Impact of Race and Location of Residence on Statin Treatment Among Veterans With Type 2 Diabetes Mellitus

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Rural residence and ethnic-minority status are individually associated with increased cardiovascular (CV) mortality. Statin therapy is known to reduce the risk of cardiovascular mortality. Although ethnic disparities in statin treatment exist, the joint impact of urban/rural residence and race/ethnicity on statin prescribing is unclear. Veterans Health Administration (VHA) and Centers for Medicare and Medicaid data were used to perform a longitudinal study of Veterans with Type 2 diabetes mellitus from 2007 to 2016. Mixed effects logistic regression with a random intercept was used to model the longitudinal association between the primary exposure (race/ethnicity and residence) and statin prescribing. After adjusting for covariates, non-Hispanic White (NHW)-Rural Veterans were 7% (odds ratio [OR] = 1.07; confidence interval [CI] 1.05 to 1.08), non-Hispanic Black (NHB)-Rural Veterans were 4% (OR 1.04; CI 1.00 to 1.08), and Hispanic-Urban Veterans were 20% (OR 1.20; CI 1.17 to 1.23) more likely to be prescribed statins versus NHW-Urban Veterans; whereas, NHB-Urban Veterans were 14% (OR 0.86; CI 0.85 to 0.55) and Hispanic-Rural Veterans were 10% (OR 0.90; CI 0.85 to 0.96) less likely. When disability and dual use were removed from the full model, compared with NHW-Urban, the odds of statin prescribing in NHW-Rural Veterans remained unchanged (OR 1.06; CI 1.04 to 1.07) whereas the odds of statin prescribing in all other groups were higher. In conclusion, NHB-Urban and Hispanic-Rural Veterans had lower odds of statin prescribing versus NHW-Urban Veterans; whereas NHW-Rural, NHB-Rural and Hispanic-Urban Veterans had higher odds. The findings in ethnic-minorities changed when we accounted for markers of VHA care (i.e., disability, dual use) showing that these individuals are more likely to receive statins when they receive more VHA care. Published by Elsevier Inc. (Am J Cardiol 2020;125:1492−1499)

Compared with individuals without diabetes mellitus (DM), patients with DM are more likely to develop cardiovascular (CV) disease, experience CV events and have poorer CV outcomes.[1] Key strategies for the prevention of CV events in patients with DM include managing hypertension and dyslipidemia.[2] For the latter, statins have been traditionally used to lower low-density lipoprotein (LDL) cholesterol levels to goals based on CV risk; however, more recent guidelines recommend fixed-dose statins without specified LDL goals in nearly all patients with DM.[2] Racial and ethnic minorities in the United States (US) have higher rates of CV mortality than non-minorities[3,4] and several studies have documented racial and ethnic disparities in statin use.[5−11] Similarly, rural residence is associated with higher rates of CV deaths.[12,13] However, very few studies have assessed the impact of rural residence on statin prescribing and the interplay between rural/urban residence and race/ethnicity and their impact on statin treatment in patients with DM is unclear. Thus, our aim is to evaluate the joint impact of rural residence and race/ethnicity on statin treatment in older US Veterans with type 2 DM.

Methods

This was a retrospective cohort study using national clinical and administrative data of adult Veterans with type 2 DM from 2007 to 2016. The cohort was formed for an earlier study.[14] In brief, multiple clinical and administrative

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files from the Veterans Health Administration (VHA) Corporate Data Warehouse and CMS data were linked to create a unique dataset containing a large cohort of veterans with type 2 DM. The Veterans Health Information Systems and Technology Architecture was the primary source for the Corporate Data Warehouse data extracts, which included prescription data, diagnostic codes, laboratory values, and demographic information embedded in outpatient visit, outpatient pharmacy, and inpatient admissions domains. We expanded the dataset to merge Medicare Part D data as described below. Medicare Part A, B, and D data were linked to the VHA dataset. The datasets were linked using patient scrambled social security numbers. The study was approved by the institutional ethical review board of the Medical University of South Carolina. The authors report no potential conflicts of interest relevant to this article. This article represents the views of the authors and not those of the Medical University of South Carolina or VHA.

We included patients based on the following inclusion criteria: (1) Veterans with type 2 DM (n = 714,212) as defined by 2 or more International Classification of Disease Clinical Modification 9 codes for DM (250, 357.2, 362.0, and 366.41) during the 24 months before 2002 and again during 2002 with prescriptions for insulin or oral hypoglycemic agents in 2002 based on a previously validated algorithm[14]; (2) 65 years or older on January 1, 2006 (Medicare qualified). Veterans who met the study inclusion criteria were identified and followed longitudinally from January 2007 until December 2016, loss to follow-up, or death.

The primary exposure variables were the combination of race/ethnicity and urban/rural residence. Race/ethnicity was defined based on VHA and CMS sources and was classified as non-Hispanic White (NHW), non-Hispanic Black (NHB), Hispanic, and other, with NHW serving as the reference group.[15] The term "NHB" is used to describe African American or black populations, and the term "NHW" is used to describe white populations to maintain consistent terminology. Urban/rural residence was based on Rural Urban Commuting Area codes which were derived from the patient's zip code; urban residence was coded as the reference.[16]

We also controlled for several demographic, clinical, and socioeconomic variables. Age was treated as a continuous variable. The time variable was based on annual visits coded from 0 to 9, with 2007 as index year, and was modeled as a continuous variable. Gender was treated as nominal with males as the reference group. Smoking status was classified as smoker and nonsmoker (reference group). Marital status was classified as married or nonmarried (reference group). Percentage service-connectedness, representing the degree of disability related to military service, was dichotomized at >50% versus <50% (reference group). Patients with service-connected DM and those with >50% service-connected disability do not pay for medications in the VHA system, while others are usually subject to a copay. Medical co-morbidities were captured using the Elixhauser Co-morbidity Index[17] and were measured using International Classification of Disease Clinical Modification 9 and 10 codes obtained from both VHA and CMS. International Classification of Disease Clinical Modification-10 codes were applicable after October 1, 2015. We controlled for the following clinical variables: number of annual primary care visits (time-varying) and atherosclerotic cardiovascular disease (acute coronary syndrome, atherosclerotic cerebrovascular disease, coronary heart disease, and peripheral artery disease). Finally, we also controlled for annual CMS-VHA dual utilization, splitting groups by over 80% VHA, 50% to 80% VHA and <50% VHA utilization, with the first group defined as the reference group. Dual-use status was time-varying over the study period, based on a patient's annual primary care visits and inpatient stays.

The primary outcome was any statin treatment (0 = no statin use vs 1 = any statin use). High-intensity statin use (0 = no or low/moderate intensity stain use vs 1 = high-intensity statin use) also served as an outcome for this analysis.[2] The proportion of patients on statins was measured each year. Patients were considered to be on statins in a given year if they filled 1 or more prescriptions for a statin during that calendar year. Data on statin use was considered missing if patients had no prescription data. We found this assumption to be reasonable as the use of at least 1 prescription medication would be expected among patients with DM. Prescription data from both the VHA and Medicare Part D was utilized.

In preliminary analyses, crude associations were examined between statin use variables and all measured covariates using appropriate statistical methods. Mixed effect logistic regression with a random intercept was used to model the association between the primary exposures (race/ethnicity and urban/rural residence) and statin use after adjusting for all measured covariates, including the interaction between urban/rural residence and race/ethnicity. Since our primary interest is to assess the synergistic impact of race and location of residence on statin treatment, we created a composite variable of race and location. Odds ratios (OR) and associated 95% confidence intervals (CIs) were computed from unadjusted and adjusted models using mixed effect logistic regression models with adjustment for clustering and repeated measures through random intercept model. This model allows for drop out as long as it is assumed to be at random. The Stata procedure xtlogit was used to fit the model.[18,19] Our analysis assumes missing at random which we found to be reasonable given the large sample size, many covariates involved and small magnitude of missing data we have in the statin use outcome variable. We also fitted a logistic regression model with the missing indicator for statin use as the outcome through xtgee for examining which covariates were most associated with missingness (see supplementary appendix Table 1). The missing indicator model showed that annual CMS-VHA dual utilization was strongly associated with missingness. Moreover, we did a sensitivity analysis by fitting the same xtlogit models after imputing the data 10 times (multiple imputation with chained equations) and the results were consistent (see supplementary Table 2) with the xtlogit estimates. Residual analysis was used to assess goodness-of-fit. All analyses were conducted using Stata ver. 15 (StataCorp. 2017. Stata Statistical Software: Release 15. College Station, TX: StataCorp LLC).

Results

Table 1 displays demographic characteristics from 2007 to 2016 by urban or rural residence. From the total sample of 714,212 (age ≥65 years) Veterans with DM, 35% were from rural areas and the remaining 65% were from urban areas. The mean (standard deviation [SD]) age was 76 years (6) and 99% were male. NHW were more likely to live in the rural areas (92% rural vs 78% urban); whereas the NHB (13% urban vs 5% rural), Hispanic (7% urban vs 2% rural), and other race (2.3% urban vs 1.8% rural) cohorts were more likely to live in the urban areas.

Similarly, the demographic characteristics by race/ethnicity status are summarized in supplementary Table 3. From the total sample (n = 714,212), 83% were NHW, 10% were NHB, 5% were Hispanic and the remaining 2% were in the other race cohort.

Figure 1 displays the proportion of Veterans with any statin use by location of residence, where urban area use decreased from 80% (in 2007) to 65% (in 2016) and rural area use decreased from 81% (in 2007) to 68% (in 2016). Supplementary Figure 1 displays the proportion of Veterans with high-intensity statin use over time by location of residence. High-intensity statin use increased in both groups over time from approximately 4% in 2007 to approximately 20% in 2016.

Figure 2 displays the proportion of Veterans with any statin use over time by race/ethnicity status. For NHW, the proportion of Veterans with any statin use consistently decreased from 81% (in 2007) to 66% (in 2016). For NHB, the proportion of Veterans with any statin use remained the same in 2007 and 2008 (80%) and then increased to 81% (in 2009) and then consistently decreased to 69% (in 2016). The proportion of Hispanic Veterans with any statin use increased slightly from 82% (in 2007) to 83% (in 2008) and finally decreased to 72% (in 2016). Figure 3 presents the proportion of Veterans with any statin use over time by race/ethnicity and location of residence. The proportion of Veterans with any statin use again decreased over time (from 78%−83% in 2007 to 64%−72% in 2016). Supplementary Figure 2 displays the proportion of Veterans with high-intensity statin use over time by race/ethnicity status. High-intensity statin use increased in all groups over time from <5% in 2007 to 18%−23% in 2016.

Table 2 presents the OR and 95% CI estimates from mixed effect logistic regression sequential models for the outcome of any statin use. In the full model, NHB and other race-Urban Veterans were 14% less likely to be on a statin as compared with NHW-Urban Veterans. However, Hispanic-Urban Veterans were 20% more likely to be on a statin versus NHW-Urban Veterans. NHW-Rural Veterans

Table 1
Demographic and clinical characteristics by location, 2007−2016

Variable	Location		Total
	Urban	Rural	
N	(n = 462,676) (65%)	(n = 251,536) (35%)	(n=) 714,212 (100%)
Age (years) mean (standard deviation)	76 (6.3)	76 (6.1)	76 (6.2)
Mortality rate (year 2007)	68%	68%	68%
Men	99%	99%	99%
Non-Hispanic white	78%	92%	83%
Non-Hispanic black	13%	4.9%	10%
Hispanic	7.0%	1.7%	5.2%
Other race	2.3%	1.8%	2.1%
Married	58%	62%	60%
>50% service-related disability	17%	16%	17%
Smoker	14%	15%	14%
Number of Elixhauser comorbidities mean number per group (standard deviation)	7.9 (3.3)	8.3 (3.3)	8.1 (3.3)
Number of primary care visits, mean per year (standard deviation)	4.7 (4.1)	4.6 (4.0)	4.7 (4.1)
Hemoglobin A1c ≥8%	10%	10%	10%
Hemoglobin A1c <8%	63%	63%	63%
Hemoglobin A1c Missing	27%	27%	27%
Acute coronary syndrome	23%	27%	24%
Atherosclerotic cerebrovascular disease	20%	22%	21%
Coronary heart disease	65%	69%	66%
Peripheral artery disease	45%	48%	46%
Statin use − None	18%	18%	18%
Statin use - Low/Moderate	71%	72%	71%
Statin use − High	3.6%	3.5%	3.5%
Statin use - Missing*	7.5%	6.5%	7.2%
Any statin use	74%	76%	75%
High-intensity statin use	3.6%	3.5%	3.5%
Dual VA-CMS utilization > 80% VA utilization	49%	45%	47%
Dual VA-CMS utilization 50%-80% VA utilization	7.1%	7.7%	7.3%
Dual VA-CMS utilization < 50% VA utilization	32%	35%	33%
Dual VA-CMS utilization Missing	13%	13%	13%

CMS = Center for Medicaid and Medicare Services; VA = veteran affairs.
* Missing indicates patients with no prescription data.

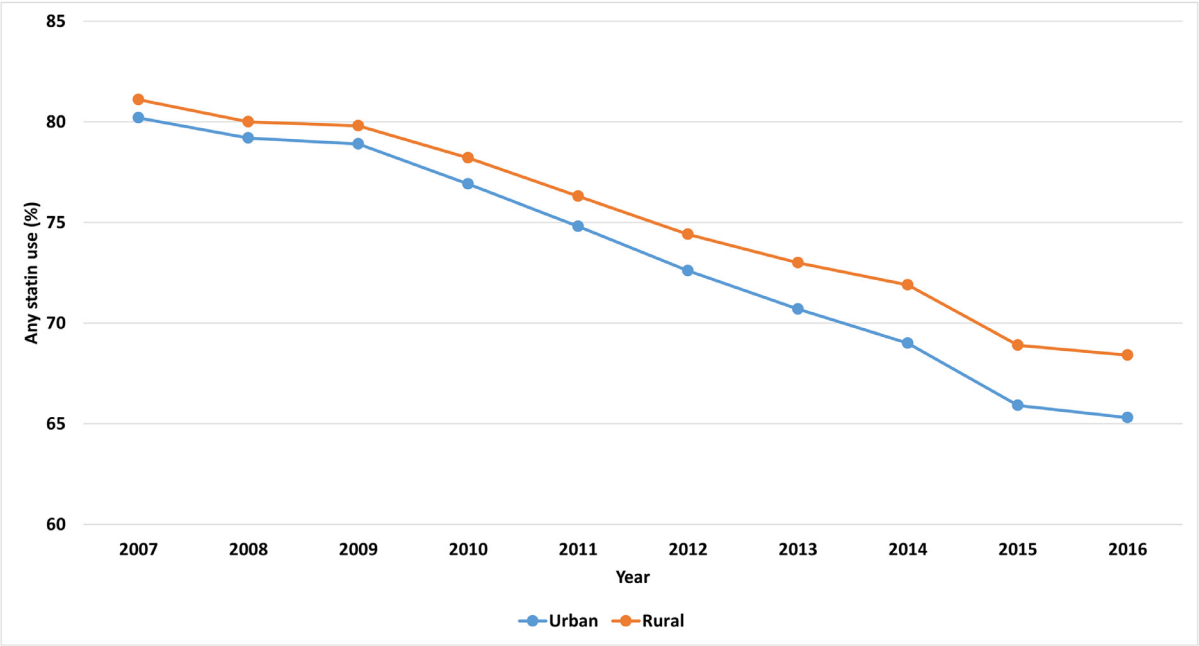

Figure 1. Proportion of any statin use over time by location of residence.

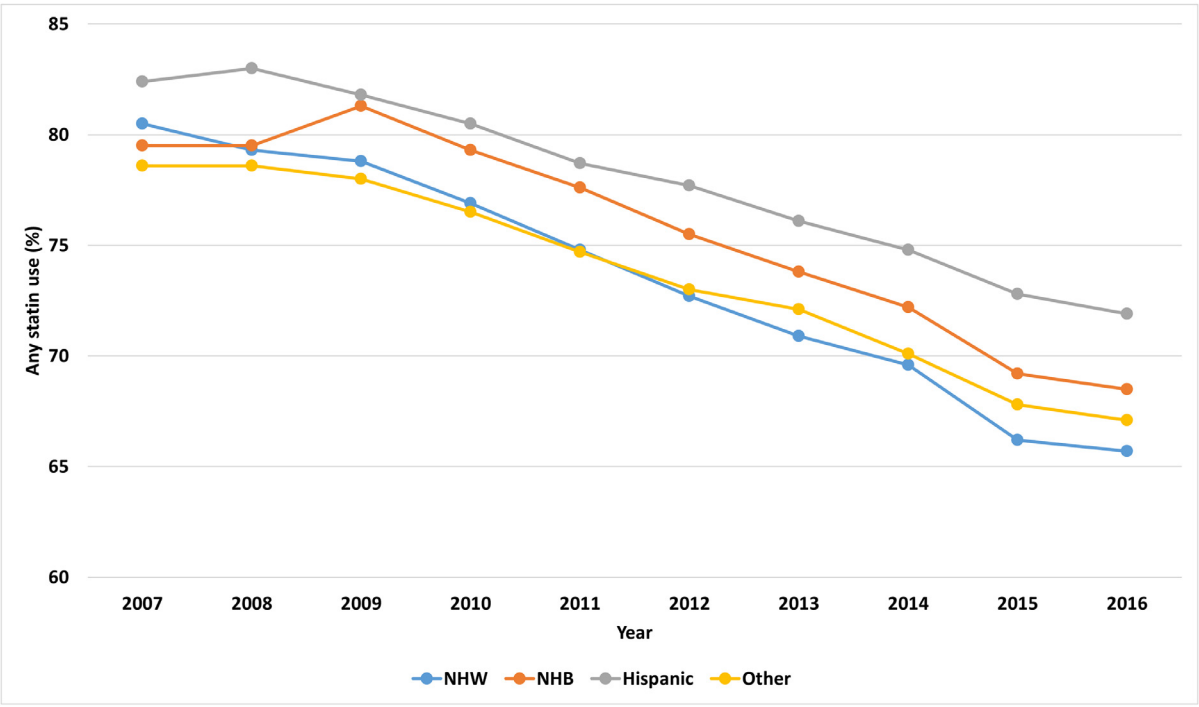

Figure 2. Proportion of any statin use over time by race/ethnicity. NHB = non-Hispanic black; NWH = non-Hispanic white.

were 7% and NHB-Rural Veterans were 4% more likely to be on a statin compared with NHW-Urban Veterans. However, Hispanic-Rural Veterans were 10% less likely to be on a statin.

Table 2 also presents results of the full model without disability and dual use, with NHW-Urban as the reference group. The odds of statin use in NHW-Rural Veterans were nearly the same the full model without disability and dual use (OR 1.06; CI 1.04 to 1.07) and the full model (OR 1.07; CI 1.05 to 1.08). However, the odds of statin use in all other groups were higher in the full model without disability and dual use than in the full model. For example, the odds of statin use in NHB-Urban group was slightly higher in the full model without disability and dual use (OR 1.06; CI 1.04 to 1.09) but 14% lower in the full model (OR 0.86; CI 0.85 to 0.88). Similarly, among the NHB-Rural Veterans,

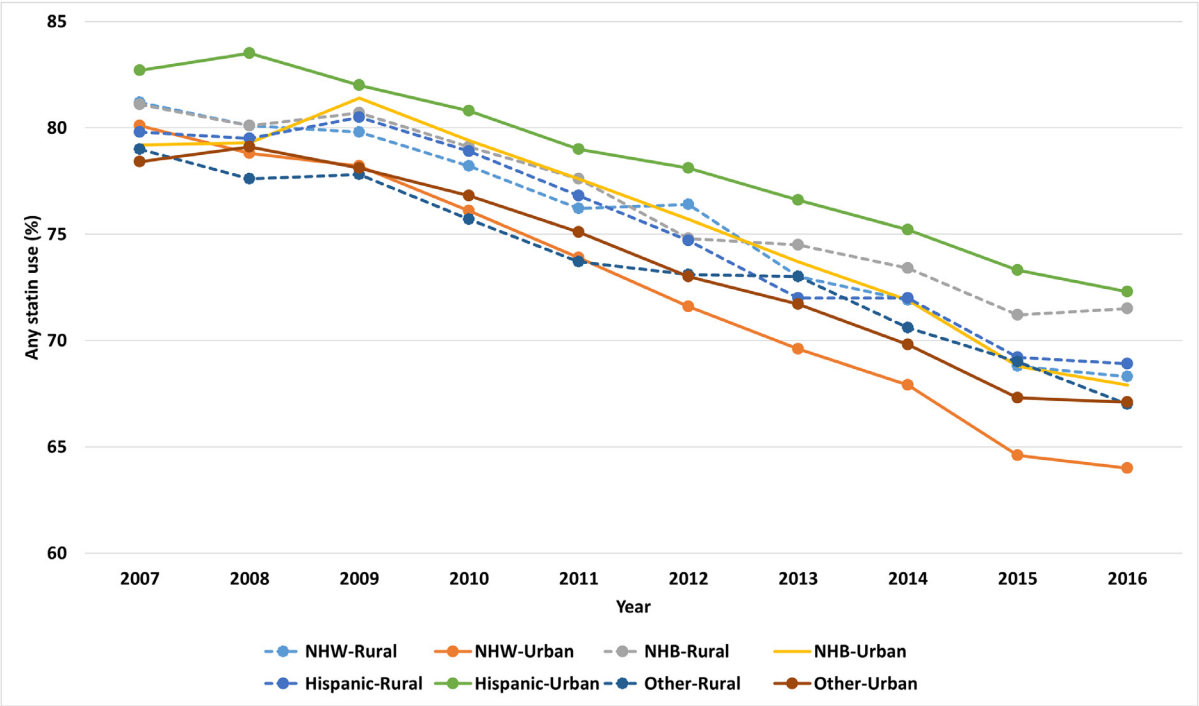

Figure 3. Proportion of any statin use over time by race/ethnicity and location of residence. NHB = non-Hispanic black; NWH = non-Hispanic white.

the odds of statin use were 14% (OR 1.14; CI 1.10 to 1.19) in the full model without disability and dual use but only 4% (OR 1.04; CI 1.00 to 1.08) in the full model. A similar pattern was observed for Hispanic and Other race cohorts.

Table 3 presents the sequential models for high-intensity statin use from the mixed effect logistic regression models. Differences in statin prescribing patterns in racial/ethnic minority patients were again observed based on place of residence. For instance, in the analysis of high-intensity versus no statin use, NHB-Urban Veterans had a 13.0% higher (OR 1.13; CI 1.07 to 1.20), NHB-Rural Veterans had a 43.0% higher (OR 1.43; CI 1.26 to 1.62) and Hispanic-Urban Veterans had a 17.0% higher (OR 1.17; CI 1.07 to 1.20) odds of high-intensity statin use compared with NHW-Urban Veterans in the full model. In contrast, Hispanic-Rural Veterans had a 60% lower (OR 0.40; CI 0.33 to 0.50) odds of high-intensity statin use.

Discussion

In this longitudinal analysis of 714,212 older Veterans with DM, we evaluated the impact of rural residence and race/ethnicity on statin treatment using national data from both the VHA and CMS. Compared with NHW-Urban Veterans, NHB-Urban, Hispanic-Rural and Other-race Veterans had 10% to 16% lower odds of statin use; whereas NHW-Rural, NHB-Rural, and Hispanic-Urban Veterans had 4% to 20% higher odds of statin use. These results provide evidence that statin prescribing patterns for racial/ethnic minority patients differ based on place of residence.

Several studies evaluating statin use have documented racial disparities.[5–11] In a study of 899,664 Veterans with DM over 40 years of age, NHB Veterans had a lower odds of statin initiation than NHW Veterans (OR 0.74; CI 0.72 to 0.76).[5] NHB were also 39% less likely to be taking statins than NHW ($p < 0.001$) in an analysis of US National Health and Nutrition Examination Survey (NHANES) data.[8] Similarly, among 4,288 US patients with DM, statin use was higher among white men (66%) than black men, white women and black women (range 54% to 58%; $p < 0.001$).[6] In contrast, a study of 63,576 Veterans with an index LDL over 190 found that Black Veterans were more likely to receive statins than NHW Veterans (OR 1.14; CI 1.09 to 1.19).[20] Our analysis adds to this growing body of literature, demonstrating that patterns of statin prescribing significantly differ among minorities based on urban or rural residence. For instance, while NHB Veterans living in rural areas were more likely to receive statins when compared with NHW-Urban Veterans in our analysis, NHB living in urban areas were less likely. Moreover, Hispanic Veterans living in urban areas were more likely to receive statins than NHW-Urban Veterans but Hispanic Veterans living in rural areas were less likely. It appears access to care greatly influences statin prescribing differently across racial/ethnic groups.

Disability and dual healthcare system use had an important impact on our findings. A higher % disability, or service-connectedness, qualifies Veterans for improved, less expensive healthcare coverage from the VHA and perhaps improved access to care. For example, those with >50% service-connected disability have no copay for prescribed medications in the VHA system. This could incentivize the use of the VHA over other healthcare systems among Veterans that also have non-VHA insurance coverage (e.g., Medicare). In our fully-adjusted model, >50% service-connected disability was associated with 33% higher odds of

Table 2
Sequential models for the odds of any statin use by race/ethnicity and location, 2007−2016

Variable	Any statin use vs none					
	Base Model n = 705,018	With race × location n = 705,018	Full model (No disability) n = 682,111	Full model (No disability, dual use) n = 682,111	(Full model) n = 682,111	p-Values (Full model)
Annual visit (0 to 9)	0.83 (0.83, 0.84)	0.84 (0.83, 0.84)	0.95 (0.95,0.95)	0.95 (0.95,0.95)	0.95 (0.94, 0.95)	<0.001
Location of residence						
Rural vs Urban (ref.)	1.14 (1.13, 1.15)					
Race-ethnicity						
non-Hispanic white	ref					
non-Hispanic black	1.15 (1.13, 1.17)					
Hispanic	1.52 (1.48, 1.56)					
Other race	1.02 (0.99, 1.06)					
Race × location						
non-Hispanic white × urban		ref	ref	ref	ref	
non-Hispanic white × rural		1.17 (1.15, 1.18)	1.06 (1.05,1.08)	1.06 (1.04,1.07)	1.07 (1.05, 1.08)	<0.001
non-Hispanic black × urban		1.18 (1.16, 1.20)	0.89 (0.87,0.91)	1.06 (1.04,1.09)	0.86 (0.85, 0.88)	<0.001
non-Hispanic black × rural		1.21 (1.17, 1.26)	1.07 (1.03,1.11)	1.14(1.10,1.19))	1.04 (1.00, 1.08)	0.024
Hispanic × urban		1.62 (1.58, 1.66)	1.21 (1.18,1.24)	1.71 (1.67,1.75)	1.20 (1.17, 1.23)	<0.001
Hispanic × rural		1.20 (1.12, 1.27)	0.92 (0.87,0.98)	1.11 (1.04,1.19)	0.90 (0.85, 0.96)	0.001
Other race×urban		1.09 (1.04, 1.14)	0.90 (0.87,0.94)	1.00 (0.96,1.04)	0.86 (0.83, 0.90)	<0.001
Other race × rural		1.04 (0.98, 1.11)	0.87 (0.82,0.92)	0.88 (0.83,0.94)	0.84 (0.79, 0.89)	<0.001
Sex						
Female vs male (ref.)			0.94 (0.90,0.98)	0.89 (0.85,0.93)	0.95 (0.91, 0.99)	0.046
Age (per year)			0.95 (0.95,0.95)	0.94 (0.94,0.94)	0.95 (0.95, 0.95)	<0.001
Marital status						
Married vs unmarried (ref.)			1.01 (1.00,1.01)	0.89 (0.88,0.90)	0.99 (0.98, 1.00)	0.468
Disability (>50% service-related)					1.33 (1.31, 1.35)	<0.001
Smoking status						
Smoker vs nonsmoker (ref.)			1.00(0.98,1.01))	1.11(1.10,1.13)	0.99 (0.98, 1.00)	0.547
Number primary care visits (per year)			1.08(1.08,1.08))	1.03(1.03,1.03)	1.08 (1.08, 1.08)	<0.001
Atherosclerotic cardiovascular events						
Acute coronary syndr.			1.03 (1.02,1.04)	1.00 (0.99,1.01)	1.02 (1.00, 1.03)	<0.001
Atheroscl. cerebro. dis.			0.97(0.96,0.98)	0.92 (0.90,0.93)	0.97 (0.96, 0.98)	<0.001
Coronary heart dis.			1.02 (1.00,1.03)	0.86 (0.85,0.87)	1.01 (1.00, 1.02)	0.010
Peripheral artery dis.			1.04 (1.03,1.05)	0.95 (0.94,0.96)	1.03 (1.02, 1.04)	<0.001
Dual VA-CMS status						
>80% VA utilization			ref		ref	
50%-80% VA utilization			0.93 (0.92,0.94)		0.93 (0.91, 0.94)	<0.001
<50% VA utilization			0.23 (0.23,0.23)		0.23 (0.22, 0.23)	<0.001
Intra-cluster correlation (ICC)	0.47(0.47,0.47	0.47(0.47,0.47)	0.38 (0.38,0.38)	0.42(0.42,0.43	0.38 (0.38,0.39)	

CMS = Center for Medicaid and Medicare Services; VA = Veteran Affairs.

statin prescribing (p <0.001). A similar relation between VHA utilization and statin prescribing was observed with dual VHA-CMS use. Compared with the high VHA utilization group, dual VHA/CMS and CMS predominant use was associated with 7% and 77% lower odds of statin prescribing, respectively (p <0.001 for both). Interestingly, including both of these markers of VHA care (i.e., disability and dual use) in the model appeared to have an important impact on our findings among minority Veterans specifically. The odds of statin use in NHW-Rural versus NHW-Urban Veterans were nearly the same in the model without disability and dual use as compared with the full model; however, the odds of statin use in all other groups were higher in the full model without disability and dual use. Our findings suggest that VHA care may increase minority Veterans' likelihood of being prescribed statins, likely due to improved access to low cost or free medications and care. Alternatively, these findings could reflect benefits of receiving care solely within an integrated healthcare system. Dual use, or receipt of medical treatment across healthcare systems, has been associated with poor care coordination and this may decrease the likelihood of receiving evidence-based medication regimens.[15,21] With dual use, prescribers often only have access to clinical documentation in single healthcare system. Incomplete information on co-morbidities, prior events, allergies, lab values, etc., may interfere with treatment decisions. For example, determining if a patient qualifies for a statin requires access to complete documentation of co-morbidities impacting CV risk, previous CV events and LDL levels. It is possible that providers caring for minority Veterans utilizing less VHA services had less complete information while making treatment decisions and that this decreased the likelihood of receiving a statin.

Table 3
Sequential models for the odds of high-intensity statin use by race/ethnicity and location, 2007−2016

Variables	Odds Ratios (95% Confidence Intervals) for Xtlogit (Logistic Random-Intercept Models)					
	High-intensity statin vs none or low/moderate		High-intensity statin vs none		High-intensity statin vs low/moderate	
	Base Model n = 705,018	Full Model n = 682,111	Base Model n = 535,936	Full model n = 440,296	Base Model n = 668,654	Full Model n = 653,832
Annual visit (0 to 9)	1.38 (1.38, 1.39)	1.70 (1.70, 1.71)	1.09(1.09,1.10)	1.52(1.51,1.53)	1.70(1.70,1.70	2.00(2.00,2.00)
Location of residence						
Rural vs Urban (ref.)	0.94 (0.92, 0.97)		1.07(1.03,1.11)		0.84(0.82,0.87)	
Race-ethnicity						
non-Hispanic white	ref		ref			
non-Hispanic black	1.60 (1.53, 1.67)		1.90(1.80,2.00)		1.56(1.50,1.64)	
Hispanic	0.84 (0.80, 0.89)		1.47 (1.36,1.58)		0.63(0.59,0.68)	
Other race	0.93 (0.85, 1.01)		1.00 (0.90,1.12)		0.86 (0.77,0.96)	
Race × location						
non-Hispanic white × urban		ref		ref		ref
non-Hispanic white × rural		0.76 (0.74, 0.79		0.82 (0.79,0.85)		0.68 (0.66,0.71)
non-Hispanic black × urban		1.42 (1.35, 1.49)		1.13 (1.07,1.20)		1.52 (1.44,1.62)
non-Hispanic black × rural		1.41 (1.28, 1.56)		1.43 (1.26,1.62)		1.42 (1.26,1.60)
Hispanic × urban		0.80 (0.75, 0.85		1.17 (1.07,1.20)		0.68 (0.63,0.74)
Hispanic × rural		0.44 (0.37, 0.53)		0.40 (0.33,0.50)		0.37 (0.30,0.45)
Other race × urban		0.90 (0.81, 1.00)		0.82 (0.72,0.94)		0.91 (0.80,1.03)
Other race ×rural		0.59 (0.50, 0.70)		0.48 (0.39,0.59)		0.55(0.45,0.67)
Sex						
Female vs male (ref.)		1.16 (1.03, 1.31)		1.22 (1.05,1.42)		1.26 (1.09,1.46)
Age (per year)		0.86 (0.86, 0.86)		0.79 (0.78,0.79)		0.85 (0.85,0.85)
Marital status						
Married vs unmarried (ref.)		1.06 (1.04, 1.09)		1.12 (1.08,1.16)		1.09 (1.05,1.13)
Disability (>50% service-related)		1.02 (0.98, 1.05)		1.42 (1.36,1.49)		0.88 (0.82,0.92)
Smoking status						
Smoker vs nonsmoker (ref.)		0.89 (0.86, 0.93)		0.86 (0.82,0.90)		0.86 (0.82,0.90)
Number primary care visits (per year)		1.04 (1.04, 1.05)		1.12 (1.11,1.12)		1.02 (1.02,1.03)
Atherosclerotic cardiovascular disease						
Acute coronary syndr.		1.88 (1.82, 1.94)		1.96 (1.88,2.04)		2.17 (2.09,2.26)
Atheroscl. cerebro. dis.		1.26 (1.22, 1.30)		1.19 (1.14,1.24)		1.36 (1.31,1.41)
Coronary heart dis.		3.32 (3.21, 3.43)		3.38 (3.25,3.52)		4.40 (4.23,4.58)
Peripheral artery dis.		1.34 (1.31, 1.38)		1.36 (1.31,1.40)		1.45 (1.40,1.50)
Dual VA-CMS status						
>80% VA utilization		ref		ref	ref	ref
50-80% VA utilization		0.92 (0.91, 0.95)		0.77 (0.74,0.80)	0.93 (0.92,0.94)	0.98 (0.96,1.00)
<50% VA utilization		0.49 (0.48, 0.50)		0.10 (0.10,0.11)	0.23 (0.23,0.23)	0.76 (0.74,0.77)
Intra-cluster correlation	0.80 (0.80,0.80)	0.80 (0.80,0.80)	0.86 (0.86,0.86)	0.83 (0.83,0.83)	0.86 (0.86,0.86)	0.86 (0.85,0.86)

CMS = Center for Medicaid and Medicare Services; VA = Veteran Affairs.

Our findings are also relevant given current trends in healthcare organization, delivery, and quality measurement. Dual use has increased significantly in the Veteran population since 2014, and it is projected to increase sharply with the recent launch of the Maintaining Internal Systems and Strengthening Integrated Outside Networks Act of 2018.[22] This law consolidated several previous community care programs, expanded the number of Veterans eligible to receive non-VHA community care, and added a new urgent care benefit for Veterans.[22] Concerns have been raised regarding medication safety and access among patients eligible for both VHA and other pharmacy benefits (e.g., Medicare Part D).[15,21−23] Given the aforementioned findings, it would be prudent to evaluate the impact of the Mission Act on access to statins and other prescription medications among minority Veterans, particularly medications that are high cost or have high copays. In addition, Healthcare Effectiveness Data and Information Set measures for statin prescribing, which are endorsed by the National Quality Forum and adopted by the VHA and other healthcare systems, do not adjust for race or place of residence.[24] Our current findings may provide insight for clinics and systems interested in improving overall quality of care and reducing disparities in statin prescribing.

Our study has several strengths including the large sample size and the use of both VHA and CMS prescription data, but there are some limitations. First, we were unable to identify why patients were not receiving statins (e.g., statin intolerance, cost). Second, we did not have data to evaluate the impact of out-of-pocket co-payments for statins on our findings. Lastly, we were not able to adjust for several relevant socioeconomic factors such as employment, education, and income.

In conclusion, compared with NHW-Urban Veterans, NHB-Urban, Hispanic-Rural, and other-race Veterans had lower odds of statin use; whereas NHW-Rural, NHB-Rural, and Hispanic-Urban Veterans had higher odds of statin use. Including markers of VHA care (i.e., disability and dual use) in our models impacted results among minority Veterans and our findings suggest that these individuals may be more likely to receive statin treatment when they have more interaction with the VHA system.

Author Contributions

The research idea was conceived by MG and DT. The analysis was done by KB, RW and MG. The first draft of the manuscript was prepared by EW. All coauthors participated substantially in the writing and critical review of the manuscript. All authors approved the final version of the submitted manuscript. Both KB and RW are joint second co-authors while both MG and DT are joint senior co-authors.

Disclosures

The authors report no potential conflicts of interest relevant to this article. This article represents the views of the authors and not those of the Medical University of South Carolina (MUSC) or Veteran Health Administration (VHA).

Supplementary materials

Supplementary material associated with this article can be found in the online version at https://doi.org/10.1016/j.amjcard.2020.02.027.

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