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Angina in Coronary Artery Disease Patients With and Without Diabetes: US National Health and Nutrition Examination Survey 2001–2010

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ABSTRACT

Background: Angina pectoris (AP) is common in coronary artery disease (CAD), but whether those with diabetes mellitus (DM) experience AP as often as those without DM is unclear.

Hypothesis: AP prevalence is similar in those with vs without DM in a community sample with CAD.

Methods: In adults with CAD in the US NHANES 2001–2010, AP was determined by self-report and Rose questionnaire and compared by DM status. Physical functioning and medication use were also evaluated.

Results: Of 1957 adults with CAD, 619 (28.2%) had DM. Prevalence of AP was similar in those with vs without DM (48.9% vs 46.3%; $P = 0.38$). There was a trend toward more severe AP in those with glycated hemoglobin ≥7% (50.4%) vs <7% (27.1%; $P = 0.09$). Adjusted logistic regression showed a similar odds of AP (1.06, 95% CI: 0.84-1.33) in those with vs without DM, although among DM, a 2-fold greater odds of AP in women vs men. Physical functioning was worse in those with vs without AP overall (score of 25.9 vs 24.3; $P < 0.001$) and further diminished within those with comorbid DM (26.7 vs 24.0; $P < 0.001$). Among those with AP, those with vs without DM were more likely on β-blockers, statins, angiotensin-converting enzyme inhibitors, and antiplatelet therapy.

Conclusions: AP in CAD patients is similar among those with vs without DM, despite greater use of evidence-based therapies in DM patients. Greater physical limitations exist in those with vs without AP, and further diminish with comorbid DM.

Introduction

The combination of diabetes mellitus (DM) and coronary artery disease (CAD) confers substantial increased risk for morbidity and mortality than does the presence of either condition alone.[1] Angina pectoris (AP) is a highly prevalent condition in persons with known CAD, including those with comorbid DM. Among studies of patients with more acute CAD, the Bypass Angioplasty Revascularization Investigation 2 Diabetes (BARI 2D) trial of persons with CAD and DM showed angina rates 1 year following coronary intervention to be higher than previously conducted trials in non–DM-specific CAD populations.[2] In addition, a recent analysis of the Translational Research Investigating Underlying Disparities in Acute Myocardial Infarction Patients' Health Status (TRIUMPH) prospective cohort study showed that patients with DM vs without have greater angina prevalence and severity following acute myocardial infarction (MI), despite more aggressive antianginal management.[3] Not previously reported in a large national US sample of noninstitutionalized adults with stable CAD is the comparison of AP prevalence in those with and without DM and physical functioning associated with AP in such persons.

This study compares, within community-based noninstitutionalized US adults with CAD from the National Health and Nutrition Examination Surveys (NHANES) from 2001 to 2010, the prevalence of AP overall and among those with and without DM, and according to glycemic control among those with DM. We also examined the relationship of AP with physical functioning, medication use in those with vs without DM among those with AP, and predictors of AP likelihood in persons with or without DM.

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Methods

Study Sample

We examined AP prevalence and CAD risk factors in the NHANES 2001–2010 among 1957 adults age ≥18 years with CAD. The NHANES is a survey of a non-institutionalized

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sample of persons representative of the US population that includes interviews and physical examinations to assess health of participants.

Definitions

Coronary artery disease was defined as self-report of the participant noting that they had been told by a health care provider that they had a heart attack or coronary heart disease (CHD). Angina pectoris was based on having either been diagnosed (ever told by doctor or other health professional of having AP; self-report) or current symptoms confirmed by Rose Questionnaire grade I or II AP. Questions and criteria for AP were based on the Rose Questionnaire.[4] Diabetes mellitus was defined by fasting glucose ≥126 mg/dL, nonfasting glucose ≥200 mg/dL, previous physician diagnosis of DM, or use of insulin or hypoglycemic medication. Antianginal medication use (including β-blockers and calcium channel blockers) was based on participant medicine bottles brought in at study visit.

Coronary artery disease risk factors included total cholesterol (TC) and high-density lipoprotein cholesterol (HDL-C), triglycerides, systolic blood pressure (SBP), body mass index (BMI), waist circumference, cigarette smoking, and family history of CAD. Other covariates included ethnicity, defined as non-Hispanic white, non-Hispanic black, or Hispanic. Smoking status was defined by whether a person never smoked, previously smoked but has since stopped (past smoker), or continues to smoke (current smoker). Glycated hemoglobin (HbA_{1c}) was measured using high-performance liquid chromatography. Systolic blood pressure measurements were taken using a mercury sphygmomanometer and then averaged over up to 4 measurements. Total cholesterol was measured enzymatically after hydrolyzation and oxidation. High-density lipoprotein cholesterol was measured using a direct immunoassay technique. Furthermore, the use of antianginal medications as classified by NHANES (based on participants' self-reporting at the time of NHANES visit) was evaluated.[5] The physical functioning section provides self-reported data on functional limitations caused by long-term physical, mental, and emotional problems or illness, and it is used to assess an individual's level of disability.[6] Physical functioning assessment was based on NHANES physical functioning questions with index based on the sum of the scores of each of the 25 items (a higher score indicates worse physical functioning).

Statistical Analysis

We initially characterized subjects from NHANES 2001–2010 with CAD, among those with vs without DM according to age and other demographics, HbA_{1c}, and CAD risk factors. Using χ^2 test of proportions, we examined the prevalence of AP and risk factors among those with vs without DM, as well as risk factors among those with vs without AP having DM. The prevalence of AP according to extent of glycemic control among those with DM was also assessed. Prevalence of AP was based upon having been diagnosed (told by doctor of having AP) or Rose Questionnaire verified class 1 or class 2 AP in our CAD sample overall, and among those with vs without DM. Finally, we also used multiple logistic regression to assess the likelihood of having AP (any and by Rose Questionnaire) in those with vs without DM adjusted for risk-factor differences (age, sex, race, smoking, SBP, TC, HDL-C, and BMI) between those with vs without AP. The mean physical functioning index (as described above) was examined in those with vs without AP (any and by Rose Questionnaire) by the Student *t* test, and using analysis of covariance, adjusted for the above covariate risk factors. The χ^2 test of proportions was also used to compare prevalence of cardiovascular medication use among those with AP (any and by Rose Questionnaire) according to DM status. SAS version 9.2 (SAS Institute, Inc., Cary, NC) was used for all statistical analysis and for providing 10-year sample weighted estimates (for means and proportions). A P value of <0.05 (2-tailed) was considered to be statistically significant.

Results

Among 24 904 adults age >18 years projected to a weighted population of 199.8 million, we identified 1957 adults (representing 11.8 million) with CAD. Of them, 619 (28.2%) were classified as having DM (Figure 1). Table 1 shows that in those with vs without DM, sex and smoking status were similar. However, age, waist circumference, BMI, SBP, and HbA_{1c} were significantly higher and mean TC and HDL-C significantly lower in those with vs without DM. Figure 2 shows that the overall prevalence of AP did not differ between those with vs without DM by self-report (43.9% vs 40.9%; $P = 0.32$), Rose questionnaire (13.0% vs 12.2%; $P = 0.71$), or either (48.9% vs 46.3%; $P = 0.38$).

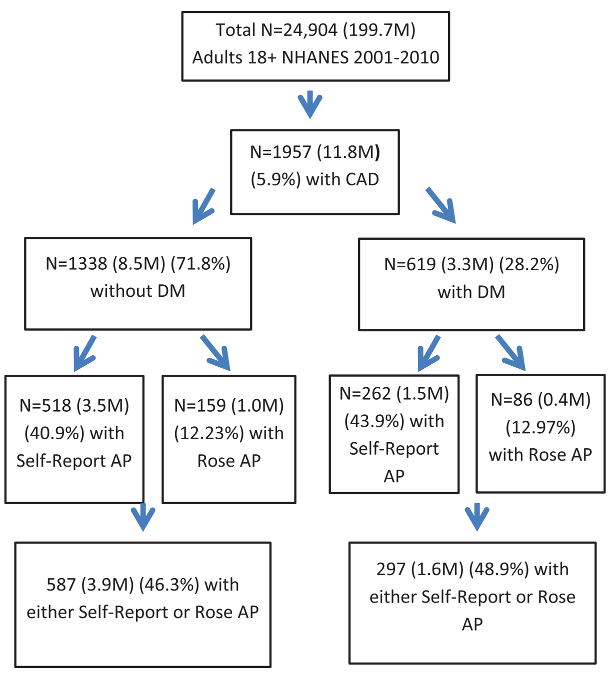

Figure 1. Flow diagram showing derivation of study sample. Sample n-size with weighted n in millions in parenthesis. Abbreviations: AP, angina pectoris; CAD, coronary artery disease; DM, diabetes mellitus; NHANES, National Health and Nutrition Examination Survey.

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Table 1. Demographic and Risk Factor Information According to Presence of DM

	DM, n = 619 (28.2)	No DM, n = 1338 (71.8)	*P* Value
Female sex	253 (42.9)	502 (40.2)	0.37
Age, y	66.8 ± 0.6	64.6 ± 0.5	<0.05
Ethnicity			
Non-Hispanic white	333 (72.9)	914 (82.3)	<0.001
Mexican American or other Hispanic	131 (7.7)	194 (6.0)	
Non-Hispanic black	133 (13.6)	189 (8.1)	
Other	22 (5.8)	41 (3.7)	
Smoking status			
Current smoker	132 (20.8)	324 (25.7)	0.14
Past smoker	271 (44.7)	554 (41.2)	
Waist circumference, cm	110.4 ± 1.0	102.2 ± 0.5	<0.001
BMI, kg/m^2	32.3 ± 0.4	28.9 ± 0.2	<0.001
HbA$_{1c}$, %	7.0 ± 0.1	5.6 ± 0.01	<0.001
SBP, mm Hg	132.9 ± 0.9	129.7 ± 0.8	<0.05
TC, mg/dL	181.0 ± 2.8	191.5 ± 2.0	<0.05
HDL-C, mg/dL	46.4 ± 0.7	50.7 ± 0.5	<0.001
AP, %[a]	48.9%	46.3%	0.38

Abbreviations: AP, angina pectoris; BMI, body mass index; DM, diabetes mellitus; HbA$_{1c}$, glycated hemoglobin; HDL-C, high-density lipoprotein cholesterol; SBP, systolic blood pressure; SE, standard error; TC, total cholesterol.
Sample sizes vary slightly according to variable listed. Data are presented as n (%) or mean ± SE, unless otherwise noted. Means and percentages represent population-weighted values. Percentages of those with or without DM with given factor noted in parentheses.
[a]Based on being positive either by self-report or Rose questionnaire.

Table 2. Risk Factor Comparisons by Presence of AP Among Subjects With DM (N = 619)

	AP, n = 297	No AP, n = 322	*P* Value
Female sex	138 (47.8)	115 (38.2)	0.07
Age, y	66.3 ± 0.7	67.2 ± 0.8	0.44
Ethnicity			
Non-Hispanic white	162 (73.2)	171 (72.7)	0.83
Mexican American or other Hispanic	61 (7.3)	70 (8.1)	
Non-Hispanic black	63 (13.1)	70 (14.2)	
Other	11 (6.5)	11 (5.1)	
Smoking status			
Current smoker	63 (23.0)	69 (18.6)	0.53
Past smoker	135 (44.0)	136 (45.3)	
Waist circumference, cm	111 ± 1.5	110 ± 1.2	0.83
BMI, kg/m^2	32.3 ± 0.5	32.4 ± 0.5	0.85
HbA$_{1c}$, %	7.0 ± 0.1	7.0 ± 0.1	0.75
SBP, mm Hg	132 ± 1.5	134 ± 1.3	0.32
TC, mg/dL	183 ± 5.4	179 ± 3.3	0.48
HDL-C, mg/dL	46.3 ± 0.9	46.4 ± 1.2	0.93

Abbreviations: AP, angina pectoris; BMI, body mass index; DM, diabetes mellitus; HbA$_{1c}$, glycated hemoglobin; HDL-C, high-density lipoprotein cholesterol; SBP, systolic blood pressure; SE, standard error; TC, total cholesterol.
Sample sizes vary slightly according to variable listed. Data are presented as n (%) or mean ± SE, unless otherwise noted. Means and percentages represent population-weighted values. Percentages of those with or without AP with given factor noted in parentheses. Angina based on being positive either by self-report or Rose questionnaire.

Among those with DM, mean HbA$_{1c}$ was similar (7.0%) in those with vs without AP, as was age, ethnicity, TC and HDL-C, blood pressure, smoking, waist circumference, and BMI. Also, in our sample with DM, among those with vs without angina, there was a trend toward a greater percentage of females (47.8% vs 38.2%; $P = 0.07$; Table 2). Prevalence of AP did not differ by glycemic control: 47.6% for HbA$_{1c}$ <6%, 50.6% for HbA$_{1c}$ 6% to <7%, 47.6% for HbA$_{1c}$ 7% to <8%, 49.1% for HbA$_{1c}$ 8% to <10%, and 46.2% for those with HbA$_{1c}$ ≥10%; however, there was a nonsignificant trend toward more severe AP (class 2 as assessed by Rose Questionnaire) in those with HbA$_{1c}$ ≥7% (50.4%) vs <7% (27.1%; $P = 0.09$). This trend for a greater likelihood of Rose class 2 angina in those with HbA$_{1c}$ >7% vs <7% also held in multiple logistic regression adjusted for age, sex, and other risk factors (odds ratio [OR]: 1.73, 95% confidence interval [CI]: 0.71-4.25); however, glycemic control was not related to the likelihood of any angina (OR: 0.92, 95% CI: 0.65-1.31) or Rose AP in general (OR: 0.97, 95% CI: 0.54-1.71).

From multiple logistic regression (Table 3), adjusted for age, sex, and risk factors (including BMI), the odds of AP remained similar (1.06, 95% CI: 0.84-1.33) in those with vs without DM. Women, however, were nearly 2-fold more likely to have angina than men (OR: 1.74, 95% CI: 1.31-2.30). Specifically examining the likelihood of Rose AP in similar adjusted analyses shows similar results with no greater odds in those with vs without DM (OR: 0.90, 95% CI: 0.60-1.03), but more than a 2-fold greater likelihood of Rose AP in women vs men (OR: 2.39, 95% CI: 1.64-3.49). A similar analysis done specifically in those with DM showed no single variable to be significantly related to the likelihood of AP; however, a trend toward an increased likelihood of AP in women compared with men is present (OR: 1.66, 95% CI: 0.91-3.02; data not shown). In predicting Rose AP in a similar analysis among those with DM, women vs men were also more likely to have Rose AP (OR: 2.07, 95% CI: 1.12-3.57) in adjusted analyses.

We also assessed physical functioning using the self-reported data on functional limitations. In the overall CAD

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Table 3. Multiple Logistic Regression Examining Factors Associated With AP (N = 1787)

	OR	95% CI
DM	1.06	0.84–1.33
Age (per SD)	0.88	0.76–1.01
Ethnicity (compared with white)		
Mexican-American/other Hispanic	1.06	0.74–1.52
Non-Hispanic black	0.73	0.53–1.01
Other	1.67	0.82–3.38
Female sex	1.74	1.31–2.30
Smoking status		
Current smoking	1.04	0.71–1.51
Past smoking	1.13	0.85–1.51
SBP (per SD)	1.01	0.90–1.13
DBP (per SD)	0.90	0.79–1.02
TC (per SD)	1.11	0.96–1.28
HDL-C (per SD)	0.95	0.83–1.09
BMI (per SD)	1.10	0.96–1.26

Abbreviations: AP, angina pectoris; BMI, body mass index; CI, confidence interval; DBP, diastolic blood pressure; DM, diabetes mellitus; HDL-C, high-density lipoprotein cholesterol; OR, odds ratio; SBP, systolic blood pressure; SD, standard deviation; TC, total cholesterol.
Angina based on being positive either by self-report or Rose questionnaire.

cohort, we found that physical functioning was worse in those with vs without any AP (score of 25.9 vs 24.3; $P < 0.001$) or Rose AP (score of 29.4 vs 24.5; $P < 0.001$), with an even greater difference observed in those with vs without AP in the subset who had comorbid DM (26.7 vs 24.0, $P < 0.001$ for any AP and 30.7 vs 24.7, $P < 0.001$ for Rose AP; Figure 3). Adjustment for covariate risk factors showed these differences to persist in the overall CAD sample (score of 25.6 vs 24.1, $P < 0.001$ in those with vs without any angina and 28.7 vs 24.4, $P < 0.001$ in those with vs without Rose AP) and among those with DM (score of 26.3 vs 24.1, $P = 0.01$ in those with vs without any angina and 28.3 vs 24.8, $P = 0.03$ for those with vs without Rose angina).

In evaluating medication usage among those with any AP, comparing those with vs without DM there was great usage of β-blockers (63.3% vs 48.6%; $P < 0.001$), statins (62.1% vs 41.4%; $P < 0.001$), angiotensin-converting enzyme inhibitors (ACEIs; 41.4% vs 25.9%; $P < 0.001$), and antiplatelet therapy (17.4% vs 11.9%; $P < 0.05$; Figure 4). Examining these frequencies in those with Rose AP shows similar frequencies comparing those with vs without DM for β-blockers (66.9% vs 50.1%; $P < 0.01$), statins (70.9% vs 38.4%; $P < 0.001$), ACEIs (45.9% vs 29.6%; $P = 0.03$), and antiplatelet therapy (16.6% vs 12.7%; $P = 0.38$).

Discussion

Despite conventional belief that CAD patients with DM may experience less AP, our data from a sample of noninstitutionalized US adults with stable CAD suggest a similar likelihood of any AP and Rose AP specifically, irrespective of DM status, with a trend toward greater AP severity in DM patients with worse glycemic control. These observations exist despite greater use of evidence-based therapies in AP patients with DM vs without. β-Blockers and statins were the medications most commonly taken by patients with AP and DM in our study, and use of these therapies, along with ACEIs and antiplatelet therapy, was more common in AP patients with vs without DM. In our previously published report of adherence to secondary prevention treatment goals and recommended therapies in US adults with CHD in 2005 to 2006, we reported overall prevalence of β-blocker usage and usage in subjects with AP at 43% and 58%, respectively; however, that analysis did not examine AP prevalence comparing those with vs without DM, nor the use of antianginal medications specifically.[7]

In assessing the association of AP with daily physical activities, our results show that there is greater limitation in physical functioning in patients with AP, with further diminution of greater magnitude associated with AP in those with comorbid DM. These results also held in multivariable analyses and when looking at Rose AP specifically. The greater limitation of physical function in patients with AP and DM over AP alone could be in part due to increased BMI in DM patients; however, a difference in limitation of physical function was not seen when comparing patients with DM vs without in the overall CAD cohort. Perhaps greater AP severity, as found in DM patients with worse glycemic control, could be hypothesized as part of the explanation. Severity of persistent angina has been shown to be previously associated with impaired physical functioning as well as depression and anxiety,[8] and frequency of angina attacks with emotional, physical, social, and global scores of quality of life.[9]

In our analysis, women report more angina compared with men, both overall and in those with comorbid DM. Our results show an approximately 2-fold greater odds of angina in women compared with men, both overall and among those with DM and when looking at Rose AP specifically in fully adjusted analyses. This is interesting given conventional wisdom that women with CAD tend to have more atypical symptoms not characteristic of AP. The Bypass Angioplasty Revascularization Investigation 2 Diabetes (BARI 2D) trial of persons with CHD and DM also found that women with DM were more likely than men to have AP (67% vs 58%; $P < 0.01$).[10] We found similar results in our analysis, with a greater prevalence of AP among those with DM in women vs men (54.5% vs 44.8%; $P = 0.053$). Angina pectoris also is associated with further increases in mortality. Moreover, in the Rancho Bernardo population-based study of older persons, Carpiuc et al found that women with AP among those with DM had a 3- to 4-fold greater risk of dying from CAD compared with women without AP among those with DM.[11] There is a lack of studies of AP prevalence among nonhospitalized populations. A recent report from NHANES in the general adult population age ≥40 years showed angina prevalence to range from 2% to 3% in men and women age

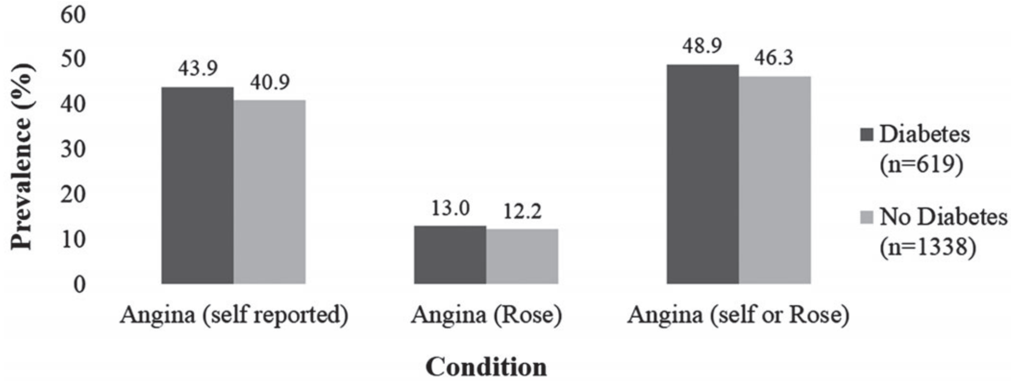

Figure 2. Prevalence (%) of angina (self-reported, Rose Questionnaire, or both) according to DM status. Abbreviations: DM, diabetes mellitus.

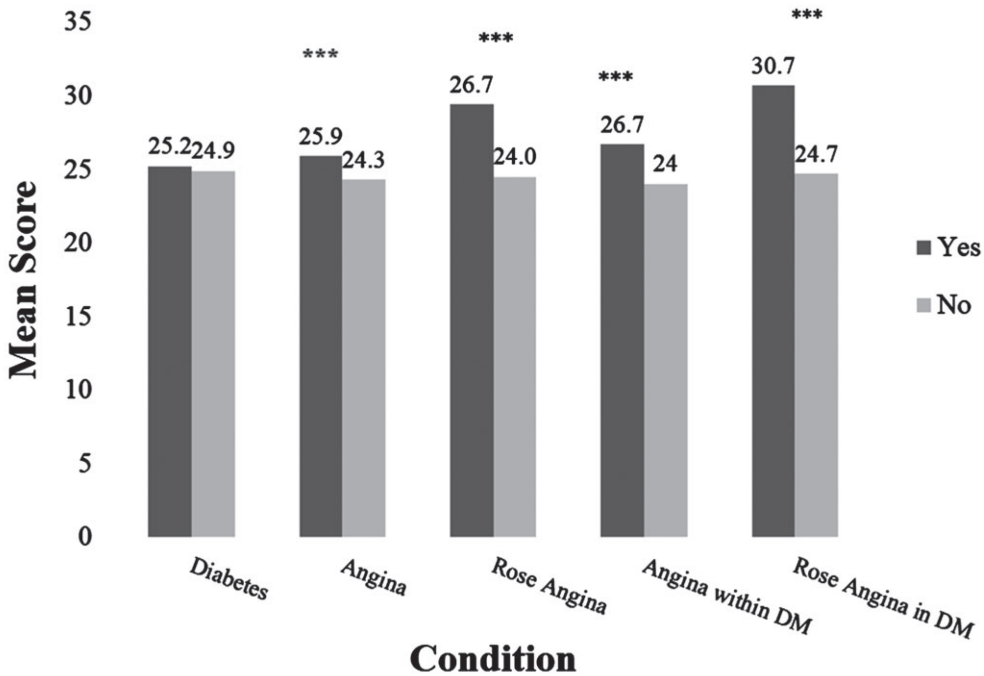

Figure 3. Mean index of physical functioning composite index according to DM status, angina status, and angina status among persons with DM. Higher scores indicate worse physical functioning. ****P* < 0.001 comparing those with vs without condition. Abbreviations: DM, diabetes mellitus.

40 to 64 years and in those age ≥65 years from 8% to 11% in men and 5% to 9% in women.[12] Also, in the population-based Cardiovascular Health Study of older adults, the prevalence of angina ranged from 9.1% in those without prior MI to 18.9% in those with an unrecognized MI and 63.3% in those with a recognized MI.[13] These reports did not note prevalence according to the presence or absence of DM, however.

Study Limitations

Our study has some limitations. Our sample represents a noninstitutionalized community-based sample of persons with CHD with and without DM that can be generalized to the US population. However, due to the cross-sectional nature of our study, we were unable to determine temporality between self-reported AP status and DM status. The data from NHANES also has limited ethnic categories, and certain ethnicities, including Asians, are not included. Also, the self-report determination of AP is fairly nonspecific, relying on the subject self-reporting that they had ever been told by a doctor or other health professional of having AP; thus, differentiation according to typical or atypical symptoms was not available. However, other population-based studies have documented the validity of self-reported angina as a valid diagnosis of angina.[14,15] Furthermore, the Rose questionnaire is much more rigid in its determination of AP, requiring current symptoms be present; thus, the prevalence by Rose is expectedly lower. Thus, we used a combination of AP by either self-report or Rose questionnaire to capture past or current AP, and completeness of response to self-report and Rose questionnaire items has been previously documented to be >99% by a recent report of AP prevalence in the general US

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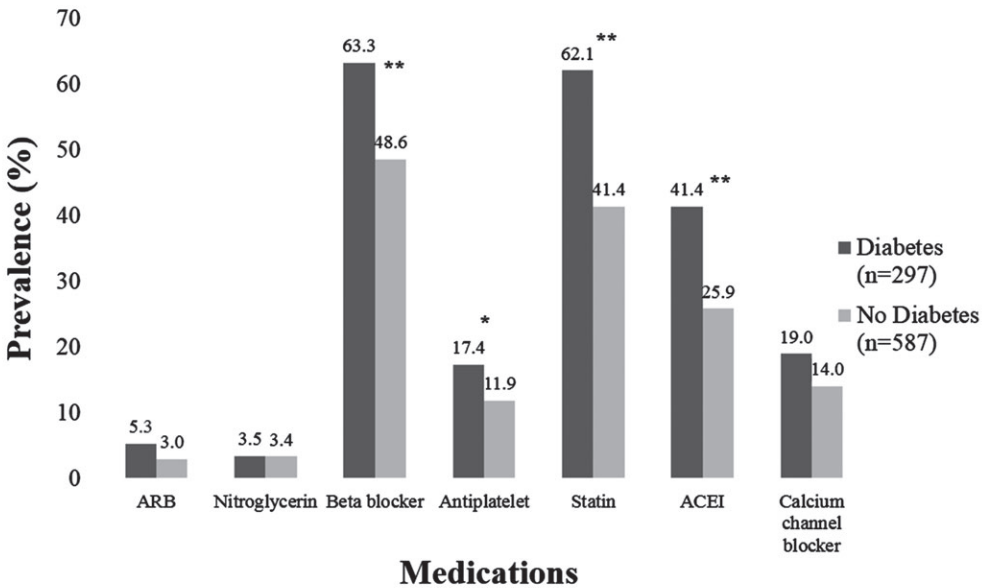

Figure 4. Prevalence (%) of medication use according to DM status among persons with angina. *$P < 0.05$, **$P < 0.001$ comparing those with vs without DM. Abbreviations: ACEI, angiotensin-converting enzyme inhibitor; ARB, angiotensin receptor blocker; DM, diabetes mellitus.

adult population (not specifically persons with CHD) that also shows lower AP prevalence by Rose questionnaire from self-report vs the Rose questionnaire.[12]

Conclusion

Our study demonstrates that in persons with known CHD, the prevalence of AP is similar in those with and without DM, with a trend toward greater AP severity in DM patients with worse glycemic control. These data help provide clarification to the commonly held misconception that AP is less prevalent in patients with DM. In addition, among patients with AP, those with DM appear to be better medically managed with evidenced-based cardiovascular therapies compared with those without DM. Despite this, the observed similar prevalence of AP in DM patients may suggest particular challenges in treatment of this comorbid population. Furthermore, the presence of comorbid DM in AP patients presents greater limitations in physical functioning than are seen in the overall AP population. Therefore, attention to appropriate angina management in CAD patients with DM is warranted, with goals of symptom improvement and improved physical functioning.

References

1. Malik S, Wong ND, Franklin SS, et al. Impact of the metabolic syndrome on mortality from coronary heart disease, cardiovascular disease, and all causes in United States adults. *Circulation.* 2004;110:1239–1250.
2. Dagenais GR, Lu J, Faxon DP, et al; Bypass Angioplasty Revascularization Investigation 2 Diabetes (BARI 2D) Study Group. Effects of optimal medical treatment with or without coronary revascularization on angina and subsequent revascularizations in patients with type 2 diabetes mellitus and stable ischemic heart disease. *Circulation.* 2011;123:1492–1500.
3. Arnold SV, Spertus JA, Lipska KJ, et al. Association between diabetes mellitus and angina after acute myocardial infarction: analysis of the TRIUMPH prospective cohort study. *Eur J Prev Cardiol.* 2015;22:779–787.
4. Rose GA. The diagnosis of ischaemic heart pain and intermittent claudication in field surveys. *Bull World Health Organ.* 1962;27:645–658.
5. US Department of Health and Human Services, US Centers for Disease Control and Prevention. *National Health and Nutrition Examination Survey (NHANES) 2007–2008 Laboratory Procedures Manual*. Hyattsville, MD: US Department of Health and Human Services; 2009.
6. US Department of Health and Human Services. *National Health and Nutrition Examination Survey Physical Functioning Questionnaire*. http://wwwn.cdc.gov/nchs/nhanes/2009-2010/PFQ_F.htm. Published September 2011. Accessed September 2013.
7. Tang L, Patao C, Chuang J, et al. Cardiovascular risk factor control and adherence to recommended lifestyle and medical therapies in persons with coronary heart disease (from the National Health and Nutrition Examination Survey 2007–2010). *Am J Cardiol.* 2013;112:1126–1132.
8. Jespersen L, Abildstrøm SZ, Hvelplund A, et al. Persistent angina: highly prevalent and associated with long-term anxiety, depression, low physical functioning, and quality of life in stable angina pectoris. *Clin Res Cardiol.* 2013;102:571–581.
9. Akyildiz ZI, Ergene O; PULSE Study Group. Frequency of angina and quality of life in outpatients with stable coronary artery disease in Turkey: insights from the PULSE study. *Acta Cardiol.* 2014;69:253–259.
10. Tamis-Holland JE, Lu J, Korytkowski M, et al; BARI 2D Study Group. Sex differences in presentation and outcome among patients with type 2 diabetes and coronary artery disease treated with contemporary medical therapy with or without prompt revascularization: a report from the BARI 2D Trial (Bypass Angioplasty Revascularization Investigation 2 Diabetes). *J Am Coll Cardiol.* 2013;61:1767–1776.
11. Carpiuc KT, Wingard DL, Kritz-Silverstein D, et al. The association of angina pectoris with heart disease mortality among men and women by diabetes status: the Rancho Bernardo Study. *J Womens Health (Larchmt)*. 2010;19:1433–1439.

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DOI:10.1002/clc.22488

12. Will JC, Yuan K, Ford E. National trends in the prevalence and medical history of angina: 1988 to 2012. *Circ Cardiovasc Qual Outcomes.* 2014;7:407–413.
13. Sheifer SE, Gersh BJ, Yanez ND 3rd, et al. Prevalence, predisposing factors, and prognosis of clinically unrecognized myocardial infarction in the elderly. *J Am Coll Cardiol.* 2000;35:119–126.
14. Lampe FC, Walker M, Lennon LT, et al. Validity of a self-reported history of doctor-diagnosed angina. *J Clin Epidemiol.* 1999;52:73–81.
15. Haapanen N, Miilunpalo S, Pasanen M, et al. Agreement between questionnaire data and medical records of chronic diseases in middle-aged and elderly Finnish men and women. *Am J Epidemiol.* 1997;145:762–769.

Published online in Wiley Online Library (wileyonlinelibrary.com)
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