The Impact of Medicaid Expansion on Diabetes Management

Jusung Lee,[1] Timothy Callaghan,[1] Marcia Ory,[2] Hongwei Zhao,[3] and Jane N. Bolin[1,4]

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OBJECTIVE

Diabetes is a chronic health condition contributing to a substantial burden of disease. According to the Robert Wood Johnson Foundation, 10.9 million people were newly insured by Medicaid between 2013 and 2016. Considering this coverage expansion, the Affordable Care Act (ACA) could significantly affect people with diabetes in their management of the disease. This study evaluates the impact of the Medicaid expansion under the ACA on diabetes management.

RESEARCH DESIGN AND METHODS

This study includes 22,335 individuals with diagnosed diabetes from the 2011 to 2016 Behavioral Risk Factor Surveillance System. It uses a difference-in-differences approach to evaluate the impact of the Medicaid expansion on self-reported access to health care, self-reported diabetes management, and self-reported health status. Additionally, it performs a triple-differences analysis to compare the impact between Medicaid expansion and nonexpansion states considering diabetes rates of the states.

RESULTS

Significant improvements in Medicaid expansion states as compared with non–Medicaid expansion states were evident in self-reported access to health care (0.09 score; $P = 0.023$), diabetes management (1.91 score; $P = 0.001$), and health status (0.10 score; $P = 0.026$). Among states with large populations with diabetes, states that expanded Medicaid reported substantial improvements in these areas in comparison with those that did not expand.

CONCLUSIONS

The Medicaid expansion has significant positive effects on self-reported diabetes management. While states with large diabetes populations that expanded Medicaid have experienced substantial improvements in self-reported diabetes management, non–Medicaid expansion states with high diabetes rates may be facing health inequalities. The findings provide policy implications for the diabetes care community and policy makers.

Diabetes has been a reported major chronic health condition in the U.S. for decades. By 2050, ~21% of the adult population will have diabetes, a considerable increase from 12% in 2015 (1). Diabetes causes significant health complications and related social costs, imposing substantial challenges to both public health practice and society overall (2,3). According to recent estimates, the economic impact of diabetes is large and growing, with disease costs moving from U.S. $174 billion in 2007 to >$327 billion in 2017 (4). The burden of diabetes for American society requires serious actions to control diabetes and reduce its associated problems.

[1]*Department of Health Policy and Management, School of Public Health, Texas A&M University, College Station, TX*
[2]*Department of Environmental and Occupational Health, School of Public Health, Texas A&M University, College Station, TX*
[3]*Department of Epidemiology and Biostatistics, School of Public Health, Texas A&M University, College Station, TX*
[4]*College of Nursing, Texas A&M University, College Station, TX*

Corresponding author: Jusung Lee, lee14@tamu.edu

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Diabetes prevention and control requires an investment in a strategic approach that includes multifaceted dimensional tactics, given that diabetes is associated with a wide range of risk factors and complications, for which the combined roles of laypersons and health professionals are essential (5). Glasgow (5) proposes three stages of diabetes management including background context, cycle of care, and follow-up outcomes. The essence of the proposed diabetes management is that surrounded by the social and environmental contexts, patients who follow a continuous cycle of care composed of health care, self-care behaviors, and short-term physiologic outcomes could have improved long-term health outcomes (5).

A health professional's clinical care is a critical component of diabetes management. Clinical guidelines recommend that people with diabetes undergo routine checkups for vital examinations and receive appropriate care (6). Continuous and coordinated interactions with health care providers are needed to facilitate timely examination of health status and maintain personalized diabetes management. The literature has shown that patients with diabetes with periodic preventive procedures and interaction with providers are more likely than those without to experience better health outcomes and less likely to visit the emergency room (7). Unfortunately, however, the literature reports that in 2009, 15% of individuals with diabetes, aged 18–64 years, lacked health insurance, potentially preventing their needed access to essential diabetes care delivered by providers (8). Postponing or foregoing necessary care due to a lack of health insurance coverage can result in unintended consequences, such as aggravated conditions, unexpected complications, and escalated medical costs (9,10).

Another vital component of diabetes management is self-care behaviors. The literature about chronic disease self-management emphasizes the patients' central role in managing their disease and its efficacy in improving their health outcomes and reducing health care utilization (11). Consistent monitoring of physiologic indicators, including self-blood glucose and regular foot checks, is vital and effective for successful diabetes management. A suggested strategy to promote adherence to self-care behaviors entails consistent diabetes self-management education and support to ensure that people with diabetes gain sufficient knowledge and skills (12). Among resources that might be available in the community, health care professionals play a central and unique role in educating and supporting patients for effective self-management of their diabetes (12).

Individuals' disease management activities occur in a broad sphere of support, including family and community-level support as well as social support through state and federal policies that frame social contexts in which individual and institutional behaviors are structured (5). Andersen (12) notes the importance of national-level policies and resources as they are recognized as the basis for improved access to health care and changes in people's behavioral patterns of using health care (5). From the perspective of a federal-level policy, the U.S. experienced a historic change in its health care system through the passage of the Affordable Care Act (ACA) in 2010, which was primarily intended to reduce uninsured rates, increase preventive care, and improve healthy behaviors. According to the Kaiser Family Foundation, in 2012, >47 million nonelderly Americans were uninsured (13), of whom the majority were low-income working adults. Considering the significant number of low-income Americans who had no coverage before the reform, the ACA could have reshaped the social context for health care and controlled chronic health issues like diabetes among people who would otherwise remain uninsured.

Under the ACA, its key provisions are anticipated to be beneficial for diabetes control, as it incentivizes people with diabetes or prediabetes to receive essential services for preventing or managing the disease. Among the reform's provisions, the core changes included an individual mandate for insurance coverage and the removal of pre-existing condition exclusions on coverage. The ACA also ensures preventive services for adults without additional costs, such as screenings for blood pressure, depression, type 2 diabetes, and obesity (14). Another principal policy of the reform was the mandatory expansion of Medicaid to all individuals earning <138% of the federal poverty level (FPL) across the country. However, with the 2012 Supreme Court decision in National Federation of Independent Business versus Sebelius allowing individual states to decide on whether or not to opt in to Medicaid expansion (15), states optionally implemented the expansion in January 2014. Researchers acknowledged that the reform would have a positive impact on diabetes management by offering individuals with diabetes necessary care (14,16). Kaufman et al. (17) found an increased number of patients who were newly diagnosed with diabetes in Medicaid expansion states compared with nonexpansion states. A more recent study in clinical settings found improved health care access but no improvement in diabetes care provided by clinicians (18), while another study found an increase in prescriptions filled in Medicaid expansion states (19). However, previous studies covered a limited time period and focused on access and clinical care and were thus limited in scope regarding impact evaluation. Despite the possibly significant role of Medicaid expansion on diabetes control, the literature reveals scant knowledge about such an impact on diabetes management that accounts for both a state's Medicaid expansion status and a time period of before and after the policy implementation.

Therefore, this study investigates the impacts of the Medicaid expansion on diabetes management among low-income adults with diabetes. In addition, as some states have higher diabetes rates than others, referred to as "diabetes belt" states by the Centers for Disease Control and Prevention (CDC) (20), those states need substantial improvements in diabetes management to reduce the high burden of the disease. Thus, the current study compares the impacts of Medicaid expansion between expansion and nonexpansion states while considering diabetes rates of the states.

RESEARCH DESIGN AND METHODS

Study Design

We used a quasi-experimental method, difference-in-differences modeling, that evaluates the effects of policy implementation by comparing the changes in outcomes between the Medicaid expansion group and the non–Medicaid expansion group after Medicaid expansion (21).

Data

This research uses 2011–2016 data from the Behavioral Risk Factor Surveillance System (BRFSS), a nationally representative public database of self-reported responses to a telephone survey among noninstitutionalized adults aged ≥18 years (22). In 2011, the BRFSS started including a cell phone–based survey to improve the representativeness of the data. The 2011–2013 and the 2014–2016 periods cover the years prior to and after the Medicaid expansion implementation, respectively. The policy effects take time to occur, and there is a need for investigating measurable changes after the Medicaid expansion. Thus, the current study included 24 states plus the District of Columbia that expanded Medicaid as of January 2014 and 19 states that remained nonexpansion states until 2016 to evaluate the impacts of the Medicaid expansion (23), as in Supplementary Figs. 1 and 2. About 95% of adults >65 years old are covered by health insurance, including Medicare (24). Given that the Medicaid expansion mainly targets low-income adults <65 years old, those belonging to the 18–64 age range, with diabetes diagnoses of either type 1 or type 2 and incomes <138% of the FPL, are included in this study. To identify the yearly FPL (25), the study uses 2011–2016 Federal Poverty Guidelines from the Office of the Assistant Secretary for Planning (26) and the Evaluation and Federal Register (27). As the BRFSS categorizes income levels, a percentage of the FPL is calculated using the midpoint of each income category divided by the FPL of the corresponding year (25). Additionally, as suggested by the literature examining states' Medicaid expansion (25), this study controls for state unemployment rates over the study year from the Bureau of Labor Statistics (28).

Measurements

Primary Covariate

It is the interaction term between the indicator variable of the Medicaid expansion (coded as 1 if expanded Medicaid) and the indicator variable of the Medicaid expansion time period (coded as 1 for the post-Medicaid expansion).

Secondary Covariates

Demographic and socioeconomic characteristics included age, sex, race/ethnicity, marital status, education, and employment. Age was a categorical variable as 18–34, 35–44, 45–54, and 55–64 years. Race/ethnicity was classified as white, Hispanic, African American, or other. Marital status was categorized as married/unmarried couples, divorced/widowed/separated, or never married. Education level was categorical as less than high school graduation, high school graduation, some college or technical school education, and college graduation. Employment status had four categories: currently employed, homemaker/student, currently unemployed, and retired. In addition, the study included comorbidity of chronic conditions: asthma, cancer, angina or coronary heart disease, arthritis, obesity, and physical and mental disability.

Outcome Variables

This study identified a range of variables related to self-reported access to health care, self-reported diabetes management, and self-reported health status. Then, ordinal factor analysis was performed to evaluate the impact by factor variables that well reflect the identified variables (29).

Outcome Measures. The variables about self-reported access to health care include each respondent's current health insurance status and nonconsultation with a doctor due to the cost involved in the past 12 months. The health insurance status was dichotomized as yes or no. The literature has determined financial affordability as the primary reason for people to forgo or postpone the necessary health care (30). Nonconsultation with a doctor due to the cost involved was measured as having or not having such experience.

For diabetes management, we included measures capturing care provided by health professionals and self-care. Health professional measures included reports of how often respondents visited a doctor for consultation over the past 12 months. Routine doctor visits that enable patient–provider interactions can lead to improved self-efficacy and patient outcomes (31). In addition, regular checking of hemoglobin A_{1c} and foot conditions by doctors is considered a critical component for effective diabetes management (6,32). Participants reported how often they had feet checks in the past 12 months. The participants were also asked about the number of times in the past 12 months when their hemoglobin A_{1c} was checked by health professionals.

To measure diabetes self-care behaviors, the study included measures designed to account for self–blood glucose checks and self-feet checks (32,33). Participants reported the number of times they were self-checking their blood for glucose or sugar and how often they check their feet themselves daily or within a period of time. While AADE7 Self-Care Behaviors recommend seven key domains to focus on including healthy eating, monitoring vital information of diabetes, and healthy coping, the current study includes items available in the BRFSS, all of which are vital for self-monitoring.

The analysis also includes a composite measure designed to capture various aspects of overall health status. Considering the significant relationship of diabetes with mental and physical health (34), first, mental health was measured, using a BRFSS question about how many days in the past 30 days the mental health was not good. Participants also reported how many days in the past 30 days their physical health status was not good. Both mental and physical health status was dichotomized as not good if participants reported any experience that mental or physical health was not good and otherwise as good. Furthermore, the self-rated general health status was measured. Excellent, very good, and good were combined as good; otherwise, the response was coded as not good.

Key Outcome Variables. The factor analysis produced three-factor variables based on the Empirical Kaiser Criterion, a recently advanced factor retention method (35). The three-factor variables were titled as self-reported access to health care, self-reported diabetes management covering both self-care behaviors and care provided by health care professionals, and self-reported health status. Self-reported access to health care reflected two variables, insurance status and nonconsultation with doctors due to costs. Self-reported diabetes management, another factor variable, represented five variables, such as doctor visits for consultation, feet checks, hemoglobin A_{1c} checks, self-blood glucose checks, and self-feet checks. The third factor variable, self-reported health status, reflected mental health, physical health, and general health. Factor-based scores were calculated by adding up the values of the identified variables by each factor to get key outcome variables.

Statistical Analysis

This analysis begins with a baseline descriptive analysis of the characteristics of Medicaid expansion states and non–Medicaid expansion states before the Medicaid expansion using *t* tests and χ^2 tests.

Difference-in-differences model is $Y_{ist} = \beta_0 + \beta_1 * Post_t + \beta_2 * Expanded_s + \beta_3 * Post_t * Expanded_s + \gamma * X_{ist} + \delta * State_s + \theta * Year_t + \varepsilon_{ist}$, where i, s, and t denote the individual, state, and time period, respectively; β_3 is the change in outcome associated with Medicaid expansion; and X_{ist} is the covariate.

After descriptive analysis, this study examines unadjusted and adjusted effects in the outcome variables between Medicaid expansion states and non–Medicaid expansion states after the expansion. In the multivariate linear model, the coefficient of the interaction term represents the difference in the changes of the outcomes in the Medicaid expansion states compared with the non–Medicaid expansion states accounting for the pre- and the post-Medicaid expansion. The model includes covariates for age, sex, race/ethnicity, education, employment status, marital status, comorbidity, and state-year unemployment rate. The model also adjusts for state and quarter-year fixed effects. The estimation is based on robust SEs, clustered at the state using the generalized estimating equations. A sensitivity analysis was conducted with expansion states excluding five states that already provided low-income adults expanded insurance coverage before 2014 Medicaid expansion and nonexpansion states excluding one that provided expanded coverage to low-income adults under nonexpansion status.

Finally, the analysis concludes with a triple-differences analysis (difference-in-difference-in-differences), a robust analytic approach that allows for comparing the impact of Medicaid expansion while also accounting for differences in diabetes rates across states. The CDC identified 15 states with high diabetes rates as a diabetes belt based on a county-level evaluation of diabetes rates with 2007 and 2008 data (20). Its approach recognized counties with high diabetes rates and then categorized states based on county diabetes rates, suggesting that it does not necessarily reflect state-level diabetes rates. Motivated by the CDC, this study identified the top 15 states with high diabetes populations among 50 states plus the District of Columbia based on the CDC's 2013 state-level diabetes rates to reflect the up-to-date figures of the states before the Medicaid expansion, whereas the rest of the states were grouped as a non–high diabetes group (Supplementary Fig. 3). All statistical analyses were performed using SAS version 9.4.

RESULTS

The baseline characteristics of the study sample by Medicaid expansion status are shown (Table 1). The age composition in nonexpansion states was the largest (41.4%) and smallest (11.0%) in the age-groups of 55–64 and 18–34 years, respectively. The expansion states showed a similar pattern in the age composition. The percentage of females in the nonexpansion group was 57.9%, significantly higher than 53.4% in the expansion group ($P = 0.024$). African Americans accounted for 33.3% of the sample in the nonexpansion group, while they accounted for only 14.8% in the expansion group. The comparison of the racial/ethnic composition between the two groups was statistically significant ($P < 0.001$). Divorced or separated constituted 35.6% in the nonexpansion group, while the figure was 32.4% in the expansion group ($P < 0.001$). In the nonexpansion group, 61.3% were unemployed, while the figure was 56.5% in the expansion group ($P = 0.006$). In states' unemployment rates, the nonexpansion group had 7.9% (SD 1.3%) compared with 7.6% (SD 1.4%) in the expansion group. Although some variations existed, education ($P = 0.080$) and comorbidity ($P = 0.562$) did not show a significant difference between the two groups.

The baseline means of the key outcome variables are presented in Table 2. While the score for self-reported access to health care was significantly higher in the expansion group than in the nonexpansion group (1.42 vs. 1.33; $P < 0.001$), the score differences between the two groups were not statistically significant for self-reported diabetes management ($P = 0.150$) and self-reported health status ($P = 0.824$).

In the adjusted model (Table 3), the estimated changes of scores were 0.09 ($P = 0.023$) in self-reported access to health care and 1.91 in self-reported diabetes management ($P = 0.001$). The estimated score change in self-reported health status was 0.10 ($P = 0.026$), which was statistically significant. In the subgroup comparison analysis, though there are four groups, the key interest of the current study is comparisons between Medicaid expansion and Medicaid nonexpansion groups among states with high diabetes rates because those states need substantial improvements in diabetes management to reduce the high burden of the disease. In comparing the adjusted change of scores in outcomes between the Medicaid expansion and the Medicaid nonexpansion status among states with high diabetes rates (Table 4), the findings were statistically significant in self-reported access to health care (0.20 score; $P < 0.001$) and self-reported health status (0.17 score; $P < 0.001$). Self-reported diabetes management (1.63 score; $P = 0.055$) was close to being statistically significant.

CONCLUSIONS

The current study evaluated changes in self-reported access to health care, self-reported diabetes management, and self-reported health status between Medicaid expansion and nonexpansion states from 2011 to 2016. This study contributes to the growing body of literature about the impacts of the ACA's Medicaid expansion on diabetes management. First, covering both clinical and self-management adherence in diabetes management as a comprehensive strategy, this study provides evidence of the significant impacts of Medicaid expansion on managing diabetes. Second, this study additionally evaluates changes in outcomes between states that expanded Medicaid and those that did not, accounting for diabetes rates of the states. This analysis shows that the Medicaid expansion was associated with significant improvements in self-reported access to health care and self-reported diabetes management. In addition, the self-reported health status revealed a difference between expansion and nonexpansion states in that the former presented better health status. Among states with high diabetes rates, those that opted in to Medicaid expansion

Table 1—Baseline (2011–2013) characteristics of the study sample

	Medicaid nonexpansion states (n = 6,138)		Medicaid expansion states (n = 6,230)		
	n	Percentage (95% CI) or mean (SD)	n	Percentage (95% CI) or mean (SD)	P value
Age (years)					0.601
18–34	335	11.0 (9.3, 12.8)	363	11.1 (9.2, 13.1)	
35–44	633	15.0 (13.3, 16.7)	746	17.0 (15.1, 18.8)	
45–54	1,756	32.6 (30.5, 34.8)	1,852	31.4 (29.0, 33.7)	
55–64	3,414	41.4 (39.3, 43.4)	3,269	40.5 (38.2, 42.9)	
Sex					0.024
Male	2,051	42.1 (39.9, 44.4)	2,321	46.6 (44.0, 49.2)	
Female	4,087	57.9 (55.6, 60.1)	3,909	53.4 (50.8, 56.0)	
Race/ethnicity					<0.001
White	3,238	51.6 (49.5, 53.7)	3,403	50.3 (48.0, 52.5)	
Hispanic	262	7.7 (6.4, 9.1)	1,019	23.0 (20.3, 25.6)	
African American	2,113	33.3 (31.2, 35.3)	851	14.8 (13.0, 16.6)	
Other	379	5.1 (4.2, 6.1)	844	10.6 (9.3, 11.9)	
Education					0.080
Less than high school	1,527	34.2 (32.0, 36.4)	1,379	32.8 (30.1, 35.5)	
High school	2,383	35.0 (33.0, 37.1)	2,405	35.0 (32.7, 37.3)	
Some college	1,514	22.7 (21.0, 24.4)	1,648	24.3 (22.3, 26.2)	
College graduation	671	7.2 (6.3, 8.0)	754	7.6 (6.6, 8.5)	
Marital status					<0.001
Married	2,254	42.5 (40.4, 44.6)	2,390	43.4 (40.8, 45.9)	
Divorced/widowed/separated	2,699	35.6 (33.6, 37.7)	2,516	32.4 (30.3, 34.5)	
Never married	1,154	21.5 (19.5, 23.5)	1,272	23.7 (21.4, 26.0)	
Employment					0.006
Employed	1,252	24.1 (22.0, 26.1)	1,426	27.4 (24.9, 29.8)	
Home/student	367	6.4 (5.4, 7.3)	479	8.1 (6.8, 9.4)	
Unemployed	3,847	61.3 (59.2, 63.5)	3,614	56.5 (53.9, 59.0)	
Retired	619	7.2 (6.3, 8.0)	648	7.5 (6.5, 8.5)	
Comorbidity	6,138	2.0 (1.9, 2.0)	6,230	1.9 (1.8, 1.9)	0.562
Unemployment in states	6,138	7.9 (1.3)	6,230	7.6 (1.4)	<0.001

experienced improvements in evaluated outcomes compared with those that opted out of Medicaid expansion. These findings suggest that Medicaid expansion was associated with substantial improvements in the management of diabetes and health status, particularly among states with large populations with diabetes that expanded Medicaid. However, health disparities in non–Medicaid expansion states with high diabetes rates appear to be not only an emerging public health concern but also a call for action to reduce the high burden of the disease in these states.

Previous studies on the general population have documented the positive impact of the ACA's Medicaid expansion on a variety of health indicators, such as access, health behaviors, and health outcomes (25,36). Some studies focused specifically on diabetes and noted the potential positive effects of the new policy on diabetes management (14). Researchers found that Medicaid-expanded states experienced improved accessibility, an increase in prescription, but not receipt of diabetes care provided by clinicians (16,18,19). However, their results were limited by either using 1 or 2 years of data after expansion or including only a few aspects of diabetes management. Besides, there have been only a few studies about the impact of Medicaid expansion focusing on the population with diabetes. The current study used data over an extended period, and it examined diabetes management as a comprehensive diabetes-managing strategy. In addition, this study evaluated the impact of Medicaid expansion on diabetes management, accounting for diabetes rates of the states. The improved access and diabetes management adherence found in this study are positive signals for the better health outcomes that follow as the literature established the link between the former and the latter (37). The literature also suggests that people with diabetes who adhere well to diabetes management are

Table 2—Baseline (2011–2013) score means of outcome variables by Medicaid expansion status

	Medicaid nonexpansion states (n = 6,138)		Medicaid expansion states (n = 6,230)		
	n	Mean (95% CI)	n	Mean (95% CI)	P value
Self-reported access to health care	6,137	1.33 (1.30, 1.35)	6,230	1.42 (1.37, 1.48)	<0.001
Self-reported diabetes management	5,746	11.62 (11.10, 12.13)	5,929	11.08 (10.54, 11.62)	0.150
Self-reported health status	6,088	1.11 (1.05, 1.18)	6,199	1.13 (1.05, 1.20)	0.824

Table 3—Adjusted score changes in self-reported access to health care, diabetes management, and health status

	Medicaid nonexpansion states (n = 10,875)		Medicaid expansion states (n = 11,460)		Difference in differences	
	Pre	Post	Pre	Post	Adjusted changes	*P* value
Self-reported access to health care	1.47 (1.40, 1.54)	1.57 (1.45, 1.68)	1.43 (1.39, 1.47)	1.62 (1.54, 1.69)	0.09 (0.01, 0.13)	0.023
Self-reported diabetes management	11.67 (10.60, 12.74)	11.38 (10.03, 12.72)	10.82 (9.93, 11.72)	12.44 (11.44, 13.43)	1.91 (0.81, 2.30)	0.001
Self-reported health status	1.22 (1.15, 1.29)	1.10 (0.92, 1.29)	1.23 (1.10, 1.37)	1.22 (1.01, 1.43)	0.10 (0.01, 0.20)	0.026

Data are mean (95% CI) unless otherwise indicated. Pre indicates from 2011 to 2013, and Post indicates from 2014 to 2016. Multivariate regression adjusted for population characteristics, such as age, sex, race/ethnicity, education, marital status, employment, comorbidity, and state and quarter-year fixed effects.

more likely to prevent progression in diabetes-related complications (33).

It is similarly important to acknowledge the evolving concerns of health disparities between expansion and nonexpansion among states with high diabetes populations. While the focus of previous studies has been mainly on the health benefits of the new policy implementation, this study causes alarm in public health communities about the emerging health inequalities in states with high diabetes populations that opted out of Medicaid expansion. It suggests that those states would have encountered exacerbated health effects on their population because of less access to health care and poorer adherence to diabetes management compared with those with high diabetes rates that adopted Medicaid expansion. Researchers found that the decisions of states to opt in or out of the Medicaid expansion were influenced by various factors, such as professional and business lobbyists and public interest groups (38), which might not reflect well on the health needs of the population. Policy makers may consider public health benefits as a high priority in policy decision making to improve the health of the population.

We recognize important limitations in this study. First, it is difficult to infer a causal relationship with cross-sectional data by nature, although the quasi-experimental model could alleviate the data's weakness. Second, this study did not account for Medicaid expansion under the Section 1115 waivers, as states could have varying rules under the waivers. Third, while a range of indicators for diabetes management is possible, our data include only a subset. Physiologic measures are important constituents in determining the impact of the Medicaid expansion on diabetes management as self-reporting does not necessarily reflect health outcomes assessed by clinicians. Also, given the skyrocketing price of insulin and its limited access or availability, it is paramount that future studies seriously consider advancing the current study by including a wider range of factors related to diabetes management. Fourth, the BRFSS is a self-reported survey, which is subject to recall bias. Although researchers note that findings with self-reported data are consistent with those of nonsurvey-based data (39), because of errors in memory and recall biases, there is speculation of the limitations of self-reports. The self-reported data may result in measurement errors and undermine the accuracy of the findings. Objective measures in future studies are needed to improve the understanding of the impact of Medicaid expansion and confirm the findings in

Table 4—Adjusted score changes in self-reported access to health care, diabetes management, and health status between subgroups

	Pre	Post	Δ (Post − Pre)	*P* value	Group comparisons	*P* value
Self-reported access to health care						
H-N	1.32 (1.24, 1.40)	1.38 (1.27, 1.49)	0.06 (−0.05, 0.17)	0.275	Reference	—
H-E	1.41 (1.36, 1.45)	1.67 (1.58, 1.77)	0.26 (0.14, 0.38)	<0.000	0.20 (0.09, 0.31)	<0.001
N-N	1.44 (1.36, 1.51)	1.57 (1.47, 1.68)	0.13 (0.06, 0.21)	0.001	0.07 (−0.01, 0.16)	0.083
N-E	1.51 (1.45, 1.57)	1.67 (1.59, 1.74)	0.15 (0.05, 0.26)	0.003	0.09 (0.00, 0.18)	0.042
Self-reported diabetes management						
H-N	10.10 (9.10, 11.11)	9.68 (8.45, 10.91)	−0.43 (−1.23, 0.38)	0.298	Reference	—
H-E	9.45 (8.45, 10.44)	10.65 (9.36, 11.95)	1.20 (−0.70, 3.10)	0.215	1.63 (−0.04, 3.29)	0.055
N-N	10.04 (8.53, 11.55)	9.92 (8.36, 11.47)	−0.12 (−1.21, 0.97)	0.827	−0.30 (−0.67, 1.28)	0.542
N-E	12.59 (11.59, 13.58)	14.24 (13.41, 15.08)	1.66 (0.22, 3.10)	0.024	2.08 (0.86, 3.30)	0.001
Self-reported health status						
H-N	1.39 (1.27, 1.50)	1.26 (1.04, 1.47)	−0.13 (−0.29, 0.04)	0.141	Reference	—
H-E	1.32 (1.20, 1.44)	1.37 (1.19, 1.55)	0.05 (−0.12, 0.21)	0.592	0.17 (0.09, 0.26)	<0.001
N-N	1.32 (1.22, 1.42)	1.27 (1.04, 1.38)	−0.11 (−0.25, 0.04)	0.159	0.02 (−0.07, 0.10)	0.649
N-E	1.10 (0.96, 1.23)	1.07 (0.86, 1.27)	−0.03 (−0.20, 0.11)	0.740	0.10 (−0.02, 0.22)	0.105

Data are mean (95% CI) unless otherwise indicated. Multivariate regression adjusted for population characteristics, such as age, sex, race/ethnicity, education, marital status, employment, comorbidity, and state and quarter-year fixed effects. H-E, high diabetes states that expanded Medicaid (AR, DE, KY, and WV); H-N, high diabetes states that did not expand Medicaid (AL, GA, MS, NC, OK, SC, TN, and TX); N-E, low diabetes states that expanded Medicaid (AZ, CO, CT, DC, HI, IL, IA, MD, MA, MN, NV, NJ, NM, ND, OH, OR, RI, VT, and WA); N-N, low diabetes states that did not expand Medicaid (FL, ID, KS, ME, MO, NE, SD, VA, WI, and WY) (see Supplementary Data for classification of states into four groups).

this study. Next, the BRFSS question asking nonconsultation is not specifically for diabetes. While acknowledging this limitation, because the sample population is persons with diabetes who need routine diabetes care and care for any diabetes-related complications, this question would provide important information about the access issue and implications as to whether there are noteworthy changes in accessibility after the Medicaid expansion in persons with diabetes. Furthermore, advanced technology may allow alternatives or simpler ways for blood glucose monitoring. Nevertheless, regular blood glucose checking is one of the most recommended health behaviors by the diabetes care community for successful diabetes management. In addition, given that differences of scores in outcomes are based on second- or third-order data, the interpretation of the findings may not be straightforward. Finally, despite the fact that the BRFSS was well documented for its representativeness and generalizability, it is critical to keep continued efforts to ensure high-quality data and reduce any potential bias.

Despite some limitations, the findings of this study comparing important elements of diabetes management add to the literature. First, this present study provides evidence that the Medicaid expansion under the ACA is associated with substantial improvements in self-reported access to health care and self-reported diabetes management in persons with diabetes. There is also an indication of an improved self-reported health outcome in states that expanded Medicaid in comparison with those that did not. Particularly, states with high diabetes rates that adopted the Medicaid expansion experienced self-reported health benefits markedly. In contrast, states with a high diabetes burden that did not expand Medicaid under the ACA may be facing worsened public health practices and outcomes due to substantial barriers to access to health care compared with those with high diabetes rates that expanded Medicaid, suggesting emerging health inequalities between the states and a call for action to address this critical public health issue. Therefore, the findings of the current study provide policy implications not just for the diabetes care community but also for policy makers at all levels in America in their efforts toward diabetes management and its control.

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