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Risk Factors for Low Pharmacy Refill Adherence among Older Hypertensive Men and Women by Race

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Abstract

Background: Sex-race stratification may lead to identification of risk factors for low antihypertensive medication adherence that are not apparent when assessing risk factors in women and men without race stratification. We examined risk factors associated with low pharmacy refill adherence across sex-race subgroups (white women, black women, white men, black men) within the Cohort Study of Medication Adherence among Older Adults (n=2,122).

Methods: Pharmacy refill adherence was calculated as proportion of days covered (PDC) using all antihypertensive prescriptions filled in the year prior to a baseline risk factor survey. Sex- and

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sex-race-stratified multivariable Poisson regression models with robust standard errors were used to estimate adjusted prevalence ratios and 95% confidence intervals for associations between participant characteristics and low adherence.

Results: Prevalence of low adherence was 22.9% versus 40.7% in white versus black women ($p<0.001$) and 26.3% versus 37.2% in white versus black men ($p=0.003$). In multivariable models, reducing antihypertensive medication due to cost was associated with low adherence within each sex-race subgroup. Additional factors associated with low adherence included shorter hypertension duration and comorbidities in white women; not being married and depressive symptoms in white men; and 6 primary care visits/year and complementary and alternative medicine use in black men. Among men, not being married and reporting depressive symptoms were associated with low adherence for whites, but not blacks.

Conclusions: Identification of sex-race-specific risk factors for low antihypertensive medication adherence may guide development and implementation of tailored interventions to increase antihypertensive medication adherence and blood pressure control among older patients.

Keywords

medication adherence; hypertension; risk factors; older adults; proportion of days covered (PDC)

Introduction

Hypertension is a leading cause of mortality and disease burden, and a major public health and clinical challenge affecting older adults.^{1–3} Despite advances in hypertension management and treatment, almost 30% of adults taking antihypertensive medication have uncontrolled blood pressure.^{1,4} Low adherence to antihypertensive medication is associated with poor blood pressure control in older adults,⁵ and higher rates of emergency room visits, hospitalizations, cardiovascular events and mortality.^{6–8} Understanding risk factors for low antihypertensive medication adherence may support development of personalized interventions to promote adherence and improve blood pressure control among older adults.

Sex and race differences in the prevalence of hypertension, blood pressure control, and antihypertensive medication adherence are well documented.^{1,5,9,10} A higher prevalence of hypertension and uncontrolled blood pressure has been reported among older women compared to older men, and among blacks compared to whites.^{1,2,11,12} Race differences in antihypertensive medication adherence mirror those for blood pressure control – antihypertensive medication adherence and blood pressure control are lower among blacks compared with whites.¹³ Studies reporting sex differences in pharmacy refill adherence among men and women are less consistent: some studies report similar prevalence of low pharmacy refill adherence in older men and women,^{5,14} while others report higher prevalence of low pharmacy refill adherence among older women compared to men.¹⁰ Furthermore, sex and race differences research has helped to uncover risk factors for low antihypertensive medication adherence that are sex- or race-specific. For example, Holt and colleagues found that reduced sexual functioning and high BMI were associated with low self-report antihypertensive medication adherence among older, hypertensive men but not women.⁹ In this case, sex stratification uncovered sex-specific risk factors for low

antihypertensive medication adherence that would not have otherwise been identified using a non-stratified approach.

The recent mandate from the NIH¹⁵ to include, where appropriate, assessment of sex differences together with the current era of personalized and precision medicine are powering efforts to examine sex and race differences. While growing recognition of the importance of sex and race differences in research and increasing number of sex-stratified and race-stratified assessments are promising, stratification by sex and race (e.g., white women, black women, white men, black men) may be necessary to identify risk factors for antihypertensive medication adherence that would not be identified in a sex- or race-stratified analysis alone. However, few studies have comprehensive risk factor data from a predominantly black and white patient population linked to patient-level pharmacy fill data and self-reported race to evaluate patterns across sex-race subgroups.

The Cohort Study of Medication Adherence among Older Adults (CoSMO) includes data from a comprehensive patient adherence risk factor survey linked to pharmacy fill and medical claims, and medical records in over 2,000 community-dwelling older black and white women and men with treated hypertension.⁵ We examined socio-demographic, clinical, psychosocial, behavioral, and health care factors^{5,16} associated with low pharmacy refill adherence in women, men and across four sex-race subgroups of CoSMO participants: white women, black women, white men, and black men. Sex-race stratification may lead to identification of risk factors that are not apparent when assessing risk factors in women and men without race stratification, which, in turn, may guide development and implementation of tailored interventions to increase antihypertensive medication adherence and blood pressure control among older patients.

Methods

Study Population, Study Design, and Data Collection

We conducted a cross-sectional analysis of baseline data from the Cohort Study of Medication Adherence among Older Adults (CoSMO). The CoSMO study design, participant baseline characteristics and response rates have been previously described.⁵ In brief, CoSMO enrolled 2,194 adults aged 65 years or older with essential hypertension from a large managed care organization in southeastern Louisiana. Recruitment and completion of baseline telephone interviews by participants occurred from August 21, 2006 to September 30, 2007. CoSMO was approved by Ochsner Clinic Foundation Institutional Review Board, and the privacy board of the managed care organization; participants provided verbal consent to participate in this minimal risk study. This analysis included 2,122 individuals with pharmacy fill data for antihypertensive medication at baseline and reporting black or white race. Data from a patient risk factor survey and pharmacy utilization and medical claims databases of the managed care organization were analyzed.⁵

Outcome: Pharmacy Refill Medication Adherence

Pharmacy refill adherence was calculated as proportion of days covered (PDC) using all antihypertensive prescriptions filled in the year prior to the baseline risk factor survey. PDC

was calculated as the number of days with medication available divided by the number of days between the first and last pharmacy fills in the one-year period. A PDC for each antihypertensive medication class was calculated for each participant and an overall PDC was calculated as the average across all antihypertensive medication classes. Low adherence was defined as PDC less than 0.80.⁷

Risk Factors for Low Antihypertensive Medication Adherence

Using a conceptual model as a guide,⁸ risk factors were assessed using a telephone-administered comprehensive participant risk factor survey.⁵

Socio-demographic and Clinical Risk Factors—Socio-demographic and clinical characteristics included sex, race, age, marital status, educational attainment, hypertension duration, weight and height. Body mass index (BMI) was calculated as weight (kg)/height (m²). Hypertension knowledge was assessed using a validated tool;¹⁷ participants with scores in the lowest tertile were categorized as having low hypertension knowledge.¹⁸ Comorbidities were identified from claims data and used to calculate the Charlson Comorbidity Index score, which was dichotomized as <2 versus ≥2.^{19,20} The number of classes of antihypertensive medications filled in the year prior to the baseline survey was obtained from a pharmacy utilization database and categorized as <3 classes versus ≥3 classes.⁵

Healthcare System Risk Factors—Participant satisfaction was assessed using three domains from the Group Health Association of America Consumer Satisfaction Survey: overall satisfaction, access to care and communication.²¹ Mean scores corresponding to a poor and fair rating were classified as not satisfied. Reducing antihypertensive medication due to cost was ascertained by asking participants if they had taken less high blood pressure medication than was prescribed because of the cost (yes vs no); and participant-reported number of visits to a primary care provider in the year prior to the baseline survey was categorized as <6 visits versus ≥6 visits.⁵

Psychosocial and Behavioral Risk Factors—Lifestyle behaviors included smoking status and weekly intake of alcoholic beverages.⁵ Presence of depressive symptoms was defined as a score ≥16 using the 20-item Center for Epidemiologic Studies Depression Scale.²² Low social support was defined as scores in the lowest tertile utilizing the RAND Medical Outcomes Study Social Support Survey,²³ and low coping was defined as scores below the median utilizing the shortened version of the John Henry Active Coping scale.²⁴ Perceived high stress was defined as a score in the highest tertile utilizing the Perceived Stress Scale.²⁵

Self-management Risk Factors—Self-management behaviors⁵ included the use of complementary and alternative medicines at least several times or on a regular basis in the year prior to the baseline interview (CAM; dichotomized as yes or no)²⁶ and the use of lifestyle modifications (i.e., salt reduction, fruit and vegetable consumption, exercise and weight management) to lower blood pressure.²⁷ The total number of lifestyle modifications was summed for each participant and dichotomized as <2 or ≥2.⁵

Statistical Analysis

Participant characteristics and prevalence of low antihypertensive medication adherence were calculated overall and within each sex-race subgroup. Within each sex, chi-square tests were used to determine the statistical significance of differences in participant characteristics by race. Bivariate associations of participant characteristics with low PDC adherence were assessed within sex and sex-race subgroups. Sex- and sex-race-stratified multivariable Poisson regression models with robust standard errors were used to estimate the adjusted prevalence ratios and 95% confidence intervals for associations between participant characteristics and low adherence. All variables were included simultaneously in the multivariable models, with the exception of stress (due to its collinearity with depressive symptoms) and the healthcare satisfaction domains related to communication and healthcare access (due to their collinearity with overall healthcare satisfaction). We tested for effect modification by race by including multiplicative interaction terms for each main effect (e.g., race * cost) in separate sex-stratified multivariable models. Interaction was tested at the $\alpha=0.05$ level of significance. Analyses were performed using Stata version 14.1 (StataCorp, College Station, TX). The figure was created using R 3.4.3 (R Foundation for Statistical Computing, Vienna, Austria).

Results

Of the 2,122 participants, 48.9% were 75 years old or older, 59.2% were women (37.3% white women, 21.9% black women), and 40.8% were men (31.9% white men, and 8.9% black men). Overall, 29.1% of the study population had low antihypertensive medication adherence (Table 1). The prevalence of low adherence differed between whites and blacks (24.4% and 39.7%, respectively, $p<0.001$), but not between men and women (28.6% and 29.5%, respectively, $p=0.682$).

Black women were more likely to have low adherence compared to white women (Table 1; 40.7% and 22.9%, respectively, $p<0.001$). Compared to black women, white women were older and were *more likely* to have had hypertension for less than ten years, to be taking fewer than three classes of antihypertensive medications, and to consume two or more alcoholic beverages per week. Also, white women were *less likely* to be unmarried, have less than a high school education, have low hypertension knowledge, have two or more comorbidities, have a high BMI, indicate that they were not satisfied with their healthcare, reduce antihypertensive medications due to cost, have low social support, have high stress and report two or more lifestyle modifications for blood pressure management than black women.

The prevalence of low antihypertensive medication adherence associated with participant characteristics, among women overall and for white women and black women, separately, is presented in Table 2. In the multivariable-adjusted model for all women (Table 3), hypertension duration less than ten years, having a comorbidity score ≥ 2 , taking fewer than 3 classes of antihypertensive medications, reducing medications due to cost, depressive symptoms, and being black were associated with low adherence. Among white women, reporting hypertension duration less than ten years (PR = 1.40; 95% CI: 1.06, 1.83; $p=0.016$), having a comorbidity score ≥ 2 (prevalence ratio (PR) = 1.49; 95% CI: 1.13, 1.97;

p=0.004), and reducing medications due to cost (PR = 2.31; 95% CI: 1.58, 3.39; p<0.001) were associated with low adherence (Table 3). For black women, only reducing antihypertensive medications due to cost (PR = 2.10; 95% CI: 1.62, 2.73; p<0.001) was associated with low adherence (Table 3). Among women, there was no effect modification by race for any participant characteristic (p-values for all interactions >0.05).

The prevalence of low antihypertensive medication adherence was higher among black men than white men (Table 1; 37.2% versus 26.3%, respectively, p=0.003). Compared to black men, white men were *more likely* to be 75 years or older, be taking fewer than three classes of antihypertensive medication, and consume two or more alcoholic beverages per week. White men were *less likely* than black men to have less than a high school education, have low hypertension knowledge, reduce medications due to cost, report depressive symptoms, and engage in two or more lifestyle modifications for blood pressure control.

The prevalence of low antihypertensive medication adherence associated with participant characteristics, among men overall and for white men and black men, separately, is presented in Table 4. In the multivariable-adjusted model for men overall (Table 5), reducing medications due to cost was associated with low adherence. In the sex-race subgroup models, not being married (PR = 1.36; 95% CI: 1.00, 1.85; p=0.047), reducing antihypertensive medication due to cost (PR = 2.23; 95% CI: 1.44, 3.44; p<0.001), and experiencing depressive symptoms (PR = 1.63; 95% CI: 1.14, 2.34; p=0.007) were associated with low adherence among white men. In black men, reducing antihypertensive medications due to cost (PR = 1.68; 95% CI: 1.05, 2.67; p=0.030), reporting six or more primary care visits in the last year (PR = 1.54; 95% CI: 1.04, 2.28; p=0.032), and complementary and alternative medicine use (PR = 1.73; 95% CI: 1.15, 2.60; p=0.009) were associated with low adherence. Among men, not being married and having depressive symptoms had a different effect on low adherence among white men compared to black (p-values for the interactions were 0.038 and 0.004, respectively; Figure 1).

Discussion

In this study, we identified socio-demographic, clinical, psychosocial, behavioral, self-management, and health care system risk factors associated with low pharmacy refill medication adherence in adults with essential hypertension by sex and within sex-race subgroups. The prevalence of low antihypertensive medication adherence was higher among blacks versus whites, overall and when stratified by sex. No sex differences in the prevalence of low adherence were identified. While *reducing medications due to cost* was associated with low antihypertensive medication adherence across sex-stratified and sex-race-stratified analyses, other risk factors were identified only after sex-race stratification. Furthermore, statistically significant interactions by race among older men revealed important distinctions in black and white men regarding the association between low adherence and not being married, and between low adherence and having depressive symptoms. This study extends prior research by evaluating a comprehensive set of risk factors linked to an objective measure of medication adherence in women and men and stratifying by four sex-race groups. These results may provide insight into sex-race-specific risk factors for low antihypertensive medication adherence in older women and men and lead to development of

personalized strategies to address low adherence and improve blood pressure control in older patients.

Risk factors associated with Low Pharmacy Refill Adherence across sex-stratified and sex-race subgroup analyses

Consistent with previous studies,^{28,29} reducing medications due to cost, a modifiable risk factor, was associated with low PDC adherence in both men and women, and across sex-race subgroups. While the overall percentage of participants who reported reducing their medications due to cost was low (only 3.6% of participants), the association was strong, signaling that targeted medication cost reduction interventions could produce substantial benefits for a subset of patients for whom cost is a barrier. Cost-related underuse of medications for older adults with chronic disease is associated with health care coverage factors (increasing out of pocket costs and inadequate prescription coverage) as well as the quality of the physician - patient relationship.^{29,30} A survey of Medicare Beneficiaries found that 39% of seniors who reported cost-related non-adherence had not talked with their physicians about this barrier.³⁰ While deficiencies in health care coverage for medications are amenable to changes at the policy level, there may also be opportunities for healthcare providers to address cost-related nonadherence by addressing this barrier during clinic visits and prescribing lower cost (e.g., generic) medications as appropriate.

In our study, blacks reported higher prevalence of cost-related nonadherence than whites. Similarly, Gellad and colleagues (2007) found that issues related to medication affordability were more prevalent among blacks than whites³¹ and in a focus group study, Holt and colleagues found that black participants elaborated on cost issues more than white participants.³² Thus, special attention to medication cost barriers among black patients may be warranted.

Risk Factors associated with Low Pharmacy Refill Adherence for women

Among all women, having shorter duration of hypertension, having more comorbidities, taking fewer classes of antihypertensive medications, and reporting depressive symptoms were associated with low antihypertensive medication adherence. These results are consistent with previous reports.^{6,33–36} Furthermore, sex-race stratification revealed that the associations between comorbidities and low antihypertensive medication adherence, and shorter hypertension duration and antihypertensive medication adherence found among all women were driven primarily by white women. While neither number of comorbidities nor duration of hypertension is “modifiable” in the context of a healthcare encounter, considering these risk factors may help providers to identify patients at risk for low antihypertensive medication adherence.

The associations between taking three or more classes of antihypertensive medications and low medication adherence, and reporting depressive symptoms and low adherence that were detected among all women were no longer significant when the analysis was stratified by sex-race. Because the magnitude of these effects were similar for white women and black women, sex-race stratification decreased the sample size and thus reduced the statistical power to detect a difference in prevalence of low adherence between those with and without

these risk factors. In the case of depressive symptoms, for example, the prevalence ratios for white women and black women were nearly identical to the prevalence ratio for all women, but the decreased sample size produced larger confidence intervals spanning 1. Thus, for women, evaluating both sex- and sex-race stratification revealed important information about risk factors for low antihypertensive medication adherence.

Risk Factors associated with Low Pharmacy Refill Adherence for men

While only *reduction in medications due to cost* was associated with low medication adherence in the overall model for men, further stratification by race revealed risk factors unique to white or black men. Depressive symptoms were associated with low adherence among white men; however, this risk factor had a non-significant protective effect for black men (p-value for interaction = 0.004). While previous research documented an overall association between depression and nonadherence in non-stratified analyses,^{37,38} and an association between depression and nonadherence among women in sex-stratified analyses,⁹ our finding may provide new insights on sex-race differences. It is possible that aggregating white and black men in a single model obscures an association between depressive symptoms and low antihypertensive medication adherence for white men. Further research is needed to explain this race difference, and to demonstrate whether interventions to address depressive symptoms can improve antihypertensive medication adherence and blood pressure control among older men with comorbid depression and hypertension.

Race also modified the effect of marriage on low antihypertensive medication adherence among men. Specifically, not being married was associated with low medication adherence among white men only (p-value for interaction term = 0.038). The finding for white men is consistent with studies that have reported marriage or spousal support as a protective factor for low medication adherence, poor cardiovascular outcomes, and increased mortality among elderly men.^{39,40} Having a spouse may discourage unhealthy lifestyle behaviors, such as alcohol consumption, smoking, or substance abuse, or may provide practical support for remembering doctor appointments, pharmacy visits, previous medical history, and assisting with maintaining medication adherence.^{39,41} While marital status is not modifiable in the context of a medical encounter, it may serve to flag hypertensive patients at risk for low adherence. We were unable to assess the impact of marital quality on low adherence in black or white men. Recent studies have identified marital quality as a determinant of cardiovascular health outcomes, antihypertensive medication adherence and blood pressure control,⁴² with some health benefits of high relationship quality unique to blacks.⁴³ Future research is needed regarding marital quality and its influence on health behaviors and antihypertensive medication adherence in men with hypertension.

The current study also found a statistically significant association between having six or more visits to a primary physician in the prior year and low antihypertensive medication adherence only among black men. It is possible that those with lower adherence have poorly controlled disease and worse health, requiring them to visit a physician more often.⁴⁴ Further research is needed to understand this race difference.

The association between CAM use and low antihypertensive medication adherence, which was specific to black men, is consistent with previous research related to race differences in

the use of CAM. Previous studies have reported high prevalence of CAM use among blacks,^{45,46} and in our study, black men reported higher prevalence of CAM use compared to white men (the difference was marginally significant). Using data from the current cohort, Krousel-Wood and colleagues demonstrated that black participants were more likely than their white counterparts to have low adherence to antihypertensive medications when reporting CAM use.⁴⁶ It is possible that the difference in the association between CAM use and low adherence between blacks and whites can be explained by race differences in the types of CAM used and whether it is used as a complement or an alternative to antihypertensive medication. This was beyond the scope of the current analysis and should be the focus of future research. Our analysis extends previous findings by demonstrating that the race difference in the association between CAM use and low antihypertensive medication adherence was present only among men and highlights an opportunity for providers to communicate with men about their CAM use and any trade-offs with respect to antihypertensive medication adherence.

Added value of sex-race subgroup analysis

Our results among women demonstrate that sex-race stratification can clarify the effect of race on associations between risk factors and low antihypertensive medication adherence identified in sex-stratified analyses. Furthermore, sex-race stratification may uncover risk factors that are not identified in analyses stratified by race or sex alone, as we found in men. Both of these functions enhance our ability to identify those at risk for low medication adherence and develop interventions targeting relevant risk factors for low antihypertensive medication adherence. In addition, sex-race stratification can aid reproducibility of results: inconsistent results in prevalence rates and determinants of low adherence seen across previous studies may be due to differences in the sex-race distribution of participants.

Limitations and Strengths

The findings should be considered in light of the study limitations. The cross-sectional and observational nature of the study does not allow for causal inferences. Although the study included a relatively large sample of elderly black and white participants, the number of black male participants (n=188) was low compared to other sex-race subgroups, which could limit the statistical power of the study to detect significant associations for this subgroup; future studies including larger sample sizes for subgroup analyses are needed to confirm the findings. Pharmacy refill is an indirect measure of adherence and we cannot confirm that the medications were actually taken correctly by patients; however, prior research has found that pharmacy refill adherence is associated with blood pressure control and outcomes.⁴⁷ Further, some of the patients may have filled prescriptions outside of the managed care organization's database and these claims data may not have been included in the analysis. In addition, the inclusion of English-speaking community-dwelling older adults in a managed care organization from one geographical area may not be generalizable to all patients with hypertension. While the factors identified in these analyses can be used as markers for low antihypertensive medication adherence, further research is needed to determine whether or not changes in modifiable risk factors associated with low adherence lead to improved adherence and better blood pressure control.

This study has several strengths, including a diverse sample of black and white participants with respect to socio-demographic characteristics and the presence of cardiovascular risk factors. Antihypertensive medication adherence was assessed using an objective measure of PDC, which has been correlated to blood pressure control and cardiovascular disease outcomes.^{47,48} We were able to link comprehensive participant risk factor survey data to pharmacy refill adherence and medical claims. The restriction of the study sample to older adults in a managed care setting minimizes the confounding effects of health insurance, access to care, and employment status in the older adult population. Finally, because hypertension is a prevalent disease in older adults, the results of this study may be useful in the management of a substantial portion of the elderly, insured population with hypertension.

Conclusion

Differences in prevalence of and risk factors associated with low pharmacy refill adherence were identified across four sex-race subgroups of CoSMO participants. This study extends prior research by highlighting sex-race differences not identified when looking at sex or race alone and by providing insights on the effect of race on associations between low adherence and risk factors identified in sex-stratified analysis. It is possible that these differences may underlie inconsistencies in adherence research results among women versus men. The identification of risk factor differences in sex-race groups may inform future clinical studies and personalized precision health care aimed at improving antihypertensive medication adherence and blood pressure control.

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Figure 1:

Prevalence Ratios for Low Antihypertensive Medication Adherence among White and Black Men for Depressive Symptoms and Marital Status

Model adjusted for age, education, hypertension knowledge, hypertension duration, comorbidities, body mass index, number of classes by antihypertensive medications, healthcare satisfaction, reduction in medications due to cost, number of visits to primary physician in past year, smoking status, alcohol use, social support, coping, complementary and alternative medicine use, and adoption of healthy lifestyle modifications

Table 1.

Characteristics of CoSMO Study Participants, Overall and in Sex-Race Sub-groups

		Women			Men		
	Overall (n=2,122) n (%)	White (n=792) n (%)	Black (n=464) n (%)	p- value	White (n=678) n (%)	Black (n=188) n (%)	p- value
Socio-Demographic Factors							
Age ≥ 75 years	1038 (48.9)	425 (53.7)	205 (44.2)	0.001	333 (49.1)	75 (39.9)	0.025
Not married	920 (43.4)	422 (53.3)	303 (65.3)	<0.001	147 (21.7)	48 (25.5)	0.263
Less than high school education	439 (20.7)	120 (15.2)	155 (33.5)	<0.001	78 (11.5)	86 (45.7)	<0.001
Low HTN knowledge	680 (32.1)	220 (27.8)	178 (38.4)	<0.001	200 (29.5)	82 (43.6)	<0.001
Clinical Factors							
HTN duration < 10 years	779 (36.9)	332 (42.2)	148 (32.0)	<0.001	235 (34.7)	64 (34.0)	0.864
CCI score ≥ 2 ^a	1050 (49.5)	328 (41.4)	237 (51.2)	0.001	375 (55.4)	110 (58.5)	0.446
BMI ≥ 25 kg/m ²	1625 (76.7)	534 (67.5)	398 (86.0)	<0.001	535 (78.9)	158 (84.0)	0.119
<3 classes of anti-HTN medications ^a	1180 (55.6)	469 (59.2)	238 (51.3)	0.006	389 (57.4)	84 (44.7)	0.002
Health Care System Factors							
Not satisfied with overall healthcare	98 (4.6)	29 (3.7)	30 (6.5)	0.023	28 (4.1)	11 (5.9)	0.316
Not satisfied with healthcare communication	225 (10.6)	85 (10.8)	53 (11.5)	0.707	62 (9.1)	25 (8.4)	0.089
Not satisfied with access to healthcare	96 (4.5)	31 (3.9)	24 (5.2)	0.293	28 (4.1)	13 (6.9)	0.112
Reduced medications due to cost	77 (3.6)	15 (1.9)	32 (6.9)	<0.001	19 (2.8)	11 (5.9)	0.043
6+ visits to primary care physician ^a	483 (22.8)	165 (20.9)	111 (24.0)	0.211	162 (23.9)	45 (23.9)	0.998
Psychosocial/Behavioral Factors							
Current or former smoker	1068 (50.7)	326 (41.5)	168 (36.5)	0.084	453 (67.2)	121 (65.1)	0.580
≥ 2 alcoholic beverages per week	446 (21.1)	135 (17.1)	27 (5.8)	<0.001	243 (36.1)	41 (22.0)	<0.001
Depressive symptoms	276 (13.0)	113 (14.3)	72 (15.5)	0.546	61 (9.0)	30 (16.0)	0.006
Low social support	719 (33.9)	265 (33.5)	190 (41.0)	0.008	201 (29.7)	63 (33.5)	0.308
Low coping	1007 (47.5)	383 (48.4)	227 (48.9)	0.863	302 (44.5)	95 (50.5)	0.145
High stress	718 (33.8)	273 (34.5)	195 (42.0)	0.008	188 (27.7)	62 (33.0)	0.160
Self-Management Behaviors							
Complementary and alternative medicine	560 (26.4)	197 (24.9)	139 (30.0)	0.050	166 (24.5)	58 (30.9)	0.078

		Women			Men		
	Overall (n=2,122) n (%)	White (n=792) n (%)	Black (n=464) n (%)	p- value	White (n=678) n (%)	Black (n=188) n (%)	p- value
2 lifestyle modifications	1736 (81.8)	630 (79.6)	417 (89.9)	<0.001	523 (77.1)	166 (88.3)	<0.001
Medication Adherence							
Low proportion of days covered	618 (29.1)	181 (22.9)	189 (40.7)	<0.001	178 (26.3)	70 (37.2)	0.003

^a in the prior year

CCI – Charlson Comorbidity Index; BMI – Body Mass Index; HTN – hypertension; CoSMO-Cohort Study of Medication Adherence among Older Adults

Statistically significant results are indicated by bold text

Table 2.

Prevalence of Low Pharmacy Refill Antihypertensive Medication Adherence Associated with Participant Characteristics among CoSMO Women, Overall and by Race

	All women (n=1256)		White women (n=792)		Black women (n=464)	
	% with low PDC	p- value	% with low PDC	p- value	% with low PDC	p- value
Socio-Demographic Factors						
Age ≥ 75 years	29.5	0.959	22.6	0.848	43.9	0.216
Age <75 years	29.4		23.2		38.2	
Not married	31.2	0.120	23.2	0.792	42.2	0.363
Married	27.1		22.4		37.9	
<High school graduate	37.5	0.001	25.8	0.399	46.5	0.080
High school graduate	27.2		22.3		38.0	
Clinical Factors						
Low HTN knowledge	33.7	0.026	22.7	0.958	47.2	0.026
Not low HTN knowledge	27.5		22.9		36.7	
HTN duration <10 years	32.7	0.042	27.7	0.004	43.9	0.353
HTN duration ≥ 10 years	27.3		18.9		39.4	
CCI score ≥ 2 ^a	34.9	<0.001	28.1	0.003	44.3	0.118
CCI score <2 ^a	25.1		19.2		37.2	
BMI ≥ 25 kg/m ²	30.9	0.051	24.0	0.294	40.2	0.662
BMI <25 kg/m ²	25.2		20.6		43.1	
<3 classes of anti-HTN medications ^a	31.1	0.143	25.0	0.091	43.3	0.252
3+ classes of anti-HTN medications ^a	27.3		19.8		38.1	
Health Care System Factors						
Not satisfied with overall healthcare	44.1	0.012	41.4	0.015	46.7	0.501
Satisfied with overall healthcare	28.8		22.2		40.4	
Not satisfied with healthcare communication	34.1	0.216	28.2	0.216	43.4	0.685
Satisfied with healthcare communication	29.0		22.3		40.5	
Not satisfied with access to healthcare	30.9	0.809	32.3	0.203	29.2	0.236
Satisfied with access to healthcare	29.4		22.5		41.4	
Reduced medications due to cost	76.6	<0.001	66.7	<0.001	81.3	<0.001
Did not reduce medications due to cost	27.7		22.0		37.7	
6+ visits to primary care physician ^a	34.4	0.039	28.5	0.052	43.2	0.516
<6 visits to primary care physician ^a	28.0		21.4		39.8	
Psychosocial/Behavioral Factors						
Current or former smoker	28.7	0.693	21.2	0.404	43.5	0.393
Never smoker	29.8		23.7		39.4	

	All women (n=1256)		White women (n=792)		Black women (n=464)	
	% with low PDC	p- value	% with low PDC	p- value	% with low PDC	p- value
2 alcoholic beverages per week	22.2	0.031	21.5	0.698	25.9	0.105
<2 alcoholic beverages per week	30.5		23.0		41.7	
Depressive symptoms	38.9	0.002	30.1	0.048	52.8	0.024
No depressive symptoms	27.8		21.7		38.5	
Low social support	33.2	0.029	26.4	0.091	42.6	0.488
Medium/high social support	27.3		21.1		39.4	
Low coping	28.4	0.397	20.9	0.196	41.0	0.919
Medium/high coping	30.5		24.8		40.5	
High stress	31.6	0.195	24.2	0.520	42.1	0.623
Low/medium stress	28.2		22.2		39.8	
Self-management Behaviors						
Complementary and alternative medicine use	35.4	0.005	26.9	0.118	47.5	0.053
No complementary and alternative medicine use	27.3		21.5		37.9	
2 lifestyle modifications	30.1	0.275	23.3	0.526	40.3	0.561
<2 lifestyle modifications	26.3		21.0		44.7	

^a in the prior year

CCI – Charlson Comorbidity Index; BMI – Body Mass Index; HTN – hypertension; pharmacy fill - Proportion of Days Covered (PDC); CoSMO – Cohort Study of Medication Adherence among Older Adults

Statistically significant results are indicated by bold text

Table 3.

Multivariable-Adjusted Prevalence Ratios for Low Pharmacy Refill Antihypertensive Medication Adherence among CoSMO Women, Overall and for Black and White Women Separately

	All women (n=1228) PR (95% CI)	White women (n=775) PR (95% CI)	Black women (n=453) PR (95% CI)
Age 75 years	1.10 (0.92, 1.33)	1.08 (0.81, 1.43)	1.14 (0.90, 1.44)
Not married	1.03 (0.86, 1.23)	1.03 (0.78, 1.35)	1.04 (0.82, 1.32)
Less than high school education	1.16 (0.96, 1.41)	1.13 (0.80, 1.60)	1.16 (0.92, 1.45)
Low HTN knowledge	1.07 (0.89, 1.29)	0.92 (0.67, 1.26)	1.19 (0.94, 1.50)
HTN duration <10 years	1.28 (1.08, 1.53) **	1.40 (1.06, 1.83) *	1.14 (0.90, 1.44)
CCI score 2	1.30 (1.09, 1.56) **	1.49 (1.13, 1.97) **	1.15 (0.90, 1.45)
BMI 25 kg/m ²	1.09 (0.88, 1.36)	1.15 (0.86, 1.55)	1.01 (0.74, 1.38)
<3 classes of anti-HTN medications	1.26 (1.05, 1.50) *	1.31 (0.98, 1.74)	1.19 (0.94, 1.49)
Not satisfied with overall healthcare	1.11 (0.80, 1.54)	1.52 (0.92, 2.51)	0.94 (0.62, 1.40)
Reduced medications due to cost	2.18 (1.77, 2.68) ***	2.31 (1.58, 3.39) ***	2.10 (1.62, 2.73) ***
6+ visits to primary care physician	1.06 (0.87, 1.29)	1.24 (0.93, 1.66)	0.93 (0.71, 1.20)
Current or former smoker	0.99 (0.83, 1.17)	0.85 (0.65, 1.11)	1.13 (0.90, 1.41)
2 alcoholic beverages per week	0.97 (0.72, 1.32)	1.08 (0.75, 1.54)	0.77 (0.42, 1.40)
Depressive symptoms	1.25 (1.01, 1.55) *	1.26 (0.90, 1.76)	1.25 (0.96, 1.63)
Low social support	1.08 (0.91, 1.28)	1.16 (0.89, 1.52)	1.02 (0.82, 1.27)
Low coping	0.85 (0.72, 1.01)	0.79 (0.61, 1.04)	0.92 (0.74, 1.15)
Complementary and alternative medicine use	1.19 (0.99, 1.43)	1.14 (0.85, 1.53)	1.20 (0.96, 1.52)
2 lifestyle modifications	1.09 (0.85, 1.41)	1.14 (0.81, 1.61)	1.03 (0.71, 1.48)
Black	1.62 (1.35, 1.95) ***	--	--

CCI – Charlson Comorbidity Index; BMI – Body Mass Index; HTN – hypertension; PR – prevalence ratio; CI – confidence interval; CoSMO – Cohort Study of Medication Adherence among Older Adults

Statistically significant results are indicated by bold text

*
p<0.05,

**
p<0.01,

p<0.001

Table 4.

Prevalence of Low Pharmacy Refill Antihypertensive Medication Adherence Associated with Participant Characteristics among CoSMO Men, Overall and by Race

	All men (n=866)		White men (n=678)		Black men (n=188)	
	% with low PDC	p-value	% with low PDC	p-value	% with low PDC	p-value
Socio-Demographics and Patient Characteristics						
Age ≥75 years	27.9	0.669	27.0	0.653	32.0	0.227
Age <75 years	29.3		25.5		40.7	
Not married	33.3	0.099	33.3	0.028	33.3	0.517
Married	27.3		24.3		38.6	
<High school graduate	35.4	0.034	32.1	0.216	38.4	0.767
High school graduate	27.1		25.5		36.3	
Clinical/Treatment Variables						
Low HTN knowledge	29.8	0.603	28.0	0.504	34.2	0.441
Not low HTN knowledge	28.1		25.5		39.6	
HTN duration <10 years	27.8	0.706	24.7	0.527	39.1	0.709
HTN duration ≥10 years	29.0		26.9		36.3	
CCI score ≥2 ^a	30.7	0.132	28.8	0.099	37.3	0.990
CCI score <2 ^a	26.1		23.2		37.2	
BMI ≥25 kg/m ²	28.3	0.644	25.4	0.340	38.0	0.630
BMI <25 kg/m ²	30.1		29.4		33.3	
<3 classes of anti-HTN medications ^a	28.5	0.945	26.7	0.741	36.9	0.933
3+ classes of anti-HTN medications ^a	28.8		25.6		37.5	
Health Care System Variables						
Not satisfied with overall healthcare	38.5	0.166	32.1	0.473	54.6	0.221
Satisfied with overall healthcare	28.2		26.0		36.2	
Not satisfied with healthcare communication	33.3	0.298	30.7	0.410	40.0	0.730
Satisfied with healthcare communication	28.0		25.8		36.4	
Not satisfied with access to healthcare	34.2	0.424	28.6	0.776	46.2	0.490
Satisfied with access to healthcare	28.4		26.2		36.6	
Reduced medications due to cost	60.0	<0.001	57.9	0.001	63.6	0.062
Did not reduce medications due to cost	27.5		25.3		35.6	
6+ visits to primary care physician ^a	32.4	0.178	28.4	0.486	46.7	0.133
<6 visits to primary care physician ^a	27.5		25.6		34.3	
Psychosocial/Behavioral Variables						
Current or former smoker	28.6	0.939	26.3	0.895	37.2	0.971
Never smoker	28.3		25.8		36.9	

	All men (n=866)		White men (n=678)		Black men (n=188)	
	% with low PDC	p-value	% with low PDC	p-value	% with low PDC	p-value
2 alcoholic beverages per week	26.8	0.431	25.1	0.702	36.6	0.875
<2 alcoholic beverages per week	29.3		26.5		37.9	
Depressive symptoms	39.6	0.015	44.3	0.001	30.0	0.371
No depressive symptoms	27.4		24.5		38.6	
Low social support	30.3	0.473	27.4	0.670	39.7	0.622
Medium/high social support	27.9		25.8		36.0	
Low coping	30.7	0.210	28.5	0.238	37.9	0.850
Medium/high coping	26.9		24.5		36.6	
High stress	31.6	0.219	28.7	0.365	40.3	0.539
Low/medium stress	27.4		25.3		35.7	
Hypertension Management Behaviors						
Complementary and alternative medicine use	32.1	0.178	27.1	0.773	46.6	0.078
No complementary and alternative medicine use	27.4		26.0		33.1	
2 lifestyle modifications	28.6	0.954	26.2	0.949	36.1	0.396
<2 lifestyle modifications	28.8		26.5		45.5	

^a in the prior year

CCI – Charlson Comorbidity Index; BMI – Body Mass Index; HTN – hypertension; CoSMO – Cohort Study of Medication Adherence among Older Adults

Statistically significant results are indicated by bold text

Table 5:

Multivariable-Adjusted Prevalence Ratios for Low Antihypertensive Pharmacy Refill Medication Adherence among CoSMO Men, Overall and for Black and White Men Separately

	All men (n=850) PR (95% CI)	White men (n=666) PR (95% CI)	Black men (n=184) PR (95% CI)
Age ≥ 75 years	0.92 (0.73, 1.15)	1.00 (0.76, 1.31)	0.78 (0.52, 1.18)
Not married ^a	1.16 (0.90, 1.51)	1.36 (1.00, 1.85) *	0.79 (0.48, 1.29)
Less than high school education	1.18 (0.90, 1.54)	1.24 (0.87, 1.76)	1.27 (0.84, 1.92)
Low HTN knowledge	0.96 (0.76, 1.22)	0.98 (0.74, 1.31)	0.89 (0.60, 1.31)
HTN duration <10 years	0.96 (0.76, 1.21)	0.94 (0.71, 1.25)	1.05 (0.70, 1.58)
CCI score ≥ 2	1.11 (0.87, 1.40)	1.19 (0.90, 1.59)	1.03 (0.67, 1.59)
BMI ≥ 25 kg/m ²	0.95 (0.72, 1.25)	0.87 (0.64, 1.18)	1.37 (0.76, 2.49)
<3 classes of anti-HTN medications	1.12 (0.90, 1.40)	1.13 (0.87, 1.47)	1.19 (0.77, 1.86)
Not satisfied with overall healthcare	1.14 (0.76, 1.71)	0.95 (0.56, 1.64)	1.46 (0.83, 2.58)
Reduced medications due to cost	1.93 (1.36, 2.74) ***	2.23 (1.44, 3.44) ***	1.68 (1.05, 2.67) *
6+ visits to primary care physician	1.14 (0.90, 1.46)	1.02 (0.75, 1.38)	1.54 (1.04, 2.28) *
Current or former smoker	0.98 (0.78, 1.24)	0.93 (0.70, 1.24)	1.09 (0.74, 1.62)
≥ 2 alcoholic beverages per week	0.98 (0.77, 1.24)	1.02 (0.77, 1.34)	0.81 (0.50, 1.30)
Depressive symptoms ^b	1.16 (0.84, 1.61)	1.63 (1.14, 2.34) **	0.58 (0.30, 1.10)
Low social support	1.00 (0.78, 1.27)	0.91 (0.68, 1.23)	1.19 (0.81, 1.76)
Low coping	1.12 (0.89, 1.39)	1.11 (0.85, 1.44)	1.10 (0.75, 1.62)
Complementary and alternative medicine use	1.13 (0.90, 1.43)	1.01 (0.76, 1.35)	1.73 (1.15, 2.60) **
≥ 2 lifestyle modifications	0.96 (0.72, 1.27)	1.02 (0.74, 1.42)	0.71 (0.39, 1.30)
Black	1.29 (1.00, 1.67)	--	--

^a p-value for not married-by-race interaction in overall model = 0.038

^b p-value for depressive symptoms-by-race interaction in overall model = 0.004

CCI – Charlson Comorbidity Index; BMI – Body Mass Index; HTN – hypertension; PR – prevalence ratio; CI – confidence interval; CoSMO – Cohort Study of Medication Adherence among Older Adults

Statistically significant results are indicated by bold text

* p<0.05,

** p<0.01,

*** p<0.001