

BRIEF REPORT

# Prevalence of multiple cardiac risk factors in US adults with diabetes

Marianne McCollum<sup>a</sup>, Samuel L. Ellis<sup>a</sup>, Elaine H. Morrato<sup>a,b</sup> and Patrick W. Sullivan<sup>a</sup>

<sup>a</sup> School of Pharmacy, University of Colorado at Denver and Health Sciences, Denver, CO, USA

<sup>b</sup> Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA

*Address for correspondence:* Marianne McCollum, PhD, 4200 East 9th Avenue, University of Colorado at Denver and Health Sciences Center, School of Pharmacy, Box C238, Denver, CO 80262, USA. Tel.: +1 303 315 8952; Fax: +1 303 315 4630; email: Marianne.McCollum@uchsc.edu

*Key words:* Cardiovascular disease – Diabetes – Risk factors

## ABSTRACT

*Purpose:* The National Cholesterol Education Program, Adult Treatment Panel III (NCEP ATP III) included diabetes mellitus (DM) as a risk factor for major coronary events equivalent to existing coronary heart disease (CHD). This study estimates the national prevalence of additional CHD risk factors for US adults with and without DM and heart disease using Medical Expenditure Panel Survey (MEPS) data.

*Methods:* In this retrospective study using nationally representative 2000 and 2002 MEPS survey data, DM and CHD for adult respondents ( $n = 44\,481$ ) were identified by ICD-9 codes or self-reported DM, coronary heart disease, angina, heart attack or stroke, or other heart disease. Six additional risk factors assessed were hypertension, hypercholesterolemia, smoking, age ( $\geq 45$  years [men],  $\geq 55$  years [women]), obesity, and physical inactivity. The national prevalence of cardiac risk factors was assessed in four subgroups: CHD-/DM-, CHD-/DM+, CHD+/DM-, CHD+/DM+.

*Results:* The CHD-/DM+ group had significantly

higher mean risk factor counts than did the CHD-/DM- group and the CHD+/DM- group (2.6 versus 1.4 and 2.4, respectively; both  $p < 0.01$ ). The CHD+/DM+ group had the highest mean risk factor count at 3.4. Proportions of US adults in each subgroup with two or more risk factors were CHD-/DM-: 39.5%; CHD-/DM+: 81.9%; CHD+/DM-: 74.9%; CHD+/DM+: 95.1%. Limitations of this study include the use of self-reported data and the lack of data regarding family history of CHD, both of which are likely to result in conservative prevalence estimates.

*Conclusion:* Results presented here indicate that diabetes, with or without co-morbid heart disease, is associated with a high prevalence of cardiac risk factors in US adults. The prevalence estimates reported here demonstrate the extensiveness of this public health issue. It is essential that medical providers treat modifiable risk factors in patients with diabetes aggressively with lifestyle modifications and pharmacotherapy consistent with NCEP ATP III recommendations.

## Introduction

Diabetes affects over 20 million Americans, and is associated with a risk of death twice that of people without diabetes<sup>1</sup>. Direct costs to treat diabetes in 2002 were \$92 billion, double the estimate from just 5 years

earlier<sup>2</sup>. In addition, diabetes is the leading cause of blindness and renal failure in the United States<sup>1</sup>.

The National Cholesterol Education Program, Adult Treatment Panel III (NCEP ATP III) included diabetes mellitus (DM) as a risk factor for major coronary events equivalent to existing coronary heart

disease (CHD)<sup>3</sup>. This designation is supported by a number of studies using various large US and European cohorts reporting an increased risk for cardiac events and mortality among people with metabolic syndrome and diabetes<sup>4-10</sup>. Cardiac risk factors have been shown in clinical trials to be treatable<sup>11</sup>, and Healthy People 2010 has set national targets for smoking cessation, weight control, and monitoring of cholesterol levels and blood pressure<sup>12</sup>.

National statistics on the prevalence of individual cardiac risk factors are available from the American Heart Association and databases such as the Center for Disease Control's Behavioral Risk Factor Surveillance System<sup>13-15</sup>, as well as other large cohorts<sup>16</sup>. However, data on the magnitude of the combined public health problem, the prevalence of multiple cardiovascular risk factors in patients with and without diabetes and CHD, are limited. We used the Medical Expenditure Panel Survey (MEPS) to determine the US prevalence of multiple CHD risk factors (in addition to CHD and/or DM) among people with and without CHD and DM.

## Patients and methods

Data on demographic characteristics, behaviors, and medical conditions (i.e., age, sex, body mass index [BMI, calculated from self-reported height and weight], smoking history, and physical activity) were obtained from the MEPS databases. MEPS is cosponsored by AHRQ and the National Center for Health Statistics (NCHS), and is a nationally representative sample of the US civilian non-institutionalized population<sup>17</sup>. Use of the MEPS database for these analyses met two important criteria. First, because the database is nationally representative, the results are generalizable to the US population. Second, the database includes the patient-level variables necessary to conduct this study.

The sample design of the MEPS survey includes stratification, clustering, multiple stages of selection, and disproportionate sampling<sup>17</sup>. MEPS sampling weights reflect adjustments for survey non-response and population totals from the Current Population Survey. To obtain nationally representative prevalence estimates from MEPS survey data, MEPS survey weights were applied in all statistical analyses<sup>17</sup>.

MEPS uses a rolling survey design in which data collection is begun for a new representative sample of households each year and repeated over a 2-year period to provide overlapping panels of survey data<sup>17</sup>. MEPS data from alternating years (2000 and 2002) were pooled for these analyses to increase sample size. Given the overlapping design, data from 2001 were excluded to avoid using repeated measures for a subset of the same subjects.

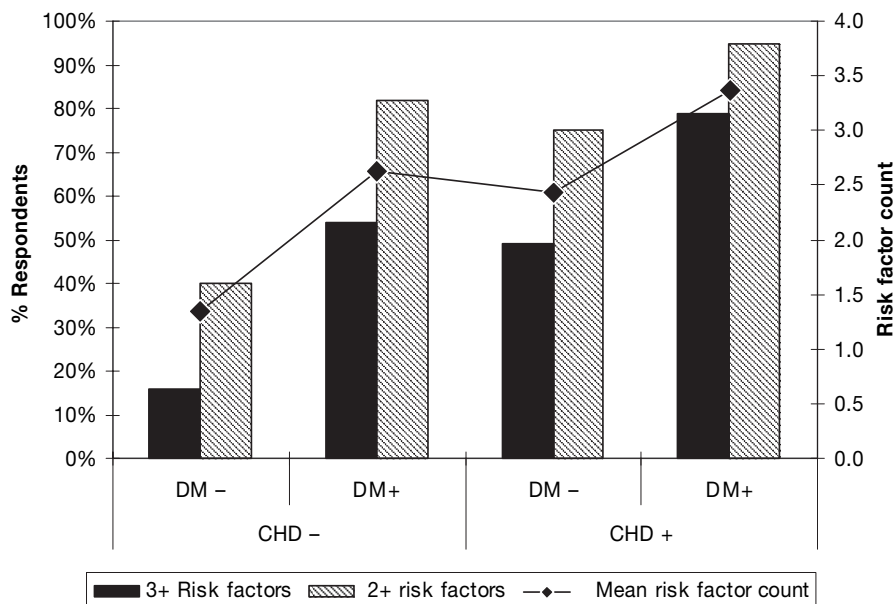
Medical conditions were based on ICD-9-Clinical Modification (ICD-9) codes<sup>18</sup>, truncated to three digits in the MEPS database to ensure privacy for respondents. All analyses were conducted using STATA 8.1 (StataCorp, College Station, TX) to account for the complex sampling structure of MEPS by using MEPS-provided person-level and variance adjustment weights, ensuring nationally representative estimates. The Colorado Multiple Institution Review Board approved this study.

MEPS respondents 18 years of age and older were included and assigned to one of four groups: CHD-/DM-; CHD-/DM+; CHD+/DM-; or CHD+/DM+. CHD status was based on ICD-9 codes for one or more of the following: acute myocardial infarction (MI), acute ischemic heart disease (IHD), old MI, angina, chronic IHD, heart failure, stroke, atherosclerosis, peripheral vascular disease, or a yes answer when the respondent was asked if they had ever been diagnosed with CHD, angina, heart attack, stroke, or other heart disease. Diabetes status was based on the presence of ICD-9 code or a yes answer when asked if they had ever been diagnosed with diabetes.

Data on six cardiac risk factors, exclusive of diabetes and/or cardiovascular disease, were obtained from the MEPS database: hypertension (based on ICD-9 code), hypercholesterolemia (based on ICD-9 code), history of smoking, age (men  $\geq 45$  years, women  $\geq 55$  years), obesity as determined by body mass index (BMI)  $\geq 30$  kg/m<sup>2</sup>, and lack of physical activity. Differences between mean CRF counts and proportion of each group at each risk factor level were determined using the z-test.

## Results

A total of 44 481 respondents 18 years of age or older were surveyed, a cohort that represented 416.4 million US adults during the 2 years (2000 and 2002). Prevalence of multiple risk factors and mean risk factor counts for each group are shown in Figure 1. The prevalence of two or more cardiac risk factors was significantly higher among adults with diabetes than without, regardless of CHD status (CHD+: 95% vs. 75%; CHD-: 82% vs. 40%, both  $p < 0.01$ ). Similarly, adults with diabetes with and without CHD had a significantly higher prevalence of three or more risk factors compared to those without diabetes (CHD+: 79% vs. 49%; CHD-: 55% vs. 16%, both  $p < 0.01$ ). Mean risk factor counts, exclusive of diabetes or CHD, were significantly higher ( $p < 0.01$ ) for the CHD-/DM+ group (2.6, SE = 0.03) than either the CHD-/DM- group (1.3, SE = 0.01) or the CHD+/DM- group



**Figure 1.** Percent of respondents with two or more and with three or more risk factors and mean risk factor count, exclusive of diabetes or CHD, stratified by CHD and DM status. Notes: Risk factors include diagnosis of hypertension (based on ICD-9 code), hypercholesterolemia (based on ICD-9 code), history of smoking, age (men  $\geq 45$  years, women  $\geq 55$  years), obesity as determined by body mass index (BMI)  $\geq 30 \text{ kg/m}^2$ , and lack of physical activity. Risk factor counts are exclusive of CHD and DM. Abbreviations: CHD = coronary heart disease; DM = diabetes mellitus.

(2.4, SE = 0.03). The CHD+/DM+ group had a mean CRF count of 3.4 (SE = 0.04), significantly higher than the CHD-/DM+ and CHD+/DM- groups ( $p < 0.01$ ).

## Discussion

The presence of diabetes, with or without existing CHD, is associated with a high prevalence of multiple cardiac risk factors in the general population, putting people with diabetes at high risk for major coronary events. Of note as well is the result that 40% of US adults without diagnosed diabetes or CHD have two or more cardiac risk factors, a proportion that would increase with the inclusion of family history. The national prevalence of multiple cardiac risk factors in US adults reported here demonstrates the extensiveness of this public health issue in patients before and after developing diabetes and/or CHD.

Clinical trials investigating treatment of type 2 diabetes have in the past focused on individual risk factors<sup>19</sup>. The high prevalence of multiple cardiac risk factors reported here supports the need for study and implementation of multifactorial treatment interventions. A number of ongoing trials continue to investigate the ability of multiple interventions targeting lifestyle issues, hypertension, dyslipidemia, and glycemic control to reduce cardiovascular risk in diabetes<sup>20</sup>. Completed trials, such as the STENO-2 study, document the significant benefits in micro-

vascular and macrovascular outcomes that accompany multi-interventional strategies to reduce cardiovascular risk factors<sup>21</sup>. The public health challenge remaining is to translate these research results into routine practice in primary care settings.

Limitations of this study include the use of self-reported data and the lack of data regarding family history of CHD. In addition, information on undiagnosed conditions is not included in the database. However, self-reported data are often used in large database studies involving diabetes<sup>7,9,22</sup>, and the potential under-reporting of conditions from patient self-report is likely to result in conservative prevalence estimates.

Future studies with the MEPS database will build upon the results of the present study by investigating levels of use of appropriate medications and patterns of physician advice to exercise and monitor diet in patients with cardiovascular risk factors. Further study is also warranted to identify the prevalence of risk factors in cohorts in which clinical data and family history are available. Based on the limitations of national data sets, these studies may be limited to smaller, regional or local cohorts.

## Conclusion

Considering the proportions of US adults with diabetes and with multiple cardiac risk factors in this nationally

representative database, it is important that health care providers aggressively educate patients and treat modifiable risk factors through lifestyle modifications and pharmacotherapy consistent with NCEP ATP III recommendations before patients develop CHD. For patients with diabetes, with or without CHD, effective treatment is critical for primary and secondary prevention of cardiovascular disease.

## Acknowledgments

**Declaration of interest:** This study was conducted without external funding. No editorial assistance was obtained for the preparation of this manuscript, and no conflicts of interest exist on the part of any authors.

## References

- Centers for Disease Control and Prevention. National diabetes fact sheet: general information and national estimates on diabetes in the United States, 2005. Atlanta, GA: US. Department of Health and Human Services; 2005
- American Diabetes Association. Economic costs of diabetes in the US in 2002. *Diabetes Care* 2003;26:917-32
- National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). Third report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III) final report. *Circulation* 2002;106:3143-421
- Haffner SM, Lehto S, Ronnema T, et al. Mortality from coronary heart disease in subjects with Type 2 diabetes and in non-diabetic subjects with and without prior myocardial infarction. *New Engl J Med* 1998;339:229-34
- Juutilainen A, Lehto S, Ronnema T, et al. Type 2 diabetes as a 'coronary heart disease equivalent'. *Diabetes Care* 2005;28:2901-7
- Whiteley L, Padmanabhan S, Hole D, et al. Should diabetes be considered a coronary heart disease risk equivalent? *Diabetes Care* 2005;28:1588-93
- Egede LE, Nietert PJ, Zheng D. Depression and all-cause and coronary heart disease mortality among adults with and without diabetes. *Diabetes Care* 2005;28:1339-45
- Wannamethee SG, Shaper AG, Lennon L. Cardiovascular disease incidence and mortality in older men with diabetes and in men with coronary heart disease. *Heart* 2004;90:1398-403
- 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;110:1245-50
- Lee CD, Folsom AR, Pankow JS, et al. Cardiovascular events in diabetic and nondiabetic adults with or without a history of myocardial infarction. *Circulation* 2004;109:855-60
- Bowman BA, Gregg EW, Williams DE, et al. Translating the science of primary, secondary, and tertiary prevention to inform the public health response to diabetes. *J Public Health Manag Pract* 2003;November:S8-14
- US Department of Health and Human Services. Healthy people 2010, 2nd ed. With understanding and improving health and objectives for improving health [2 vols]. Washington (DC): US Government Printing Office; November 2000
- American Heart Association. Heart disease and stroke statistics – 2005 update. Dallas (TX): American Heart Association; 2005
- Egede LE, Zheng D. Modifiable cardiovascular risk factors in adults with diabetes. *Arch Intern Med* 2002;162:427-33
- Strine TW, Beckles GL, Okoro CA, et al. Prevalence of CVD risk factors among adults with diabetes by mental distress status. *Am J Health Behav* 2004;28:464-70
- Katon WJ, Lin EHB, Russo J, et al. Cardiac risk factors in patients with diabetes mellitus and major depression. *J Gen Intern Med* 2004;19:1192-9
- Anon. Overview of the medical expenditure panel survey. Rockville (MD): Agency for Healthcare Research and Quality; January 2004. <http://www.meps.ahrq.gov/whatis/meps/overview.htm> [accessed February, 2004]
- Anon. The International classification of diseases, 9th revision, clinical modification : ICD-9-CM. 2nd ed. Washington (DC): US Dept. of Health and Human Services, Public Health Service, US Government Printing Office; 1980
- Gaede P, Pedersen O. Target intervention against multiple-risk markers to reduce cardiovascular disease in patients with type 2 diabetes. *Ann Med* 2004;36:355-66
- Mazzone T. Strategies in ongoing clinical trials to reduce cardiovascular disease in patients with diabetes mellitus and insulin resistance. *Am J Cardiol* 2004;93:27C-31C
- Gaede P, Vedel P, Larsen N, et al. Multifactorial intervention and cardiovascular disease in patients with type 2 diabetes. *New Engl J Med* 2003;348:383-93
- Saydah SH, Fradkin J, Cowie CC. Poor control of risk factors for vascular disease among adults with previously diagnosed diabetes. *J Am Med Assoc* 2004;291:335-42

CrossRef links are available in the online published version of this paper:

<http://www.cmrojourn.com>

Paper CMRO-3418\_3, *Accepted for publication:* 03 April 2006

*Published Online:* 21 April 2006

doi:10.1185/030079906X104894