Published in final edited form as:

Ann Epidemiol. 2011 March ; 21(3): 149–155.

Are statin medications associated with lower urinary tract symptoms in men and women? Results from the Boston Area Community Health (BACH) Survey

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Abstract

PURPOSE—Statins may ameliorate lower urinary tract symptoms (LUTS) through anti-inflammatory or other pathways. We investigated the association between statin use and storage, voiding, and overall LUTS symptoms.

METHODS—The Boston Area Community Health Survey is an epidemiologic study of Boston, MA residents (2301 men; 3202 women) aged 30–79. LUTS, voiding and storage symptoms were ascertained through an interviewer-administered questionnaire and defined as scores of ≥ 8 , ≥ 5 , and ≥ 4 , respectively, on relevant components of the American Urologic Association Symptom Index. Participants were included if they had a history of provider-diagnosed high cholesterol or recently used statin medications (N=1,346). Associations were estimated using odds ratios (ORs) and 95% confidence intervals from multivariate logistic regression.

RESULTS—In multivariate models, statin use had no association with LUTS (OR=1.03, 95% CI: 0.70, 1.51) among women. No associations were observed for any LUTS among younger (<60) men, but among older (60+) men, we observed significant inverse associations for voiding (OR=0.23, 95% CI: 0.08, 0.66), storage (OR=0.24, 95% CI: 0.11, 0.56) and overall LUTS (OR=0.15, 95% CI: 0.05, 0.44).

CONCLUSIONS—Our results suggest that use of statins is associated with a lower prevalence of urologic symptoms among older men but not among women or younger men.

MESH Keywords

urination disorders; statins; HMG-CoA; epidemiology

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INTRODUCTION

Lipid regulators including statins were the most widely-sold prescription drugs in the U.S. in 2006, and are indicated for long-term use.[1,2] As such, their physiologic effects beyond their stated indication deserve research attention. Statins are hypothesized to improve kidney function and to slow the progression of chronic kidney disease as reflected in ongoing clinical trials, such as the Lipid-lowering and Onset of Renal Disease Trial.[3] The beneficial effects of statins may be through lipid-lowering or directly through anti-inflammatory effects on the kidney.[3] An anti-inflammatory pathway is also of interest in the pathophysiology of lower urinary tract symptoms (LUTS).[4] Statins are hypothesized to affect smooth muscle,[5] which could have beneficial effects on bladder fibrosis[6] and improve blood flow to the bladder.[7] In the Boston Area Community Health (BACH) Survey, we observed a strong inverse association (OR=0.24, 95% CI: 0.08, 0.76) among women for painful bladder syndrome among users of statins vs. non-users.[8] Atorvastatin and symptoms of LUTS have been examined among men in a clinical trial, but use was not found to improve existing lower urinary tract symptoms considering the International Prostate Symptom Score (IPSS), and did not improve other outcomes related to benign prostatic hyperplasia.[9] To our knowledge, the relationship between statin medications and LUTS has not previously been considered in women. In this analysis, our objectives were to consider the symptomatic experience of LUTS among those on lipid-lowering treatments (compared to those with a history of high cholesterol, not currently drug-treated) in a population-based epidemiologic study of men and women, with separate considerations of voiding and storage symptoms.

MATERIALS AND METHODS

Study design and data collection

The BACH Survey is supported by the U.S. National Institutes of Health (National Institute of Diabetes and Digestive and Kidney Diseases) and is a population-based, epidemiologic cohort study conducted among 5,503 men and women aged 30 to 79 residing in Boston, Massachusetts. A multistage, stratified cluster sampling design was used to recruit approximately equal numbers of persons in pre-specified groups defined according to age (30 to 39, 40 to 49, 50 to 59, 60 to 79), race and ethnic groups (black, Hispanic, white) and gender. This analysis was cross-sectional using baseline data collected between April 2002 and June 2005 during a two-hour, in-person interview conducted by a trained, bilingual interviewer after acquisition of written informed consent. Interviews for 63.3% of eligible persons were completed, with a resulting study population of 2301 men and 3202 women comprised of 1767 black participants, 1877 Hispanic participants and 1859 white participants. A non-fasting venous blood sample (20 ml) was collected as close to awakening as possible. All protocols and procedures were approved by the Institutional Review Board of New England Research Institutes. Further details of the study design and procedures are available.[10]

Urologic symptoms and cholesterol measures

LUTS were defined using the American Urologic Association (AUA) Symptom Index (equivalent to the IPSS scale) that measures seven urologic symptoms.[11] Higher scores indicate more symptoms (score range 0–35). We defined the presence of LUTS as a score of 8 or more, corresponding to the presence of moderate to severe symptoms, with further stratification by voiding (obstructive) symptoms and storage (irritative) symptoms. Consistent with a prior study,[12] our operational definition for the presence of storage symptoms was a score of 4 or higher (possible range 0–15) for the three relevant questions (frequency, urgency, nocturia). This cutpoint corresponds with the convention of using 8+

on the full LUTS scale to indicate “moderate and higher”. A subscale of voiding symptoms was created from the four symptom-specific questions (possible range 0–20) for questions related to incomplete emptying, intermittency, weak stream, and hesitancy, with a cutpoint of 5 or higher to create a dichotomous variable to indicate the presence of “moderate and higher” voiding symptoms.

To date, cholesterol measurements in the BACH Survey have been conducted on 1,899 (82.5%) of 2,301 men who donated a blood sample, but measurements are not yet conducted on 1,872 women donors. As such, we used a self-report of health care provider diagnosis of high cholesterol in our analyses.

Medication use

BACH participants were asked to gather all medications used in the past four weeks for label recording by the interviewer. In addition, participants were asked whether they were taking drugs for specific indications, such as ‘any medications for cholesterol or fats in your blood?’ Medication labels and/or responses were coded using the Slone Drug Dictionary, [13] which links medications to their components and classifies them using a modification of the American Hospital Formulary Service Drug Pharmacologic Therapeutic Classification System.[14] We first considered the prevalence of use of any prescription antilipemic (including statins, fibric acid derivatives, bile acid sequestrants, niacin and ezetimibe) as use of lipid-lowering medications (LLM). As the vast majority of these (>90%) were statins, the analyses presented in this manuscript are confined to persons who used statins only vs. persons who did not use any LLM.

Covariates

Race/ethnic groups were self-identified and were considered in order to measure health disparities. A socioeconomic status (SES) variable was constructed as a function of standardized income and education variables for the Northeastern U.S. and reclassified into low, middle and high.[15] Depressive symptoms were considered present among participants with at least five of eight symptoms on the abridged Center for Epidemiologic Studies Depression Scale.[16] Other comorbidities were based on the query, “Have you ever been told by a health care provider that you have or had...?” A composite yes/no variable for cardiac disease was made from any report of myocardial infarction, angina, congestive heart failure, and coronary artery bypass or graft surgery. Similarly for vascular disease, a composite yes/no variable was made from a history of pulmonary embolism, deep vein thrombosis, carotid artery surgery, Reynaud’s disease, peripheral vascular disease, intermittent claudication, aortic aneurysm, or surgery or angioplasty for arterial disease of the leg. Body mass index (BMI) was calculated from interviewer-measured weight and height. The mean of two interviewer-measured blood pressure values were used to define a case of measured hypertension using the cutpoints in the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure[17] (i.e., high systolic pressure: ≥ 140 mm Hg or high diastolic pressure: ≥ 90 mm Hg); we also used a self-report of provider diagnosed hypertension as an alternative definition.

Analytic sample and statistical analysis

To avoid ‘confounding by indication’ in this pharmacoepidemiologic study,[18] participants were included in the analysis if they reported a history of provider-diagnosed high cholesterol or use of statins in the past 4 weeks, with the goal of constructing a subpopulation with treated or untreated high cholesterol in which to make comparisons. Our analytic goal was to understand the association between statin use and storage and voiding symptoms, without confounding by established urologic disease or conditions associated

with LUTS. Therefore, we excluded any subject with a history of genitourinary cancers, Parkinson's disease, multiple sclerosis, those who self-reported conditions indicating a past history of urinary disorders (including prolapsed bladder and a yes response to the query, 'Have you been told by your health care provider that you have problems with the bladder emptying as a result of nerves or muscles that supply the bladder not working well?'), those who have had use of a catheter recommended to them, those who reported past treatment for incontinence, had bladder or prostate surgery, or were current users of medications for urinary conditions. The influence of other chronic conditions related to age and the risk of LUTS, such as diabetes, were examined as covariates in multivariate models.

While prior BACH analyses used sampling weights and had the goal of creating prevalence estimates generalizable to the broader Boston, MA,[19] this analysis is etiologic in nature and based on a subpopulation, thus our analyses were unweighted in order to improve statistical power. Analyses were conducted using 9.2 of SAS and 10.0.1 of SUDAAN. Missing data were replaced by plausible values using multiple imputation;[20] less than 1% of data were missing for most variables. Income (used to construct SES) was missing for 3%, 4% and 11% of white, black and Hispanic subjects, respectively. Medication variables were not imputed. Because exploratory analyses revealed numerous potential confounders (as displayed in Table 1) and any identified association may be spurious, a multivariate logistic regression model was used to identify associations between LUTS outcomes and use of statin medications using adjusted odds ratios (ORs) and 95% confidence intervals (CIs). The goal of model building was to identify and control for confounders of the main exposure (statin use) and LUTS outcomes using a 15% change-in-estimate criterion.[21] The following potential confounders were considered for all models: stroke, diabetes, cardiac and vascular disease, self-reported high blood pressure, arthritis, asthma, socioeconomic status, use of diuretics and other antihypertensives, body mass index, and smoking status. To determine the structure of the final model, a full model was fit and using backward selection, only those covariates that induced a 15% change in the odds ratio for the statin/outcome estimate were included in the final model. As study design variables, race/ethnicity and age were always retained in the models.

RESULTS

There were 1,828 participants in BACH with a history of high cholesterol or recent LLM use, 33% of the baseline sample. After deletion of 392 persons who had prior evidence of urologic disease, there were 593 men and 842 women remaining in our analysis sample with a self-reported history of high cholesterol (n=761) and/or who used LLMs (n=675). 92% of 675 LLM users were taking a statin. In order to make our conclusions generalizable to the statin class, we deleted 89 persons not exclusively using statins from the presented analyses for a final analysis sample of n=1,346.

The demographic and health characteristics of statin users and non-users with high cholesterol are presented by gender in Table 1. Men on statins were nearly 10 years older on average compared to non-users with high cholesterol, were more likely to be white, and to have health insurance. Men on statins were also much more likely to have major comorbidities including diabetes, cardiac and vascular disease, a history of stroke and self-reported hypertension, and to be using antihypertensives. Similar to men, women on statins were nearly 10 years older on average. They were less likely to be Hispanic or uninsured. Women taking statins were more likely than non-users to be obese and were much more likely to have diabetes, cardiac, vascular disease, self-reported hypertension, and arthritis. As with the men, they were much more likely to use an antihypertensive.

The prevalence of LUTS (AUA score 8+) in our analysis sample was 17.7% among men and 21.1% among women (Table 2). For both men and women, storage symptoms were more prevalent than voiding symptoms using the dichotomous definition. Among men, the prevalence of voiding symptoms differed more by statin use compared to storage symptoms (14.3% among statin users vs. 9.5% among non-users), whereas among women, it varied more by statin use within storage disorders (40.0% statin users vs. 35.7% non-users) compared to voiding. Among men, there were significant differences in age-stratified mean AUA, voiding, and storage scores by statin use, with older (60+) users consistently having lower scores than non-users and younger users (<60) having consistently higher scores than non-users. These differences were not observed among women.

Confounding (by age and a differential pattern of comorbidity) is likely to be present given the characteristics of statin users and the association of cardiovascular risk factors with LUTS.[22] In exploratory models adjusted for race/ethnicity, a significant interaction term for statin use and continuous age was identified in voiding and storage models for men ($p=0.007$ and $p=0.002$, respectively), suggesting that the association with statins was not uniform by age; this interaction was also explored in women but not found to be present ($p=0.63$ and $p=0.86$, respectively). For consistency, age-stratified models are presented for both women and men (Tables 3 and 4, respectively). In the models for women, few confounders were identified and there were no significant associations in the final models for women of all ages for voiding (OR=1.09, 95% CI: 0.67, 1.75), storage symptoms (OR=1.00, 95% CI: 0.73, 1.37) or overall LUTS (OR=1.03, 95% CI: 0.70, 1.51), or in age-specific models.

Among men, consistent with effect modification, odds ratios were substantially different comparing the odds of storage symptoms among younger (<60) versus older (60+) men. For older men we observed a strong inverse association (suggestive of a ‘protective effect’) for overall LUTS (OR=0.15, 95% CI: 0.05, 0.44), and both voiding (OR=0.23, 95% CI: 0.08, 0.66) and storage (OR=0.24, 95% CI: 0.11, 0.56) symptoms in the final models; this effect was not observed among younger men for either symptom group.

To investigate whether our results were due to general lipid-lowering effects vs. effects of statins, we repeated our Table 4 models including 89 users of other LLMs (53 of these did not also use statins), and estimated associations of exposure to any LLM in place of statins-only use. Our associations considering all LLMs were similar in magnitude to statins-only estimates for men, and remained statistically significant (data not shown).

COMMENT

Given the popularity of medications in the statin class, it is prudent for researchers to examine their potential effects on other organ systems for evidence of unintended consequences or conversely, potential benefits. We considered the association of statins with voiding and storage symptoms among men and women with a proxy indication for use of statins in order to avoid a bias common to pharmacoepidemiologic studies, “confounding by indication”, where persons with the indication may be at higher risk for the outcome.[18] For example, there is some evidence that persons with diabetes and high LDL may be at higher risk for benign prostatic hyperplasia (BPH),[23] potentially increasing the risk of voiding symptoms. This may occur through a mechanism related to atherosclerosis and chronic ischemia of the small vessels.[24] Analyses confined to persons with the high cholesterol indication is a strategy to avoid this bias.

Even after subsetting our population on indication, however, the characteristics of users compared to non-users revealed numerous potential confounders, given known risk factors

for LUTS were found to be associated with the exposure (statins), (e.g., age, diabetes and cardiovascular disease). In final analyses adjusted for multiple variables, we found statistically significant inverse associations (of substantial magnitude) between statin use and both voiding and storage symptoms among older men, suggesting that use of statins is associated with a lower occurrence of prevalent LUTS. This is consistent with the hypothesis that statins might protect against urologic symptoms, but was observed only among older men. Unfortunately, duration of statin use was not available in our data, but presuming older men have been using statins for longer, it might suggest that duration of use might affect LUTS. The lack of findings among women, the effect on both storage and voiding symptoms in men and age dependence are consistent with the hypothesis that statins protect against LUTS by virtue of some effect related to growth of the prostate. Experimental data from several groups has shown that obstruction of the bladder, such as may occur with BPH, triggers a relative ischemia during a detrusor contraction.[25,26] This ischemia has been linked to impaired contractility that could contribute to voiding symptoms and/or detrusor overactivity causing storage symptoms.[27,28] Perhaps statins reduce atherosclerosis in the vasculature supplying the bladder reducing the impact of minor or moderate obstruction in men, thereby preventing a worsening of ischemia and the development of LUTS. Acute effects of statins to influence LUTS seem unlikely. A clinical trial of atorvastatin found that six months of use did not improve overall IPSS scores or BPH outcomes compared to men receiving placebo in a population with prostatic enlargement and baseline IPSS scores 13+.[9] It has also been observed in a small clinical study that the addition of lovastatin to finasteride treatment did not improve voiding symptoms measured by IPSS scores after 4 months.[29] Possibly, these studies had too short a treatment duration to observe an effect. In the Rancho Bernardo Study, the presence of BPH symptoms did not differ by lipid-lowering treatment status; duration of treatment was not reported in this study.[23]

Consistent with our findings, a recent longitudinal analysis of the Olmsted County cohort of men (aged 40–79 in 1990) found an inverse relationship between prior use of statins and LUTS defined as symptom score 8+ (multivariate-adjusted hazard ratio=0.48, 95% CI: 0.34, 0.68), as well as an inverse relationship with decreased peak urinary flow rate and benign prostatic enlargement.[30] Our results lend support to this work by showing an association with LUTS in the same inverse direction, although of stronger magnitude. We are not aware of any prior clinical trials or epidemiologic studies that specifically examine our study question in women, nor used untreated men with elevated cholesterol as a comparator group.

Our study is cross-sectional and represents a ‘snapshot’ of statin use and urologic symptoms at one point in time, and cannot determine cause and effect. It is also unknown whether any hypothesized protective effect might be due to statin use or to general lipid-lowering. While our results for men were consistent when users of all LLMs were considered, we had insufficient numbers of persons using only non-statin LLMs to understand potential effects above and beyond those conferred by statins. The unknown timing of statin use with respect to onset of urologic symptoms and their severity is also a limitation of our analysis. The duration and severity of hyperlipidemia is also unknown. However, our community-based setting allows for examination of the experience of symptoms among those drug treated and not drug treated, which may reveal a more realistic picture of LUTS. While we did not have serum cholesterol measurements on the women in our study, we found that 89.6% of men self-reporting a history of high cholesterol (not currently using LLMs) also had measured high cholesterol (defined as low-density lipoprotein (LDL) levels ≥ 130 among those with triglycerides < 200 mg/dl, or ≥ 160 among those with triglycerides ≥ 200 , with non-high-density lipoprotein as a proxy for LDL). This finding suggests our approach in women will not result in a great deal of misclassification.

Strengths of our study include knowledge of the history of diagnosed urologic disease among participants. While compliance with prescribed medications and duration of use was not captured, we had comprehensive ascertainment of medications in our study. Other strengths include capture of urologic symptoms using validated scales, and a study population containing both men and women of diverse age, race/ethnicity and SES.

CONCLUSION

In conclusion, the results of our study provide some evidence that statins ameliorate overall LUTS and storage and voiding symptoms among older men, but no similar associations were found among women or younger (<60) men. The observed associations among older men may be a manifestation of longer duration of use of statins. Given the magnitude of these associations, further investigation of the potential effects of statins may be warranted.

Acknowledgments

Funding: The project described was supported by Award Number R21 DK 082652 from the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) (NIH). Funding for the BACH Survey was provided by NIDDK U01 DK 56842. The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIDDK or the NIH.

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Characteristics of those with treated and untreated hyperlipidemia* among men (n=550) and women (N=796) in Boston Area Community Health Survey, 2002–2005.

TABLE 1

Covariates [‡]	MEN			WOMEN		
	Statin use (n=231)	No statin use (n=319)	p-value [§]	Statin use (n=355)	No statin use (n=441)	p-value [§]
Age						
Mean (Standard Error)	57.6 (0.7)	48.4 (0.6)	<0.001	61.3 (0.5)	52.3 (0.6)	<0.001
Median	57.6	47.3		61.2	52.1	
65+ (%)	26.4	8.3	<0.001	35.8	17.8	<0.001
Socioeconomic status (%)			0.127			0.002
Low	43.5	38.1		57.2	48.2	
Middle	36.1	44.8		35.2	37.0	
High	20.4	17.1		7.6	14.8	
Race/ethnicity (%)			0.005			0.002
Black	25.5	29.0		37.8	33.2	
Hispanic	29.4	39.4		24.5	35.8	
White	45.0	31.6		37.8	31.0	
Health insurance (%)			0.002			<0.001
Private	56.1	59.5		40.0	47.0	
Public	33.5	21.8		51.3	37.4	
None	10.5	18.7		8.7	15.6	
Smoker (%)			0.015			0.076
Never	32.7	44.6		46.9	52.1	
Former	37.8	29.1		29.7	22.5	
Current	29.5	26.3		23.5	25.4	
Body mass index (%)			0.137			<0.001
<25.0	14.1	17.6		9.0	22.4	
25.0–29.9	41.3	46.1		30.1	30.3	
30.0+	44.6	36.4		60.9	47.4	
Type I or Type II diabetes (% yes)	33.4	10.1	<0.001	42.0	11.9	<0.001
Cardiac disease (% yes)	29.1	8.6	<0.001	23.4	8.1	<0.001

Covariates [‡]	MEN		WOMEN		p-value [§]	p-value [§]
	Statin use (n=231)	No statin use (n=319)	Statin use (n=355)	No statin use (n=441)		
Vascular disease (% yes)	13.4	5.8	14.4	8.5	0.004	0.010
Stroke (% yes)	4.8	0.9	1.7	1.0	0.008 [¶]	0.446 [¶]
Hypertension (self-report) (% yes)	61.8	36.5	62.5	42.9	<0.001	<0.001
Hypertension (measured) (% yes)	31.6	26.2	23.4	21.7	0.171	0.564
Arthritis (% yes)	24.7	17.4	54.5	35.0	0.041	<0.001
Depression symptoms (% yes)	13.9	14.4	29.5	26.7	0.866	0.377
Asthma (% yes)	11.8	11.1	24.3	18.6	0.797	0.051
Taking antihypertensives (% yes)	49.4	12.8	56.1	25.6	<0.001	<0.001
Taking diuretics (% yes)	18.6	5.3	28.2	15.4	<0.001	<0.001

* Treated hyperlipidemia was defined as statin use, while untreated hyperlipidemia was self-reported history of high cholesterol without any cholesterol medication use.

[‡] Percents shown are column percents.

[§] P-values from chi-square or Wald-type F tests.

[¶] P-values from Fisher's exact test.

Prevalence of lower urinary tract symptoms (LUTS), voiding and storage symptoms and distribution of American Urologic Association (AUA) symptom scores and standard errors (SE) by use of statin medications and gender, among persons with a history of high cholesterol (N=1,346).

TABLE 2

	MEN			WOMEN		
	Overall (n=550)	Statin users (n=231)	No use (n=319)	Overall (n=796)	Statin users (n=355)	No use (n=441)
Prevalence of LUTS (%)	17.7	20.2	15.9	21.1	23.4	19.2
Prevalence of voiding symptoms (%)	11.6	14.3	9.5	10.9	11.4	10.6
Prevalence of storage symptoms (%)	29.3	30.9	28.2	37.6	40.0	35.7
Overall AUA score (Mean, SE)	4.1 (0.2)	4.4 (0.3)	3.9 (0.2)	4.8 (0.2)	5.0 (0.3)	4.6 (0.2)
Median	2	2	3	3	3	3
Older (60+) (Mean, SE)	5.1 (0.4)	4.2 (0.5)	7.3 (0.9)	5.2 (0.3)	5.3 (0.4)	5.1 (0.5)
Younger (<60) (Mean, SE)	3.8 (0.2)	4.6 (0.4)	3.4 (0.2)	4.5 (0.2)	4.5 (0.4)	4.5 (0.3)
Median	3	2	5	4	4	3
Voiding score (Mean, SE)	1.5 (0.1)	1.6 (0.2)	1.4 (0.1)	1.4 (0.1)	1.4 (0.1)	1.4 (0.1)
Older (60+) (Mean, SE)	1.8 (0.2)	1.4 (0.2)	2.9 (0.6)	1.4 (0.2)	1.4 (0.2)	1.3 (0.3)
Younger (<60) (Mean, SE)	1.4 (0.1)	1.8 (0.3)	1.2 (0.1)	1.4 (0.1)	1.4 (0.2)	1.4 (0.1)
Storage score (Mean, SE)	2.6 (0.1)	2.8 (0.2)	2.5 (0.1)	3.4 (0.1)	3.6 (0.2)	3.3 (0.1)
Older (60+) (Mean, SE)	3.3 (0.3)	2.8 (0.3)	4.4 (0.5)	3.9 (0.2)	3.9 (0.2)	3.8 (0.3)
Younger (<60) (Mean, SE)	2.4 (0.1)	2.8 (0.2)	2.3 (0.1)	3.1 (0.1)	3.1 (0.3)	3.1 (0.2)

* P-values from chi-square or Wald-type F tests for statin use vs. no use.

Odds ratios (OR) and 95% confidence intervals (CI) from final multivariate logistic regression models* for association of statin medications and lower urinary tract symptoms (LUTS) among **women** (stratified by age) with a history of high cholesterol (N=796).

TABLE 3

Statin use vs. no use	VOIDING		STORAGE		LUTS	
	OR	95% CI	OR	95% CI	OR	95% CI
Overall	1.09	(0.67, 1.75)	1.00	(0.73, 1.37)	1.03 [‡]	(0.70, 1.51)
Older women (60+) (n=313)	1.03 [‡]	(0.48, 2.22)	1.09	(0.68, 1.74)	1.62	(0.91, 2.90)
Younger women (<60) (n=483)	1.04	(0.53, 2.03)	0.90	(0.58, 1.41)	0.92	(0.55, 1.55)

* The following potential confounders were considered for all models: stroke, diabetes, cardiac and vascular disease, self-reported high blood pressure, arthritis, asthma, socioeconomic status, use of diuretics and other antihypertensives, body mass index, and smoking status. All final models adjusted for race/ethnicity, and continuous age.

[‡] Models for LUTS overall and voiding among older women were additionally adjusted for cardiac disease.

Odds ratios (OR) and 95% confidence intervals (CI) from final multivariate logistic regression models* for association of statin medications and lower urinary tract symptoms (LUTS) among **men** (stratified by age) with a history of high cholesterol (N=550).

TABLE 4

Statin use vs. no use	VOIDING		STORAGE		LUTS	
	OR	95% CI	OR	95% CI	OR	95% CI
Older men (60+) (n=143)						
	0.23[†]	(0.08, 0.66)	0.24[‡]	(0.11, 0.56)	0.15[§]	(0.05, 0.44)
Younger men (<60) (n=407)						
	1.27 [†]	(0.59, 2.74)	1.16 [¶]	(0.71, 1.90)	1.02 [‡]	(0.53, 2.00)

* The following potential confounders were considered for all models: stroke, diabetes, cardiac and vascular disease, self-reported high blood pressure, arthritis, asthma, socioeconomic status, use of diuretics and other antihypertensives, body mass index, and smoking status. Estimates shown in bold had confidence intervals excluding 1.00.

[†] Final model adjusted for race/ethnicity, diabetes, cardiac disease, and continuous age.

[‡] Final model adjusted for race/ethnicity, use of antihypertensives, and continuous age.

[§] Final model adjusted for race/ethnicity, diabetes, cardiac disease, asthma, and continuous age.

[¶] Final model adjusted for race/ethnicity, and continuous age.