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Changes in Cholesterol-Lowering Medications Use Over a Decade in Community-Dwelling Older Adults

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Abstract

Background—The impact of evidence-based guidelines and controlled trial data on use of cholesterol-lowering medications in older adults is unclear.

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Objective—To examine whether utilization patterns of cholesterol-lowering medications in community-dwelling older adults changed following the release of the National Cholesterol Education Program Adult Treatment Panel III guidelines and results from the Prospective Study of Pravastatin in the Elderly at Risk in 2002.

Methods—Community dwelling elders enrolled in the Health, Aging and Body Composition Study in 1997/1998, and followed for up to 11 years. An interrupted time-series analysis with multivariable generalized estimating equations (GEE) was used to examine *level* and *trend* changes in cholesterol-lowering medication use before and after 2002, adjusting for sociodemographic, health-related behaviors and health status.

Results—Cholesterol-lowering medication use increased nearly 3-fold from 14.9% in 1997/1998 to 42.6% in 2007/2008 with statins representing the most common class used (87%–94%). Multivariable GEE results revealed no difference in the *level* of cholesterol-lowering medication use after 2002 (adjusted odds ratio: 0.95, 95% confidence interval [CI] 0.89–1.02). Multivariable GEE results revealed *trends* changes in the rate of increase in cholesterol-lowering medication declined after 2002 (adjusted ratio of odds ratios 0.92, 95% CI 0.89–0.95).

Conclusions—The use of cholesterol-lowering medication increased substantially over a decade in community dwelling elders, but was not related to a change in level or trend following the release of the guidelines and evidence-based data.

Keywords

aged; anticholesteremic agents; hydroxymethylglutaryl-CoA reductase inhibitors; statins; drug utilization

INTRODUCTION

Although cardiovascular disease remains the leading cause of death and disability among the elderly in the US, the incidence of coronary heart disease (CHD) and associated mortality actually declined by approximately 25% from 1997 to 2007.^{1–3} This decline may be due to improved medical care and use of evidence-based preventive medications, including cholesterol-lowering therapy.^{3, 4} Recommendations for the detection and control of hypercholesterolemia for adults have been offered since 1988, by the National Cholesterol Education Program (NCEP) Adult Treatment Panel (ATP).^{5–8}

In 2002, NCEP ATP III guidelines were published and for the first time strongly recommended the use of statins for older persons with established CHD or at high risk for developing CHD (e.g., diabetes mellitus).⁷ These recommendations were based in part upon the results from the subgroup analysis of several previous trials with statins,^{9–13} and the 2002 Prospective Study of Pravastatin in the Elderly at Risk (PROSPER).¹⁴ Conclusively extrapolating the results from subgroup analysis to all older adults was controversial, in part because most of these trials had defined an upper age limit (70–75 years of age) that favored the inclusion of only “younger” older adults.^{9–11} The 2002 Medical Research Council/British Heart Foundation Heart Protection Study (HPS) included a good proportion (28%) of participants aged 70 years.¹² Among 1263 individuals aged 75 to 80 years at baseline, the rate of major coronary events was significantly lower in the statin group than placebo group.¹² The PROSPER is the only trial focused on an exclusively elderly cohort involving 5804 older men and women (aged 70 to 82 years).¹⁴ They found that the risk of CHD death, or non-fatal myocardial infarction was significantly reduced in those with established CHD, but not in those receiving the drug for primary prevention (e.g., diabetes mellitus).¹⁴

There is limited information about the use of cholesterol-lowering medications before and after 2002 in older adults aged 70 years. From the National Health and Nutrition

Examination Survey years 1999–2002 and 2003–2006, cholesterol-lowering medication use significantly increased overall in adults aged ≥ 60 years (46% vs. 57%), but no information was reported about use in this age group that had CHD and/or with diabetes.¹⁵ Physician prescribing inertia despite clinical practice guidelines or evidence-based data may be due to lack of familiarity of the benefits of specific pharmacotherapy, or difficulty in balancing the impact on quality of life with patient's comorbidities, functional status, life expectancy and preferences.¹⁶ In addition, these publications are somewhat inconsistent regarding the need for cholesterol-lowering medications in the elderly (e.g., those with diabetes but without CHD).^{7, 14, 17–20} To date, no formal assessment of the impact of these publications on use of cholesterol-lowering medications in the elderly has been undertaken. Therefore this study examines whether utilization patterns of cholesterol-lowering medications in community-dwelling older adults changed following the release of the NCEP ATP III guidelines and results from the PROSPER in 2002. The Health, Aging and Body Composition Study, a cohort study that enrolled well-functioning elders aged ≥ 70 years, provided an opportunity to examine our research question.

METHODS

Study Design, Sample, and Source of Data

An interrupted time-series analysis was used to examine yearly *level* and *slope (trend)* changes in the utilization of cholesterol lowering medications.²¹ A random sample of 3075 black and white men and women, aged 70–79, were recruited from Medicare beneficiaries residing in Pittsburgh, PA and Memphis, TN.^{22, 23} The baseline visit of the Health Aging and Body Composition Study occurred in 1997/1998 at which time participants reported no difficulty walking one-quarter of a mile (400 m), climbing 10 steps without resting, performing basic activities of daily living; no use of a cane, walker, crutches or other special equipment to ambulate.^{22, 23} Twenty baseline participants were excluded because of missing medication information. The study was approved by the Institutional Review Boards of the Universities of Pittsburgh and Tennessee, and written informed consent was obtained from each participant.

Data Collection and Data Management

The information collected annually during in-person visits by trained interviewers included blood samples, a battery of detailed physiological measurements and questionnaire material regarding sociodemographic characteristics, multiple aspects of health behavior and health status, and medication use.^{22, 23} From the collected fasting blood samples obtained in 1997–1998, 2002–2003, 2004–2005, 2007–2008, serum cholesterol, HDL-C and triglyceride values were determined by a colorimetric technique on a Vitros 950 analyzer (Johnson & Johnson, New Brunswick, NJ). LDL-C was calculated using the Friedewald equation.^{24, 25} Both health behavior and health status factors and medication use data were used to define specific conditions of interest in this study (i.e., diabetes mellitus and hypertension). Hypertension was defined by self-reported diagnosis of hypertension and use of anti-hypertensive medications.²⁶ Diabetes was defined by self-reported diagnosis of diabetes or use of anti-diabetic medications.²⁷ Several comorbidities examined in the current study (i.e., CHD, stroke, or peripheral artery disease [PAD]) were centrally adjudicated by a post hoc committee based on conclusive evidence from hospitalization or death records.^{22, 23}

For medications, at baseline (1997–1998), and annually for 10 years (except years 2000–2001, 2003–2004, and 2005–2006), participants were asked to bring all prescription medications taken in the previous month. Trained interviewers transcribed information from the medication containers on medication name, dosage form, and whether the medication was taken as needed. The medication data were coded using the Iowa Drug Information

System and then entered into a computerized database.²⁸ These methods of medication data collection are considered highly accurate and concordant with information contained in pharmacy claims data.²⁹

Outcome Variable: Cholesterol-Lowering Medication Use

The dichotomous outcome variable was use of any cholesterol-lowering medication from any of two discrete classes: 1) statins, and 2) others (i.e., fibrates, bile acid binding resin agents, probucol, niacin, and cholesterol absorption inhibitors (i.e., ezetimibe)). These two classes correspond to IDIS codes 24060009–24060404 and 88080004.²⁸

Primary Independent Variable

The independent variable for these analyses was time (i.e., baseline [1997–1998] and each follow-up year). The year 2002 was the year in which the NCEP ATP III guidelines and the results of the PROSPER were released. Therefore, two non-overlapping time segments were defined for the time series: 1997–2002 and 2003–2008.

Covariates

Several characteristics that could potentially confound or modify cholesterol-lowering medication use were adjusted for in the analysis, and were grouped into three domains: 1) sociodemographic, and 2) health-related behaviors and 3) health status.^{30–33}

Sociodemographic factors that were characterized as categorical variables included race (black, white), sex, study site, education (postsecondary education, high school graduate, and less than high school graduate), and living status (alone, not alone). Age was considered as a continuous variable. A dichotomous time-varying variable for prescription drug coverage was also included to account for patients on and off insurance over the study period.

Health-related behaviors were characterized as categorical variables for smoking status and alcohol use (current, past, or never). Health status factors were characterized as dichotomous measures (present vs. absent) for self-reported health conditions, including congestive heart failure, chronic kidney disease, pulmonary disease, and cancer. A time-varying dichotomous variable was created for self-rated health (excellent/good vs. not). A categorical variable for body mass index (BMI- underweight or normal [$<25.0 \text{ kg/m}^2$], overweight [$25.0\text{--}29.9 \text{ kg/m}^2$], or obese [$\geq 30.0 \text{ kg/m}^2$]) was created.³⁴ The number of overall prescription medications (excluding cholesterol-lowering drugs) was included as a time-varying continuous variable as a proxy for comorbidity.³⁵ Dichotomous variables were created for cognitive impairment ($3\text{MS} < 80$) and high depressive symptoms (Center for Epidemiologic Studies Depression Scale score >15).^{36, 37} Interviewers were trained with the standard manual of operation and certificated for all the clinical assessments (e.g., 3MS test).³⁸

Main Statistical Analyses

All analyses were performed using SAS® version 9.3 (SAS Institute Inc. Cary, NC). Appropriate descriptive statistics (mean, standard deviation, frequency and percentage) were employed to summarize participant characteristics and main analytic variables. For descriptive purposes, we also reported the prevalence of fibrate and ezetimibe use separately from other non-statin agents because fibrates were the second commonly used cholesterol lowering medications and ezetimibe was introduced to the market in 2002.¹⁵ We conducted a multivariable interrupted time-series analysis (using generalized estimating equations [GEE]) to estimate changes in the *level* and the *slope (trend)* of the outcome rates after 2002.^{21, 39} This analysis used the SAS® GENMOD procedure with an autoregressive working correlation structure to account for potential multiple years of data from the same

participants and the resulting stochastic non-independence of observations.^{21, 39} Specifically, level changes were calculated by comparing the predicted prevalence use in the year 2002–2003, which was extrapolated from the slope of the time series 1997–2002, with the observed prevalence use in the year 2002–2003. The *level* changes were calculated as an adjusted odds ratio (OR) and 95 percent confidence interval (95% CI). An odds ratio greater than one for *level* changes would indicate that the 2002 publications did have an immediate impact on cholesterol-lowering medication use. *Slope or trend* changes were calculated as the ratio of adjusted odds ratios and 95% CI. This approach estimates the change in cholesterol-lowering medication use following 2002 publications controlling historical year-to-year changes prior to 2002 as well sociodemographic, health-related behaviors and health status factors.⁴⁰ A ratio of adjusted odds ratios for *slope or trend* changes greater than one would indicate that the guidelines had an impact on yearly rate of increase in cholesterol-lowering medication use. Both sociodemographic, health-related behaviors and health status factors were controlled for in these multivariable analyses.

Sensitivity and Stratification Analyses

A series of sensitivity analyses were conducted to better understand and assure the robustness of the main findings. First, changes in utilization patterns of cholesterol-lowering medications were evaluated among four mutually exclusive subgroups using the definitions of risk factors based on the 2002 NCEP ATP III guidelines.⁷ The four subgroups were: 1) any CHD (including myocardial infarction, angina pectoris, surgical or percutaneous revascularization); 2) no CHD, diabetes only (CHD risk equivalent); 3) no CHD or diabetes, but either with PAD, stroke, or ≥ 2 CHD risk factors (hypertension, current smoking, or low-levels of HDL-C [i.e., < 35 mg/dL]), and 4) no CHD or diabetes or PAD or stroke, and < 2 CHD risk factors. Those with PAD (n=83) or stroke only (n=86) were considered into group 3 because of insufficient sample sizes for examining the impact of these conditions separately, and many of these elders had multiple comorbidities/risk factors. For the second sensitivity analyses, we replaced missing covariate values with those generated using the multiple imputation.⁴¹ Most demographic and health behavior/status covariates had complete information, and none had more than 5% with missing information. The third sensitivity analysis was performed by restricting the analysis to only those with data for the entire 10 year time period. The final sensitivity analyses used 2004–2005 as the index year to separate the pre- and post-guideline periods and allow for a potential lag effect from dissemination and physician awareness of the guidelines. A year lag effect was selected because it may take at least 1 to 1.5 years for physicians being informed about these publications through different sources.^{42, 43} Finally, a stratification analysis by race was conducted to examine any differences in utilization patterns.

RESULTS

The baseline characteristics are shown in Table 1 according to all participants. Among 3055 participants, mean age was 74 years, 52% were female, 41% were black, 30% lived alone, 62% had prescription medications coverage, 5% had severe depressive symptoms, and 10% had cognitive impairment. Table 2 shows the prevalence of cholesterol-lowering medication use in the elderly from 1997–2008. Overall, 14.9% of the elders took cholesterol-lowering drugs at baseline (1997–1998) with statins accounting for 87% of the overall rate. The overall rate of cholesterol-lowering drugs use increased to 26.7% in 2001–2002 and to 42.6% by 2007/2008. In particular, statin use increased to 24.9% in 2001–2002 and to 39.1% in 2007–2008. The use of fibrates slightly increased from 1% in 1997–1998 to 2% in 2007–2008, and the use of bile acid sequestrants, probucol, and niacin remained the same over that 10 year time period (about 1.5%). The use of ezetimibe increased from 0.1% in 2002 when introduced to the market to 5% in 2007–2008.

Table 3 shows the results of the multivariable interrupted time-series analysis estimating changes in the *level and the slope (trend)* of cholesterol lower drug use rates after 2002. There was no *level* change of any cholesterol-lowering medication use the year before compared with the year after 2002 (adjusted OR 0.95, 95% CI 0.89 to 1.02). The multivariable results also revealed a decline in *trend* changes for the rate of increase in cholesterol-lowering medication after 2002 (adjusted ratio of odds ratios 0.92, 95% CI 0.89 to 0.95). Similar results for lack of change in level but changes in trend were seen for statin and other cholesterol lowering medications. (Table 3).

Sensitivity and Stratification Analyses

At baseline, 18% had any history of CHD, 11% had diabetes only, 28% were in the group that had PAD, stroke or ≥ 2 risk factors, and 43% were in the group of < 2 risk factors (Table 1). In Figure 1, among those with any history of CHD, diabetes only, had PAD, stroke, or ≥ 2 risk factors, or no CHD, DM, PAD, or stroke and < 2 risk factors, 30.6%, 11.8%, 14.0%, and 9.7% took cholesterol-lowering medications in 1997–1998; 49.9%, 30.1%, 24.0% and 14.6% in 2001–2002; and 68.8%, 46.1%, 35.4%, and 26.6% in 2007–2008, respectively. A similar pattern was seen with statins for each of the four groups. Similar findings were also seen for *level* and *trend* changes as noted for the overall sample (data not shown). None of the additional sensitivity analyses appreciably changed our main findings (data not shown). Blacks were less likely than whites to take any cholesterol-lowering medications (whites vs. blacks: 17.2% vs. 11.8% in 1997–1998; 30.2% vs. 21.2% in 2001–2002; and 45.7% vs. 36.8% in 2007–2008, respectively). Similar findings were also seen by race for level and trend changes (data not shown).

DISCUSSION

Our study found that the use of cholesterol-lowering medications in the elderly nearly tripled during the period of 1997–2008 (14.9% to 42.6%). Moreover, as one might expect given their greater ability to reduce LDL-C, statins were the most common drug class used. These findings are consistent with that reported by other studies.^{15, 33, 44–46} It was interesting to find that only half of those with known CHD and/or diabetes received any cholesterol lowering agent. It is difficult to determine if this represents under use of an important medication for secondary prevention as shown in other studies,^{47–49} or rational omission since published data is only valid for those up to 82 years of age,^{14, 50} and the mean age of Health ABC study participants in 2007–2008 was 82.4 ± 2.8 years. It is also notable that use of cholesterol lowering agents for primary prevention (i.e., those without CHD equivalent risk factors) occurred in up to 26.6% participants despite the lack of convincing efficacy evidence and the potential for greater adverse drug effects in older adults.⁵¹ Similar to the reports by other studies,^{15, 33, 44} despite the observed increase in cholesterol-lowering medication use in both racial groups, blacks remained less likely than whites to take cholesterol-lowering medications. A possible explanation is that long-term persistence in statin use has been shown to be worse in older blacks than whites.⁵²

We hypothesized that after the release of the NCEP ATP III guidelines and the results from the PROSPER Study in 2002, that the use of cholesterol-lowering medication would increase immediately (i.e., change in *level*). However, our study showed this new data in 2002 had no immediate impact on cholesterol-lowering medication use. One possible explanation for this finding is that the dissemination and implementation of clinical guidelines and evidence-based results are complex and take years to overcome barriers in clinical practice.^{53, 54} Additional unique factors in the elderly that may further contribute to the lag in dissemination of evidenced-based guidelines in to clinical practice for the elderly include difficulty in translating the results from highly selective trial populations to a heterogeneous community population, competing causes of morbidity and mortality (e.g.,

cancer), polypharmacy and drug interactions, short remaining life expectancy, reported poor adherence of statins, and patient economic concerns.^{52, 55–57}

We also hypothesized that after 2002 that there would be an increase in yearly rate of cholesterol-lowering medication use (*i.e.*, *change in slope*). Instead, we saw that there was a decrease in the yearly rate of increase of cholesterol-lowering medication use. Although the use of cholesterol-lowering medication in the elderly has increased substantially over time, the *change in slope* declined with advancing age is consistent with the findings from other studies.^{47–49}

So what are the clinical implications of these study findings for clinical pharmacy practice? The potential underuse of cholesterol lowering therapy in those elders aged 80 with CHD or risk equivalent that was observed in this study may be appropriate as summarized by a recent review.¹⁸ The authors concluded that there is insufficient evidence to support the initiation or continuation of cholesterol-lowering treatment in this patient group.¹⁸ Moreover, it may also be appropriate to not utilize cholesterol-lowering medications in those elders with CHD or risk equivalent that also have a limited life expectancy given that it takes 2 to 5 years of statin treatment to reduce the risk of cardiovascular events.¹³ Lack of secondary prevention with cholesterol-lowering medications in older adults may also be justified given that they are at higher risk to experience adverse effects (e.g., myalgia with statins). This increase in the risk of cholesterol-lowering medication adverse effects may be due to a number of factors including: 1) age-related decline in systemic clearance, 2) multiple comorbidities and medications, 3) drug interactions (e.g. macrolides inhibiting CYP3A4 hepatic enzyme metabolism of atorvastatin, lovastatin or simvastatin), and 4) medication adherence difficulties that can be seen especially in those with cognitive impairment.^{58, 59} Having said this, the use of these agents should not be considered as contraindicated for elders aged 80 years in good health since the potential benefit may be most pronounced in this patient group due to the known increased risk of coronary heart disease with increasing age. It is important for health care professionals to discuss these potential benefits and risks with older patients with CHD or risk equivalent and take into account their informed preferences.⁵⁷

Some limitations should be taken into account when interpreting the results of this study. Inherent to most longitudinal studies examining a broad range of older adults, the potential for survivor bias should be considered. However, the results from a sensitivity analysis, restricted to participants in the study from 1997–2008, yielded similar results. It is also possible that any use of cholesterol-lowering medications may be underestimated as medication use was measured at multiple fixed annual time points. We also cannot rule out potential confounding by such factors as family history of premature CHD, dietary therapy, and adherence to medications as information about these were not collected in the Health ABC study. Lastly, the study sample was drawn from two US cities and may not be generalizable to all other populations.

CONCLUSION

This study found that the use of cholesterol-lowering medication increased substantially over a decade in community dwelling elders, but was not related to a change in level or trend following the release of the guidelines and evidence-based data. Further studies are warranted to better guide cholesterol-lowering therapy and investigate the potential benefits and barriers of treatment among the oldest old elders (> 85 years) with CHD or at high risk.

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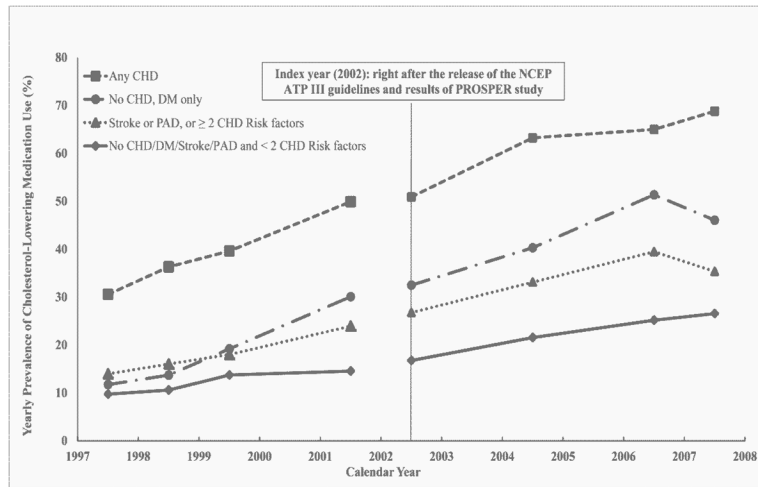


Figure 1. Yearly Prevalence of Cholesterol-Lowering Medication Use by Four Groups from 1997–2008

Table 1

Baseline Characteristics of the Health ABC Cohort and Four Subgroups (N=3,055)^a

Sociodemographic Factors	All (n=3,055)	Any CHD (n=556)	Diabetes only (n=349)	PAD, or Stroke or 2+ risk factors (n=836)	< 2 risk factors (n=1314)
Age, mean (SD)	73.6 (2.9)	74.0 (2.9)	73.5 (2.9)	73.4 (2.9)	73.6 (2.9)
Female sex	1574 (51.5)	202 (36.3)	169 (48.4)	404 (48.3)	799 (60.8)
Black race	1266 (41.4)	220 (39.6)	211 (60.5)	372 (44.5)	463 (35.2)
Pittsburgh site	1516 (49.6)	305 (54.9)	164 (47.0)	401 (48.0)	646 (49.2)
Education					
Postsecondary	1285 (42.2)	227 (40.8)	117 (33.7)	355 (42.7)	586 (44.6)
High school	996 (32.7)	182 (32.7)	105 (30.3)	283 (34.1)	426 (32.4)
Less than high school graduate	766 (25.1)	147 (26.4)	125 (36.0)	193 (23.2)	301 (22.9)
Living alone	920 (30.2)	146 (26.3)	111 (31.8)	257 (30.7)	406 (30.9)
Prescription drug coverage	1883 (61.7)	383 (68.9)	213 (61.2)	499 (59.9)	788 (60.0)
Health-related behaviors	All (n=3,055)	Any CHD (n=556)	Diabetes only (n=349)	PAD, Stroke, or 2+ risk factors (n=836)	< 2 risk factors (n=1314)
Smoking status					
Current	316 (10.4)	53 (9.6)	30 (8.7)	187 (22.4)	46 (3.5)
Past	1397 (45.8)	311 (56.0)	165 (47.6)	324 (38.8)	597 (45.5)
Never	1337 (43.8)	191 (34.4)	151 (43.80)	324 (38.8)	670 (51.0)
Alcohol use					
Current	1505 (49.5)	276 (49.8)	100 (28.7)	422 (50.8)	707 (54.0)
Past	677 (22.3)	141 (25.5)	134 (38.5)	192 (23.1)	210 (16.0)
Never	859 (28.3)	137 (24.7)	114 (32.8)	216 (26.0)	392 (30.0)
Health Status Factors	All (n=3,055)	Any CHD (n=556)	Diabetes only (n=349)	PAD, Stroke, or 2+ risk factors (n=836)	< 2 risk factors (n=1314)
Congestive heart failure	40 (1.3)	22 (4.2)	6 (1.7)	10 (1.2)	2 (0.2)
Chronic kidney disease	45 (1.5)	11 (2.0)	5 (1.4)	12 (1.4)	17 (1.3)
Pulmonary disease	127 (4.2)	26 (4.7)	20 (5.8)	26 (3.1)	55 (4.2)
Cancer	577 (18.9)	112 (20.2)	57 (16.3)	164 (19.6)	244 (18.6)
Excellent/good self-rated health	2558 (83.8)	418 (75.2)	261 (74.8)	691 (82.8)	1188 (90.4)
Body mass index					
Under/Normal	982 (32.1)	173 (31.1)	71 (20.3)	233 (27.9)	505 (38.4)

Health Status Factors	All (n=3,055)	Any CHD (n=556)	Diabetes only (n=349)	PAD, Stroke, or 2+ risk factors (n=836)	< 2 risk factors (n=1314)
Overweight	1293 (42.3)	237 (42.6)	146 (41.8)	364 (43.5)	546 (41.6)
Obese	780 (25.5)	146 (26.3)	132 (37.8)	239 (28.6)	263 (20.0)
Number of prescription drugs, mean (SD)	2.9 (2.6)	4.4 (2.9)	4.0 (2.7)	2.9 (2.4)	2.1 (2.3)
Severe depressive symptoms (CES-D > 15)	144 (4.8)	31 (5.6)	15 (4.4)	41 (4.9)	57 (4.4)
Cognitive impairment (3MIS < 80)	304 (10.0)	59 (10.7)	44 (12.7)	89 (10.7)	112 (8.6)

Lipid profiles	All (n=3,055)	Any CHD (n=556)	Diabetes only (n=349)	PAD, Stroke, or 2+ risk factors (n=836)	< 2 Risk factors (n=1314)
Total cholesterol (mg/dL), mean (SD)	202.8 (38.7)	193.7 (39.5)	201.1 (39.4)	199.7 (40.0)	209.0 (36.3)
LDL-C (mg/dL), mean (SD)	121.7 (34.8)	115.5 (35.5)	122.3 (35.4)	122.7 (35.7)	123.4 (33.4)
HDL-C (mg/dL), mean (SD)	53.9 (17.0)	49.3 (16.4)	50.6 (15.6)	46.8 (12.4)	61.2 (17.2)
Triglyceride (mg/dL), mean (SD)	138.7 (82.9)	148.3 (87.1)	144.1 (91.7)	156.2 (102.6)	122.3 (58.3)

^aData represented as N (%), unless otherwise stated;

Abbreviations: CES-D: Center for Epidemiologic Studies-Depression scale; HDL-C: high-density lipoprotein cholesterol; LDL-C: low-density lipoprotein cholesterol; PAD: peripheral artery disease

Table 2

Prevalence of Cholesterol-Lowering Medication Use from 1997–2008

	1997–1998 (n=3055)	1998–1999 (n=2908)	1999–2000 (n=2820)	2001–2002 (n=2631)	2002–2003 (n=2515)	2004–2005 (n=1780)	2006–2007 (n=1592)	2007–2008 (n=1344)
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Any cholesterol lowering medications	456 (14.9)	509 (17.5)	586 (20.8)	702 (26.7)	737 (29.3)	656 (36.9)	676 (42.5)	573 (42.6)
Any statins	395 (12.9)	461 (15.9)	542 (19.2)	654 (24.9)	695 (27.6)	615 (34.6)	620 (38.9)	525 (39.1)
Any fibrates	35 (1.2)	30 (1.0)	32 (1.1)	33 (1.3)	29 (1.2)	29 (1.6)	33 (2.0)	28 (2.1)
Any bile acid sequestrants, probucol, niacins	43 (1.4)	33 (1.1)	33 (1.2)	35 (1.3)	40 (1.6)	21 (1.2)	21 (1.3)	21 (1.6)
Any ezetimibe	0 (0)	0 (0)	0 (0)	0 (0)	2 (0.1)	38 (2.1)	77 (4.8)	69 (5.1)

Table 3
 Effect of the Release of the NCEP ATP III Guidelines and Results from PROSPER Study in 2002 on Cholesterol-Lowering Medications Use^a

Drug Class	Level Changes			Trend Changes		
	Observed vs. Predicted (using pre-guideline trend) Difference in Use in year 2003 (Adjusted OR, 95% CI) ^a	P-value	Pre-Guideline Trend per year (Adjusted OR and 95% CI) ^a	Post-Guideline Trend per year (Adjusted OR and 95% CI) ^a	Post-vs. Pre-Guideline Difference in Trends Over Time per year (Adjusted ROR, 95% CI) ^a	p-value
Any Cholesterol Lowering Medication Use	0.95 (0.89, 1.02)	0.18	1.18 (1.15, 1.20)	1.09 (1.02, 1.15)	0.92 (0.89, 0.95)	<0.0001
Any Statin Use	0.95 (0.88, 1.01)	0.12	1.19 (1.16, 1.22)	1.07 (1.01, 1.13)	0.90 (0.87, 0.93)	<0.0001
Any Fibrate/Other Use	1.04 (0.83, 1.30)	0.74	1.02 (0.93, 1.08)	1.24 (1.01, 1.46)	1.22 (1.10, 1.35)	0.0003

^aMultivariate generalized estimating equations models adjusted for sociodemographics (race, age, sex, site, education, living status), health behavior (alcohol use), and health status (pulmonary disease, body mass index, polypharmacy, and prescription medications coverage). Polypharmacy and prescription coverage are time-varying variables.

Abbreviation: CI: confidence interval; OR: odds ratio; ROR: ratio of odds ratio