19,783 (32.0)	18,709 (32.4)	
Obese	8904 (31.6)	6841 (26.9)		21,359 (34.0)	18,924 (31.0)	
Chronic diseases and conditions (%)						
Mean comorbidities (S.D.)	1.62 (0.01)	1.52 (0.01)	<0.001	2.51 (0.02)	2.40 (0.02)	<0.001
High blood pressure	8681 (24.4)	6752 (21.9)	0.0002	32,642 (39.9)	28,427 (36.3)	<0.001
High cholesterol	18,656 (58.3)	15,950 (58.2)	0.5127	51,701 (71.3)	48,513 (71.1)	0.9428
Heart attack	1017 (2.6)	826 (2.8)	0.3798	6324 (6.9)	5460 (6.5)	0.1496
Angina	933 (2.2)	641 (1.9)	0.0436	5734 (6.2)	5013 (5.7)	<0.001
Stroke	781 (2.2)	550 (1.5)	0.0002	4955 (5.8)	4067 (4.9)	0.0061
Asthma	4102 (14.0)	3575 (13.8)	0.7107	11,037 (17.5)	11,024 (18.2)	0.0773
Cancer	1329 (3.4)	1080 (3.1)	0.1363	7303 (7.9)	6563 (7.4)	0.2453
Skin cancer	933 (2.0)	633 (1.6)	0.0278	5885 (5.2)	437 (4.4)	<0.001
COPD[b]	2246 (6.2)	1748 (5.8)	0.2608	9926 (12.3)	8652 (11.0)	<0.001
Arthritis[c]	6614 (16.5)	5182 (14.9)	0.0027	28,208 (32.2)	25,182 (30.5)	0.0018
Depression	6794 (20.8)	5572 (19.1)	<0.001	18,317 (28.1)	17,603 (27.1)	0.0471
Kidney disease	661 (2.2)	511 (1.7)	0.0086	3206 (4.1)	2979 (3.8)	0.1478
Diabetes	2604 (7.3)	1919 (5.8)	0.0001	12,798 (15.9)	11,240 (14.8)	0.0064

(%) Denotes column percentage.

Number of participants in each state: AL = 6503, AK = 4578, AZ = 4252, AR = 5268, CA = 11,518, CO = 13,649, CT = 7710, DE = 5206, District of Columbia = 4931, FL = 34,186, GA = 8138, HI = 7858, ID = 5630, IL = 5608, IN = 10,338, IA = 8157, KS = 23,282, KY = 11,013, LA = 5251, ME = 8097, MD = 13,011, MA = 15,071, MI = 12,759, MN = 14,340, MS = 7453, MO = 7118, MT = 9693, NE = 17,139, NV = 5101, NH = 6463, NJ = 13,386, NM = 9316, NY = 8979, NC = 8860, ND = 7806, OH = 11,971, OK = 8244, OR = 5949, PA = 11,429, RI = 6531, SC = 10,717, SD = 6895, TN = 5815, TX = 10,917, UT = 12,769, VA = 8464, WA = 11,162, WV = 5899, WI = 6589, WY = 6454.

[a]Estimated using Chi-Square test.

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[b] Including emphysema or bronchitis.

[c] Including gout, lupus, or fibromyalgia.

[d] 3801 missing BMI observations in uninsured; 6108 missing BMI observations in low-Income.

Table 3

Multivariable association of ACA Medicaid expansion status and mean number of comorbidities[†].

	Model 1[a] β (p value) N = 483,865	Model 2[b] β (p value) N = 457,487	Model 3[c] β (p value) N = 446,610
Expansion			
Yes	–	–	–
No	0.040 (<0.001)	0.026 (0.002)	0.037 (<0.001)
Age			
18–24 (referent)	–	–	–
25–54	0.757 (<0.001)	0.627 (<0.001)	0.692 (<0.001)
55–64	1.825 (<0.001)	1.659 (<0.001)	1.572 (<0.001)
65	2.428 (<0.001)	2.301 (<0.001)	2.066 (<0.001)
Gender (%)			
Male (referent)	–	–	–
Female	0.192 (<0.001)	0.231 (<0.001)	0.078 (<0.001)
Race			
White (referent)	–	–	–
Black	0.121 (<0.001)	0.023 (0.134)	−0.158 (<0.001)
Hispanic	−0.284 (<0.001)	−0.305 (<0.001)	−0.379 (<0.001)
Asian	−0.564 (<0.001)	−0.410 (<0.001)	−0.380 (<0.001)
AI/AN	0.391 (<0.001)	0.317 (<0.001)	0.185 (<0.001)
Other race	0.199 (<0.001)	0.172 (<0.001)	0.104 (<0.001)
BMI			
Normal weight (referent)		–	–
Underweight		0.114 (0.001)	0.091 (0.005)
Overweight		0.257 (<0.001)	0.241 (<0.001)
Obese		0.860 (<0.001)	0.781 (<0.001)
Household income			
50,001 (referent)			–
35,001–50,000			0.159 (<0.001)
25,001–35,000			0.280 (<0.001)
15,000–25,000			0.548 (<0.001)
<15,000			0.932 (<0.001)
Have a regular doctor (%)			
Yes, only one (referent)			–
More than one			0.281 (<0.001)
No			−0.466 (<0.001)
Time since visited doctor (%)			
<12 Months (referent)			–

	Model 1[a] β (p value) N = 483,865	Model 2[b] β (p value) N = 457,487	Model 3[c] β (p value) N = 446,610
1 year–<2 years			−0.289 (<0.001)
2 years–<5 years			−0.360 (<0.001)
5 years			−0.563 (<0.001)

[a]Adjusted for age, gender, and race.

[b]Adjusted for age, gender, race and BMI.

[c]Adjusted for model 2 covariates plus income, having a regular doctor and time since last check-up.

[†]Parameter estimates calculated using generalized linear regression.