Modifiable Cardiovascular Risk Factors in Adults With Diabetes
Prevalence and Missed Opportunities for Physician Counseling

Leonard E. Egede, MD, MS; Deyi Zheng, MB, PhD

Background: Cardiovascular disease (CVD) is the leading cause of death in adults with diabetes mellitus (DM). Counseling by physicians is effective in inducing lifestyle modification.

Objective: To determine the prevalence of modifiable CVD risk factors and counseling by physicians among adults with DM.

Methods: Data on 9496 adults with DM and 150493 adults without DM from the 1999 Behavioral Risk Factor Surveillance System were analyzed to yield estimates of CVD risk factors and counseling by physicians during routine visits. Multiple logistic regression was used to adjust estimates for age, sex, ethnicity, education, and income. Population estimates were created using software for the statistical analysis of correlated data (SUDAAN) because of the complex survey design of the Behavioral Risk Factor Surveillance System.

Results: Diabetes mellitus was more prevalent in adults aged 55 and older and in blacks and Hispanic or other ethnicities (both P < 0.001). Modifiable CVD risk factors, such as hypertension (56% vs 22%), high cholesterol (41% vs 20%), obesity (78% vs 57%), and insufficient physical activity (66% vs 56%), were more prevalent in adults with DM (all P < 0.001) and differed by ethnicity, sex, and age. Counseling about weight loss (50% vs 21%, P < 0.001), smoking cessation (78% vs 67%, P = 0.01), eating less fat (78% vs 71%, P < 0.001), and increasing physical activity (67% vs 36%, P < 0.001) was less than ideal in both groups and did not change after adjusting for age, sex, ethnicity, education, and income with multiple logistic regression.

Conclusions: Although adults with DM have a high prevalence of modifiable CVD risk factors, counseling by physicians about lifestyle modification is less than optimal. There is a need to improve patient counseling for lifestyle modification by primary care physicians.

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Diabetes Mellitus (DM) is prevalent in the United States. About 10.5 million persons had a diagnosis of DM in 1999, and about 800,000 new diagnoses are made each year.1 Diabetes is associated with significant morbidity and mortality, and the economic burden of DM to the individual and to society is substantial, including direct costs and indirect costs, such as disability, work loss, and premature mortality.1-3

Cardiovascular disease (CVD) is the leading cause of death in persons with DM. Persons with DM have a 2- to 4-fold increased risk of death from CVD than adults in the general population of similar age. In addition, CVD accounts for 48% of deaths among persons with DM4-5 and is listed as the cause of death in about 65% of persons with DM.6 Once patients with DM develop CVD, the prognosis worsens, compared with persons without DM,7-12 and the cost of care increases dramatically.13,14

Although there are several recognized CVD risk factors, strategies to reduce the risk of CVD focus on controlling hypertension, high cholesterol, obesity, smoking, and sedentary lifestyle, because they are amenable to lifestyle modification. Because more than 70% of adults with DM receive routine care in primary care settings,15 primary care physicians are particularly well suited to provide counseling about lifestyle modification. Consequently, the US Preventive Services Task Force,16 American Heart Association,17 and American Diabetes Association18 recommend counseling about modifiable CVD risk factors during preventive health examinations in primary care.
RESEARCH METHODS AND DESIGN

This is a cross-sectional study of data on adults with DM obtained from the 1999 BRFSS. The BRFSS is a state-based, random-digit dialing telephone survey of the non-institutionalized, civilian population of the United States aged 18 and older. Details about the BRFSS survey and methods have been published previously.20-22

Our sample included only individuals who responded to specific BRFSS questions. “Yes” responses were coded as one group, while “no,” “not sure,” “don’t know,” or “refused to answer” were combined into another group. Individuals who had no responses coded (“missing” or “skipped”) were excluded from our analysis. In 1999, there were 9496 adults with diagnosed DM, based on self-report that a physician had told them they had DM. We excluded persons who reported a diagnosis of DM during pregnancy. We defined modifiable CVD risk factors as the presence of hypertension, high cholesterol, obesity, smoking, or insufficient physical activity. Our definition of modifiable CVD risk factors is consistent with that used in previous studies.23-27

Hypertension and high cholesterol groups were each derived from respondents who reported ever having been told by a physician that they had high blood pressure or high cholesterol. The obesity category was derived from the respondents’ body mass index (BMI) and was defined as weight in kilograms divided by the square of height in meters. We based our classification of overweight and obesity on the recommendation by the National Heart, Lung, and Blood Institute in 1998.28 According to this classification, a BMI less than 18.5 is classified as underweight, 18.5 to 24.9 as normal weight, and 25.0 to 29.9 as overweight. Further classifications include obesity 1 (BMI, 30.0-34.9), obesity 2 (BMI, 35.0-39.9), and extreme obesity (BMI, ≥40.0). For the analysis, we used 4 weight categories: normal weight (BMI, 18.5-24.9), overweight (BMI, 25.0-29.9), obesity (BMI, 30.0-39.9), and extreme obesity (BMI, ≥40.0).

Current smoking was defined as individuals who reported having smoked 100 cigarettes in their lifetime and who smoked currently. Insufficient physical activity was defined as individuals who reported having no leisure-time physical activity or physical activity less than 20 minutes 3 or more times per week. Education was defined as the highest grade or year of school completed, and income was defined as the annual household income from all sources. The physician checkup group was derived from respondents who reported seeing a physician for a routine checkup within the past year (1-12 months previously).

To determine the prevalence of modifiable CVD risk factors among adults with DM and the prevalence of counseling by physicians about such risk factors, we analyzed data from the 1999 Behavioral Risk Factor Surveillance System (BRFSS).10

Opportunity for counseling was present if an individual reported having a checkup by a physician within the previous 12 months. Counseling was said to have occurred if during the previous 12 months an individual reported that a physician or other health care professional talked to them about weight loss, exercise, eating foods with less fat or cholesterol, or quitting smoking. Missed opportunity for counseling about modifiable CVD risk factors was defined as the absence of counseling in an individual with CVD risk factors who reported having a physician checkup within the previous 12 months.

Three ethnic groups (white, black, and Hispanic or other) and 3 age categories (18-34, 35-54, and ≥55 years) were used for the analysis. Two categories of income (<$23 000 and ≥$25 000), based on federal poverty levels, and 2 categories of education (less than high school and high school education or higher) were determined.

We performed 3 levels of statistical analyses. First, the prevalence of CVD risk factors was compared between adults with and without DM. Second, the prevalence of CVD risk factors was determined among persons with DM by ethnicity, sex, and age. To determine the prevalence of counseling by physicians for modifiable CVD risk factors, the denominator consisted of the number of persons with each CVD risk factor seen by a physician in the previous year.

For example, opportunity for counseling for smoking cessation was determined among smokers who reported having at least one physician checkup in the previous 12 months. Similarly, among persons who had a checkup, opportunities for counseling about weight loss were among persons with overweight and obesity, counseling about eating less fat among persons with high cholesterol, and counseling about regular physical activity among all adults. This resulted in different sample sizes for the different CVD risk factors.

Third, we compared the prevalence of counseling for modifiable CVD risk between adults with and without DM. Multiple logistic regression was used to control for age, sex, ethnicity, education, and income for counseling by physicians about CVD risk factors to obtain adjusted prevalence. Because of the complex sampling design of the BRFSS, commercially available software (SAS29 and SUDAAN30) was used for statistical analyses to obtain variance estimates. The weighting factor in BRFSS produces national estimates of missing data for differences of sampling in geographic regions, telephone density, number of telephones in a household, number of adults in a household, selected cluster size, and distribution of age, sex, and ethnicity in the selected population of the sampling states.19

RESULTS

Table 1 compares the baseline characteristics of adults with and without DM. Women constituted 52% of both groups (P < .93). There were higher percentages of blacks and Hispanic or other ethnicities in the DM group compared with the group without DM, and there were higher percentages of adults aged 55 and older in the DM group (both P < .001). Likewise, the percentage of persons with less than a high school education (59% vs 46%) and a household income less than $25 000 (58% vs 42%) was higher among adults with DM compared with adults without DM (both P < .001).

Comparing modifiable CVD risk factors between groups with and without DM, the prevalence of self-reported insufficient physical activity was high in both
groups, but was higher among persons with DM (66% vs 56%, P < .001). Similarly, the prevalence of hypertension (56% vs 22%), high cholesterol (41% vs 20%), and overweight and obesity (78% vs 57%) was higher among adults with DM compared with adults without DM (all P < .001). Conversely, the prevalence of smoking was higher in adults without DM (23% vs 15%, P < .001).

**Table 2** compares the prevalence of modifiable CVD risk factors by ethnicity, sex, and age among adults with DM. Hypertension was more prevalent in blacks, followed by whites and Hispanic or other ethnicities (64% vs 56% vs 50%, P < .001). Overweight and obesity were more prevalent in blacks and Hispanic or other ethnicities and less prevalent in whites (84% vs 78% vs 77%, P = .002). The prevalence of smoking (15% vs 19% vs 15%, P = .07), high cholesterol (42% vs 42% vs 38%, P = .26), and insufficient physical activity (66% vs 61% vs 73%, P = .27) was not significantly different across the 3 ethnic groups.

Comparing risk factors by sex, the prevalence of hypertension (59% vs 53%, P < .001) and high cholesterol (43% vs 39%, P = .01) was higher in women than in men. Although men and women had similar overweight and obesity prevalence (79% vs 78%), women were more likely to have extreme obesity with a BMI of 40 or higher (16% vs 6%, P < .001). The prevalence of insufficient physical activity and smoking did not differ significantly by sex.

Comparing CVD risk factors across age groups (Table 2), the prevalence of hypertension (27% vs 49% vs 62%) and high cholesterol (17% vs 40% vs 44%) increased with increasing age (both P < .001). The prevalence of insufficient physical activity did not differ significantly (77% vs 61% vs 67%, P = .13), while overweight and obesity (77% vs 83% vs 77%, P < .001) differed across the 3 age groups in an unpredictable manner. In contrast, the prevalence of smoking decreased with increasing age (29% vs 23% vs 11%, P < .001).

A comparison of the prevalence of counseling for modifiable CVD risk factors in adults with and without DM is shown in Table 3. Among adults with a BMI of 25 or higher who reported having a physician checkup within the previous year, 50% of adults with DM reported receiving counseling from a health care professional about weight loss, compared with 21% in adults without DM. Similarly, among adults who reported having a physician checkup who also had modifiable CVD risk factors, such as smoking, physical inactivity, or high cholesterol, the prevalence of counseling was less than optimal. Adults with DM were more likely to receive counseling about increasing physical activity (67% vs 36%, P < .001), smoking cessation (78% vs 67%, P = .01), and

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**Table 1. Baseline Characteristics Among Persons With and Without Diabetes**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>With Diabetes (n = 12 214 135 [9496])</th>
<th>Without Diabetes (n = 193 469 510 [150 493])</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sex</strong></td>
<td></td>
<td></td>
<td>.93</td>
</tr>
<tr>
<td>Men</td>
<td>48.1 (46.4-49.8)</td>
<td>48.0 (47.6-48.4)</td>
<td></td>
</tr>
<tr>
<td>Women</td>
<td>51.9 (50.2-53.6)</td>
<td>52.0 (51.6-52.4)</td>
<td></td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
<td>&lt;.001</td>
</tr>
<tr>
<td>White</td>
<td>66.0 (64.2-67.8)</td>
<td>73.5 (73.1-73.9)</td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>14.4 (13.2-15.6)</td>
<td>9.4 (9.2-9.6)</td>
<td></td>
</tr>
<tr>
<td>Hispanic or other</td>
<td>19.6 (17.9-21.3)</td>
<td>17.1 (16.8-17.5)</td>
<td></td>
</tr>
<tr>
<td><strong>Age, y</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-34</td>
<td>6.0 (5.0-7.0)</td>
<td>33.1 (32.7-33.5)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>35-54</td>
<td>28.2 (26.6-29.8)</td>
<td>39.3 (38.9-39.7)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>≥55</td>
<td>65.8 (64.1-67.5)</td>
<td>27.6 (27.2-28.0)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;High school</td>
<td>59.3 (57.6-61.0)</td>
<td>45.8 (45.4-46.2)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>≥High school</td>
<td>40.7 (39.0-42.4)</td>
<td>54.2 (53.8-54.6)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td><strong>Income</strong></td>
<td></td>
<td></td>
<td>&lt;.001</td>
</tr>
<tr>
<td>&lt;$25 000</td>
<td>57.9 (57.6-61.0)</td>
<td>41.7 (41.3-42.1)</td>
<td></td>
</tr>
<tr>
<td>≥$25 000</td>
<td>42.1 (40.4-43.8)</td>
<td>58.3 (57.9-58.7)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td><strong>Physician checkup</strong></td>
<td></td>
<td></td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Normal weight (18.8-24.9)</td>
<td>21.6 (20.1-23.1)</td>
<td>43.4 (43.0-43.8)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Overweight (25.0-29.9)</td>
<td>34.0 (32.3-35.7)</td>
<td>35.4 (35.0-35.8)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Obese (30.0-39.9)</td>
<td>33.3 (31.7-34.9)</td>
<td>15.8 (15.5-16.1)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Extremely obese (≥40.0)</td>
<td>11.1 (10.0-12.2)</td>
<td>5.5 (5.3-5.7)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td><strong>BMI</strong></td>
<td></td>
<td></td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Normal weight (18.8-24.9)</td>
<td>21.6 (20.1-23.1)</td>
<td>43.4 (43.0-43.8)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Overweight or obese (≥25.0)</td>
<td>78.4 (77.0-80.0)</td>
<td>56.6 (56.2-57.0)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Normal weight (18.5-24.9)</td>
<td>21.6 (20.1-23.1)</td>
<td>43.4 (43.0-43.8)</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

*Data are given as percentage (95% confidence interval). Body mass index (BMI) is defined as weight in kilograms divided by the square of height in meters.
†Weighted sample size [unweighted sample size].
‡This question was not asked by all states.

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previous studies on DM. The finding of a higher prevalence of modifiable CVD risk factors among persons with DM is not surprising. The clustering in certain individuals of DM, hypertension, high cholesterol, and obesity, known as the metabolic cardiovascular syndrome or the deadly quartet, has been described. In fact, a recent article put DM alongside other major risk factors as an important cause of CVD for a similar reason.

In this study, the prevalence of overweight and obesity, insufficient physical activity, cigarette smoking, hypertension, and high cholesterol is similar to the findings reported by the Centers for Disease Control and Prevention, based on data from the 1997 BRFSS. In our study, the prevalence of overweight and obesity in persons without DM was 57%, compared with 54% in the general population in the 1997 study. The prevalence of insufficient physical activity (56%) differed from that reported in 1997 (28%). A likely explanation for the difference is the fact that individuals of DM, hypertension, high cholesterol, and obesity, known as the metabolic cardiovascular syndrome or the deadly quartet, has been described. In fact, a recent article put DM alongside other major risk factors as an important cause of CVD for a similar reason.

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Table 3. Comparison of the Prevalence of Counseling for Modifiable Cardiovascular Disease Risk Factors Among Persons With and Without Diabetes

<table>
<thead>
<tr>
<th>Counseling Topics</th>
<th>With Diabetes</th>
<th>Without Diabetes</th>
<th>P Value‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight loss</td>
<td>374 852 (221)</td>
<td>49.8 (40.6-59.0)</td>
<td></td>
</tr>
<tr>
<td>Smoking cessation</td>
<td>134 272 (156)</td>
<td>77.7 (69.7-85.7)</td>
<td></td>
</tr>
<tr>
<td>Increasing physical activity</td>
<td>886 279 (875)</td>
<td>67.4 (63.2-71.7)</td>
<td></td>
</tr>
<tr>
<td>Eating less fat</td>
<td>1 572 274 (1245)</td>
<td>77.9 (73.8-82.0)</td>
<td></td>
</tr>
</tbody>
</table>

CI indicates confidence interval.
†Weighted sample size (unweighted sample size).
‡P value adjusted for age, sex, ethnicity, education, and income.

nition of physical inactivity used in the years of comparison. The calculation for physical inactivity in 1997 was based on the percentage of adults who did not engage in any leisure-time physical activity other than regular job duties.22,34 In contrast, physical inactivity in 1999 was defined as individuals who reported having no leisure-time physical activity or who had physical activity less than 20 minutes 3 or more times per week.19 The 1999 definition is more likely to increase the percentage of insufficient physical activity among adults in the United States than the 1997 definition used for the estimates by the US Preventive Services Task Force16 on state-specific prevalence of participation in physical activity were close to our estimates. The definition of insufficient physical activity used in that study was similar to the definition in our study, and 64% to 84% (median, 73%) of respondents reported no leisure-time activity or irregular activity. Therefore, our estimate on insufficient physical activity in the US population appears to be reliable.

The findings from this study suggest that primary care physicians are doing a less than optimal job in counseling patients about lifestyle modification for CVD risk factors, particularly in those at high risk. Counseling efforts in primary care were less than ideal in patients with and without DM. These findings are concerning because they indicate that, despite the evidence that each modifiable CVD risk factor is independently associated with heart disease and mortality, physicians are not acting in a consistent manner. The evidence is established for hypertension, high cholesterol, cigarette smoking, physical activity, and obesity.33,54

There is also evidence to support the efficacy of counseling by physicians in modifying CVD risk behavior, including smoking cessation, physical activity, healthy diets, leading to the recommendations published by the US Preventive Services Task Force,16 American Heart Association,17 and American Diabetes Association.18 Consequently, it is unclear why the prevalence of counseling remains less than optimal in primary care settings.

This is not the only study that has documented low levels of counseling by physicians for CVD risk factors. A recent study19 on physician advice about CVD risk reduction in 7 US states and Puerto Rico showed that only 42% of persons surveyed reported receiving a physician’s advice to avoid high-fat or high-cholesterol foods. About the same percentage reported receiving advice to exercise more. Those with a history of heart attack, myocardial infarction, angina, coronary heart disease, or stroke were more likely to report receiving a physician’s advice to eat less fat and exercise more. Although estimates of counseling in this study differ from those in that study, the pattern of increased counseling for patients at higher risk is similar.

Primary care physicians have mentioned several reasons for the low prevalence of counseling, including not having adequate time to provide counseling, having limited training in counseling techniques, and being doubtful about the effectiveness of their counseling efforts.66-72 These reasons may partly explain the low prevalence of counseling of patients with DM observed in this study.

There are 3 limitations to this study. First, because the data were based on self-report, there is the potential for recall bias, especially regarding counseling about CVD risk factors by physicians. This is less likely to apply to this study because previous studies73-76 have shown that self-reported information on DM, CVD risk factors, and health promotion habits is reliable.

However, what constitutes adequate counseling remains unclear. The US Preventive Services Task Force16 distinguishes physician counseling from physician advice, and defines physician counseling as a more interactive and in-depth encounter, as opposed to physician advice, which may involve a brief recommendation to adopt or modify a behavior. Also, whether patients considered referral to weight loss centers, smoking cessation programs, or counseling during DM education programs as counseling by their physician cannot be determined in this study.

Second, because the BRFSS is a telephone-based survey, households without telephones were excluded. This may bias our estimates to a certain degree. The extent of such bias is likely to be minimal for 2 reasons. First, telephone coverage for households was high in the United States in 1999, ranging from 89% to 99%.19 Second, several studies77-79 on the reliability and validity of the telephone survey in the BRFSS compared with in-person or household interviews have shown that the estimates obtained by both methods are similar for most of the population.
Third, because the BRFSS is limited to civilian and noninstitutionalized adults, generalization can only be made to that segment of the population covered by the survey.

There are 2 major implications of our study. First, there is the need for primary care physicians to recognize the prevalence of modifiable CVD risk factors among adults with DM. Recognizing the pattern in which these CVD risk factors cluster in persons with DM may improve identification of high-risk patients. In addition, physicians can use data from this study to stratify patients with DM during routine office visits, as recommended by the American Heart Association.26,27 Second, although there is evidence to support counseling by physicians—and several guidelines and recommendations encourage counseling about modifiable CVD risk factors—primary care physicians appear to be performing at less than optimal levels. This may suggest that strategies to improve counseling techniques in primary care are needed, especially on how to counsel patients to modify high-risk behavior. There may be benefit in incorporating counseling skills into medical residency education or as continuing medical education activity for primary care physicians.

CONCLUSIONS

Although adults with DM have a high prevalence of modifiable CVD risk factors, counseling by physicians about lifestyle modification is less than optimal. There is a need to improve patient counseling for lifestyle modification by primary care physicians.

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REFERENCES

