FEATURE ARTICLE

Race Disparities in the Use of Prevention, Screening, and Monitoring Services in Michigan Medicare Beneficiaries With Type 2 Diabetes and Combinations of Multiple Chronic Conditions

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People with diabetes need routine health care to prevent potential exacerbations of diabetes and detect or prevent the development of additional chronic conditions that can worsen the course of diabetes. Using 2012 Medicare claims data from the State of Michigan for 443,932 beneficiaries with type 2 diabetes, we determined that there are differences between white and racial/ethnic minority people with diabetes in accessing any preventive care and in the amount of service used once they do access care, even after adjusting for the presence of multiple chronic conditions.

Diabetes is one of the most prevalent chronic diseases in the United States (1), with health care costs rising from $237 billion in 2012 to $327 billion in 2017. More than 60% of the cost of diabetes care is borne by Medicare and Medicaid (2). Although the largest expenditures are for hospital inpatient care and prescription medications, a significant amount is spent on prevention and screening services (e.g., physician visits, imaging, and laboratory testing). Health screening is associated with higher outpatient service utilization for detection and treatment of many comorbidities (3).

More than 40% of people with diabetes also have comorbidities (4). Diabetes, along with cardiovascular disease (CVD), cancer, chronic obstructive pulmonary disease (COPD), stroke, Alzheimer's disease (AD), and chronic kidney disease (CKD) are among the top 10 multiple chronic conditions (MCCs) that are leading causes of death in the State of Michigan (5).

Screening, prevention, and intervention services should reduce the burden of MCCs. However, variations exist in the use of screening services among groups defined by different sociodemographic characteristics, especially race (6–12). The goal of this study was to determine whether racial/ethnic minorities with type 2 diabetes and MCCs access and use prevention and intervention services at different rates compared with their white counterparts.

The importance of screening people with diabetes for stroke and CVD (11–14), cancer (7–9,15), COPD (16), AD (6), and CKD (10,17) is well documented. Most of the literature that describes screening and prevention services for people with diabetes and MCCs only considers the presence of one additional chronic condition (i.e., CKD in addition to diabetes). This research considers differences in use of prevention and intervention services within subgroups of individuals with type 2 diabetes who also have various combinations of six additional MCCs. In addition, we determine how sociodemographic variables influence the use of prevention and intervention services.

Research Design and Methods

Data

We requested claims data from the Centers for Medicare & Medicaid Services (CMS) for 1,851,328 Medicare beneficiaries of all ages in the State of Michigan who were enrolled in Medicare and received services that were

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billed to Medicare at any time during 2012. We obtained data from the Master Beneficiary Segment Files (MBSFs) of CMS that included four databases with information about each beneficiary: the Base Segment database, the Chronic Conditions Warehouse (CCW) database, the Cost and Use database, and the Part D Drug file. The Base Segment database provides basic demographic information for each beneficiary. The CCW codes for the presence of 27 chronic conditions tracked by CMS. The Cost and Use database provides information about total annual costs for various services. The Part D Drug file contains information about drug use and costs.

We merged these files to create one database that contains all MBSF variables for 1,851,328 Medicare beneficiaries in the State of Michigan. Our main inclusion criteria included beneficiaries >65 years of age with a diagnosis of type 2 diabetes. When someone who is <65 years of age receives disability payments through the Supplemental Security Income program, they are also eligible for Medicare. Early disability can contribute to poorer health outcomes for many health conditions. For that reason, we eliminated 351,002 beneficiaries who were <65 years of age to eliminate early disability as a confounder in our analyses, leaving 1,500,326 Medicare beneficiaries remaining.

To identify those with type 2 diabetes, we used indicators from the CCW. The CCW data include a variable that identifies people with diabetes (n = 511,120, or 34.1% of beneficiaries >65 years of age), but that includes people with either type 1 or type 2 diabetes. Because our goal was to study beneficiaries with type 2 diabetes, we eliminated beneficiaries with type 1 diabetes diagnosis codes *(International Classification of Diseases*, 9th revision [ICD-9], codes 250.x1 or 250.x3) or a secondary diabetes code (ICD-9 codes 249.xx), or a mix of codes in Part B Carrier, Home Health, Hospice, and Outpatient Claims data. Finally, we removed 4,475 beneficiaries with race designated as Other or Unknown because of the uncertain nature of these groupings, resulting is a final sample size of 443,932 (29.6% of beneficiaries >65 years of age).

Independent Variables

We included the following independent variables as covariates in our analyses: age in years, sex coded 0 = male and 1 = female, patient location coded 0 = rural county and 1 = urban county, and race coded 1 = non-Hispanic white (white), 2 = Black/African American (black), 3 = Asian/Pacific Islander (A/PI), 4 = Hispanic, and 5 = American Indian/Alaska Native (AIAN). We also included a proxy measure of income called Part D subsidy. According to CMS, "The Part D benefit requires enrollees to pay both premiums and cost-sharing, but the program also has a low-income subsidy (LIS) that covers some or all of those costs for certain low-income individuals, including deductibles and cost-sharing during the coverage gap (18)." Each beneficiary receives a code for each month of the year that indicates whether they received any level of the subsidy. We coded this variable as 0 = full subsidy (received subsidy in all 12 months), indicating lowest income; 1 = partial subsidy (received subsidy in 1–11 months), indicating moderate income; and 2 = no subsidy (did not receive subsidy in any month), indicating highest income.

Finally, we included a categorical variable that accounts for combinations of type 2 diabetes and MCCs. The leading causes of death that are chronic conditions in the State of Michigan (5) are: heart disease, cancer, chronic lower respiratory disease (we used the chronic conditions variable for COPD), stroke, AD, diabetes, and nephritis/CKD. We use the CCW indicator for congestive heart failure (CHF) as our proxy measure for heart disease. We use a combined measure of ever being diagnosed with one of the following cancers for our cancer variable: breast, colorectal, endometrial, lung, and prostate. Finally, we use the CCW variables for stroke, AD, and CKD as indicators of those conditions.

Because our aim was to examine whether disparities in service utilization exist based on race, as well as combinations of type 2 diabetes plus MCCs, we created a new variable that identifies beneficiaries as having diabetes alone, as well as any of the 63 combinations of type 2 diabetes and chronic conditions that exist. Instead of including all 64 combinations of disease in our analyses, we chose a cross-section of combinations representing type 2 diabetes plus one, two, three, or four additional MCCs (generally based on the highest prevalence in each category), including type 2 diabetes alone (as a reference category), type 2 diabetes plus CHF, type 2 diabetes plus cancer, type 2 diabetes plus COPD, type 2 diabetes plus stroke, type 2 diabetes plus CKD, type 2 diabetes plus CHF/COPD, type 2 diabetes plus CHF/CKD, type 2 diabetes plus CHF/COPD/CKD, type 2 diabetes plus CHF/COPD/stroke/CKD, and type 2 diabetes plus all other combinations of MCCs.

Dependent Variable

Our dependent variable provided a novel measure of prevention, screening, and monitoring services use, generally through outpatient services billed through Physician Part B, which includes medically necessary

TABLE 1 Sample Characteristics (n = 443,932)

Independent Variables	Value	Dependent Variables	Value
Age in years, mean (SD)	77.19 (7.88)	Use of prevention services	
Sex		Used any prevention services	401,312 (90.4)
Male	195,073 (43.9)	Did not use prevention services	42,620 (9.6)
Female	248,859 (56.1)	Weighted PSMU, mean (SD)	113.81 (161.08)
Race		EM costs, $, mean (SD)	1,100.23 (2,600)
White	364,156 (82.0)	EM events, mean (SD)	10.97 (26.4)
Black	64,475 (14.5)	EM annual total costs, $	493,006,677
A/PI	5,564 (1.3)	EM annual total events	4,868,904
Hispanic	8,185 (1.8)	EM cost/event, $	101.25
AIAN	1,552 (0.3)	EM weight	4.93
Part D subsidy		IMG costs, $, mean (SD)	279.61 (462.11)
Full subsidy	68,048 (15.3)	IMG events, mean (SD)	5.49 (7.91)
Partial subsidy	14,733 (3.3)	IMG annual total costs, $	125,482,451
No subsidy	361,151 (81.4)	IMG annual total events	2,461,186
Patient location		IMG cost/event, $	50.98
Rural	46,882 (10.6)	IMG weight, weight	2.48
Urban	397,050 (89.4)	LAB costs, $, mean (SD)	303.81 (502.04)
Combinations of diabetes and MCCs		LAB events, mean (SD)	14.81 (21.45)
Diabetes	109,901 (24.8)	LAB annual total costs, $	136,375,532
Diabetes + CHF	25,534 (5.8)	LAB annual total events	6,644,491
Diabetes + cancer	17,667 (4.0)	LAB cost/event, $	20.52
Diabetes + COPD	25,927 (5.8)	LAB weight	1
Diabetes + stroke	10,700 (2.4)	Part B costs, $, mean (SD)	650.03 (650.09)
Diabetes + CKD	23,790 (5.4)	Part B events, mean (SD)	7.65 (7.82)
Diabetes + CHF/COPD	21,623 (4.9)	Part B annual total costs, $	291,679,736
Diabetes + CHF/CKD	20,185 (4.5)	Part B annual total events	3,433,480
Diabetes + CHF/COPD/CKD	27,335 (6.2)	Part B cost/event, $	84.95
Diabetes + CHF/COPD/stroke/CKD	15,408 (3.5)	Part B weight	4.14
Diabetes + all other combinations of MCCs	145,862 (32.9)		

All values are n (%) except where otherwise noted.

services for prevention and screening, and evaluation and management for chronic conditions, including diabetes. The Cost and Use database provides information about total annual costs and numbers of events for several cost categories for each Medicare beneficiary. Each beneficiary has a total annual cost included for each of these categories, as well as the number of events the beneficiary experienced during the year for a given category. An event might include an overnight hospital stay, an emergency department visit, or a skilled nursing stay. Because we were interested in services that might be considered for prevention, monitoring, or screening, we focused on four specific cost and event categories that included these types of services under Medicare Part B, as described above: Evaluation and Management (EM), Laboratory Testing (LAB), Imaging (IMG), and Physician Part B services (Part B). We use these measures as proxies for prevention, screening, and monitoring services because the bulk of the activities included in these categories take place as part of routine medical care outside of the hospital.

We calculated a weighted index of utilization of services (Prevention, Screening, and Monitoring Use [PSMU]) using the following cost and number-of-event variables from the Cost and Use database: EM (comprising the following variables as named in the Cost and Use database: EM_MDCR and EM_EVENT), IMG (comprising the following variables as named in the Cost and Use database: IMG_MDCR and IMG_EVEN), LAB (comprising the following variables as named in the Cost and Use database: TEST_MDC and TEST_EVE), and Part B (comprising the following variables as named in the Cost and Use database: PHYS_MDC and PHYS_EVE) claims. In each case, the "MDC" (or "MDCR") variable, as named in the database, is the total annual Medicare payment for each cost category. The "EVE" (or "EVEN" or "EVENT") variable, as named in the database, is the annual count of events for that type of service. Many services are counted under Part B claims, and while physicians are often involved in EM activities, these activities are tabulated separately, as are IMG and LAB services.

We developed our PSMU index by adding the total costs and total events across all beneficiaries for each service category. We developed weights for these services by dividing the total costs by the total events for each

$$PSMU = EM(4.93) + IMG(2.48) + LAB(1) + Part\ B(4.14)$$

Example with one event in each category:

$$PSMU = 1(4.93) + 1(2.48) + 1(1) + 1(4.14) = 12.55$$

Example with mean number of events in each category:

$$PSMU = 10.97(4.93) + 5.49(2.48) + 14.81(1) + 7.65(4.14) = 114.17$$

FIGURE 1 PSMU formula and examples.

category, resulting in a cost/event ratio, and then dividing each cost/event ratio by the lowest ratio (in this case, 20.52 for the LAB cost/event ratio) to determine the weight in each category. Cost/event ratios, as well as resulting weights for each cost category, are included in Table 1.

For each beneficiary, we multiplied the number of events in each category by the applicable category weight and then added the results from each category together to determine the weighted PSMU index. Finally, we dummy-coded any use of services to create groups that used no services at all during the year (coded as 0) and those that had any service use during the year (coded as 1). Figure 1 includes the PSMU index formula, as well as example calculations. The mean PSMU in our cohort was 113.81, and 90.4% of beneficiaries had any type of service use (Table 1).

Statistical Analysis

We used SAS v. 9.4 software (SAS Institute, Cary, NC) to fit a selection model (19) to determine how race, age, sex, Part D subsidy, rural location, and combinations of type 2 diabetes and MCCs influence PSMU. The first component of the selection model was a binary probit model that predicted "selection" (nonzero services use or the category of beneficiaries that used any service during the year) for the dummy-coded service use variable, as a function of age, male sex, race, rural location, and type 2 diabetes plus combinations of MCCs. The second component of the selection model predicted the PSMU index for those who use any service, using the same covariates.

We included interactions between race/ethnicity and the 10-category MCCs variable to test the hypothesis that different combinations of MCCs moderate differences between the race/ethnicity groups in terms of the probability of any prevention services use and the mean PSMU (for those with any use). Stated differently, the inclusion of these interactions allowed for an examination of whether combinations of MCCs resulted in larger or smaller differences between race/ethnicity groups for these outcomes. We evaluated the need for the selection model (to reduce selection bias in the substantive model for our PSMU measure) by estimating and testing the correlation of the residuals in the two components of the overall model.

Results

Table 1 includes descriptive statistics for our sample. The average age of our sample was 77.2 years, and a majority were female (56.1%), white (82.0%), and residing in urban counties (89.4%). More than 15% of beneficiaries received the full Part D subsidy, whereas 3.3% received a partial subsidy, suggesting income low enough to meet subsidy requirements. Approximately 25% of beneficiaries had a diagnosis of type 2 diabetes alone. The most prevalent combinations of MCCs with type 2 diabetes were CHF/COPD/CKD at 6.2%, CHF and COPD (both at 5.8%), and CKD (5.4%).

Results for the two separate components of the overall fitted model are presented in Table 2. The first component of the interaction model (Table 2, second column) predicts use of any prevention and intervention services. Regarding race × MCCs interactions, the only significant interactions are for blacks with various combinations of MCCs (in the interest of space, we included only significant interactions; readers are invited to request the entire table from the corresponding author). Blacks had decreased log odds of any service use compared with whites if they had diabetes alone. However, this disparity narrowed significantly for blacks who also had COPD; the net difference in log odds between blacks and whites changed from $\beta = -0.170$ to $\beta = -0.170 + 0.117 = -0.053$, meaning that the difference in the probability of any service use between these two groups became much smaller when considering individuals who also has COPD (only). Similarly, the interactions of black × stroke, black × CHF/COPD, black × CHF/COPD/stroke/CKD, and black × all other combinations of MCCs changed the gap in log odds of any services use from −0.170 for blacks with diabetes only compared with whites to −0.293, −0.061, −0.066, and −0.063, respectively. In general, with more chronic conditions, the disparities between blacks and whites in the probability of any service use decreased, with the exception of blacks with diabetes plus stroke (for whom the disparity increased).

The second component of the model (Table 2, third column) predicts the value of PSMU for those using any services. There were several significant race × MCCs interactions that predict increased mean PSMU. Blacks,

TABLE 2 Heckman Selection Model Predicting Use of Any Services and Level of Services Use

	Any Services Use, Unstandardized β (SE)	Level of Services Use, Unstandardized β (SE)
Regression intercept	1.83 (0.03)*	132 (2.53)*
Age	0.01 (0)	−0.93 (0.03)*
Male sex	−0.10 (0.01)*	−5.80 (0.50)*
Race (reference: white)		
Black	−0.17 (0.02)*	−6.12 (1.62)*
A/PI	0.19 (0.04)*	−19.8 (3.51)*
Hispanic	−0.02 (0.03)	−16.0 (3.31)*
AIAN	0.03 (0.08)	−9.46 (7.95)
Part D subsidy (reference: no subsidy)		
Partial subsidy	0.03 (0.02)	65.4 (1.35)*
Full subsidy	0.22 (0.01)*	15.2 (0.70)*
Rural location	0.07 (0.01)*	−37.0 (0.79)*
Diabetes and combinations of MCCs (reference: diabetes)		
Diabetes + CHF	0.05 (0.01)*	31.3 (1.25)*
Diabetes + cancer	0.11 (1.01)*	20.8 (1.43)*
Diabetes + COPD	0.13 (1.01)*	23.3 (1.20)*
Diabetes + stroke	0.09 (0.01)*	30.6 (1.78)*
Diabetes + CKD	0.21 (2.01)*	30.6 (1.26)*
Diabetes + CHF/COPD	0.17 (1.01)*	62.8 (1.32)*
Diabetes + CHF/CKD	0.25 (2.01)*	85.9 (1.38)*
Diabetes + CHF/COPD/CKD	0.42 (4.01)*	152 (1.21)*
Diabetes + CHF/COPD/stroke/CKD	0.55 (5.01)*	195 (1.56)*
Diabetes + all other combinations of MCCs	0.39 (3.01)*	105 (0.77)*
Interactions†		
Black × COPD	0.12 (0.03)‡	9.35 (3.56)‡
Black × stroke	−0.12 (0.04)§	0.85 (5.40)
Black × CHF/COPD	0.11 (0.03)‡	4.22 (3.53)
Black × CHF/CKD	−0.02 (0.03)	8.74 (3.48)§
Hispanic × CHF/CKD	0.01 (0.09)	19.8 (8.76)§
Black × CHF/COPD/CKD	0.02 (0.03)	29.1 (3.09)*
Black × CHF/COPD/stroke/CKD	0.10 (0.04)§	86.5 (3.53)*
A/PI × CHF/COPD/stroke/CKD	0.01 (0.24)	96.9 (14.0)*
Hispanic × CHF/COPD/stroke/CKD	0.01 (0.14)	51.8 (10.3)*
Black × all other combinations of MCCs	0.11 (0.01)*	51.7 (1.95)*
Hispanic × all other combinations of MCCs	0.004 (0.05)	20.0 (4.69)*
AIAN × all other combinations of MCCs	0.04 (0.12)	−24.1 (10.9)§

*P <0.001. †Only significant interactions are included; readers are welcome to contact the corresponding author for the complete table. ‡P <0.01. §P <0.05.

A/PIs, and Hispanics who only had diabetes and had any record of PSMU had significantly lower mean use than whites. However, this gap changed in a positive direction when considering race and interactions with MCCs. For example, for those who also had CHF/COPD/stroke/CHF, the differences in mean level of PSMU changed in a positive direction for all three groups and became net positive differences in a significant manner. The net gaps in mean use for blacks, A/PIs, and Hispanics relative to whites become ~80 (β = −6.12 + β = 86.5), 77 (β = −19.8 + β = 96.9), and 36 (β = −16.0 + β = 51.8), respectively (Figure 2).

These results suggest that whites with diabetes and these four chronic conditions actually had a significantly lower mean level of PSMU relative to the other three race/ethnicity groups, adjusting for the other covariates. Figure 2 shows the differences in mean PSMU index for all race/ethnicity groups with diabetes alone compared with whites and the difference in service use for the significant interactions of race and MCCs. Essentially, blacks, A/PIs, Hispanics, AIANs with diabetes only, and AIANs with all other MCCs had lower mean levels of service use compared with whites. For all other significant combinations of MCCs shown in Figure 2, whites had lower mean service use for the combinations specified compared with the corresponding race group with these combinations.

For the model's selection component, the estimated correlation between the residuals in the two components was −0.05 (SE = 0.01), supporting the need for the selection model to reduce bias in the substantive model for the PSMU index. We also note that all subgroup differences reported here would likely have been significant regardless of the large sample sizes employed in this study; the effect sizes we found were quite large and would likely have emerged as significant in smaller samples.

Discussion

Using 2012 Michigan Medicare claims data for a cohort of beneficiaries with type 2 diabetes, we analyzed the effects of race, age, sex, rural status, Part D subsidy, combinations of MCCs, and race × MCCs interactions on the use of prevention and intervention services. Consistent with much of the previous literature (6,8,10,11), we observed variations in the use of prevention, screening, and monitoring services among subgroups based on race and ethnicity. First, we found that, among individuals with diabetes alone, blacks have significantly decreased odds of any service use. This disparity narrowed when considering individuals with MCCs, with the exception of individuals who also had a stroke (only), for whom the disparity increased. Second, we found that, among individuals with diabetes only who used services, blacks, A/PIs, and Hispanics all had significantly reduced mean service use relative to whites. These gaps changed substantially when considering individuals with MCCs, to the point where several minority groups had significantly increased mean service use relative to whites.

These results indicate that allowing for heterogeneity among subgroups of individuals defined by MCCs is important when investigating racial/ethnic disparities in service use. The results also provide some interesting possibilities for future research. For example, why do blacks generally have lower odds of using services, but when they do use services, their service utilization level is higher than whites when taking the same MCCs into account? Several possibilities exist: first, just as there is a general lack of awareness of screening services for breast cancer among black women (9), there may also be a lack of awareness of the importance of routine screening for other comorbidities among the black population. In addition, there may be a general lack of trust in the health care system among blacks resulting from past experiences (20). This mistrust may lead to decreased motivation to seek treatment. This pattern of behavior may explain why, by the time they do receive services, their health may have deteriorated to the point of requiring additional resources compared with whites with similar MCCs.

Our data provide some evidence to support these ideas. To illustrate, additional analyses indicate that 38.4% of A/PIs with type 2 diabetes have none of the other MCCs we studied, and this percentage is greater than for whites (25.6%), blacks (18.3%), Hispanics (30.2%), and AIANs (27.5%). In addition, although this same trend existed for A/PIs with type 2 diabetes plus one additional chronic condition (specifically CHF or cancer), the prevalence of all other combinations of type 2 diabetes plus one or more MCCs was significantly lower for A/PIs compared with all other groups. Conversely, the picture is bleaker for blacks. In blacks, the prevalence of type 2 diabetes and two or more MCCs was statistically higher in all cases (except for a couple of instances in which the prevalence equaled that for AIANs). In other words, the finding that blacks are at lower odds for using any services may manifest itself in the fact that they generally have more MCCs compared with other racial groups, and once they do seek interventions, they require more comprehensive care for those additional MCCs.

Our study adds to the growing literature that highlights disparities in access to care and use of health care services between racial and ethnic minorities and whites (6–12). Our results confirm a similar pattern in Medicare beneficiaries with type 2 diabetes and MCCs in the state of Michigan. What is less clear is what can be done earlier in the life course to address the issues of access to primary care and utilization of prevention and screening services to help prevent development of type 2 diabetes and progression of diabetes to the addition of MCCs. After all, accessing Medicare at the age of 65 years does not alleviate a lifetime of earlier disparities in access to care.

Although we did not have access to data regarding lifelong access to care or health insurance coverage for this cohort, data from the state of Michigan indicate that, in 2011, 12% of the population was uninsured, including ~10% of whites compared with almost 20% of Hispanics and 17% of blacks (21). With the implementation of the Affordable Care Act (ACA) and the choice by Michigan to expand Medicaid, the uninsured population fell to 5% in 2017, with fewer than 5% of whites remaining uninsured, whereas 12% of Hispanics and 9% of blacks remained uninsured (22). Clearly, the decision to expand opportunities for insurance coverage has reduced the number of uninsured, but the gap between the white and minority uninsured rates remains. The ACA is not the only determining factor in insurance status; employment

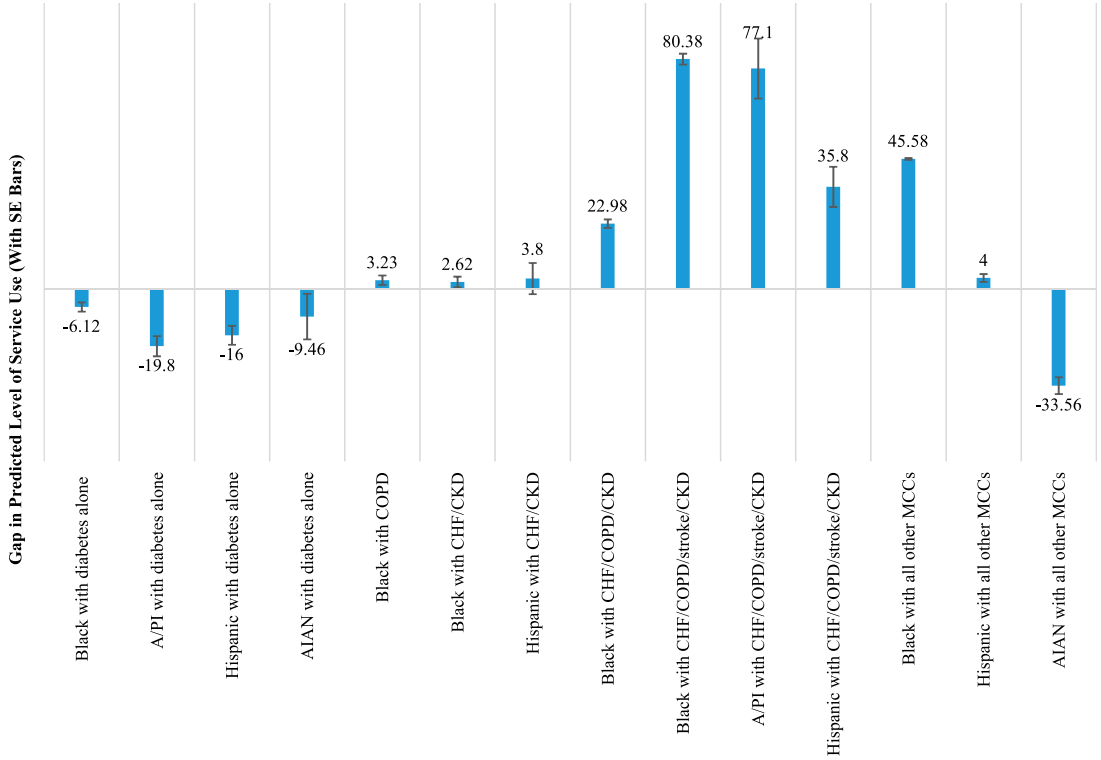

FIGURE 2 Service level gaps compared with whites with similar combinations of MCCs.

still remains the main avenue for obtaining health insurance before the age of 65 years, and although many argue that Michigan has recovered from the Great Recession, there is still a gap in employment rates between whites and racial and ethnic minorities (22).

It is likely that the cohort included in this study experienced the same insurance and employment conditions during their life course that affected their access to continuous care. In addition, it is important to recognize that many minority groups are disenfranchised from the health care system because of matters of trust and past discrimination. With continued focus on increasing access to insurance and health care through continued insurance reform, differences in access to care may continue to narrow. In addition, programs aimed at increasing employment opportunities for racial and ethnic minorities will also increase access to insurance and, ultimately, access to care. However, at some point, these returns may diminish unless systemic racism and lack of trust in the health care system are addressed through targeted policy initiatives that continue to make access easier and more welcoming for all.

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DUALITY OF INTEREST

No potential conflicts of interest relevant to this article were reported.

AUTHOR CONTRIBUTIONS

J.M.C. obtained and managed data, conducted statistical analysis, and wrote/reviewed/edited the manuscript. B.T.W. conducted statistical analysis and wrote/reviewed/edited the manuscript. B.H., N.H., M.M.K, and R.P. contributed to the literature review/introduction, interpretation of results, and discussion. J.M.C. is the guarantor of this work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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