The impact of formal diabetes education on the preventive health practices and behaviors of persons with type 2 diabetes


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Abstract

Background. Diabetes-related morbidity and mortality are primarily attributable to complications such as heart disease, stroke, lower extremity amputation, kidney disease, blindness, and visual impairment, many of which potentially can be delayed or prevented.

Methods. We examined the association of diabetes self-management education (DSME) with preventive health practices and behaviors among 22,682 persons with type 2 diabetes using data from the 2001 and 2002 Behavioral Risk Factor Surveillance System (BRFSS). BRFSS is an ongoing, state-based, random-digit-dialed telephone survey of noninstitutionalized adults aged ≥18 years.

Results. Approximately 48% of all adults with type 2 diabetes had never attended a DSME course. Among both diabetic persons who used insulin and those who did not, persons who received DSME were significantly more likely than those who had not received training to be physically active, to have received an annual dilated eye exam and flu vaccine, to have received a pneumococcal vaccine, to have checked their blood sugar daily, and to have had a physician or other health professional check their feet for sores or irritations and their hemoglobin A1C level in the past year.

Conclusions. These data indicate the importance of DSME in the promotion of health practices that could prevent or delay potential diabetes complications among persons with type 2 diabetes.

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Keywords: Diabetes education; Health practice; Complication

Introduction

Diabetes mellitus is a prevalent and costly condition that is associated with substantial morbidity and premature mortality. In 2002, 18.2 million persons in the United States were estimated to have diabetes, of whom 5.2 million were undiagnosed [1]. Type 2 diabetes accounts for about 90% to 95% of all diabetes cases [1]. The care of persons with diabetes is of growing importance to public health, as 1.3 million people aged 20 years or older are newly diagnosed each year [1]. Moreover, the number of persons with diabetes is expected to continue to rise with the increasing prevalence of obesity [2–4], the aging of the population, and the development of new diabetes healthcare strategies and technology promoting a longer life span among persons with this disease [5]. In addition, the health care of persons with diabetes has serious economic implications. In 2002, the cost of diabetes was estimated to be $132 billion, including $92 billion in direct health care costs and $40 billion in indirect costs, such as decreased work productivity and premature mortality [1].

Although underreported on death certificates, diabetes is estimated to be the sixth leading cause of death in the United States [1]. Most instances of diabetes-related morbidity and mortality are attributable to increased levels of biologic and behavioral risk factors that result in complications such as heart disease, stroke, lower extremity amputations, kidney disease, and blindness or visual impairment [1].
While there have been numerous advancements in the treatment of diabetes, their successful implementation places behavioral and psychological demands on persons with the disease [6,7]. Research suggests that diabetes self-management education (DSME) is associated with improved glycemic control among persons with either type 1 or type 2 diabetes, although this benefit may diminish over time [8–10]. In addition, diabetes can be a progressive disease challenging diabetic persons to continue to learn new disease management skills over time [11]. The American Diabetes Association (ADA) therefore recommends that diabetic persons assess both their self-management skills and knowledge at least annually and participate in diabetes education on an ongoing basis [12]. The Task Force on Community Preventive Services has reported that disease management education (DSME) is associated with improved glycemic control among persons with either type 1 or type 2 diabetes, although this benefit may diminish over time [11]. The American Diabetes Association (ADA) therefore recommends that diabetic persons assess both their self-management skills and knowledge at least annually and participate in diabetes education on an ongoing basis [12]. The Task Force on Community Preventive Services has reported that community settings provide the best forum for adults with type 2 diabetes to receive DSME [13–15].

Despite these recommendations, previous research indicates that 50% to 80% of persons with diabetes have significant deficits in knowledge pertaining to the management of their disease [16], and fewer than half of those with type 2 diabetes have ideal glycemic control [17]. Prior research also suggests that little time is devoted to diabetes management during routine office visits in primary care settings [18]. Notably, persons with diabetes who do not receive DSME are four times as likely as those who do to develop a major diabetes complication [19]. Consequently, one of the Healthy People 2010 objectives is to increase the proportion of persons with diabetes who receive formal DSME from 40% in 1998 to 60% by 2010 [20].

Given the relevance of DSME to the reduced prevalence of diabetic complications [19], we examined the associations between DSME and preventive health practices and behaviors among persons with type 2 diabetes. In addition, we explored the possibility that these associations may vary depending on whether or not the respondent uses insulin.

Methods

The Behavioral Risk Factor Surveillance System (BRFSS) is an ongoing, state-based, random-digit-dialed telephone survey of noninstitutionalized persons aged 18 years or older in the United States, Guam, Puerto Rico, and the Virgin Islands. BRFSS monitors the prevalence of key health- and safety-related behaviors and characteristics. In 2001 and 2002, trained interviewers administered standardized diabetes questions in 47 states (excluding Illinois, Missouri, and Oregon) and the District of Columbia. BRFSS methods, including its weighting procedure, are described elsewhere [21,22]. BRFSS participants were considered to have diabetes if they reported having been told by a doctor that they had the disease. Those who had not been so told and women who reported having diabetes only during pregnancy were considered not to have the disease. People were considered to have type 2 diabetes if their age at diagnosis was 30 years or older or if their age at diagnosis was less than 30 years and they did not use insulin [23,24]. Persons with type 2 diabetes were further dichotomized into insulin users and insulin nonusers. To determine whether respondents had ever received DSME, they were asked “Have you ever taken a course in how to manage your diabetes?”

The BRFSS also asks respondents questions about smoking, physical activity, height and weight, and alcohol consumption. Respondents were considered to be current smokers if they reported smoking at least 100 cigarettes in their lifetime and were currently smokers. Those who formerly smoked or never smoked were considered to be nonsmokers. Persons were considered to be physically inactive if they had not participated in any leisure time physical activity or exercise during the previous 30 days [25]. Body mass index (BMI) was calculated as weight in kilograms divided by the square of height in meters. Persons were considered obese if their BMI was ≥30 kg/m² [26,27]. Finally, binge drinking was defined as the consumption of five or more drinks on at least one occasion in the past month.

Participants with diabetes were also asked if they had had a dilated eye exam in the past 12 months, and if they examined their feet for sores and irritations and checked their blood sugar levels at least once daily. In addition, respondents were asked whether they had had an influenza shot within the previous 12 months, had ever received a pneumococcal vaccine, and had been to a physician, nurse, or other health professional in the past 12 months for their diabetes. Moreover, respondents were asked if their provider had checked their feet for sores or irritations, performed a hemoglobin A1C test, and checked their blood cholesterol level. The analysis for provider directed measures was restricted to those respondents who had visited their doctor, nurse or other health care professional during the past 12 months for their diabetes.

In the 2001 and 2002 BRFSS survey, 23,211 participants with type 2 diabetes responded to the diabetes education question. Those without complete data for study variables (n = 529) were excluded, leaving data from 22,682 respondents available for analysis.

We first conducted bivariate analyses of the relationships between DSME status and sociodemographic characteristics using the pairwise test. We used logistic modeling to examine the associations between DMSE status and preventive health practices and health risk behaviors, controlling for age, sex, race/ethnicity, employment status, marital status and education. The logistic form of each model produced conditional marginal probabilities of the use of healthcare practices and health behaviors by DSME and insulin use statuses. For all analyses, only P values <0.05 were considered statistically significant. SUDAAN (Research Triangle, release 8.0.0, Research Triangle Park, NC: 2001) software was used in all analyses to take into account the complex sample design and to calculate adjusted prevalence estimates, and 95% confidence intervals (95% CIs).
Results

Approximately 94.1% (95% CI: 93.6%–94.6%) of adults with diabetes had type 2 diabetes, 21.4% (95% CI: 20.3%–22.5%) of whom used insulin ($n = 4933$). Approximately 52.2% (95% CI: 50.9%–52.5%) of all adults with type 2 diabetes attended DSME, comprising 66.4% (95% CI: 63.4%–69.4%) of those who used insulin and 48.3% (95% CI: 46.9%–49.7%) of those who did not use insulin. Those who attended DSME were significantly more likely than those who did not to be aged 35 to 44 years and aged 55 to 64 years, black non-Hispanic, to have greater than a high school education, to be married, and to be insulin users (Table 1). Those who did not attend DSME were significantly more likely than those who received DSME to be aged 18 to 34 years and aged 75 years or older, Hispanic, to have less than a high school education, to be previously married, to be unable to work, and to be insulin nonusers.

Tables 2 and 3 delineate the association between DSME status and preventive health practices and behaviors among type 2 diabetic adults who used insulin and those who did not. First, we analyzed data from respondents reporting insulin use. Insulin users who attended DSME were significantly more likely than those who did not attend DSME to be physically active, to have received an annual flu shot, and to have received a pneumococcal vaccination. Similarly, those with DSME were significantly more likely to have had an annual dilated eye exam, to have checked their blood sugar daily, to have had their feet examined by a health care professional, to have had an annual dilated eye exam, to have checked their feet for sores and irritations, to have had a hemoglobin A1C test, and to have had their blood cholesterol checked in the past year. Moreover, they were more likely than those without DSME to have gone to a health care professional concerning their diabetes in the past year. Among those who had gone to a health care professional in the preceding year, and to have attended DSME.

Next, we examined those with type 2 diabetes who did not use insulin (Tables 2 and 3). Those who received DSME were significantly less likely than those without DSME to smoke and to be physically inactive. Similarly, insulin nonusers with DSME were significantly more likely than those without DSME to have had a pneumococcal vaccine, an annual dilated eye exam and flu shot, and to have performed daily self-examination of their feet and blood sugar levels. Moreover, they were more likely than those without DSME to have gone to a health care professional concerning their diabetes in the past year. Among those who had gone to a health care professional in the past year, insulin nonusers who had attended DSME were significantly more likely than those who had not attended DSME to have had a health care professional check their feet for sores and irritations, to have had a hemoglobin A1C test, and to have had their blood cholesterol checked in the past year.

Discussion

Our results support the importance of DSME in promoting preventive health behaviors of persons with type 2 diabetes; as those with DSME were significantly more likely to engage in preventive care measures and were significantly less likely to engage in health risk behaviors potentially fostering diabetic complications. Notably, preventive care deficits associated with not receiving DSME were evidenced in persons with type 2 diabetes who used insulin, as well as among those who did not. Furthermore, our research indicates while the prevalence of DSME among people with type 2 diabetes who used insulin (66.4%) met the 60% goal specified in Healthy People 2010 [20], the prevalence of DSME among those who did not use insulin (48.3%) did not.

Research suggests that several groups are less likely to engage in and benefit from DSME [28,29], specifically, ethnic minorities, older persons, and persons with language

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**Table 1**

<table>
<thead>
<tr>
<th>Race/ethnicity</th>
<th>Unadjusted percentage of those who attended DSME (95% CI)</th>
<th>Unadjusted percentage of those who did not attend DSME training (95% CI)</th>
<th>Pairwise $P$ value</th>
</tr>
</thead>
<tbody>
<tr>
<td>White, non-Hispanic</td>
<td>66.1 (64.2–68.0)</td>
<td>64.0 (61.9–66.0)</td>
<td>0.1406</td>
</tr>
<tr>
<td>Black, non-Hispanic</td>
<td>14.5 (13.2–15.7)</td>
<td>12.6 (11.4–13.7)</td>
<td>0.0287</td>
</tr>
<tr>
<td>Hispanic</td>
<td>12.2 (10.6–13.9)</td>
<td>16.2 (14.2–18.2)</td>
<td>0.0031</td>
</tr>
<tr>
<td>Other</td>
<td>7.2 (6.1–8.4)</td>
<td>7.2 (6.0–8.4)</td>
<td>0.9872</td>
</tr>
</tbody>
</table>

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Notes:

- a 95% confidence interval.
- b Asian, non-Hispanic; Native Hawaiian/Pacific Islander, non-Hispanic; American Indian/Alaska Native, non-Hispanic; other race, non-Hispanic; multirace, non-Hispanic.
- c Previously married includes those divorced, widowed, or separated.
- d Never married includes those never married or member of an unmarried couple.

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People 2010 [20], the prevalence of DSME among those with diabetes attended DSME, comprising 66.4% (95% CI: 63.4%–69.4%) of those who used insulin and 48.3% (95% CI: 46.9%–49.7%) of those who did not use insulin.
barriers and low literacy. Consistent with these reports, we found that persons aged 75 years or older, those who are Hispanic, and those with less than a high school education were less likely to receive DSME. In addition, we observed that those aged 18 to 34 years, those previously married, and those unable to work were also at increased risk for not receiving DSME. Wherever the deficits, there is a need for the adaptation of DSME to accommodate the unique needs of underserved groups.

The National Standards for Diabetes Self-Management Education [30], developed by individuals from major organizations and disciplines interested in the care of persons with diabetes, is the cornerstone for defining quality diabetes self-management education. One of the many important standards in this document requires that DSME involve the interaction of the diabetic person with Certified Diabetes Educators from a number of different disciplines (e.g., registered nurse, registered dietitian, behaviorists, exercise physiologists, optometrists, pharmacists, physicians). Notably, our results suggest that persons who received DSME were more likely to receive appropriate screening from their health care provider. This may be, in part, to the ability of the person who received DSME to understand their total health care needs, monitor their diabetes treatment plan, and effectively communicate their needs and concerns to a broad range of health care professionals. Whatever the reason, these finding underscores the importance of DSME in enhancing the quality of medical care received by persons with type 2 diabetes.

There are several limitations to our study. Because BRFSS is a telephone survey, it excludes some people known to have a higher prevalence of diabetes, among these

### Table 2

<table>
<thead>
<tr>
<th></th>
<th>Insulin users</th>
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<th>Insulin nonusers</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Adjusted percentage$^a$</td>
<td>Adjusted percentage$^a$</td>
<td>Adjusted percentage$^a$</td>
<td>Adjusted percentage$^a$</td>
</tr>
<tr>
<td></td>
<td>of those with DSME (95% CI)$^b$</td>
<td>of those without DSME (95% CI)$^b$</td>
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<td>of those without DSME (95% CI)$^b$</td>
</tr>
<tr>
<td>Received a flu shot in the past year</td>
<td>68.7 (65.7–71.8)</td>
<td>59.4 (54.0–64.7)$^*$</td>
<td>60.4 (58.2–62.5)</td>
<td>48.2 (46.2–50.2)$^{**}$</td>
</tr>
<tr>
<td>Ever received a pneumococcal vaccine</td>
<td>61.6 (58.0–65.3)</td>
<td>49.3 (44.2–54.3)$^{**}$</td>
<td>50.5 (48.1–52.9)</td>
<td>36.8 (34.6–38.9)$^{**}$</td>
</tr>
<tr>
<td>Had a dilated eye exam in past 12 months</td>
<td>81.3 (78.6–84.0)</td>
<td>74.6 (70.1–79.1)$^*$</td>
<td>75.2 (73.4–77.0)</td>
<td>64.0 (62.0–65.9)$^{**}$</td>
</tr>
<tr>
<td>Check feet for sores or irritation at least once a day</td>
<td>77.9 (75.2–80.7)</td>
<td>75.2 (70.8–79.1)</td>
<td>70.9 (68.9–72.8)</td>
<td>59.6 (57.6–61.5)$^{**}$</td>
</tr>
<tr>
<td>Check blood sugar at least once a day</td>
<td>85.3 (83.1–87.4)</td>
<td>78.7 (75.1–82.4)$^*$</td>
<td>55.3 (53.2–57.3)</td>
<td>38.5 (36.5–40.4)$^{**}$</td>
</tr>
<tr>
<td>Saw a health care professional for their diabetes in the past year</td>
<td>98.2 (97.6–98.8)</td>
<td>97.7 (96.5–99.0)</td>
<td>92.0 (90.7–93.3)</td>
<td>86.0 (84.6–87.4)$^{**}$</td>
</tr>
</tbody>
</table>

**Among those who saw a health care professional for diabetes in the past year**

| Health care professional checked feet for sores or irritations in past 12 months | 85.6 (83.4–87.9) | 77.1 (73.0–81.2)$^{**}$ | 78.3 (76.4–80.1) | 62.1 (60.0–64.2)$^{**}$ |
| Received a hemoglobin A1C test in the past 12 months | 94.0 (92.4–95.6) | 88.6 (84.7–92.5)$^*$ | 93.5 (92.5–94.5) | 86.8 (85.2–88.4)$^{**}$ |
| Had cholesterol checked in past 12 months | 90.5 (88.3–92.7) | 88.0 (83.9–92.0) | 91.8 (90.5–93.2) | 88.2 (86.6–89.9)$^{**}$ |

$^a$ Adjusted by age, sex, race or ethnicity, employment status, marital status and education.

$^b$ 95% confidence interval.

* Conditional effect $P$ value $< 0.05$.

** Conditional effect $P$ value $< 0.001$.

### Table 3

<table>
<thead>
<tr>
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<th>Insulin users</th>
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<th>Insulin nonusers</th>
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<td></td>
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<td>of those with DSME (95% CI)$^b$</td>
<td>of those without DSME (95% CI)$^b$</td>
</tr>
<tr>
<td>Obesity</td>
<td>52.3 (48.9–55.7)</td>
<td>48.0 (42.8–53.3)</td>
<td>46.8 (44.6–49.0)</td>
<td>44.3 (42.3–46.3)</td>
</tr>
<tr>
<td>Smoking</td>
<td>10.7 (8.8–12.5)</td>
<td>12.5 (9.6–15.4)</td>
<td>13.7 (12.3–15.2)</td>
<td>15.9 (14.5–17.4)$^*$</td>
</tr>
<tr>
<td>Physically inactive</td>
<td>45.0 (41.4–48.6)</td>
<td>54.1 (48.3–59.9)$^*$</td>
<td>30.6 (28.6–32.5)</td>
<td>39.4 (37.4–41.4)$^{**}$</td>
</tr>
<tr>
<td>Binge drinking</td>
<td>1.7 (0.9–2.4)</td>
<td>1.0 (0.5–1.5)</td>
<td>3.0 (2.3–3.6)</td>
<td>3.2 (2.6–3.8)</td>
</tr>
</tbody>
</table>

$^a$ Adjusted by age, sex, race or ethnicity, employment status, marital status and education.

$^b$ 95% confidence interval.

* Conditional effect $P$ value $< 0.05$.

** Conditional effect $P$ value $< 0.001$. 

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are residents of institutionalized settings, such as nursing homes [31] and persons of lower socioeconomic status without a telephone [32]. Furthermore, people with severely impaired physical or mental health might not have been able to complete the survey. It must also be considered that these data were self-reported and not validated by physical examination. Additionally, we did not have information on the time interval that had elapsed since the last DSME, the number of times that the respondents attended training, or the training setting. Finally, our data are cross-sectional, and thus we were unable to infer causality between DSME and preventive health practices and behaviors.

Our research underscores the importance of DSME, as those who received training engaged in preventive care behaviors and received preventive care services more often than persons who did not receive DSME, thereby potentially preventing or delaying diabetes complications. In addition to corroborating previous research regarding persons at risk for not receiving DSME [28,29], our research suggests other groups such as young adults, those previously married and those unable to work that might also be at risk. These findings suggest a need for the development of programs designed to address the specific needs of these currently underserved groups. Additionally, Hispanics were less likely to receive DSME suggesting a need for culturally competent DSME training and marketing. As the prevalence of diabetes is expected to continue to rise [2–5], DSME may play an increasingly important role in enhancing both the health and the quality of life of individuals with type 2 diabetes.

Acknowledgments

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References

[27] WHO Consultation on Obesity. Obesity: preventing and managing the


